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MONTHLY REVIEW

JANUARY 1956—No. 105

INDIAN ROADS CONGRESS, NEW DELHI

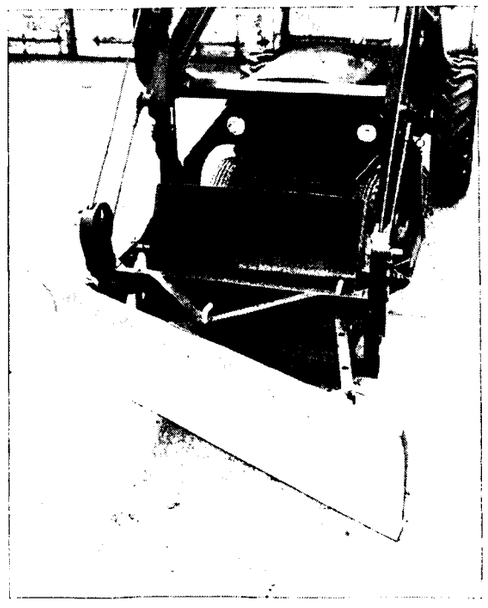
LOADING

Attachments for Front Discharged and Angledozing Make Machine More Varsatile

TWO NEW ATTACHMENTS add to the versatility of the Merton Overloader. One makes possible the controlled discharge of material at the front of the machine in addition to the usual discharge from a variable height at the rear. For front discharge the operator engages a simple trip mechanism by moving a lever alongside the main handle which controls all the other bucket movements.

Will Fit Mark 5 Machines

Another new attachment is the angledozer equipment illustrated below. This comprises a fabricated steel frame about which the angledozer blade and pusher arm pivot. The blade, which is wider than the Overloader, can be used for such tasks as back filling trenches, snow clearance, and rubbish chute levelling.



For Bulldozing or Angledozing

The pivot frame is quickly fitted to the toe of the Overloaded bucket and secured hoist pins on the bucket by means of two wedges. The blade can be angled 25 degrees either way by the removal of two link pins which tie the pusher arm to the frame. An unusual feature is that the pusher arm extensions are accommodated in the bucket when the blade is in the angled position.

The hoist ropes pass round phosphor-bronze busher sheaves in the centre of the framework and are anchored to pins located at the top of the vertical section of the overhead rails. The effect is to give the operator finer control of the blade, especially on levelling.

Width of the blade in the bulldozing position is 8 ft. and in the angledozing positions 7 ft. 3 in.; its height is 1 ft. 9¾ in.

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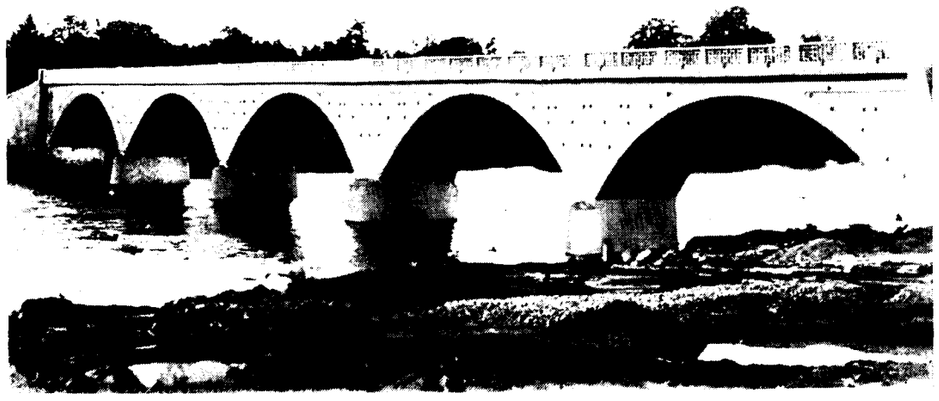
Mand bridge on Dharamjaigarh-Kharsia road, Central span 175 ft, side spans 64 ft and 55 ft.



Maini River Bridge on Jashpur-Pathalgaon road, 5 spans of 60 ft each

TRANSPORT-COMMUNICATIONS
MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

JANUARY 1956

ROAD DEVELOPMENT IN MADHYA PRADESH

By

Shri H. R. Gupta

THE Central Provinces which is the former name of Madhya Pradesh, was originally formed in 1861. It had then an area of about 1,50,000 square miles stretching from Bundelkhand in the north to the Madras Presidency in the south, from the frontier of Bengal in the east to independent Malwa and to the Deccan in the west, and comprised of 17 districts. The Sambalpur district was transferred to Bengal in 1902. In the same year Berar became an integral part of the Central Provinces. The State as now constituted, after the attainment of independence in 1947 and the merger of States in 1948, has 22 districts occupying an area of 1,31,000 miles and a population of 2.1 crores. The density of population is 163 per square mile.

When the Province was formed in 1861 there was not one road completely built though there were many under construction. The metalling of Jabalpur-Mirzapur road, now a section of National Highway No. 7 was completed in 1852-53 but the bridging for the most part remained undone. After the formation of the Province, the construction of Jabalpur-Nagpur (another section of National Highway No. 7) Nagpur - Chanda, Telegaon - Nachangaon and Nagpur Bhandara road (now a Section of National Highway No. 6) Roads was undertaken and 5 bridges on Jabalpur-Mirzapur road were completed during 1861-62.

The period from 1862-63 to 1902-03 was a period of great activity : the construction and improvement of a large number of roads and bridges was undertaken and as stated above in 1902 Berar with 1802 miles of roads became a part of this Province. At the end of 1902-03, the length of metalled and unmetalled roads maintained by the Public Works Deptt. and Local authorities in the Central Provinces and Berar stood at 7111 miles made up as under :

	Metalled roads. Miles	Unmetalled roads. Miles
Maintained by Public works Deptt.	1798	3175
Maintained by Local authorities	67	2071
	1865	5246

In spite of World War I the progress achieved during the 20 years ending

1922-23 was not inconsiderable. The length of metalled roads increased from 1865 miles to 4255 miles while the length of unmetalled roads decreased from 5246 miles to 3900 miles, the reduction being due to certain roads having been metalled. By 1935-36, the total milage of roads in the Province including those maintained by Local authorities stood at 9682 miles. Although it is situated in the heart of India and has immense mineral, agricultural and forest resources, its development has been greatly hindered for want of adequate means of communication.

The milage of extra-municipal roads at the commencement of the First Plan was as under :

(a) **Metalled roads**		
(i) Bituminous and concrete	375	miles
(ii) Water-bound Macadam	5,995	,,
	6,370	,,
(b) Unmetalled roads	5,642	,,
Total	12,012	,,

The road milage of metalled roads is thus 0.048 per square mile of area, and is very much below normal requirements.

National Highways

The National Highways which run through the State are :

No. 6 Bombay-Calcutta road.
No. 7 Banaras-Cape Comorin road.
No. 26 Jhansi-Sagar Lakhnadon road.
No. 43 Raipur-Vizianagaram road.

The total length of these in the state is 1,164 miles.

The first plan provides for the construction of missing links of 90 miles in length and improvement of 808 miles. The total estimated cost of these works is Rs 3.49 crores with a target of expenditure of 1.59 crores during the plan period. Satisfactory progress has been attained. The Gandhi Bridge across Mahanadi river on route No. 6 and the Dudh bridge on route No. 43 at the cost of Rs 28 and 4 lakhs respectively have been completed.

State Roads

The Plan initially provided for the construction of 129 miles of class I roads, and the upgrading of 1,138 miles of existing moorum or earthen roads to metalled roads at an estimated cost of Rs 4.39 crores. The ceiling for expenditure was, however, fixed at Rs 2 crores. It was clear that many works would remain incomplete and be carried over to the Second Five Year Plan for completion.

In spite of this limit, it was found necessary to add new works during the course of the Plan period. The works subsequently added were the construction of 698 miles of new roads and the improvement of 346 miles of existing roads at a cost of Rs 3.48 crores. Thus, the Plan, as it finally emerged, provided for the construction or improvement of 2,311 miles of roads at a cost of Rs 7.87 crores.

Construction or improvement of 1,172 miles is expected to be completed at the end of the Plan period. The estimated expenditure will be Rs 2.28 crores against the target of Rs. 2 crores. The spillover into the second Plan will be of the order of Rs 5.59 crores.

Out of the 72 road schemes under construction, mention may be made of the following :

(1) Old Bombay Road

The length of this road is 131 miles. Except for a few bridges and culverts in the Hatwans-Kareli section, the entire road will be completed during the plan period. It will be an important highway connecting the northern districts of Madhya Pradesh with Bombay in the west and Uttar Pradesh in the north and will facilitate the export of the produce from the rich Narmada Valley.

(2) Rajim—Gariabund road

A length of 20 miles out of a total length of 28 miles has already been completed. This road will open up an under-developed area and facilitate its development.

(3) Ratanpur—Katghora road

The raising of this road 32 miles in length will be a great boon to the

Katghora tehsil of the Bilaspur district. It will provide an outlet for the forest produce and help exploit the mineral deposits in this area.

(4) Saraipalli-Raigarh road

This inter-district road 14½ miles in length will link Raigarh with National Highway No 6. The construction of the road including the bridges and culverts has been nearly completed.

Ghogri Nallah Bridge on Jashpur-Pathalgaon Road, 5 spans of 38 ft each.

(5) Dharamjaigarh Kharsia road

This road is 33 miles in length and connects Dharamjaigarh with Kharsia, the nearest railway station. It will provide an outlet for the forest and agricultural produce of protentially rich but undeveloped tract of Chattisgarh. Metalling and construction of 2 major bridges have been completed.

Ibb bridge on Jashpur-Pathalgaon road, 11 spans of 48 ft each.

(6) Dharamjaigarh-Raigarh road

The entire length of 23½ miles including bridges has been completed. The construction of this road has opened out a vast undeveloped area.

(7) Pathalgaon-Jashpur road

This road is 62½ miles in length and forms part of the main road from Raigarh to Jashpurnagar. It provides through communication throughout the year with the interior. Metalling has been completed in the entire length and all important bridges have been constructed.

(8) Dharamjaigarh-Pathalgaon-Ambikapur-Baikunthpur road

This important road 122½ miles in length connects the district headquarters of Rai-

garh and Ambikapur. It traverses a rich hilly area and provides communication in an under-developed area. All major bridges and 84 crossings have been constructed and about 50 per cent of the road length has been metalled.

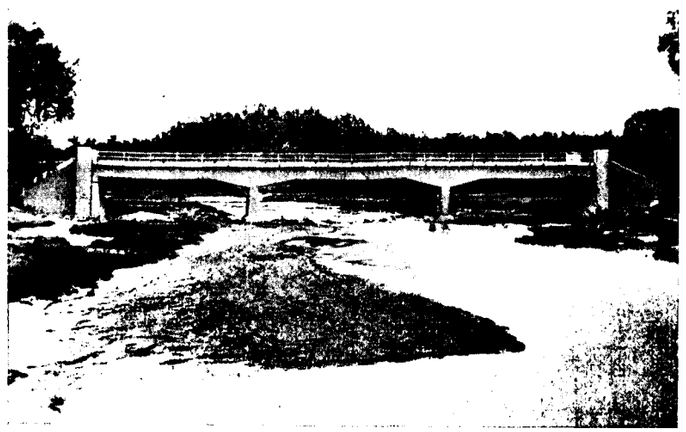
Lanjee Bridge on Dharamjaigarh-Pathalgaon Ambikapur road, 3 spans of 33 ft each.

