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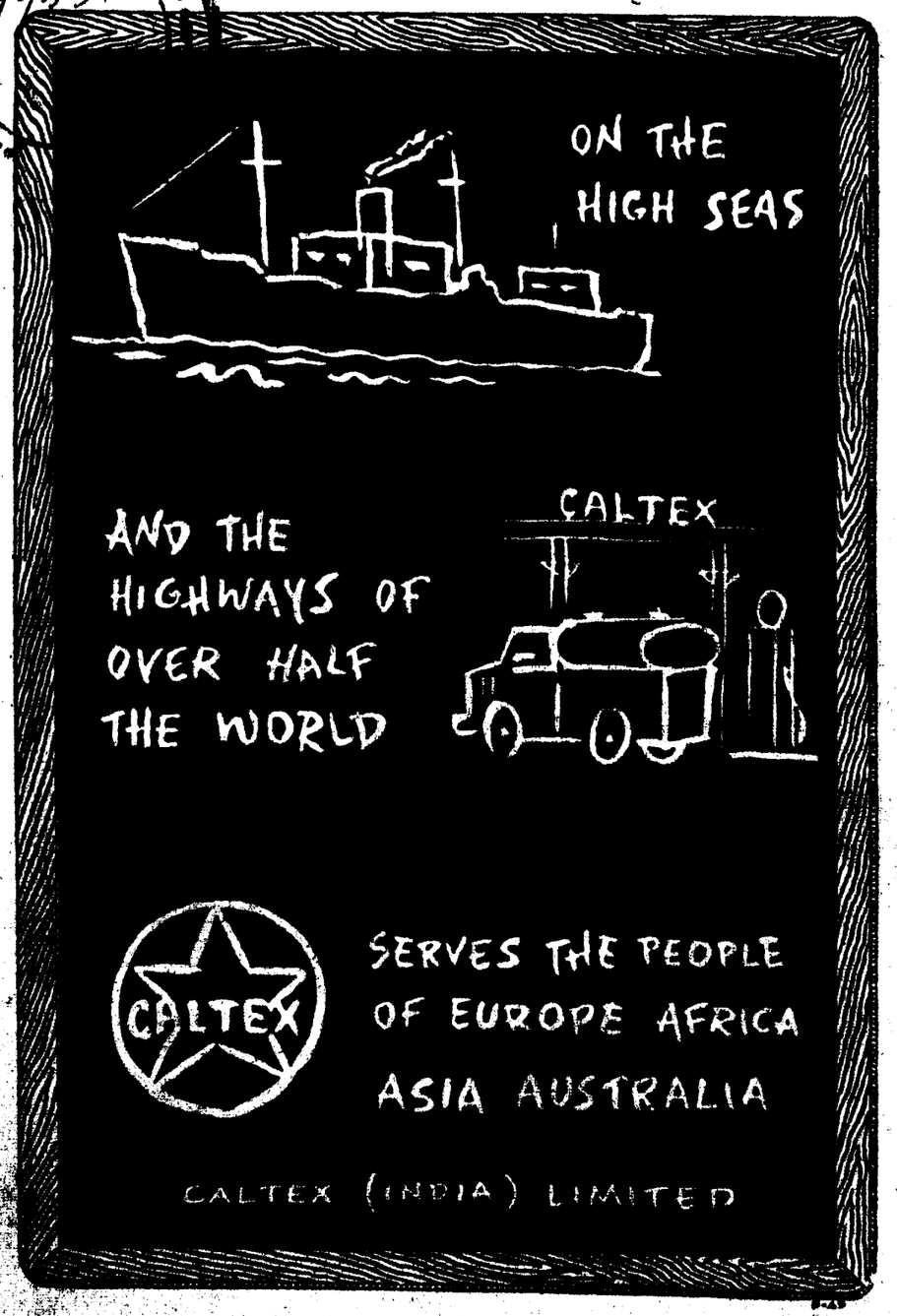

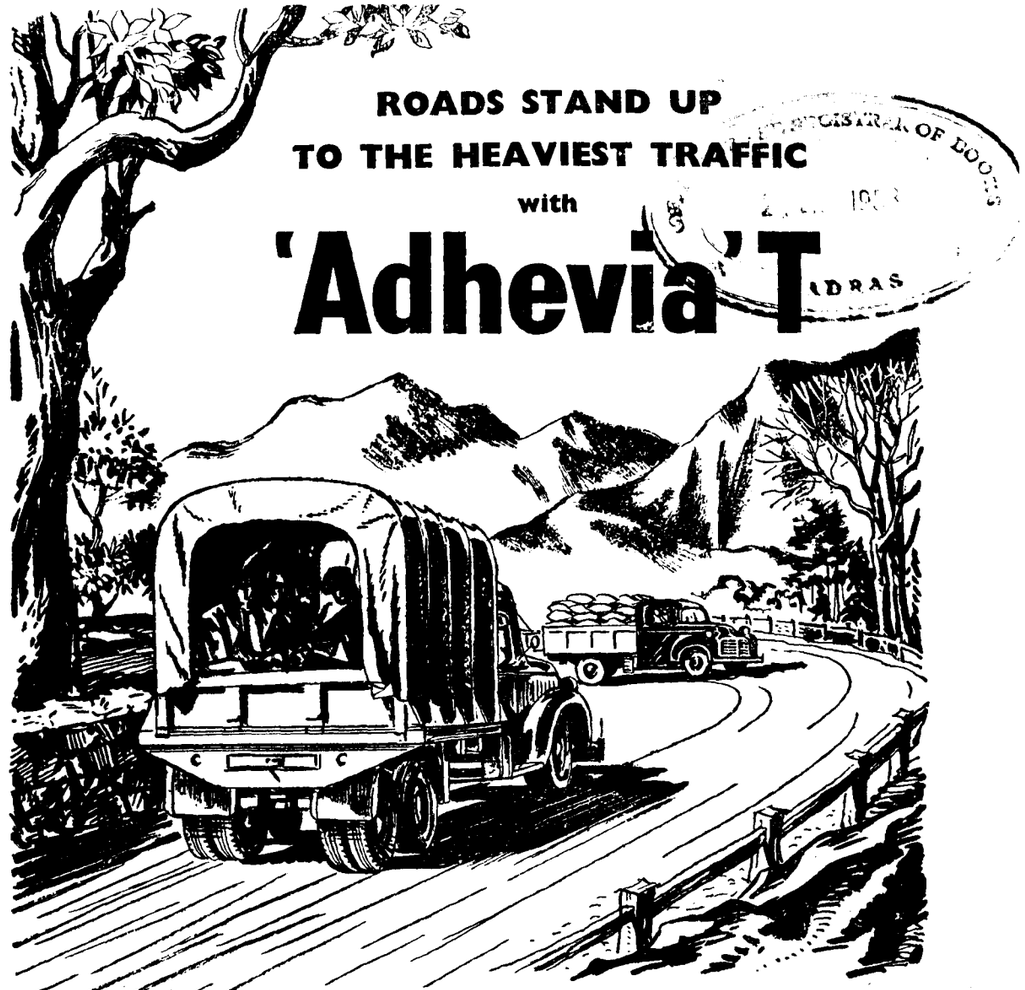

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TRANSPORT-COMMUNICATIONS

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TRANSPORT-COMMUNICATIONS
MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

JANUARY 1958

HIGHWAY PROBLEMS ON THE ANVIL

SOME members of the Indian Roads Congress may have fresh memories of the first session of the Congress held in Delhi 23 years ago. They will indeed wonder how quickly time passes! Since then, full sessions of the Congress have been held at places throughout the length and breadth of India, and by now there is no State left where the session has not been held. Each session is a milestone in the history of the Indian Roads Congress and the problems dealt with by this body cover all the aspects of road development in India. Both the Central and State Governments have largely accepted and acted upon the sound and unbiased advice offered and recommendations made by the Congress. As one of the past Presidents of the Society has so nicely stated elsewhere in this issue, that is precisely where the strength of the Congress lies.

Holding of the sessions at different places throughout India has not only helped in acquainting people with the work of the Society, but has also enabled its members to have a first-hand knowledge of the various local problems and difficulties. This year is a special occasion when the Congress is holding its full session in the Union Capital—the place of its birth. Naturally, a little stock taking is not out of place on such occasions and we publish elsewhere in this issue a brief account of the work done and the role played by the Indian Roads Congress in the development of India's road system.

This session is also auspicious on account of the Seminar on Low Cost Roads organized by the ECAFE, which will immediately follow the Congress session. We take this opportunity to extend a most hearty welcome to the delegates for the Seminar and trust it will be possible for them to participate in the proceedings of the Congress and give the members the benefit of their experience and practices.

Low cost roads is a problem not only of India but of all the far eastern countries which are backward in communications. For the rising standard of living of the peoples, cheap transport constitutes the very life-line of nourishment and development. How to achieve it is the problem. At least one thing is certain about low cost roads. It is that we should consider the picture of road construction and maintenance, road transportation and operation as a whole. Evidently, no ready-made formula can be applied in such cases. A balance between several diverse factors has to be struck. But it seems there is no question

of any compromise regarding the permanent features of road design requirements or the fundamental principles of basic policy. We give elsewhere in this issue some interesting (though 'unconventional') thoughts on the low cost aspect of road development under the present conditions by a past President of the Society. We cannot forget his contribution to these problems which still exist to-day; however, the marching times tend to render the way to their solution clearer.

Until recently, as far as road construction was concerned, we were used to think only of the pavement. With recent advances in the science of soil mechanics it is clear that we have now also to think of the soil below. In this connection, direct observations and experimentation in the field are more important than elaborate analytical computations on account of the complex nature of the materials involved. The solution seems to lie in the field itself. Suitable grading and mixing of different local materials to secure the required characteristics which can be determined by various standard tests has given satisfactory results in many places in India. Grading and compaction of the subgrade soil is effective and economical. Control of moisture and precautions regarding adequate drainage conditions of the road embankments are very essential. If soil problems receive proper attention at the outset and adequate measures are taken in proper time, the work becomes simpler later on.

Studies of pavement failures—both rigid and flexible-have revealed that side by side with modernization of roads, strengthening of existing pavements is also a problem. For these the remedy probably lies in raising the embankments and increasing the thickness of road crust. For new roads, due precautions can be taken as regards compaction of the subgrade soil, provision of adequate embankments, which initially cost much less than the pavement, moisture and drainage control and provision of sufficient thickness of road crust according to well established design methods tested in practice. Regarding concrete pavements, experience has shown that thin slabs, even if laid over stone macadam base, crack under increased total traffic and increased weight of individual vehicles. An adequate thickness of slabs has, therefore, to be initially provided. Concerning flexible pavements, experience has been that under increasing traffic on our roads the performance of open-graded mixtures is not found satisfactory in places as the surfaces are mostly uneven and not impervious to moisture effects. Properly designed dense carpets may, therefore, offer solution to the problem at least in heavy trafficked sections.

The traffic problem on our roads is becoming more and more acute every day. The problem is particularly very serious in urban areas and efforts to tackle it on a scientific basis are called for. There is no ready-made solution to this problem which calls for detailed field studies and adequate organization to handle it. In America, traffic engineering sections which were previously set up in Police departments have now been brought into Engineering departments and there are no traffic engineering departments now under police control in cities of over 2 lakh population. However, close contact with enforcement authorities is maintained. In cities under 2 lakh population, a few traffic engineering sections do come under police control and this tendency increases as the city size decreases. For cities of less than 50,000 population, the traffic engineer is mostly found in the police department, although cities of this size often use the services of consultants. In India, even a beginning in this direction has yet to be made.

It is not enough to think of road problems only. Bridging problems are also equally important, and many bridges are yet to be built to completely mobilise the country's road system. However, sufficient knowledge and experience is available in the country as regards both the behaviour of rivers and streams and performance of bridges under different load conditions to be able to tackle the future problems with confidence. The execution of some of the big bridging problems will be rendered easy by new methods and techniques of construction. Prestressed concrete which was of interesting novelty some years ago is now becoming an established practice, although much work remains to be done in this field. However, the possibilities of this method for long-span bridges seem promising. The work no doubt calls for precision and workmanship which requires specialized knowledge of special techniques and equipment. It is hoped the cost of prestressed work will decrease with time and experience and by the standardization procedures now being adopted.

These and some other problems will be on the anvil at the next session of the Indian Roads Congress. Although ready-made solutions to these problems may not be found, pooling of experience and ideas from various quarters will result in the evolution of a correct approach for exploiting the full potential of new methods and techniques that are being developed.

ROADS COME FIRST

"I have come to the conclusion that one thing to which we must give topmost priority is roads—roads of all kinds, not only very up-to-date bituminized or cement roads, but roads of any kind, to open out vast areas of this country which are closed up today and which you cannot reach unless you walk or ride.....I give roads first priority."

Shri Jawaharlal Nehru

THE 22ND SESSION OF THE INDIAN ROADS CONGRESS—NEW DELHI—JANUARY 1958

AT the invitation of the Government of India, the 22nd Session of the Indian Roads Congress is being held at New Delhi from the 4th to 8th January 1958 followed by a Seminar on "Low-Cost Road" organised by the ECAFE. Seven Papers, brief summaries of which are given below, will be discussed at the I.R.C Session. A general report on road research done in India will also come up for discussion on the 7th afternoon. There will be a panel discussion on the "Use of Soil for Cheap All weather Road Construction." Many technical committees of the Congress will meet during the Session. It is expected that about 300 delegates from all parts of India and some delegates from abroad will attend the Session. An engineering exhibition on a modest scale in which various Ministeries of the Government of India, P. W. Ds. of States, and engineering firms will participate, is also to be held on this occasion. The President of India will inaugurate the Session on the 5th noon.

SUMMARIES OF PAPERS

1. Paper No. 199 "Construction of a Bridge across Pennar River at Nellore."—J. V. Prasad.

The Paper describes the construction of the Pennar Bridge on National Highway No. 5 in Andhra State. The bridge consists of 27 spans of 71 ft each and 10 spans of 61 ft each R. C. T-beams simply supported. The foundations are partly open and partly on wells. The piers and abutments are of mass concrete. The roadway is 22 ft wide with 5 ft cantilever footpaths.

The general features of the bridge are described and the details of construction which was done departmentally are given, including the various difficulties encountered during execution of the work. Details of cost are also included.

The Paper also describes the load test of the superstructure.

2. Paper No. 200 "Asphalt Paving Mixtures–Their Design and Composition"—Norman H. Taylor.

The Paper deals with the design of asphalt paving mixtures on the analogy of soil and cement mixtures. The design is based on various physical tests which are described. The design from first principles of sheet asphalt, stone filled sheet asphat and asphaltic concrete mixtures is given. The effects of varying proportions of sand, filler, aggregate, different types and quantities of bitumen as well as the effects of compaction and water absorption are also demonstrated.

3. Paper No. 201 "Construction of Prestressed Concrete Superstructure for the Bridge over River Hindan at Ghaziabad" A.S. Bishnoi and J.S. Mathur.

River Hindan lies between Delhi and Ghaziabad on a very important route connecting Delhi with Uttar Pradesh. The old bridge was a steel girder bridge 14 ft wide. It has been replaced by a prestressed concrete superstrueture 24 ft wide over the existing piers which were already wide enough. Freyssinet type of prestressing has been used.

The bridge has 5 spans 82 feet clear. The new superstructure consists of 3 simply supported prestressed concrete T-beams which were precast and launched. The existing steel girders were made use of for launching. The deck slab and cross beams were cast in situ and were transversely prestressed.

The Paper describes in detail the precasting of beams, their prestressing and launching into spans. The design of the mix and the experiments conducted in the field have been described. The outline of the design of the bridge has been given. The load test carried out in one span has also been described giving the observations recorded and inferences drawn.

4. Paper No. 202. "Experimental Soil Stabilized Road Construction in Black Cotton Soil Area"—J. F. Mistry.

The Paper deals with experimental work of soil stabilized base course on Dabhoi-Bodeli Road in Baroda District of Bombay State. This road passes through a black cotton soil area.

Experimental work done in the laboratory with local soils and their combinations is described. The design of the pavement arrived at and the method of construction are also described.

From cost data given it is seen that stabilized soil base course effects a saving of 42.48 per cent per 100 sq. ft. over 4½ in. thick brick soling.

5. Paper No. 203 "Study and Investigation of Performance and Failures of Road Pavements in Uttar Pradesh"—H.G. Verma & D. C. Chaturvedi.

The Paper describes the performance and failures of both rigid and flexible pavements in Uttar Pradesh. Under rigid pavements evolution of thin concrete pavements, their design and performance are dealt with. The design and performance of flexible pavements are also described. Causes of failures of pavements such as heavy traffic intensity, subgrade conditions and insufficient thickness of crust are discussed. Results of both field and laboratory investigations carried out on cement concrete pavements on Grand Trunk Road (Bulandshahar Distt.) are described. Under flexible pavements, investigation of failures on Meerut—Baghpat Road are discussed and recommendations for improvements are suggested in such cases. The need for designing pavements under conditions prevalent on our roads is stressed and broad conclusions given.

6. Paper No. 204 "Scientific Aspects of the Road Traffic Problem"—T. S. Khanna.

This Paper is an outline study of the road traffic problem in India.

The seriousness of the traffic problem in India has been pointed out and a scientific approach to the problem has been suggested.

Reference is made to the different agencies like traffic police, traffic laws and courts and other agencies that could be engaged to tackle the traffic problem in a well planned and co-ordinated way.

Tentative recommendations are made regarding organization required for handling the problem.

7. Paper No. 205 "The Importance of Subgrade Compaction in the Economic Design of Flexible Pavement"—S. R. Mehra & H. L. Uppal.

The Paper presents a case for proper compaction of the subgrade so as to substitute a part of the thickness of the pavement with processed soil.

Effects of heavier traffic in dry areas and of increasing moisture content in the subgrade even with normal traffic on the settlement of the subgrade are demonstrated.

The conclusion is that by compaction of the subgrade soil on new roads the thickness of pavement which is found inadequate today can be made sufficient for the heavier traffic of the future.

AVERAGES

A man dived into the public bath and got drowned in 7 ft 6 in. of water. At the inquest a statistician said, "I don't know what all the bother is about because the average depth in the bath is only 4 ft 6 in.

THE WORK AND ROLE OF THE INDIAN ROADS CONGRESS

(Contributed)

THE origin of the Indian Roads Congress can be traced to the Indian Road Development Committee (the Jayakar Committee) appointed by the Government of India in November 1927, which not only recommended that a portion of the Reserve in the Central Road Fund should be set apart for research and experiment, but also advocated periodical holding of road conferences to discuss, among other things, questions relating to road construction and maintenance. Following these recommendations, certain grants were made from time to time for various experiments, and the "Indian Roads" published by the Department of Industries and Labour provided a medium for dissemination of useful technical information.

A road Conference first met in 1931 and committees were formed to discuss various technical matters. This Conference can be said to have been the real predecessor of the Congress, and if the Congress did not come into being then it was only because the arrangements suggested by the Indian Road Development Committee were introduced, in the first instance, for five years only.

In April 1934, however, the Central Legislature adopted a resolution which provided for the continuation of the Road Fund for an unspecified period. This naturally altered the entire outlook, and the way was clear for a wider organization. The Central Government, after consulting the State Governments, convened an inaugural meeting of the Indian Roads Congress at New Delhi in December 1934. This meeting was opened by Sir Frank Noyce, then Member for Industries and Labour, and was attended by 73 Engineers from all parts of India. Thus was the Indian Roads Congress founded and constituted.

Before the Indian Roads Congress came into existence there were no generally accepted specifications or standards of any kind; there was no forum in India for discussion of road engineering problems; there was no organized method of correlating experimental and testing work carried out in the various States, and no method of disseminating the results of these tests and experiments; there was no co-ordinated study of road problems and no means by which the Central and State Governments could obtain the collective opinion of road engineers in the country. The Indian Roads Congress has largely filled these lacunae.

