

Indian Roads Congress

Silver Jubilee Souvenir

1934 - 1959

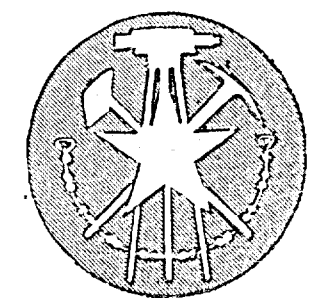
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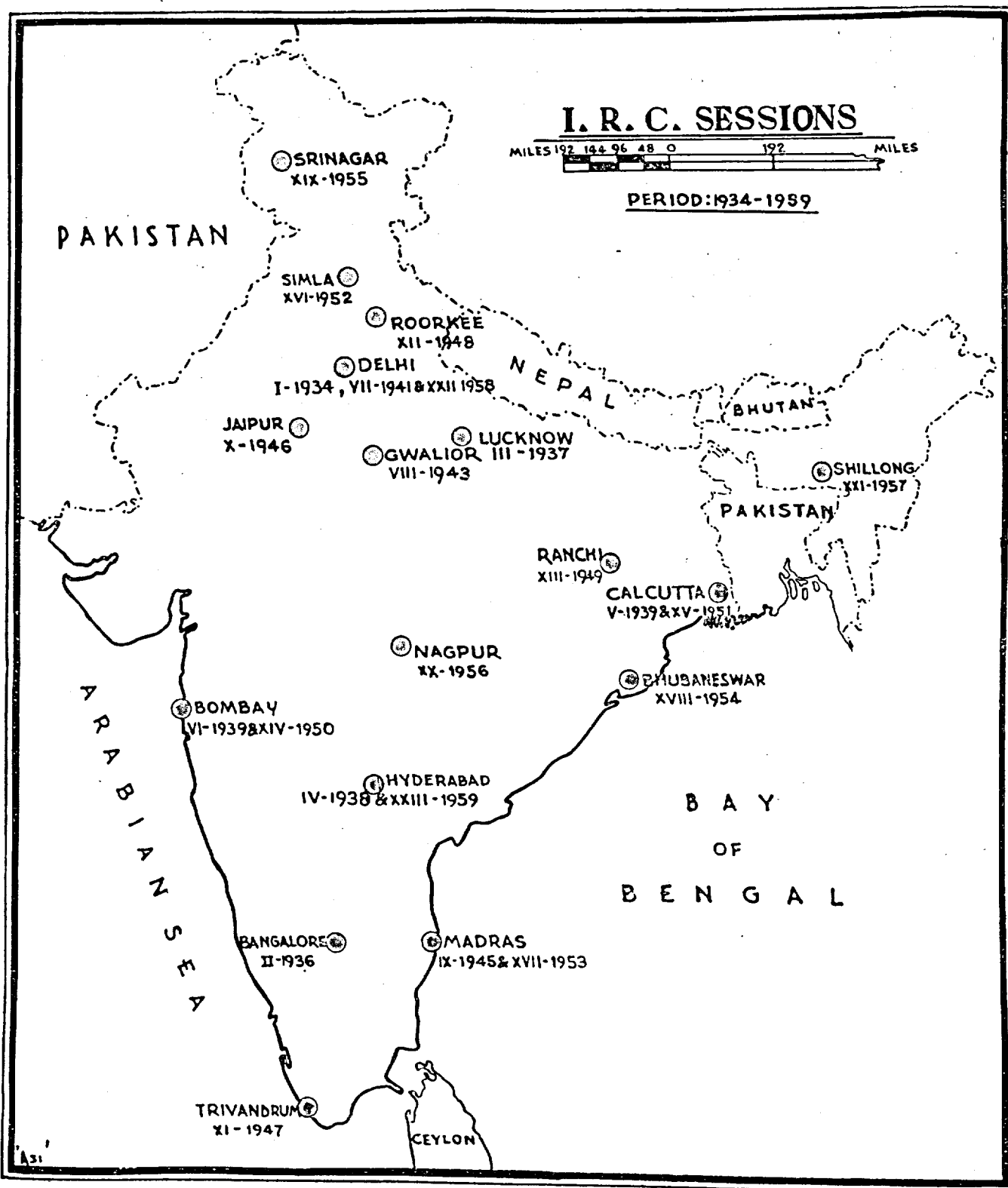
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SILVER JUBILEE
SOUVENIR
INDIAN ROADS CONGRESS

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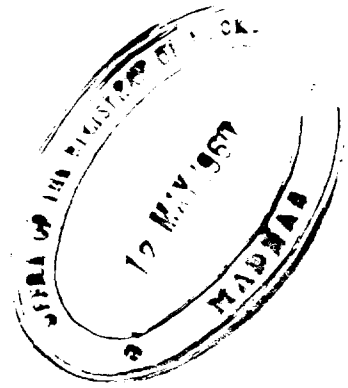


D^r Rajendra Prasad
President of the Republic of India
is pleased to be the
Patron

of the
Indian Roads Congress, New Delhi.

By Command of the President of the Republic of India

Military Secretary's Office, } Bhaurage, Colonel,
The 5th March 1951. } Military Secretary to the President



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Dr. RAJENDRA PRASAD
PRESIDENT OF INDIA

420

FOREWORD

THE Indian Roads Congress completes 25 years of life in December 1959. Starting with a modest membership of 73 in 1934 the Society has now on its rolls nearly 2,000 members including associate members. The bulk of the membership consists of individual members who are qualified engineers belonging to various road departments of the Central and State Governments. The Indian Roads Congress may thus be considered to perform largely the functions of an association of state highway officials with the active and enlightened collaboration of non-official members as well.

The objects of the Congress are to promote the science and practice of road building in the country; to provide a channel for the expression of collective opinion of its members on matters affecting roads; to advise on technical education; to direct highway research; to suggest legislation for the development and improvement of roads; and to suggest improved methods of planning, designing, constructing and maintaining roads.

During its life of 25 years, the Indian Roads Congress has strived to fulfil these objects and at its 24 annual sessions and other meetings it has discussed 222 technical Papers and several other questions

pertaining to various aspects of design and construction of roads. The Papers along with the discussions are published in the Journals of the Indian Roads Congress. Several Committees of the Congress have also taken up the study of specialised subjects with a view to evolve uniform standard specifications and practices to be adopted in road construction all over India.

In this *Souvenir* brochure issued to commemorate the SILVER JUBILEE of the Congress we have the pleasure to publish the messages received from the highest dignitaries of the State and other well-wishers of the Society. We also give the messages received from our distinguished Past Presidents who have added so much lustre and brilliance to the activities of the Society. Included in the brochure are also an account of the work done by the Indian Roads Congress during its life of 25 years, notes on road development and research in India, and the role played by trade and industry in road construction in India.

We record our most profound gratitude to all the dignitaries and well-wishers for their kind messages which give so much inspiration and encouragement in our humble work. We also convey our sincere thanks to all the contributors for the instructive material incorporated in this brochure.



RASHTRAPATI BHAVAN,
NEW DELHI

December 2, 1953
Agrahayana 11, 1881(Saka).

Roads have been rightly described as the arteries of a nation. It is more so in case of a vast country like India with its varying terrains, its far-flung areas and its rural economy. The importance of improved communications in a country like ours is so great that economists often equate roads with progress and prosperity.

I am glad to say that the Indian Roads Congress has so much useful work to its credit. During the last two decades, particularly since Independence, our road-building programme has been stupendous not only in design but in actual implementation. It is gratifying to see that this activity has been able to keep pace with the general tempo of our programme of reconstruction. On this I would like to congratulate the Indian Roads Congress and wish their Silver Jubilee celebrations success.

Rajendra Prasad



VICE-PRESIDENT
INDIA

NEW DELHI

21st October 1959

I am glad to know that you will soon be celebrating the Silver Jubilee of the Indian Roads Congress.

When we compare the roads in our country with those in other countries we note what a long distance we have yet to traverse. I hope Your Congress will do its utmost to bring about an improvement in our roads.

I wish the Conference success.

Yours faithfully,

(S. Radhakrishnan)

PRIME MINISTER'S HOUSE
NEW DELHI

October 25, 1959

MESSAGE

I send my good wishes to the Indian Roads Congress on the occasion of its completing twentyfive years of its activities. Roads are of high importance in India and, therefore, the science and practice of road-building should be studied carefully. New methods are being evolved in other parts of the world and perhaps we are a little backward in utilizing them. We cannot always copy the expensive methods of rich countries. We have to devise our own ways of doing things more cheaply and yet effectively.

B. D. JATTI,
Chief Minister.



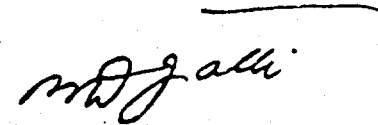
BANGALORE-1,
Dated. 1st October 1959

MESSAGE

I am glad to learn that the Indian Roads Congress has chosen Bangalore to celebrate its Silver Jubilee session early in the year 1960. It is in the fitness of things that a souvenir giving an account of the history and achievements of the Indian Roads Congress should be published on this memorable occasion. The development of communications whether by road, rail or air is perhaps in no way less important than the development of agriculture or industry. It is particularly so in a vast country like India whose road system is very unsatisfactory for her needs, the surfaced or metalled roads being only about 10 miles per hundred square miles. This was the reason why the development of road communications in particular formed one of the major items of India's first Five-Year Plan and an expenditure of about Rs. 156 crores was incurred in this respect. We have, however, got to go a long way to achieve the desired target of progress in respect of the national highways, the State highways and the district and village roads.

I hope that the deliberations of the Indian Roads Congress would help to hasten the progress of the country in this regard.

I wish the Congress every success.


(B.D. Jatti)

MESSAGE FROM

SHRI MAQBOOL AHMAD,

Minister of P.W.D. & Local Self Government, Bihar

I am glad to learn that the Indian Roads Congress is going to celebrate its Silver Jubilee at its next Annual Session in Bangalore early in 1960.

Since I took over charge of the Public Works Department of the State of Bihar, I have been watching with interest and admiration the activities of the Indian Roads Congress. The Congress has been doing valuable services to the country by conducting researches and evolving cheap and better methods of road construction which is to-day an important and urgent item of national development. The deliberations the Congress holds at its sessions and meetings and the technical papers and journals it publishes have been of great help in resolving the road problems and evolving suitable road development plans for the country. I hope the Congress will continue to render similar and even greater service to the country in future.

I wish the Silver Jubilee Session all success

MESSAGE FROM

SHRI NATHU RAM MIRDHA,

Minister for P.W.D., Government of Rajasthan

I have watched with close interest the continued progress made by the INDIAN ROADS CONGRESS in the development of roads in our country and I have great pleasure in sending my best wishes to its Silver Jubilee Session to be held in Bangalore.

Indian Roads Congress, as a sole organisation connected with the development of Roads in India, has played a very important role in that it has evolved suitable and economical standards, specifications and designs for the construction of Roads and Bridges.

I am also glad to observe that your Congress is devoting attention to devising methods for construction of cheap and durable roads.

I wish the delegates attending this Session of the Congress the best of success in their deliberations.

MESSAGE FROM

SHRI SHANKER LAL TIWARI,

Minister for P.W.D., Government of Madhya Pradesh

I have great pleasure in sending my greetings and good wishes to the Indian Roads Congress meeting on the happy occasion of its Silver Jubilee Session to be held at the beautiful Bangalore city. Indian Roads Congress has rendered a great service to the nation by providing a forum for technical experts and Engineers engaged in the design and construction of roads to meet and exchange ideas and evolve common standards and policies. By its achievement it has raised great expectation about its future role.

I wish every success to the Bangalore Silver Jubilee Session.

SILVER JUBILEE 1934—1959



PRESIDENT, I.R.C. 1939—43.

Sir KENNETH MITCHELL, K.C.I.E., C.I.E., I.S.E.,
(Formerly, Chief Controller of Road Transport & Development & Addl. Secretary,
War Transport Dept., Govt. of India)

Message

THE happy occasion of the Silver Jubilee of the Congress is to me one also of great personal gratification and pride. Not all of our founder-members are, alas, with us now, but the past achievements, present repute and future prospects for good of the Congress cannot fail to be so to all of us who helped to launch the ship, as well as to succeeding members. Our constitution seemed at the time to be unorthodox but was adopted so as to secure the full co-operation of all Engineers and officers concerned with the provision of better roads without violence to the principles and practice of the (then) provincial autonomy. The written constitution has I think withstood the test of time. The genius of succeeding generations of members, in ever growing numbers, had done the rest.

From my heart I send you all my congratulations and best wishes for the future.

—K. G. MITCHELL



PRESIDENT, I.R.C., 1943—45.
Shri J. VESUGAR, I.S.E.

THE time for generalities is long past. If we are to be ready for the new order we must be prepared for new ideals. One such idea would be to create a National Road Trust, representative of the Centre, Provinces and States, with authority over the country's entire road system. Succeeding to the revenues collected from tax payers in their capacity as road users, the Trust—as qualified custodians of the national interest—would allocate these funds in a manner most conducive to this end. Assured of steadily increasing assets, the Trust might be allowed to borrow the funds necessary for the Development Plan.

—From the Presidential Address by Shri J. Vesugar (Formerly Consulting Engineer to the Govt. of India (Roads), Ninth Session—Madras—February 1945.

MESSAGE

AS a founder member of the Indian Roads Congress who, under the direction of our founder, Sir Kenneth Mitchell, prepared some experimental road lengths for inspection by members attending the first meeting and submitted a paper describing them, and who was later honoured by election as President for the Congress held in Jaipur, I have watched with great interest and pride the continued and increasing success of the Congress in both administrative and technical matters. It will, I feel sure, go from strength to strength in the service of India and its people for whom road communications are of vital importance. My greetings to the President, Council and Members and best wishes for the future.

—SIR ARTHUR DEAN



PRESIDENT, I.R.C., 1945—46.
Sir ARTHUR DEAN, C.I.E., M.C., E.D.,
(Formerly Chief Engineer, C.P.W.D.)

I.R.C. SOUVENIR



PRESIDENT, I.R.C., 1946.
Shri L. A. FREAK, I.S.E.

“IRRESPECTIVE of what form of protection is finally accepted for labour, we Road Engineers wish to devote the greatest share of our time to engineering and for this reason I suggest that some Labour Tribunal Organization be immediately set up for watching the interests and welfare of labour and for dealing with any disputes which may arise. Labour disputes should not be an added burden on the shoulders of the engineers.”

—(From the Presidential Address by Shri L. A. Freak, (Formerly Chief Engineer, P.W.D., B. & R. Punjab), Twenty-Seventh Council Meeting—Karachi—October, 1946.

“ALREADY it is seen from the newspapers that one Province has by a stroke of the pen halved its road programme while another has considerably increased its programme. What are the implications of sudden changes like this? How do they affect the engineering organisation that is to carry out the plan, the machinery and plant that is to be collected for road construction, and all the arrangements required for carrying out work scientifically and economically? Are changes to be made like this every year? If so, will this great country ever get the good road communications which it so badly needs?”

—From the Presidential Address by Shri J. Chambers (Formerly Chief Engineer, W. & B. Dept., Bengal) — Eleventh Session—Trivandrum—February 1947.



PRESIDENT, I.R.C., 1946—47.
Shri J. CHAMBERS, C.I.E., M.C., O.B.E., I.S.E.



PRESIDENT, I.R.C., 1947—48.
Shri C. G. KALE, C.I.E., I.S.E.

“I would like to lay emphasis upon the immediate need for placing road finances on a sound basis so that road development and construction may proceed according to plans which have been co-ordinated and integrated with other forms of development. New construction must not be allowed to deteriorate by insufficient provision for subsequent maintenance. Nor must roads improved at high cost be transferred to local or other agencies merely on the plea that Provincial funds are inadequate to meet the extra recurring charges of annual maintenance.”

—From the Presidential Address by Shri S. N. Chakravarti, (Formerly Chief Engineer, P.W.D., B. & R., U.P.)
—Ranchi—February, 1949.

“AS every road engineer knows, the success of the Road Fund is entirely due to the fact that road grants are non-lapsing. At Nagpur, we desired that the proceeds of all road user taxes should be earmarked in the form of non-lapsing grants for expenditure on roads. This recommendation was made by very senior and experienced road engineers who had spent their whole lives on building roads and administering road finance. Engineers who realised the importance of steady finance upon the entire field of road transport-communications in India.”

—From the Presidential Address by Shri C. G. Kale, (Formerly Chief Engineer, P. W. D., Bombay)—Twelfth Session—Roorkee—April, 1948.



PRESIDENT, I.R.C., 1948—49.
Shri S. N. CHAKRAVARTI, I.S.E.



PRESIDENT, I.R.C. 1949—50.
Rai Bahadur BRIJMOHAN LAL, I.S.E.
(Formerly Chief Engineer and Secretary,
P.W.D., B. & R., Punjab)

MESSAGE

ON the occasion of its Silver Jubilee Session I have great pleasure in extending my congratulations to the Indian Roads Congress for the immense success achieved by it in the short space of twenty-five years. The Congress has greatly progressed in promoting the Science of Highway Engineering, in particular by the formulation of Standards for geometric design of roads and types of pavements, and more specially for design of highway bridges and culverts. But the major achievement of the Congress has been the bringing together of all the Road Engineers of this vast country and thus helping them in solving by mutual discussion their every day problems in design and construction of roads and bridges. However, a lot of work is still needed, in particular towards research in methods of cheap, durable and motorable roads in rural areas for development of our villages. I wish the Congress all success.

—BRIJMOHAN LAL



PRESIDENT, I.R.C., 1950—51.
Rai Bahadur A. C. MUKERJEE, I.S.E.
(Formerly Chief Engineer, P.W.D., B. & R., U.P.)

MESSAGE

THE vehicle and the highway are the two inseparable partners in a road transportation system. Their balanced development makes the system efficient and economical. Where the scientific advance in one lags much behind than in the other, the latter suffers and the community is deprived of the benefit from the improvement. Our Roads Congress must continue its vigilant watch on the highways of the country, pressing strongly for the improvement of the road where its surface and design are obsolete for the traffic which it is expected to carry and for the improvement of the vehicle where the latter stands in the way of the efficiency of the highway and thus strive continuously to bring about a reduction in the cost and an improvement in the quality of the transportation service.

—A. C. MUKERJEE



PRESIDENT, I.R.C., 1951—52.
Shri G. M. McKELVIE, C.I.E., O.B.E., I.S.E.
(Formerly Consulting Engineer, (Roads) and
Joint Secretary to the Govt. of India)

MESSAGE

I have been asked, as a past-President and Life-Member of the Indian Roads Congress to send a message for inclusion in a publication commemorating the Silver Jubilee of our Society.

The dictionary tells us the word Jubilee comes from a Hebrew word meaning a ram's horn or trumpet. The Hebrew jubilee year was announced by sound of trumpet and our Society will be sounding its own trumpet this Silver Jubilee Year. It is a good thing that we should have this

opportunity to review and record our past achievements for reasons I shall mention later.

I leave it to abler pens than mine to tell of the contributions our Society has made to road development in India since it was founded by Sir Kenneth Mitchell in 1934. They will tell of our struggles to formulate a road policy for India as a whole and how our advice on road policy, road finance, and road research has so largely been accepted by the Central and State Governments. They will not forget to mention our technical achievements, our Bridge Code and our many Papers on road standards.

By a happy coincidence our Society is celebrating its Silver Jubilee shortly after the formulation of the New Road Plan, the successor to the Nagpur Plan. The new plan presents new and difficult problems which our Society must help to solve. The thought of our past achievements will undoubtedly stimulate an ambition in our present Members to tackle the new problems with vigour and to suggest solutions. Paraphrasing Addison, they might say—

“’Tis not in mortal, to command success,
But we’ll do more O Engineer; we’ll
deserve it”.

Certainly the Proceedings and Papers of our Society show that throughout the years of its existence, our Members have become increasingly active, in the cause of road development. The justification for our trumpet blowing on this occasion is suggested by the words of the school song on “men of little showing”—

“Let us now praise famous men—
Men of little showing—
For their work continueth,
And their work continueth,
Broad and deep continueth,
Greater than their knowing!”

—G. M. McKelvie



PRESIDENT, I.R.C. 1952—53.
Shri T. MITRA, I.S.E.
(Formerly Consulting Engineer, W. & B., W. Bengal)

MESSAGE

THE Indian Roads Congress is celebrating its Silver Jubilee on the completion of 25 years from its birth. In this period of its existence it has grown from a tiny baby to a body of matured intelligence whose advice is sought for by many and listened to with respect by all.

New India requires "Service before Self" for its quick and sturdy growth and, for such growth, the services of Engineers are of paramount and vital importance. Progress in industry depends upon quick and easy communications and for this, the Road Engineers would have to take the leading part and to help the country's economy by utilising our country's products and by using locally available materials to as great an extent as possible. The Road Research Centres, both in the Centre and in the States, are helping the Road Engineers in their efforts in this respect.

I send my warmest good-wishes for the success of the Silver Jubilee Celebrations and for the growth of the Indian Roads Congress from stature to stature.

—T. MITRA

I.R.C. SOUVENIR



PRESIDENT, I.R.C., 1953—54
Shri R. K. BATRA, I.S.E.

"PHYSICALLY, roads are a piece of the social, industrial, and agricultural equipment of the country which must be maintained. The State, as the owner of these roads, is no more free than an industrialist is—not to maintain his tools and plant. If we do not maintain the roads adequately, certain unpleasant consequences follow and we actually waste money."

—From the Presidential Address by Shri R. K. Batra, (Formerly Chief Engineer, P.W.D., B. & R., Madhya Pradesh)—Eighteenth Session—Bhubaneswar—February, 1954.

SILVER JUBILEE 1934—1959



PRESIDENT, I.R.C., 1954—55.

Shri H. P. MATHRANI, I.S.E.

Joint Secretary to the Govt. of India
Ministry of Transport & Communications.

MESSAGE

IT gives me great pleasure to send my heartiest greetings to the Indian Roads Congress at the time of its SILVER JUBILEE and also to extend my good wishes to all those brother Engineers who will be participating in the deliberations of the Silver Jubilee Session.

Roads are not new in any country, much less in India. They are as ancient as the mother earth. They represent the urges of man for union and for unity. They are inextricably linked with human progress and with the modern idea of Welfare State. In India the Nagpur Plan laid the foundation of road development on a comprehensive basis. Since then much has been

achieved through the First and the Second Five Year Plans in the building up of a network of roads extending to the remotest parts of the country and in the building of bridges over the mighty rivers which cross this sub-continent. The country is now embarking on a still more ambitious Plan of road development for the next 20 years to which we wish all success.

The Indian Roads Congress has played a significant part in this march of development throughout its life of 25 years and it can look with satisfaction on the work done not only in the discussion of technical problems and dissemination of useful information but also in guiding the evolution of technical standards and codes of practice which have led to economy and durability in road construction. Much more still remains to be accomplished both in road and bridge design and construction and in the field of soil mechanics considering that tremendous advances have been made in these fields as a result of extensive research with which it is necessary to keep pace.

The Indian Roads Congress has held its annual sessions all over India. I had the privilege of presiding at the Kashmir Session held in Srinagar in 1955 and I know that the annual sessions are indeed very happy occasions which provide a meeting ground for engineers from all over India and much useful work is done during these sessions. They also provide us an opportunity to acquaint the public with the progress of road development in the country and thus to secure their understanding and co-operation. This year the session at Bangalore is particularly an eventful one, as it marks 25 years of life of the Society and the attainment by it of a certain standing and status. I have no doubt that the old traditions will continue and the Indian Roads Congress will march from strength to strength in its excellent work in the service of the nation.

—H. P. Mathrani

I.R.C. SOUVENIR



PRESIDENT, I.R.C., 1955—56.

Shri K. K. NAMBIAR,
Chief Engineer, Concrete Association of India

MESSAGE

IT gives me very great pleasure to send this message for the Souvenir to be published to commemorate the Silver Jubilee of the Indian Roads Congress with which I have had the good fortune to be associated virtually from its inception.

The Indian Roads Congress has a creditable record of high technical efficiency, developed both through its technical papers as well as through the deliberations of its various committees during the last quarter of a century. The close liaison which the Congress has established between the Government Departments and other agencies associated with road and bridge construction and road transport has contributed a great deal to the successful planning and speedy execution of road development schemes in India.

Since the last world war there have been rapid strides in the development of the science of High-SILVER JUBILEE 1934—1959

way Engineering. Even the highly advanced countries are finding it difficult to match their achievements to the requirements of modern road transport. The slender financial allocations available to the Highway Engineers in India and their inability to go in for large scale mechanisation of highway construction and maintenance make the problem more acute in this country. Advanced countries, like the United States of America, are pressing into service the latest inventions and techniques to improve the speed and quality of highway construction. I cannot illustrate this better than by quoting the words of Mr. Ellis L. Armstrong, the present Commissioner of the Bureau of Public Roads, U.S.A.

“Advances in engineering are improving the quality of the new highways. The comparatively new tools of photogrammetry and aerial surveying, electronic distance-

measuring apparatus and geophysical techniques for sub-surface exploration are receiving widespread application. The electronic highspeed computer and the unbelievable speed with which computations can be made on it, is freeing engineers from routine repetitive computations and allowing solutions to be determined that heretofore were impossible in terms of time and manpower. It is now practical, for example, to compare the physical and economic factors of six or eight possible locations of a route in a shorter time than previously was required to analyse one or two. Bridge designers can select the best structure from a whole series of trials. Complex and extensive analysis of traffic origin and destination data can be performed".

Therefore, before we can bring our science of Highway Engineering to a standard corresponding with those of advanced countries, a lot of experience will have to be derived by the study of large scale highway construction progressing abroad.

Tradition and prestige should not bar the way in accepting proven methods. Even West Germany which had possibly the most advanced system of modern motor roads prior to the last war and, even today, stands second only to U.S.A., bases its practice on principles developed in the U.S.A. In a recent article reviewing the practice of road construction in West Europe, Dr. Ing. Hermann Kunde, Chief Engineer, Department of Road Construction, Federal Ministry of Traffic, Bonn, West Germany, wrote as follows:

"The Federal Republic of Germany is confronted with the task of carrying out a large highway construction programme.

At such a time it is worthwhile to cast a look at the road construction of neighbouring West-European countries, to examine our own development critically by comparing it with the technical stage of the countries.

When working together and evaluating the experience of others, each country can be teacher and student at the same time. It is true, all European countries are in the same position of being a student of the United States of America with her highly developed road building methods. Whether the construction of sub-base or surface, the thickness determination, or testing is concerned, each West-European country is found to have numerous procedures adopted from U.S. practice, often with little or no changes. I see nothing disadvantageous in this development, for the United States with her mass transportation system offers European countries an effective picture of future traffic, and of the measures which must be taken to keep pace with traffic".

Therefore, it leaves us no option but to change our existing methods and approach highway Planning and Construction on a much bolder scale, if full benefits of this large governmental expenditure are to be consolidated for public good. Already much is being done in basic research carried out by our laboratories and likewise our field practices will have to be re-oriented to translate those results in the field. I am sure that in this activity the Indian Roads Congress will retain the leadership as heretofore and I wish it continued success.

—K. K. NAMBIAR



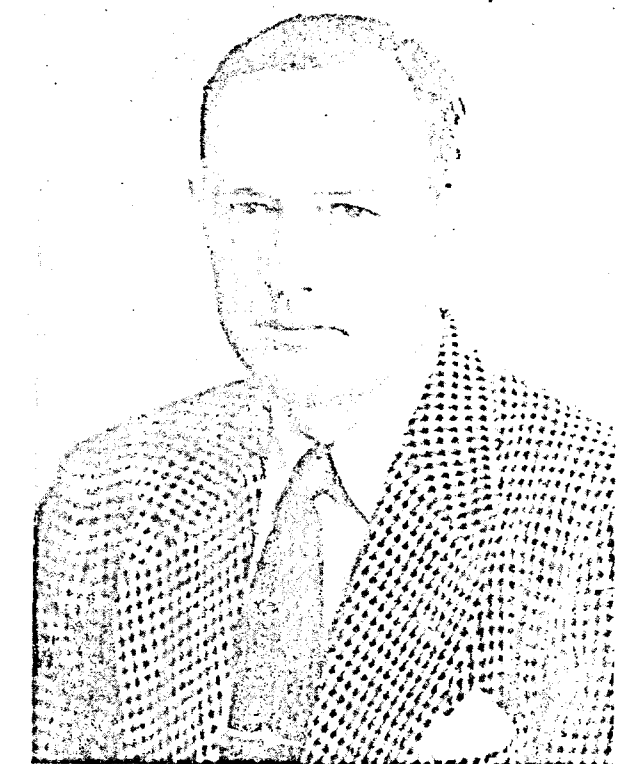
PRESIDENT, I.R.C., 1956—57.
Shri P. L. VARMA, Member, U.P.S.C.

MESSAGE

THE Indian Roads Congress came into being twenty five years ago. At its birth, the road system in India hardly existed as such. Roads were not very popular and road expenditure was frowned upon by State Finance. Gradually, through subsidies, persuasion and some gentle pressure the States have come to realise the importance of a well-integrated road system and in this the Indian Roads Congress has played an important part.

But much still remains to be done. There are formidable rivals in the field and if road development is not to be fed merely on the leavings, a more vigorous road policy is called for. Here again the Indian Roads Congress will have an important role to play.

—M. S. BISHT



PRESIDENT, I.R.C., 1957—58.
Shri M. S. BISHT,
Member, Public Service Commission, U.P.

MESSAGE

HIGHWAYS are assuming a dynamic role. They generate economic activity in remote areas. Their impact vitalises urban and rural communities. They establish collective action amongst the tillers of land, merchants and State. The awareness of their utility has been hazy and incomplete and consequently was not reflected effectively in the first two Plans. I pray the Silver Jubilee Session to be a guiding light in creating road-consciousness so that Highway programme may be accorded a sizable accommodation in the Third Plan.

—P. L. VARMA



PRESIDENT, I.R.C., 1958—59.
Shri W. X. MASCARENHAS, I.S.E.
Chief Engineer & Executive Director,
Life Insurance Corporation

MESSAGE

WHEN 25 years ago it first came into being, the Indian Roads Congress faced an uphill task, as road development only received the grudging attention of the Central and State Governments, and though the Central Road Fund had been instituted specially to promote it, railway interests were so powerful that only feeder roads were viewed with any favour and arterial roads that might in a way divert existing railway traffic continued to be generally neglected. Today largely as a result of the weaknesses of the Indian transportation system disclosed during the progress of the Second World War and the needs of the country's

expanding economy since Independence a much saner view prevails and the policy of an integrated communications system that the Indian Roads Congress has consistently advocated has at last come to be accepted in principle by the Union and State Governments.

The Indian Roads Congress has played a notable part in bringing about this happy consummation but it cannot afford to be content with its laurels. Much yet remains to be done before the transportation system of the country can even remotely approach in resiliency and efficiency that of the more progressive countries of the world. The Congress must now devote itself with single-mindedness of purpose to pressing the following overdue reforms:

1. The establishment of a separate Communications Deptt. in the States in which specialization is fostered and encouraged.
2. The creation of an all-India Service of Engineers to man such Departments.
3. The promotion of Research so that all road design and construction is put on a strictly rational and scientific basis.
4. Mechanisation of modernised road surface construction to ensure quality control and the best value for money spent.

These four reforms should be the main planks of the Indian Roads Congress platform of the future and to achieve them we should bear in mind the exhortation of Shri Bhimsen Sachar, Governor of Andhra Pradesh, to the last Annual Meeting of the Indian Roads Congress.

"Engineers should have the courage of their convictions". Let our watchword then be "Courage".

—W. X. MASCARENHAS



Shri T. R. S. KYNNERSLEY

MESSAGE

MAY I send through you my heartiest congratulations to the Indian Roads Congress on completing 25 years of valuable life.

Valuable these years have certainly been to India and I am proud of the fact that I had a close association with this organisation in its early years.

Good roads, as every school-boy now knows, are necessary to the prosperity of any country; but to the Indian sub-continent, with its vast distances, largely lacking in the essential means of transport to connect its 700,000 villages—they are absolutely vital.

As President for some years of the sister association, the I.R.T.D.A., may I be permitted to wish all Congress members strength to pursue the fight for better roads, so that their efforts in the next 25 years may be crowned with the success they deserve.

— T. R. SNEYD-KYNNERSLEY



A. RUMPLER
President, International Association of
Road Congresses

MESSAGE

THIS is a happy coincidence in the history of Road Congresses.

The Indian Roads Congress, which will hold its Session in Bangalore in January 1960, will celebrate its Silver Jubilee on this occasion; its twenty five years of existence corresponds to fifty years since the creation of the Permanent International Association of Road Congresses which held its Eleventh session in Rio de Janeiro.