Central Road Fund

The construction and improvement of 185 miles of roads is being financed from the Road Fund. Out of the same source, the Penganga bridge on the Akolah Hingoli road has already been completed while the Narmada bridge on the Khandwa-Indore road is in progress.

Public Participation

To encourage the public to take an active interest in road development, a scheme of public participation was initiated at the end of 1953. The public contribute one-third of the cost in cash, or kind or both, while the Government bears the rest of the two-thirds. The response in some districts has been very encouraging and 196 miles of roads are under execution under this scheme.



Kanjee bridge on Dharamjaigarh-Pathalgaon Ambikapur road. central span 55 ft, side spans 44 ft each.

A special sanction of Rs 16 lakhs has been made for black-topping of important State roads. Under this scheme 984 miles have already been black topped.

Besides the above schemes, a sum of Rs 22 lakhs at the rate of Rs one lakh per district per year, is being placed at the disposal of Deputy Commissioners for the construction of village roads. 348 miles of roads are under construction and 148 miles have already been completed under this scheme.

Kele Bridge, 8 spans of 40 ft each

Great difficulty has been experienced during the first plan period in giving due weight to regional and district claims. It has, therefore, been found necessary to evolve a formula which could ensure an equitable and balanced road development throughout the State.

We need 13,000 miles of metalled roads according to the Nagpur Plan to meet the basic needs of the State. Against this, we are likely to have 8,000 miles by the end of the current Plan.

It is proposed to attain the target of 13,000 miles in the next two plans and to distribute the milage district-wise on the basis of the following factors :

a. Area
b. Population
c. Revenue
d. Number of towns with a population of over 500
e. Number of Police Stations
f. Number of Railway Stations
g. Business Centres

Having arrived at the length in each district in accordance with the above factors, the length of existing roads is deducted to arrive at the district quota for the next two plan periods. From that quota is deducted the length of roads which obviously must be constructed and which is of provincial or inter-district importance. The balance of the district quota is intimated to the Deputy Commissioner for fixing priorities in consultation with the District Advisory Committee. This formula has proved successful and has given satisfaction to the public and facilitated the disposal of demands for new roads by the administration.

Some of the bridges recently constructed in the State are shown in the Photographs.

OUR ROADS

"Our road is not built to last a thousand years, yet in a sense it is. When a road is once built it is a strange thing how it collects traffic, how every year as it goes on, more and more people are found to walk thereon, and others are raised up to repair and perpetuate it, and keep it alive ; so that perhaps even this road of ours may, from generation, to generation continue to exist and be useful hundreds and hundreds of years after we are mingled in the dust."

ROBERT LOUIS STEVENSON.

ADMINISTRATION AND FINANCING OF ROADS IN JAPAN

System of Administration

PUBLIC roads in Japan are classified under the Road Law (as amended in 1952) into four classes, i.e., primary national highways, secondary national highways, prefectural roads and municipal roads. The authority and responsibility for the improvement, maintenance and other general management of these roads are shared by the national government and the local governments. The outline is as follows:

The national government designates the routes of primary and secondary national highways, and undertakes major improvement projects on these roads as the national government's own projects. It also gives aid, as prescribed by the Road Law, to the other road projects undertaken by the local governments if such aid is justifiable from the point of view of the overall road programme. The authority and responsibility for the improvement, maintenance and other general management of primary and secondary national highways are delegated to the governor of prefectures. The expenditures for these functions are borne by the prefectures with the single exception of the cost for improvement projects for which the national government assumes financial responsibility.

Prefectural roads and municipal roads are administered and financed by the competent prefectural or municipal authority. Five major cities, however, are deemed to be on the same level as the prefectures.

The central authority responsible for road administration is the Ministry of Construction in which the Road Bureau is organised. Six regional construction bureaux are set up under the direct supervision of the Minister of Construction to carry out the projects undertaken by the national government. Another organisation, the Road Council, was created to advise the Minister of Construction, and is conducting investigations on the major road programme, road policy, the administration system and other major problems. The local governments have a more or less similar organisation and similar division of responsibilities as the national government although naturally their organisation is on a smaller scale than that of the national government.

NATIONAL GOVERNMENT'S SOURCE OF ROAD FUNDS

Source of Funds

The road expenditures provided by the national government make up the source of funds for both the national government's undertakings and the road projects carried out by the local governments. The main source of money in the general fund is the gasoline tax revenue. The ratio of national funds in road project costs varies within the range one-third to three-fourths, mostly one-half, while the remainder has to be borne by the local public entities. In addition, there is a group of toll-road projects financed by loan from the national government. This loan is handled under a special account system. The appropriation to the road budget of an amount equivalent to the gasoline tax revenue has been put into practice from the fiscal year 1954. The adoption of this system has meant the establishment of a sound legislative basis for road financing at national government level. Until the fiscal year 1953, the national government's source of road funds had been largely from general tax revenue. The percentage of road budget

in the overall national budget is as shown below:

Road Budget in Overall National Budget

(M 1,000 yen)

Fiscal Year	A National Budget (general account)	B Road Budget	B/A per cent
1935	2,208,000	21,900	0.99
1940	5,860,000	20,300	0 35
1945	21,496,000	61,300	0 28
1950	664,500 000	5,450,000	0.82
1954	999,588,000	14,933,600	1.49

(Note: The budget for toll roads is excluded)

LOCAL PUBLIC ENTITIES' ROAD FUNDS

The prefecture's source of road funds comprises general tax revenue, national government's aids, funds distributed by the national government for the purpose of stabilising the financing of local public entities, local government bonds accepted by the national government, etc. The municipalities' road funds are based on similar elements.

The percentage of road funds in the total local budget is as shown below:

Prefectures' Road Budget in Overall Expenditure

(In million yen)

Fiscal year	A Prefectures overall budget (general account)	B Road budget	B/A per cent
1951	312,943	11,740	3.7
1952	419,242	14,647	3.5

(Note: Five major cities and municipalities are excluded.)

The local public entities derive Funds for road improvement from National aid, Prefecture's aid, General revenue, Bond revenue, and User's contribution and donation.

Method of Distributing Road Funds

The government is obliged to appropriate road funds to an amount equivalent to the gasoline tax revenue, and therefore it can safely be said that it has a very reasonable and stable source of road funds. The government distributes funds to regional construction bureaux, and to the prefectures, giving due consideration to various conditions such as the area, population, road milage, total bridge length, number of automobiles in the prefecture, the status of road improvement, etc. The funds distributed are definitely earmarked to individual projects.

Law Relating to Improvement of Roads by Gasoline Tax Revenue

(i) BACKGROUND OF LEGISLATION

The maxim that there is an explicit need to secure the source of funds to accelerate road improvement has long been accepted in Japan. Nevertheless, the gasoline tax was not specifically earmarked for the road improvement funds at the time of its creation in 1949.

The condition of roads, on the other hand, remains poor. Out of 140,657 kilometres of national highways and prefectural roads, the length of improved roads with two or more lanes amounts only to 20,560 kilometres, or 15 per cent of the total length. The paved roads including those equipped with low-type surface total 7,630 kilometres, or 5.4 per cent of the total length and 37 per cent of the length of improved roads. And, of 121,039 bridges on national highways and prefectural roads, 63,668 bridges, or 53 per cent of the total number, are permanent bridges (steel masonry or concrete) and the remaining 57,371 or 47 per cent are wooden bridges.

The number of automobiles, in the meanwhile, has greatly increased, being over 1,127,000 on on April, 1954. It is equivalent to 5.1 times the number in 1938 which was about 220,000 and 8.6 times 130,000, the number in 1945, when the war ended. The rate of increase is in excess of 200,000 per annum. The tonnage transported by road vehicles has also

shown an appreciable increase along with the improvement of the quality of road vehicles. Approximately 70 per cent of the total tonnage hauled by various means of transport in 1952 went by road.

These factors together with the demand for prompt improvement of roads resulted in the enactment, in July 1953, of the Law for Temporary Measures concerning the source of Funds for the Improvement of Roads.

Main Features of the Law

A brief outline of the main features of the law is given below :

FIVE-YEAR ROAD IMPROVEMENT PROGRAMME: The law prescribes that the government shall establish a five-year road improvement programme starting from 1954 and that the government shall assume responsibility to complete the programme.

SOURCE OF FUNDS FOR ROAD IMPROVEMENT: The law provides that the government shall appropriate for five years starting in 1954 the amount equivalent to the revenue from gasoline tax levied under the Gasoline Tax Law to meet the national expenditure needed for the five-year road improvement programme.

SPECIAL PROVISIONS ON CONTRIBUTION: The law provides that the national government's contribution or aid to the local public entities may be increased to a higher rate than the one currently used for the five-year period starting from the fiscal year 1954.

Effect of Legislation

The enactment of this law has the effect of creating a better and more reasonable relationship between the road user's burden and road improvement expenditure, accelerating the improvement of roads, enabling a well-planned and economic progressing of road improvement works, facilitating the establishment of a long-term local financing programme and the execution of projects.

Gasoline Tax

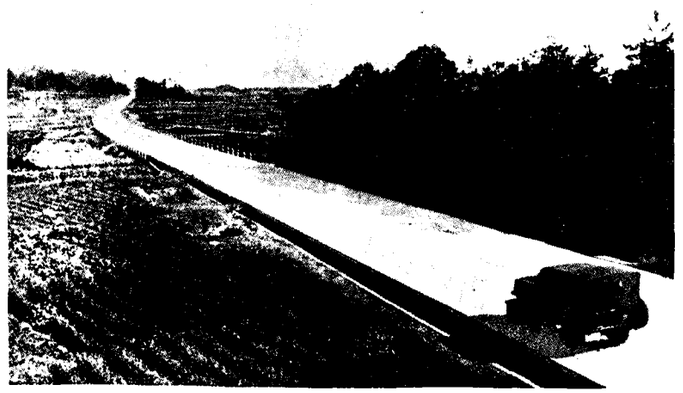
The Gasoline Tax Law was introduced in April 1949. The rate of tax in 1954 is 13,000 yen per kilo-litre which amounts to 54 per cent of the retail price. The total annual revenue of gasoline tax in 1954 is estimated at 23,767 million yen.