The part played by roads in the economic development of a country hardly needs to be emphasised. India is predominantly an agricultural country and trunk roads spanning its length and breadth and feeder roads interlacing the districts and providing an outlet for the produce of the villages in the interior are factors of inestimable economic value. However, the necessity for the expansion of roads on a nation-wide scale brings in its train a number of problems pertaining both to pooling of experience of road construction from all over the country and setting uniform standards of road development.

During the twenty-two years of its life the Congress has:

(1) discussed 199 technical Papers at its general sessions on subjects covering all aspects of road development in India;

(2) fixed many road standards relating to geometric and other features of road construction and maintenance;

(3) published a Code of Practice on Bridges and Bridge Specifications (now under revision to include the latest technical information);

Photo 1.
Inspection of Bombay-Poona Road (Bombay Session-1939)

Photo 2.
A social function at Bombay Session-January 1950

Photo 3.
Bridges Committee meeting at Calcutta Session (Feb. 1951)

Photo 4.
Chief Engineers meeting held at Calcutta Session in Feby. 1951.

Photo 5.
A stall at the Exhibition—Srinagar Session in June, 1955.

Photo 6.
A stall at the Exhibition, Simla Session in April, 1952.

(4) held 21 Annual Sessions and 49 Council meetings to discuss road problems both technical and administrative; and

(5) appointed many Committees to study detailed aspects of various technical problems.

The Second World War brought into special prominence the necessity for an integrated road system. Lack of well-developed through routes and bridges at important crossings, and the fact that there was a limit to what the railways could carry, emphasised that the trunk roads could be properly developed only if the Centre took over their development and maintenance. That co-operation between the Centre and the States, and States and Local Government units, each functioning in its own sphere, was productive of excellent results was also evident from the history of road development in other countries, notably the U.S.A., France and Australia.

On the cessation of hostilities, the Indian Roads Congress, as a body primarily interested in the development of road communications in India, considered the post-war planning for road development and the Council in October 1943 passed a resolution which paved the way for the Conference of Chief Engineers of Provinces and States held at Nagpur in December 1943 to prepare a road development plan for the whole of India. This Conference produced the well-known "NAGPUR REPORT" which marked the real beginning of road planning and development on an All-India basis.

The targets of the Nagpur Plan have now been very nearly achieved. However, some of its recommendations have not yet been fully implemented. Mention may be made in particular of the proposal regarding the establishment of non-lapsing funds for highways both in the Central and State budgets and for the establishment of an independent Road Board to coordinate road development activities in the country. The Indian Roads Congress has continued to press these proposals from time to time and it is hoped they will be implemented in the near future.

The Indian Roads Congress has also devoted attention to matters pertaining to the training of engineers in road construction and techniques. On the advice of the Congress, the Government of India sent delegates of serving road engineers to the U.K. & U.S.A. in 1946 and 1947 respectively; invited two famous American engineers—General Fleming and Mr. Thos. H. MacDonald to India in 1946 to advise on road development; and set up a Central Road Research Institute which is now a full-fledged Institute doing research work on all problems connected with road design and construction in India.

The Congress has also operated a Road Test Track at Alipore, Calcutta, provided by the Government of India. The experiments carried out on this Test Track have established certain principles on matters concerning which there had been great differences of opinion and this has led to considerable economy in design.

COMMITTEES

The technical activities of the Indian Roads Congress are mainly carried out through its several Committees and Sub-committees consisting of experts in particular subjects. A brief indication of their functions is given below:

(1) **Specifications and Standards Committee**: Drafting standards on various items of road work, viz., Layout of roads, Design of pavements, Curves, Dimensions and Weights of Vehicles, Design of Roundabouts, Intersections, etc.

Many of these standards have already been published as Papers in the Journals of the Indian Roads Congress and discussed at the General Sessions. Draft standards on other items are under consideration.

The following five standards have also since been issued as finalised standards of the Congress:

(1) Type Design for Highway Milestones;

(2) Route-Marker Signs for National Highways;

(3) Dimensions and Weights of Road-Design Vehicles;

(4) Recommended Practice for the Location and Layout of Roadside Motor-Fuel Filling Stations; and

(5) Type Designs for Boundary and Furlong Stones.

(2) **Bridges Committee**: Drafting Standard Specifications and Code of Practice for Road Bridges in India. Drafts of Sections I & II have already been published in the Journal. Section I of the Bridge Code has also been published in finalised form. Section II is expected to be issued shortly. The remaining Sections are under consideration.

(3) **Test Track Committee**: Proposing tests and examining results of tests carried out at the Road Test Track, Calcutta. The results of these tests are being published in the form of bulletins, the first two of which have already been published as Road Research Bulletins Nos. 1 and 2.

The present series of tests are being carried out to determine, under various adverse conditions, the comparative performance of stabilised soil base courses of different thicknesses.

(4) **Research Organization Committee**: To sponsor, guide and co-ordinate road research in the country. Thus it serves as a liaison body to co-ordinate the research activities both in directing them along specified channels and in popularising and getting the results adopted widely on a practical scale.

(5) **Soil Research Committee**: Studying the problem of low cost roads in India with special reference to soil stabilised roads. On the recommendation of this Committee, the Government of India are also financing field experiments in various parts of the country.

(6) **Road Transport Operation Cost Committee**: This Committee was appointed at the instance of the Govt. of India to study (i) the cost of operation of motor vehicles on different classes of roads; (ii) the economy resulting from road improvements. The Committee is guiding scientifically designed experiments under controlled conditions being conducted by two major State transport undertakings. The data received is to be examined by the Committee for making necessary recommendations on the subject.

(7) **Road Development Committee**: Studying road and road transport problems. This Committe has recently submitted a detailed report suggesting ways and means to increase the road transport capacity both on a long-range basis and for the implementation of the second Five-Year Plan.

Other Committees deal with the following subjects:

(1) Education of the Highway Engineer.

(2) Manufacture in India of Road-making Machinery and Mechanization of road-making operations.

(3) Provincialisation of Local Bodies Engineering services.

(4) Cement Concrete Road Surfacing.

(5) Prevention of Ribbon Development.

(6) Community Project Road Maintenance.

One of the Committees has also studied the subject of Bituminous Treatment of Wet Aggregates. Large-scale experiments have been carried out by various States according to the specifications recommended by the Indian Roads Congress. The results have shown that even in wet weather, road surfacing with bitumen can proceed without any constructional difficulties and sacrifice of efficiency.

A Sub-Committee was appointed by the Indian Roads Congress to consider the subject of evolving an improved design for **bullock-cart wheels**

the pay loads on the carts without increasing the tractive effort required of the bullocks and at the same time to decrease the destructive effects of the bullock-cart wheels on the roads.

Long research was carried out and a report on the tests is embodied in two Papers on "A Design of Bullock-Cart Wheels"—Parts IV and V published in Vol. XV-1 and 2 of the Journal of the Indian Roads Congress.

The Transport Advisory Council of the Government of India accepted the recommendation of the Indian Roads Congress and agreed that the improved bullock-cart wheels with 3½ in. wide tyres be tried the field and popularised with a view to stopping ultimately the manufacture of wheels with narrower tyres.

Panel Discussions on important subjects are also arranged during the Sessions. The discussion on "Surface Dressing" has already been completed. Panel discussion on "the use of soil in all-weather cheap road construction" is still is progress.

PUBLICATIONS

The Indian Roads Congress issues two publications, viz., the "Journal" and the "Transport - Communications Monthly Review."

The Journal is a quarterly publication and contains technical Papers and Sections on Plant, Machinery and Apparatus, Information Service, Research, Statistics, etc.

Two Medals are awarded annually for exceptionally good Papers contributed for discussion at the Session.

The Indian Roads Congress has arranged with the Central Road Research Institute to publish Research Notes of the Institute in the Journal of the Congress and the Road Research Bulletins.

The **Transport - Communications Monthly Review** is a monthly magazine. It contains original articles and abstracts from technical Journals for the information of all those interested in roads and road transport. The magazine gives a lot of information of interest to the engineer as well as to the general public.

The Congress possesses a fairly comprehensive road engineering library. Information on various technical problems or references to relevant literature are supplied in answer to enquiries from time to time.

PROPOSALS FOR THE FUTURE

Like any other organization, the Indian Roads Congress has a programmre for expansion of its activities. It is proposed to expand the Library and Information services of the Congress and to set up a Highway Museum. The Congress also proposes to issue more Standards on different aspects of road design.

Other proposals include studies relating to economy in design of various structures; study of road needs for tourist traffic; study of needs of landscaping of highways, etc.

To end the account, a brief mention may be made about the organization and finances of the Congress. The management of the affairs of the Society vests in the Council which consists both of nominated and elected members. The day-to-day affairs are managed by an Executive Committee consisting of office-bearers from amongst the members of the Council. The Consulting Engineer (Road Development) is the permanent Treasurer of the Society.

As regards finances, about sixty per cent of the income of the Society comes from contributions from the Central and State Governments. The balance is made up by income from subscriptions from members and sale proceeds of publications. The income from the last two sources being limited, the Indian Roads Congress depends on aid of both Central and State Governments, whom it primarily serves for increase in its financial resources for undertaking increased activities in future for the fulfilment of its objectives.

It is not possible to enumerate all the benefits the Society has provided, but the fact that such a large percentage of road engineers in India (present membership 1600) has joined the Society is in itself an indication of the value the profession places on its activities.

ROADS AND ROAD TRANSPORT IN INDIA
A SURVEY

By

B. V. Vaghi,* B.E. (Civil), M.I.E. (Ind).

Early History

ROAD as a means of communication in India has been mentioned in the Rig Veda and excavations of cities that existed between 3500 and 2500 B.C. have revealed broad streets. In the reign of Chandra Gupta (322-298 B.C.) a road about 1,150 miles connected the North-Western frontiers of India with the Capital of Chandra Gupta at Patliputra (modern Patna). There are references in various old writings to roads, their lay-outs and widths etc. Some of the old roads were subsequently repaired by the Moguls who also built some additional roads. Later, rest-houses known as Sarais, were provided for the benefit of travellers. British military engineers also built some main roads like the Bombay/Agra Road. However, the main incentive for the development of roads in the old days appears to be defence. Their role in the civic life of the community came to be recognised later when Public Works Departments were set up in the country and roads were transferred to them. At the time the railways arrived in the country about 104 years ago there was a fairly good net-work of roads and the railways profited by it by laying their principal lines parallel to existing roads.

Subsequent Developments

Roads began to be neglected since the advent of the railways and this neglect continued even after the advent of the motor vehicle in the country and the first attempt on the part of Government to recognise the role of roads did not materialise till 1927 when a Road Development Committee was appointed. Another attempt materialised after 15 years in 1943 when a Conference of Chief Engineers evolved what is known as the Nagpur Road Scheme. However, implementation of this scheme was slow till the inception of the country's 1st 5-year Plan in 1951–52. It is now expected that the mileage target in the Nagpur Plan will be exceeded by the end of the 2nd 5-year Plan in 1960-61 but a number of major and minor bridges will be left over.

In 1913–14 there were about 50,000 mile of surfaced and about 1,19,000 miles of unsurfaced roads in the country making in all about 1,69,000 miles. It will be seen that the mileage of surfaced roads was about 30 per cent of the total mileage. Since then and beginning from the year in which the Nagpur Plan was framed the growth of our roads has been as follows :—

Year	Surfaced Mileage (percentage)	Unsurfaced Mileage (percentage)	Total Mileage
1943–44	88,000 (40)	1,32,000 (60)	2,20,000
1950–51	97,546 (39)	1,50,963 (61)	2,48,509
1955–56	1,21,617 (38.4)	1,95,051 (61.6)	3,16,668
1960–61 Expected	1,44,000 (38)	2,35,000 (62)	3,79,000†

This shows that during a period of 47 years from 1913–14 to 1960–61 our total road milage will be nearly two-and-a-quarter times that in 1913–14 but it will not be fully bridged; also that the percentage of our surfaced roads will rise only from 30 to 38 per cent! Moreover, only a fraction of our surfaced roads will have a modern dustless surface and many of them will not have a proper geometric

* Executive Vice-President, The Indian Roads and Transport Development Association.

† Not fully bridged.

design. Considering that this is an age of motor transport these defects are serious.

National Highways

We have now a classification of our roads into the following five categories :

National Highways

State Highways

Major District Roads

Other District Roads

Village Roads.

Of them the National Highways being the principal arteries of the country are the most important since they will cater for long-distance inter-State traffic similar to railway traffic, apart from their strategic importance. In view of these facts the Government of India has assumed responsibility for them since 1947 and a National Highways Act was passed last year. Considering that the present railway milage in the country is 34,736 (1955-56 figure) one would expect our National Highways to be about 40,000 miles. However, the Nagpur Scheme recommended only 20,000 miles of which the Central Government has taken over only 13,800 miles. However, even this small milage is deficient in the following respects :

(i) Only 2,000 miles have a two-lane carriage-way.

(ii) Of the remaining 11,800 miles of one-lane carriage-ways about 200 miles have no modern surface.

(iii) Most of the remaining about 11,600 miles have only a light surfacing.

(iv) About 56 major and some minor bridges are missing and provision for them has not yet been made in the 2nd 5-year Plan.

These are very serious draw-backs in our arterial system and must receive top priority in future.

A Comparison

Although our road milage will have increased by about 125 per cent during the 47 years from 1913–14 to 1960–61 its comparison with the road milages in other countries, based on figures for the year 1955, is as follows :

(a) **By Area: In miles per square mile of territory.**

Great Britain :	3.24	Ceylon :	0.38
France :	3.03	Spain :	0.38
U.S.A. :	1.00	India :	0.25

(b) **By Population: In miles per 1,00,000 persons.**

Australia :	5,769	Spain :	251
Canada :	3,385	Iraq :	242
U.S.A. :	1,834	Ceylon :	115
France :	1,502	Malaya :	110
Great Britain :	384	Phillipines :	87
		India :	82

This may show the extent to which we are deficient in respect of road milage alone. If we add to it other deficiencies mentioned above viz. a poor proportion of surfaced roads, need to provide modern surfaces on them, lack of bridges, lack of proper geometric design, and lack of two-lane carriageways on the National Highways the picture becomes alarming.

Owing to the fact principally that the railways in this country are a National Undertaking while the bulk of road transport is privately owned there has always been an emphasis on developing the railways and this emphasis has been such that in any scheme of transport development the railways get first priority. In the 1st 5-year Plan the railways were allotted Rs 423 crores while roads received Rs 156 crores i.e. about 37 per cent of the railway allotment. If the same ratio of their respective allotments were maintained in the 2nd Plan roads should have received about Rs 481 crores against about Rs 1,300 crores to be received by the railways (it is now understood that this allotment is going to be raised to Rs 1425 crores) but roads were allotted only about Rs 270 crores!

Role of Road Transport

This fact makes it necessary to examine the roles played by the railways and road transport in the development of our country. Apart from pedestrians roads

cater for three types of vehicles in the country, viz., bicycles, bullock-carts and motor transport. The demand for bicycles rose from about 29,000 in 1912–13 to 2,60,000 in 1947–48. By 1960–61 about 12½ lakhs of bicycles are to be produced in the country and latest advices suggest that the Planning Commission is thinking of raising this figure to about 15 lakhs per annum. In 1943 there were about 8 million bullock-carts in the country which, according to the estimate of the Consulting Engineer, Roads, Government of India in 1943 carried about 100 million tons of freight in that year, which freight, incidentally, was about the same as that carried by the railways in that year. To-day the number of carts in the country is estimated at about 10 million. The first motor vehicle appeared in this country in 1898. To-day their number is 4,18,067 (1955-56 figure).

All this increase could not have taken place if these vehicles were not useful to the community. Moreover, so far as motor transport is concerned this increase has taken place inspite of very severe restrictions placed on it at the instance of the railways between 1940 and 1956. Therefore, the utility of road transport cannot be questioned and in regard to its relative role our bullock-carts alone handle the same freight as the railways on the basis of 1943 estimate.

Investments

There is another aspect by which the utility of a service to a community can be gauged. That is its investments in different types. In so far as it is possible to ascertain the relative investments of the country in various means of communications appear to be as follows in the year 1955–56 :

1.	Roads and various types of road transport including services ...	Rs 1,400	crores
2.	Railways ...	975	,,
3.	Water transport, ports, shipyards ...	215	,,
4.	Posts, telegraphs and Broadcasting ...	100	,,
5.	Air Corporations ...	16	,,
6.	Telephone industries ...	4	,,
7.	Miscellaneous, say ...	10	,,
		1,320	crores

In other words, the country's investment in roads and road transport is nearly the same as that in all other means of communication and nearly one-and-a-half times that in the railways. And yet inspite of these facts roads and road transport do not receive the treatment which is their due.

Vehicle-Density

By 1955-56 the investment in our roads was about Rs 456 crores : by 1960-61 it is expected to be about Rs 726 crores. The extent to which this huge investment is being utilised can be gauged from the fact that in 1955 we had only about 1 motor vehicle per mile of our roads. Including the truck-equivalent of bullock-carts it comes to about 1.56. An analysis of 55 countries in the world with a population of 5 million and over shows that in 13 countries including India the number of motor vehicles per mile is up to 1, in 21 countries it is from 1 to 5, in 9 countries it is from 5 to 10, and in 12 countries above 10. The largest group is that having 1 to 5 vehicles per mile. This fact suggests that our roads, if they are properly attended to, may be capable of carrying 4 to 5 times the present number of our vehicles.

Therefore, to continue to neglect our roads as in the past is to render a disservice to our country both by discouraging the growth of a service in which, by its investment, the community has shown itself to be more interested than in any other means of communication and by not utilising to the full extent the country's investment in roads.

Proposed Road Scheme

There is no doubt that in our schemes of economic development roads and road transport have to receive far more attention than at any time in the past and it is hoped that the country's new road plan on which the Chief Engineers are now working will take a note of this fact. In any future scheme of road development it will not be enough to take into consideration only the expected economic development of our country as envisaged in our successive 5 year plans over the next 20

(Continued on page 31)

UNCONVENTIONAL THOUGHTS ON THE INDIAN ROAD PROBLEMS

By

SIR KENNETH G. MITCHELL*

IN an article " Revision of the Nagpur Plan " in the August issue, the Editor of " Transport-Communications " briefly surveyed past achievements and future prospects and suggested another Nagpur Conference to survey the field. Good luck to that Conference ! He recalled the fuller survey by Shri Varma in the Shillong Roads Congress Presidential Address and cited the estimate that, at the rate of recent progress (itself a marked achievement) it would take India seventy-five years to reach an " availability factor " of good roads or approximately one-fourth of that obtaining in certain countries of Europe today. The precise target is not so important, at the moment, as the fact that, in terms of the next twenty years or so, the demand for more and more roads is virtually infinite. Thus the immediate question is whether, with a given level of finance, progress can be hastened, and, if so, how ? I would add, as a corollary, that if you can give the people more roads for their money, the people through Parliament may well give you more money to spend.