On this happy event, the members of P.I.A.R.C. through the President of the Association send to the Indian Roads Congress their sincere wishes for great success of the Session in Bangalore the labours of which will add to those of our Association for the greatest benefit of the technique of construction and development of roads.

— A. RUMPLER

MESSAGE

HIGHWAYS uninterrupted and passable in all weathers enrich the lives of nations, economically and socially. They open up new areas to economic activity, stimulate trade and travel, bring the nations closer and improve international understanding.

The building of a highway network, particularly in a difficult terrain, taxes the ingenuity of the engineers to the maximum. Through knowledge and experience accumulated over the years, engineers have conquered natural barriers and are day by day improving the techniques of construction and maintenance of roads.

India can be proud of its network of roads. The country is vast and the topography in some parts is difficult. There are extensive mountain ranges, some of the highest in the world, wide and raging torrents, alluvial rivers meandering along in curves with a very wide sweep, vast deserts, thick forests and marshy stretches.

In the development of techniques and methods of construction of roads and bridges, the Indian Roads Congress (IRC), which is now commemorating its Silver Jubilee, has played a very important part. It has by research work, pooling of knowledge and experience and preparation of technical papers, evolved design standards for different types of roads and bridges for the benefit of the country. On the international level, it has contributed substantially in the formulation of recommendations for the construction of cheaper roads by methods of soil stabilization at the United Nations ECAFE Seminar on Low-Cost Roads held in New Delhi in 1958, immediately following the annual congress of the IRC. I am happy to reaffirm that ECAFE is fully co-operating with the IRC and is taking advantage of its research work and the knowledge disseminated in its technical publications.

Despite concerted and vigorous efforts by
SILVER JUBILEE 1934—59



Shri M. S. AHMAD
Chief, Transport and Communications
Division of the Economic Commission
For Asia and the Far East

highway engineers, the highways of Asia cannot still meet adequately the requirements of highway transportation. This is largely due to the fact that the development of highway design and pavement standards has not kept pace with the phenomenal and rapid advance in the design and construction of motor vehicles. Therefore, more effective and urgent action is necessary to improve highways, particularly in and around big cities, to deal with the ever increasing volume and speed of motor traffic.

It is our hope that the IRC will address itself vigorously to this urgent task by driving ahead with its technical work programme in order that better design standards are evolved and solutions found for difficult technical problems. ECAFE will watch progress with great interest, and will continue to assist in every possible way.

I may take this opportunity to mention the United Nations ECAFE's project on Asian highways which, when it materializes, will link up the Asian countries with the Middle-East and Europe. To the engineers of the ECAFE region this should be a challenge. To develop the road network forming the international highways, it is necessary that national network should be extended and improved to meet at least the minimum standards for international highways. In this respect Asia could be proud of having a road network connecting Asian countries even centuries before Christ. The Indian Roads Congress, we hope, will make its due contribution to the practical realization of the above project which will, in fact, be a revival, extension and improvement of the old caravan routes.

On behalf of ECAFE, I wish to convey to the Congress our congratulations on the results achieved in the past and extend our warmest good wishes for its future success.

—M. S. AHMAD

JUBILEE PRESIDENT



Shri U. J. BHATT,
Chief Engineer,
P.W.D., B. & R., Bombay



Shri H. P. SINHA, I.S.E.,
Hon. Treasurer,
Consulting Engineer (Road Development)
and Joint Secretary to the Govt. of India



Shri B. PRASAD, Vice-President
Chief Engineer,
P. W. D., B. & R., Bihar



Shri L. R. PATEL, Vice-President
Director and General Manager,
Messrs William Jacks & Co.



Shri N. DURRANI, Vice-President
Chief Engineer, (Highways),
Andhra Pradesh



Shri A. J. D'COSTA
Hon. Secretary



Shri D. G. BHAGAT
Hon. Deputy Treasurer

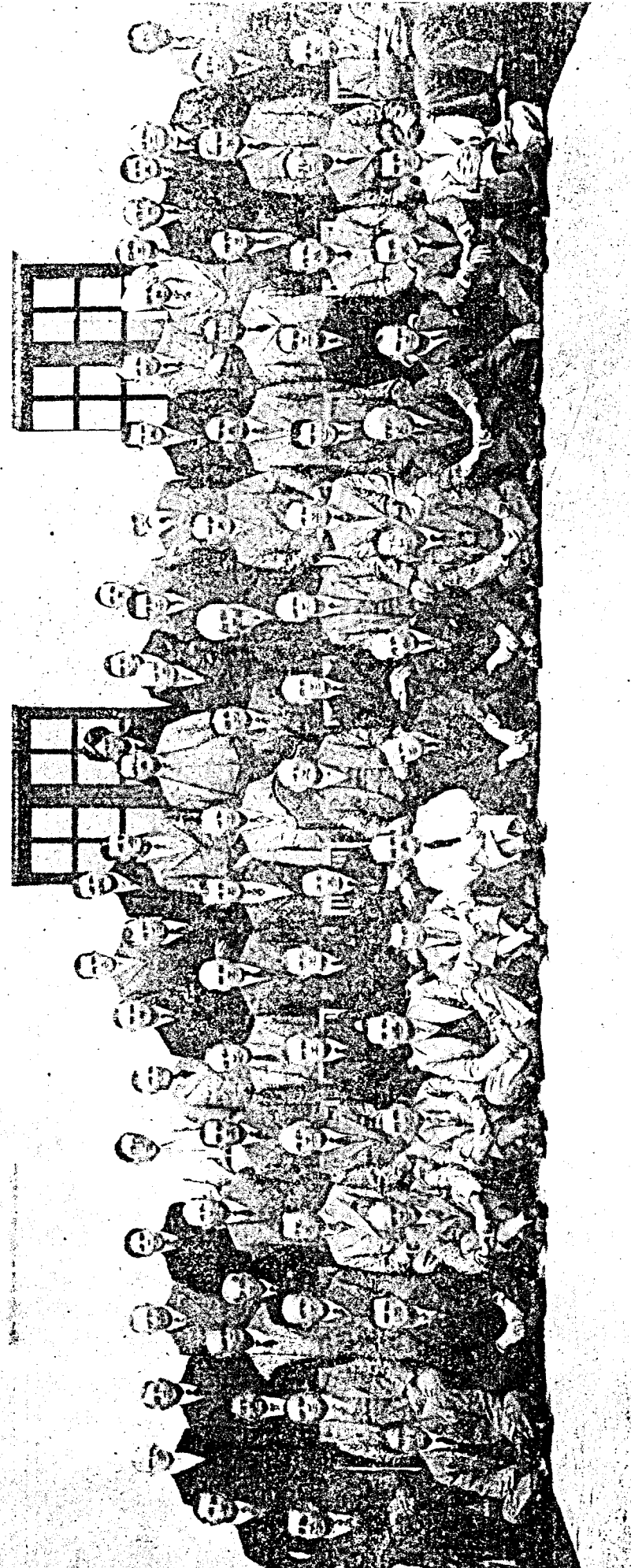


SARDAR HUKAM SINGH
Technical Secretary

SILVER JUBILEE 1934—1959

THE INDIAN ROADS CONGRESS

10TH DECEMBER 1934



1st Row Sitting from:—Mr. D. Daniel, Mr. A. Eastmond, Mr. L. E. Greening, Mr. G. Reid Shaw, Capt. W. B. Robertson, Mr. Surati, Mr. G. G. C. Adami, Mr. W. Brodie, Left to Right Mr. W. H. Rowlands, Mr. S. Bashiram, Lt. Col., H. C. Smith, Mr. R. G. Burt, Mr. W. B. Gurnell, Mr. C. D. N. Meares.
2nd Row Sitting:—Mr. C. F. Hunter, Rai Bahadur A. P. Varma, Mr. A. Vipan, Mr. B. F. Taylor, Mr. J. G. Powell, Mr. O. H. Teulon, The Hon. Mr. E. Miller, Mr. H. A. Hyde, The Hon. Sir Frank Noyce, K.C.S.I., C.B.E., I.C.S., Mr. D. Macfarlane, The Hon. Mr. D. G. Mitchell, Mr. A. Brebner, Mr. D. J. Blomfield, Mr. G. B. E. Truscott, Lt. Col., E. L. Farley, D. B. N. N. Ayyangar, Mr. F. T. Jones.
3rd Row Standing:—Mr. K. G. Mitchell, C.I.E., Mr. Pramatha Nath De, Mr. V. R. Talvarkar, Mr. G. P. Bhandarkar, Mr. R. W. Parkhurst, Mr. D. V. W. Otley, Mr. S. G. Stubbs, Mr. V. A. Stein, Major W. B. Whishaw, Mr. P. L. Bowers, Mr. Nurmahomed Chinoy, Sardar Bahadur T. S. Malik, Mr. A. Croad, Khan Bahadur M. Z. A. Faruqui, Mr. Kishen Chand, Mr. S. S. Bhagat, Rai Bahadur Sunder Lal, Rai Sahib L. Hari Chand.
4th Row Standing:—Mr. G. L. W. O. Moss, Rai Bahadur S. N. Bhaduri, Mr. A. W. H. Dean, Mr. A. S. de Mello, Mr. T. C. Marschako, Mr. W. H. Kerr, Mr. H. E. Ormerod, Mr. P. V. Chance, Mr. K. E. L. Pannell, Capt. G. F. Hall, Mr. H. Hughes, Mr. S. G. Edgar, Sardar Utam Singh, Mr. G. A. M. Brown, Lt. Col., A.V.T. Wakely, Mr. D. G. Sowani, Mr. M. A. Abbassi, Mr. G. W. D. Bredon, Mr. S. N. Chakrawarty.
5th Row Standing:—Mr. W. G. Turnbull, Col., G. E. Sopwith, Mr. Ghoghari, Mr. N. V. Modak, Mr. E. O. Austin, Mr. Perry, Capt. Wyatt, R.E.

INDIAN ROADS CONGRESS

AN ACCOUNT OF ITS WORK

1. ORIGIN

1.1. 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 the dissemination of useful technical information. A Road Conference first met in 1931 and Committees were formed to discuss various technical matters.

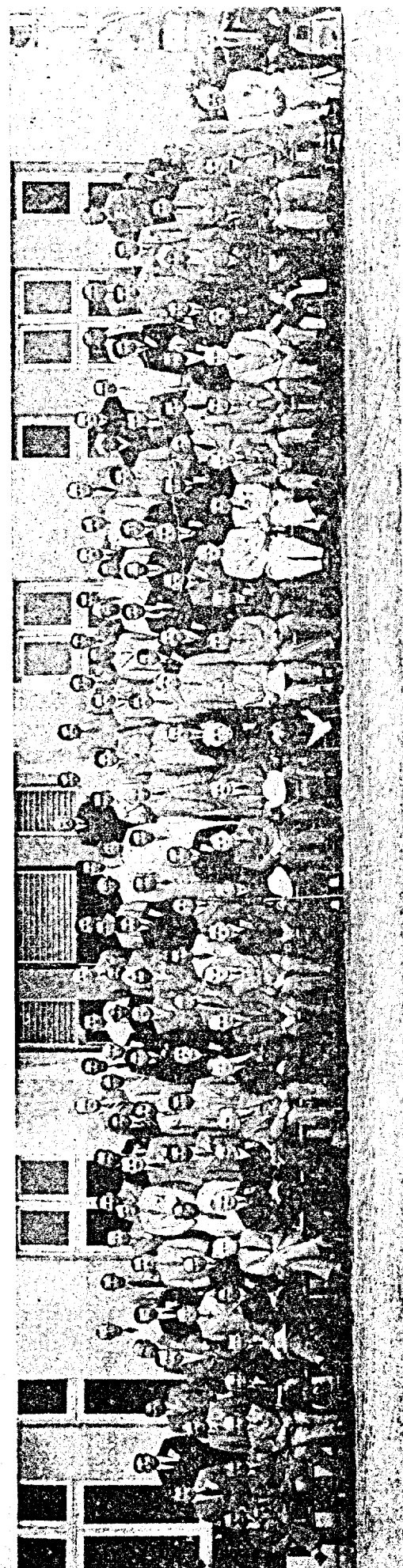
1.2. This Conference can be said to have been the real predecessor of the Congress, and if it did not come into being then, it was only because the arrangements suggested by the Indian Road Development Committee were introduced in the first instance for five years only.

1.3. 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 road was clear for a wider organisation. 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. When the activities of the Indian Roads Congress increased, it was registered in 1937 under the registration Act of 1860.

2. AIMS AND OBJECTS

2.1. The Indian Roads Congress was constituted to provide a forum for regular pooling of experience and ideas on all matters affecting the construction and maintenance of roads in India, to recommend standard specifications and to provide a platform for the expression of professional opinion on matters relating to Road Engineering, including such questions as those of organisation and administration. The objects of the Indian Roads Congress are given below:

- to promote and encourage the science and practice of building and maintenance of roads;
- to provide a channel for the expression of collective opinion of its members on matters affecting roads;
- to promote the use of standard specifications and to propose specifications;
- to advise regarding education, experiment, and research connected with roads;
- to hold periodical meetings to discuss technical questions regarding roads;
- to suggest legislation for the development and improvement and protection of roads;
- to suggest improved methods of administration, planning, design, construction, operation, use, and maintenance of roads;
- to establish, furnish, and maintain libraries and museums for furthering the science of road making;
- to publish, or arrange for the publication of proceedings, journals, periodicals, and other literature for the promotion of the objects of the Society;



SIXTH INDIAN ROADS CONGRESS
BOMBAY, DECEMBER 1939



The President of India delivering the Inaugural Address,
22nd Session, New Delhi, January 1958

- (j) to accept subscriptions, subsidies, donations, endowments, and gifts in furtherance of the objects of the Society ;
- (k) to invest and deal with the funds of the Society or entrusted to the Society, to acquire and hold any movable or immovable property, and to borrow or raise money for the furtherance of the objects of the Society and to sell, lease, exchange or otherwise deal with the same ;
- (l) to grant pay, prizes, honoraria, or scholarships, (including travelling scholarships), for meritorious work in furtherance of the objects of the Society ;
- (m) to do all such other lawful things as may be incidental or conducive to the attainment of the above objects.

It may be said that this organisation is similar to the American Association of State Highway Officials.

3. MEMBERSHIP

3.1. In addition to a Patron and Vice-Patrons, the Congress consists of Ordinary Members, Associate Members and Honorary Members.

3.1.1. His Excellency Field Marshal the Right Honourable Lord Wavell was the Patron of the Congress for the duration of His Viceroyalty.

3.1.2. Dr. Rajendra Prasad, the President of the Republic of India, has been pleased to accord his Patronage to the Indian Roads Congress during the tenure of his office.

3.2. Beginning with a modest membership of 73 in 1934, which became 173 in 1935, the Congress has now (1959) no less than 2,000 Members representing Engineers of all ranks from Central and State Governments, Military Engineering Services and Commercial interests. An idea about the steady increase in its membership can be had from the following table :

Year	No.	Year	No.	Year	No.
1934	73	1943	596	1952	1314
1935	173	1944	612	1953	1255
1936	255	1945	748	1954	1270
1937	342	1946	919	1955	1379
1938	393	1947	1030	1956	1493
1939	448	1948	1136	1957	1593
1940	489	1949	1265	1958	1682
1941	484	1950	1243	1959	2000
1942	544	1951	1293		

4. ADMINISTRATION

4.1. The affairs of the Congress are controlled by a Governing Body, known as the Council, representative of all interests. It consists of thirty-six members nominated by Government of India, Central P.W.D., Engineer-in-Chief's Branch, C.R.R.I., and State Governments as well as elected from amongst the ordinary and Associate members.

4.2. The Executive Committee consisting of the President, three Vice-Presidents, the Treasurer and Secretary manages the day-to-day administration, examines and makes recommendations to the Governments on points arising from time to time, in connection with road development, which cannot wait for the meeting of the Council. The Consulting Engineer to the Govt. of India (Road Development) is the permanent Treasurer of the Society.

5. ACTIVITIES

5.1. The Indian Roads Congress has in the past done very useful work for the Government and for Indian Road Engineering in general and it proposes to do even more useful work in the future. Before the Indian Roads Congress was

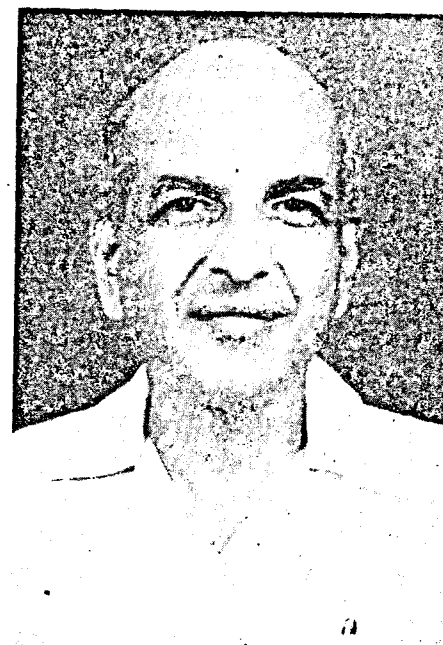
PAST SECRETARIES



Shri JAGDISH PRASAD
1937—1939



Shri K. S. RAGHAVACHARY
1939—1945



Shri H. SUNDER RAO
1947—1950



Shri J. M. TREHAN
1950—1953



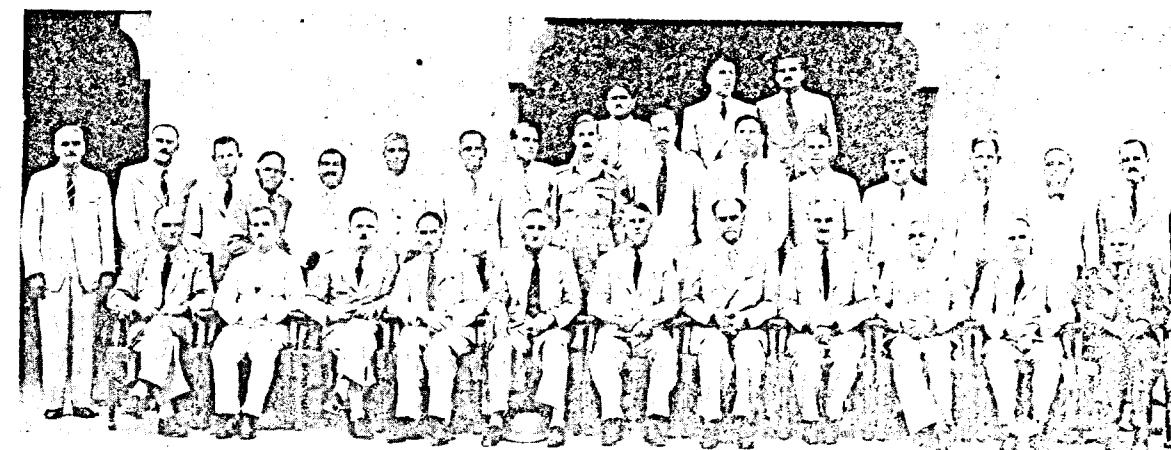
Shri J. SUBRAHMANYAM
1953—1956



Shri P. A. KRISHNASWAMI
Tech. Secretary, 2-12-52—15-6-53



Shri B. N. SHENOY
Tech. Secretary 30-7-53—3-8-55

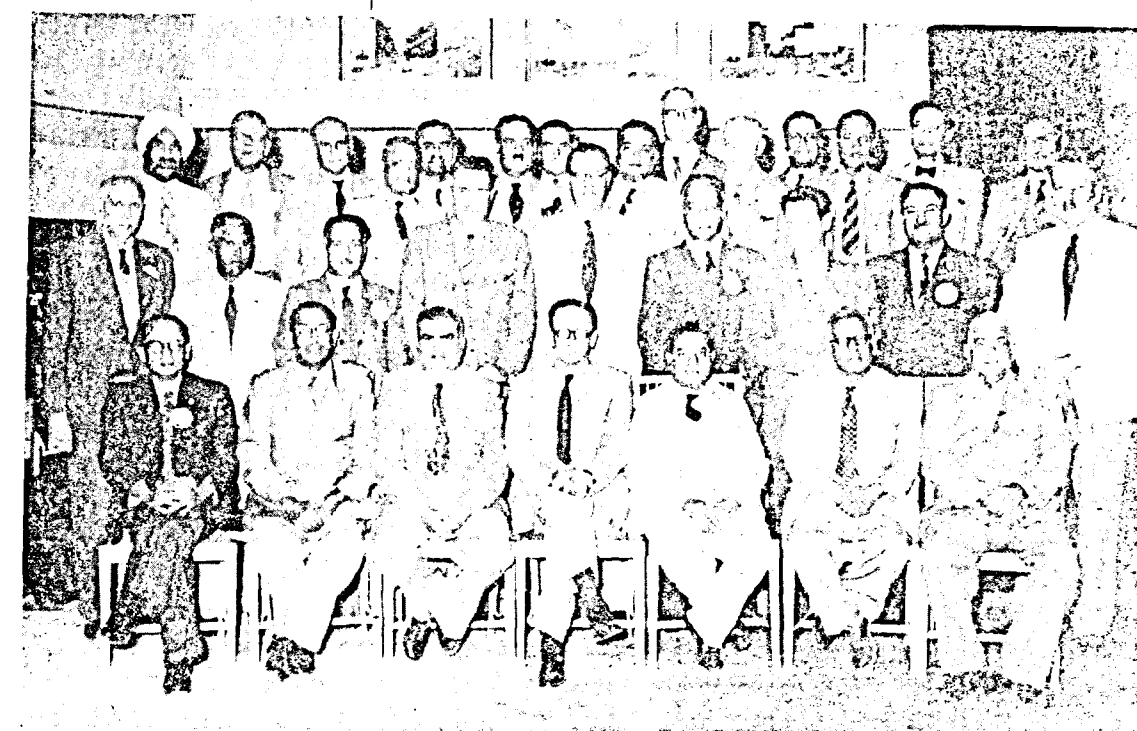


21st Council Meeting held at Lucknow in September 1944

constituted in 1934, there were no generally accepted bridge specifications or road standards of any kind; there was no forum in India for discussion of road engineering problems; there was no organised 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.

5.2. 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



39th Council Meeting at Simla in April 1952

SILVER JUBILEE 1934—1959

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.

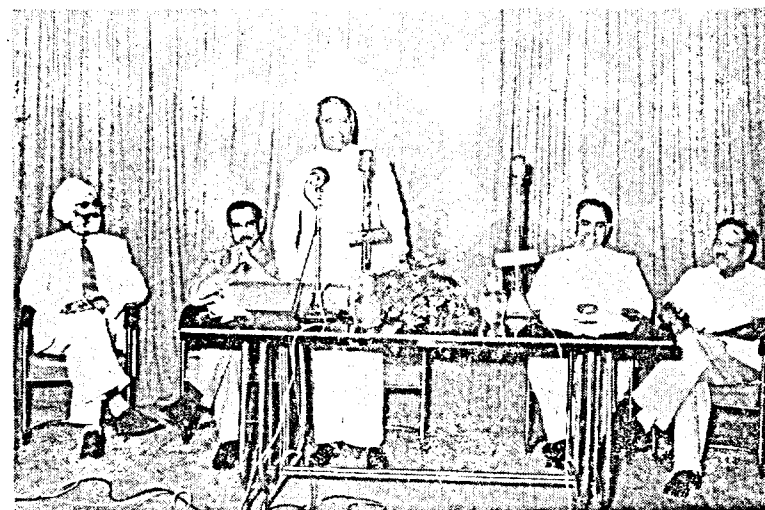
5.3. During the twenty-five years of its life the Congress has:

- (1) discussed 212 technical Papers at its general Sessions (some of the Papers reached a very high standard of merit) 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;
- (4) held 23 Annual Sessions and 54 Council meetings to discuss road problems; and
- (5) appointed many committees to study detailed aspects of various technical problems.

5.4. 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



52nd Council Meeting held at Bombay in August 1958



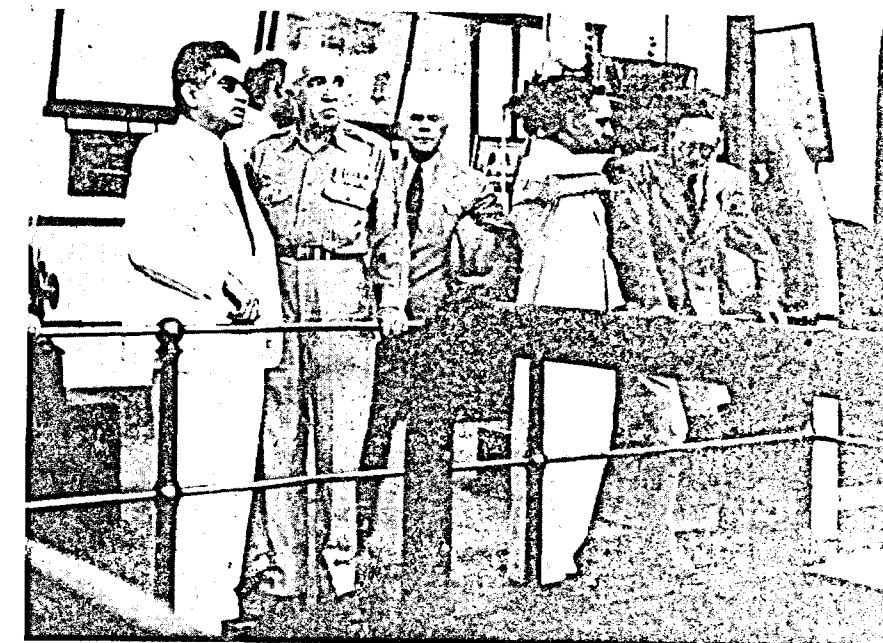
Shri S. K. Patil former Minister of Transport & Communications, Government of India, inaugurating the 52nd Council Meeting in August 1958

over their development and maintenance. That co-operation between the Centre and States and States and Local Bodies, 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.

5.5. 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.

5.6. The targets of the Nagpur Plan have been more than fully 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

I.R.C. SOUVENIR



Major General P. B. Fleming and Mr. T. H. MacDonald, the American Road Experts visited the College of Engineering, Poona, on 30th March 1946. In the picture Mr. Tolani is seen showing the working of different boilers in the College

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.

5.7. 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, Major General P. B. 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.

5.8. A most useful measure introduced by the Society is the issue of the Code of Practice on Bridges. This Code has been generally accepted throughout India. It often forms the basis of Government bridge contracts and its use has led greatly to improved bridge designs in the country and consequent saving in expenditure.

To give another example, the experiments carried out by the Society on the Road Test Track at Alipore, Calcutta, have established certain

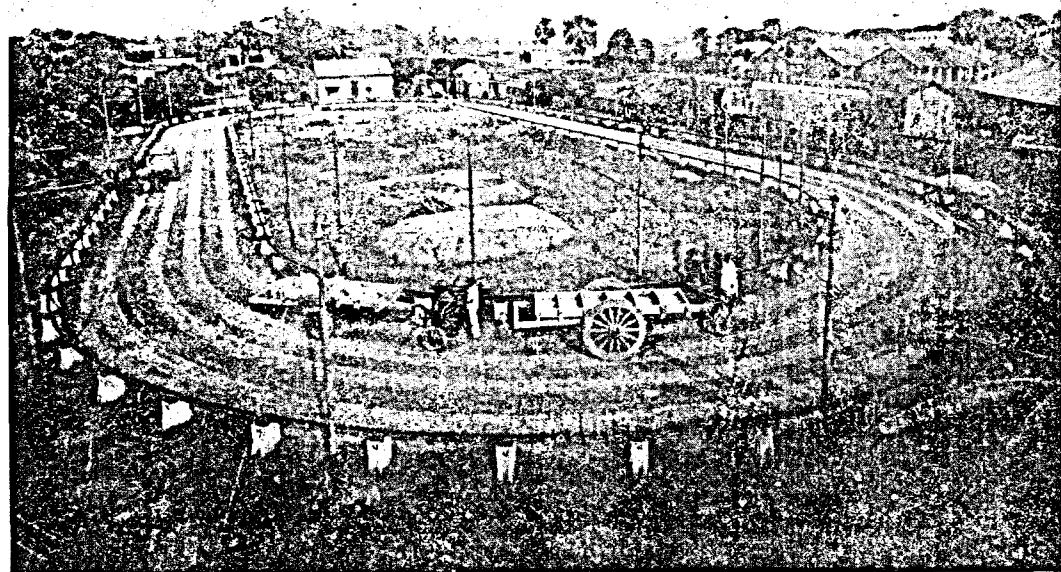
SILVER JUBILEE 1934—1959

principles on matters concerning which there had been great differences of opinion and this had led to considerable economy in design.

5.9. A subcommittee was appointed by the Indian Roads Congress to consider the subject of



Shri B. V. VAGH who studied the problem of bullock-cart wheel



ROAD TEST TRACK, CALCUTTA

evolving an improved design for *bullock-cart wheels* so as to improve the pay load 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 Volume XV—parts 1 & 2 of the Journal of the Indian Roads Congress.

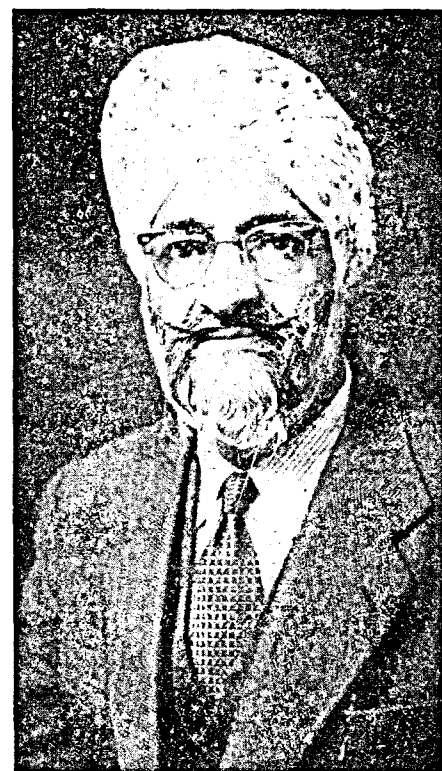
5.10. Among other duties, the Indian Roads Congress acts as a Technical Society obtaining agreement on road and road engineering standards for the whole of India. The duty of fixing Road Engineering standards for India was assigned to the Indian Roads Congress by the Chief Engineers' Conference held at Nagpur in December 1943.

5.11. The technical activities of the Indian Roads Congress are mainly carried out through its several committees and sub-committees (personnel of the committees given at pp. 53-55) consisting of experts in particular subjects. A brief indication of their functions is given below:

Committees

(1) **Specifications and Standards Committee:** Drafting standards on various items of road work,

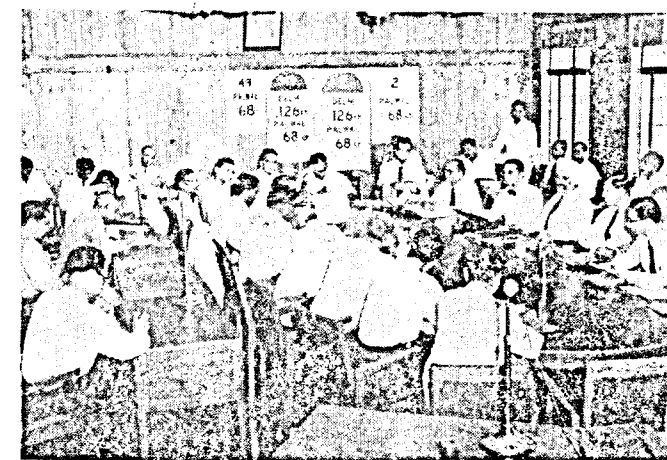
viz., Layout of Roads, Design of Pavements, Standard Sizes of Maps and Scale, Curves—Horizontal, Transition, Superelevation and Extra



Shri SUJAN SINGH
One of the past Vice-Presidents who has actively participated in the work of the committees

Widths, Vertical Curves and Sight Distances, Design of Rigid Pavements, Glossary of Highway Engineering Terms, Standard Form for Recording Data on Cement Concrete Pavements, Maximum Dimension and Weights of Road Design Vehicles, A Policy on Roadside Advertisement, Recommended Practice for Location and Layout of Roadside Motor-Fuel Filling Stations, Design of Roundabouts, Intersections, Traffic Rotaries, Specification for $\frac{3}{4}$ in. Light Chipping Bituminous Carpets, Recommended Practice for Numbering Bridges & Culverts, etc.