Five-Year Road Improvement Programme

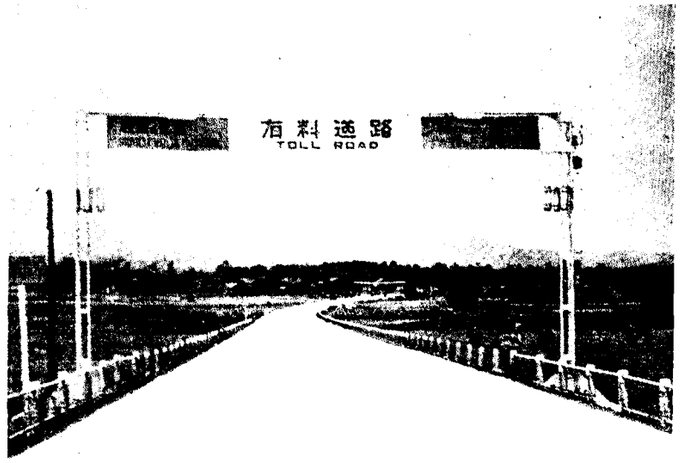
The government has been conducting a technical study of a road improvement programme, and has the long-term road improvement programme as the basic overall scheme. The object of the scheme is the betterment of all national highways and major local roads through (i) improvement of all unimproved section, (ii) replacement of all 10-metre or longer wooden bridges by permanent bridges, and (iii) the surfacing of all heavy traffic stretches. The total cost needed for these projects is estimated at 1,788 billion yen. The five-year road-improvement programme shaped in 1954 is the working programme laid down by law, and is a component part of the long-range programme. The programme will cover approximately 2.3 times as much annual progress as the road programme for 1953, and the completion of this programme will be the basis for the long-term programme which can be thoroughly accomplished only by the succeeding programmes. The five-year road-improvement programme has its main emphasis on (i) improvement of main trunk roads, (ii) surfacing of heavy traffic roads, and (iii) replacement of bridges of limited load capacity. The following table is a summary of the programme :

	Primary national highways	Secondary national highways	Designated local roads	Other local roads
Road improvement	1,800 km.	1,400 km.	2,200 km.	4,630 k.m.
Bridge replacement	38 km. (approx. 800 bridges)	36 km. (approx. 700 bridges)	57 km. (approx. 900 bridges)	88 km. (approx. 1200 bridges)
Surfacing	2,110 km.	1,180 km.	910 km.	540 km.

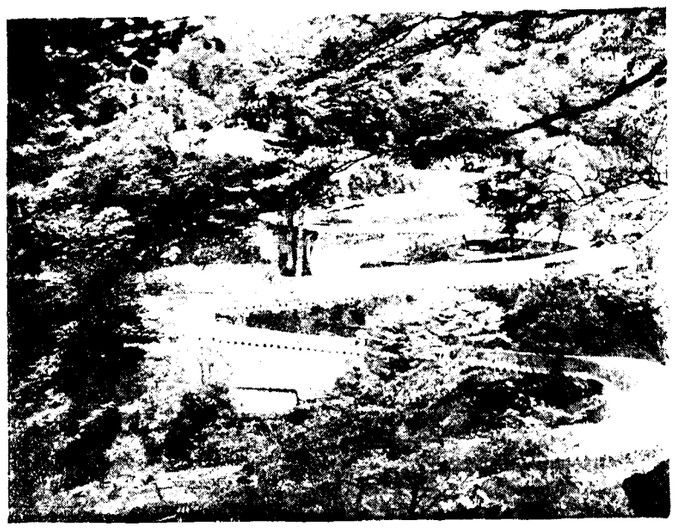
Kilometer = 0.62 miles.



Toll Road-Primary National Highway, No. 23, From Kushida-mura to Ujiyamada City, Cement Concrete pavement



Primary National Highway No. 36-From Sapporo City to Chitose Town, Hokkaido



Toll Road-Secondary National Highway, Nikko-Utsunomiya-Bituminous concrete pavement

The source of funds for this five-year road improvement programme consists of an appropriation out of the national treasury equivalent to the gasoline tax revenue, plus an appropriation out of general revenue of the national treasury and the funds provided by the local public entities, and amounts to approximately 260 billion yen.

Improvement of Roads Through Toll Road System.

THE TOLL ROAD SYSTEM Whereas the toll road system has a long history in western countries, it was not adopted in Japan, because the roads were supposed to be open to the public without any charge. However, the radical increase in vehicular traffic and the resultant vigorous requests for the improvement of roads caused the government to give serious consideration to the adoption of a toll road system. Finally a system of road improvement through tolls was temporarily adopted in 1952 as a supplementary measure to accelerate the improvement of roads.

The circumstances that create a toll road are (i) that the user of the road will get appreciable benefits from its use, (ii) that there is an alternate road without any charge, and (iii) that the funds for the new construction or improvement are required to be amortised.

The toll road project is operated as follows: (i) The Ministry of Construction receives a loan from the funds of the national government (which goes into a special account created for this purpose) and starts construction under its direct supervision if the project is on a national highway or re-loans the funds to the prefecture for starting construction if the project is on a prefectural road, (ii) after the completion, the tolls are collected mainly from the automobiles and each competent road administrator deposits such revenue in the special account, (iii) the amortization has to be completed within the period of 20 years or less, (iv) the rate of interest is 6.5 per cent per annum, and (v) when the amortization of the fund is completed, the road becomes a free road, etc.

Therefore, the system is so operated as to select those projects which require a huge sum of funds in a rather limited period of time such as a long bridge, long tunnel, etc., or the industrial tourist roads possessing a high potential economic benefit which can well pay off the investment in a short period through the toll collection. There are 23 toll road projects under way now at a total cost of approximately 13,500 million yen. The investment made on these projects during the period from 1952 to 1954 amounts to approximately 6,000 million yen.

Determination of Toll Rate

The determination of the toll rate is a difficult problem. In Japan the toll rate is fixed at less than the monetary value of benefits attainable from the use of the toll road because (i) a toll road project has to be amortizable over the period of the loan, and (ii) a toll road must attract many road users willing to pay tolls, this second factor being more important. Therefore, the toll rate is determined within the limit of benefits which comprise tangible savings made possible by the improvement of the road structure such as the savings in vehicle operating cost, transportation cost, travelling cost, loading and unloading costs, packing cost, etc.

Road Financing Methods in the Future

The use of the toll road system should be continued and expanded for some longer time to aid in the development of roads. In view of the expected continuation of rapid development of vehicular traffic in Japan, a study is being conducted on a programme of motor-way or express-way construction. This project is proposed to be operated under the toll road system, and in addition to the national expenditure, the funding schedule of this project is so constituted as to attract investment of private funds through bonds, and foreign investment.

[*From the Report of Japan to the Tenth International Association of Roads Congresses.*]

BRIDGING THE RIVER GANGA AT GARHMUKTESWAR

By

Shri M. S. Bisht

Introduction

THROUGH ages Ganga has been the object of adoration and veneration of the people of India. The river divides the State into two parts and yet there are only three road bridges across the river during its lengthy flow in the State. The bridge at Kanpur is 330 miles from Hardwar and 237 miles from Garhmukteshwar. The second bridge is at Allahabad and the third, a combined rail-cum-road bridge, at Banaras, are at 430 and 530 miles respectively from Hardwar. See map on p. 18.

The existing crossings over the river at many places are by means of ferries and pontoon bridges, which are at best makeshifts and are a source of hindrance to free flow of traffic. The necessity of providing an adequate number of all-weather crossing over Ganga has been realised both by the State and the Central Governments, and it is proposed to construct a permanent bridge at Garhmukteshwar. Besides this, the existing railway bridge over Ganga at Kachlaghat on Bareilly Badaun-Mathura State Highway is also being decked for the road traffic. See p. 18.

Necessity of the Bridge

The National Highway No. 24 running from Delhi to Lucknow crosses the river Ganga at Garhmukteshwar. At present there is no road bridge at this place and all the vehicular traffic has to pass over a boat bridge which is constructed at an estimated cost of Rs 80,000 every year and remains in operation for only 7 months. In the rainy season for about 5 months, only passenger traffic is ferried and vehicular traffic by road is completely suspended, and thus eastern districts of Uttar Pradesh are cut off from western districts. Even in dry weather, heavy loaded trucks cannot cross the river as the boat bridge is safe only for 3 tons. The approaches to the boat bridge are sandy and although steel and wooden tracks are laid, traffic is very much inconvenienced and the vehicles get bogged in sand frequently. Every year Kartika mela is held at Garhmukteshwar in the month of November when 12 lakhs of pilgrims on an average come and take bath in the holy Ganga. As there is no permanent bridge and pucca approach roads to the existing ferry, the District Board has to incur an expenditure of Rs 90,000 every year to make elaborate arrangements for constructing temporary approaches, etc. Therefore, the construction of a permanent high level bridge at this crossing is considered a top priority project.

Initial Proposals

The proposal was investigated for the first time in the year 1948 and it was felt that the existing 14 ft wide railway bridge at Garhmukteshwar could be utilized for road traffic as well and a provision of Rs 6.6 lakhs for decking the railway bridge was made in the first Five-Year Plan. Consultation with the railway authorities showed that the girders of the railway bridge were weak for both road and rail traffic and that the road authorities have to pay for regirdering which was estimated at Rs 74.25 lakhs. This was considered very high for a rail-cum-road bridge with all its attendant inconveniences. The idea of redecking the existing railway bridge was dropped and detailed survey

for a separate road bridge was taken in hand in 1949-50. But due to financial stringency the actual construction of the bridge could not be included in the first Five-Year Plan of the National Highways and it was decided to include the construction of this bridge in the second Five Year Plan. There has, however, been a persistent public demand for the bridge and it was felt in the year 1954 that the construction of this bridge could not be postponed any longer.

Location and Site

The river runs roughly in the middle of a wide 'khadir' nearly eight miles wide and meanders between between high banks from year to year. With a view to select the best site for the proposed bridge extensive aerial survey and reconnaissance of the river over a length of nearly 14 miles, 8 miles on the upstream side of the existing railway bridge and 6 miles on the downstream side, were carried out. The following four sites were investigated. See page 19.

Site No. 1.—Nearly 6 to 7 miles upstream of the existing railway bridge. This site was investigated because it appeared that site was on a straight reach and the river was only about half a mile wide at the place. But after detailed survey it was found that there was neither a straight reach nor the river was confined between defined banks. The low banks are nearly 1¼ miles apart and there are two channels. The main channel flows by the side of the village Hashimpur and the bridge would have to be sited on the channel. The other channel on the right side will have to be closed by suitable training works. Two guide bunds nearly 3,000 ft long and 11 miles length of approaches would be necessary, thus raising the cost of bridge. This site was, therefore, rejected.

Site No. 2. At the existing ferry, about four miles upstream of the railway bridge. The existing ferry lies on the route from Delhi to Moradabad and is connected by metalled roads on both sides except for a portion of 5 miles. The river is very wide here and there are three channels, one flowing by the side of Tigri village, the other nearly 1¼ miles from Tigri and the third nearly 2⅛ miles from Tigri towards Garhmukteshwar with big alluvial sandy islands in between. During floods, all the channels merge into one. To make the bridge at this site would have meant bridging the first channel flowing by the side of Tigri village which carries 70 per cent of the discharge and extensive training works which would push up the cost of project high. Also, this would have severely affected the course of the river at Railway bridge site. Though there was a pressing demand from the public for siting the bridge at this site for convenience of public attending the annual Garh Fair, the high cost of training works. prevented the selection of this site.

Site No. 3.—The third site investigated (index plan, See p. 19) is at Puth village nearly 6 miles downstream of the railway bridge. The river after flowing in the middle of the wide 'khadir' strikes at this site the right bank which is high and permanent. It was found from local enquiries that the river has not changed its course at this place for the last 60 years. The river at this point has a straight reach and the right bank being 14 ft higher than the maximum H. F. L., no guide bund would be required on the right side. Though this would have been the best site it was discarded because of an increase of 9 miles in the Delhi-Moradabad route and the heavy cost of approach roads.