At one time before the railway era " dirt roads " in India were passable for eight months in the year. The distribution of rain over the year and the relatively light traffic conduced to this. **Tavernier**, from Europe, who travelled in India nearly two centuries before railways, reported that travel in carriages drawn by trotting bullocks was quite as comfortable as in Europe. Subsistence farming gave way to the growing and transporting of money crops. The heavy bullock-cart was evolved, and since on the plains there were no gradients to put a limit on loads, they were too much for ' dirt ' roads. Thus, since the advent of motor transport, the problem now facing Road Engineers in India is a great one and a challenge. For some years now, and at least since the existence of the Roads Congress, the facts have been faced and solutions have been sought. Early trials of mechanical blade-grading of earth roads showed that in the nature of Indian climate and soils such roads would not generally stand up to the bullock cart, and ways of improvement were examined. Thus for some years S. R. Mehra and others did much to advance our knowledge of soil stabilization in relation to roads ; Murrell and Vagh in particular worked on the evolution of a less road-destructive cart wheel and tyre ; the pneumatic rubber tyred cart wheel proved on examination to be not an economic possibility for the general case ; the Roads Congress sponsored the Calcutta Test Track examination of low-cost bituminous surfaces in relation to bullock cart wheels ; and, on the administrative side, all Road Engineers, whether in the service of the P. W. D., of Local Bodies or of business interests, were, through the Congress, brought together into one team, as it were, devoted to the problem of improving the " road-rupee ratio." In short, all possibilites and all the more conventional methods of road improvement have been studied, but the problem remains an immense one. Is there any, at present, unconventional direction in which an advance might be made ? I am going to suggest a possible one.

In this connection I would recall to you a little story of the war. A scientist was called in to advise how to produce a still more powerful armour-piercing shell. After the first discussions he pointed out that the object in view was to sink enemy ships. This could be done by making a hole in the ship, but also it might be possible to sink the ship by temporarily reducing the weight and buoyancy of the surrounding water. I do not know if he succeeded in the latter,

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possibly not, but the point of the story is that there may be a solution to a problem outside conventional thinking.

It seems to be in the immense milage of the minor district roads and the village roads that a very difficult part of the problem lies. We want to find some way of "stage-development" from inexpensive beginnings, so that large areas may benefit from that stage and quickly. Without segregation of cart from other traffic, must we not now admit that the bullock-cart will defeat stage-development, based on really low cost beginnings from the outset and the people will have to wait long for the easier travel, for more ready access to villages, doctors and travelling dispensaries, for improved facilities for education and all the rest. In time the bullock-cart may disappear, perhaps. The time taken for this to happen would depend, among other things, on the progress of mechanisation of farming, and it would not happen until the cost of mechanical transport were sufficiently low. The real cost of transport includes the cost of the road, so the road must start cheaply. We come back to the idea of segregation and, for all except the bullock cart, stage development from the dirt road upwards.

But it is fairly obvious that few soils would stand up to passenger buses at conventional speeds. On the other hand, we know that rolling loads as such and at low speeds do little damage. It is my belief, as I have already suggested in other places, that you could run quite heavy motor vehicles, designed for and incapable of exceeding, say, 10 m. p. h., on dirt roads made of a wide variety of soils, if you segregated cart traffic. It is my conviction, too, that it is mainly convention that connotes much higher speeds as a necessary part of motor transport. I realize that there are many complications and difficulties and that India is not perhaps the most suitable country for such a development. To go into all aspects would take too long for a short note of this nature; and indeed, until things have been tried out the most difficult problems cannot be stated with certainty. Among them, naturally, two are obvious. Will bullock-cart drivers observe segregation, and drivers of fast, heavy private cars submit to the necessary restrictions? I can only suggest that in the circumstances of today when people appreciate what is at stake and you have community road improvement, public opinion would be behind the necessary regulations and that is half the battle. Perhaps the strongest argument is that the alternative is, may be, seventy-five years?

I have not previously urged this idea for India because it seemed to me that an under-developed country with a dearth of roads and where the heavy bullock cart was not so strongly entrenched, would offer more ideal conditions. I tried therefore in rather a desultory way to interest vehicle manufacturers in England in the evolution of the vehicle. They seem to be too far engrossed in competing for the market in conventional vehicles to turn aside to look at this, and the attitude here seems to be that it is "too late" to think of designing the vehicle to the road. That seems a little unenterprising and conventional-minded but no doubt they know their own business best. A reasonable trial would cost a little money but very large sums might be saved.

I do not think that it is necessary here to go into more detail, and would only add my best wishes to the Congress, to my many old friends in it, and to the new Nagpur Conference if set up – and one parting shot. The world seems to me to have mesmerized itself with speed for its own sake. It may be better for the many to travel slowly and in comfort soon than to wait for 75 years for speed.

THE ART OF SPEECH

If you doubt whether the art of conversation, is dead, first wait outside a telephone kiosk while a lady finishes her speech.

SOME OBSERVATIONS ON ROAD DEVELOPMENT IN INDIA

By

G. M. McKELVIE*

I was very flattered at the invitation to contribute an article to the 'Annual Number' of the T.C.M.R., but after some thought I have decided that I am so much out of date and out of touch with your current problems that my article would only remind you of —

"Old, forgotten, far-off things,
and battles long ago."

In the hope, however, that the lines on which I have been thinking might be of some use to the Indian Roads Congress, (when considered in light of your much more up-to-date knowledge of affairs), I append with all the due diffidence a few observations.

It was suggested my article might include my impressions of the I. R. C. I see from the recent Presidential Address printed in the T.C.M.R. and from what I could cull from the I.R.C. Journals that the Congress through its President (and no doubt in other ways) continues the excellent practice of offering its advice to the Central and State Governments.

In the past, these Governments have, to a very large extent, accepted and acted on the advice offered; but this, I think, has been so mainly for two reasons. Firstly, because the Governments concerned were satisfied that their own Chief Engineers and senior staff had concurred in the advice (which was therefore well considered and based on an intimate knowledge of the Governmental administrative machine), and secondly, because the Congress had always shown itself capable of a high standard of technical and administrative achievement.

I am glad to see the old traditions continue and that control of the affairs of the Congress through its Council vests largely in the hands of the Chief Engineers of the States and the Centre. This is the strength of the Congress as it is the strength of the American Association of State Highway Officials in the U.S.A. (on the model of which the Congress was founded). Our Congress in its way has, I think, done as good work as its American prototype.

It seems from what was said by your President in May 1957 and in some of the editorials in the T. C. M. R. that the Nagpur Plan of 1943 (which was intended to be a 10-year Plan only) has now been given effect to in full. It is now time to draw up a fresh plan. I can think of very little that anyone could add to the excellent advice on the requirements of the new Plan given by your last President.

Certainly a Chief Engineer's Conference should be called to make this Plan but, long before the Conference meets, a great deal of spade work will, I think, have to be done in the office of the C.E.R. in analysing what has already been achieved, listing carefully the difficulties met with in executing the old Plan, and setting out for the consideration of the Conference a very clear and detailed statement of proposals with the pros and cons carefully indicated against each item.

My experience, both in India and in the U.K., has been that unless the ground has been thoroughly prepared beforehand a large meeting of busy experts will not have time to formulate quickly their agreed opinion on the proposals. It would perhaps be advisable, as we did in Gwalior in 1943, to deal with the proposals in draft form at meetings of Congress Comittees summoned a few months before the full proposals are put to the Conference of C.Es. This gives notice of the problems to be considered and time to think them over and to offer suggestions.

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In the first place the conference might consider whether any of the principles of the Nagpur Plan require modification. From what has been recorded in I.R.C. publications it appears to me that no one has suggested any change or amplification. The main principles are :

(1) The road network of each State should be an integral part of the road network of India.

(2) All classes of roads should be regarded as of importance for the national welfare : one class should not progress at the expense of another : development should be balanced as between classes and should proceed in a planned sequence.

(3) Roads should NOT be developed ahead of the requirements of the traffic they carry or will carry in the immediate future. A National Highway can have stretches with earth surfacing and part of a village road a concrete surface if the traffic in each case requires these surfaces.

(4) Roads should be free to all. There should be no toll barriers except in special cases to finance loans raised to finance the construction of large bridges or important road works. The tolls should cease as soon as the loans are repaid.

(5) Road maintenance to proper standards should (with hardly an exception) have priority over construction of new roads.

(6) The road plan should be statutory with regular funds set aside by Statute for road maintenance and development. Road development is a long-term measure and should not be subject to the vicissitudes of temporary changes in political philosophy.

(7) Roads are a service to all forms of development and road development should form part of all development schemes.

(8) Statutory provision, essentially common throughout India, should be made for regulation of traffic, control of ribbon development, levy of betterment taxes on road-side lands, and removal of encroachments.

The Conference will no doubt give advice, as the Nagpur Conference did, on the standards that should be drawn up to give effect to recent technical advances in road construction. But, I am afraid, they will have to record that nowhere in the world has anyone been able to make cheaper roads than have been made in India in the past. Certainly, as shown in the third of our principles above, roads should be constructed in stages, no road having a better surface specification than is required by the traffic it is to carry.

The Congress will no doubt stress the need for regular funds set aside by Statute for road maintenance and development. When budget conditions are favourable, these funds could be augmented but they should never be cut below the basic provision.

I notice that there have been suggestions that the 'grid' in the Grid and Star formula of the Nagpur Plan should be made closer but I think the new Plan will also have to introduce more 'stars' in accordance with the seventh principle quoted above to take into account the new industries that are being established in India. Much preliminary work will have to be done to ascertain the size and probable road traffic requirements of these industries.

But, I think, the biggest problem to be tackled will be that of personnel. An All-India service of Engineers appears to be indicated. Selected officers from this service should be trained in secretariat work when young as under secretaries, deputy secretaries, etc., for a few years as in the old days. The President of the Indian Roads Congress in his speech in May 1957 had many excellent things to say on this subject and I heartily agree with him.

ROAD FINANCE

By

R. A. DESHPANDE*

ROADS are a service for all forms of development, whether Agriculture, Trade, or Industry. They are vital to the integration and to the social and economic progress of a Nation. They give access to a country's untapped wealth and opening for utilization of the potentially rich areas of the world. Roads must be built to increase production, to distribute surpluses, to exchange ideas and services and to extend the cultural and economic benefits of the modern age. In the development of roads, therefore, national conception is necessary not only because of their strategic importance but also because of the need for co-ordination between different types of roads.

Development of motor transport after World War I resulted in the growing public demand for a better system of roads in India. The Indian Road Development Committee appointed by the Government of India in 1927–28 came to the conclusion that road development in India was passing beyond the financial capacity of provinces and was becoming a national interest, which might, to some extent, be a proper charge on central revenues. As recommended by the Committee, a Central Road Fund was consituted with effect from the 1st March 1929 to assist States in financing their road development schemes. A part of the customs and excise duty on petrol began to be credited to the Fund. Grants from this Fund were given to States for Road Development particularly in rural areas. But much work could not be done under this scheme as the annual contributions to the Fund amounted to Rs 1½ crores only. With the growth in petrol consumption and increase in the rate of contribution to the Fund from two annas to two annas and six pies, the revenues of this Fund increased from Rs 1.5 crores to Rs 5 crores. Although this amount is very small compared with the needs of the country, a fair amount of work reckoned over a number of years has been carried out in the country by resources provided by this Fund.

The Nagpur Conference of Chief Engineers convened in 1943 drew up an integrated plan which envisaged the construction of 25,000 miles of National Highways, 65,000 miles of State Highways, 1,60,000 miles of District Roads, and 1,50,000 miles of Village Roads. Modified to apply to the Indian Union, the milage of different classifications of roads is as under :—

National Highways	20,750 miles
State Highways	53,950 miles
Distt. & Village Roads.	2,56,300 miles
Total	3,31,000 miles
Surfaced Roads	1,23,000 miles
Un-surfaced Roads	2,08,000 miles
Total	3,31,000 miles

Thr growth of road mileage between 1943 to 1956 is given in the table below :

Year.	Surfaced miles	Un-surfaced miles	Total miles
1943	88,000	1,32,000	2,20,000
1951	97,546	1,50,963	2,48,509
1956	1,21,617	1,95,051	3,16,668

The estimated cost of the Nagpur Plan for the Indian Union was Rs 371.8 crores. At hundred per cent increase over pre-war rates, the present cost of the Nagpur Plan would be of the order of Rs 744 crores. In comparison, actual expenditure incurred from 1943 up to the end of 1955-56 is as below :

National Highways	Rs 28 crores
Other Roads	,, 131 crores
Total	Rs 159 crores[1].

In the second plan, the total allotment including Central and State plans for Road Development amounts to about Rs 246 crores in addition to Rs 25 crores to be provided from the Central Road Fund. It is estimated that with this programme

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of investment the target for road milage proposed in the Nagpur Plan will be practically reached by 1960-61[2].

Taking the area of the country and the population into consideration, the total milage of roads in existence at present is admittedly short of requirement. The Second Five-Year Plan envisages greater economic and social activity all-round. This implies a larger agricultural out-put and increased production of capital goods and essential services. The targets under the Second Plan envisage increase in production from 151.672 million tons in 1955-56 to 228.40 million tons in 1960-61. National income is expected to increase from Rs 10,800 crores during the First plan period to Rs 13,480 crores during the Second plan and the per capital income from Rs 281 to Rs 331 during the same period. The achievement of these targets will not be possible without adequate and efficient transport facilities. Otherwise the increased agricultural products may rot in the fields, raw materials may not reach the factories and the results would be local gluts and scarcities. To make the plan a success roads will have to play a more predominant part as the Railways are over-strained and are not likely to be able to cope with all the additional traffic. In this connection, it would also be relevant to examine the structure of transport systems in some other countries. Take Australia for instance. Road Transport there carries 26 per cent of the goods traffic in terms of ton miles, while Railways carry just above 24 per cent, the remainder being practically the share of coastal shipping. In India, Railways carry 35,000 million ton miles, Road Transport less than about 20,000 and the share of water transport is negligible. In Europe and America today Road Transport has developed to such an extent that the expansion of Railways has practically ceased. The reason why India is confronted with a transport shortage is that alternative mode of transport by road is not being adequately utilised. In the pre-independence era, the Railways prevented the development of road transport. It is now becoming increasingly clear that, in this country Railway Transport by itself cannot handle all the traffic, despite the fact that an outlay of over Rs 1425 crores is being earmarked for its development during the Second Five-Year Plan. Road Transport has necessarily to play an important role in the National Economy. Apart from being a valuable adjunct to the Railways, Road Transport has a distinctive service to render in opening up new areas which are inaccessible to the Railways.

Considering all these factors it is imperative that an intensive Road Development Programme should be launched immediately if we are to keep pace with the transport needs of the Country. It would not be improper to suggest that a Ten-Year Road Development programme with the following targets should be chalked out immediately.

Surfaced roads	2,00,000 miles
Un-surfaced roads	3,00,000 miles
Total	5,00,000 miles

In order to complete such a programme, it is necessary to have funds to the extent of Rs 500 crores during the next ten years. The problem is how to finance such a heavy development programme?

The problem of financing road development is admittedly very complicated and difficult. The Motor Vehicle Taxation Enquiry Committee thoroughly investigated this problem and made a number of recommendations on this subject. The Taxation Enquiry Commission has also made a useful contribution on this problem of road development finance. The suggestion for the creation of Road Funds in every State in addition to the Central Road Fund is thoroughly sound. It has also approved the principle of ear-marking revenues for Road Development and has suggested the creation of an All-India Rural Communications Fund which should be more substantial and non-lapsable. Similarly, there will not be opposition to the proposal of levying a cess of one anna per rupee of land revenue if substantial funds are made available for the development of rural roads.

While the proposition that the entire revenue from the road user taxes and levies should be placed in the Roads Fund and that its diversion to any other purpose should be statutorily prohibited is economically sound and justifiable, it is not practicable in the present circumstances as it would curtail the other State

activities on which these revenues are being spent by the State at present. As the aim is all round growth and not lop-sided or sectional progress, it is necessary that fresh sources should be tapped for financing the development of roads rather than diverting the existing sources.

If we have to embark on an ambitious programme, it is necessary that we should think afresh about the financial aspects therein. Lack of finance for roads is only the result of a certain attitude towards roads in general. This attitude betrays itself in the readiness with which funds intended for roads are diverted to other purposes. The twin defects in the prevailing system of financing road development are, firstly the funds are uncertain and secondly they are inadequate. A certain continuity in the supply of funds is essential if wasteful expenditure is to be avoided and programmes are to be pursued without interruption. Shri K.K. Nambiar in his presidential address to the Indian Roads Congress at its twentieth session in 1956 suggested that a Statutory non-lapsing fund for financing all road development and maintenance pragrammes should be created. He also mentioned the desirability of issuing Highway Bonds for raising additional funds, as has been done in certain other advanced countries.

For financing a road development programme involving an outlay of Rs 500 crores during the next ten years, the above proposals would not be adequate. What we need today is a Road Finance Corporation which should guarantee the continuity of funds for the development of roads without any breaks. Hence the proposal is that an all India Road Finance Coporation should be established immediately, jointly financed by the Government of India and the State Governments. The Corporation should be essentially a credit institution and its activities should be confined to the construction of new roads. The maintenance and improvement of the existing roads should continue to be the responsibility of the respective State and Central Governments. The Corporation should distribute the annual grants to the respective State Governments according to need and priority and consistent with the 10-Year Road Development plan. The Central and State Governments should jointly subscribe an annual contribution of Rs 30 crores from their current revenues. This is not a big amount as they have already agreed to subscribe to this extent during the Second Five-Year Plan. During the Second plan, the Central and the State Governments have agreed to finance the road development to the extent of Rs 271 crores during the next five years. As this outlay also includes provision for repairs and maintenance and improvement of the existing roads, the share for the construction of new roads can roughly be taken at about Rs 150 crores. This gives an annual expenditure of Rs 30 crores for development of roads. They should be able to guarantee this amount during the ten-year programme from their annual revenues. Thus Rs 300 crores out of the Rs 500 crores required for the road development plan can be met out of the existing revenues.

As regards the remaining Rs 200 crores required during the ten-year period, the Corporation should be permitted to launch a phased borrowing programme. The borrowing should be based on the principle of compulsory contribution from those persons or institutions who are benefitted by the development of roads and who have a stake in their progress. Since the loan targets for each category of persons or institutions will be based on their economic and paying capacity, there should be no serious objection for its contribution from the public. Besides, as they only contribute towards loans of the Road Finance Corporation, which are guaranteed by the Central Government at suitable rates of interest, there should be no cause for serious objections. Further, the bulk of the finance for road development will go towards acquisition of land, purchase of materials and payment of labour. The foreign exchange requirements for the purchase of machinery are considerably reduced with the manufacture of steam and diesel road rollers in the country. Hence, there should be no foreign exchange difficulties for launching this Road Development programme. The Corporation should issue twenty-year Development Loan Bonds, contribution to which should be made compulsory to the following institutions and persons.

(a) Every owner of a motor vehicle should purchase the Development Loan

Bonds to the extent indicated against each during a period of 5 years from its purchase or from the date of issue of the bonds whichever is later.

The total number of motor vehicles in India is 3,10,145. Their distribution among the different categories is shown below [3].

Category	Total No.	Amount of Loan Bond required to be subscribed during the period of 5 years.
Motor Cycles	27,105	Rs 500/- (each)
Private Cars	1,45,953	Rs 1,500/- (each)
Public Service Vehicles	45,753	Rs 1,000/- (each)
Goods Vehicles	85,509	Rs 1,000/- (each)
Miscellaneous	3,825	Rs 500/- (each)
Total	3,10,145	

If the above proposal is accepted, we would be assured of a loan capital of Rs 37 crores during the next five years and thereafter we may get an yearly subscription of Rs 2 crores for additions during the year. Thus, for our Ten-Year Developent Programme, we would be getting about Rs 47 crores from this source.

(b) The Post & Telegraphs Department has, in particular, responsibility for the development of roads as without roads its progress cannot be effective. The gross-annual receipts of this Department are about Rs 50 crores and it would not be much if this Department is made to contribute to the extent of Rs 1 crore for each year.