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



A meeting of Specifications and Standards Committee

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

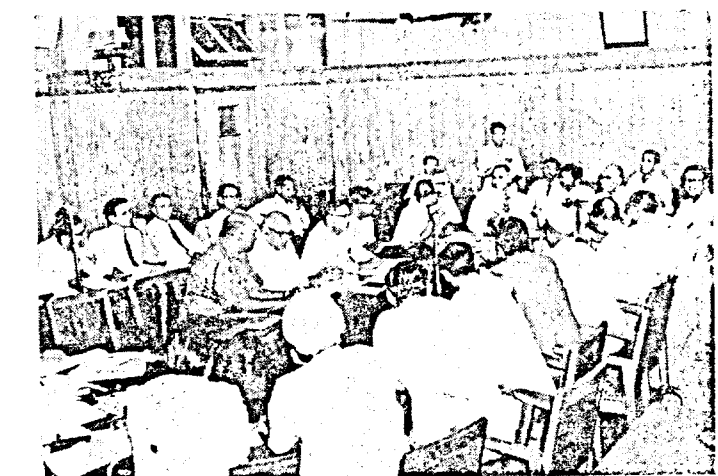
- Type Designs for Highway Milestones ;
- Route-Marker Signs for National Highways ;
- Dimensions & Weights of Road-Design Vehicles ;
- Recommended Practice for the Location and Layout of Roadside Motor-Fuel Filling Stations ;
- Type Designs for Boundary & Furlong Stones ; and
- Recommended Practice for Numbering Bridges and Culverts.

(2) **Bridges Committee:** Drafting Standard Specifications and Code of Practice for Road Bridges in India and to prepare type designs for the superstructure for the various span lengths. Sections I and II of the Bridge Code have



Shri S. L. BAZAZ,
Convenor, Bridges Committee

already been published in finalised form. The remaining Sections are under compilation. The Committee also prepared some type designs of unreinforced hingeless masonry arches.



A meeting of the Bridges Committee

(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 & 2.

(4) **Research Organisation Committee:** To study highway research done in the country and to decide on which subjects research should be carried out and where; to keep an eye on the results of research and on their application and implementation; to consider the general report on highway research along with the discussion thereon at the Sessions of the Indian Roads Congress and to take steps for organising further research where necessary. Thus this Committee serves as a liaison body to co-ordinate the research activities both in directing them along specified channels and in disseminating and implementing the results on a practical scale.



A meeting of the Research Organisation Committee

(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.

(6) **Road Transport Operation Cost Committee:** This Committee was appointed at the instance of the Government of India to study (i) the cost of operation of motor vehicles on different classes of roads and (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



Shri N. D. DAFTARY,
Convenor, Road Transport Operation
Cost Committee

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 Committee has recently submitted a detailed report



Shri S. R. MEHRA,
Convenor, Soil Research Committee

suggesting ways and means to increase the road transport capacity both on a long-range basis and

I.R.C. SOUVENIR

for the implementation of the second Five-Year Plan.

(8) **Community Project Road Maintenance Committee:** A considerable length of roads has been constructed under the Community Project



Dr. F. P. ANTIA,
Convenor, Road Transport Development
Committee

and National Extension Service Schemes. To make this mileage of roads a permanent addition to the road system of the country, it was felt that there was a need for considerable improvement in the standard of these roads as well as a satisfactory arrangement for their future maintenance. Accordingly, the Indian Roads Congress appointed a committee in 1957 to study the problem and recommend measures to be adopted. The Committee has collected information on the practices prevalent in regard to the construction and maintenance of these roads in different States and after careful consideration and study of the various aspects of the problem, at their meeting in January 1959, finalized a note on the Recommended Practice for the Maintenance of Roads constructed under the Community Projects.

Other committees deal with the following subjects :

- (a) Education of the Highway Engineer
- (b) Manufacture in India of Road-Making

SILVER JUBILEE 1934—1959

Machinery and Mechanization of road-making operations

- (c) Provincialization of Local Bodies Engineering Services
- (d) Cement Concrete Road Surfacing
- (e) Prevention of Ribbon Development.

One of the Committees 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. This is contrary to the previous belief on the subject.

6. PANEL DISCUSSION

Panel discussions on important subjects are also arranged during the Sessions. The discussion on "Surface Dressing" was held in 1955 and 1956. The Specifications and Standards Committee are now finalising specifications for bituminous surface treatments in the light of the discussion and written replies. Panel discussion on

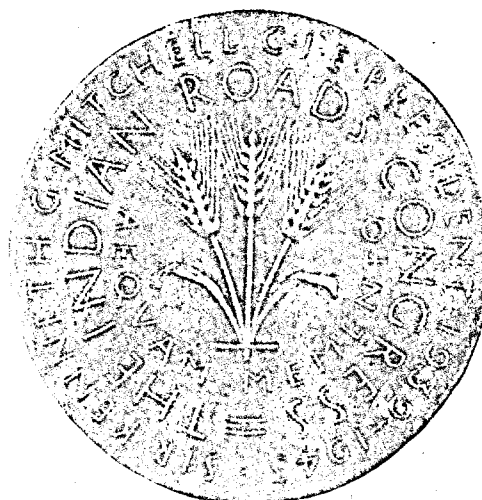


E. A. NADIRSHAH,
Convenor of Education
Committee and Cement
Concrete Road Surfacing
Committee

"the use of soil in all weather cheap road construction" was arranged during the sessions held in May 1957 and in January 1958. At the last Session, a panel discussion on "Roads in water-logged areas" was arranged. The discussions are



THE MITCHELL MEDAL
(Actual Size)



Shri GOVERDHANLAL
receiving a Medal from Yuvraj Karansingh,
Sadar-i-Riyasat, Jammu & Kashmir.



THE I.R.C. MEDAL
(Actual Size)



I.R.C. SOUVENIR

published in Volume XXIII—part 4 of the Journal of the Indian Roads Congress.

7. PUBLICATIONS

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

The "Journal" which is a quarterly publication and contains Papers on Standards, Specifications, Roads and Layout, Bridges, etc., in addition to Sections on Plant, Machinery and Apparatus, Information Service, Research, Statistics, etc., is now in demand in the U.S.A., the U.K., Australia, New Zealand, Canada, Japan, Germany and Switzerland. Evidence of considerable interest has been shown in many other countries in the Standards and Codes of Practice being evolved by the Congress. In fact, the Congress through the activities of its technical committees, is earning a lasting reputation for itself in many advanced countries. In India, these standards have led to considerable improvement in design and technique of construction of bridges and roads.

With the increase in the number of technical Papers published, the size of the Journal has considerably increased. Copies of the Journal are supplied free to all Members of the Congress and a few complimentary copies are also sent to State Governments and to the various technical Institutions in India and abroad.

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

The "Transport-Communications Monthly Review" is a monthly publication. The Indian Roads Congress is popularising modern ideas on Road Development and Road Engineering by publishing original articles and abstracts from technical Journals for the benefit of highway engineers who, owing to their pre-occupation with official duties, are not able to keep abreast of the latest advances in the science of road engineering. The magazine gives a lot of information of interest to the engineer as well as to the general public. Copies of this publication are issued free of charge to the Ministers at the Centre, States, other

SILVER JUBILEE 1934—1959

officials and non-officials. Members and subordinate engineering staff are supplied this publication at a concessional rate.

7.2. **Other Publications:** In addition to these regular publications, Road Research Bulletin (Nos. 1 & 2) containing the results of tests carried out at the Road Test Track at Majherhat, Calcutta, upto the year 1947 were also published. The results of tests carried out from 1948 will be published in a series of Road Research Bulletins, which are under compilation.

Road Research Bulletins Nos. 3 to 6 containing a batch of some interesting Papers on Road Research have also been issued.

Bridging India's Rivers: It contains an account of bridges recently built on National Highways. This publication was considered such a useful piece of work that the Government of India decided to have the copies for distribution among the Indian embassies abroad. An up to date edition of this publication has been brought out at the Jubilee Session.

Glossary of Highway Engineering Terms: Some sections of the Glossary have already been published. The complete Glossary will be printed in the form of a book when all the sections are ready.

7.3. **Papers:** The following is a list of the subjects on which 212 Papers along with the discussions thereon have been published in the Journals of the Indian Roads Congress:

1. Roads in General
2. Road Surveys, Design, Layout and Construction
3. Soil and Earthwork; Soil Science as adapted to Road Foundation, Banks and Earth Surfaces, Soil Stabilization, etc.
4. Water-Bound Macadam roads, and other low-cost roads such as moorum, brick and other forms of trackways
5. Tar and Bitumen Surfacing, Carpets, etc.
6. Concrete
7. Miscellaneous Materials and Processes; Aggregates Tests, Sizes, etc.
8. Bridges, Retaining Walls and other structures.

9. Traffic Statistics, Regulation and Control of Traffic, Economics of Road and Road Transport
10. Road Maintenance and Road Usages
11. Standardisation of Designs, Loadings, Impact, Specifications
12. Research and Experiments
13. Administration and Finance
14. Plant, Machinery and Apparatus.

7.4. There is no doubt that a study of Papers such as these and of the discussions on the Papers is of incalculable benefit to the Road Engineers of India. Those who are fortunate enough to be able to partake in the discussions, and otherwise partake in the activities of the Society not only receive additional benefits themselves but are in a position to benefit their brother engineers by placing their knowledge at the disposal of the profession.

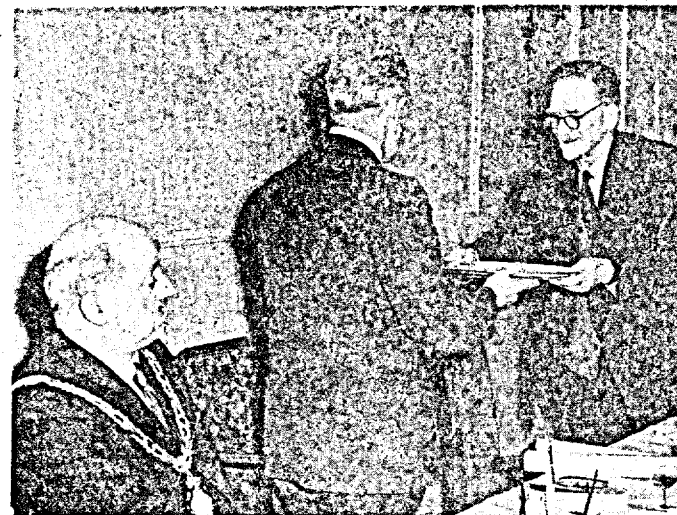
7.5. Members can contribute Papers to the Journal of the Indian Roads Congress which, if accepted, are printed and circulated to the Members *free of cost*. The comments from the various members offered either at the General Session or by correspondence are published later and are supplied *free of cost* to Members. The Journal thus provides a medium for exchange of valuable ideas and opinions to the mutual benefit of individual members and the Society as a whole.



Brig. S. K. BOSE, receiving a Medal from His Excellency the Governor of Madhya Pradesh.

MEDALS AND PRIZES

The following Medals are available for award :



At a meeting of the Institution of Highway Engineers, U. K., Shri G. M. McKelvie receiving the Salver presented to him by the Council of the I.R.C.

(i) The Mitchell Medal :

For exceptionally good Papers contributed to the Indian Roads Congress in any year. This has been instituted to perpetuate Sir Kenneth Mitchell's connections with the Congress.

(ii) The Indian Roads Congress Medal :

For Papers considered by the Council of the Indian Roads Congress to be of a decidedly more than average merit.

These Medals are awarded according to the Rules and Regulations framed by the Council. A



Shri S. R. MEHRA and Dr. H. L. UPPAL, receive a Medal from His Excellency the Governor of Andhra Pradesh.

list of Papers which have been awarded Medals is given on pages 45, 47 and 49.

I.R.C. SOUVENIR

Papers Awarded "The Mitchell Medal"

Paper	Author	Volume in which printed	Session & year at which awarded
1. Paper No. 8—"Cement Concrete Roads."	W. J. Turnbull	I	Jaipur—1946
2. Paper No. 26—"The Necessity for a Reasonably Uniform Standard Loading for Design of Concrete Bridges and a suitable Loading for such and other Types of Bridges on Highways in India".	M. G. Banerjee	II	do
3. Paper No. 30—"Construction of Shillong—Jaintipur Road, Khasi Hills, Assam".	F. E. Cormack	II	do
4. Paper No. A (1)—"A Method of Calculating the Stability of Braced Pile Piers" and Paper No. A (2)—"The Dhakuria Lake Bridge".	Guthlac Wilson	IV	do
5. Paper No. D—"Reinforced Concrete Bridge across the Godavari River at Shahgadh in Hyderabad State."	Dildar Hussain	IV	do
6. Paper No. M—"Ribbon Development."	A. S. Trollip	V	do
7. Paper No. A—39 "Evolution of the Thin Concrete Road in the United Provinces."	W. F. Walker	VI	do
8. Paper No. L—39—"Impact of Reinforced Concrete Road Bridges as compared to Steel Bridges".	E. P. Nicolaides	VI	do
9. Paper No. G—40—"Sevoke Bridge".	J. Chambers	VII	do
10. Paper No. B—41—"A Note on the Reconstruction of Roads carried out in the U.P. with special reference to experiments carried and the use of Traffic Statistics".	S. N. Chakravarti	VIII	do
11. Paper No. 1—43—"The Revised Specifications for Bitumen Roads in the Punjab."	Abdul Aziz	VIII	do
12. Paper No. 99—"Bituminous Treatment of Wet Aggregates."	C. J. Fielder	IX	do
13. Paper No. 105—"Economics of Highway Types."	K. S. Raghavachary	X	Trivandrum—1947
14. Paper No. 135—"Low Cost Roads in India and Use of Soil Science for their Improvement."	G. Srirangachary	XIII	Bombay—1950

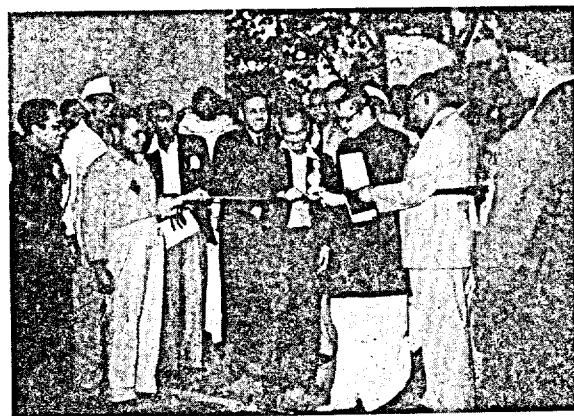
Papers Awarded "Indian Roads Congress Medal"

1. Essay on "Improving the Technical Education of Road Engineers."	V. N. Rangaswamy	—	Madras—1945
2. Paper No. 120—"Well Foundations of the Kalabagh Bridge over the Indus."	Dr. R. K. N. Iyengar	XII	Bombay—1950

SILVER JUBILEE 1934—1959



Dr. B. C. ROY,
Chief Minister of W. Bengal inaugurating
the Session on the 18th Feb. 1951



Opening of the I.R.C. Exhibition at Calcutta
by Shri B. C. SINHA on the 18th Feb. 1951



YUVRAJ KARAN SINGH,
Sadar - i - Riyasat, Jammu & Kashmir inaugurating
the Session on the 19th June 1955



BAKSHI GHULAM MOHD,
opening the I.R.C. Exhibition at Srinagar on the 18th June '55

I.R.C. SOUVENIR

3.	Paper No. 142—"Failure of a Five Span Masonry Arch Bridge across the Bhogeswari River near Pen, District Kolaba in the Province of Bombay."	K. G. Bhate	XIV	Calcutta—1951
4.	Paper No. 147—"An Adaptable Steel Centring for R.C. Bridges."	A. Nageswara Ayyar	XV	do
5.	Paper Nos. 121, 128, 137, 148 and 151—"A design for Bullock-Cart Wheels—Parts I to V."	B. V. Vagh	XI, XII, XIII & XV	Simla—1952
6.	Paper No. 161—"The Investigation, Design and Construction of the Cauvery Bridge at Pugalur."	K. K. Nambiar & K. Namasivayam	XVII	Bhubaneswar—1953
7.	Paper No. 167—"The Design of Small Bridges and Culverts."	Goverdhan Lal	XVIII	Srinagar—1955
8.	Paper No. 171—"A New Approach to the Analysis of Stability of Slopes."	P. C. Varghese	XIX	Nagpur—1956
9.	Paper No. 179—"The Influence of a Superimposed Layer in Increasing the Load Bearing Capacity of a Rigid Pavement."	Brig. S. K. Bose	XIX	do
10.	Paper No. 193—"Influence Fields for Finite Concrete Slabs Supported Freely along Two Opposite Edges and Free at the Other Two."	K. C. Ray, R. Subramoniam & S. Badaruddin	XXI	New Delhi—1958
11.	Paper No. 205—"The Importance of Subgrade Compaction in the Economic Design of Flexible Pavement."	S. R. Mehra & Dr. H. L. Uppal	XXII	Hyderabad — 1959

Papers Highly Commended

	Paper	Author	Volume in which printed	Session & year at which announced
1.	Paper No. 141—"Fundamentals of Highway Needs and Highway Planning."	D. G. Bhagat & Jagdish Bahadur	XIII	Bombay—1950
2.	Paper No. 152—"Organisation of Bridging Activities."	G. R. Nangea	XV	Simla—1952
3.	Paper No. 154—"Behaviour of Brick Metal in Tar Carpets."	K. C. De	XV	Simla—1952
4.	Paper No. 158—"Construction of Shillong-Silchar Road."	S. C. Pal & R. C. Das	XVI	Madras—1953

SILVER JUBILEE 1934—1959

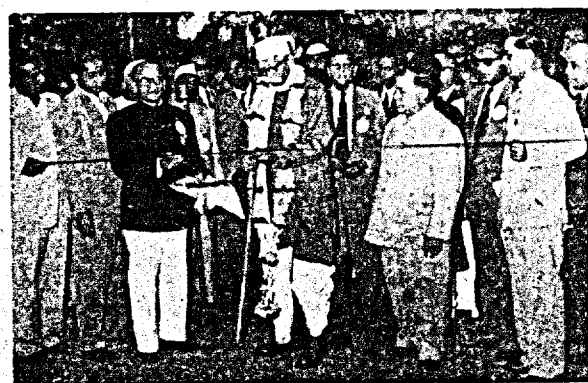
47



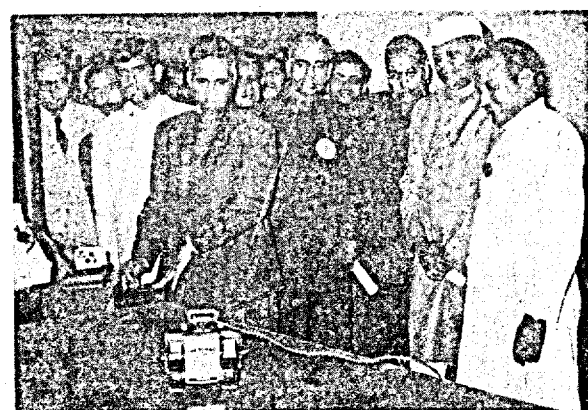
Even at social functions, important problems are often discussed



Shri G. S. GANAPATHY,
Chief Engineer (General), Mysore.



Shri R. S. SHUKLA,
Chief Minister, Madhya Pradesh opening the
I.R.C. Exhibition, January 1956



A stall at the I.R.C. Exhibition
at New Delhi—January 1958

5.	Paper No. 160—"The Design of Road Beds."	G. Srirangachary	XVI	Madras—1953
6.	Paper No. 168—"Stabilization of Certain Clayey Soils in India by Heat Treatment."	Brig. S. K. Bose	XVIII	Srinagar—1955
7.	Paper No. 172—"Bituminous Treatment of Brick Metal Water-Bound Macadam Surfaces in U.P."	D. C. Chaturvedi	XIX	Nagpur—1956
8.	Paper No. 177—"Design and Construction of Prestressed Concrete Bridge Across River Palar."	K. K. Nambiar	XIX	do
9.	Paper No. 180—"Stabilised Soil Construction in the Formation of Tuticorin-Tiruchendur Road."	E. C. Chandrasekharan & T. S. Chandrasekhar	XX	Shillong—1957
10.	Paper No. 191—"Resistance to Abrasion of Concrete Pavements."	P. J. Jagus & M. R. Chatterjee	XXI	New Delhi—1958
11.	Paper No. 192—"Design and Construction of Prestressed Concrete Bridge across River Coleroon."	K. K. Nambiar & P. G. Nambiar	XXI	do
12.	Paper No. 200—"Asphalt Paving Mixtures—Their Design and Composition."	N. H. Taylor	XXII	Hyderabad—1959

Sir Kenneth Mitchell & Shri Nur Mohammad Chinoy Prize—Rs 250.

1.	"Post-war Goods and Passenger Road Transport and its Economics."	Prof. K. B. Madhava*	XI-1
2.	do	N. S. Surya	XII-3

Indian Roads Congress prize of Rs 100/-.

"Road-Mindedness—How to Create Wide-spread Public Demand for More and Better Roads in India."	Malik N. M. Khan	XI-2
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8. LIBRARY

8.1. The Indian Roads Congress possesses a fairly comprehensive library which is at the disposal of the Members and books are supplied on loan.

Roads Congress has a programme for the expansion of its activities. Some of the proposals for expansion are given below :

9. PROPOSALS FOR THE FUTURE

Like any other organisation, the Indian

9.1. **Library and Information Bureau :** To utilise the library to the fullest extent, it would be necessary to have an Information Bureau on the lines of the Bureau attached to the Central Board of Irrigation and Power.

*Prof. K. B. Madhava generously returned the prize and offered for competition again for the best essay on the same subject and it was then awarded to Shri N. S. Surya.

Information on various technical problems or references to relevant literature are at present supplied by the Indian Roads Congress in answer to enquiries from time to time, but due to the shortage of staff, the scope is restricted at present. An expansion of this work would prove beneficial to road engineers all over the country.

9.2. Museum: It is also proposed to set up a Highway Museum containing specimens of road materials collected from various parts of India and specimens of materials on which tests and analyses have been carried out and results recorded.

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.

10. FINANCE

About sixty per cent of the income of the Society comes from contributions from the Central and State Governments. Other sources of income of the Society are Membership fees paid annually by Members, revenue obtained from the sale of the publications and advertisement fees. The income from the last three sources being limited, the Indian Roads Congress depends on aid of both Central and State Governments, whom it primarily serves for increased activities in future for the fulfilment of its objectives.

11. ANNUAL GENERAL SESSIONS

At the General Sessions, held annually, to which both the Central and State Governments send senior and junior officers as delegates, Members get opportunities of meeting road engineers of eminence from every part of India and of exchanging views and ideas by social contact. A young engineer in particular has much to gain and learn by such contact.

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 2000) has joined the Society is in itself an indication of the value the profession places on its activities.

So far twenty-three Annual Sessions have been held in different places. Brief particulars are given below:

Inaugural Session—Delhi - December 1934

Opened by the Hon'ble SIR FRANK NOYCE
Chairman - Shri D. G. Mitchell, C.S.I., C.I.E., I.C.S.
Delegates-73
Papers-15

2nd Session—Bangalore - January 1936

Opened by the DEWAN OF MYSORE
President - Rai Bahadur Chhuttan Lal
Vice-Presidents: Dewan Bahadur N. N. Ayyangar
Shri S. G. Stubbs
Col. G. E. Sopwith
Honorary Treasurer: Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Honorary Secretary: Shri R. L. Sondhi
Delegates-75
Papers-20

3rd Session—Lucknow-February 1937

Opened by the GOVERNOR of the United Provinces
(Now Uttar Pradesh)
President - Rai Bahadur Chhuttan Lal
Vice-Presidents: Lt. Col. W. De Haigh
Rai Bahadur S. N. Bahaduri
Nawab Ahsan Yar Jung Bahadur
Hon. Treasurer: Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Hon. Secretary: Shri Jagdish Prasad
Delegates-100
Papers-8

4th Session—Hyderabad (Deccan) - January 1938

Opened by Member, H.E.H. The Nizam's Executive Council
President - Shri S. G. Stubbs, O.B.E., I.S.E.
Vice-Presidents: Rai Bahadur S. N. Bahaduri
Nawab Ahsan Yar Jung Bahadur
Brig. E. C. Walker
Hon. Treasurer: Shri L. B. Gilbert
Hon. Secretary: Shri Jagdish Prasad
Delegates-105
Papers-8

5th Session—Calcutta - February 1939

Openend by MINISTER of Communications & Works,
Government of Bengal
President - Shri S. G. Stubbs, O.B.E., I.S.E.
Vice-Presidents: Rai Bahadur S. N. Bahaduri
Shri W. L. Murrell
Col. G. E. Sopwith
Hon. Treasurer: Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Hon. Secretary: Shri Jagdish Prasad
Delegates-112
Papers-11

6th Session—Bombay - December 1939

Opened by the GOVERNOR of Bombay.
President - Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Vice-Presidents: Shri H. E. Ormerod,
Shri Bashiram, I.S.E.,
Shri N. V. Modak.
Hon. Treasurer: Sir Kenneth Mitchell, K.C.I.E., C.I.E.,
Hon. Secretary: Shri K. S. Raghavachary
Delegates-125
Papers-12

7th Session—Delhi - January 1941

(This was only a Council Session to which local members were also invited).
Opened by MEMBER FOR COMMUNICATIONS,
Government of India
President - Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Vice-Presidents: Shri H. E. Ormerod
Shri S. Bashiram
Shri N. V. Modak
Hon. Treasurer: Sir Kenneth Mitchell, K.C.I.E., C.I.E.
Hon. Secretary: Shri K. S. Raghavachary
Thirty Members of Council & 12 Ordinary Members attended

8th Session—Gwalior - October 1943

Openened by HOME MEMBER to His Highness the
Maharaja Scindia's Government
President - Sir Kenneth Mitchell, K.C.I.E., C.I.E.,
Vice-Presidents: Sir Arthur Dean
Shri H. E. Ormerod
Shri N. V. Modak
Hon. Treasurer: Shri J. Vesugar
Hon. Secretary: Shri K. S. Raghavachary
Delegates-100
Papers-13

9th Session—Madras - February 1945

Opened by the GOVERNOR of Madras
President - Shri J. Vesugar
Vice-Presidents: Sir Arthur Dean
Shri H. E. Ormerod
Shri N. V. Modak
Hon. Treasurer: Shri G. M. McKelvie
Hon. Secretary: Shri K. S. Raghavachary
Delegates-136
Papers-5

10th Session—Jaipur - February 1946

Opened by the PRIME MINISTER of Jaipur State
President - Sir Arthur Dean
Vice-Presidents: Shri H. E. Ormerod
Shri N. V. Modak
Shri L. A. Freak
Hon. Treasurer: Shri G. M. McKelvie
Hon. Secretary: Shri M. B. Lal
Hon. Assistant Secretary: Shri A. J. D' Costa
Delegates-217
Papers-10

11th Session—Trivandrum - February 1947

Opened by the DEWAN of Travancore State
President - Shri J. Chambers
Vice-Presidents: Shri H. E. Ormerod
Shri N. V. Modak
Shri L. A. Freak
Hon. Treasurer: Shri G. M. McKelvie
Hon. Deputy Treasurer: Shri G. A. D. Cochrane
Hon. Secretary: Shri H. Sunder Rao
Hon. Asst. Secretary: Shri A. J. D' Costa
Delegates-229
Papers-7. A new feature in the form of a Technical Exhibition was introduced at this Session.

12th Session—Roorkee - April 1948

Opened by the MINISTER OF COMMUNICATIONS,
U.P.
President Shri C. G. Kale
Vice-Presidents: Shri S. N. Chakravarti
Shri H. K. Nivas
Shri I. A. T. Shannon
Hon. Treasurer: Shri G. M. McKelvie
Hon. Secretary: Shri H. Sunder Rao
Hon. Asst. Secretary: A. J. D' Costa
Delegates-170
Papers-13

13th Session—Ranchi - February 1949

Opened by the CHIEF MINISTER of BIHAR
President - Shri S. N. Chakravarti
Vice-President: Shri M. L. Bahl
Shri I. A. T. Shannon
Shri B. V. Vagh
Hon. Treasurer: Shri G. M. McKelvie
Hon. Secretary: Shri H. Sunder Rao
Hon. Asst. Secretary: Shri A. J. D' Costa
Delegates-237
Papers-8

14th Session—Bombay - January 1950

Opened by the Premier of Bombay
President - Shri Brijmohan Lal
Vice Presidents: Shri M. L. Bahl
Shri B. N. Shenoy
Shri C. J. Fielder
Hon. Treasurer - G. M. McKelvie
Hon. Secretary - Shri H. Sunder Rao
Hon. Asst. Secretary: Shri J. M. Trehan
Delegates-223
Papers-8

15th Session—Calcutta - February 1951

Opened by the Chief Minister of West Bengal
President - Shri A. C. Mukerjee
Vice-Presidents: Shri N. P. Gurjar
Shri S. B. Joshi
Hon. Treasurer: Shri G. M. McKelvie

Hon. Treasurer - Shri H. P. Mathrani
Hon. Deputy Treasurer - Shri Goverdhan Lal
Hon. Secretary - Shri J. Subrahmanyam
Delegates-224
Papers-9

16th Session—Simla - April 1952

Opened by his Excellency the Governor of the Punjab
President - Shri G. M. McKelvie
Vice-Presidents : Shri C. M. Bennett
Shri T. Mitra
Shri E. A. Nadirshah
Hon. Treasurer Shri H. P. Mathrani
Hon. Deputy Treasurer - Shri Goverdhan Lal
Hon. Secretary - J. M. Trehan.
Hon. Asst. Secretary - Shri N. Sen (till 24-5-51)
Shri T.N. Bhargava (from 25-5-51)
Delegates-200
Papers-5

17th Session—Madras - February 1953

Opened by Shri Ranga Reddi, Minister for Public Works,
Madras State

President - Shri T. Mitra

Vice-Presidents : Shri W. A. Griffiths
Shri K. K. Nambiar
Shri P. L. Varma

Hon. Treasurer : Shri H. P. Mathrani

Hon. Deputy. Treasurer - Shri Goverdhan Lal

Hon. Secretary : Shri J. M. Trehan

Hon. Asst. Secretary : Shri T. N. Bhargava (till
17-12-52)

Shri A. Mukerjee (from 17-12-52)

Delegates-226

Papers-4

18th Session—Bhubaneswar - February 1954

Opened by Shri Naba Krushna Chowdhury, Chief
Minister, Orissa State
President - Shri R. K. Batra.
Vice-Presidents : Shri K. K. Nambiar
Shri L. R. Patel
Shri M. S. Mathur
Hon. Treasurer - Shri H. P. Mathrani
Hon. Deputy Treasurer - Shri Goverdhan Lal
Hon. Secretary - Shri J. Subrahmanyam
Hon. Asst. Secretary - Shri A. Mukerjee
Delegates-197
Papers-5

19th Session—Srinagar - June 1955

Opened by Yuvraj Karan Singh, Sadar - i - Riyasat,
Jammu & Kashmir
President - Shri H. P. Mathrani .
Vice-Presidents : Shri C. M. Bennett
Shri U. N. Mahida
Dr. F. P. Antia

20th Session—Nagpur-January 1956

Opened by Dr. B. Pattabhi Sitaramayya, Governor of
Madhya Pradesh

President - Shri K. K. Nambiar
Vice-Presidents : Shri D. N. Gupta
Shri M. S. Bisht
Shri W. A. Griffiths

Hon. Treasurer - Shri H. P. Mathrani
Hon. Deputy Treasurer - Shri Goverdhan Lal
Hon. Secretary - Shri J. Subrahmanyam

Delegates-240
Papers-8

21st Session—Shillong - May 1957

Opened by Shri Bisnuram Medhi, Chief Minister of Assam

President - Shri P. L. Varma

Vice-Presidents : Shri H. R. Gupta
Shri R. C. Roy
Shri W. A. Griffiths

Hon. Treasurer - Shri H. P. Sinha

Hon. Deputy Treasurer - Shri D. G. Bhagat

Hon. Secretary - Shri J. Subrahmanyam

Delegates-272

Papers-10

22nd Session—New Delhi - January 1958

Opened by Dr. Rajendra Prasad, President of India
President - Shri M. S. Bisht
Vice-Presidents: Shri B. Chaudhury
Shri C. J. Fielder
Shri Kishore Lal
Hon. Treasurer - Shri H. P. Sinha
Hon. Deputy Treasurer - Shri D. G. Bhagat
Hon. Secretary - Shri A. J. D'Costa
Delegates-284
Papers-7

23rd Session—Hyderabad - January 1959

Opened by Shri Bhimsen Sachar, Governor of Andhra Pradesh

President - Shri W. X. Mascarenhas

Vice-Presidents : Shri J. M. Rijhwani
Shri D. C. Sharma
Shri Sujan Singh

Hon. Treasurer - Shri H. P. Sinha

Hon. Deputy Treasurer - Shri D. G. Bhagat

Hon. Secretary - Shri A. J. D'Costa

Delegates-288

Papers-7

PERSONNEL OF THE TECHNICAL COMMITTEES

1. SPECIFICATIONS AND STANDARDS COMMITTEE

Goverdhan Lal ... *Convenor*
J.M. Trehan ... *Member-Secretary*

(i) *Geometric Design Division*

R. C. Roy	T.S. Khanna
K. K. Nambiar	J. Subrahmanyam
S. N. Gupta	Kishore Lal
K. Ramaswamy Reddy	P. L. Varma
C.L. N. Ivengar	K. Sinha

(ii) *Pavement Design Division*

M. S. Bisht	P. J. Jagus
J. Subrahmanyam	C. J. Fielder
U. J. Bhatt	Sujan Singh
S. R. Mehra	K. F. Antia
R. N. Dogra	P. D. Shivdasani
C. G. Swaminathan	

(iii) *Specifications & Costing Division*

Dr. Bh. Subbaraju	Chief Surveyor of
R. C. Roy	Works, / E-in-C's
	Branch
J. Subrahmanyam	G. C. Khanna
H. R. Gupta	H. S. Batliwala

2. BRIDGES COMMITTEE

S. L. Bazaz ... *Convenor*
M. P. Nagarsheth ... *Member-Secretary*

(i) *Location, Layout and Hydraulics Division*

A representative of E-in-C.	U. J. Bhatt
H. P. Sinha	A representative of
A representative of C. W. & P. C.	C.B.I. & P. Dr. K. L. Rao

(ii) *Substructure and Superstructure Division*

K. F. Antia
D. S. Desai
S. K. Ghosh
Joint Director, Standardization
(Building & Structures)
P. C. Poonen
A representative of the Building Research
Institute

3. TEST TRACK COMMITTEE

R. C. Roy	...	<i>Convenor</i>
C. J. Fielder		N. N. Majumdar
S. N. Gupta		Sujan Singh
Director, C. R. R. I.		T. C. Sahani
K. K. Nambiar		Director, Highways
H. P. Sinha		Research Station, Madras
J. K. Banerjee		K. N. Basu
J. M. Trehan	...	<i>Member-Secretary</i>

4. RESEARCH ORGANISATION COMMITTEE

H. P. Sinha ... *Convenor*

A representative of E-in-C. (connected with research work)

Addl. Consulting Engineer to the Government of India (Roads)

Chief Engineer, Buildings & Roads, Uttar Pradesh

Chief Engineer, (Highways), Madras

Chief Engineer, Buildings & Roads, Punjab

A representative of Railway Testing & Research Centre, Ministry of Railways, Lucknow

A representative of Central Standards Office for Railways [Joint Director, Standardisation (Track)]

A representative of the Poona Irrigation Research Station

A representative each from Lucknow, Madras, Karnal, Bihar & Hyderabad Research Stations

Director, C. R. R. I.