Site No. 4.—1,400 ft downstream of railway bridge. This site could be still nearer the railway bridge if the railways did not have any objection. The greatest advantage in siting near the railway bridge is of a steady channel flowing through the bridge and the absence of training works. It will not be out of place to mention here that the railways had great trouble during the high floods of 1948 to protect their embankment in mile 39 and prevent the outflanking of the main bridge. During the 1948 floods the main channel eroded its left bank continuously and the erosion approached the railway embankment, the shortest distance of the eroded bank being 482 ft from

centre line of track at mile 39/15. In one season alone, the total erosion was 3,000 ft and the rate of scour was as much as 70 ft per day on some days. Model experiments were conducted at the Hydraulic Research Station, Poona, and on their recommendation the Railways extended the left guide bund by a straight length of 1,300 ft with provision of a curved head of length 12.57 chains with a radius 600 ft and an angle of 120 degrees. The experiment also indicated a possibility of further scour of the left bank at mile 39/15 even after extension of guide bund and, therefore, the Railways put up a 3 mile long diversion which would serve not only as a second line of defence but also enable the bridge to function even if there was a breach in the main line bank. The Railways spent Rs 28 lakhs on these protective measures and these measures proved very effective and the erosion of left bank has been checked.

It would, therefore, be very apparent that full use should be made of the extensive river training works constructed by the Railways and, therefore, it has been now finally decided to locate the road bridge 600 ft downstream of the existing railway bridge. The Railway authorities have also agreed to the road bridge at this site with spans different from that of railway bridge.

Waterway

The estimated discharge of the river Ganga at Garhmukteshwar is of the order of 3.5 lakhs cusecs. A linear waterway of 1,600 ft with proper guide bunds to cater for this discharge would have been quite sufficient. But in view of the fact that this bridge will be sited very close to the railway bridge, it has become imperative to provide the same waterway as provided in the existing railway bridge. The railway bridge at Garhmukteshwar has 11 spans of 200 ft each and at Balawali about 73 miles upstream of the Garh bridge the railway bridge consists of 11 spans of 250 feet. each. At Rajghat, about 42 miles downstream of this bridge, the railway bridge consists of 33 spans of 80 ft each with a clear waterway of 2,640 feet. Based on the waterway of the existing railway bridge, it has been decided to adopt a waterway of 2,200 ft, which is the same as that of the railway bridge at Garhmukteshwar.

Soil Characteristics

Borings of the strata near the proposed bridge site showed that clay mixed with kankar was available at a depth varying from 110 to 126 feet.

Width and Loading

As the bridge is located on an important National Highway, a 24 ft wide roadway with 5 ft side walks on either side has been provided. The bridge has been designed for I.R.C Class AA loading or two lanes of I.R.C. Class A loading whichever is more severe. A crowd load of 85 lb per sq. ft. has been allowed for the footpath. The side walks will prove very useful as this bridge will provide a pedestrian link between Moradabad and Meerut districts and specially during the Ganga Fair at Garhmukteswar held every year.

Type of Bridge

Spans of 160 ft with reinforced concrete balanced cantilever box girders, a type, which has been adopted for a number of major bridges in India, has worked out to be the most economical. The Department has prepared a design for a R.C.C. balanced cantilever box girder bridge having 13 spans of 160 ft and 2 end spans of 111 ft 6 in. giving a waterway of 2200 feet. A prestressed concrete bridge over this crossing is also feasible.

Superstructure

The detailed design consists of seven main units each comprising of a main span of 160 ft with two cantilever spans of 48 ft-6 in. and eight units of suspended span of 63 ft. The superstructure is of box type consisting of three ribs with depth varying from 16 ft at springing to 7 ft at crown and width from 10½ in. to 13 in. The deck slab is 8 in. thick with a wearing coat varying from 2½ in. at crown to 3½ in. at edges. The three ribs are

concreted at the bottom with a vault slab 6 in. thick increased to 9 in. at the supports. The slab has been designed on Pigeaud's theory.

A clear road width of 24 ft has been kept for vehicular traffic and two five feet foot paths are provided on either side of the road. The foot paths shall comprise of 2¼ in. precast slabs resting on kerb beams at the edges and deck slab on the inside end. Ample hollow space has been left between the deck slab and the precast slab for laying down cables, pipes etc.

The cross beams have been designed as stiffeners. The cross beams have opening to reduce concrete and weight and also to provide facility for fixing and removing shuttering. The main ribs together with cross beams, deck slab and vault slab have been taken as one unit and designed accordingly, assuming that the cross stiffeners, deck and vault slabs distribute the live load equally on each of the ribs Cast steel Rocker & Roller bearings of 380 tons capacity have been provided under the main spans for longitudinal expansion of 2 in. and for rotation. The bearings under the suspended span are of sliding type.

Substructure

The superstructure is supported by 13 piers and two abutments all in brick masonary in 1 : 4 cement mortar with a width of 8 ft at top and batter of 1 : 24.

Approach Roads

Because the bridge proposed to be located 600 ft downstream of the railway bridge and the existing Meerut-Bareilly road 4 miles away from the bridge site, it has become necessary to provide new approach roads to the bridge. On the Meerut side the approach roads will take off from Delhi—Lucknow N. H. from furlong 4 of mile 53 and will be 5 miles 440 ft long. On the Moradabad side, however, very long approaches have to be constucted, for the area between the bridge site and the existing road is all 'khadir' and gets flooded during rains. To avoid the 'khadir' area and level crossing on the railway line, a long detour of 9⅛ miles has to be made connecting the bridge with 41 of Meerut-Bareilly road. The proposed road runs more or less parallel to the existing railway line. The total cost of approaches is estimated to be about Rs 35 lakhs.

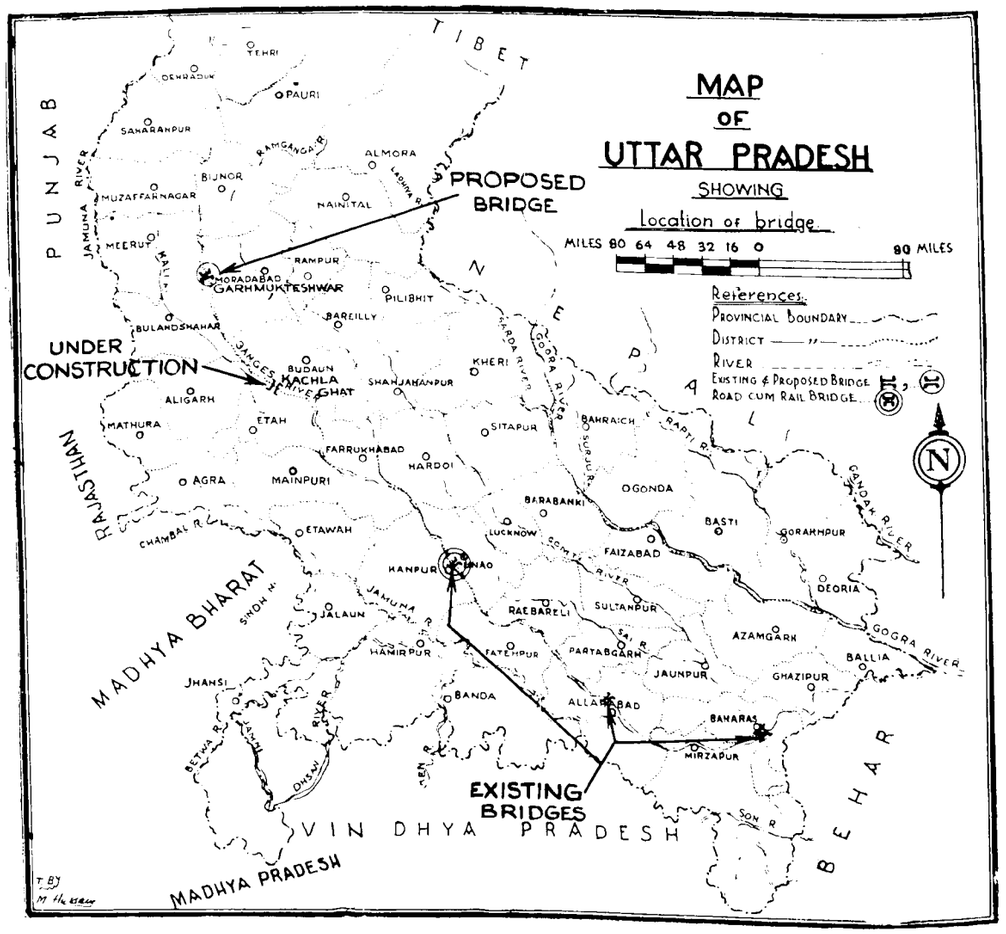
River training works

Even after utilising the guide bunds of the existing bridge, it is contemplated to provide 119 ft and 440 ft long guide bunds on the upstream and downstream sides respectively. The top level of the guide bunds will be kept the same as that of the existing railway bund. The cost of the guide bunds is estimated at 5.8 lakhs.

General

The work on approach roads on Meerut side is in full swing. Preliminary arrangements for starting the work on the main bridge are being made and it is expected to start the work by the end of the current year. It is hoped that by June 1959 it will be possible to open the bridge to traffic.

The total cost of the project including cost of approach roads and river training works is estimated at Rs 1.25 crores.