(c) The Indian Film Industry should also be made to contribute to these loans as the Film Industry is benefitted by better and efficient roads. There are about 600 producers, 60 studios, 40 laboratories and 600 distributors in the Film Industry in India. The capital invested in the Industry is estimated at about Rs 42 crores and the gross revenue per year is Rs 25 crores. The Indian films are exhibited in about 3,500 cinema houses, of which 850 are mobile cinemas. This only shows how much they should be interested in the development of roads, as it should open them fresh areas for operation. Hence, there should be no objection to ask this Industry to contribute to the Development Loan Bonds of the Road Finance Corporation to the extent of Rs 3 crores per year. This would give another Rs 30 crores.

(d) The Insurance Corporation should be similarly made to contribute Rs 1 crore per year which would give Rs 10 crores.

(e) The Irrigation Works should be made to contribute to the Development of Roads. Without proper roads, the increase in the agricultural produce cannot be marketed and hence the development of roads in the surrounding area should be the responsibility of the irrigation works. Although the present revenue from water rates is small, it is about Rs 11 crores (as in 1953-54) for the whole of India. It is likely to increase in view of the many big river valley projects which are recently constructed and are under construction. With the imposition of the betterment levy and the irrigation cess, the revenue is still to increase. Besides, the principle of profit as advocated by the Taxation Enquiry Commission should be accepted in the fixation of the water rates and the present abnormal low rates for the established irrigation works in States like Punjab, U.P. and Andhra should be suitably increased. With all this we may expect an annual irrigation revenue of Rs 25 crores per year and at least Rs 2 crores should be invested in the Road Development Bonds of the Road Finance Corporation.

(f) Similarly, major industries like Textiles, Jute and Cement should be asked to contribute to this borrowing programme by insisting a minimum joint subscription of Rs 5 crores per annum.

By accepting the above proposals, it would be possible to raise an assured loan capital of Rs 167 crores during the next ten years. The Bonds should also be

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SECOND FIVE-YEAR ROAD DEVELOPMENT PLAN FOR WEST BENGAL

By

S. N. GUPTA,* B.E., M.S. (U.S.A.), M.I.E., (INDIA), M. ASCE.

THE partition of Bengal resulted in complete disruption of the whole communication system of West Bengal which itself was divided into three isolated blocks. Assam, Tripura, Manipur and rest of eastern India got cut off from the main land. Besides this, additional problems were created in the border between West Bengal and Pakistan as also in the border area between Pakistan and Assam, Tripura—mainly due to want of proper communication.

The original road development plan prepared in 1946 based on the "Nagpur Plan" had to be revised and a fresh 20-year road development plan for the truncated State of West Bengal was drawn up with a provision of 13,281 miles of all categories of roads — construction and improvement. On a modest estimation, this would cost Rs 150 crores. The first phase of this integrated plan which is called the first five-year plan was carved out of this. Due to impact of circumstances, political as well as socio-economic, this five-year plan had to suffer changes and the final plan was framed comprising the period 1951-52 to 1955-56 inclusive.

At the beginning of the first five-year plan, India had 97,000 miles of metalled roads and about 1,47,000 miles of unmetalled roads. Out of the total outlay of Rs 2,356 crores in the first plan Rs 557 crores i.e., 23.6 per cent of it was meant for Transport and Communications. Out of this 557 crores, a sum of 130 crores was allotted to road development which is 5.5 per cent of the total outlay. This together with grants from the Central Road Fund amounts to about Rs 155 crores. Between 1947 and 1951 i.e., in the post-independence pre-plan period, Rs 48 crores have been spent on roads, so that since achievement of independence, the total investment on road development has been of the order of Rs 200 crores.

In the second plan with the total outlay of Rs 4,800 crores there is a provision of Rs 246 crores for road development which represents 5.1 per cent of the total. In addition to this there is Rs 25 crores to be provided from the Central Road Fund. This brings the total allotment to Rs 271 crores. It is estimated that, with this programme of investment, the target of road milage proposed in the Nagpur Plan will be practically reached by 1960-61. As against a provision of Rs 93 crores for road development in States in the first Plan, a total provision of Rs 164 crores has been made in the Second Plan. About 18,000 miles of surfaced roads are expected to be constructed under this programme during the 2nd plan period. The programme takes account of the special needs of the backward areas which could not be given adequate attention in the first plan.

In West Bengal the total outlay during the first Plan period was 70.6 crores, out of which Rs 13.85 crores was allotted to Road Development, which comes to 19.2 per cent of the total outlay compared to 5.5 per cent allotted in the All India Plan. It is, therefore, evident that more stress had been given towards road development in West Bengal than in the Centre.

West Bengal even after partition has the highest density of population, being 799 per sq. mile in 1951 which is about three times the density of India as a whole.

The Table on the next page shows the milage of existing roads, surfaced and unsurfaced, in the different States in India as it stood just after the independence.

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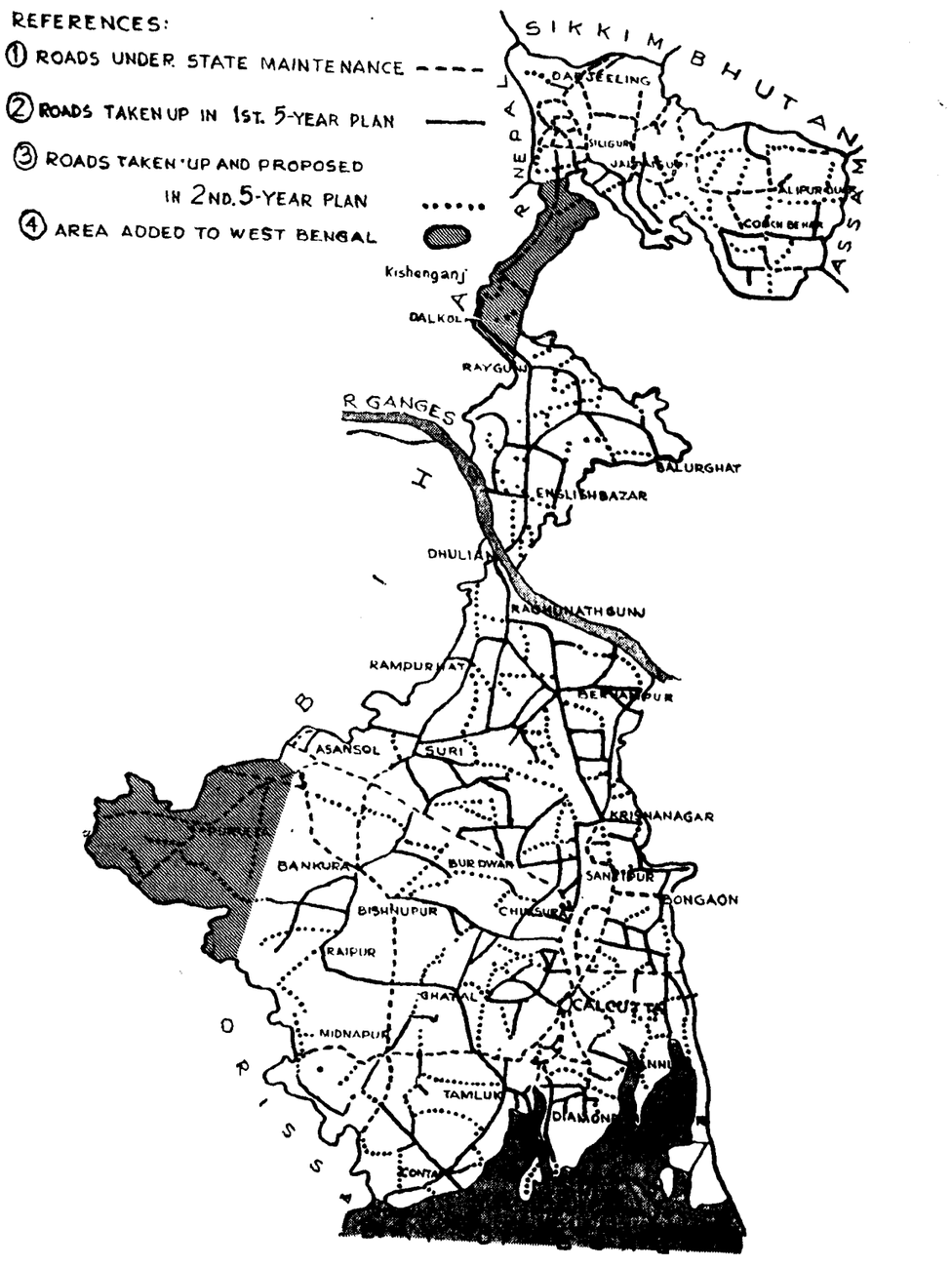

State	Area in sq. miles	Population in thousand	Density	Total milage of roads	Road milage per 1000 of population	Road milage per sq. mile of area
1	2	3	4	5	6	7
West Bengal (including Cooch-Behar) ...	29,563	21,862	739	12,154	0.56	0.41
Bihar ...	69,745	36,340	521	31,496	0.87	0.45
U.P. ...	1,06,247	55,021	518	31,986	0.58	0.30
Madras (including Andhra)	1,27,610	49,825	390	38,540	0.77	0.30
Bombay (including States merged) ...	1,22,732	29,114	237	27,765	0.95	0.23

The Government of West Bengal had under their maintenance 1,181 miles of roads in 1948. During the First Plan period an additional 2,665 miles were constructed to different stages of completion. An additional 1,479 miles of District Board Roads have been taken over under State maintenance. This brings the total milage of State roads to 5,308, apart from the milage that would still be maintained by local bodies. This gives a road milage of 0.64 per 1,000 population against 0.56 in 1948, and a road milage of 0.47 per sq. mile of area against 0.41 in 1948. (Population based on 1951 census which showed an increase of 13.63 per cent excluding the areas added under States reorganization). All India figures at the end of the First Plan period were 0.23 per sq. mile and 0.72 per thousand population. The corresponding figures for U.S.A. were 1.1 and 21.44 respectively.

As already stated Rs 13.85 crores were provided in the first plan. Taking into account the amount spent during the pre plan period, and the amounts spent under other heads during the plan period, this State spent to the tune of Rs 30 crores in all upto the end of the first plan period on road development alone. This amounts to Rs 12,000/ spent per 1000 of population or Rs 6,000 per village, assuming an average population of 500 per village.

The second plan begins where the first left off. The works which were not completed during the 1st 5-Year Plan stage, were carried on to the 2nd Five Year Plan and a lot more were added to it. The skeleton structure of road communication has been laid in the 1st Plan. The target under the second plan is to extend the road net work by filling up the skeleton so as to connect all the thana headquarters with a system of good roads. Ultimately the object is to extend the road network in such a way that no village will be more than 5 miles away from this road network. As the roads play a vital part in the country's economy, a larger programme of works has been undertaken for the second 5-Year Plan with reasonable augmentation of existing resources, both technical and materials.

In West Bengal, the total outlay during the 2nd plan is Rs 1,537 crores out of which Rs 17.1 crores has been allotted to road development which comes to about 11.1 per cent of the outlay. So more stress has been given to roads in West Bengal than in the Centre during the 2nd Five Year Plan also. Although there is a decrease in percentage in the State's allocation, the total outlay on road has shown an increase by 25 per cent.

In West Bengal, 35.5 miles of N.H. and 2,179.5 miles of S.H. are proposed during the 2nd 5-Year Plan. About 1,122.11 miles are carried over from the 1st 5-Year Plan to the 2nd 5-Year Plan which means a total milage of 3,348.11 during the 2nd plan. The target for total milage after completion of the 2nd 5-year plan stands at 7,523.34 miles for West Bengal. The total milage of metalled roads outside this plan maintained by various local bodies when added to this exceed the target as per "Nagpur Plan."

As a result of redistribution of territories, an area of 3,166 sq. miles with a population of 14,46,385 has been added to West Bengal. Increase in total outlay

during the 2nd plan increased proportionately by Rs 4.00 crores of which Rs 41.0 lakhs is proposed to be allotted towards road development.

West Bengal has her own problems which impede the progress and which have increased the cost of construction per mile of road compared to other more fortunate States of the Union. These may be briefly stated as follows :

(1) In major parts, the soil condition is not good necessitating adoption of a costlier specification of road pavement.

(2) High banks are usually required to keep the roads above levels.

(3) Larger waterways have to be provided and not a few of them are major bridges.

(4) Scarcity of building materials and transport difficulties.

(5) Local people are not available in adequate numbers for such work.

(6) Complicated land tenure system causing delay in land acquisition.

Inspite of these bottlenecks the progress made up-to-date in road development is not a mean achievement.

Mechanised Construction

The method of mechanised construction as applied to road building has not yet been fully and warmly accepted. Whilst the engineers themselves have a mixed feeling towards its adoption, the public as a rule has a misapprehension that it is a misfit in a country of abundant and cheap man-power. This is a controversial subject requiring thorough statistical study. It is the aim to improve the standard of living of the people. This should envisage conversion of unskilled labour to skilled labour and making the skilled labour more and better skilled. Mechanisation is one of the major and sure steps towards this direction.

Research

With the advent of motoring era, the construction of a highway capable of carrying high-speed traffic with reasonable comfort has presented many complicated problems. Through sheer necessity, the subject of highway engineering has developed into a specialised science. In every developing science, research naturally forms an integral part of the same.

The extensive area of a region makes it expensive to construct and maintain a network of highways. The problem is more complex in an agricultural country like India. The iron-tyred bullock-cart is an inseparable part of it, posing a serious problem to road engineers. The problem is further accentuated by the fact that, due to lean finances, the cost per mile of an all-weather road that can be justified in India is only a fraction of what most western countries actually spend on their low-cost roads.

The R & B Research Institute established on a modest scale in this State is probably the first one of its type in the eastern region. This Institute has been able to introduce stabilised soil in the construction of low cost roads where adoption of conventional specifications proved expensive.

The Government of India maintains a Road Test Track in Calcutta under the executive control of the State Government where various road specifications suited to this region have been tested with profit.

(*Continued from page 24*)

open for public for voluntary contribution. Although much cannot be expected, still we can get at least about Rs 5 crores for each year and thus in all we can safely take Rs 200 crores as the loan capital during the ten years period.

The above proposals are not based on imaginary or theoretical grounds. They are suggested from a practical point of view and they can be implemented without any serious repercussions on the economy of the country. If there is a definite road policy in the country, it is not difficult to complete a road development programme within the next ten years.

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ROAD DEVELOPMENT IN UTTAR PRADESH

By

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Introduction

INDIA is moving fast on the road to prosperity. Gigantic projects are taking shape and a new era of peace and prosperity is being ushered in throughout the country. In these development plans roads have been given quite a prominent place. It has been fully realised both by the Government and the public that without an adequate system of communications the progress of the country cannot be speedy. Roads are the starting point of all progress and must come first.

Highway Engineers have thus been given an excellent opportunity of serving the Nation. They have been called upon to shoulder a great responsibility and they have to ensure that the tax-payer's money is utilised in the most economical and judicious way, to the maximum advantage of the country. To achieve this end the road schemes have to be planned on a modern and scientific basis, so as to be able to cater for our present and future needs. The Nagpur Conference of Chief Engineers held in 1943 laid down certain basic principles for evaluating the needs of roads in an area and evolved the Star and Grid formula to calculate the road milage requirements. According to this formula a total length of 1,47,000 miles of metalled and 2,53,000 miles of unmetalled roads was fixed as the target for India.

U.P. Road Schemes

In the limits fixed by the Grid and Star Formula, drawn by the Nagpur Conference, Uttar Pradesh had to formulate its own schemes. The target aimed at in the U.P. was to provide a road within 5 miles of every village, the standard of construction and maintenance varying with the anticipated traffic. Any future developments of Industries, Factories, and Agricultural farms were to be considered in deciding the specifications of construction.

The existing road system in State was most unsatisfactory. It was inefficient and inadequate. There were hardly 9,387 miles of metalled roads and 25,523 miles of unmetalled roads in 1946, against a requirement of 16,584 and 42,307 miles respectively. The War conditions had proved the last straw on the camel's back and the roads which were already in a deplorable condition were called upon to bear the heavy military traffic for which they were never designed.

Post-war Development Plans

After the termination of the War an attempt was made, for the first time, to plan the road system on a scientific basis in the year 1946. A scheme costing Rs 68 crores was drawn out and work was started on its first Phase at a cost of Rs 21 crores. This scheme provided for the reconstruction of 2,320 miles of local metalled roads, construction of 1,642 miles of new metalled roads and 5591 miles of new unmetalled roads besides 501 miles of C.C. Tracks. By 1949 a sum of Rs 12 crores was spent on these schemes when due to financial stringency all works were stopped.

First Five-Year Plan

In 1951, the Country launched its First Five-year Plan. In Uttar Pradesh, the plan for roads was estimated to cost Rs 783 lacs, but the expenditure was to be limited to Rs 522 lacs during the plan period. All the incomplete works of Phase I Programme were included in this plan. As the plan developed, it was felt that provisions made were inadequate and the State Government sanctioned several projects outside the plan. In the later part of the plan period the Government of India also sanctioned a new scheme at a cost of Rs 2.5 crores for counteracting the increasing unemployment in the country. The scheme provided for construction of 32 roads in backward areas and in the hill districts.

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Second Five-Year Plan

It was decided to evolve the Second Five-Year Plan on a more rational basis. Within the framework fixed by the Star and Grid formula, the requirements of each district were worked out in detail and master plans were, drawn out on the basis of investigations through fact-finding surveys regarding economical, financial traffic and engineering aspects of each individual road proposed. Proposals for new roads were discussed with the local representatives and admininistrative officers and enquiries were also made from the villagers regarding their requirements.

Information was also obtained regarding population, location of villages of various sizes, number of bullock carts, agricultural and non-agricultural areas, military and tourist centres and places of historic and religious importance. A master plan was then prepared after detailed studies of all the maps and statements to meet the requirements of population, productivity, traffic and other considerations.

Planning of Roads

The Second Phase of planning included the selection of roads of immediate necessity from the master plan. As the resources available were absolutely inadequate to meet all the requirements, priorities had to be given to more important roads. Certain principles had therefore to be laid down for drawing up the Second Five-Year Plan.

(a) Highest priority was given to the construction of all missing links and all major and minor bridges situated on National Highways and their modernisation in entire length of 1,500 miles. Where traffic conditions warranted, widening to 22 ft was also provided to cater for two-traffic lanes. These schemes are likely to cost Rs 11.7 crores and are being financed by the Central Government.

(b) The first step in the State planning was the selection of State Highways. These were to be the main roads of the State which had not been taken over as National Highways. A total length of 2,547 miles was selected primarily on the basis of traffic requirements. They mostly joined district or divisional head-quarters. Major portions of these highways were formed by the existing metalled roads. Construction of missing gaps in the State Highways was given the topmost priority in the Second Five-Year Plan. It was also contemplated to connect all district head-quarters with the head-quarters of all adjoining districts.

(c) Selection of M.D.Rs. and O.D.Rs. was then made. There were repeated representations from the different sections of the public for and against selection of particular roads of local importance. Meetings of all M.Ps, and M.L.As, M.L.Cs, local bodies, Administrators and District Planning Committee were therefore held in each district with the P.W.D. representatives and their recommendations were carefully considered. The final selection was made on the basis of the ultimate utility of each road, unbiased by any political or party considerations.

(d) The essential criterion for the selection of a new road was the basic principle laid down by the Nagpur Plan that no village in a well developed agricultural area should remain more than 5 miles and in undeveloped area more than 20 miles from a main road.

(e) A road system has to be balanced and should enable an equitable distribution of natural resources. More roads had therefore, to be provided in areas of high productivity, of thick population and near trading centres and industrial towns.