A representative of R. & B. Laboratory, West Bengal

K. F. Antia

P. J. Jagus

J. M. Trehan ... *Member-Secretary*

5. SOIL RESEARCH COMMITTEE

Director, C. R. R. I. ... *Convenor*
 U. J. Bhatt Dr. H. L. Uppal
 A representative of A representative of
 Hyderabad Engineering Research Station B. & R. Research
 Laboratory, Karnal
 Director, Highways Research Station,
 Madras D. C. Chaturvedi
 A representative of A. K. Deb
 C.B. I. & P.
 S. N. Gupta R. N. Dogra
 T. M. Menon
 J. M. Trehan ... *Member-Secretary*

6. EDUCATION COMMITTEE

E. A. Nadirshah ... *Convenor*
 Goverdhan Lal
 K. F. Antia R. N. Dogra
 S. R. Mehra K. K. Nambiar
 C. L. N. Iyengar D. P. R. Cassad
 J. M. Trehan ... *Member-Secretary*

7. PROVINCIALIZATION OF LOCAL BODIES ENGINEERING SERVICES COMMITTEE

Fateh Chand ... *Convenor*
 Shoba Ram ... *Deputy Convenor*
 G. D. Joglekar M. P. Srivastava
 H. S. Sharma S. P. Sinha
 H. S. Batliwala
 S. K. Rajagopalan ... *Member-Secretary*

8. PAPERS COMMITTEE

H. P. Sinha ... *Convenor*
 Goverdhan Lal P. L. Varma
 N. D. Daftary D. C. Sharma
 D. G. Bhagat
 Secretary, I.R.C. ... *Member-Secretary*

9. MANUFACTURE OF ROAD MAKING MACHINERY AND MECHANIZATION COMMITTEE

R. S. Bhalla ... *Convenor*
 Sujan Singh P. N. Srivastava
 Kishore Lal L. R. Patel
 A representative of K. M. Wahi
 E-in-C. G. R. Nangea
 W. X. Mascarenhas

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 Goverdhan Lal R. C. Roy
 Chief Engineer U. J. Bhatt
 (Highways), Madras. Kishore Lal
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 L. S. Lulla D. P. R. Cassad
 Dr. M. K. Ganguli ... *Member-Secretary*

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Director, C.R.R.I. ... *Convenor*
 Consulting Engineer (Road Development)
 A representative of C. P. W. D.
 J. M. Trehan
 Dr. Bh. Subbaraju

13. CEMENT CONCRETE ROAD SURFACING COMMITTEE

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 C. L. N. Iyengar Jagdish Prasad
 Chief Engineer Goverdhan Lal
 (Highways) Madras K. K. Nambiar
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 C. L. N. Iyengar C.R.R.I. (T. S. Khanna)
 M. S. Nerurkar R. N. Dogra
 D. V. Sahni
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16. PREVENTION OF RIBBON DEVELOPMENT COMMITTEE

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 P. L. Varma B. V. Vagh
 E. A. Nadirshah C. E., U.P.
 C.E., W. Bengal C. E., Kerala
 C. E., Bombay
 Hardayal ... *Member-Secretary*

17. COMMUNITY PROJECTS ROAD MAINTENANCE COMMITTEE

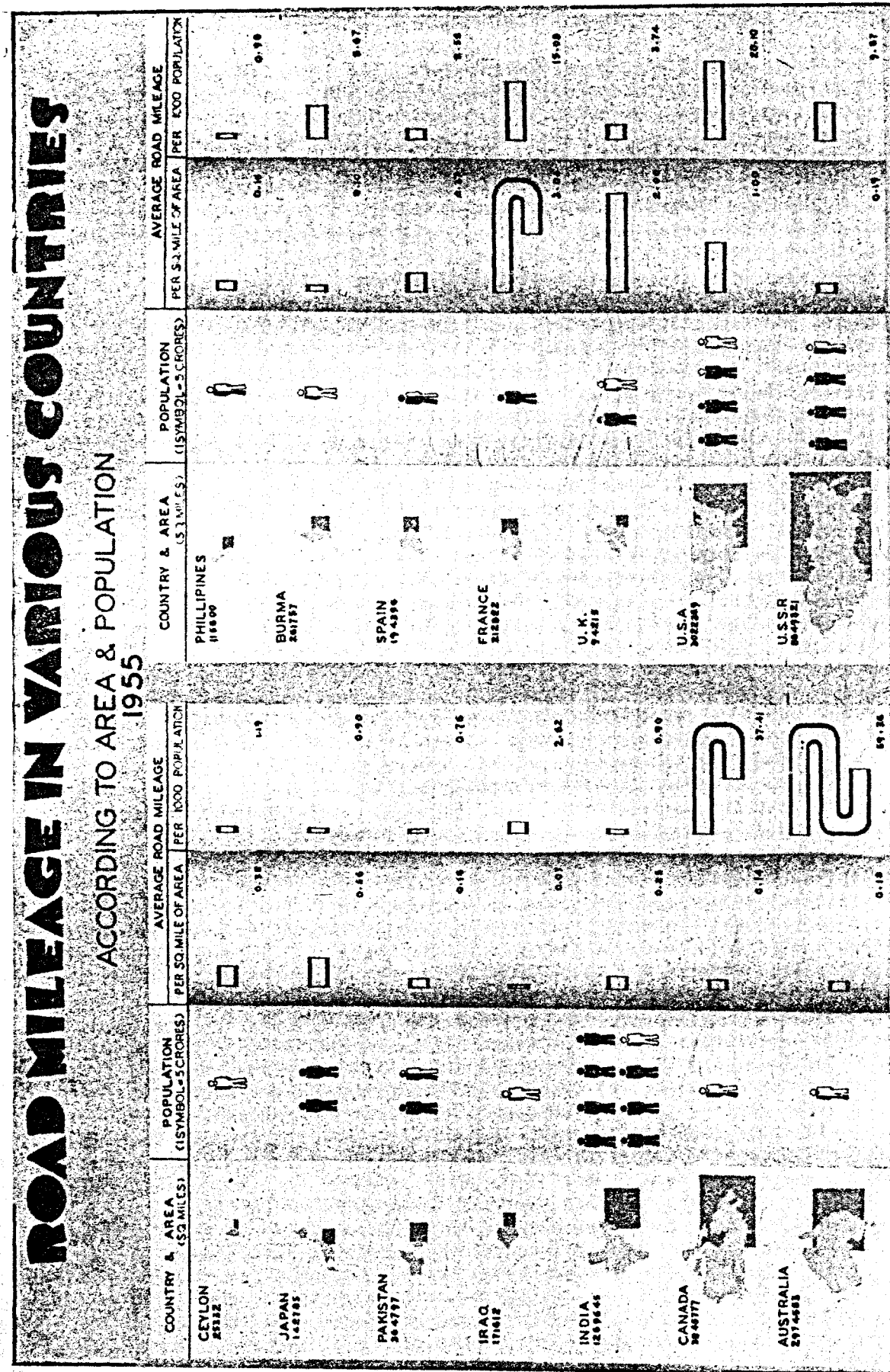
K. K. Nambiar ... *Convenor*
 N. Durrani P. L. Varma
 H. P. Sinha D. C. Sharma
 Dr. H. L. Uppal N. D. Mirchandani
 D. G. Bhagat H. S. Batliwala
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 R. C. Roy S. R. Mehra
 J. M. Trehan ... *Member-Secretary*

The Consulting Engineer to the Govt. of India (Road Development) is an ex-officio Member of all Committees.

SILVER JUBILEE 1934—1959



ROAD DEVELOPMENT IN INDIA

A REVIEW

The indispensability of roads as a vital means of communication has been well recognised since times immemorial in India. Their development and maintenance has, therefore, always been an essential part of State functions in this country. Good roads and easy communications necessarily go with civilisation and civilised administration; and Indian civilisation goes back not less than five thousand years.

Vedas & Epics

The Rigveda mentions the existence of highways called Mahapathas. Later, the literature of the Aryan period (3500-2500 B.C.) shows that roads planted with trees connected villages and were maintained at the expense of the king's treasury or at the expense of groups of villages. Kautilya (about 300 B.C.) records the great importance attached to roads from the economic and military point of view. In his day, the principal 'rajapatha' or royal road was that which passed through Patliputra, where the present Patna town is situated. This road ran from east to west and continued right up to the northwest frontier.

Along the main routes, trees were planted, wells were dug, and post-houses or hostels for travellers were built at regular intervals. Distance pillars were noted by Megasthenes (about 200 B.C.). Imperial and provincial officers looked after the upkeep of these roads. The labour for maintenance was provided by the towns and villages on the roads. Highways were built to specified widths, varying from 4 ft for footpaths to 32 ft for regular roads. The royal roads and trade routes were often 64 ft wide. Various kinds of chariots, bullock carts, and pack animals used these roads. H'uen Tsang (700 A.D.), the Chinese traveller, wrote that he found in India good roads and rest houses with food and medical attendance for travellers and pilgrims.

The "Sukraniti" (10th to 14th century A.D.) gives details of the roads of the period. Wide roads connected towns and villages. The roads

were built with convex surfaces "like the back of a tortoise"; they had drains on both sides. Repairs were carried out every year with stones or gravel at government expense.

Moghul Period

There was again a revival of road activity when Babar (fifteenth century A.D.) restored the great trunk road which connected the cities of North India with the northwest frontier and which even now is a famous artery of the road system. Another revival of road system took place during the reign of Sher Shah (1540-1545 A.D.) He paid special attention to the security and convenience of the users of the King's Highway. He planted avenues of fruit and shade-giving tree along the roads. The headmen of villages were made personally responsible for the detection of cases of highway robbery. Rulers of the Deccan also built roads connecting the plateau with the ports of the west and east coasts.

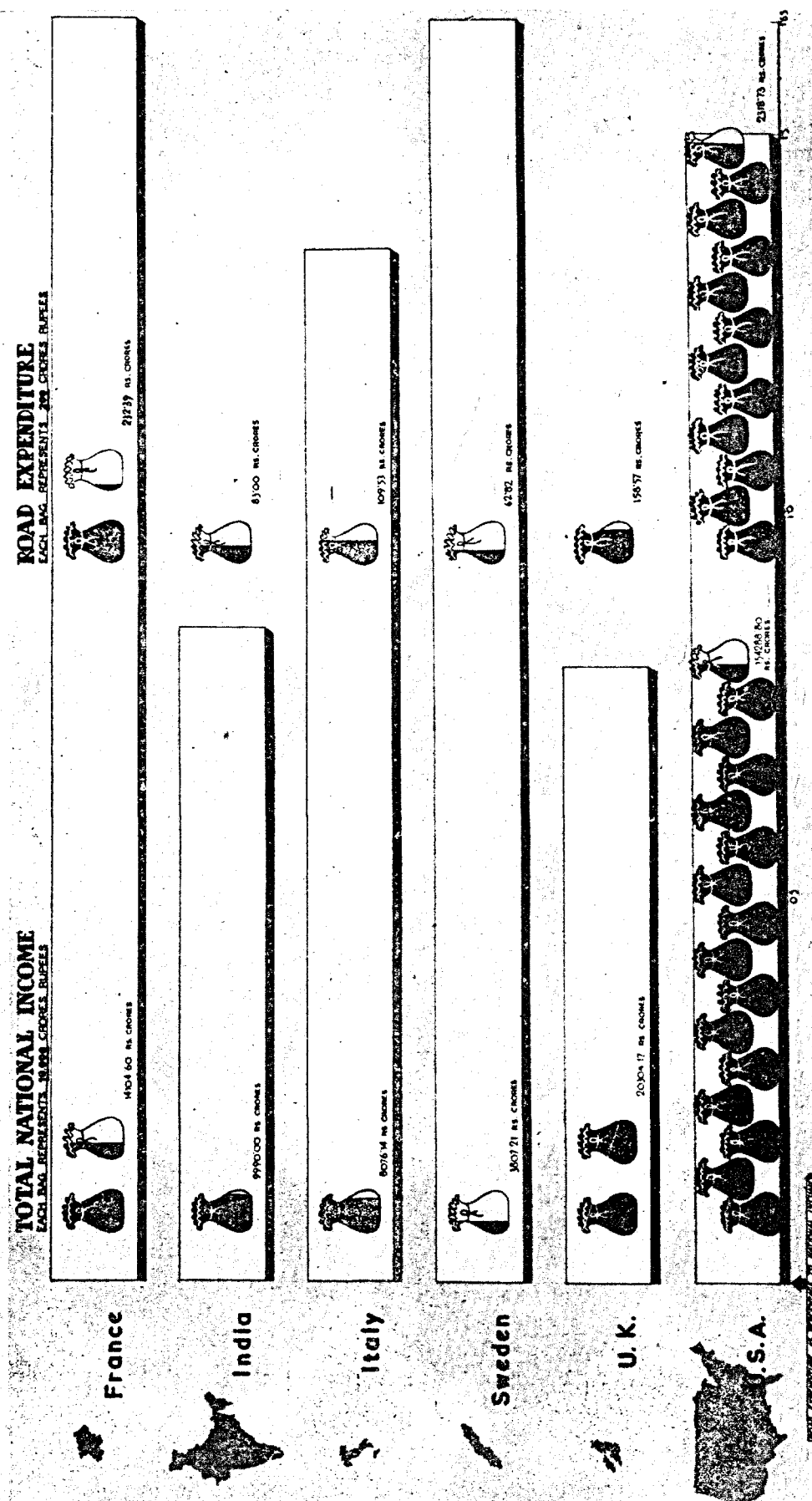
British Period

During the last century, a large number of roads, bridged and metalled and connecting important military and commercial centres, were constructed by the British military engineers although available evidence points to a deplorably bad condition of roads at the beginning of British Rule in the wake of the disintegration of the Moghul Empire in India. To Lord Dalhousie, who was responsible for opening the first Indian Railway, goes the credit of setting up the P. W. Ds to look after roads and other public works. The first administration report of the Punjab mentioned that the G. T. road from Lahore to Peshawar had been traced, surveyed and put well in progress. By 1853, metalling of the sections from Beas to Lahore had been completed.

Advent of Railways

With the advent of railways, major road works were relegated to the background and attention was mainly concentrated on the cons-

Road Expenditure as Percentage of National Income in Different Countries. 1955



truction of feeder roads to railways. In some cases, the trunk roads were even allowed to go out of repairs.

Gradually, roads came to be looked upon as a subject of local interest and importance only. Ultimately, with the enactment of the Govt. of India Act, 1919, roads became a provincial subject and were transferred from the Central Govt. to Provincial Governments who, in turn, placed the greater part of road mileage in charge of Local Bodies. The result was that, except for strategic roads, little attention was paid even to inter-State roads.

Motor Transport

Great changes took place at about the same time in the transport system all over the world. The advent of motor vehicle was accompanied by a strong demand for better roads. India was no exception. The first World War had ended and surplus military vehicles were available at cheap rates for civilian use in large numbers. Motor transport, represented mainly by buses and converted trucks, became a common feature on the principal roads throughout the country, i. e., 'on roads which had previously carried bullock carts only. The combined action of the narrow iron-tired bullock cart wheel and the fast moving motor vehicles' pneumatic-tired wheel, however, soon proved disastrous for the existing water-bound macadam road surfaces. Roads were wearing out fast, the cost of maintenance rose and the local bodies, with their meagre financial and technical resources, could not cope with the situation. Public opinion was aroused and in November 1927, the Govt. of India appointed a Committee, popularly known as the *Jayakar Committee*, to advise on a road policy. India had at that time less than 200,000 miles of roads, of which only 59,000 miles had hard surfaces, mostly water-bound macadam surface.

Road Fund

Early in 1928, the Jayakar Committee recommended that the Central Govt. should assist the provinces in the development of roads and suggested an additional tax of 2 annas per gallon of gasoline over and above the general revenue tax of six annas, imposed on this fuel. This additional tax of two annas was to be earmarked for

road development. The present gross tax on gasoline is 15 annas, of which only 2½ annas, or one sixth, is available for roads. The proceeds from this tax form the "*Central Road Fund*" which came into existence on the 1st March 1929. The creation of this Fund represents the first important measure taken by the Central Govt. to promote road development in India.

Of the total collections, 80 per cent is distributed by the Centre to States by way of allocations on the basis of gasoline consumed by each State. The amount so allocated is to be used on schemes approved by the Central Govt. The remaining 20 per cent is kept by the Central Govt. as reserve for the administration of the Fund, research, collection and dissemination of technical information, and for giving grants to States for road development, especially for such projects as would promote inter-State communication facilities or open up backward areas. The present total revenue of the Fund is about Rs 5 crores per year.

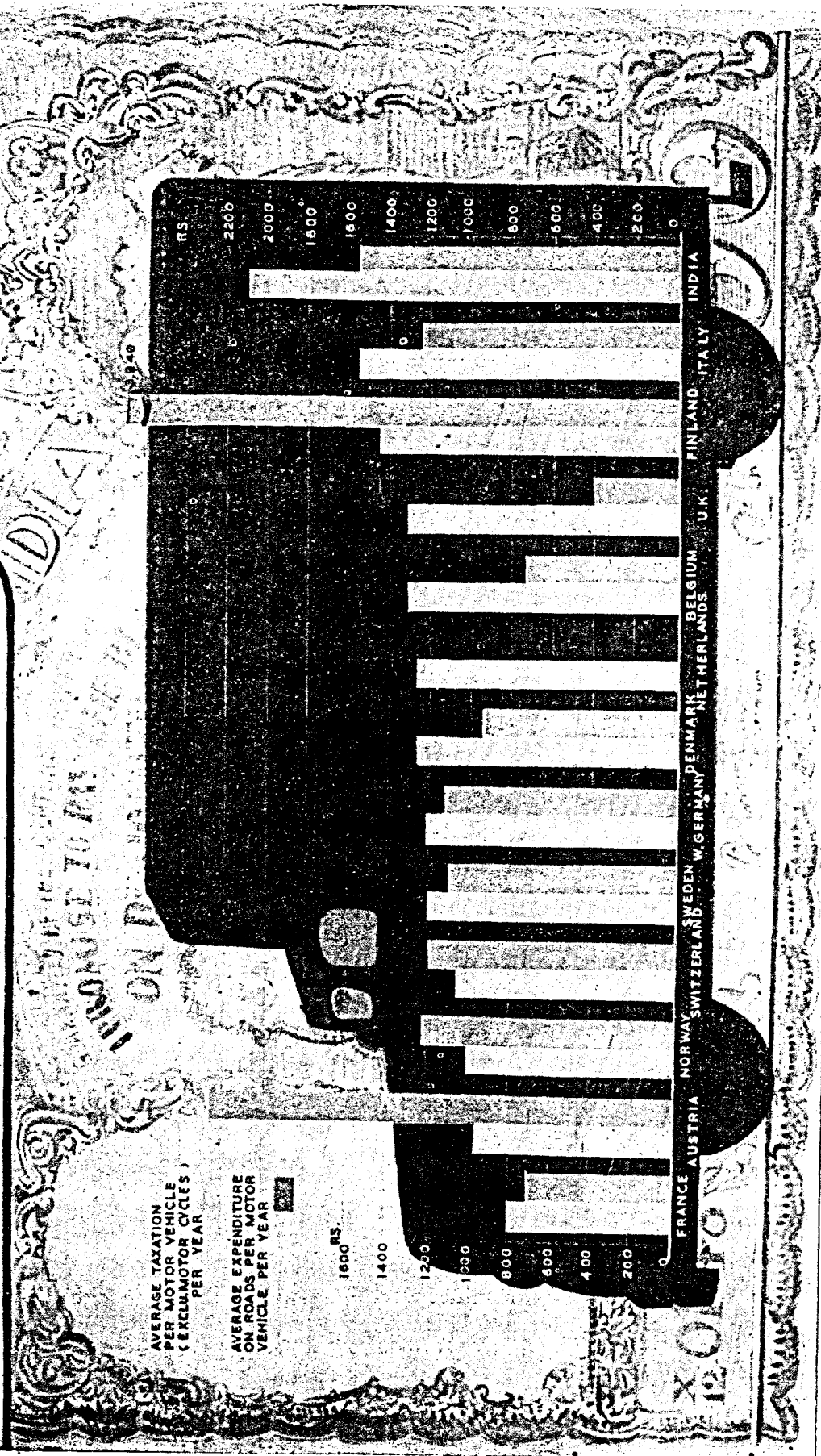
Although as compared to the present day expenditure on road development, the money provided from the Central Road Fund is small, ever since its inception the Fund has been a dependable source of revenue for road development activities in the country. So far over Rs 50 crores have been distributed from the Fund to the various States by way of allocations and grants for road development schemes approved by the Govt. of India.

Trunk Roads

Discussions took place between the Centre and the Provinces regarding the development of a skeleton trunk road system and, in the middle of 1933, the Govt. of India proposed to the Secretary of State that provision might be made specifically in the Constitution Act then under contemplation to permit national trunk roads becoming in some measure a federal charge. It was recognised that eventually it might be necessary for the future federal legislature to enact a Federal Roads Act. But, because of the emphasis on provincial autonomy, no specific provision was included in the Govt. of India Act, 1935, to cover Central interest in the development of arterial roads.

MOTOR VEHICLE TAXATION AND ROAD EXPENDITURE IN PRINCIPAL EUROPEAN COUNTRIES AND INDIA (1952-1954)

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Nagpur Plan

Experience gained during the Second World War, when intensive efforts were necessary to develop roads of strategic importance, not merely in operational areas but generally all over India, changed the entire official and public outlook on the question of roads. The realisation that a balanced road system was vital to the comprehensive post-war economic development of the country turned the thoughts of India's Statesmen and Engineers to road planning. A Conference of Chief Engineers was convened by the Govt. of India in Dec. 1943 at Nagpur and the outcome of its deliberations was a plan of road development popularly known as the Nagpur Plan. Formulation of this Plan marked the second major step in the history of road development in the country, the first major step being the creation of the Central Road Fund.

The Plan broadly envisaged that road planning in the country should be based on the consideration of the road system as an integral whole, and that programmes should be so framed as to contribute to the overall development of the national economy in a balanced manner. The main recommendation of the Plan related to the classification of roads in four categories, viz., National Highways, State Highways, District Roads and Village Roads. It also recommended that roads classified as National Highways



Anderson Bridge, West Bengal

should be entirely the responsibility of the Central Government.

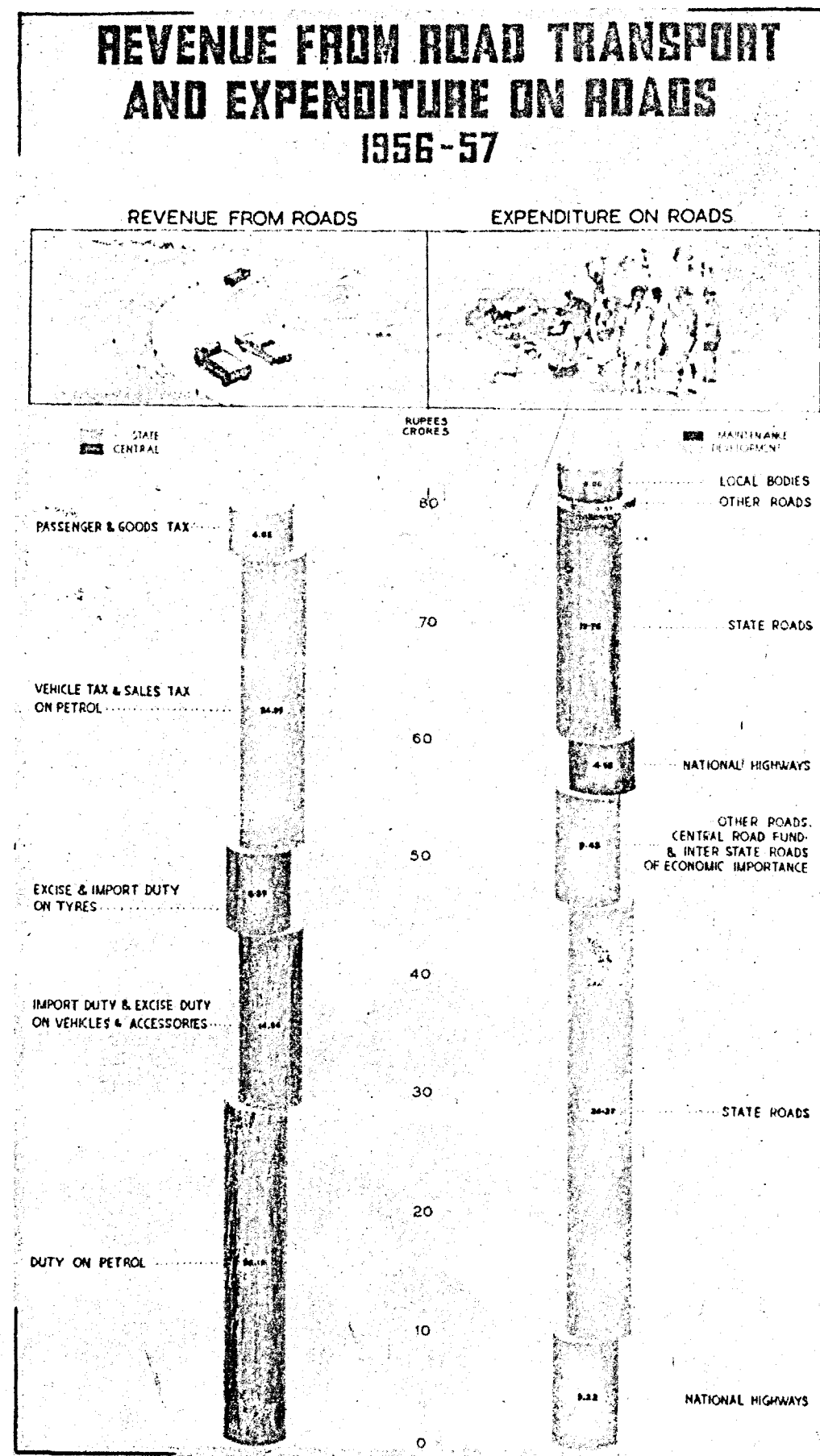
National Highways, as the name implies, are roads predominantly of national interest, as distinct from roads of predominantly local interest. They are main arterial roads running through the length and breadth of the country connecting capitals of States, major ports and foreign highways. The State Highways serve as the main trunk roads of a State. Major District Roads connect areas of production and markets with either a highway or a railway. They also form the main link between headquarters of neighbouring districts. Minor District Roads and Village Roads mostly meet the requirements of rural communities.

The Nagpur Plan took stock of the position for the country as a whole and laid down a target of 331,000 miles of roads made up of 123,000 miles of surfaced roads and 208,000 miles of unsurfaced roads. The Plan was intended to serve the needs of the country during the following 20 years and aimed at bringing every village within 5 miles of a main highway in a well developed agricultural area and within 20 miles in an undeveloped area.



A road under construction

SILVER JUBILEE 1934-1959



Beginning of a New Era—National Highways

Fully alive to the need and urgency of an all round development of roads, in April 1947, the Government of India assumed complete financial responsibility for the development and maintenance of certain roads provisionally approved by them for inclusion in a system of national highways. The main objective behind this step was to develop the major trunk roads of the country and to give relief to States so that they could concentrate more on the development of district and village roads.

Under the Constitution of Free India, National Highways have become a Central subject. The Government of India, therefore, enacted the National Highways Act in 1956 and statutorily took over the roads classified by them as National Highways. The enactment of this legislation marked a unique occasion in the history of road development in the country as this was the first time that the Central Government took over direct statutory responsibility for certain highways in

Road; the Banaras - Nagpur - Hyderabad - Cape Comorin Road; the Delhi-Ahmedabad - Bombay Road; the road (under construction) from Ahmedabad to Kandla Port and the branch road to Porbandar; the Hindustan-Tibet Road from Ambala to Tibet border via Simla; the Delhi-Moradabad-Lucknow Road; the Lucknow-Muzaffarpur-Barauni Road with a branch road to the Nepal border; the Assam Access Road; the Assam Trunk Road on the south bank of the Brahmaputra; and the road branching off from the Assam Trunk Road towards the Burma border through Manipur.