MAP
OF
UTTAR PRADESH
SHOWING
Location of bridge
PROPOSED BRIDGE
UNDER CONSTRUCTION
EXISTING BRIDGES
MILES 80 64 48 32 16 0 80 MILES
References:
PROVINCIAL BOUNDARY
DISTRICT
RIVER
EXISTING & PROPOSED BRIDGE
ROAD CUM RAIL BRIDGE
TIBET
PUNJAB
RAJASTHAN
MADHYA BHARAT
VIN DHYA PRADESH
MADHYA PRADESH
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NEPAL
TEHRI
DEHRADUN
PAURI
SAHARANPUR
ALMORA
BIJNOR
MUZAFFARNAGAR
NAINITAL
MEERUT
RAMPUR
MORADABAD
GARHMUKTESHWAR
PILIBHIT
BAREILLY
BULANDSHAHAR
BUDAUN
KACHLA GHAT
SHAHJAHANPUR
KHERI
ALIGARH
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BARABANKI
OGONDA
BASTI
GORAKHPUR
LUCKNOW
FAIZABAD
KANPUR
UNAO
DEORIA
RAEBARELI
SULTANPUR
AZAMGARH
GOGRA RIVER
JALAUN
HAMIRPUR
FATEHPUR
PARTABGARH
JAUNPUR
BALLIA
GHAZIPUR
JHANSI
BANDA
ALLAHABAD
BANARAS
MIRZAPUR
GANGA RIVER
JAMUNA RIVER
CHAMBAL R.
SON R.
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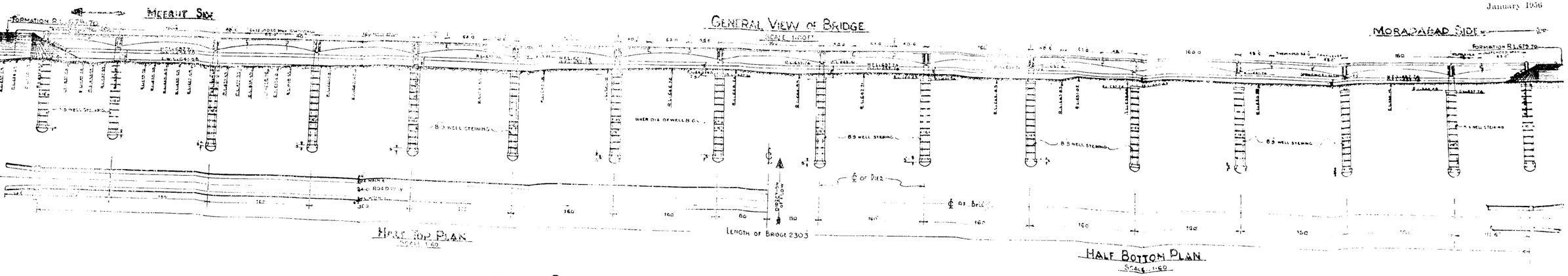
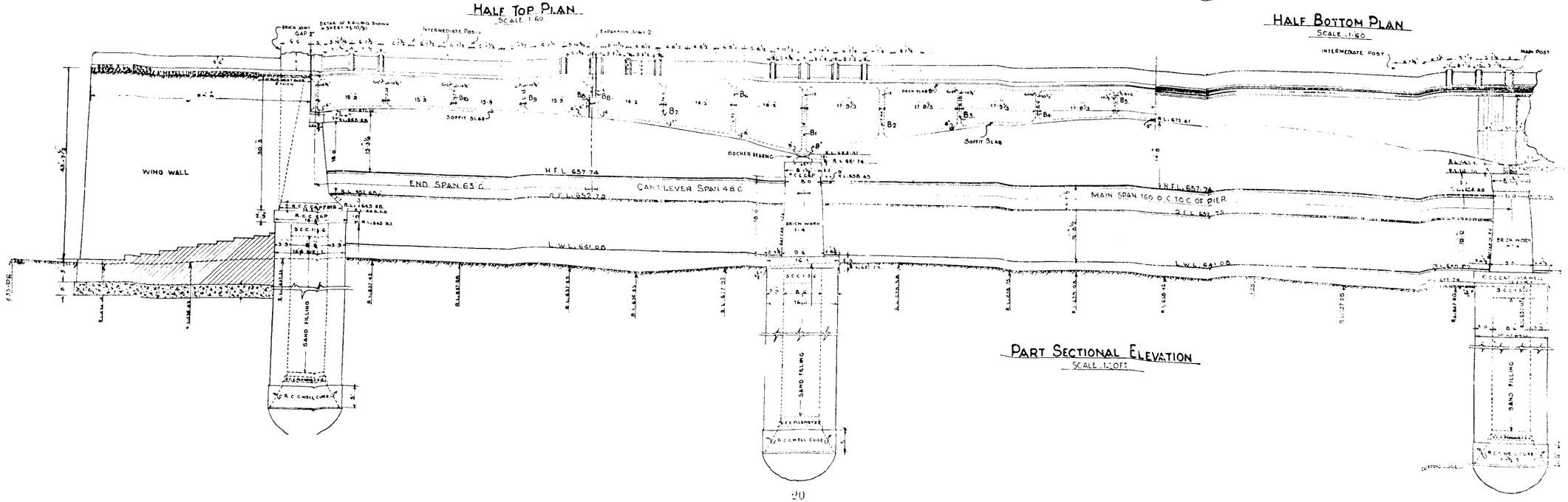
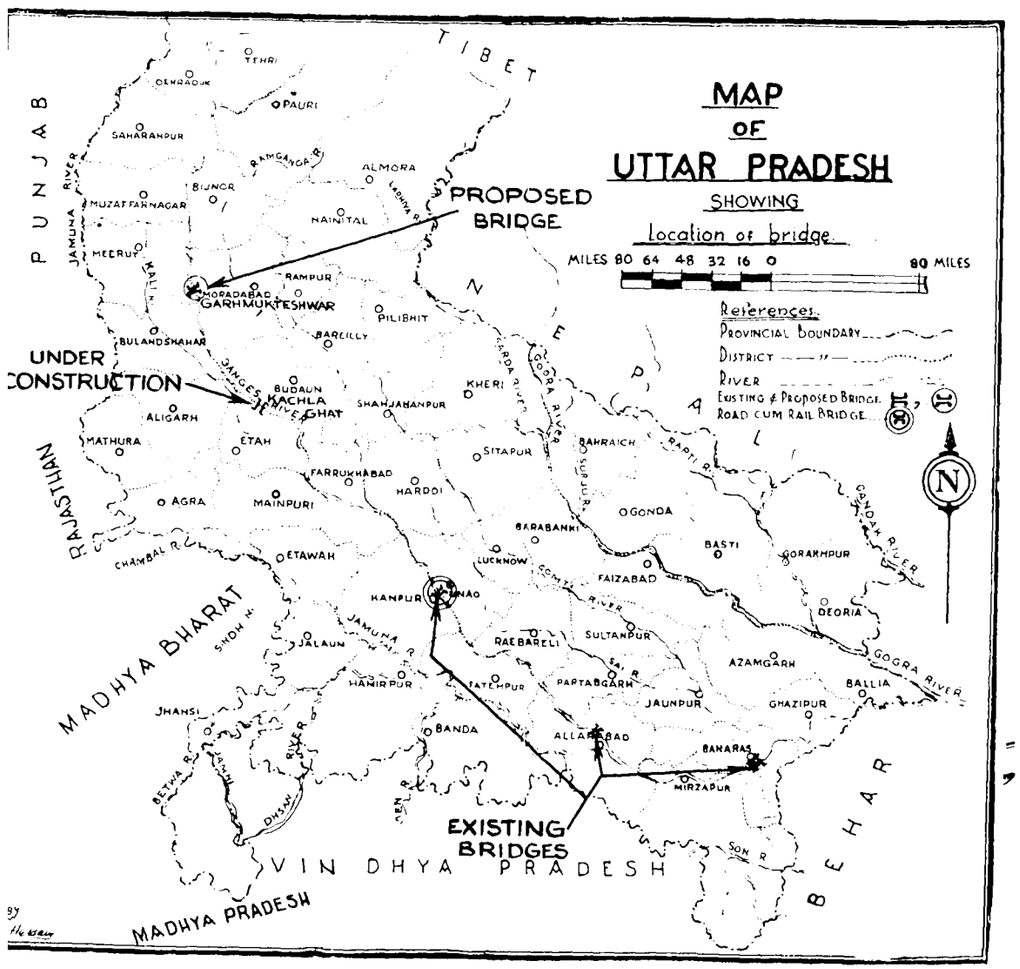
Transport-Communications Monthly Review







MODERN METHODS OF MOTORWAY CONSTRUCTION IN HOLLAND

THE first plan for the Netherlands motorways was drawn up by the Rijkswaterstaat in 1936 : it consisted of a network linking the important towns of the Netherlands and forming direct connections with neighbouring countries. Great store is set by having good east-west and north-south communications. These motorways now form the most important roads of the new National Road Plan, which is revised every ten years and provides for 1,435 miles of roads. By 1954, 316 miles of the proposed motorways had been built or were under construction.

The first motorway to be constructed in Holland was the National Road between the Hague and Rotterdam. Part of this road is built with a four-lane single carriageway and part with dual carriageways. In each case, the traffic lanes are approximately 10 ft wide. The post-war motorways, however, such as the Amsterdam-Utrecht route, are all designed according to the most up-to-date principles, with dual carriageways, access only at limited points and foolproof flyover and cloverleaf crossings and road junctions.

The carriageways are separated by a 14 ft. wide grass-covered central strip ; each carriageway is 24 ft wide and has a 9 ft wide parking lane running along its outside edge and a 6 ft wide grass-covered shoulder beyond that. The carriageways have a cross-fall of 1 in 60, the parking lanes the same or slightly greater, and the shoulders about 1 in 20. The central strip is flat. The roads are designed to give adequate visibility to drivers travelling at speeds of upto 100 miles an hour.

Gradual curves are provided to avoid monotony and for aesthetic reasons – and indeed an aerial view of the sweeping lines of the motorways across the flat Dutch landscape makes an impressive picture. Nearly all of the few slopes of these roads are artificial ones leading to a bridge or viaduct. these slopes are connected with the horizontal and with each other by transition curves.

Approximately 30 per cent of the National Plan roads already constructed are of concrete. At present, there are a number of roads still paved with setts ; these are gradually being replaced either by concrete or by bituminous pavement.

The first concrete road in the Netherlands was constructed in 1920, and Dutch experience since that date has led to the belief that concrete is the most suitable material for major road construction, for reasons of economy, as well as for its wearing, riding and visual qualities.

The most suitable available subsoil for roads in the Netherlands is the alluvial sand of a good grading, which is found in the east and the south of the country. However a great part of the important motor roads are built or will be built in the western part of the country where most important cities – Amsterdam, the Hague, Rotterdam, Utrecht – and the heaviest concentration of population is to be found, and where the natural subsoil is very poor.

Before laying the road a soil investigation is carried out and the bad subsoil is removed completely or partially, and replaced by compacted sand. The soil is excavated either dry or under water, by mechanical means, sometimes to a depth of as much as 30 ft. The sand used to replace it is mechanically pumped into the canal-like channel left by the excavation, so that a fairly uniform density is obtained. At this stage the sand bed is left for about a year for most of the settlement to take place. Dutch experience has shown that provided the embankment is constructed in this way, two-thirds of the expected settlement takes place before it is completed – usually within 1½ to 3 years.

In some places in western Holland the poor subsoil is so deep as to make removal and replacement impractical. Where this is the case, either a bottom layer of concrete resting on concrete piles, or a reinforced concrete basin resting on timber piles and filled with sand, is laid.

If a subsoil of low permeability has sufficient bearing strength for the direct support of the concrete pavement, it is only necessary to construct a layer of sand of good permeability at least 2 ft 6 in. thick as a sub-base.

Good drainage of the base is considered to be of the greatest importance. A layer of sand some 3 ft thick is *always* laid beneath the pavement as a sub-base and for drainage purposes, and the crown of the road must be at least 3 ft 6 in. and preferably 5 ft above the water table to avoid frost damage.

The slabs now used on motorways in the Netherlands are 9 in. thick, 12 ft wide and 80 ft or 125 ft long. The shorter slabs are laid in the cold weather and the longer ones in warmer weather, when slabs of 250 ft in length have also been laid with satisfactory results. The slabs are separated by expansion joints, and dummy contraction joints occur at 20 ft 6 in. intervals: as the carriageways are 24 ft wide, two slabs with a longitudinal joint between them are laid in each carriageway. The slabs are provided with tie-bars of approximately $\frac{1}{2}$ in. diameter (which are covered with asphalt for 4 in. on each side of the joint) at a depth of 5.3 in. through both contraction and longitudinal joints, and the concrete is placed in two courses, a top course 2.3 in. thick and a bottom course 6.7 in. thick.

The expansion joints are 0.5 in. to 0.6 in. wide and are made over a concrete sleeper beam with a cement content of 500 lb. per cu. yd., made some days before the placing of the concrete of the slabs. These beams are made with great care and are given a double coating of an asphaltic emulsion to lessen the friction between slabs and beam. The joints are constructed over these beams in order to prevent irregularities in the road surface which might be caused by any subsidence of the slabs at the joints.

It is regarded as very important that the beams should be wide enough to spread the load over a fairly large surface, and a width of 4 ft is specified. Experience with this construction over a period of fourteen years has been very satisfactory and no damage of any importance has occurred at joints where sleeper beams have been used.

During the placing of the bottom course of the concrete an inverted box is placed on the sleeper beam, just over the location of the expansion joint. When the course has been spread the box is removed and vertical bars are then placed in holes, previously made for the purpose in the sleeper beams, just behind the line of the joint, and against this is placed a soft wooden joint filler topped by a lath 1 in. deep. Concrete is then placed on both sides of the wooden filler and compacted with a vibratory compactor worked by hand, and then, finally, the top course of concrete is placed and compacted. The wooden lath in the top part of the joint is left in position until the sides of the joint are to be coated with primer. The day's work has always to end at an expansion joint if possible or, if not, at a dummy joint beneath which a sleeper beam has been specially placed.