Provisions in the Second Five-Year Plan

Based on the above principles the Second Five-year Plan of roads has been drawn up at a cost of Rs 16.14 crores fixed by the Planning Commission. It provides inter-alia for completion of incomplete works of the First Five-year plan at a cost of Rs 6.5 crores. The total cost of the new works proposed to be taken up will be Rs 13.43 crores, against which the outlay during the plan period is restricted to Rs 7.88 crores, the balance being carried over to Third Five-year Plan. A sum of Rs 1 crore was subsequently allotted by the State Government in addition to the above ceiling of

Rs 16.14 crores. The total programme contemplates work being taken up on the construction of 1,621 miles of metalled roads 139 miles of Shramdan and Govt. Estate Roads, 419 miles of bridle and unmetalled roads, reconstruction of 373 miles of local metalled roads and modernisation of 445 miles carrying heavy traffic, besides construction of 84 major and suspension bridges.

The actual physical targets aimed at for the Second Five-year Plan period including those of continuing Schemes of First Five-Year plan are the construction of 2028 miles of metalled roads, 75 miles of Shramdan roads, 324 miles of bridle roads, reconstruction of 251 miles of local roads and modernisation of 776 miles.

Modernisation

In the plan due stress has been given to modernisation. To cope with the ever increasing traffic, several important highways are proposed to be modernised in their entire length. Specific mention may be made of Lucknow-Varanasi road 195 miles long, Bareilly-Mathura road 127 miles long, Fatehpur-Pauri-Kirtinagar, Rishikesh-Tehri, Meerut-Garh-Bulandshahar, Moradabad-Chandausi, Badaun, Bahraich-Gonda-Faizabad and Etawah-Farrukhabad roads. Besides, many smaller bits of local importance are also to be modernised. The entire length of 1500 miles of National Highways is also under modernisation.

Bridges

The absence of bridges causes great obstruction to free flow of traffic. A well organised bridge construction programme has therefore been launched at a cost of 2.3 crores on state roads in addition to bridge programme of Rs 7 crores on National Highways. Important bridges such as Ganga bridge at Garhmukteshwar, Ramganga bridge at Bareilly, Jhararghat bridge near Jhansi, Sarju bridge at Ghat, Tons bridge at Azamgarh, Song bridge near Dehra Dun are already in hand and several others including Ghagra at Dhorighat, Yamuna at Kalpi and Sarju at Faizabad will be started shortly.

In the Second Five-Year Plan it is aimed to complete the main frame-work of the road system including the bridging of many major crossings. How far it will be possible to achieve this target will depend upon the finances made available for road projects. Better communications are the shortest road to prosperity and there is no doubt that roads will play a vital part in improving the standard of living of the people and pave the way to prosperity.

(*Continued from page 16*)

years, but also to rectify in as many respects as possible if not in all respects, the many deficiencies in our present system to which a reference has been made above, and finally to bring more villages near our road system than envisaged in the Nagpur plan. At the same time, priorities should be laid down. It is no use increasing the road mileage without providing bridges and at least macadamised or stabilised soil road surfaces. It is also no use adding a large mileage of unstabilised soil roads without making adequate provision for their maintenance. Our present development suffers from both these defects. Finally, top priority must be given not only to raising the milage of our National Highways to at least the level of the railway milage but also to the provision of two-lane carriageways, bridges, proper geometric lay-outs and modern surfaces on them. Our engineers need not be shy of the cost of such a scheme since road construction and road transport are far more labour-intensive than any other service and in a country like ours suffering from unemployment on a large scale any labour-intensive scheme has to receive priority. If hand-made cloth has to receive a certain amount of priority on mill-made cloth because it is more labour-intensive it follows that for the same reason roads and road transport have to receive a priority over the railways.

LOW COST ROADS AND RURAL ECONOMY IN THE HIMALAYAS

By

G. R. Nangea,* M.I.E. (India), M.I.C.E., M.I. Struct. E.

Introduction

The only chance of building up hill rural economy is by initiating steady activity in road construction which also helps lower the cost of carriage and transportation thus enabling the rural population to cheaply deliver their produce to the markets and also to buy their daily requirements without much difficulty. But the Himalayas pose a mighty challenge to the concept of low cost roads. Besides the inadequacy of the technical resources for patient study of the exact Himalayan problems, the financial limitations in steady investment have been responsible for the comparative neglect of these areas so far and it is this dual aspect of the problem which recommends radical approach to the exploration of an adequate pattern of transport development helping early initiation of all-round social and economic activity.

Though roads are vital to the development of hill transport economy yet no Country or Government can expend large sums without compensating revenue from the enterprise. Thus, all road development investment has to be phased to fall in consonance with the immediate gradually developing rural economy of the region. If road construction and maintenance could be initiated in a manner which would involve modest immediate investment and which could contribute substantially towards competitive economic and social life of the region as compared to the adjoining areas in the plains, it would be really very welcome.

Planning of Roads and their place in Rural Economy

Systematic long-term planning and gradual construction of a net-work of roads designed for the exact geographical and physical needs of the area is fundamental. It is then advisable to take in hand road work on the exact correct alignment just capable of allowing jeeps and lorries to reach the deep interiors and then gradually the road may be improved upon to meet the economic demands. Only such roads should be constructed which serve as the main arteries of economic life of the various areas instead of undue importance being given to any particular town or village or locality.

The existing wide contrasts in the prevailing carriage rates between the hill areas and the plains are always too evident to escape notice and these explain the precariousness of the hill economy. The proposed plan should, therefore, aim at bringing the cost of carriage parallel to the same in the adjoining areas taking up the expected busiest routes first so that competitive brisk economic activity is initiated early and the hill areas can also start developing normally. As suggested above economic activity has to be planned along with the roads and as they get constructed the exports should quickly rise up to 25 to 100 times their present level.

Building up Rural Exports

Exports play a great part in the financing of roads and have to be systematically built up. Growing of cash crops has to be encouraged. Pending discovery and exploitation of mineral wealths in the interiors, and setting up of industries, quality organic exports of potato, tea, fruit, ginger, turmeric and forest products have to be grown and sent out in large quantities bringing back capital goods, industrial materials and other domestic requirements of the hill homes.

Potato is an important cash-crop of the hills and it flourishes at altitudes from 3,000 to 11,000 ft. It is claimed that if all spare land in hills could be covered by fruit trees and potato crop and if the

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produce could be carried economically to the plains, the acute poverty of the hills could get immediately relieved.

Tea is a great foreign exchange earner and Himalayan slopes are a natural home for this industry.

Finest citrus fruit and oranges are grown in the low valleys of the Himalayas.

Apples, pears, appricots, almonds, walnuts, pistachio nuts and chilgoza are all very common produce of these hills.

In shielded valleys where rain-fall is scarce it is even possible to grow grapes.

All these bring a dozen time better economic return than growing of the ordinary grains. If systematic start is made towards rearing up of high quality fruit and setting up fruit preservation and canning industry large exports can be built on these items.

Ginger and turmeric are grown in abundance in lower valleys below 7,000 ft and by opening of roads these can substantially add to the income of the area.

Pattern of Road Development and considerations of developing Specification

The correct planning of actual construction of hill roads is also equally important. The least time usually required for the complete construction of a surfaced modern hill road of standard width and of a substantial length is 10 years though the first inspection jeep and a lorry could go on it within one and two years of the start of work respectively. There is no denying that the work could be hastened up, but it will cease to be economical and the emergency dictating such a course should justify the extra expense. The most economic method of construction of hill road is the one just tried out in Himachal Pradesh where " Stage Work " had been planned and full advantage was taken of the natural phenomena in the actual construction work. A 2 ft walkable " trace " on the exact motor road alignment is cut first. It is followed by 9 ft " track " which could be used by jeeps. This track is then widened into a 14 ft or 16 ft wide road for lorries. Further widening, metalling and surfacing is then gradually proceeded with as the traffic grows.

Initiation of Road Work

Due to continued economic stagnation beyond remedy by the individual the will to struggle that motivates human activity was lost in the Himalayan areas. These communities are extremely poor and half-starved and the malnutrition has not only undermined the health of the hillman but has deprived him of his natural aspiration for bettering his individual and community life. Propitious atmosphere needs being created for automatically inducing strong will for self-help and enterprise in bettering his economic lot and fuller and healthier community life.

What national investment in hills can set up steady activity better than the one in the construction of basic arterial roads which facilitate automatic flow of knowledge and intercourse followed by public health facility and cheap transport for a vigorous and healthy social life? The " stage " system of road work does ideally fit in this framework of mobilising and channelising intensive community activity. By providing employment for utilising all spare time of the community for a period of 10 years in nation-building activity and at the same time helping raise individual family income, it should provide incentive and initiative for private long-range enterprise in newer fields.

To start with, agricultural enterprise has to raise raw material production and export. The road ' trace ' is a signal for the cultivator to think ahead rationally to fully avail of the coming cheap transport facility. It usually takes three years for the orchards or tea gardens to get established and for complete change over in cropping pattern, while the first lorry may reach the locality in about 2 years. So the cultivater has to race against time to raise his personal income and general standard of economic life. The successful pioneer in such fields carves out a new economic horizon not only for himself but for the whole community and his personal prosperity provides a healthy incentive for a free competition in promoting

intense, allround economic activity—the idea of true democracy.

Road works can be given out on 'task system' or 'petty contracts', each ranging from Rs 100 to Rs 10,000. Thus every petty worker is encouraged to take up for himself, his relatives, friends and family these works on which they could collectively work for a few days and earn this additional sum. In actual practice the initial take up was very hesitant, but as they got more and more used to it very competitive rates were offered which also indirectly included their contribution as "Shramdan", viz., charging less for the work done which would ordinarily cost more.

Let every one avail of the employment facility when he is in need of it. Similarly, except for the stage till the road is usable by the first lorry, the Government also have absolutely no reason to forcibly hasten the pace of work in any locality. As a matter of fact, the pace of construction has to fall in step with the economic requirements of the community.

The road construction and maintenance in the Himalayas have to be planned for the modest steady investment in achieving lowest costs of transportation enabling the hill rural economy to successfully compete the plains.

The rural population has to be intimately associated with it and they have to be gradually launched into competitive enterprise in the newer fields of the quickly developing economy. A progressive road system exactly fitting in the needs of these terrains and automatically leading these regions to a more prosperous and happier life has to be aimed at.

INCIDENTAL INTELLIGENCE

A teacher assigned her class a composition to be entitled, "Things I am thankful for." One boy made his brief but eloquent: "I am thankful for my glasses, They keep the boys from hitting me and the girls from kissing me."

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

ARCH: A structure having a curved axis.

ARCH BRIDGE *or* **CULVERT**: A bridge (or culvert) with a superstructure that depends for its stability on the principle of the arch.

BRIDGING INDIA'S RIVERS

AKHARAGHAT BRIDGE OVER RIVER BURHI GANDAK IN BIHAR

By

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and

J. B. SAH, B.SC. (Engg.)†

INTRODUCTION

The 903-ft long high level R.C.C. bridge across the river Burhi Gandak at Akharaghat near Muzzaffarpur, in the 2nd mile of the Muzzaffarpur-Sitamarhi State Highway, is the longest R.C.C. bridge in North Bihar so far constructed. It is also the first R.C.C. bridge in North Bihar. The bridge was opened to traffic on 13-2-1954.

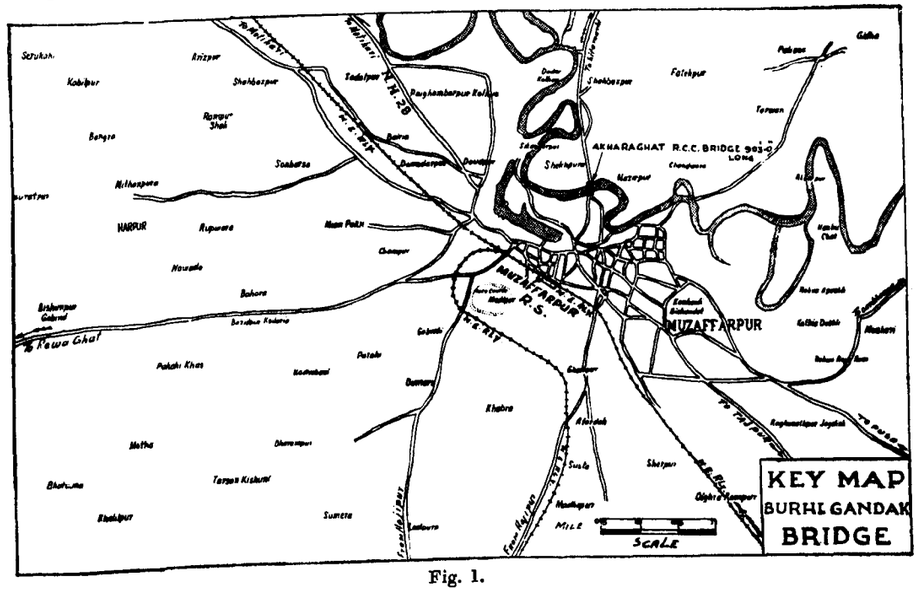

Fig. 1.

THE RIVER BURHI GANDAK

The river Burhi Gandak is a perennial river as it is joined by so many rivers emanating from Nepal hills. It serves as the main drainage line of all these rivers, bringing in the runoff from a vast area of heavy rainfall of about 80 to 100 inches in the hills and 50 to 60 inches in the plains. The maximum rainfall in 24 hours in the hills has been reported to be 32 in. and in the plains 15 inches. This causes all the streams and tributaries of the river to come in spate and cause a sudden rise of water in this river.

The catchment of the river is 1,800 square miles. It lies almost wholly in

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the plains, though its tributaries have their catchment in the hills. The soil of its banks is clayey doras and sandy at places.

The mean depth of water in the river throughout the year is about 6 to 7 ft, but the maximum and minimum depth varies from 2 ft 6 in. to 40 feet. The high flood velocity as observed was found to be 5 ft per second while the low water velocity was 1.25 to 2.00 ft per second. The mean width of the river is about 500 ft but the narrow width is about 200 ft only and the maximum width is about 900 ft excluding the spill on both banks.

The dry silt content varies from 3 oz to 14.4 oz per cu. ft. of water during the month of August and wet silt varies from 326 cu. ft. to 1,450 cu. ft. per million cu. ft. of water.

Investigation and Hydrology of Site

Originally, there was a wooden pile bridge at the site, constructed in the year 1887. But this bridge did not serve long and collapsed after a few years of service and subsequently in the year 1893 a pontoon bridge was put up and this served for a long time. However, during the flood period the maintenance of this type of bridge across such a vital key point was rather an arduous task to cope with. Often it would happen that the pontoons would get dislocated, particularly in the night, and then the communication would get disrupted. Therefore, a constant day and night vigil to guard against this trouble was required.

Finally, with the transfer of the Muzaffarpur-Sitamarhi road to the P.W.D. in 1949, a high level bridge at this site was proposed along with the improvement of the road.

The site of the bridge, Fig. 1, was selected just downstream of the existing pontoon bridge. The existence of the pontoon bridge facilitated the diversion of the road at this site during construction of the bridge.

To ascertain the bed strata of the river, borings were taken to 70 ft depth and the soil samples revealed mostly sandy soil. Nowhere any stiff strata was found.

The calculated discharge of the river was 1,00,000 cusecs. The width of the river bed at the proposed site was about 1,300 ft, out of which about 400 ft remained mostly ineffective. The length of the pontoon bridge usually during flood period was about 1,050 ft. The waterway finally adopted for the bridge was 900 ft. The Irrigation Department has subsequently constructed marginal embankments thus forcing the entire discharge through the bridge. It is seen that any further restriction of the waterway would have produced undesirable consequences.

DESCRIPTION OF THE BRIDGE

General

The bridge is a reinforced concrete balanced cantilever structure, each main span having two projected cantilevers supported on two piers, one having rocker bearing and the other having roller bearing. The suspended spans are in alternate bays, supported over the cantilevers of the two main spans, Fig. 2. The bridge was designed for two lanes of I.R.C. Class A loading.

The total length of the bridge between the faces of abutments is 901 ft, consisting of 7 equal spans of 106 ft each and two end spans of 79 ft 6 in. each measured from centre to centre.

Foundations

All the eight piers and the abutment on Sitamarhi end are founded on wells, Fig. 3. The outer diameter of each well is 24 ft and the thickness of steining is 3 ft of 1:3:6 cement concrete suitably reinforced.

The wells were designed for 42 ft depth, but later on the depth was increased to 58 feet. This extra work was done after due test for stability of the wells. The wells were then plugged with plain cement concrete at the bottom (1:2:4) and top (1:3:6) with local sand filling between the two plugs. A 2-ft 6 in. thick circular well cap of suitably reinforced cement concrete (1:2:4) was provided over the wells.

The bearing power of soil under well foundations was taken as 6 tons per sq. ft.

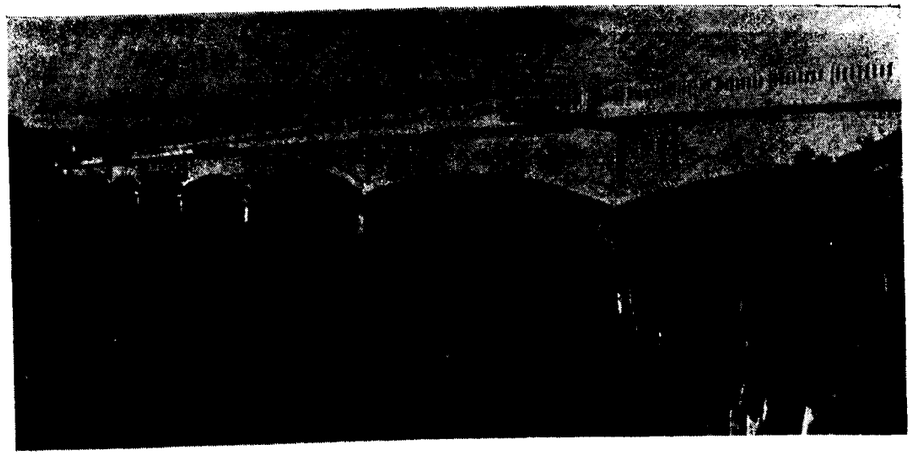


Photo 1. **A view of the completed Burhi Gandak Bridge**

Photo 2.
The Pontoon Bridge when the R.C.C. bridge was under construction

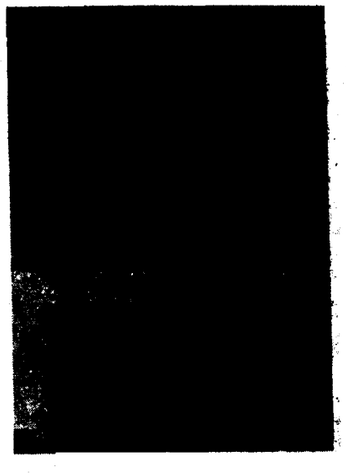


Photo 3.
A view showing the arrangement of girders and diaphragms with bearings and pier

Photo 4.
Islands for Wells Nos. 6 and 7: Bridge over piles between them

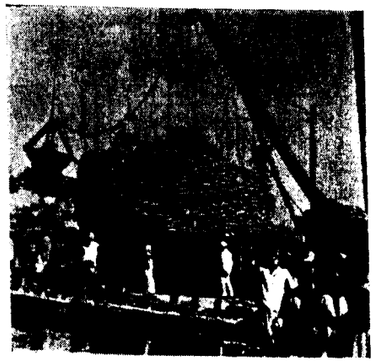


Photo 5.
Sinking Well Foundation: Kentledge loading and dredging in progress

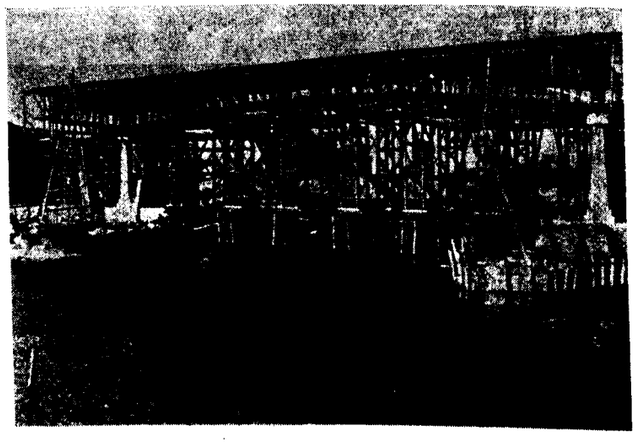


Photo 6.
Staging and centring of a full span in water portion

Substructure

The piers are of reinforced cement concrete (1 : 2 : 4) and their length is 17 ft 6 in. and thickness at top 2 ft, the side batter being 1 in 24. The pier cap is 2 ft high and 3 ft 6 in. wide at the top. The width has been increased from 2 ft thickness of the pier in order to provide proper seating for the bearings. 90 degree cutwater has been provided at the ends of each pier.