Progress

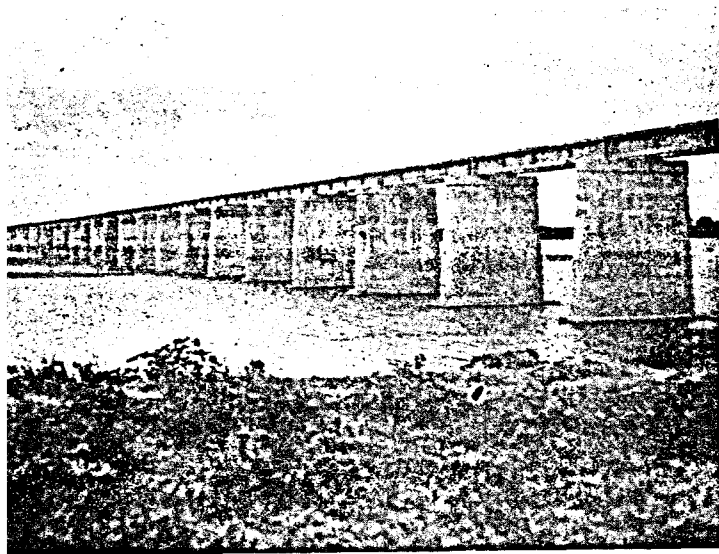
The main emphasis in the development of national highways has been to construct missing links and bridge river crossings as also to improve the surfaces of existing low-grade sections so as to provide a continuous all-weather network of arterial roads throughout the country. In April 1947, when the Government of India assumed financial responsibility for national



A completed section of a National Highway

States. The present length of roads included in the N.H. System aggregates about 13,900 miles. This system includes *inter alia* the road from Amritsar to Calcutta; the Agra-Bombay Road; the Bombay-Bangalore-Madras Road; the Madras-Calcutta Road; the Calcutta-Nagpur-Bombay

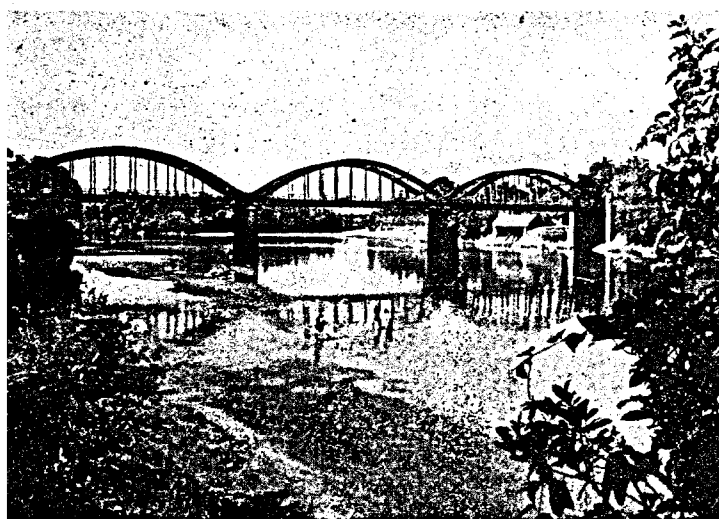
highways, approximately 1,600 miles of roads and thousands of culverts and bridges including about 150 major bridges did not exist along the selected routes. In addition, about 9,000 miles of the existing sections had low grade surfaces.



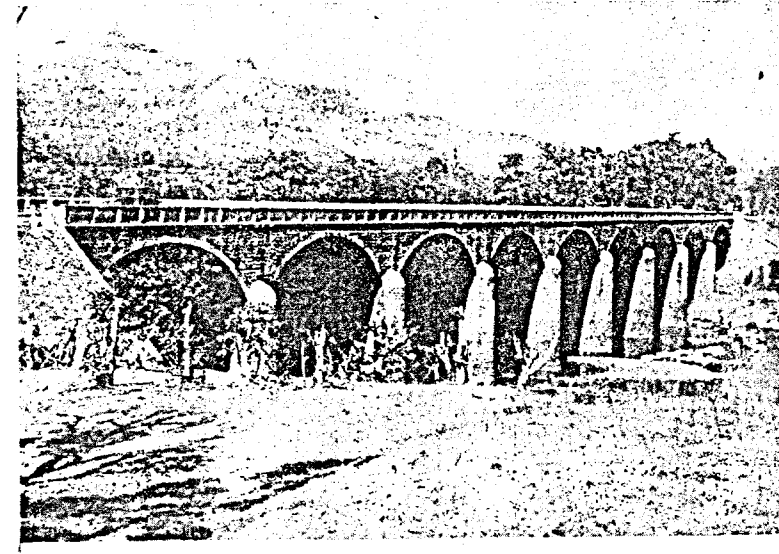
Tungabhadra Bridge

A sum of Rs 34 crores was spent on the development of national highways from 1.4.47 to 31.3.56 and 746 miles of missing links and 33 major bridges were constructed, 5000 miles of existing sections improved and 400 miles of improved sections widened to two lane carriageway.

A provision of Rs 45 crores has been made for the development of national highways in the Second 5 year Plan. Just like the first 5 year Plan, the main emphasis in this Plan is also on the construction of missing links and bridges and the improvement and upgrading of low-grade sections. The targets aimed are the construction of 700 miles of missing links and 40 major bridges



Maharaja Marthanda Verma Bridge, Kerala



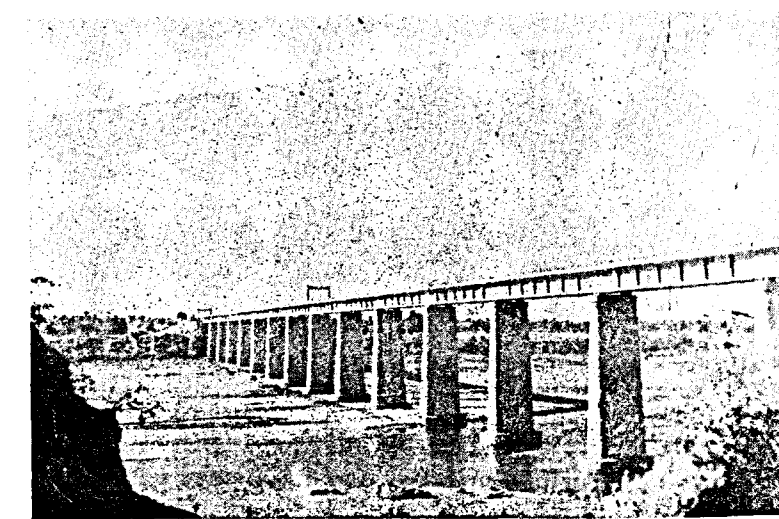
Surya Bridge on mile 89 of Bombay-Ahmedabad Road

and the improvement of 3,500 miles of national highways.

One important feature of the national highway scheme is the provision of bypasses round the congested cities and towns for the benefit of through traffic. Such bypasses are under construction at Wellington near Calcutta, Ahmedabad, Ludhiana, Mathura and Madurai.

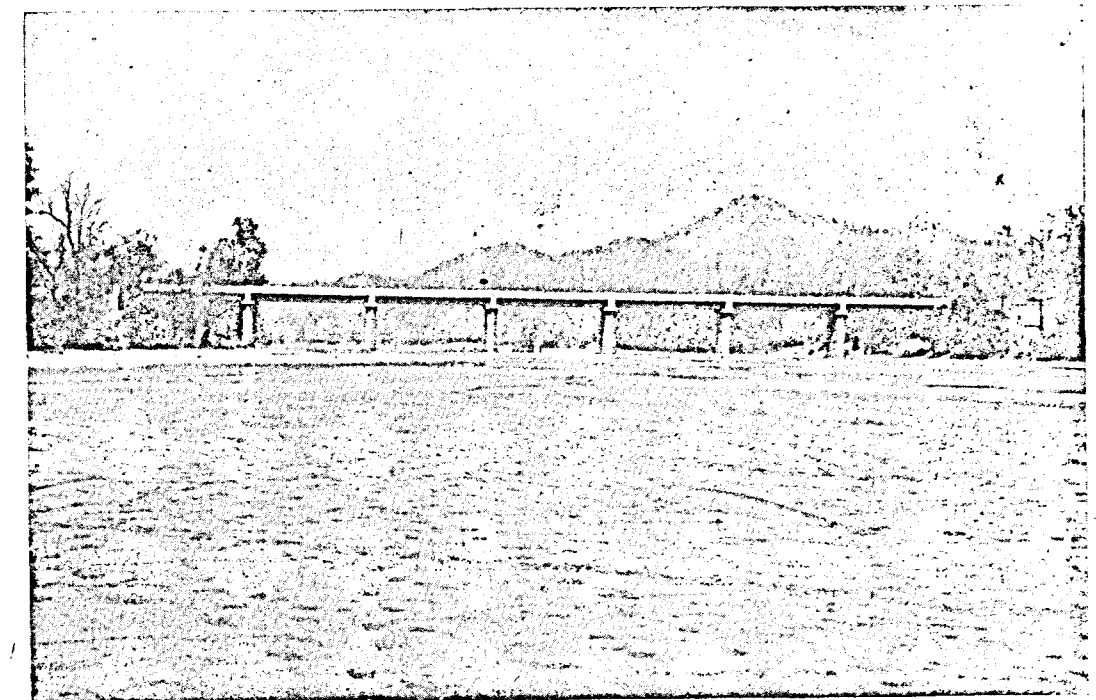
State Roads

Under the Constitution of India, all roads other than National Highways in the States, are primarily the responsibility of the State Govts. or Local Bodies concerned. While, generally State Highways are under the charge of the State P.W.D., District and Village Roads have for many

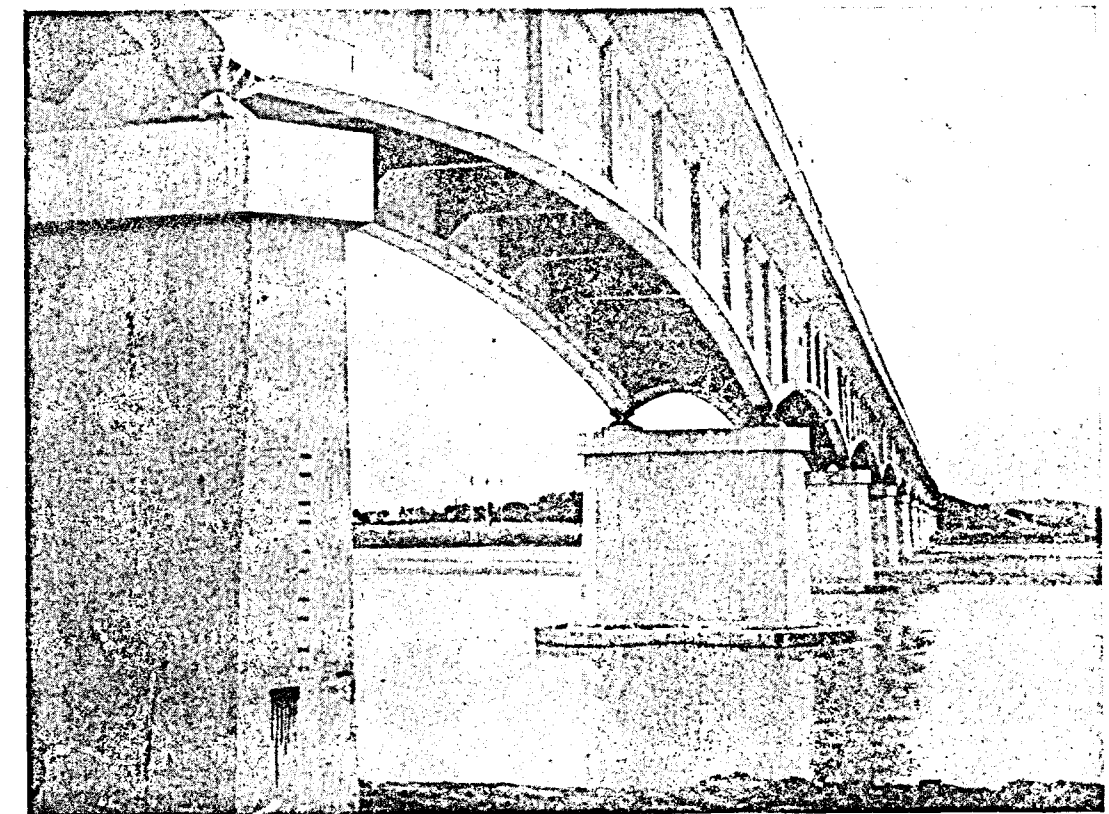


Mahi Bridge at Vasad

I.R.C. SOUVENIR

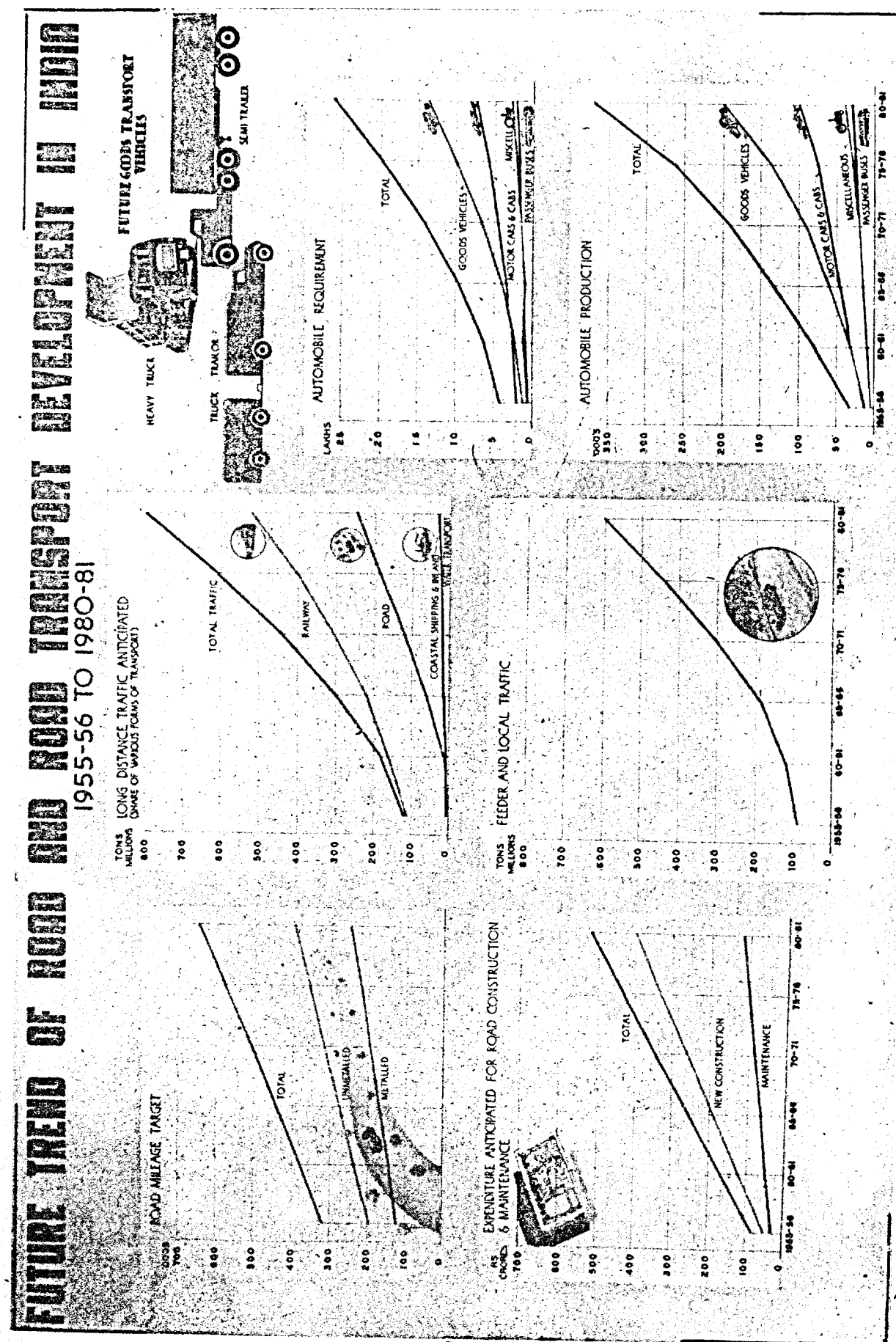


Bridge over North Koel at Garu in Palamau District (Bihar)



Kiul Bridge at Lakhisarai on Barhiya-Lakhisarai-Surajgarh-Monghyr road

SILVER JUBILEE 1934—1959



I.R.C. SOUVENIR

years been the responsibility of Local Bodies. Experience has, however, shown that due to financial limitations, the Local Bodies have not been able to discharge their responsibility effectively. Gradually, therefore, States are taking over responsibility for district and local bodies roads.

State Plans

Expenditure aggregating nearly Rs 100 crores was incurred on roads under State Plans in the first Plan period. A provision of Rs 151 crores has been made for this purpose in the current 5-yr Plan. Under the programmes drawn up by the States and Administrations of Union Territories about 21,000 miles of surfaced roads and 37,000 miles of unsurfaced roads are expected to be added to the road system of the country during the Second Plan period.

Central Aid for State Roads State Roads of Inter-State or Economic Importance

With a view to supplementing the State resources, the Central Govt. have been aiding the development of certain important arterial roads and some selected State roads of inter-State or economic importance in States. A sum of about Rs 7 crores was spent on these schemes in the first 5-yr Plan. A provision of Rs 28 crores has been made in the current 5-yr Plan.

As stated elsewhere, funds are also provided for road development from the Central Road Fund. A sum of about Rs 25 crores is expected to be made available from this source in the current plan both by way of allocations and grants.

Rural Roads

The development of village roads occupies a special place in India which is essentially an agrarian country. The objective of the village road development broadly is to connect the more important villages with the nearest marketing centres or district headquarters so as to facilitate the agriculturists to market their produce easily and economically.

The first major step towards the concentrated development of these roads can be stated to have been taken on 2-10-52 which saw the commencement of Community Development Programmes in our country. A sum of about Rs 11 crores was

spent on roads in rural areas under this programme in the first 5-yr Plan. A provision of about Rs 19 crores exists for roads under the Community Development Scheme in the current 5-yr Plan. The progress made on roads under this programme upto 31-3-58 included the construction of about 8,475 miles of surfaced roads and 70,900 miles of unsurfaced roads.

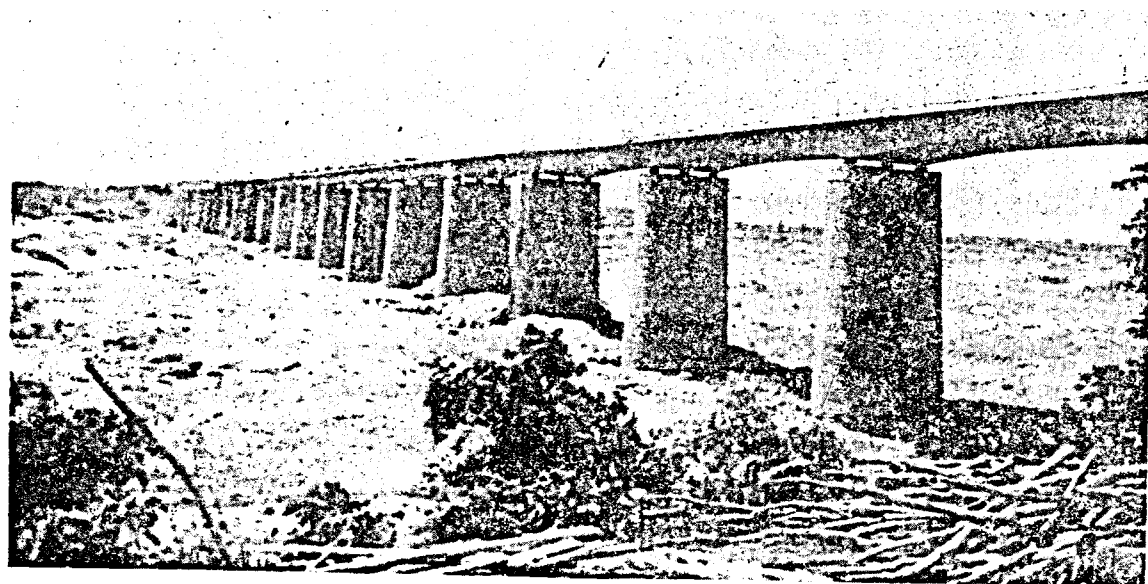
In addition, grants are also given for village roads from the Central Road Fund (Ordinary) Reserve under the Transport Ministry's Village Road Co-operative Development Scheme. In the first 5-yr Plan, grants-in-aid aggregating Rs 60 lakhs were approved to meet 1/3rd of the cost of certain selected works under this scheme, the remaining 2/3rd being shared equally by the State Govts. and the villagers concerned. These grants have been used up and it has been decided to set apart a further sum of Rs 60 lakhs from the Central Road Fund (Ordinary) Reserve for giving grants to State Govts. for the construction of village roads under this scheme during the three-year period ending 1960-61.

Overall Position

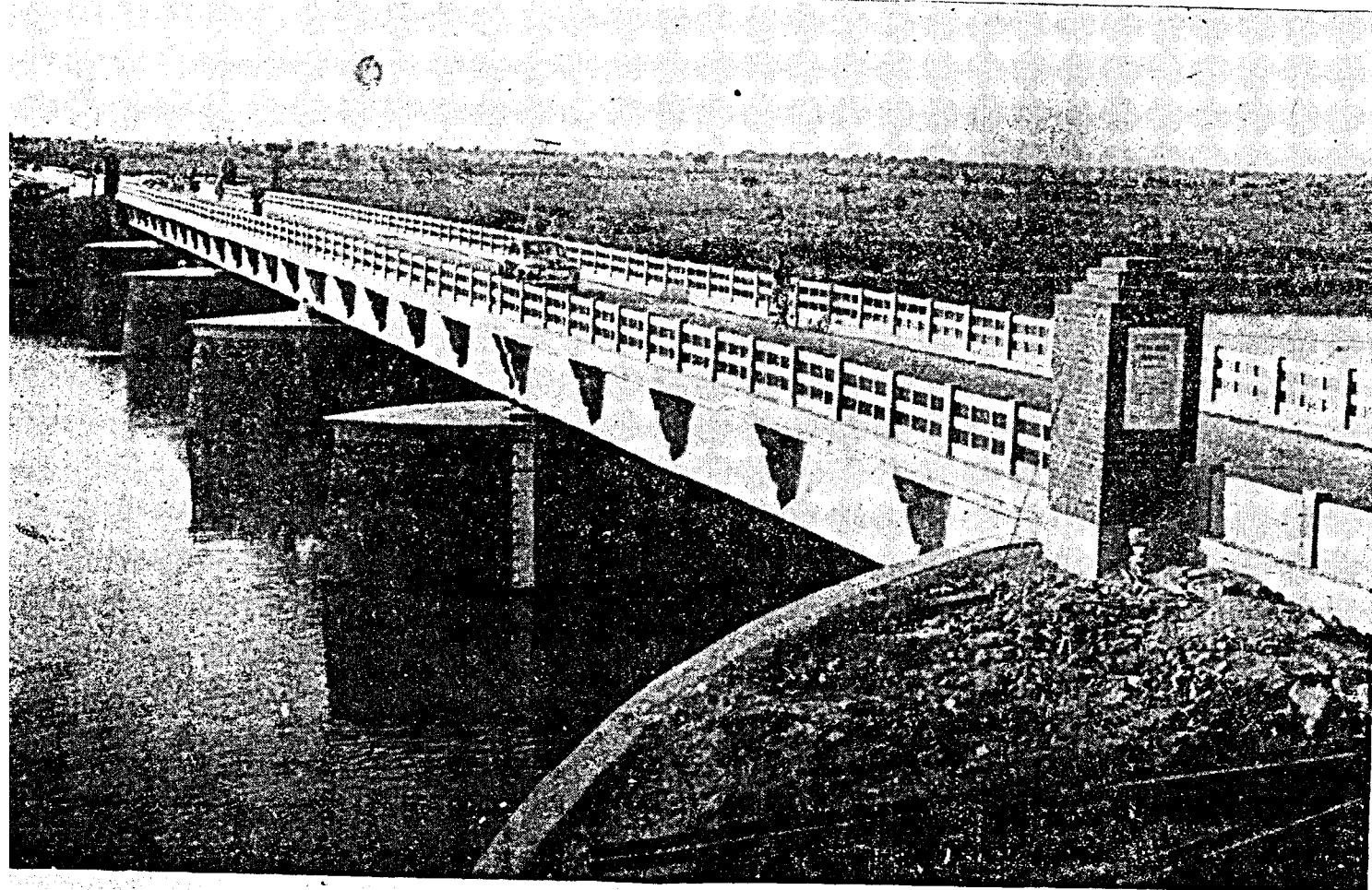
The total outlay on road development in the Second 5-yr Plan discussed above works out to about Rs 268 crores against a total expenditure of about Rs 220 crores incurred during the period from 1943 to March 31, 1956. In physical terms, the progress *vis a vis* the Nagpur Plan targets upto the end of the current plan period is expected to be as under:

	Nagpur Plan target	Position as on 31-3-58	Position as expected on 31-3-61
Surfaced roads	123,000	133,600	144,000
Unsurfaced roads	208,000	224,000	235,000

The Nagpur Plan targets have thus already been achieved fully in respect of mileage and are expected to be exceeded substantially by the end of 1960-61. However, as compared to the needs of our expanding economy, our road system is woefully inadequate and needs to be improved and expanded considerably. Besides, certain deficiencies such as sub-standard surfaces, inadequate road crust, narrow widths and unbridged river crossings still continue in the road system.



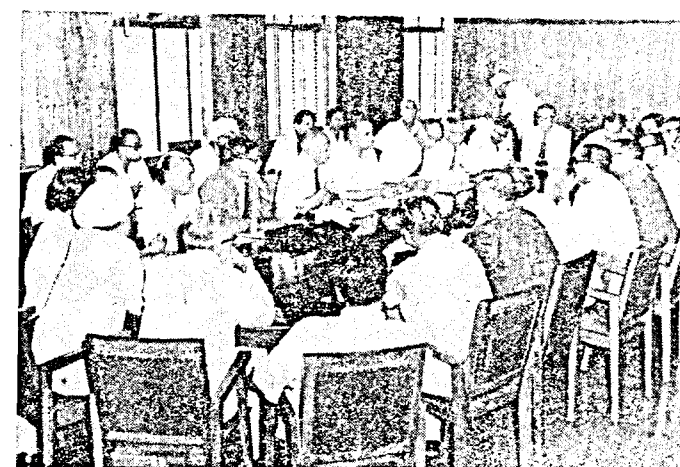
A view of the completed bridge over Betwa River at Jharaghat (U.P.)



The Bridge over River Hindan at Ghaziabad (U.P.)

Twenty-Year Plan

A new long-term plan for road development has now been prepared by the Chief Engineers in-charge of roads at the Centre and in the States for catering to the needs of the country during the next 20-year period ending 1980-81. The Plan envisages increasing the road mileage from 3.79 lakhs as expected at the end of 1960-61 to 6.57 lakhs, so as to have an increase of about 130 per cent in the mileage of National Highways, 100 per cent in the State Highways and about 60 per cent in the case of major District Roads. The total mileage (32,000) proposed for National Highways includes 1,000 miles of what are designated as "Expressways" intended to cater to heavy and fast-moving traffic in the highly industrialised and thickly populated areas. The mileage of "Other District Roads" and Village Roads is proposed to be nearly doubled.



The Chief Engineers considering the Second Road Development Plan

The broad objective of the Plan is to bring every Village—

- (i) in a developed and agricultural area within 4 miles of a metalled road and 1.5 miles of any road.
- (ii) in a semi-developed area within 8 miles of a metalled road and 3 miles of any road; and
- (iii) in an undeveloped and uncultivable area within 12 miles of a metalled road and 5 miles of any road.

The Plan envisages a total outlay of Rs 5,200 SILVER JUBILEE 1934—1959

crores over the twenty-year period ending 1981-82 as indicated below:

	Rs Crores
1. National Highways	980
2. State Highways	1,580
3. Major District Roads	1,360
4. Other District Roads	650
5. Village Roads	630
	5,200

The proposed outlay will involve stepping up the annual expenditure on road development from Rs 80 crores in 1961-62 to Rs 440 crores in 1981-82, the average annual increase being Rs 19 crores. The annual expenditure on maintenance will increase from Rs 30.5 crores in 1961-62 to Rs 135 crores in 1981-82.

The table below indicates the targets aimed at under the Nagpur Plan, the position expected at the end of the current plan and the targets laid down in the new 20-year Plan under reference:

	Nagpur Plan mileage	Mileage expected in 1960-61	Target proposed in 20-year Plan (miles)
(1) National Highways	20,000	13,800	32,000
(2) State Highways	53,000	35,000	70,000
(3) Major District Roads	50,000	95,200	150,000
(4) Other District Roads	70,000	78,300	180,000
(5) Village Roads	138,000	156,700	225,000
Total	331,000	379,000	657,000

The achievement of the proposed targets will give an average of about 52 miles per 100 square miles of area as against about 28 miles existing at present. The Plan is under the active consideration of the Government of India.

Highway Administration

National Highways being a Central subject are being administered by the Government of India themselves. The execution of the work is, however, being done by the State P.W.Ds and in some cases by the C.P.W.D. The Government of India controls the works through the Roads Wing

of the Ministry of Transport and help the State Governments in solving their technical and other difficulties.

The Roads Wing, which is headed by the Consulting Engineer (Road Development) functions on what is called the "parallel" system which envisages a combined technical and secretariat set up.

Roads other than National Highways come under the State sphere of activities. While most of the States have Public Works Departments to look after both roads and buildings, some of the States like Andhra Pradesh and Madras have stolen a march over the other States by setting up separate departments for dealing with roads exclusively. Highway Engineering has already developed into a specialised science and it is time that serious attention is given to the question of setting up of separate highways departments in all the States for dealing exclusively with roads.

Roads in States, especially district and village roads, are looked after by some autonomous bodies also like Local Bodies, Panchayats, etc. Financial limitations and difficulty in attracting suitable technical hands have been serious handicaps with most of these bodies as a result of which their supervision of road works has not proved very fruitful. Provincialisation of the engineering staff of the Local Bodies should improve matters considerably.

Road Research

In a country of the size of India where conditions differ so widely from the swamps of the Sundarbans to the deserts of Rajasthan and the high mountain ranges of the north to the deltaic plains of the east and south-east, it is indeed impossible to evolve any uniform standards for road pavement, etc. The roads have to suit the climate, physical features and soil requirements of each area and any single standard treatment is of limited application.

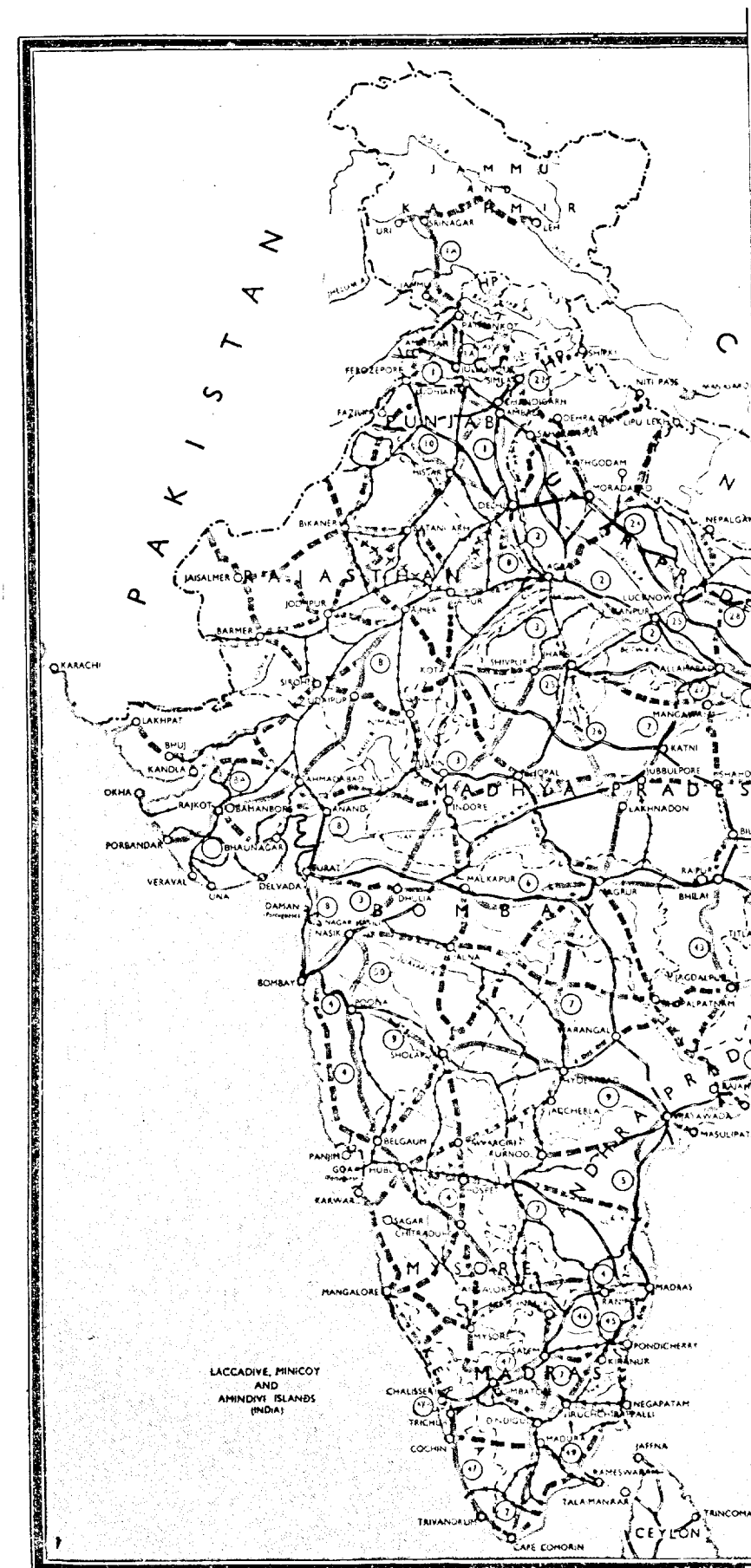
Then, there is the problem of mixed transport. Before motor transport arrived on the scene, road construction and maintenance had to cater for the 8½ million bullock carts and other slow moving vehicles. With the advent of motor transport, however, new problems continuously arise because of changing conditions of transport.