Joint sealing compound is poured into both expansion and longitudinal joints one or two hours after the primer has been applied. During the last few years a rubber-bitumen compound has been used for joint-sealing with very satisfactory results.

The contraction joints are 2.4 in. deep and about 0.06 in. wide, and they are made as soon as the top course of concrete has been compacted. A jointing tool or knife is vibrated vertically into the concrete and withdrawn, and then inserted once more into the concrete with a strip of 'Ruberoid' wrapped round it: the tool is then withdrawn, leaving the joint filler sticking up above the road surface. After the concrete is finished the joint has a width of as little as 0.08 in. The next day the projecting 'Ruberoid' and any surplus mortar are scraped off.

The concrete mixes used for these roads are now generally made with ordinary Portland cement. This is preferred to the rapid-hardening Portland and blast furnace cements used in the earlier motor roads in the Netherlands, because it is found to be cheaper and give a concrete with less shrinkage. On the other hand when using a rapid-hardening Portland cement the output can be increased and the road forms removed sooner.

The fine aggregate is generally dredged river sand, as this is nearly all of particles of 0.01 in. to 0.05 in. sizes and it is otherwise difficult to obtain well graded sand. Generally the specification requires the sand to have a fineness modulus of at least 2.4, but uses of much coarser sand with a fineness modulus of about 3.1 to 3.4 improves the workability of the concrete and the skid-resistance of the road surface. Tests made some months ago have shown that slabs made with this coarse sand, whether they are fifteen years old or new, have an equally rough surface. The coarse aggregate used is generally dredged river gravel: when the first motor roads were constructed the coarse aggregate for the top layer of concrete was always of broken stone of some kind but it was found that ordinary river gravel with a high quartzite content gave good service at less cost. The aggregate for the concrete of the top course is of 0.2 in. to 1.2 in. size, while that for the bottom course is 0.2 in. to 1.9 in. size. The concrete of the top course is made with a richer mix than that of the bottom. The mix proportions are respectively 675 lb. of cement and 500 lb of cement per cubic yard of aggregate. For both mixes the sand content of the aggregate is generally 35 to 40 per cent; the slump varies from 0 in. to 1 in. depending on the method of compacting and finishing and must not be more than 1 in.

The concrete is usually mixed at a central plant. The composition of the mixes is checked at least twice a day in a testing hut near the mixing plant, and it is compulsory for the testing hut to be connected both with the mixing plant and the site by telephone or radio. The mixing plant is generally not more than $3\frac{1}{2}$ miles from the site and the concrete is covered by tarpaulins when in transit.

The placing and compacting of the concrete is carried out very carefully. The sub-base, after having been compacted and smoothed, is covered with waterproof paper before the work begins. Steel road forms, bedded on concrete slabs 2 in. thick, are used, and the machinery used in spreading and compacting runs on the forms. The concrete for the bottom course is tipped from the lorries into a mechanical spreader as it has been found that to tip the concrete directly on to the sub-base results in very irregular compaction. Mechanical vibrators running on the forms are used to compact both courses of concrete: the machines used for the top course are lighter than those for the bottom course and are equipped with an additional finishing beam. The vibrator is passed over the bottom course of concrete three times, after which the surface of the concrete is loosened in order to obtain good bond with the top course. After the top course of the concrete has been spread by hand, the lighter vibrator, which has a reciprocating beam, is passed over it at least three times: on the third pass the finishing beam which forms a part of the machine is brought into action. The greatest care has, of course, to be taken when the machine is passing over an expansion joint, and vibration is only continued over the joint at the third pass. The top course must be finished within an hour of placing the bottom course and all the concrete has to be used within two hours of mixing. The concrete is brushed with a stiff broom in order to roughen the surface, and is covered with wet hessian for twenty-four hours and then with wet sand for three weeks. The completed road, when measured longitudinally with a straight edge, must not vary more than $\frac{1}{8}$ in. in 16 ft 4 in. Cores are cut from the slab at intervals as a check on the quality of the road: they are tested at the National Road Laboratory for uniformity of thickness and for density.

The maintenance of the motor roads consists for the most part of refilling the joints. Occasionally it is necessary to deal with settlement at expansion joints, and this is done either by resurfacing with an additional layer of concrete or by mud-jacking. The application of thin layers of new concrete to the carefully cleaned and roughened surface of the old concrete requires very careful workmanship but gives excellent results. In many cases these layers have already withstood traffic and weather for several years.

(*Concrete Quarterly, July-Sept., 1955.*)

GEOPHYSICAL METHODS OF EXPLORATION

IN the Paper "Geophysical Methods of Exploration and Their Application to Civil Engineering Problems", J. Robertshaw and P. D. Brown describe in detail geophysical methods of exploration giving examples of the use of these to actual cases.

Geophysics is a science concerned with the physical properties of the earth. The main physical properties exhibited by the earth are magnetism, density, electrical conductivity, and elasticity. Variations in the subsurface geology are accompanied by variations in one or more of these physical properties which can be measured by the geophysicist at the surface of the earth. With the instruments now available these measurements present no difficulty, but it is then the geophysicist's job to try to deduce the changes in the subsurface geology responsible for the changes in the physical properties he has measured.

The first essential in starting a site investigation is to make a geological survey to determine the possible subsurface conditions which may be expected. This should be followed by a geophysical survey, where applicable, in order to obtain a general picture of the subsurface geology, thus providing a basis for the subsequent drilling and testing programme to obtain detailed information where it is most required. Information from the first few bore holes is normally sufficient to provide a control on the interpretation of the geophysical data, from which a more detailed picture of the subsurface conditions between the bore holes can then be obtained.

The advantage of a geophysical survey lies in the speed and economy with which an area can be explored compared with other methods. Indeed, the object is to save money by eliminating unnecessary drill holes and to amplify the information obtained from the holes that are put down. However, geophysical methods of exploration are not applicable in all cases, and must be used with discretion.

Of the several geophysical methods of exploration the electrical resistivity and seismic methods are the ones most usefully applied to civil engineering problems.

Electrical Resistivity Method

When metal spikes, called current electrodes, are connected to a battery or generator, current flows through the ground. To measure the resistivity, which is defined as the resistance offered by a unit cube of the material to the flow of an electric current perpendicular to one of its faces, another pair of electrodes are driven on the line joining the current electrodes so that the distance between the four electrodes is equal. The resistivity of the ground is proportional to the voltage drop betwen the two electrodes in the middle divided by the current applied to the current electrodes multiplied by the spacing.

In practice, the ground is seldom composed of a homogeneous material. So the resistivity measured is the "apparent resistivity". By plotting a curve called "resistivity curve", relating electrode spacing to the apparent resistivity and superimposing it on theoretical standard curves which have been computed for various values of depth and resistivity ratio, the depth of the layer in the field is determined.

Seismic Method

In this method, a charge of gelignite is exploded in the ground. The resulting waves are picked up by a number of seismometers located in the ground at various distances. By study of the time in which the vibrations are picked up by the seismometers the depth and the profile of the layers are determined.

It is always advisable to correlate the geophysical survey with bore holes on the site. However, it is not essential that the borings be made prior to the survey, because a preliminary interpretation can be made without them. The preliminary interpretation, in fact, enables a more judicious siting of the bore holes with a consequent reduction in the total number of bore holes required.

In general, the seismic method is more accurate than the resistivity method. With a seismic survey and not less than two bore holes, the depth to the bedrock can be determined on most sites with sufficient accuracy to meet practical requirements. With this method a mean accuracy of 94 per cent has been achieved on depths greater than 20 feet. A similar claim cannot be made for the electrical resistivity method for which the applications are more limited. However, when the geological conditions are favourable, an accuracy of 90 per cent can be expected with the resistivity method and it is undoubtedly quicker and less expensive than the seismic method.

(*From "Proceedings of the Institution of Civil Engineers, Part I, Vol. 4, September 1955.*)

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

BLACK COTTON SOIL: Soil formed by the decomposition of rocks like trap, granite, gneiss, basalt, or limestone, by long continued weathering. The clay content (particle size less than 0.002 mm) is from 40 to 50 per cent.

BROWNIAN MOVEMENT: The state of constant unordered motion, of solid particles in a fluid medium visible under the microscope, which is due to the fact that each particle possesses an electrical charge which cause it to repel other particles similarly charged.

GOOD ROADS INCREASE PRODUCTION

We are certain that much of the increase in American productivity is attributable to the building up of an excellent road transport system based upon good roads.

[*From a Report by Organization for European Economic Co-operation.*]

URBAN ROADS—UTILITIES AND SERVICES

Recommended by a Subcommittee, amended and approved in the combined plenary session of the Seminar and Conference of town planners in October 1955.

THE Seminar recommends that the Central Road Research Institute, Delhi, should be requested to undertake study in respect of Road Services and Traffic with reference to urban areas, and that the Standards in respect of highways should be according to the recommendations of the Indian Roads Congress, in order to enable movement of animal-drawn and mechanically propelled vehicles with reasonable speed, comfort and safety. It is essential that all Town Planning Organisations in the States should establish close contact and collaboration with the above-mentioned authorities

Urban roads shall be classified according to traffic movement as below.

Arterial Roads. All roads passing within the city limits and linking the State or National Highway system with limited access, including ring roads, by-pass roads, etc.

Major Roads. All those roads within the city which connect important places

Minor Roads. All roads collecting traffic from different parts of the town and linking with one another and/or with the major roads.

Streets All roads which cater to the internal communication of a local area which may be residential, commercial or industrial.

Pathways All access ways intended to give access to individual premises and where vehicular traffic is forbidden.

Standards

The following standards are recommended for the different classes of urban roads.

The widths and other specifications shall be as in the Table given below:

Nature of road	Single or dual road	No. of carriage lanes	Width of foot-paths	Width of Cycle tracks	Overall width of road land	Building lines*
Arterial-roads	Dual	2+2	No foothpaths or cycle tracks. But shoulders of 10 ft should be provided. Service roads to be provided where developments are likely.			
Major roads	Dual	2+2	14 ft on either side	9 ft	112 ft	5 ft
Minor roads	Single	2 to 3	6 ft to 10 ft on either side	6 ft where provided	44 to 66 ft	5 ft
Streets	Single	1 to 2	6 ft on either side	nil	32 ft to 42 ft	5 ft
Pathways	Single	6 ft to 10 ft	nil	nil	12 ft to 16 ft	5 ft

* Width beyond road land on either side.

In the case of Streets 32 ft wide, the maximum width of carriageway *i.e.*, between kerb to kerb shall be not less than 20 ft with a minimum paved width of 12 ft.

As far as possible, locating major roads passing through residential areas shall be avoided. On major roads existing towns and cities, footpaths and cycle tracks shall be provided wherever possible. In the case of new major roads being planned, footpaths and cycle tracks shall be invariably provided.

Gradients Camber Visibility at Curves and junctions and Superelevation

The Seminar recommends that the specifications recommended by the Indian Roads Congress should be adopted in so far as they are applicable to urban conditions.

Drainage

Proper and efficient drainage shall be provided. The drain off should be efficient and should prevent flooding of the street during heavy rains.

Kerbs

Curbs shall be of a height of 4″ to 8″ and shall be chamfered or rounded off and should be painted with black and white strips with a durable paint.