The abutments are of plain cement concrete (1 : 3 : 6) and the length of each is 18 ft, thickness at top 4 ft, earth side batter being 1 in 12 and that on water side 1 in 4, the height being 20 ft. A ballast wall of R.C.C. (1 : 2 : 4) has been constructed over each abutment to retain earth and to provide for necessary seatings to the end suspended span girders on the abutment. The thickness of the ballast wall is 1 ft and the thickness of the R.C.C. cap is 1 ft 6 in., the length of the ballast wall being 30 ft.

The abutment on Muzaffarpur side was not provided with well foundations as it was not required in this case because of the main stream flowing along Sitamarhi end; so, a 3-ft thick footing of plain cement concrete (1 : 4 : 8) with 1 ft projection on each end, increasing the total bearing area to 20 ft by 14 ft 8 in., was provided under this abutment. The bearing power of soil under base of abutment was taken as $2\frac{1}{2}$ tons per sq. ft.

Bearings

Eight sets of cast steel roller and eight sets of rocker bearings were used on this bridge (fig. 4). These were duly tested.

The roller bearings, each having 4 rollers of 4-in. diameter, have been provided under the free end of each of the main span girders and the rocker bearings under the fixed end.

The sliding bearings at the free ends under the two girders of each of the suspended spans consist of two $\frac{1}{2}$-in. thick mild steel plates, each 2 ft by 1 ft 8 in. in size with $\frac{1}{4}$ in. thick copper plate in between.

The expansion bearing provided over the abutment caps to house each end suspended span girder consists of two plates with a $\frac{1}{4}$-in. copper plate in between the two plates.

Superstructure

The superstructure consists of two R. C. C. longitudinal girders spaced at 14 ft centre to centre. The bridge consists of 4 main spans of 106 ft each with cantilever projections of 26 ft 6 in. on either end of the main span and 5 suspended spans of 53 ft each including the two end suspended spans. For the sake of economy, the length of 24 ft 6 in. in each of the cantilever portions and 25 ft on opposite side in the main span have been designed as web and flange type, the flange width varying from 2 ft $10\frac{1}{2}$ in. to $16\frac{1}{2}$ in. all through except at cantilever ends where it has been increased to 2 ft to accommodate the sliding bearing. In the rest of the portion of the main span, the web thickness is $16\frac{1}{2}$ in., all through without any flange. In all the suspended spans, the web thickness is $13\frac{1}{2}$ in. all through, except where sliding bearings are provided where the web thickness has been increased to 2 ft. The depth of web including 2 ft high flange, wherever provided, varies from a maximum of 10 ft at the support to a minimum of 6 ft at the centre of the main span.

Three diaphragms in each main span, one in each cantilever and two in each of the suspended spans, have been provided to act as struts between the two longitudinal girders. The thickness of diaphragms is 12 in. and they are spaced at 26 ft 6 in. centre to centre.

The two longitudinal girders support the deck slab with 4 ft overhang on either side from the centre line of the girder, giving 22 ft wide roadway. The thickness of slab between girders is $9\frac{1}{2}$ in. and at the overhanging ends 6 inches. The slab is raised in the centre by 2 in. so as to give a slope of 1 in 66 from the centre sloping towards the kerb, $9\frac{1}{2}$ in. high haunches at 45 deg. have been provided between the slab and the girders.

The wearing coat over the deck slab is of 1 : 2 : 4 cement concrete with a uniform thickness of 3 inches.

Beyond the clear roadway of 22 ft, R. C. C. kerbs of 9 in. by 12 in. have been

monolithically cast with the slab and the parapet. Tha road kerbs have been raised by $\frac{1}{4}$ in. on the parapet side for providing a drainage slope. The height of the road kerbs over the wearing coat is 9 inches. The R. C. C. parapet is 6 in. thick and 2 ft 3 in. high over the road kerbs giving a total height of 3 ft above the finished roadway. The parapet is of panelled construction and expansion joints have been carried from the road.

Provision of expansion joints has been made in the roadway at the ends of suspended spans. Two angles, 2 in. by 2 in. by $\frac{1}{4}$ in. as shown in Fig.4, have been embedded in the level of the top of the slab and a 5 in. by $\frac{1}{4}$-in. flat iron is placed over the angles. On one side, the plate is welded to one of the angle irons whereas the other side slides freely over the other angle iron. The clearance of $\frac{1}{2}$ in. left between the free end of the plate and concrete is filled with bituminous material.

The details of reinforcement of girders are shown in Fig. 5.

Cast iron drain pipes of 6 in. diameter have been provided at 39 ft 6 in. spacing, with every fifth spacing at 53 ft, under the road kerbs to effect the drainage of the roadway.

TESTING OF THE BRIDGE

The following two tests were performed on the bridge. The tests were carried out to ensure full stability of the structure.

(a) Testing well foundations for observation of settlement of the wells under designed load.

(b) Testing of the superstructure of the bridge to observe the deflection of the girders which should be within the permissible limit.

Testing of Well Foundations

Originally, the depth of steining was kept 42 ft, i.e., the R.L. at the top of the steining being fixed at R.L. 156.75 (low water level), the R.L. of the cutting edge was taken down to R.L. 114.75.

Well No. 1 after being sunk to the depth of 42 ft was put to test with a kentledge of sand bag. It was foreseen that the test of the well foundation, with inside excavated, would not be correct as the soil would move under the test load during the test. Therefore, after excavating up to the required depth, sufficient quantity of sand, as calculated from the Rankine's formula, was filled in the well to prevent any such upheaval of soil before the test load was applied.

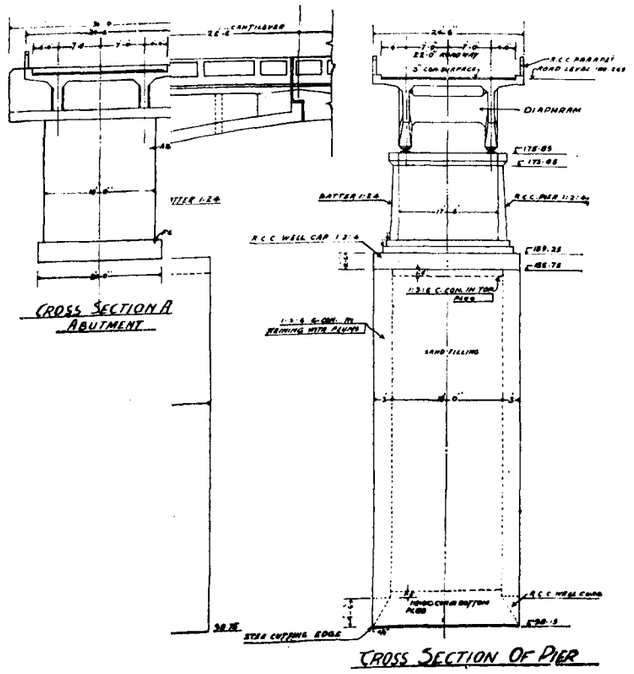
The following sinking was observed under the different test loads for well No. 1 after it was sunk to a depth of 42 ft:

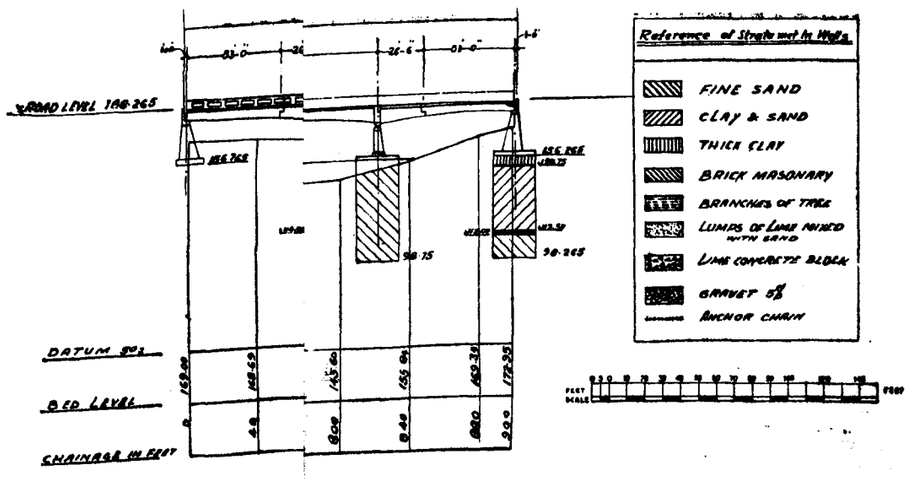
Super load tons	Settlement inches
300	$1\frac{1}{2}$
400	$7\frac{3}{4}$
450	$13\frac{1}{2}$
500	$19\frac{1}{2}$

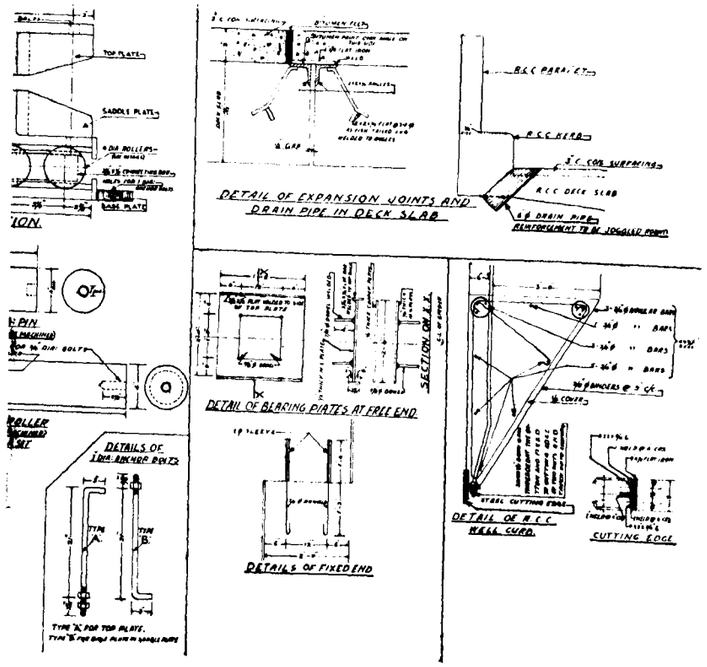
These observations were plotted on a graph, as load settlement curve–vide page 167 of "Soil Mechanics in Engineering Practice" by Terzaghi and Peck. In plotting the graph, the dead weight of steining with due allowance for buoyancy was added to the super load to obtain the correct graph of total load at the base in tons versus the settlement in inches. From the tangent drawn to the above curve it was found that the safe load borne by the soil at that level was 615 tons. Therefore, the bearing power of the soil at that level was $\frac{615 \text{ tons}}{\text{area of base}} = \frac{615}{198} =$ 3.1 ton per sq. ft. But the maximum pressure under the base of the well taking all forces into consideration came to 4.23 tons per sq. ft. As normally found, it was assumed that the bearing pressure of soil increased roughly by 1 cwt per sq. ft. for every extra foot depth. It was decided to sink the well 8 ft further and then test it again, and if satisfactory results were not obtained, further sinking would be resorted to.

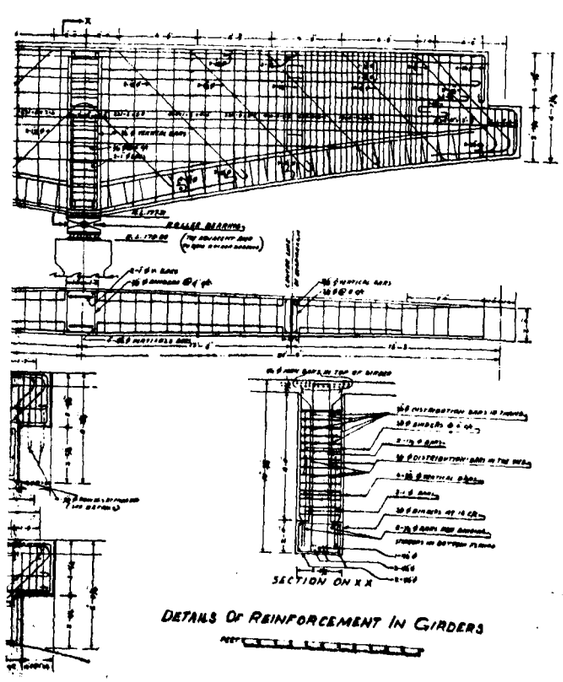
Well Nos. 1, 2 and 3 were sunk accordingly by 8 ft extra depth over the designed depth of 42 feet. Well No. 1 was then again tested with the super load gradually increased to 525 tons. A sinkage of $8\frac{1}{2}$ in. was observed at this level.

The kentledge was then unloaded and an extra sinking by further 8 ft was decided.









DETAILS OF REINFORCEMENT IN GIRDERS

After sinking the well No. 1 to 58 ft depth, i.e., up to R.L. 98.75, the well was again tested with load up to 560 tons. No further sinkage was observed. This fulfilled all the conditions and then the plugging etc. was done.

Other wells were not tested. As the conditions in other wells were very much similar to those of well No. 1, 2 and 3, the cutting edge of the rest of the wells was also taken down to R.L. 98.75.

Testing of the Superstructure

The bridge was designed for I.R.C. Class A loading. It was thought essential to test the bridge for maximum deflection and notice its behaviour under the designed load. After complete laying of the wearing coat over the deck slab, the test was applied and it lasted from 31-10-1953 to 30-11-1953. The maximum allowable deflection was 1/600 of the span with 50 per cent overload. Therefore, with design load it should be $\frac{1}{600} \times \frac{1}{1.5} = \frac{1}{900}$ of span i.e., for main span $\frac{1}{900} \times 106 \times 12 = 1.41$ in., and for suspended span, $\frac{1}{900} \times 53 \times 12 = 0.7$ in. maximum.

The test load consisted of sand in cement bags, each bag containing about 100 lb average. The specimen bags selected at random were weighed and the average of 5 bags was found to be 100 lb per bag. A loading platform was used for representing the live load equivalent of the I.R.C. Class A loading. The impact factors of 20.6 per cent for suspended and cantilever spans and 11.9 per cent for main spans were adopted as per design calculations. The standard contact area under the loading was also truly represented by the equal size of wooden blocks of 10 in. by 20 in. and 8 in. by 6 in. The 6-ft distance between the axles and the spacing between the loads were correctly reproduced.

The loading was always done in a manner so as to produce the maximum bending and maximum shear exactly according to the design procedure. A precision level was used to read deflections.

The following points on each girder were selected for the observations of deflection :

(i) Centre of suspended span,
(ii) Free end of first cantilever of main span,
(iii) First pier at main span end,
(iv) Centre of main span,
(v) Second pier at main span end,
(vi) Free end of the second cantilever of main span.

Before loading the superstructure, the R. L. on all the above points on each girder and each abutment were fixed by precision level. Then the loading platform was prepared and loading was completed in 1½ hours.

The observations were taken just after loading and two hours after loading, then before unloading and just after unloading. Thus the load was kept for at least two hours in each operation.

The main span was tested for both maximum positive and maximum negative bending moments at the centre of the span.

The tests for upstream and downstream girders were carried out alternatively in the same way.

The spans were also loaded for the maximum shear in each case.

Behaviour

(a) No crack in the superstructure was noticed anywhere during the test except at the cantilever ends where fine hair cracks were noticed in the end lip of cantilever No. 1. These were opened to find if they extended throughout the section, but they were found to be only surface cracks. These hair cracks were found 4 to 6 in. from the edge of the lip and the portion was in the region of the concrete cover over the main reinforcement where heavy concentrated load from the suspended span came. The contact area was further reduced and shifte towards the edge of the lip due to th bending of the suspended spans.

(*Continued on Page 44*

BRIDGING ACTIVITY IN UTTAR PRADESH

By

M. S. Bisht,* CE., AMSCE.

UTTAR Pradesh is one of the largest States of the Indian Union with a net-work of roads in every nook and corner of the State. It is, however, intersected by a large number of rivers big and small. While these rivers have lent fertility to the land and have influenced our culture and civilization, yet these very rivers have been the gratest obstacles to the growth of our communication system.

Our climate and geography is such that for four months during the rainy season these rivers assume dreadful proportions. Thus from June to October we have great masses of land separated from each other without any means of road communications. The railways with their all-weather tracks do provide relief to certain areas, but they are only a facet of the communication system. To the common man road links matter more.

Fortunately both the State and the Central Governments are well alive to the seriousness and urgency of the problem and ever since the dawn of independence large amounts have been earmarked for the completion of important bridges on State and National Highways. During the First Five-Year Plan twenty six major bridges costing Rs 97 lacs were completed and opened to traffic. The picturesque bowstring bridges over Bygool and Bhakra rivers near Bareilly, the 325 feet R.C. open spandrel arch, the largest of its type in India, over river Ladhya, the light prestressed superstructure over river Uttangan, the modern balanced cantilever over little Gandak near Deoria and many others are today the living monuments to the skill of our engineers.

Unfortunately our First Five-Year Plan was restricted due to limited financial provisions. Inadequacy of funds had always been a bottle-neck to all highway planning and though we and other States have been pressing for statutory provisions for highways, it is regrettable that Government has not yet been able to find a way to concede our request.

The Second Five-Year Plan is, however, much more generous and liberal as compared to the first with regard to provisions for bridges. In the brief spell since its commencement fifteen bridges of an approximate cost of Rs 88 lacs have already been opened to traffic. The 230 feet suspension bridge over Alaknanda which is the first of its type yet built in India, the new wide Prestressed bridge over Hindan near Ghaziabad, the 600 ft balanced cantilever bridge over Rapti at Basti connecting Nepal border with India, the 225 ft single span steel bridge over Sarju at Ghat connecting the northern interiors with the plains of this State have been completed and opened to traffic. Nearly every type of Balanced Cantilever, Bow String, Arch, Steel Lattice Girder, Suspension bridge and Prestressed bridge has been designed and constructed.

But all these bridges belong now to the past. For the future we have far more ambitious plans, and though recently our schemes have received a set back due to shortage of foreign exchange, we have still hopes that a major part of our plans will still mature. To-day we have twenty bridges of all categories costing Rs 154 lacs in the various stages of construction. The 2,067 ft long continuous cantilever bridge at Jhararghat, balanced cantilever bridges over Gomti at Hydergarh and over Karmnasha are in advanced stage of construction and are to be completed latest by June 1958. Work on Ramganga bridge on the Bareilly-Mathura road is in full swing to lay fourteen simply supported prestressed spans of 155 ft each. This bridge is being financed solely by the U.P. Government.

Our biggest bridges are proposed to be built on National Highways, for which seventeen bridges at a cost of Rs 2½ crores

* Chief Engineer, P.W.D. Uttar Pradesh.