Fully conscious of the need and importance of Highway Research in the country, the Government of India established a Central Road Research Institute at New Delhi in 1952 on the suggestion of the Indian Roads Congress. Some of the State Governments followed suit and set up road research laboratories. Much progress has been made as a result of these measures. Considerable ground, however, yet remains to be covered. It is hoped that in years to come it will be possible to step up the tempo of research work in the country and ere long it will be possible for Government to set up a countrywide network of Highway Research Stations.

Resume

In India our objective is to reach the heart of rural areas everywhere so that even the remotest villages in the country are connected with the main transport system. All our efforts in the field of road development have been concentrated mainly to achieve this objective so far. Account is, of course, also being taken of the rapid changes which are taking place in the scope and character of highway transportation, and due attention is being paid to the needs of high speed and heavy vehicles which are fast increasing in number.

Rapid strides have been made both in regard to the extension of the mileage and the improvement of road surfaces as also bridging of river crossings to achieve our objectives in the field of road development. Considerable leeway, however, yet remains to be made up. The new 20-year Plan which is under the consideration of the Govt. and which aims at nearly doubling up the present road mileage by the end of 1980-81 will be a great stride indeed in the history of road development in the country and will show that roads which, for some time past, had been neglected, are once again in the forefront of the schemes of National Development and the Government is fully conscious of their national value. The time, therefore, is not far off when we will be able to achieve our dream of providing a countrywide network of roads and to take the fruits of our economic renaissance to every individual in the country, no matter where he or she lives.



ROAD RESEARCH IN INDIA

CENTRAL ROAD RESEARCH INSTITUTE, NEW DELHI

1. Introduction

In modern times mobility and efficiency of transportation are prerequisites to the industrial development and economic advancement of a country and this in turn depends, among other things, upon an efficient network of roads. A balanced road system is most vital to the overall development of a country and has become a dire necessity in connection with the Five-Year Plans. Large milages of roads, adequate to the needs of development, have to be constructed economically and maintained efficiently to cater to the ever-increasing demands of modern traffic and transportation.

For designing and constructing roads from the economic and safety point of view and to maintain them properly, it is essential to utilise scientific research methods. Till about the year 1939, road construction techniques in this country followed stereotyped methods of design, construction and maintenance, systematic road research was very limited. Realising the importance of scientific investigations for the advancement of highway engineering in recent years, some road research laboratories have been established with a view to provide solutions to the many problems arising out of large scale road construction. The most important of such research institutions is the Central Road Research Institute established in the year 1952 as one of the National Laboratories in India.

The main objectives of the Central Road Research Institute are: (1) to acquire up-to-date information on road research from all over the world and to apply the results in India after suitable modifications, (2) to improve the existing techniques of road construction and maintenance and provide suitable specifications in conformity with the requirements of the country with special reference to the nature of the local materials available, (3) to investigate the properties of local soils with a view to evolve a cheap type of rural road, (4) to study the characteristics of various cementations of bituminous binders and their

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rational use with locally available aggregates, and (5) to tackle the problems of road safety in relation to the geometrics of highways and the psychology of a road user, so as to make roads safer for all types of traffic.

Effective liaison and co-ordination has been established between the Central Road Research Institute and other Road Research Laboratories in the country through the Indian Roads Congress and the results of research are being disseminated for the benefit of the Public Works Departments of various States and industries connected with road materials like Cement, Tar and Bitumen. Technical advice and aid is being rendered to various organisations. Training facilities are provided to engineers, scientists and university staff as well as to engineering students. On the result of laboratory investigations, experimental pilot plant roads are constructed, to be later on adopted in large scale construction, with a view to achieving economy and efficiency in the various road projects during the Five Year Plans.

2. Functions and Organisation

The Institute provides technical 'know-how' for the construction and maintenance of cheaper, durable and safer roads, the users of the research results mainly being the States P.W.Ds., C.P.W.D., Municipal Corporations, Traffic Authorities, etc. The research activities, conducted in the background of diverse Indian conditions of soil, climate and traffic cover a wide range of highway engineering and traffic subjects.

Research work has been organised under five technical divisions, namely:

1. Soils Division :
2. Concrete Division (Rigid Pavements)
3. Bitumen Division (Flexible Pavements)
4. Roads Division
5. Traffic Engineering, Economic & Statistics Division.

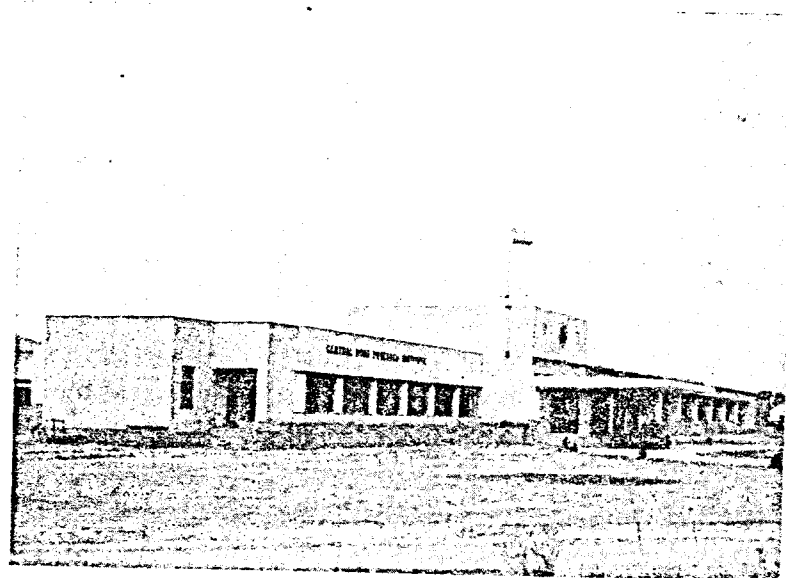


Photo 1. Front view of the Central Road Research Institute

Besides, there is a technical information section which is meant for an effective dissemination of the results of research to the interested parties. During 1959, about 700 organisations and individuals in India and abroad received

publications of this Institute. Other auxiliary sections of the Institute are the Workshop, Library and Intelligence, Administration, Accounts, Civil Works, Photography, Drawing, Purchase and Stores.

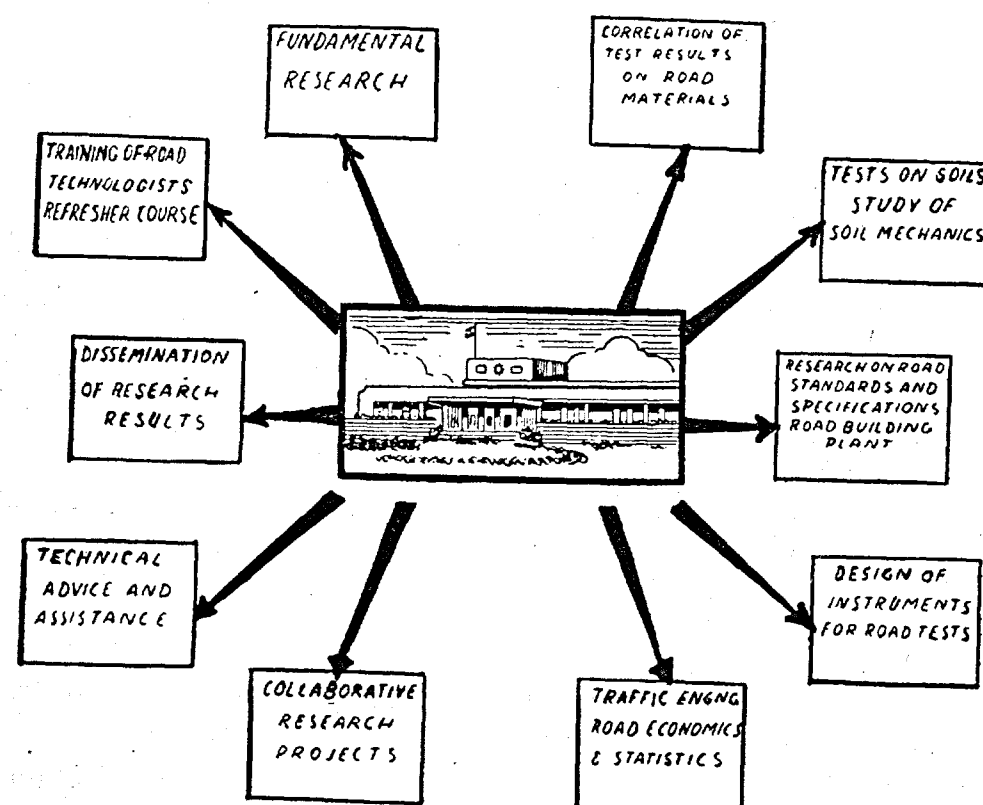


Fig. 1.

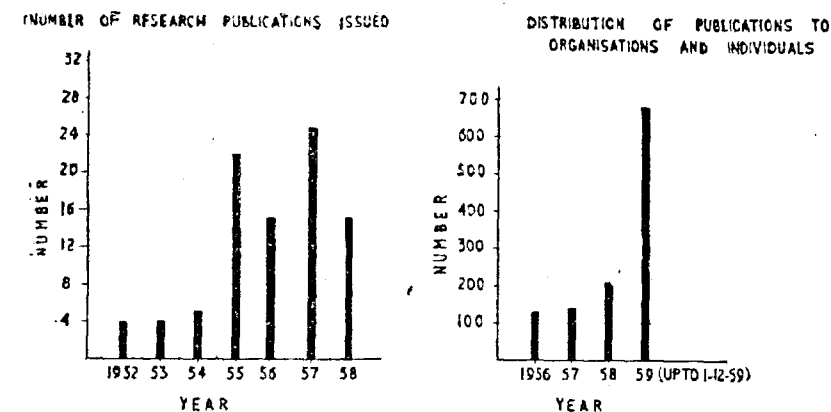


Fig. 2.

3. Research Activities

Applied research and also the required amount of fundmental work on road materials, designs and specifications for roads, and road traffic studies are undertaken in the Institute. Stress is, however, laid on comparatively short-term applied research, the results of which could be used for solution of urgent problems. Generally, such problems, after the completion of laboratory investigations, are subjected to test-track scale and semi-field scale experiments in order to select the most suited specifications. Thereafter, they are further put to full-scale field trials in different regions of the country.

The applied research is directed towards problems such as economy in road construction by soil stabilization techniques. It is also directed towards achieving simplification and standardisation of road construction methods in comparatively difficult areas such as black cotton soil, deserts, water-logged areas, etc., as also towards the improvement of the already existing techniques such as replacing a part of cement by surkhi in concrete pavements, improving the bituminous carpets for increasing wheel loads, etc. Besides, the Institute maintains a separate division to study the traffic engineering problems.

Some examples of the work being tackled in the Institute are given below:

(i) Low cost all-weather stabilised soil roads

With the object of providing cheap all-weather roads within the slender resources available, the Institute has sponsored an alternative method to the conventional W. B. M. usable for a very substantial part of the road construction

programme. The method consists primarily in blending the local soils to produce a soil mixture which would be stable under changing weather and moisture conditions. To increase the load carrying capacity of the blended soil, cheap locally available soft aggregate in the form of brick ballast, kankar, moorum or laterite is suspended in it. The soil holds the aggregate together and also protects it from crushing within the crust, by surrounding each piece. The road consists of two

layers. The lower layer is graded soil compacted at optimum moisture, and the upper layer of the blended stable soil has about 35 per cent of soft aggregate suspended in it to provide abrasive resistance and to increase its load carrying capacity. The upper layer can be given bituminous surface treatment. Over two hundred and fifty miles of road have been constructed by this method during the last many years and the method, having thus stood the test of time, is ready for wide application. In many places where the method is not yet known, small pilot plant roads are being constructed with a view to training the staff and working out the necessary details and adjustments in the various stages of execution to suit local requirements.

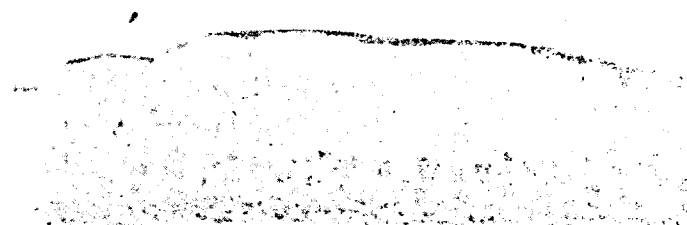


Photo 2. Stabilized soil road crust removed after eleven years service

For providing cheaper roads, soft aggregates like moorum, laterite, kankar etc., from some parts of India, which have been considered unsuitable as road construction materials so far, have been studied in the laboratory and specifications have been proposed according to which it

should be possible, to use the local materials in different parts of the road crust.

The highly clayey Black Cotton soils met with in the Indian plateau, due to their high shrinkage and expansion characteristics, render the task of road construction and maintenance in such areas both difficult and expensive. In this Institute, efforts are being made to stabilize the soil with (1) Lime treatment with and without wood tar; and (2) Heat treatment. Stabilization with lime has given encouraging results in the laboratory as well as in the field. With further development of this lime stabilization technique, it would be possible not only to have better roads in such areas but also much cheaper in cost, as the actual thickness of the hard crust required over treated sub-grade or base would be considerably less. Construction of experimental roads in black cotton soil areas are being contemplated.

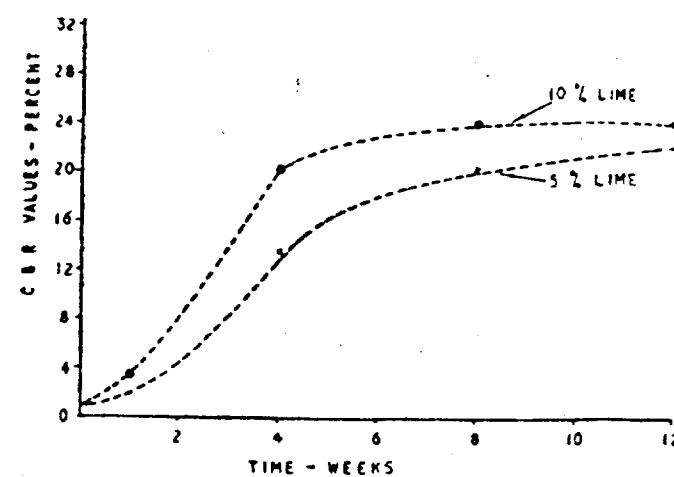


Fig. 3.

(ii) Road construction in desert areas

The desert areas of Rajasthan present a peculiar problem in road construction as there is a great scarcity of both water and conventional road construction material like hard stone. The problem is further aggravated as the sand available is very fine in texture and the traffic is not purely pneumatic. Efforts have been made to solve this problem by stabilizing the available fine sand in road construction. This has been successfully and economically achieved in the laboratory by an admixture of sand with a small percentage of a bituminous cutback. Laboratory results with as many as 50 different specifications are now being tried on a semi-field scale on the test track laid

within the premises of the Institute. After the trials are found to be successful, it is hoped to put up full-scale field experiments.

For concrete road construction in such regions, membrane curing of concrete, instead of water curing, is being tried to economise the use of water which is very scarce and expensive.

(iii) Improving roads in water-logged areas

To tackle successfully the problem of constructing and maintaining roads in water-logged areas, a study has been undertaken at the Institute to work out some specifications, based on laboratory experiments. This might provide the answer to the problem encountered in many parts of the country. A full-scale field test track has been laid on the Delhi-Mathura Road at Palwal by-pass. The main objective of the test track is to evolve suitable techniques to arrest the upward movement of moisture from the sub-grade for roads in water-logged areas.

(iv) Research on concrete for road purposes

Surkhi is widely used as pozzolana in India. An extensive fundamental study of its pozzolanic reaction has been made in the Institute and certain useful results have been obtained. It has been found, contrary to the common belief, that any powdered well-burnt brick does not make good surkhi, since the reactivity of surkhi depends, to a great extent, upon the mineralogical composition of the clay and the temperature at which it is burnt. It has been found that while illite clays like Jamuna clay require burning at 1000° C for maximum reactivity, montmorillonite and kaolin clays should not be burnt beyond the range of 600° C—800° C. Based on these findings, arrangements are being made for a systematic and scientific manufacture of surkhi at various possible centres suitably located with regard to the availability of good clay and existing machinery. It is hoped that the progressively better understanding of the pozzolanic reactions would lead, in due course, to the development of pozzolanic cement which will not only effect considerable economy in cement, but also safeguard against certain detrimental reactions in concrete.

Air-entrainment in concrete besides improving the workability, plasticity and homogeneity

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Photo 3. Test-Track within the premises of the Central Road Research Institute

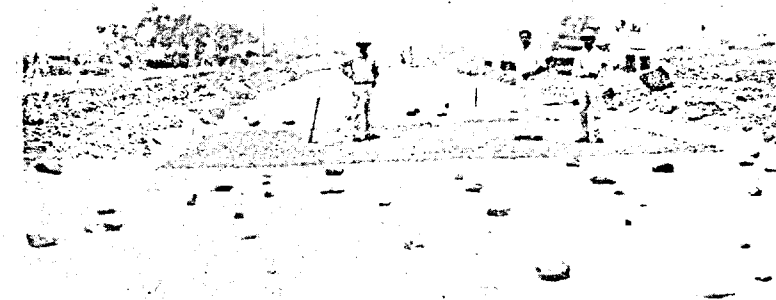


Photo 4. Polyethelene film being spread on the subgrade to check the capillary rise of water

of the plastic concrete also increases the durability to withstand several conditions of weather. Studies to determine the effect of entrainment of air on various properties of concrete, made with Indian materials and tested under prevailing conditions, are being conducted in the Institute. The air-entrained mixes under test contain 4.5 per cent air and are redesigned by reducing the W/C ratio and S/A ratio.

(v) Research on bituminous materials and pavement construction

Because of their high phenolic content and low viscosity, low temperature tars are not suitable for road construction purposes. Suitable treatments of these tars, such as strength distillation, treatment with Formaldehyde, petrol, blending with asphaltic bitumens etc., are being worked out to render them usable in road construction.

Their field behaviour is being studied in small stretches, laid within the premises of the Institute. Similarly, a detailed analysis of various grades of tars obtained from different organisations in India has been made with particular reference to the latest developments in road tar manufacture and research.

Work on design of dense graded mixtures, open graded premix carpets, surface dressing, weathering and oxidation of road tars, etc., are in progress to improve the existing construction techniques, specifications, and materials for road surfaces.

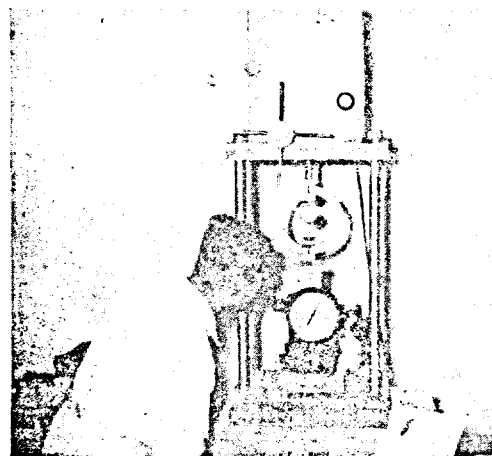


Photo 5. Testing the stability of dense carpet by Hveem method

(vi) Pavement designs

An all-India investigation for evolving a method for design of flexible pavements for conditions prevalent in India is afoot in the Institute. The investigation comprises a survey of the service conditions of various types of flexible pavements in India with the object of recommending the best suited design methods of flexible pavements and to amend, if necessary, the already available design curves for such roads, so as to render them more appropriately applicable to Indian conditions of traffic, climate and sub-grade soils.

An all-India project for determination of the sub-grade moisture conditions under roads and runways has been completed and laboratory studies are under way on the basis of information obtained with a view to lay down the ground

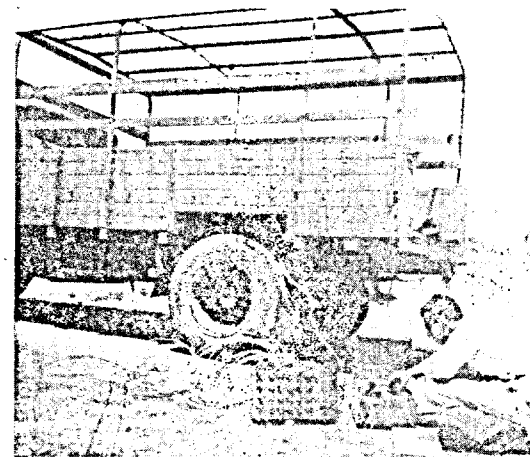


Photo 6. Measuring induced stresses in the road pavements due to static load

moisture criteria to be taken into account while designing the thickness of the flexible pavements in different regions.

An important contribution made by the Institute to applied highway engineering in the background of existing conditions has been the establishment of a case for scientific compaction of the top 12 to 15 inches of the embankment to enable it to act as an effective part of pavement thickness. The investigation makes it possible in practice to build new roads (at only very small extra cost and with the existing resources) in such a way that they will carry the increased present-day traffic without detrimental deformation.

(vii) Traffic safety problems and traffic surveys

Of late, the subject of traffic engineering has assumed great importance in India. There has been a marked increase in the fast moving pneumatic tyred traffic to feed the rapid industrialisation in the successive Five-Year Plan periods. The increase in motor traffic has not only caused an increase in the incidence of road accidents but also created the problem of handling the mixed traffic of slow and fast moving vehicles. Whether we like it or not, the conventional iron tyred slow-moving bullock-cart will remain for a long time to come on our roads side by side with the most modern mechanical transport of every kind. A solution for efficient movement of the mixed traffic has to be found out. The problem is to be tackled by scientific and systematic study of road accidents,

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improving upon the geometric design of road crossings to suit the traffic conditions, adjusting the timings of traffic signals, designing the road widths in relation to traffic, devising and adopting suitable statistical techniques for traffic survey and by conducting traffic surveys to relieve traffic congestion. Studies on some such lines have been conducted in the Institute. Field studies are being conducted in Delhi as a model city in collaboration with certain organisations connected with traffic problems. It has also been possible to implement some of the findings.

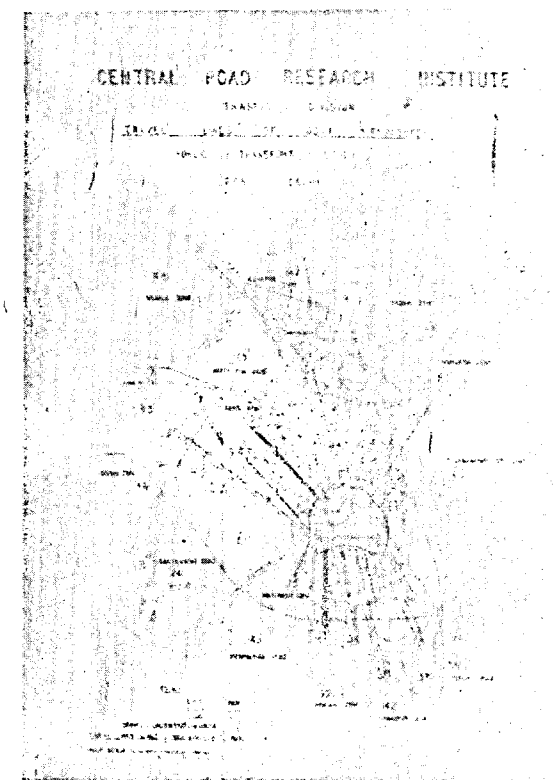


Photo 7. Origin and Destination Traffic Survey—the inner and outer cordons showing the different stations in Delhi where the survey was conducted

An important study conducted by this Institute jointly with the Town Planning Organisation is the Origin-Destination traffic survey of Delhi. This survey will help to locate new and more direct roads to pass through the city or bypass it with a view to relieve congestion in many areas of the city. The survey will further help in planning facilities for different types of traffic in relation to different income groups, residential colonies, and other neighbourhood units.

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Advice on Important Projects

The significant role of the Institute in the practice of the profession and in usefully and effectively helping the road industry and traffic authorities in the country is spot-lighted by the following more important works handled for outside organisations:

(i) Design of Factory and Township Area Roads of Heavy Electricals (P) Ltd., Bhopal, M. P.

At the instance of the factory authorities, detailed designs for each category of road were prepared taking cognizance of prevailing site conditions, local materials and the traffic load and volume expected on them. The site is located in black cotton soil area and at places has a heterogeneous sub-grade strata resulting from irregular filling. The traffic expected on some of the roads is exceptionally heavy. The construction work of the recommended system, estimated to cost Rs 9 millions, is in progress.

(ii) Design of the Eastern Express Highway, Bombay

This problem was referred to by the P.W.D., Bombay. A long section of the proposed highway is routed over low lying tidal flats randomly dissected by a number of meandering creeks subject to tidal action. The sub-soil is of high compressibility and of inadequate shear strength.

To obviate the effects of detrimental differential settlement of failure of the underlying soft clay layer, different methods of construction have been recommended. For most of the zones 'over-building' of embankment and adoption of 'stage construction' has been recommended. In some sections, use of light-weight materials such as cinder has been recommended. In some stretches, in view of the light construction schedule, some methods of expediting the settlement such as the installation of vertical sand drains have been recommended.

Construction of the embankment on the basis of these recommendations has commenced since the beginning of 1959.

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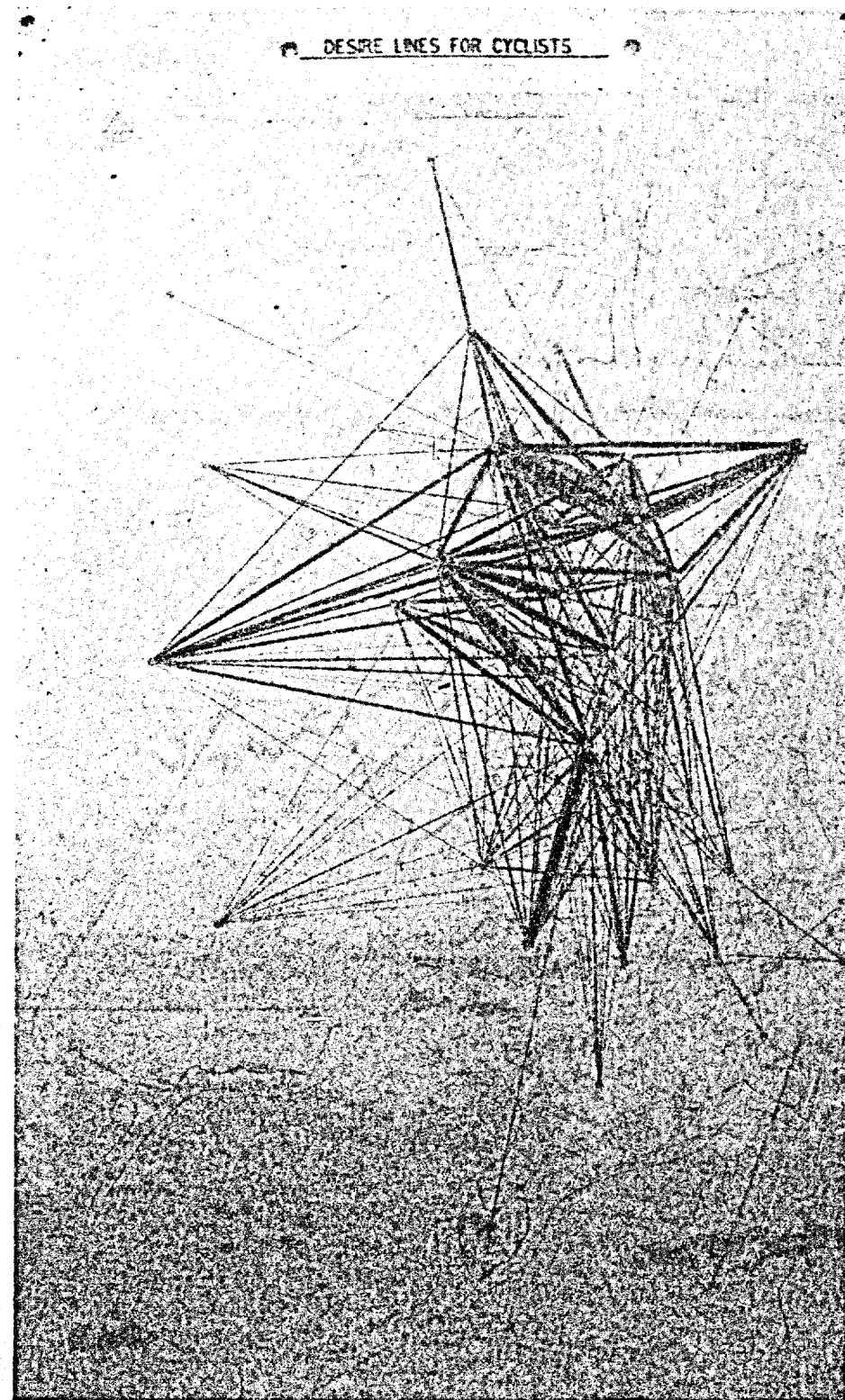


Photo 8. Origin and Destination Traffic Survey of Delhi—the "Desire Lines" for fast-moving Vehicles

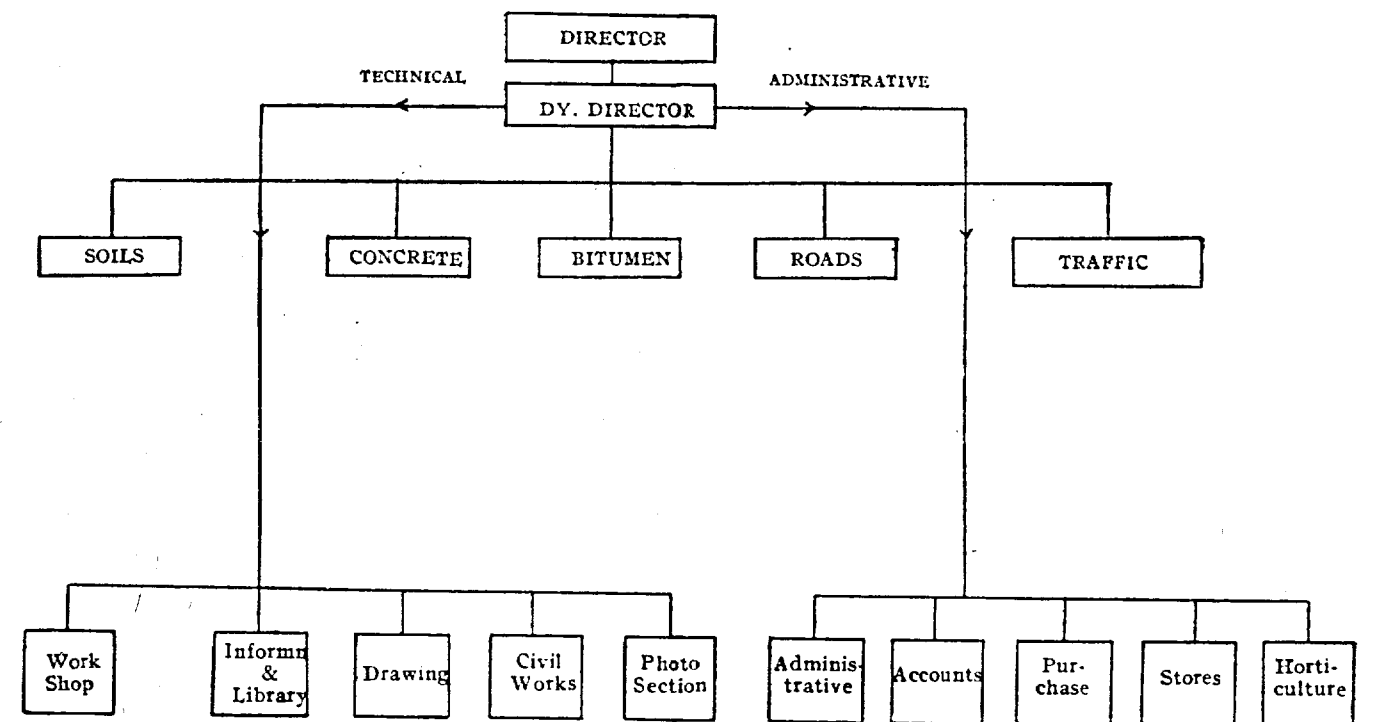


Fig. 4.