Street facilities

Adequate street facilities such as lighting, traffic signs and signals, lane markings, street-names, directional signs, pedestrian crossing markings, etc. shall be provided, suitably displayed, and well maintained.

Bus Stops

Bus recesses shall be provided at all bus stops.

Road intersections

Suitable road intersections shall be designed to provide for safe and smooth traffic movement. In this regard standards and specifications evolved by the Indian Roads Congress and the Central Road Research Institute should be followed.

Parking facilities

Facilities for parking of vehicles is important. At all points, where traffic accumulations are likely to occur such as shopping centres, offices, markets, places of amusement, workshops etc. provision shall be made to reserve and create adequate facilities for parking of vehicles. In this regard the planners should take a far sighted view and provide for future increase of traffic, and as far as possible away from the carriageway. In all new development schemes the provision of off-street parking facilities shall be made compulsory.

Loading and Un-loading facilities

As far as possible, loading and unloading of goods shall not be allowed on busy roads. Wherever possible adequate provision shall be made for off-street loading and unloading either inside the premises or on a rear street in the case of large commercial areas. In areas where such facilities cannot be provided, loading and unloading shall be restricted to hours of light traffic.

Layout of Services

Water, sewer, gas and other service lanes shall be so laid as to avoid frequent opening up of roads for repairs, maintenance and new connections.

HERE AND THERE

1. ETHIOPIA BENEFITS BY HIGHWAYS

● THE newly completed 514 mile highway between Addis Ababa and the port of Assab has reduced travelling time for trucks to two days. This journey formerly required two weeks.

Similar progress is reported with regard to the 197 mile road from Addis Ababa to Jimma. When the Ethiopian Highway programme was initiated in 1951 this route was virtually closed to passenger traffic and the normal transit time for trucks ranged from three days to one week. Today the distance can be covered in 6½ hours by passenger cars and in 10 hours by truck.

The highway programme has also benefited the coffee producing region of Dilla. The 220 mile route between Dilla and Addis Ababa, which formerly took five weeks of arduous travel, can now be covered in one day's journey.

(*From 'World Highway Report,' March, 1955*).

2. ROAD AND RAIL COMMUNICATIONS IN ALGERIA

● ALGERIA has an extensive network of roads totalling some 48,000 miles including 15,000 miles of desert tracks capable of carrying motor vehicles. Certain mountain areas remain difficult of access and there is considerable scope for improvement. Under the first 4 Year Plan (1949-52) roads were built at a cost of 2.9 milliard francs (Rs 4 crores) and the present programme, which covers the period 1953-56 envisages the expenditure of 9.5 milliard francs (Rs 13 crores). There are 1,24,000 motor vehicles in use, 61 per cent of which are passenger cars. The development of roads and the impact of general economic development is expected to bring an average rise of about 5 per cent in petrol requirements during the next few years.

The railways total some 2,700 miles, about half of which are main lines. The railways operate at a loss and improvements during 1953–56, totalling 15 milliard francs (Rs 20 crores) are only to be carried out on the main line sections. Little is to be spent on the other lines since it is considered better policy to concentrate on improving the road system.

(*From "World Highway Report, April 1955.*)

3. LACK OF COMMUNICATIONS IMPEDES PROGRESS IN COMMUNITY PROJECT AREAS

● ONE of the most important factors telling upon progress of work in the Community Project areas has been lack of communications. Even in the driest part of the year, the communication facilities are of the meagrest description; during the rainy season, they become non-existent. In the Majuli N. E. S. Block, which is situated in an island on the Brahamaputra, schools are closed in the rainy season as the water-level is high and villagers are isolated from one another. In the hill areas, the problem of communications is even more acute. There are villages in the Garo Hills from where people have to walk for three days along bridle tracks with their cotton, chillies, ginger and 'til' on their backs to reach the nearest bazaar. In some of the less accessible areas of the Bhoi Community Development Block in Khasi Hills, people are not interested in extending cultivation because the transport cost, by human load, to the bazaar is sometimes very much higher than the cost of the produce itself.

These facts perhaps explain the extraordinary interest shown by the people in the construction of roads on a vast scale. To give one example, prior to October 1952, the entire Darrang Project area with an extent of 425 square miles had only 81 miles of metalled roads and 92 miles of village roads. During the first two and a half years of starting of the Project, the people had, by their voluntary labour, built 279 miles of new roads and extensively repaired 315 miles of old existing tracks so as to make them motorable in the dry season.

In the hill areas also people have to their credit outstanding achievements in road making. In the Garo Hills Community Development Block alone, where the population is 45 per square mile and where there is sometimes 12 miles of un-inhabitated jungle separating one village from the next, the people have made 199 miles of new jeepable roads. Where but a year ago, the weary Garo was carrying 30 seers of his agricultural produce on his back to the bazaar three days' distance away, buffalo carts have now started carrying 15 maunds at a time.

In the Bhoi Community Development Block in Khasi Hills, people in their enthusiasm, have started putting up milestones on the "Project roads". The total length of new roads built by the people so far comes to 1,738 miles and that of existing village paths extensively repaired to 800 miles. The total earthwork done by voluntary labour is estimated at 5,53,00,500 cubic feet. 707 bridges and culverts have been constructed on these roads from the project funds.

(*From "Kurukshetra"—October 2, 1955*).

4. NEW REFRACTORY CEMENT

● A WHITE calcium aluminate hydraulic cement with an alumina content of 70 to 75 per cent and with total impurities less than 1 per cent, for use in refractory concrete, is now available. Refractory concretes incorporating this cement and a refractory aggregate have the setting-time and rapid hardening properties usually associated with high-alumina cement, but they also have a greatly enhanced refractoriness. Concretes made with this cement and corundum aggregate can be put into service within 24 hours of casting at temperatures up to 1800 deg. C.; such concrete, do not shrink, and have high resistance to thermal shock. This cement may also be used with other refractory aggregates such as crushed firebrick, sillimanite, chrome, and chrome-magnesite.

(*From 'Concrete and Constructional Engineering, November, 1955*)

5. PROTECTING REINFORCEMENT

● RUSTING of reinforcement is inhibited by applying thereto a cement slurry containing sodium benzoate, or by including sodium benzoate in the whole mass of concrete. The slurry may be applied by brushing or spraying. The sodium benzoate may be dissolved in the water to the extent of from 2 to 10 per cent of sodium benzoate, or may be added as a powder to the cement which is mixed with two to three volumes of sand. Two or more coats of slurry may be applied to form a coating about ⅛ in. thick which is allowed to set for 48 hours. The reinforcement may be coated either before or after it is in position.

(*From 'Concrete and Constructional Engineering, November, 1955*)

6. INTERNATIONAL CONFERENCE ON PRESTRESSED CONCRETE, AMSTERDAM

● THE findings of the Conference held from August 29th to September 2nd last year, which was attended by nearly 100 delegates from 31 nations, are given below.

It would appear that further study is required to find the right type of steel that will meet general needs so that such a steel can be stocked against the requirements of manufacturers.

That all the materials used must be of the highest quality is a **sine qua non**, the workmanship must also be of a high order and precision is essential.

It would be a great advantage if a system of standard spans and loading is developed as manufacturers could then turn out a greater number of units from each mould and even keep a stock available.

So far as construction is concerned, it would appear that pre-stressed concrete can show attractive possibilities in bridge work where saving of weight or confined headroom makes smaller sections essential.

The subjects of joints and connection with reinforced concrete are still matters of argument which will be settled by more experience.

As to cost it could not be shown that precast concrete is generally cheaper than reinforced concrete, its advantages lay in speed of construction and the greater control in the factory than obtains on the site.

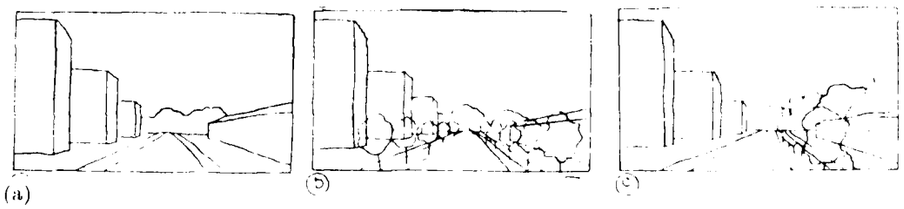
It is proposed that the subject of prestressed concrete pipes should be included at the next conference and, no doubt, this will be of special interest to highway engineers.

The value of prestressed concrete to Holland was explained by the Minister of Transport as being due (1) to shortage of steel, (2) to the high cost of imported aggregates ; these are two practical reasons so far as Holland is concerned, but they will not apply to many other countries.

(*From 'Highways and Bridges and Engineering Works' September 14th, 1955.*).

7. STREET PLANTING

● TREES may be used as a foil or element of contrast and decoration for buildings, as a unifying element in a street or to screen unsightly buildings. trees are most likely to be planted. The symmetrical and formal distribution of trees are quite unrelated to the buildings and therefore they play no part in the



The Fig. illustrates the use of trees to provide balance in a street scene.

In (a), the weight of the building mass is clearly on one side of the street. It is basically an unbalanced street picture. Sketch (b) shows the manner in which composition of the street. In sketch (c), trees are shown on one side only. Trees planted in this way give balance to the street picture.

(*From 'Journal of the Town Planning Institute'–Sept.-Oct., 1955.*)

8. CIVIL SERVANTS

● THE civil servants are men who passed a written examination with distinction, in early manhood, and thereafter led a life sheltered, regimented, secure, governed by rules, safe from external criticism, sacrosanct even from the indignity of being called to give evidence in a court of law. They acquire a characteristic mentality, address and appearance and, above all, a characteristic style of writing. They are of unimpeachable integrity, of cast-iron conservatism ; they are self-controlled. suave and courteous ; they are admirably equipped to dampen ardour, to quench zeal and to stifle enthusiasm ; but they cannot lead.

Because they are themselves regimented they want everyone regimented.

Because they are graded and catalogued they want everyone so.

Because they are anonymous they want us to be impersonal.

Because they are sheltered and cloistered they want us to be hid.

But, gentlemen, we do not want it so. It is not suitable to our great profession that it should be so.

Let me quote a paragraph from Eugene Freyssinet the great master engineer of our time :

> 'Those of my readers who have insufficiently reflected on the conditions in which technicians carry out their activities, or who are ignorant of them, will, perhaps, be astonished at the importance which I attach to the moral side of technique '.

A machine cannot be a moral being. Therefore I assert that we (engineers) cannot afford to be regimented, graded, impersonal and hidden.

[*From 'the Presidential Address of Forthington to the Institution of Civil Engineers, Ireland—Surveyor and Municipal and County Engineer, November 19, 1955*'].

9. NEW BELGIAN ROAD FUND

● UNDER a law passed on August 9, 1955, a new Road Fund has been set up by the Belgian Government with the object of speeding up the urgent work of extending and improving the national road network. It takes the place of the original Fund set up in 1952 which, although charged with a very extensive programme of construction and modernization, had achieved only limited results, largely through lack of money.

The Fund will be financially autonomous and will have authority to issue over the fifteen-year period government-guaranteed loans to the value of the required Belgian francs 30,000 million. The first loan, to the value of B. Frs. 2,500 million francs, was issued on October 17, 1955, and will be followed by equivalent loans in each of the two following years. The Fund will also receive an annual allotment from the government Extraordinary Budget, destined principally for the servicing of its loans.