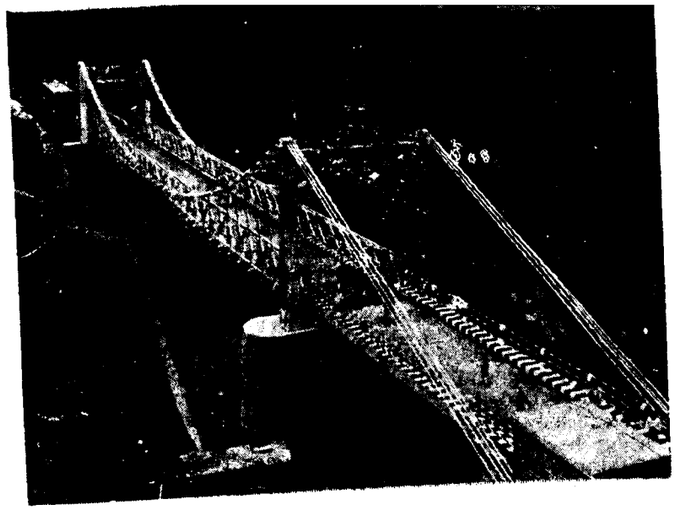


Photo 1.
The suspension bridge over Alaknanda at Kirtinagar which has provided great relief to the pilgrims bound for Badrinath & Kedarnath

Photo 2.
The picturesque Bygool bridge built in the first five year plan

Photo 3.
The Chalti Bridge, having 325 ft span, biggest of its type built in India

HIGHWAY BRIDGES IN WEST BENGAL

By

D. Ghosh, *B. Tech. (Hons)

Introduction

THE Five-Year Plans have been undertaken with the primary aim of stabilising India's economy and preparing the ground for rapid progress in future. Such plans of economic development which lay stress on rapid industrialisation need an efficient and well developed system of transport and communications in the country. Roads and railways which are so important for industrial development cannot be put through, if the bridges are not provided over the waterways crossing the alignments. Hence it is quite obvious that bridges play a vital part in our development programme.

Bridges & Five-Year Plans

During the First-Five Year Plan, though more stress was laid on road development in West Bengal than provided in the All-India Plan, construction of bridges could not be properly geared to the construction of roads. That was due to the fact that more attention was paid to the improvement and construction of many miles of roads so as to build up a skeleton structure of roadways in the country. The cost of a major bridge is considerable and with that amount many miles of road can be built; this is an important consideration when there is paucity of funds. It has been decided to take up the National Highways first and construction of bridges on the State Highways and other important roads will be taken up gradually.

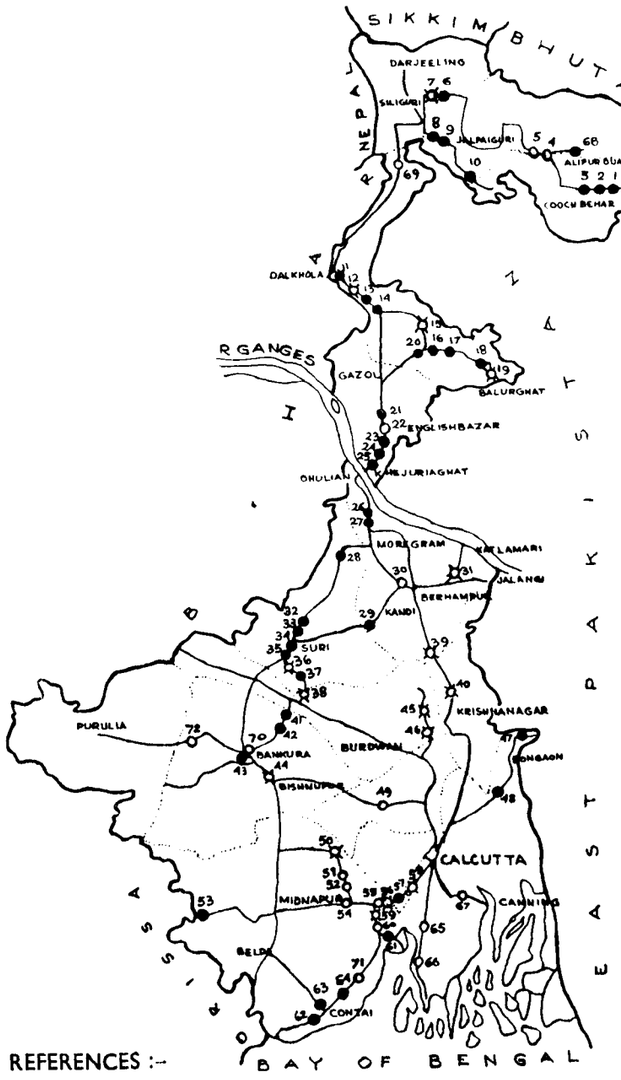
During the First Five-Year Plan only 9 major bridges having spans more than 300 ft were taken up and completed in West Bengal. A list of major bridges of more than 300 ft spans, completed during the first five-year plan is given below:

Name of bridge	Length	Total Cost (in lakhs)
1. Punarbhaba Bridge.	440 ft 0 in.	4.74
2. Pontoon Bridge.	420 ft 0 in.	2.50
3. Atrai Bridge.	490 ft 0 in.	5.51
4. Gheesh Bridge on N. H. 31.	570 ft 0 in.	9.45
5. Kaljani Bridge on N. H. 31.	455 ft 0 in.	11.21
6. Raidak Bridge on N. H. 31.	455 ft 0 in.	10.07
7. Mayurakshi Barrage Bridge.	1020 ft 0 in.	10.58
8. Buri Teesta (Timber bridge) on Jalpaiguri-Haldibari Road.	450 ft 0 in.	12.70
9. Darakeswar Bridge.	870 ft 0 in.	18.39

During the Second Five-Year Plan, more stress has been given to the construction of bridges than in the First Five-Year Plan. These include Rupnarayan Bridge which will be the longest highway bridge in West Bengal, at a cost of more than a crore of rupees. Other bridges projected during the Second Plan period include Dulong bridge which is nearing completion, Ajoy Bridge which is under construction, Mahananda Bridge at Malda, Damodar Bridge at Champadanga, Bhagirathi Bridge near Berhampore, etc.

In West Bengal, the organisational set up for designing bridges is as follows: There are two design divisions under the Superintending Engineer, Road Planning

* Assistant Engineer, Development (Roads) Department, West Bengal.



REFERENCES :-

Bridges Projected ○
„ Under Construction ⌘
„ Completed ●

MAP SHOWING LOCATION OF MAJOR BRIDGES IN WEST BENGAL

Sl No.	Name of Bridge
1	Raidak
2	Gadadhar
3	Kaljani
4	Mora Torsa
5	Torsa
6	Gheesh
7	Leesh
8	Karatoa
9	Sahu
10	Buri Teesta
11	Buri Mahanadda
12	Nagar
13	Gandhar
14	Kulick
15	Chiramati
16	Tangon
17	Punarbhaba
18	Atrai
19	Balurghat Khari
20	Patharghata
21	Behula
22	Mahananda
23	Bhagirathi
24	Tuntianala
25	Pagla
26	Falgu
27	Akheri
28	Brahmani
29	Kanamore
30	Bhagirathi
31	Sialmari
32	Deucha
33	Kulia
34	Mayurakshi
35	Chandrabhaga
36	Bakreswar
37	Sal
38	Ajoy
39	Paglachandi
40	Jalangi
41	Damodar
42	Sali
43	Darakeswar
44	Benai
45	Khari
46	Kunti
47	Kakilamari
48	Gaighata
49	Damodar
50	Silabati
51	Durbachati
52	Palaspai
53	Dulong
54	Cossye
55	Rupnarain
56	Damodar
57	Banspati Khal
58	Rajapur Khal
59	Soadighi
60	Gangakhali
61	Mahisadal
62	Pichhaboni
63	Satmile
64	Kalinagar
65	Diamond Harbour
66	Kakdwip Khal
67	Piyali
68	Kaljani
69	Mahananda
70	Gandheswari
71	Rasulpur
72	Darakeswar

Photo 1, **Kulick Bridge on N.H. 34 (West Bengal)**

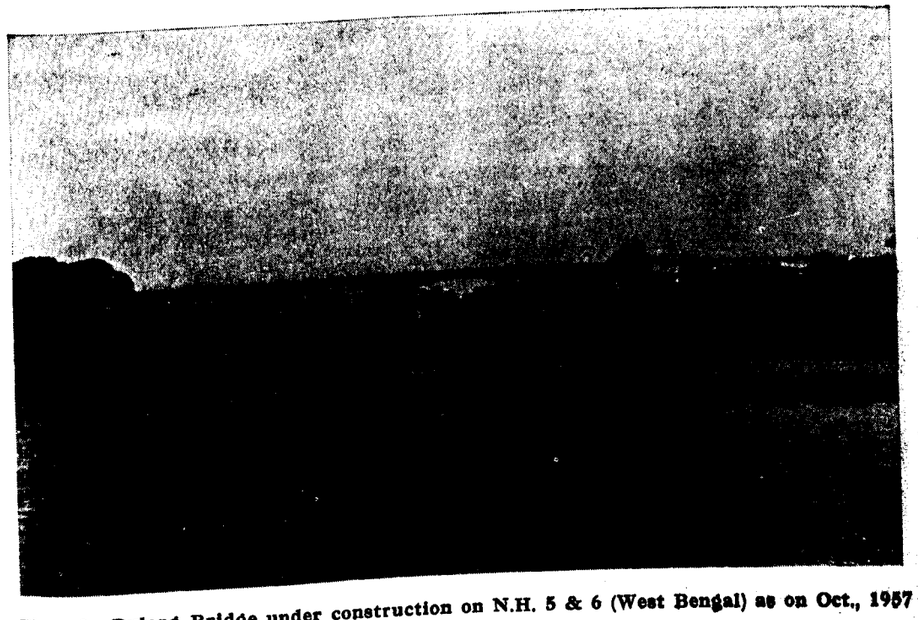


Photo 2, **Dulong Bridge under construction on N.H. 5 & 6 (West Bengal) as on Oct., 1957**

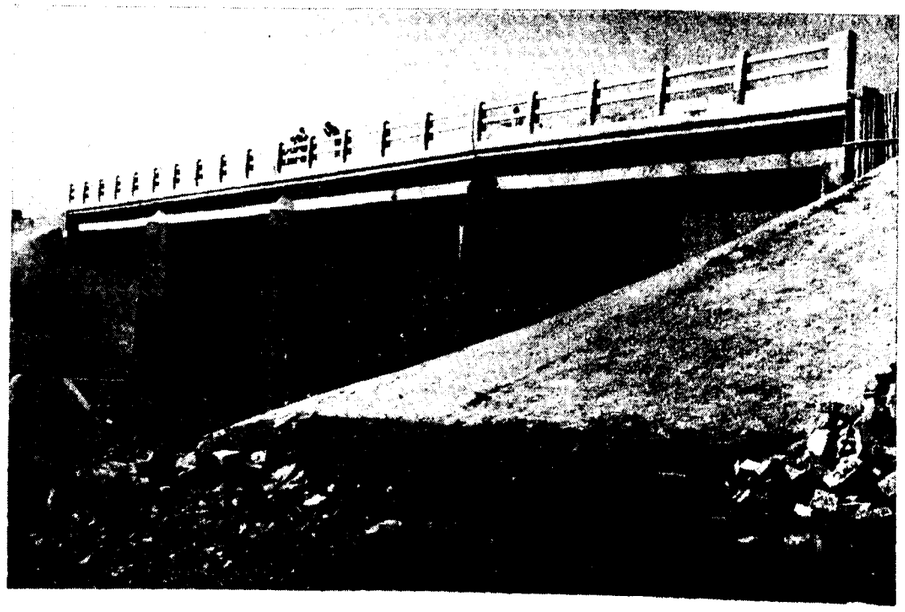


Photo 3. **Akheri Bridge on N.H. 34 (West Bengal)**

Photo 4. **Nagar Bridge under construction on N.H. 34 (West Bengal) as an Oct., 1957**

Circle. The Planning Circle is responsible for the planning portion in the construction of a bridge which includes surveying and designing. Actual execution is done by the Superintending Engineers, Construction Circles. All the Circles are under the guidance of the Chief Engineer, Development (Roads) Department. As stated earlier, since more emphasis has been given for building bridges during the current plan period, expansion of the existing design organisation becomes necessary for timely completion of the development programme.

Problems of West Bengal

The State of West Bengal is cut across by innumerable rivers and each of these rivers has its individual problems. The rivers in North Bengal are mostly hilly rivers with their ever-changing courses and tremendous onrush of water during the rainy season. There is flood almost every year and the scour is severe which makes the taming of the rivers very difficult. In southern part of Bengal, the climate is mostly saline and that factor has to be taken into account while designing bridges in that area.

In this connection, it may be stated that on the advice of the State Flood Control Board, West Bengal, a Road Bridges Committee was constituted in April, 1956 for :

1. Examining the adequacy of waterways of road bridges.

2. Suggesting remedial measures, such as

   (i) Increase in waterways,

   (ii) Protection of bridges,

   (iii) Protection of embankment slopes, and,

   (iv) Raising of formation levels of roads, where necessary, for flood control requirements.

It is seen from the Report of the Committee that almost all the North Bengal rivers experienced high floods in the years 1948, 1950, 1952 and 1954. The 1954 flood was very widespread and the entire Sub-Himalayan region from Assam to U.P. was affected. While tracing the causes of frequent high floods in the rivers of North Bengal in recent years, it is seen that the cross-sectional areas of the rivers within their banks are getting reduced due to the rise of river bed caused by the deposit of silt and debris resulting in higher flood levels with the same discharge. It may be interesting to note that in some of the rivers the rate of rise of the river bed has been to the extent of 5 ft 6 in. in one year. It is also observed that the silt charge of the rivers is generally increasing since some time past. Examining the reasons for this increased silt charge, it is observed that large slips are taking place in the hill slopes and this is being caused by the destruction of forest cover, cultivation in the slopes without proper terracing, etc. Further, the bed slope of the rivers in hilly regions is very steep and it varies from 50 ft per mile to 400 ft per mile. This causes a tremendous velocity and the bed materials being unable to withstand such a high velocity are scoured and transported down the river. This load gets deposited on the river bed on comparatively flatter slopes and this results in the formation of bars below the gorges. The channels are shallow and unstable and the slightest obstruction in one course may result in the diversion of a channel. While designing a bridge in North Bengal area, these factors are of considerable importance.

Particulars of a few bridges in West Bengal taken up during the 1st and 2nd 5-Year Plans.

Some details about a few typical bridges in West Bengal are given below :

Dulong Bridge

Dulong river crosses the N.H. 5 & 6 at 29th mile from Kharagpur towards Bihar in the district of Midnapore at Fekoghat. Before construction of the bridge, a low level causeway was in existence which used to be overtopped during the monsoon period causing much inconvenience to the traffic. The necessity for a high level bridge was, therefore, keenly felt for putting the N.H. 5 & 6 through all the year round at this crossing. The present bridge which is nearing completion has been sited 300 ft downstream of the causeway. This shifting is due to a very sharp curve of the river course on the upstream side.

The foundation consists of dumb-bell shaped concrete wells which vary in depth from 45-50 ft and rest on deep blue stiff clay soil. The piers are made up of mass concrete (with 20 per cent plum) with precast face blocks all round and about 27 ft high. The abutments consist of three R.C. columns with R.C. beams joining at the top and resting on a raft foundation. The soil below the raft was tested and salballah piles had to be provided to a varying depth of 12-20 ft for the safe design load. The embankments behind the abutments being very high, regular wingwalls are omitted. Instead, earth filling round the abutments will be protected by pitching with toe-walls in front.

The bridge has a 24 ft wide clear roadway with the usual wheel guards and R.C. barrel shaped railings on either side. It has been designed for I.R.C. Class 'AA' one lane or class 'A' two lanes loading. The bridge is of balanced cantilever type with R.C. hollow box girders and consists of five central spans of 108 ft centre to centre of piers, and two end spans of 40 ft between the centre of piers and centre of the bearings over abutments. The overall length of the bridge is about 620 ft. The superstructure rests on cast steel rocker and roller bearings over the piers.

The total estimated cost of the bridge is Rs 10,95,800 and works out to Rs 1,770 per running foot of the bridge length. The cost of the two new approaches to the bridge for connecting it to the existing road has been estimated separately and stands at Rs 1,48,000.

Ajoy Bridge

Ajoy river crosses Panagarh-Illumbazar Dubrajpur State Highway, just on the border of the district of Burdwan and Birbhum, at Illumbazar. In Ajoy river there is a heavy rush of water during monsoon, but during the dry season the depth of water becomes very shallow and there is not much flow in it. The bed is of moorum sand and the banks are of moorum mixed with clay. Boats ply in this river only during monsoon and at ferry points; so the river may not be said to be navigable in its true sense. The high velocity in the river during rains also prevents navigation.

The original design of Ajoy bridge has been revised recently due to the last year's unprecedented floods. The previous design was made for a discharge of 2,47,000 cusecs, whereas now the design has been modified for a discharge of 3,25,000 cusecs. Since revision, the height of the piers has been raised and one more span of 148 ft 0 in., has been added to the original design. After revision, the over all length of the bridge stands at 1718 ft-0 in., consisting of 10 spans of 148 ft-0 in. each with two end spans of 119 ft-0 in. each. The end spans are sloped 1 in 74.50 so that there is no additional earthwork in the approaches due to the raising of the piers.

The foundations consist of R. C. elliptical wells which vary in depth from 50 ft to 55 ft approx. Piers are of R. C. solid type and the abutments are of R. C. open type. Prestressed concrete girders with cast in situ slab has been adopted in the superstructure, on the basis of lowest tender. A 22 ft-0 in. wide roadway with 2×3 ft-0 in. wide footpaths on both sides has been adopted for this bridge. It has been designed for double lane of I.R.C. Class 'A' loading or single lane of I.R.C. Class 'AA' loading. According to the original design, the cost of the bridge is about Rs 34 lacs.

Rupnarayan Bridge

The river Rupnarayan is the name of the combined lower reaches of the rivers Damodar and Mundeswari (which carries the major portion of the discharge from Damodar), from their meeting point at Ranichak, about 14 miles upstream of Kolaghat. The river is tidal. It is navigable in certain places. Rupnarayan is the most important unbridged gap of the Eastern zone on N.H. No. 6 as it offers formidable difficulties due to its wide expanse, considerable depth of water at all seasons and quite marked tidal fluctuations.

The road bridge is sited about 875 ft upstream of the existing railway bridge over Rupnarayan at Kolaghat. There will be 13 main spans of 170 ft-0 in. c/c with two end spans of 75 ft and 120 ft on the East and West respectively. The bridge deck will be kept level over 10 spans i.e. 1,700 ft but sloped down at a gradient of 1 in 100 for 415 ft-0 in. on the

East and for 292 ft 0 in. on the West, thereby lowering the height of the East and West approaches by approximately 4 ft and 3 ft respectively. In the main bridge which will be 2,405 ft-0 in. long between the centres of bearings of the abutments, there will be a clear waterway of about 2290 ft 0 in. The Eastern approach on the left bank will be of ordinary earth-fill type. But the Western approach runs through a Railway colony at the North of the Kolaghat R. S. and as such a viaduct consisting of a series of balanced cantilever solid R.C. slabs of total length of 864 ft measured from the abutment pier will be provided such that the end of the viaduct goes well beyond the extreme permanent structure in the Railway colony, for proper ventilation as well as for economy in land space. The roadway on the entire length of the viaduct will be given a longitudinal grade of 1 in 60. Inspite of this slope, the height of road embankment at the end of the viaduct will be nearly 20 ft.

Rupnarayan Bridge is going to be the longest road bridge in West Bengal. Tenders have already been received and these are under consideration. It is presumed that the superstructure will be of prestressed concrete. According to the Departmental estimate, the cost of construction of the entire project comes to about Rs 1.12 crores.