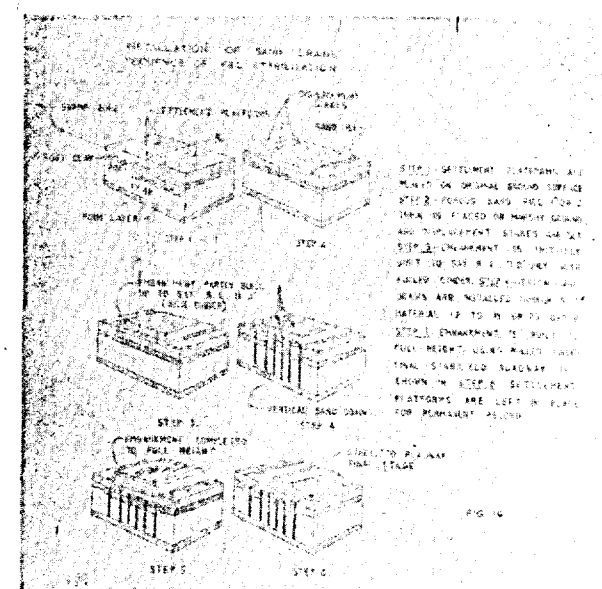


Photo 9. Sequence of Installation of sand drains

(iii) Investigations of road failures in different parts of India.

Investigations on road failures in different

parts of India were conducted and the concerned authorities advised accordingly. Some more important investigations on failures were conducted on the following roads:

- (a) Concrete road between Belgaum and Khanapur in Mysore state.
- (b) G. T. (Bituminous) road between Delhi and Karnal.
- (c) Road failures in water-logged areas of some parts in north western India.

Besides, some airfield pavements were tested for evaluation of the existing strength and, in certain cases, designs for further strengthening them were prepared.

- (iv) Certain local bodies and State Governments have been advised on important improvements of road intersections, pedestrian crossings, traffic signals, etc.

ANDHRA PRADESH ENGINEERING RESEARCH LABORATORIES

It was in 1936 and subsequent years when Dr. S. P. Raju was the Professor of Hydraulics in the Engineering College of the Osmania University and the present Director was working as his assistant, that the Public Works Department of the then State of Hyderabad referred several problems to him for investigation on model studies in his laboratory. The more important of these were the failure of the causeway across Allair river on the Hyderabad-Warangal road, some problems in connection with the proposed Tintini bridge across the Tungabhadra and protective works below the flood gates of Nizamsagar Dam. All these problems were successfully investigated and recommendations based on the model studies conducted at the hydraulic laboratory were sent to the P.W.D. The Government realised that there should be a special department to conduct research on all problems which the irrigation and highway engineers have to face. This resulted in the Engineering Research Department of the Government of Hyderabad being established in the year 1945 with Dr. S. P. Raju as its first Director.

There are several engineering research organisations in India which were functioning even before 1945 when this research department was inaugurated. These were mainly Irrigation Research Stations which chiefly dealt with hydraulic problems in connection with various irrigation projects of their States. The foremost amongst them were the Research Station at Khadakwasla under the Central Government, the Punjab Irrigation Research Institute at Lahore with its field Station at Malikpur, the U.P. Irrigation Research Institute which was first functioning at Lucknow and then shifted over to its present location at Roorkee with its hydraulic laboratory and field station at Bahadrapur, the River Research Institute of West Bengal and the Irrigation Research Laboratories at Poondi, Madras. All these research stations were primarily interested in irrigation problems and river training works. But the Engineering Research Department of the Government of Hyderabad was established as a multi-purpose organisation to deal with engineering problems

confronting all the engineering departments of the State like irrigation, highways, buildings, public health, etc. This multi-purpose concept of the Research Station has resulted in considerable savings with respect to buildings, administrative set up and equipment of the various laboratories.

When the states of India were re-organised in the year 1956, the entire Research Department of the State of Hyderabad was allotted to the Andhra Pradesh State. Thus this department continued as a multi-purpose organisation catering to the research needs of all the engineering departments of the new state of Andhra Pradesh. At present the following laboratories and sections are working under a Director who is responsible for the initiation and co-ordination of the various researches conducted in them:

1. Hydraulic Laboratory
2. Soil Mechanics Laboratory
3. Engineering Materials & Structures Laboratory
4. Engineering Physics & Chemistry Laboratory
5. Mathematics and Statistical Section.

In all the above laboratories and sections, problems dealing with the concerned subjects for all the engineering departments of the state are being successfully conducted. Thus in the Hydraulic Laboratory, in addition to problems on irrigation projects, researches in connection with the design of causeways, river training to protect bridges and other structures are conducted. Similarly, the Soil Mechanics Laboratory, conducts all soil investigations for irrigation, highways and buildings departments. The Engineering Materials and Structures Laboratory does the same in connection with materials other than soils.

During the thirteen years that the several laboratories have been functioning in this department, several research problems in connection with highways have been completed. The following paragraphs give a brief outline of the more important investigations conducted in the several laboratories in connection with highway research.

1. Hydraulic Investigations

1.1. Causeways: Numerous causeways were constructed by the Roads Department of the Hyderabad P.W.D. across streams and minor rivers of the erstwhile Hyderabad State. Many of these were founded on sand or other erodible material in the river bed. These were provided with either hume pipe vents, slab vents or arched vents. Several of these failed during heavy floods. Reasons for the failure of several of these causeways were investigated on scale models in the hydraulic laboratory and recommendations were made for their reconstruction so that such failures may not occur in future. After reconstruction these have been behaving extremely well and no further trouble has been reported. Two typical examples of such causeway failures and recommendations are:

1.1.1. Alair Causeway: This causeway on Hyderabad-Warangal road was originally provided with hume pipe vents only for a part length in its central reach. During a heavy flood which

these locations. On the basis of these investigations, it was recommended that where the river bed is of sand or other erodible material, the entire length of the causeway should be provided with vents. After this causeway has been reconstructed as recommended no further damage has occurred. All causeways and submersible bridges constructed across streams with erodible beds are now provided with vents along their entire lengths.

1.1.2. Peddavagu Causeway: This high level causeway across the Kudlair river, provided with 25 arched vents, failed in a novel manner during the 1947 floods. This failure was due to the fact that practically all the vents in the central portion of the causeway were blocked by brush wood resulting in deep erosion of the river bed upstream of the causeway with the result that the causeway tilted over to the upstream. The model investigations confirmed this and on the basis of several model tests carried out, an upstream apron was recommended in reconstructing the causeway. The causeway has since been reconstructed as per



Photo 1. Peddavagu Causeway; Failure due to chokeage of centre vents

occurred about 25 years back this causeway failed by the settlement of the structure adjacent to the vented portion on either side. Investigations carried out on scale models by Dr. S. P. Raju have established that the failure was due to vortex action adjacent to the vents which resulted in the heavy erosion downstream of the causeway at SILVER JUBILEE 1934—1959

recommendations and no further failures have occurred.

1.2. River training to safeguard highway structures: In several cases, causeways and bridges have not been properly located with the result that the structures are either outflanked or

threatened to be outflanked by the rivers. In such cases, investigations are carried out on scale models of the rivers and the locations, alignments and lengths of the river training devices like spurs, groynes and pitched islands are determined. One typical example of such river training works to protect a causeway from failure due to outflanking is the case of the Shahbazpalli causeway. This causeway across Shahbazpalli stream on Karimnagar-Kamareddy road failed no less than three times since it was constructed. The failure was due to the fact that the causeway was located at the downstream end of a sharp curve in the river which resulted in the concave bank of the river

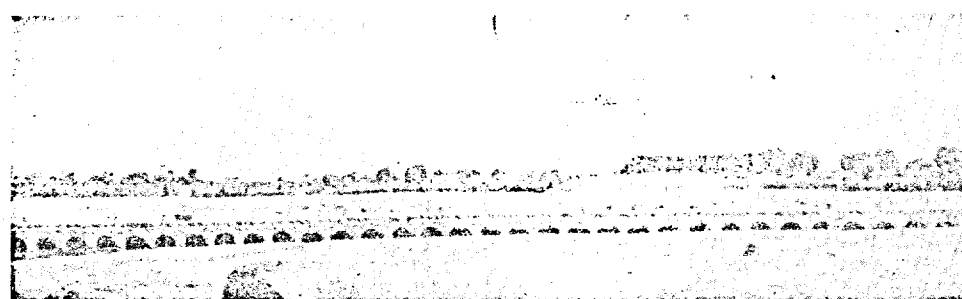


Photo 2. Shahbazpalli Causeway, with the protective spur in the background

being eroded during floods thereby resulting in the out flanking of the causeway. A series of investigations were conducted on scale models of the river to determine the location, length and alignment of the spur which would protect the concave bank of the river at the site of the causeway from erosion. Based on the results of these model investigations, a spur was designed which would safeguard the causeway from being out flanked by the river. This spur has been constructed and since then there has been no further trouble with this causeway.

2. Testing of Construction Materials

Materials referred to these laboratories for testing include concrete and concrete materials for bridges and pavement slabs, and road aggregates for use in macadam surfaces and black topping. The following are the more important of such investigations conducted in recent years.

2.1. Concrete for the Bhima bridge: After the masonry arch bridge across the Bhima River on the Gulbarga-Sholapur road was washed away in 1946, an R.C.C. bridge with portal type piers

was proposed. As a high grade concrete suitable for working stresses as high as 900 psi in compression was specified in the design, available materials were sent to these laboratories for testing and designing a suitable concrete mix. A 1:2:4 mix with a water cement ratio of 0.55 and a slump of 2 in. to 3 in. to give an ultimate crushing strength of 3,000 psi was recommended. Tests performed later on field specimens during construction showed good control.

2.2. Concrete for road works in Warangal: Concrete materials and road aggregates proposed to be used in road bridges and black topping work

in Warangal were referred for tests and recommendations as to their suitability for use for various purposes. Concrete mixes using specified cement content of $18\frac{1}{2}$ to $18\frac{3}{4}$ bags per hundred cubic feet of concrete were designed. In addition suitable aggregates were recommended for use in black topping.

2.3. Quality concrete for air craft runways: High quality concrete was specified for the construction of certain important aircraft runway slabs. Detailed investigations were made on the available aggregates. The aggregate was separated into as many as five fractions and re-mixed in suitable proportions to obtain optimum grading. The result was a highly economical mix with very satisfactory workability and strength fully satisfying the design specifications. The laboratory also carried out all the field control tests during construction. Excellent control with a coefficient of variation well within ± 10 per cent was maintained.

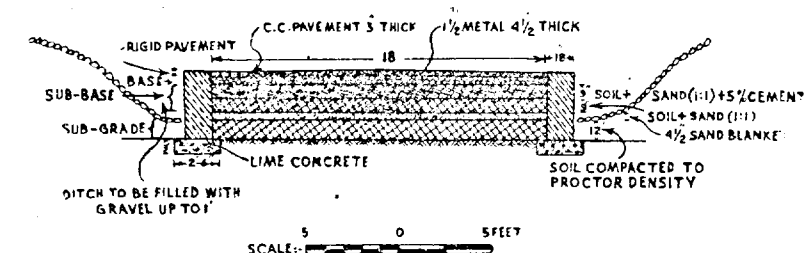
2.4 Reactive concrete aggregates: A reinforced concrete deck slab of the bridge across the

Upputeru river near Gudur, Nellore District was found to have suffered an apparent expansion of about one inch in a total length of about 70 feet within a few months after construction which is abnormal. It was suspected that the aggregate used might be alkali reactive and the cement a high alkali type. Samples of these materials used were sent to the Laboratory for investigations. Preliminary tests have shown that the aggregate is rather soft and has low resistance to weathering. Further tests to assess the alkali aggregate reactivity of the aggregates are in progress.

2.5. Tests on road aggregates: Road aggregates are tested regularly for abrasion, impact and durability characteristics and advice given to the concerned authorities to help them select suitable material. Several cases of unsound, soft and otherwise unsuitable materials were investigated and such quarries were duly rejected on the recommendations of the laboratory.

3. Design of Stabilised Soil for Road Sub-bases and Surfaces

Several cases have been referred to these laboratories for investigating the possibility of stabilising available clayey or silty soils, either mechanically or otherwise, to render them suitable



Stabilised sub-base design for approaches to Shankerpally Causeway

for use as road sub-bases and wearing surfaces. A few such problems which have been successfully tackled are briefly described below:

3.1. Soil cement stabilised sub-base for the approaches to Shankerpally causeway: The approaches to Shankerpally causeway across the Musi river are taken in cutting, passing through deep B. C. soil terrain extending to a depth of 20 feet

or more for a length of about 800 feet on either flank. To surmount the serious difficulty in getting soling stones for the approaches, a stabilised sub-base was proposed. Detailed laboratory and field investigations of the subgrade soils were conducted. Based on these test results, a 12-inch thick mechanically stabilised subgrade overlaid by a 18-inch stabilised sub-base was recommended. The sub-base consists of subgrade soil mixed with sand in 1:1 ratio and a top layer of soil-cement stabilised course using the subgrade soil mixed with sand 1:1 ratio with five per cent cement. The work has been completed according to these recommendations and the causeway is giving satisfactory service.

3.2. Design of stabilised soil sub-base at Gudur in Nellore District: A diversion road on the Madras-Calcutta National Highway to bypass Gudur town, is being constructed between Mile 83/1 and Mile 85/8. Three types of sand and one soil sample were sent to the laboratory for suggesting a suitable blend for use as sub-base. The soil and sand were mixed in different proportions and, based on C. B. R. values, a soil-sand mix of 3:1 has been recommended.

3.3. Stabilised soil-sand surface for the approach road to Paleru Anicut project: The

approach road to the Paleru Anicut project about 6 miles in length passes through fields consisting of plastic soils. These soils become slushy just after rains and the movement of vehicles to the project site is impeded. As the approach road is to serve only till the completion of the project, it was suggested that a stabilised soil-sand surface in the ratio of 2:3 might be tried.

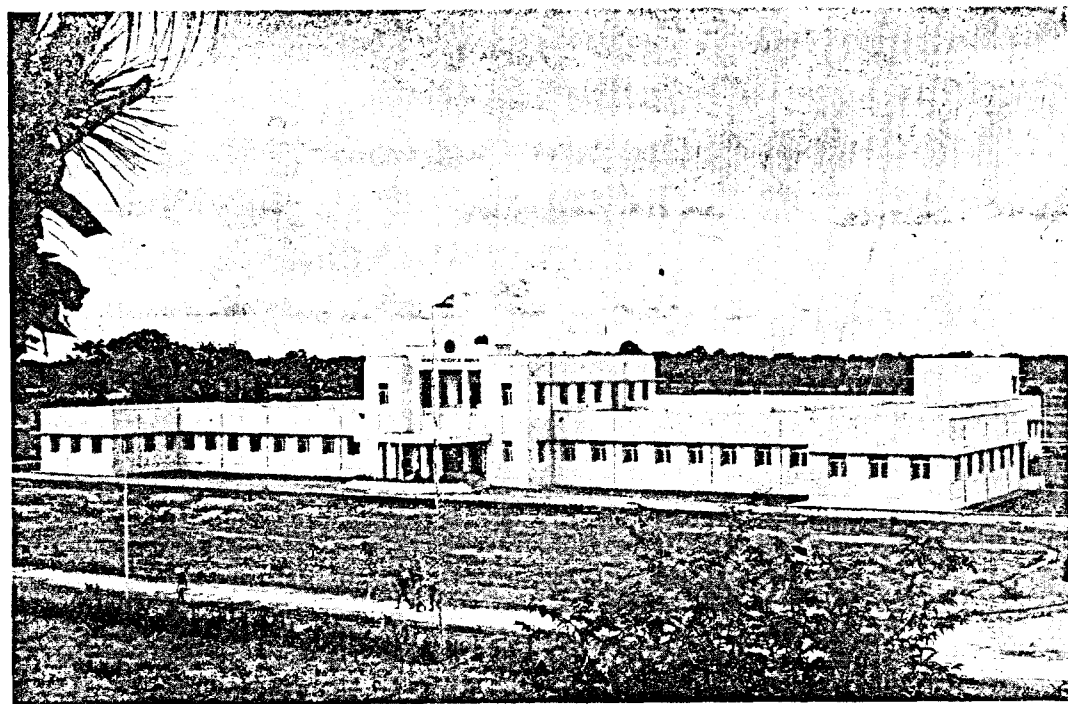
HIGHWAYS RESEARCH STATION, MADRAS

1. Introduction

In the past traffic consisted mostly of animal drawn iron tyred vehicles. With the rapid growth of traffic, the enormous increase in speed, weight, and number of motor vehicles, the conventional methods of road construction have become obsolete and a radically new approach to the problem of highway planning, design and construction is called for. The Highways Engineer to day has to tackle manifold problems ranging from modernization of the existing network of roads to suit the changing traffic pattern, to the designing of highways to cater for the future increase on an economical basis, and developing alternatives to traditional manual methods of construction by the use of machines.

The basic problems are essentially the same in all countries, although differences in climatic and traffic conditions may well change the emphasis. In India, the problems in the Gangetic plains of U. P. and Bengal, deficient in road stones, in Assam subjected to heaviest rains, are very

different from those in Madhya Pradesh with black cotton soils; areas with heavy rainfall will have skidding problems that hardly occur in places with poor rainfall. Areas deficient in road stones will have special problems in surfacing which will be out of place in States like Madras with abundant sources of good road materials. Naturally varying conditions of geology, geography, traffic, and climate that exist in this vast sub-continent, require zonal road research stations, to serve representative areas, charged with the task of investigating problems of regional importance. So proposals for establishment of a Research Station were put before the Government of Madras on 11-6-1951 and the Government of India agreed on 25-9-1952 for charging the entire expenditure for building and equipping the research station to the Central Road Fund allocations of Madras. They have also agreed for giving a recurring grant not exceeding Rs 15,000 a year from the Central Road Fund reserve towards half the annual cost to cover the works expenditure and to serve the Southern Zone in the matter of



Highways research station, Madras

tests and experiments. The work was commenced on the 3rd February 1956 and completed in a record time by November 1957.

Location and Layout

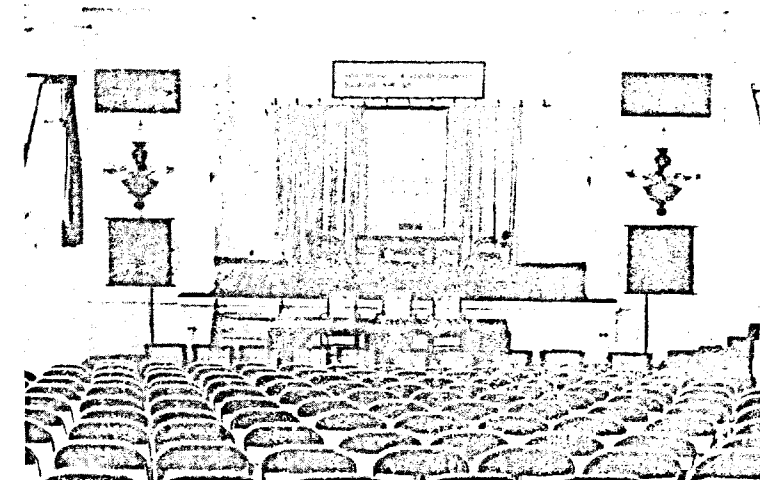
The site proposed for locating the Highways Research Station is about thirty five acres in extent and adjoins the Engineering College, Guindy, on the western side. The site chosen is ideal for research activities, set in the campus that includes institution like Alagappa Chettiar's College of Technology, Central Leather Institute etc., engaged in similar research work.

The Advisory Council

The research work is proposed to be guided by a Research Advisory Council working in close co-operation with the highway engineers of the state, industries concerned with the manufacture and supply of road materials, traffic and transport authorities, representatives of technical institutions and authorities of the city administration.

The members of the Council are:

1. Chief Engineer, P.W.D. and Director of Technical Education.
2. Superintending Engineers (Circles).
3. Divisional Engineers (one from each circle).
4. Professor of Civil Engineering (Highways), College of Engineering, Guindy.
5. An Engineer representative from the traffic department.
6. An engineering representative from road transport industry.
7. An engineering representative from bitumen industry.
8. An engineering representative from cement industry.
9. Consulting Engineer or his representative from Ministry of Transport and Communications, Government of India.
10. A representative from Indian Roads Congress.
11. City Engineer, Corporation of Madras.



A view of the auditorium of the research station

The committee advises on what investigations will be undertaken, their priorities, and reviews and verifies the result of all the studies before they are applied in the field.

Sections of the Laboratory

The activities of the laboratory can be broadly divided under the following headings:

1. Soils: Classification and testing of soils to provide foundation and pavement designs
2. Concrete: Design of concrete mixes and control of the quality.
3. Bitumen: Routine test of materials and mixes used in road construction.
4. Bridges and Miscellaneous road elements and structures: Testing of bridges, new and existing.
5. Road location, layout of junctions and designs of inter-sections, traffic flow, road safety and surface characteristics.
6. Library services: Consideration of new specifications and interpretation and revision of specifications to meet the new conditions, as they arise.

The laboratory is divided into four main sections:

1. Soils and Aggregate
2. Concrete and Structures
3. Bitumen and Tar
4. Traffic and Safety
5. Information Dissemination.

ORGANISATION CHART

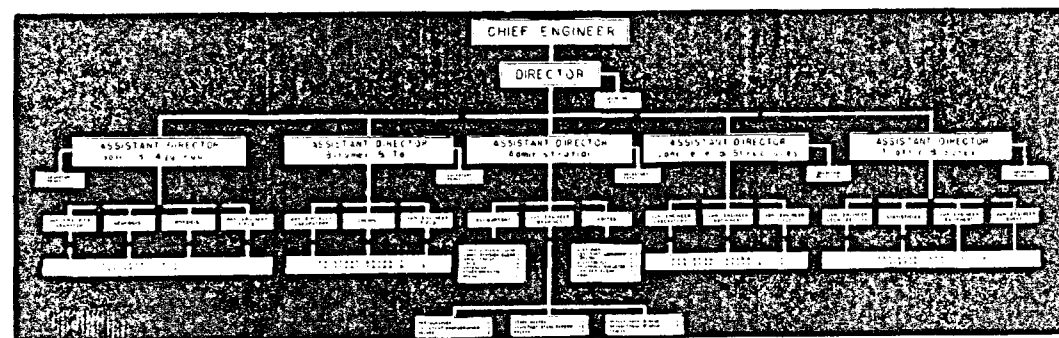


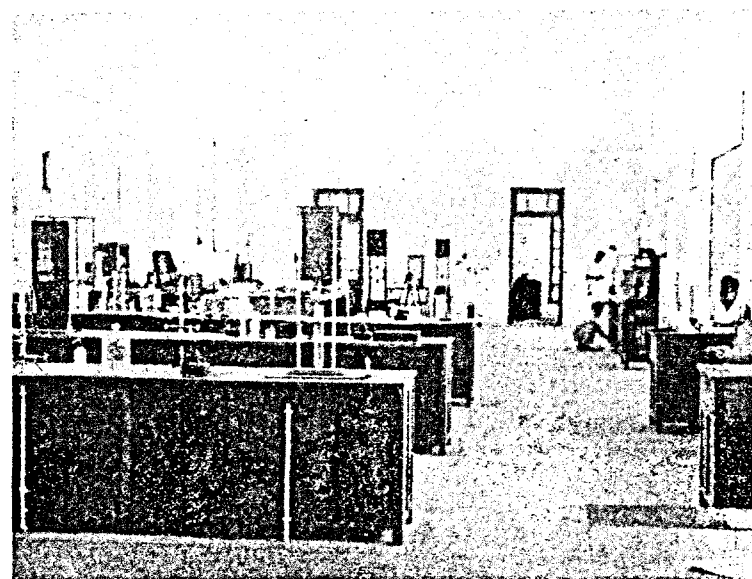
Fig. 1.

Fig. 1 is the chart showing the ultimate set up for controlling these sections. At present, however, each laboratory is being run with one senior Assistant Engineer, assisted by a Junior Engineer, one Research Assistant and a few Laboratory Assistants in proportion to the volume of work.

2. Soils Section

General

The soils laboratory is equipped with almost all the necessary equipment.



A view of soils laboratory

Its activities as at present may be divided as follows:

- (a) Soil testing for pavement design for new works and improvements to existing road structures and soil stabilisation.

- (b) Soil testing for design of bridge and building foundations.
- (c) Soil and other field testing for the investigations of road failures.

Particulars of stabilised soil roads in Madras State

The following are some of the important works so far taken up in this State and the design specifications etc. adopted in each case are indicated.

- (1) Tuticorin-Tiruchendur Road via Mukkani about 12 miles.
- (2) Ramnad-Mandapam road 71/5 to 93/2.
- (3) Kovalam — Mahabalipuram road.
- (4) Thiruvannamiyur-Muthukadu road.

Experience of soil stabilization work applied to the roads in Madras State shows that it (a) is limited as a base to carry a surfacing of higher grade material such as water-bound macadam or bituminous course; (b) can be used as a form of subgrade treatment, the object being to improve the bearing capacity of the foundation; (c) should comprise a layer

the thickness of which is based on the bearing capacity of the subgrade; (d) should have a surface of sufficient thickness to give it full protection from traffic abrasion and weathering.

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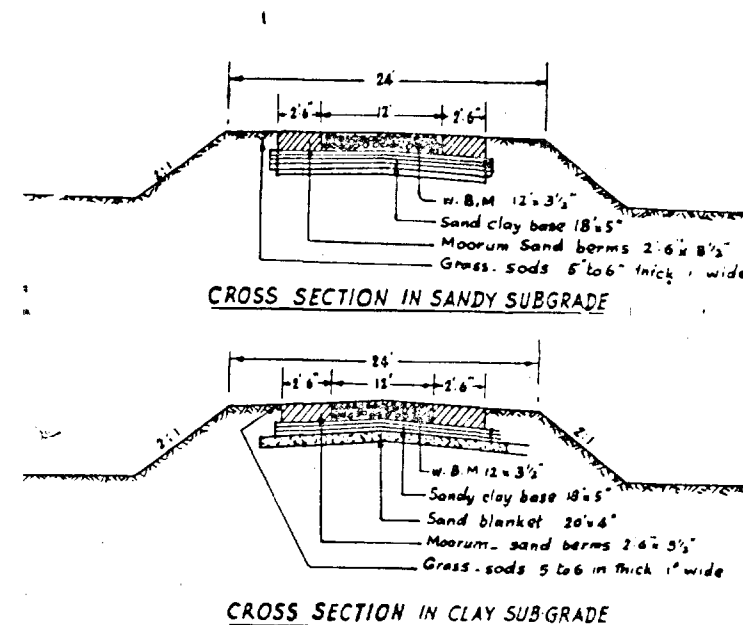


Fig. 2. Tuticorin-Tiruchendur road—Mile 1/5 to 13/3
Year of construction 1951-52.

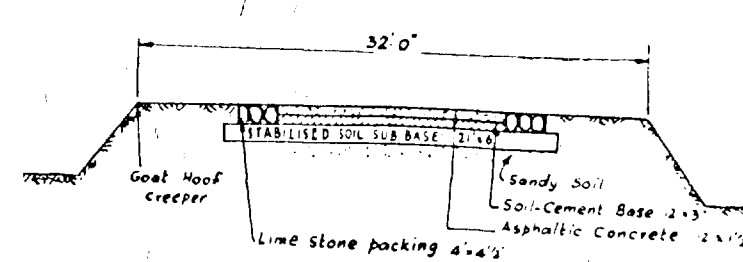


Fig. 3. Typical Cross Section of Ramnad-Mandapam road—Mile 71/5 to 93/2
Year of construction 1954.

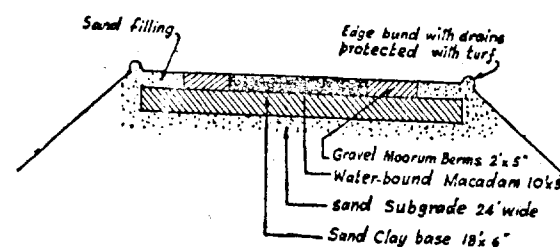


Fig. 4. Kovalam-Mahabalipuram road—Mile 0/0 to 12/2. Year of construction 1956-57.

Design of bridge and building foundations

Some of the important bridge investigations so far taken up pertaining to the present Madras state alone are given below:

1. Bridge across river Coleroon on the road from Chidambaram to Sirkali.
2. Bridge at mile 20/4 of Pattukottai Arantangi Road, Tanjore Division.

3. Bridge across Vettar at mile 21/8 of Mayuram-Muthupet road, Nagapattinam Division.
4. Bridge across Marudayar at mile 38/4 of Tiruchirapalli Chidambaram road, Tiruchirapalli Division.
5. Bridge across Kaduvayar at Vadakkupoyyur village, Nagapattinam Division.
6. Bridge across river Cauvery on N. H. 45 bypass Tiruchirappalli Town.
7. Bridge across Vedaranyam canal at Elayandi ferry, Nagapattinam Division.
8. Bridge across Pamaniar at mile 40/6 of Tanjore-Muthupet road, Nagapattinam Division.

Investigations of the road failures

Whenever a failure, whether it be of surface or subgrade, is reported all the available technical data gathered in the field and the test results on the soils are analysed and the cause of the failure ascertained. Suitable remedial measures are then suggested.

Mobile vans

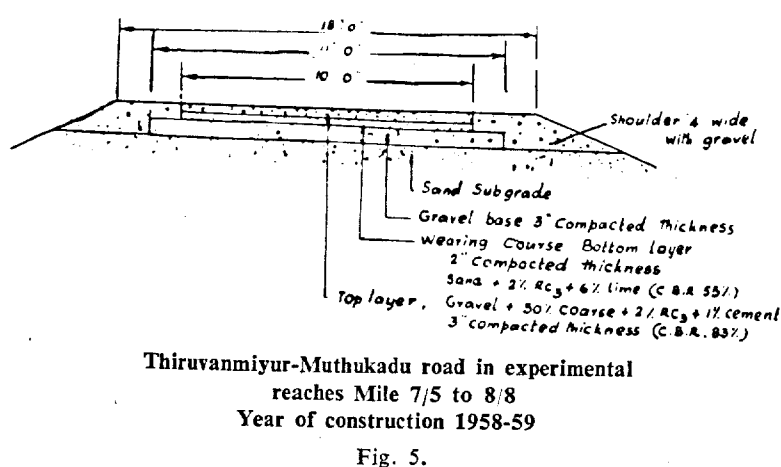
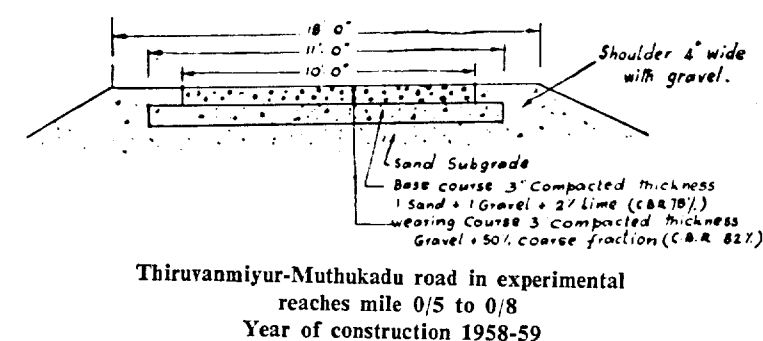
For facility in testing samples in the field for field control and other investigations two mobile laboratory vans are attached to the soils laboratory.

Manufacture of equipment

The various field soil sampling equipments like undisturbed soil samples, standard penetration shells, minor equipments etc. are all manufactured in the workshops of the Highways Department. Repairs to the machines in the laboratory are also attended to in the workshop.

General soil testing work

Selection of proper and suitable types of soils is essential for road formations, casing of guide bunds of bridges, backfill of the revetments, etc. Hence detailed examinations are taken up on different soils received and they are classified as per standard classifications and recommendations are made regarding their suitability for the intended use.



Miscellaneous

The following are some of the important miscellaneous works that were taken up in the soils laboratory:

1. Design of soil cement flooring using gravel and cement combinations for the temporary workshop of the Integral Coach Factory at Perambur.
2. Soil analysis of about 40 samples received from Neyveli Lignite Corporation.
3. Design of the soil cement blocks for river protection works in Tirunelveli District.
4. Evolving a cheap type non-erodable and water proof plastering for the low cost rural houses.
5. Design of taxi ways aprons for the existing runway at Trivandrum airport.

3. Concrete and Structures Section

General

Concrete and structures laboratory is equipped with testing machines and apparatus costing over

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Rs 2 lakhs for conducting a variety of tests pertaining to concrete, and structures.