The Fund will be under the supervision of the Minister of Public works and reconstruction and will be administered by civil servants drawn from the Ministries of Public Works, Finance, Economic Affairs, and Communications.

(*From 'Highway and Bridges and Engineering Works'—October 26, 1955.*)

CURRENT LITERATURE

ABSTRACTS

EXPERIMENTAL INVESTIGATIONS ON THE BRAKING PERFORMANCE OF MOTOR VEHICLES by H. J. H. Starks and R. D. Lister.

Proceedings of the Institution of Automobile Engineers, March 1955.

THIS paper contains the results of experimental investigations on the braking performance of different classes of road vehicles when new and as they are used on the roads. Measurements were made of the shortest braking distance obtainable on a dry surface and of the behaviour of cars during emergency braking on straight roads both when the brakes were properly adjusted and when they were deliberately put out of adjustment to simulate the condition of some braking systems observed on the road. The results not only confirmed earlier experiments with models but also showed that if the time interval between the front wheels locking and the rear wheels locking exceeds a certain critical value, this has an important influence on the behaviour of the braked car. Measurements are described on the braking performance of commercial vehicles and how this is affected by loading and by the characteristics of the braking system. Other investigations on the braking performance of public service vehicles, motor cycles, and motor-assisted cycles are also described. Certain discrepancies in the published figures for the braking performance of vehicles are discussed. The paper concludes with a summary of the braking problems which merit the attention of vehicle designers.

(Author's Summary)

"PRESTRESSED CONCRETE ROADS" by J. P. Stott. Proceedings of the Institution of Civil Engineers, Part II, October 1955.

SEVERAL prestressed concrete roads have been built in Britain and abroad. As a result, it is now possible to consider many factors about which little was known previously and to assess problems associated with this new form of construction. The Paper reviews the present situation.

Advantages and disadvantages are discussed and the function of prestressing and characteristics of prestressed slabs are briefly considered. Particular attention is paid to the formation, development, and significance of cracks.

A distinction is made between two types of prestressed road the "continuous" and the "individual slab" type. Most of the roads so far built have been in the latter category. A possible development is to use the continuous type for fairly straight and level lengths of road on uniform Subgrades in combination with the individual Slab type on curves and non-uniform subgrades.

The distribution of stress imposed by the prestress, by traffic, and temperature is discussed. Of particular importance is the relatively high tensile stress which may be set up by subgrade restraint in a long slab when it contracts. This stress may be sufficient to neutralize the prestress, at any rate in part, and it is consequently not practical to use slab lengths greater than about 400 ft. The most urgent problem awaiting solution is that of reducing subgrade restraint; an indication of experiments now in hand on this subject is given.

Some suggestions are made for design values of prestress. Information is given on existing prestressed concrete roads and available figures of cost are presented. Experience has shown that costs are approximately equal to those for concrete roads of orthodox type.

The main conclusion to be drawn from present knowledge and experience is that, by using prestressed concrete, slabs up to about 400 ft can be constructed with every prospect of a long life. Before individual slabs of longer length can be constructed, methods of reducing subgrade restraint

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(*Contd. from page 32*)

must be developed and special types of joints used. On fairly straight and level sites, with uniform subsoil conditions, a continuous type of construction without expansion joints may be possible.

LOAD TESTS ON A THREE STOREY REINFORCED CONCRETE BUILDING IN JOHANNESBURG by A. J. Ockleston, The Structural Engineer, October, 1955.

TESTS made on portions of a ten-year-old reinforced concrete building of normal construction during the course of its demolition are briefly described, and the more important results obtained are discussed.

The deflections and strains for loads within the working range were almost always less than those estimated by normal design methods, and generally agreed more closely with those calculated on the assumption that the concrete was uncracked.

The ultimate loads for failure due to bending or to diagonal tension were greater than design methods would suggest. The plastic theories gave reasonably satifsactory estimates of ultimate loads where failure was due to bending in one direction, but under-estimated by a considerable margin the strength of lightly reinforced slabs which failed as a result of bending in two directions.

CONCRETE ROADS IN BELGIUM AND WESTERN GERMANY – Their Structural Design and Performance. Road Research Technical Paper No. 35, Her Majesty's Stationery Office, 1955.

THIS Paper gives an account of the tours of inspection of concrete roads in Belgium and Germany undertaken by the Committee of Co-operative Research between the Road Research Laboratory and the Concrete Association of England. During the course of their inspections the members of the Committee saw 178 miles of concrete roads in Belgium and 343 miles in Germany. A brief description of the foundations of the roads, thickness of the concrete slab, the concrete mix, types and spacings of joints, condition of the roads, and the traffic using them are detailed. The Paper concludes with observations made by the Committee in relation to the British practice. Some of the main observations are given below :

1. Despite the fact that the concrete roads in Germany have been in use for nearly 20 years, the heavy traffic using them has not affected the concrete surface.

2. German engineers prefer the use of full width construction without a central joint as that leads to better riding qualities and avoids inequalities in longitudinal joints due to the transverse flow of concrete at superelevated portions.

3. In Germany, joints cut with a carborundum saw in hardened concrete had an excellent appearance ; they are less perceptible than those formed in the concrete at the time of laying, and, in addition, consume less sealing compound. In Belgium, a special machine was used for forming joints immediately after the concrete was laid.

4. In Belgium, unreinforced concrete slabs with no intermediate dummy joints are successfully used for lengths up to 50 ft. In Germany, the usual practice is to use 40 ft slabs.

SAFETY MARGIN

It's the driver, not the car or the condition of the road, who causes most of the accidents. A good driver allows an adequate margin of safety between his car and the others.

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BUDGETS AND ADMINISTRATION REPORTS

ADMINISTRATION REPORT OF THE HIGHWAYS DEPARTMENT MADRAS—1952-53

THE activities of the Department have been increasing steadily. The total expenditure on all Government and District Board works during 1952-53 was Rs 987 lakhs while it was Rs 881 lakhs in 1951-52.

During the year under review, 63 miles were cement concreted, 1,026 miles were black-topped, 750 miles metalled, 1,337 miles were newly formed.

Rs 969.27 lakhs were granted for Government and District Board works; while the actual expenditure incurred was Rs 987.11 lakhs.

The maintenance of roads in the State was generally staisfactory with the exception of District Board Roads which suffered much due to slender and inelastic financial conditions.

Five Year Plan :

Madras State had a sum of Rs 5 crores allotted under 'Roads' for its Five Year Plan in two stages, the first two years beginning with 1951-52 and the second of 3 years in continuation thereof. Accordingly a scheme for five years was prepared with the following provisions :

	Rs in lakhs
State Roads	245.45
Other Roads	130.00
Tools & Plant	124.55
Total	500.00

Following is the statement showing the amount expended during the year 1952-53 against the targeted amount.

	Expenditure (in lakhs)	Target (in lakhs)
State Roads	75.42	70.00
Other Roads	57.69	50.00
Tools & Plant	29.21	32.00
	162.32	152.00

Road Milage

Classification	Cement Concrete roads	Black top roads	Metalled roads	Unmetalled roads	Total
National Highways	161	757	1,065	19	2,002
Provincial Highways	123	699	2,319	12	3,153
Major District Roads	68	1,245	14,107	651	16,071
Other District Roads	—	35	5,139	2,938	8,112
Village Roads	—	6	2,615	9,529	12,150
Total	352	2,742	25,245	13,149	41,488

Statement of expenditure on Civil Works during 1952-53.

Civil works—Revenue Expenditure

		Rs in lakhs
Communications	Original	135.85
	Repairs	394.89
Establishment		50.39
Tools & Plant		80.62
Suspense		6.05

ROADS ASSIST INTERNATIONAL TOURISM

The prosperity of most nations is becoming more and more bound up with their international trade. The development of this trade is also without doubt an important factor in securing a lasting peace. Another factor which can have a big influence in fostering peace is the ever-increasing road tourist traffic. Good international roads and the simplest possible Customs formalities could greatly assist international trade and tourism.

[*From 'Highways and Bridges and Engineering Works,' October, 12, 1955.*]

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
		RAJASTHAN	
1.	1488 RJ 8	Construction of a bridge across the Kharia Nalla in mile 29/1 of Jaipur-Delhi Road, National Highway No. 8	0.90
		MADHYA PRADESH	
2.	1489 CP 6	Reconditioning and black topping of certain miles between mile 73 and 87 of Great Eastern Road in Bhandara Distt. (N. H. No. 6)	1.92
		UTTAR PRADESH	
3.	1373 UP 29	Improvement of Banaras-Sarnath Section of N. H. No. 29	1.41
4.	1490 UP 2	Construction of a bypass for Mathura town from mile 781-790 of Bombay-Delhi Road, National Highway No. 2	14.91
5.	1501 UP 24	Construction of the Moradabad side approach to the proposed bridge over the Ganga at Garhmukteshwar on National Highway No. 24	9.89
		BOMBAY	
6.	1492 BM 8	Improvements to miles 75/2 to 87/3 of the Bombay-Ahmedabad Road, National Highway No. 8	7.08
7.	1498 BM 8	Black-topping the Tawa-Talasari Section, miles 87/3 to 113/3 of Bombay-Ahmedabad Road, National Highway No. 8.	3.11
8.	1505 BM 8	Black topping Raigadh-Rattanpur Section of the Bombay-Ahmedabad Delhi Road, N. H. No.8, with $\frac{3}{4}$ in. premixed asphalt carpet.	4.78
9.		Three works each costing less than 2 lakhs.	1.90
		JAMMU & KASHMIR	
10.	1493 JK 1-A	Development of the Srinagar-Baramulla Section of the Jammu-Srinagar-Uri Road (Phase A work).	15.20
11.	1497 JK 1-A	Construction of a diversion to by-pass the south portal of the proposed low level tunnel at Banihal.	1.31

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
		DELHI	
12.	1494 DLH 2	Providing $\frac{3}{4}$ in. premix light chipping carpet on bye-pass connecting National Highway No. 1 to National Highway No. 2 (between Rajghat and Railway Siding to Power House.)	1.49
		HIMACHAL PRADESH	
13.	1496 HP 22	Construction of bridge across the Gasso Khad in mile 80 of H. T. Road (N. H. No. 22).	0.24
		BIHAR	
14.	1499 BR 31	Construction of a road bridge over Mahananda river at Sonapurhat in the 7th mile of Assam Access Road—National Highway No. 31	16.96
		WEST BENGAL	
15.	1502 WG 31	Detailed survey of the rivers Char Torsa, Dulong, Sil Torsa, Beni Torsa and the surrounding areas including the tea gardens in connection with the construction of the bridges on National Highway No. 31 in Cooch Bihar Distt.	0.21
		ORISSA	
16.	1503 RS 5	Widening the road bridge No. 546 at mile 640.6-7 on National Highway No. 5	0.23
		TRAVANCORE-COCHIN	
17.	1504 TC 47	Improvement of miles 22/0 to 23/0 of Quilon Alleppey Section of National Highway No. 47	1.98
		HYDERABAD	
18.	1506 HD 9	Constructing a high level bridge across the river Palai in mile 115 of National Highway No. 9 in Hyderabad State	4.50
		PUNJAB	
19.	1507 PB 1	Remodelling the approaches of canal bridge in mile 270/5-7 of G. T. Road (National Highway No. 1) in Amritsar District	0.15
		MADHYA BHARAT	
20.	1508 MB 3	Protection work on the Parbati bridge in mile 233 in Guna Division on National Highway No. 3.	0.25

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