Conclusion

In the foregoing chapters, only an attempt has been made to present in general an over all picture of a few major bridges that have been taken up during the successive plan periods. Dulong Bridge is nearing completion while Ajoy Bridge is still under construction. Work on Rupnarayan Bridge is yet to be taken up. Like this there are many major bridges in West Bengal which are completed or under construction or projected. Gradually, when these bridges will be completed, there will be unrestricted flow of traffic from one part of the country to the other, and this will help to a great extent in stabilising the country's economy, which is the primary aim of the Five Year Plans.

ENGINEER AND MANAGEMENT

I think the training received by the engineer is more directed towards the task of management than that of any other profession. It teaches thoroughness and strict attention to detail, power to visualise, and breeds confidence to tackle problems in a practical way backed by an understanding of human relationships.

—S. A. Findlay.

(From Inaugural Address to the Edinburgh and East of Scotland Association on October 10, 1956).

HERE AND THERE

1. NEW STANDARDS SET FOR EUROPEAN ROADS

E.C.E. Agreement

● THE Sub-Committee on Road Transport of the Economic Commission for Europe, which met at Geneva last month, approved new standards to which international roads forming part of the European system as defined in its Agreement of 1950 must conform. The system covers more than twenty countries, and about 30,764 miles.

The new standards have been selected to meet the present and future demands of road traffic expansion. They apply only to sections of road outside built-up areas. The latter should be by-passed if they constitute a hindrance or danger. Interntaional roads should be built according to the volume and the composition of the traffic to be accommodated and with reference to an appropriate design speed.

The Sub-Committee on Road Transport having considered the report of a Working Party on Main International Traffic Arteries, adopted the resolutions which the Working Party had submitted to it.

The Working Party suggested the classification of international roads into three different categories: Category I comprising roads having a single carriageway with two traffic lanes each at least 3.50 metres wide. Category II, roads having more than two traffic lanes each at least 3.50 metres wide able to accommodate a maximum of 900-1,300 vehicles/ hour in the case of 3-lane roads and 1,500-3,000 vehicles/hour in the case of 4-lane roads. The third category comprises motorways which are roads for automobile traffic only and generally have two one-way carriageways.

Road Markings

The existing international road system has been extended. It includes in particular route E3, Lisbon-Paris-Stockholm; E4, Lisbon-Berne-Copenhagen - Helsinki; E5, London-Vienna-Budapest-Belgrade - Alexandropolis-Istanbul-Ankara-the Turkish Syrian frontier; E8, London-The Hague-Berlin-Warsaw-USSR.

The Sub-Committee adopted a resolution on the standardisation of road markings, providing for three types:

Longitudinal markings, either of continuous lines signifying that no vehicle is allowed to cross or straddle it, or of broken lines which vehicles are allowed to cross, provided that traffic rules are respected; transverse markings, also consisting of continuous or broken lines, of which the first indicates the line behind which drivers should stop; other markings, being either marking on the surface of the travelled way or markings on ancillary works of the roadway, used in particular to improve the visibility, especially at night, of the kerbs or of obstacles on the roadway, or to indicate areas where waiting is forbidden. This is the first time that such standardisation is being applied to the whole of Europe.

(*From "Highways & Bridges"—October 23, 1957*).

2. BRIDGE OVER TRIOUZOUNE (FRANCE)

● IN 1951 a bridge was reconstructed over the Triouzoune, in Correze, in accordance with the successful design submitted by J. Lombardi in a competition.

The new structure which replaces a bridge now submerged by the Dordogne scheme, comprises a very slender three-hinged arch. The total length is 347 ft with a carriageway, 10 ft wide, and two cantilevered footpaths, 33 in. wide. The span/rise ratio reaches the high value of 13.4.

A section shows that the arch is composed of three vertical walls, tied together by the carriageway and a thin intrados slab. The box section thus formed is

stiffened by transverse diaphragms and it is possible to obtain access to the inside.

The pointed profile of the intrados proved satisfactory from both the practical and aesthetic points of view; in particular, the road slopes slightly longitudinally towards each end of the bridge. The concrete mix comprised 590 lb of cement per cu. yd. of concrete; the maximum stresses reached 1420 lb/sq. in.

The centering, which was adapted to the peculiar local conditions, comprised a three-hinged arch placed above the axis of the structure, from which the shuttering was suspended by steel ties.

The actual deflections in the centering agreed very closely with those calculated. The new bridge was opened to traffic at the end of 1953, after a successful acceptance test.

(*From: IABSE Bulletin No. 16, August 31, 1957.*)

3. ROAD TUNNEL IS PROPOSED AS SOLUTION FOR MADRID

● A mountain road tunnal is proposed as the solution to keeping Madrid in touch with northern and western Spain during the winter months. Frequently, road traffic is completely or partly paralysed between north and west because of snow.

Transport, tourist, industrial and other interests are urging the government to act now to prevent continued economic losses caused by blockade of motor transport in winter.

A 2½-mile long tunnel through the Sierra Guadarrama is proposed as the solution. The mountains formed the picturesque setting for the plot of the novel "For Whom the Bells Toll" by Ernest Hemingway.

Madrid depends on two trunk routes for road communications with northern and western Spain and the French frontier at Irun. One runs through the Guadarrama mountains at the pass of Alto de Los Leones, 4,265 feet high. The other crosses the eastern end of this range at Somesierra Pass, 4,770 feet high. The tunnel would bypass the part of the road most likely to be obstructed by snow.

(*From "African Roads & Transport" September—October 1957*).

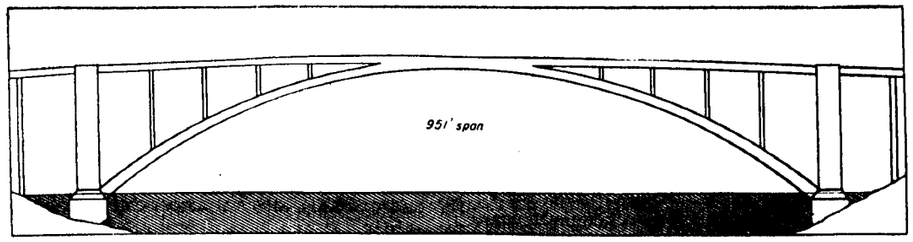
4. LONGEST CONCRETE ARCH WILL SPAN PARANA RIVER

● BRAZIL and Paraguay have announced plans to bridge the Parana River between the two countries with the longest reinforced concrete arch span ever built— 951 ft. It will cost about 2 million dollars.

Brazil's National Highway Department released engineering details on the structure after the two countries signed the agreement.

Overall, the bridge will be between 1,650 and 2,000 ft long. It will have a 43 ft wide deck about 197 ft above average water level.

The record length of the arch is necessitated by two conditions: (1) the difficulty that the steep basalt cliffs would present in building foundations for a shorter span, and (2) the navigational clearance that is required for river traffic.



The bridge will be located near the mouth of the Iguacu River, whose confluence with the Parana marks a common meeting point of the boundaries of the two countries with that of Argentina. Iguacu Falls, a scenic attraction, will be visible from the structure.

Construction of the crossing will permit completion of a highway link between Asuncion, capital of the land-locked Paraguayan republic, and Paranagua, Brazilian port city on the Atlantic.

Next in length among the world's concrete-arch bridges are an 886 ft span now under construction in Portugal (Douro Porto River) and an 866 ft span that has been built in Sweden (Angermann River.)

Two Brazilian contractors, Sotege and Constructora Rebelo S. A., will construct the new bridge. Starting work this fall, probably in September, they expect to complete the project late in 1959.

(*From "Engineering News—Record"— August 1, 1957.*)

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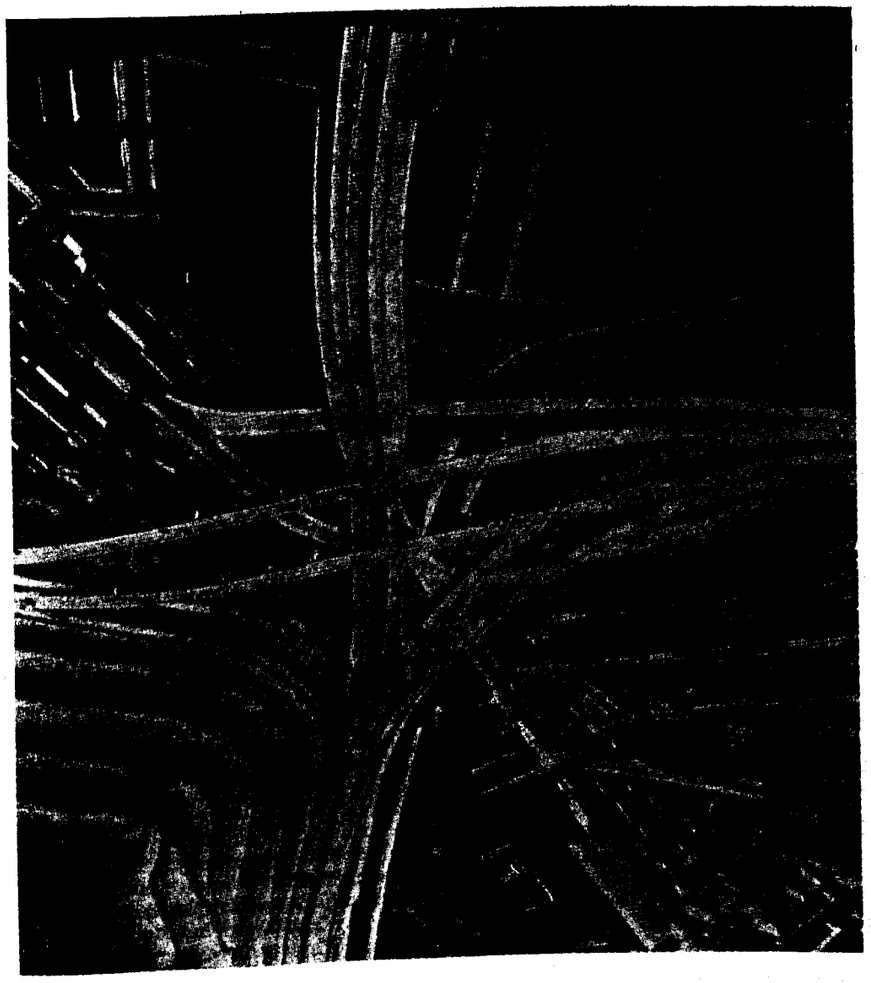
5. PITTSBURGH'S TRAFFIC BOTTLENECKS BEGIN TO BREAK

● AS a part of a long-continuing struggle to break out of the confinement of rugged hills that are a part of their everyday transportation problems, Pittsburgh's residents are today watching construction men change their city's face even more.

Right now, for instance, there are these major traffic projects going on:

The complex, 2¼-mile-long down-town interchange, on the Monongahela side of the city's business triangle;



An equally complex high-speed interchange at Etna, on the north bank of the Allegehony River some miles north of the city center;

A 17 million dollars tunnel under 400 ft high Mt. Washington, opposite the famed "Golden Triangle" which will connect directly with a new bridge across the Monongahela and with the already-operating Penn-Lincoln Parkway West, Access to the city's airport and sub-urban areas.

(*From "Engineeriag News-Record", July 11, 1957.*)

CURRENT LITERATURE

ABSTRACTS

APPLICATIONS OF ELECTRICAL RESISTIVITY MEASUREMENTS TO SUBSURFACE INVESTIGATIONS. Reported by R. Woodward Moore, Division of Physical Research, Bureau of Public Roads.

THERE has been a constantly growing trend towards the use of the earth-resistivity test on a wide variety of subsurface problems in many parts of the world. In this country the Bureau of Public Roads has been one of the pioneers in establishing the practical application of geophysical test procedures to highway construction problems. Use of the geophysical tests, the earth-resistivity test in particular, has increased rapidly during the past 10 years. At the present time 26 State highway departments have earth-resistivity equipment or have arrangements with other State agencies for cooperative resistivity work. Four States have refraction seismic equipment also. Ten other States and the Territory of Hawaii have indicated keen interest in their possible use of the resistivity test.

The work being done by the Bureau of Public Roads has been expanded during the past 2 years with the construction and purchase of 6 additional sets of resistivity equipment for use by its regional offices in this country, in the Philippines, and in Central America.

The fundamental principles of the earth-resistivity test are reviewed very briefly and a number of graphs are presented which show test data typical of that obtained in various parts of the United States and in Central America, together with correlating drill data. These tests involved such subsurface problems as bridge foundations, slope design for grading projects, landslide conditions and the location of materials of construction such as sand and gravel.

The geophysical tests are not intended to supplant conventional direct explorations by auger borings, the core drill or the test pit, although their elimination is possible in some instances. They are being recommended as valuable additional tools for use in making more complete subsurface surveys at less expense.

CODE OF PRACTICE FOR CONSTRUCTION OF PLAIN AND REINFORCED CONCRETE. Indian Standards Institution, Delhi.

THE Indian Standards Institution has just published a Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures, IS: 457–1957.

This Code of Practice is an adjuct to the Indian Standard Code of Practice for Plain and Reinforced Concrete for General Building Construction (Revised), IS: 456–1957 which was issued a few months ago. This Code of Practice primarily aims at control of mass concrete work with a view to ensuring durability, strength, impermeability and uniformity. In view of the construction of a large number of dams and other massive structures in this country, this Code should prove useful in guiding the concrete engineer in following accepted and reliable methods of concrete mix design and concrete construction work.

The Code covers specification for materials, design of concrete mixes, detailed instructions regarding mixing, handling, conveying and placing of concrete. Requirements regarding compaction and finishing of concrete are also included in the Code.

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BUDGETS AND ADMINISTRATION REPORTS

ANDHRA STATE BUDGET 1957-58

The following extracts relating to Civil Works have been taken from the Andhra State Budget for the year 1957-58.

Revenue (Civil Works)

Heads	Actuals 1955-56	Revised Estimate 1956-57	Budget Estimate 1957-58
		(In lakhs of rupees)	
Rents		12.59	15.01
Receipts from workshops		2.62	3.12
Recoveries of expenditure		23.69	21.15
Ferry receipts, Highways Department		2.22	1.99
Miscellaneous		9.69	9.31
Deduct-refunds		-0.27	-0.10
Total	*58.32	50.54	50.48

Expenditure (Civil Works)

Buildings

Original Works		22.48	10.13
Repairs		28.58	29.10

Communications

Original Works		17.78	39.61
Repairs		129.90	135.67

Miscellaneous

Original Works		0.01	...
Establishment		116.52	110.12
Tools and plant		23.50	21.40
Grants-in-aid		25.08	32.09
Suspense		12.50	7.81
Lump addition for regrant of lapses and provision for increased dearness allowance		0.05	8.05
Deduct :			
(i) Amount transferred to State Road Fund		-7.85	-9.33
(ii) Amount transferred to Central Road Fund		-8.36	-19.17
(iii) Establishment and Tools and Plant charges transferred to other Major Heads on pro-rata basis		-36.14	-31.81
(iv) Lump deduction for Probable Savings		-22.68	-20.81
Add-Recoveries		241.05	308.92
	*355.04	542.42	621.78

* Break-up is not available

(Continued)

Capital Account of Civil Works outside the Revenue Account

Original Works

Heads	Actuals 1955-56	Revised Estimate 1956-57	Budget Estimate 1957-58
		(In lakhs of rupees)	
Buildings		140.27	267.77
Communications		72.64	76.27
Orginal works under Nigam Sagar Project	33.25	...	15.00
Original works under City Improvement Board		4.28	2.00
Establishment	2.72	5.28	4.07
Outlay in connection with the formation of Andra State	58.26	34.51	8.56
Suspense	0.67	...	...
Receipts and recoveries on Capital account	-0.01	...	...
Add			
(i) Amounts transferred from '50' Civil works State's share of charges on National Highway No. 5 and charges on State Highways and Major District Roads not financed from Central Fund		3.06	5.12
(ii) Lump addition for regrant of lapses		0.10	0.21
(iii) Establishment and Tools and plant charges transferred from '50' Civil Works on prorata basis	11.35	14.54	12.49
Development Schemes	46.42	...	...
Total	152.66	274.68	391.49

Revenue from Roads

Receipts under the Indian Vehicles Act		30.00	30.00
Receipts under the Madras Vehicles Taxation Acts		175.26	175.56
Receipts under the Motor Spirit Tax		75.25	74.75
Other receipts		2.40	2.40
Deduct-refunds		-0.87	-0.87
	104.03*	282.04	281.84

*Break-up is not available. It does not include receipts under the Motor Spirit Tax

ANDHRA STATE GOVERNMENT BUDGET FOR THE YEAR 1957-58

(A brief review with reference to Civil Works)

The total revenue of the State for the year 1957-58 is estimated at Rs 5314.37 lakhs as against Rs 4725.33 lakhs (revised) estimate) for the year 1956-57 and Rs 4042.57 lakhs (actual) for 1955-56 respectively. The corresponding figures of revenue expenditure are Rs 5862.40 lakhs for 1957-58 (budget estimate) Rs 5193.73 lakhs for 1956-57 (Revised estimate) and Rs 4741.87 lakhs (actual) for 1955-56 respectively. Thus in the Budget estimate of 1957-58 there is a deficit of Rs 548.03 lakhs and in 1956-57 (Revised estimate) there is deficit of Rs 468.40 lakhs. For 1955-56 there was an actual deficit of Rs 699.30 lakhs.

Revenue expenditure on Civil Works is estimated at Rs 621.75 lakhs for 1957-58 while the revised estimate for 1956-57 places it at Rs 542.42 lakhs and actual for 1955-56 is Rs 355.04 lakhs. In terms of total State revenue the revenue expenditure works out to 11.7 per cent for 1957-58 (Budget Estimate), 11.5 per cent for 1956-57 (Revised estimate) and 7.5 per cent for actual for 1955-56.

The provision for capital expenditure on civil works outside the revenue account amounts to Rs 391.49 lakhs for 1957-58 (Budget Estimate) Rs 274.68 lakhs for the year 1956-57 (revised estimate) and Rs 152.66 lakhs for actual.

INTOXICATION AS SIMPLE AS ALL THAT

"How in the world did you manage to get in such an intoxicated state?" the magistrate asked.

"I got into bad company, your worship. There were four of us. I had a bottle of whisky—and the other three fools were teetotallers." Case dismissed!

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of Work	Amount Rs lakhs
		ASSAM	
1.	1803-AS-39	Construction of 121 culverts on the diversion road between Barpathar and Dimapur Road National Highway No. 39.	7.34
		BOMBAY	
2.	1804-BM-8	Construction of bridge across Auranga River on the diversion out side Bulsar Town on National Highway No. 8.	4.60
3.	1805-BM -8	Construction of a minor bridge at Ch 9170 over Rayan Khadi and at Ch 2,700 of the diversion outside Palsana Baleshwar and Chalton Villages on N. H. No. 8.	1.11
		JAMMU & KASHMIR	
4.		Two Works each costing less than 2 lakhs.	1.25
		RAJASTHAN	
5	T. A. No. 98-RJ-8	Carpeting of Udaipur Road in miles 8 to 9, 16 to 21/4, 22/5 to 24 and renewal, extending metal width and carpeting miles 41 to 43, National Highway No. 8.	1.89
		SIKKIM	
6.	1801-SK-31-A	Replacement of wooden bridge by Steel girders on Tista-Rangpo Section of National Highway No. 31-A in Sikkim State.	1.32

I hear that Glasgow Corporation lost one of its tower wagons the other way; it was, in fact, stolen. The frustration of a man whose tower wagon has been snaffled must be extreme.

But not so extreme, surely, as the crew of a London tower wagon who, not so long ago, came down from aloft-to find that the vehicle would not start. Someone had stolen the battery.

—Motor Transport, 27 Sept. 1957