A casting and prestressing yard is located behind the concrete and structures laboratory. A small concrete mixer of 2½ cu. ft. capacity, a cement bin, and stressing bed and a frame for testing small structural parts are housed in a shed adjoining the yard.

Mobile testing unit

A mobile laboratory unit for control testing during the execution of works, for investigation of failures and for field testing is available. This laboratory van is mounted on a six ton four wheel trailer chassis. The body is 19 ft-6 in. long and 7 feet wide with an internal height of 6 ft-5 in. The details of equipments available in the laboratory van are given.

Concrete Testing

In the concrete laboratory testing of materials for concrete, design of mixes for a specified strength and testing of concrete laid in the field to act as a check on the quantity are undertaken.

Structures

One of the most important aspects of study in Highway Research Station is testing of structures with special reference to bridges. The work mainly comprises either laboratory studies on models or prototype, or field testing.

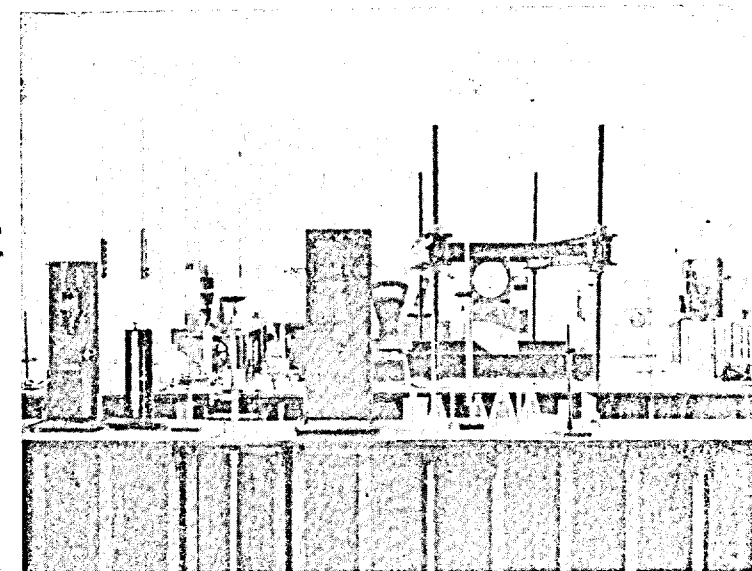
Load testing, on completed structures, is undertaken whenever an opportunity occurs. One of the important tests conducted in 1956 was on a bridge with tee-beam type superstructure near Oddanchatram in Madurai District. The reinforcements for the bridge had been gas welded. Though the load test was primarily undertaken to see whether there was any detrimental deformation under working loads, opportunity was taken for studying load distribution in tee-beam type decking.

The conclusions of this test were:

1. Full live load test

- (a) The full live load test revealed that the observed deflections were much less than

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A view of Concrete Laboratory

the calculated deflections which showed the tee-beams are stiff for carrying the design loads.

- (b) The recovery of deflection was nearly 90 per cent. The maximum recovery stipulated as per building code of American Concrete Institute should be not less than 75 per cent.
- (c) The test load was perhaps the maximum load that the bridge would be subjected as the test load was equivalent of full live load stipulated as per I. R. C. Class A loading with two lanes with impact. The structure did not show any signs of distress while loading or unloading.
- (d) In view of the considerations, the structure can be considered to be quite safe for carrying the I. R. C. Class A loading for two lanes.

Sometimes, the cement content of hardened concrete has to be determined to check how far the specifications have been followed. In structural failures, the analysis is required to be carried out for finding out how far the mix proportions have been responsible for failure.

Another important aspect of concrete testing which may have to be made use of in future is the

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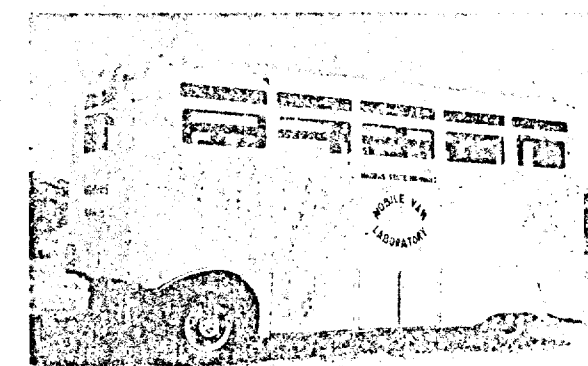
non-destruction tests by various methods including ultrasonic vibration technique and the use of radio active materials.

Work is also undertaken in the laboratory for certain basic studies of applied nature. Admixtures in concrete and mortars have been given special importance. Lissapol N and Dhydol 25 have been tried as admixtures in concrete. The results are encouraging.

In India, much importance had not so far been attached to the desirable properties such as fattiness, workability, adhesion, yield, etc., required of mortar. Hence patented admixtures Febmix, Admix, Melgan A, which are claimed to improve the above mentioned properties, were tried, and the results are again encouraging.

2. Load distribution tests

- (a) It is seen that all the beams deflected whatever be the position of load and this shows the slab is stiff and distributes loads.
- (b) When the loads are placed symmetrical to bridge axis, the intermediate beams share more load than end beams.
- (c) When the loading system is eccentric to bridge axis there is a tendency for end beam to share more and more load as the point of application of load is moved towards it from bridge axis.
- (d) The load that is shared by the end beam for the conditions of this structure



Concrete Mobile Van

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appears to obey the Law $P = 2.09 \times 1.47 x + 16.6$ where x is eccentricity and P the percentage of load taken by end beam.

- (e) It is noticed that the end beams share loads as much as intermediate beams and even more than intermediate beams in certain conditions of loading. Hence there appears to be no case to make end beams less strong than intermediate beams and it may not be correct to curtail reinforcements in end beams on the assumption that end beams are taking load only of that wheel load which is directly on the beam or in the last bay.

Test to destruction of arched bridges

A load test to destruction which is the first of its type to be undertaken in this country is proposed to be taken up shortly on an abandoned arched bridge across Uppodai in Ramanathapuram on N. H. 7. The bridge is an arched one of 7 spans not satisfying the present day standards.

Testing cut stones

There are a number of small culverts constructed in the past for which cut stones have been used for decking. In order to assess the strength of these culverts, tests were undertaken on cut stones to ascertain whether the factor of safety of 10 adopted in Trautwines formula for the design of cut stone slabs is applicable. It is generally observed that the factor of safety of 10 is on very conservative side.

Sponsored research scheme

There are a great number of culverts and bridges constructed in the past that require replacement or redecking to bring them to I.R.C. standards and also there are a vast number of culverts and bridges to be constructed in the highways system under five year plan, etc. Economy and speed with which construction of these culverts can be completed are important. Hence a method of construction which will help in solving these problems is of value and prestressed concrete appeared to be ideally suited. For bulk manufacture of structural parts preten-

sioning has rendered itself very useful especially as no patented anchorages are necessary. Also for ease of construction post-tensioning has rendered itself useful. Two types of problems are generally met with in construction of culverts and small span bridges namely sites where diversion to the existing traffic is not possible and those where it is possible. A fully prestressed section for the former and a composite type of construction for the latter appear to be particularly suited.

Tests were, therefore undertaken primarily to determine the performance of prestressed members under loads to assess the service behaviour. There is considerable interest among the designers regarding the ultimate loads condition in pretensioned and composite members and the factor of safety. Another aspect of study is the bond of high tensile wire with concrete. This work on the use of prestressed slabs and blocks in the strengthening of culverts and small span bridges is in progress with grant from C.S. & I.R.

Future programme

One of the important studies proposed to be initiated is on mortar hinges and concrete pendulum bearings. It is well known that the cost of cast steel bearing which are generally adopted for long span bridges is over 10 per cent of the cost of decking. Though concrete articulations and mortar hinges have been tried on the continent extensively, their use in this country is but meagre. In Madras State, however, mortar hinges have been tried in Coleroon and Palar bridges. It appeared that some experimental studies are of value so that it may give confidence to the designers. With this end in view, this work is proposed to be undertaken.

Another work on structure side which is proposed to be taken up is on study of the effect of different types and thicknesses of wearing surfaces on the load distribution in a structural slab. The Council of Scientific and Industrial Research have been approached for financial grant for the above mentioned scheme.

4. Bitumen and Aggregate Section

General

The bitumen laboratory of Highways Research Station started functioning only in December 1957

along with the opening of Highways Research Station. The aggregate section is at present attached to the bitumen laboratory. The laboratory is equipped with all the necessary machines.

Adhesion—aggregates and bitumen

In Madras State, the black topping work is mostly of thin carpet with precoated chippings using $\frac{1}{2}$ in. size aggregates. In many reaches, the surfacing is quite satisfactory; but in some, the aggregates being hydrophilic, the asphalt film sloughs off the aggregate thus exposing the surface of the aggregate directly to the action of traffic. So the road stones are tested regularly for bituminous work for wettability and antistripping and their values recorded.

Stripping test

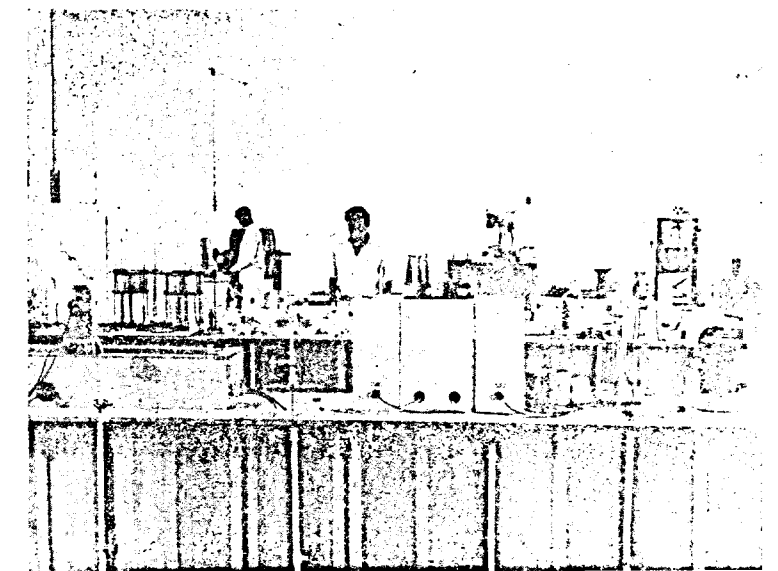
A great deal of effort is being made to develop a stripping test that will give an indication of the performance of an aggregate in service. The two most widely used stripping tests are the immersion compression test and the static immersion test.

At present in the laboratory stripping of aggregate in the presence of water is measured by the modified Riedel Weber Test. In this test the method of assessing the stripping is by visual estimation. So it is considered not accurate. Besides, the action of traffic, which has an effect on stripping, has not been taken into consideration at all. Hence it is proposed to take up a study on the immersion wheel tracking mechanism which is developed by the Road Research Laboratory, Harmondsworth, in which the combined action of traffic and water is considered for estimating stripping. The unit is under manufacture in the workshops and is expected to be put to use shortly.

Bitumen stabilization

In the field of bituminous soil stabilization, thorough dispersion of bitumen through the soil mass is essential. For this, the binder should be in a fairly fluid condition. An attempt is made to study the effect of additives to bitumen 80/100 which is extensively available.

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A view of the Bitumen Laboratory

Asphaltic Concrete Mix Design

In the design of bituminous mixtures the object is to obtain durable carpets which will remain non-skid with the locally occurring aggregates. In the normal practice various sized aggregates are collected separately and again combined in the proper proportions so that the mix can conform to the gradation requirements.

5. Traffic and Safety

The traffic and safety section whose function it is to undertake research on orderly and safe movement of traffic, deals with designs of intersections, traffic problems referred to by the Corporation of Madras and highway officials. This apart, to improve the overall journey speed by relieving the congestion, it is necessary to apply adequate standards in respect of segregation, parking of vehicles, regulation of traffic etc. So the traffic section has drafted standards for improving flow of traffic in Madras City.

A traffic survey in the various zones of the city is also proposed to be conducted in the peak and normal seasons. It is expected that it will yield data for design of intersections etc.

The traffic section will also function as an auxiliary to the other sections in testing, under field condition, materials, mixes or improved method of

laying that is found satisfactory in the laboratory. An outdoor test track in the premises of the research station which will accommodate test sections is proposed to be laid and an estimate under the Second Five-Year Plan has already been prepared and awaits approval of the Government.

Skid resistance

It is proposed to take up under C. S. & I. R. schemes, a comprehensive study of the skid resistance properties of various surfaces in relation to speed, condition of the road (dry or wet) surfaces where sharp and gritty aggregates are used, glazed or polished surfaces, surfaces with excess asphalt and smooth tread versus new tread tires.

6. Information and dissemination

Library

The library of the Highways Research Station contains about 2,500 publications. These include books, bulletins, reports, papers and reprints.

The information section maintains contact on research problems with technical institutions and libraries in India and abroad. Books and periodicals are sent out on loan and under special arrangements articles are photostated.

Specifications

The Highway Manual, the reference book for highway engineers of this State, containing

standard specifications for construction of road and road structures was first prepared in 1954. The first volume dealing with standard for roads and bridges specifications and the third containing standards and type designs have already been published. Volume II which details the methods of execution and construction practices is under preparation. Periodical revisions, additions or amendments to the specifications already issued in the light of changing theory and practice are also undertaken.

Training courses

Understanding and fruitful cooperation results from an appreciation of each others view point between the field officers in charge of the execution and research worker who tenders advice on the problem. As a step to achieve this aim the Highways Research Station has conducted three lecture courses of six weeks duration each in 1954 and 1955, in which research workers have explained their findings and their point of view to field engineers. These courses dealt with soil investigations, boring operations, field and laboratory tests and included demonstration of stabilization processes.

The beneficial effects of these courses has induced Government to sanction courses on similar lines this year also. These courses will be organised shortly.

PUNJAB P.W.D. BUILDINGS & ROADS RESEARCH LABORATORY, KARNAL

1. General

This Laboratory was originally started in the year 1944 at Lahore in joint Punjab as a part of Soil Stabilisation Construction Division. The construction work of 25 miles of experimental stabilised soil roads was completed in 1946. On the successful completion of these experimental roads, further stabilised soil road work was planned but, in the meantime, the partition of the country took place.

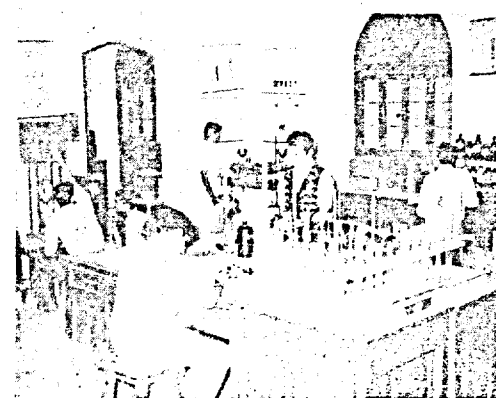
After the partition, the Laboratory was re-started in the year 1947-48 at Karnal and was

attached to the development division, Karnal. In the year 1951, the control of the Laboratory was transferred to the Principal of the Punjab Engineering College and since then he is continuing as Director of the Laboratory.

2. Construction of Stabilised Soil Houses for displaced persons

As a result of the partition, the Government was faced with a huge problem of providing housing accommodation to thousands of displaced persons who migrated from the West Punjab. Sufficient

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A corner view of main laboratory

coal was not available for burning bricks required for the house building. The Laboratory was, therefore, called upon to undertake investigations on the scientific use of local soil for replacing the burnt brick masonry in permanent house construction. Effect of all possible factors such as the proportions of various soil ingredients (silt, clay and sand), moisture content, density etc., on the strength and other engineering properties of the soil mass was studied. The effect of addition of varying quantities of cement to the soil mass on its properties was also studied before making any recommendations for adoption on field scale. The study was mainly confined to the four different types of soils generally available in Punjab. As a result of these investigations, a large scale Project for the construction of about 4000 stabilised soil houses at about a dozen places in the East Punjab was undertaken and completed by the P.W.D., Buildings and Roads Branch in the years 1948-50. These houses are still standing well although about ten years have passed.

While the construction was carried out by the field staff of the P.W.D., the scientific control was effected by the representatives of the Laboratory who checked up the soil constituents, moisture content and density at different stages.

3. Stabilised Soil Roads

The Public Works Department was also faced with the problem of construction of cheap roads in these townships and on the basis of experimental work done by the Laboratory, a number of stabilised soil roads were constructed in almost

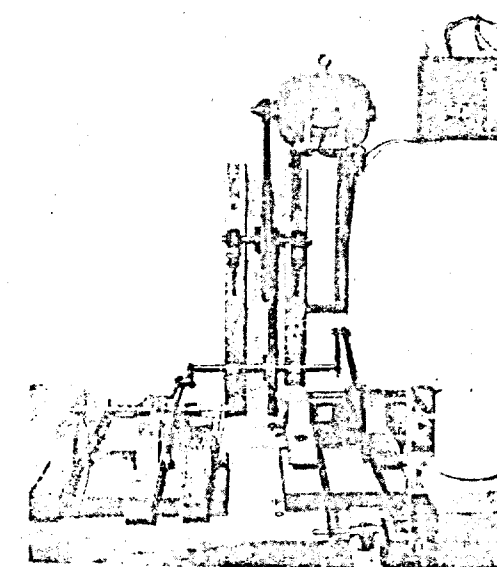
all the new township under the scientific control of the Laboratory staff. In all about 250 miles stabilised soil roads have been constructed so far in this State.

4. Research Work

After successfully solving these two immediate and urgent problems of the P.W.D., the Laboratory switched on its activities to applied research for solving day-to-day problems of the Building and Road Engineers.

A fairly comprehensive study on the various aspects of stabilisation of soils has been carried out on various types of soils including Black Cotton Soil. Effect of various chemicals, surface active agents and industrial waste products e.g., lime, cement, calcium chloride, sodium chloride, soap, turkey red oil, molasses, lignin, bitumen, copacite, groundnut husks, gluten, etc., on the engineering properties of the soils has been studied and the results published in the various scientific journals. Stabilisation of sand and sandy soils with sodium silicate has also been studied and useful results obtained.

Considerable work has also been done on the 'Design of Bituminous Mixes for Surface Carpets'. In this connection the effect of grading of the aggregate and the variation in the binder content at different temperatures has been



Tracking test apparatus

particularly studied and a Tracking Test Apparatus for testing the surface carpet specimens under field conditions has been devised.

A number of investigations in connection with the causes of failures of roads in the State have also been conducted with a view to suggesting suitable remedies for their improvement. As a part of this problem a fairly vast study of the moisture movement in the subgrade both in dry and waterlogged areas of the State was made and the data collected at intervals of a fortnight to one month for about 18 months representing the dry as well as wet seasons.

Besides the road problems, the Laboratory is also engaged in tackling various building problems. A special feature of the Laboratory in this connection is the "Evolving of a non-erodable water proof mud plaster for rural houses" made of unburnt bricks or mud walls. This plaster involves the use of a locally made bitumen cut-back in which a small percentage of paraffin has been introduced to improve its water proofing properties. Further investigations to improve the water proofing compound are in progress.

Another important feature of the building Research carried out in this Laboratory is the universal use of soap for damp-proofing pucca buildings. It has been found that soap can be effectively used both as an integral as well as a surface water proofing material for the building walls. Incorporation of small quantity of soap in the cement-sand mortar makes it absolutely damp proof while the soap spray on the already built brick walls makes them resistant to moisture absorption without disfiguring the brick appearance. The use of soap has also been found effective in checking the efflorescence in the buildings. A number of Papers on this work has already been published in the Indian Concrete Journal.

Studies have also been conducted on the use of cement saw dust for thermal insulation of cold storages and useful results of practical application have been obtained.

5. Research Publications

In all, the Laboratory has published over four dozen research papers on different applied

road and building research problems in various scientific journals like the Indian Roads Congress Journal, Indian Concrete Journal, Transport Communications Monthly Review, National Buildings Organization, Indian National Society on Soil Mechanics, etc.

6. Equipment

The Laboratory is well equipped with necessary apparatus like CBR, Triaxial Test Apparatus, Unconfined Compression Testing Machine, Direct Shear Test Apparatus, and Penetration Test Apparatus for Bitumens, Impact Test Apparatus, North Dakota Cone, Tensile and Compressive Strength Test Machines which are essentially required for testing soils, cement and bitumens.

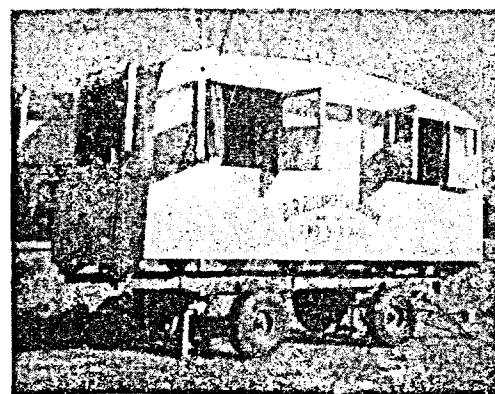
It has a full fledged Photographic Section, equipped with arrangements for making enlargements, photostats and coloured pictures. The Laboratory also possesses a small workshop and a library of its own.

7. Training Facilities:

This Laboratory being one of the pioneer Laboratories of its kind in India, has trained a number of engineers from other States who came for training in the soil stabilisation work.

8. Field Units

Besides carrying out research work on applied problems of buildings and roads, the Laboratory also supervises and effects scientific control on the construction of stabilised soil roads through its field units. As more and more importance is



View of the mobile field laboratory

being attached to the proper compaction of the subgrade before laying the road crust, this Laboratory also deputs its field staff for checking



Inside view of mobile field laboratory

the compaction by actually determining the density of the subgrade or the base over which the road crust is to be laid. For the field work, the Laboratory employs some work-charged establishment which is sent in the field for control on construction work wherever required by the field engineers.

Three mobile laboratory trailers are maintained by the Laboratory and these are sent wherever proper housing facilities for the field laboratory units are not available within easy reach of the actual construction work.

ROAD RESEARCH

At the Punjab Engineering College, Chandigarh

The College is providing facilities for advance training in the field of Highway Engineering leading to the degree of M.Sc. in Highway Engineering. The idea for provision of this course was forwarded by the committee for "Development of facilities for research, advance work and Post-Graduate Studies in India in 1951." Shri S. R. Mehra (then Principal, Punjab Engineering College) took keen interest in the project and convinced the Co-ordination Committee of the All India Council for Technical Education to approve the proposal to organize facilities for offering Post-Graduate Course in Highway Engineering at the Punjab Engineering College (at the time located at Roorkee).

The Course was finally started in 1956 under the guidance of Shri R. N. Dogra and the fourth batch of 9 students is currently registered at the Institute.

Research Facilities

The Highway Engineering Department has been vigorously trying to equip the laboratories with the latest equipment available in the market in India and abroad. The restricted import policy has its impact on the departmental plans delaying somewhat the procurement of proper equipment from abroad. The orders have since been placed and it is expected that most of the equipment will be received in the next few months.

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It is felt that laboratories especially in the fields of "Soil Mechanics", "Photogrammetry", "Asphalt", "Material Testing", and "Concrete Technology", will be very appropriately furnished providing the post-graduate students and research workers facilities for conducting advance research in the various phases of highway engineering. The details given in the following paragraphs will give some idea of the available facilities at this Institute:

(1) Soil Mechanics Laboratory

In addition to the normal testing apparatus, the laboratory will be fully equipped with the soil sampling equipment (for both disturbed and undisturbed samples) currently in use along with the apparatus for deep drilling to study the foundation problems. Facilities to conduct full scale tests like "Plate Bearing", "CBR", etc. in the field will also be available.

(2) Photogrammetry Laboratory

The Laboratory was set up under the guidance of Prof. Olin W. Mintzer. T.C.M. Expert, who worked at this College as a Visiting Professor for 2 years (1956-58). The equipment includes Parallax Bar and Stereoscope Mirror Unit, Slotted Template Kit, Sketch-Master and Stereotape—which is used primarily for planimetric and contour mapping.

(3) Bitumen Laboratory

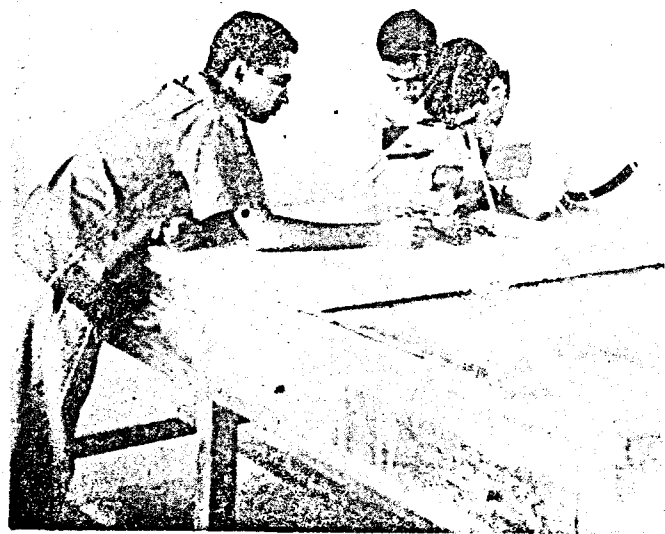
This is equipped with most of the standard apparatus used in the bitumen laboratories all over the country, e.g. Ductility Apparatus, Various Viscosimeters (Engler's and BRTA), Carbon Residue, Hubbard Field Stability apparatus, Hveem's Stabilometer, etc.

(4) Material Testing Laboratory

The laboratory is equipped with "Los-Angeles Abrasion Machine" "BSS Abrasion Machine", "Deval's Attrition Machine", "Aggregate Impact Value Testing Apparatus" and equipment for "Crushing Strength of Aggregates".

(5) Concrete Technology Laboratory

In addition to the normal equipment like the Entrained Air Meter Vibrating Machine etc., the laboratory has the latest equipment being used in research and testing of concrete. A few items worth mentioning are:



A group of post-graduate students working on measurement problems in photogrammetry Laboratory



Picture shows the post-graduate students trying out the Power Auger at the new swimming pool tank site

- (i) Sonic Testing Apparatus with Cathod Ray Oscillograph.
- (ii) Sphery Reflectoscope.
- (iii) Core Drill Power Unit.

(6) Traffic Engineering Laboratory

There is not much equipment available at the moment but it is proposed that the laboratory will be equipped so that full traffic conditions can be effectively simulated in the laboratory. It will include the following:

- (i) Photography and Projection Apparatus.
- (ii) Driver Test Vehicle—a full size mock up apparatus.
- (iii) Simulated test track, etc.
- (iv) Facilities to test the materials for signs and pavement markings.

Research Trends

After passing the written examination the post-graduate students have to write a thesis in partial fulfilment of M.Sc. Highway Engineering Degree requirements. The various thesis topics on which the students are conducting research can

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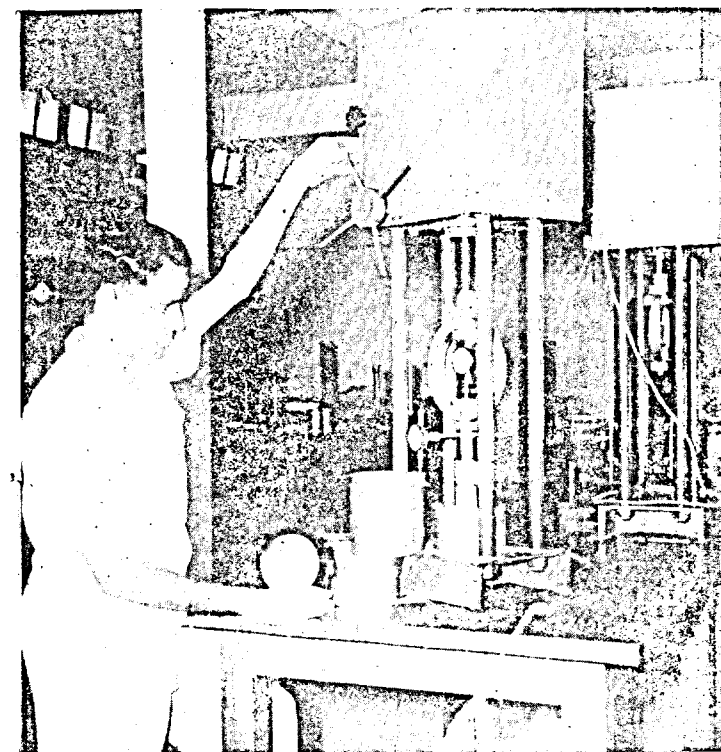
be categorized primarily under the following headings:

(1) Pavement Design

- (i) Pavement performance at natural drainage crossings.
- (ii) Stabilization of bituminous carpets.

(2) Soil Stabilization

- (i) Stabilization of gravel for use in low cost surface courses.
- (ii) Laboratory investigations into the effect of pozzolana on lime stabilized soil.



A post-graduate student working on the effect of pozzolana on lime stabilized soil

(3) Road Aggregate

- (i) Assessment of road aggregates with respect to their behaviour in highway use.

- (ii) Study of properties of road aggregates.

(4) Traffic Research

- (i) Problems of traffic accidents in Delhi.

(5) Prestressed Concrete

- (i) Prestressed concrete and economy of bridge design.

In addition to the above general categories, a few rather comprehensive subjects have been taken up by the candidates like the following:

(6) Comprehensive Thesis Topics

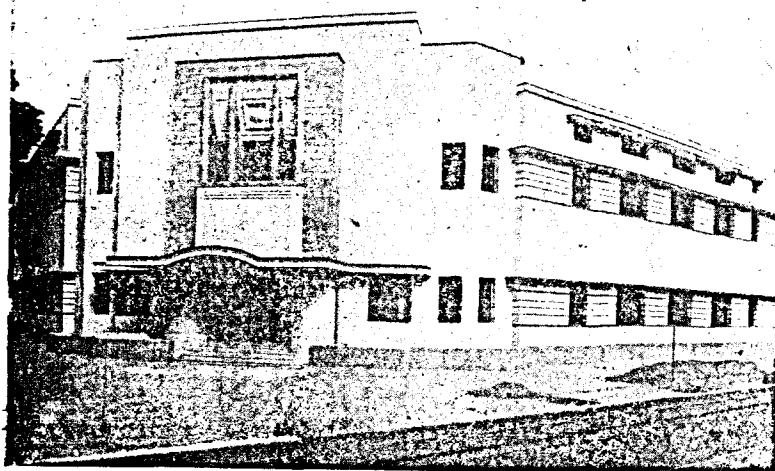
- (i) Study feasibility of greater pay loads for commercial vehicles plying on the G. T. road.
- (ii) Pavement performance survey.
- (iii) Investigation of causes of failure of Hapur-Garhmukteswar concrete road and suggestion of remedial measures to be adopted.
- (iv) Suggested specifications for Punjab roads.

The Karnal Research Laboratory has a part of its staff working at the Punjab Engineering College, Chandigarh. Two Research Fellowships have recently been granted to conduct research at the Punjab Engineering College, in collaboration with the Highway Engineering Department and they propose to start work on the following topics:

- (i) Design of bituminous mixes for surface carpets.
- (ii) Evolving a simpler method for the designing of flexible pavements.

U. P., P. W. D. RESEARCH INSTITUTE, LUCKNOW

The U. P., P. W. D., Research institute has been in existence since 1947, when a small laboratory was started in connection with soil stabilization scheme and some experimental lengths of low cost soil stabilised roads were constructed. Patries (berms) of some roads were also constructed with stabilised soil.



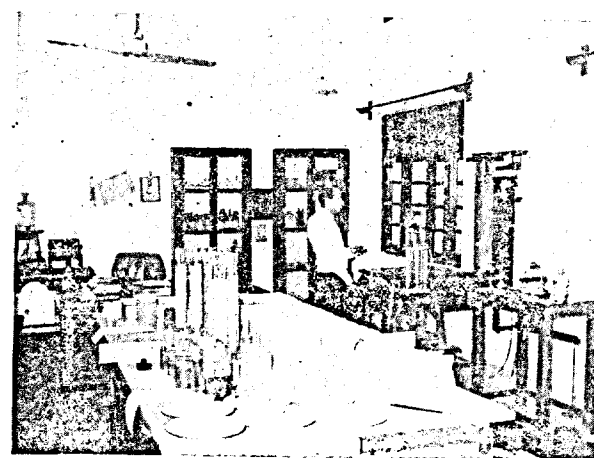
A view of U.P., P.W.D. Research Institute, Lucknow

Later on, the scheme was expanded to cover research and investigation work not only in soils but in other subjects concerning construction and maintenance of highways, buildings and bridges.

The Institute is equipped to carry out testing of all building materials according to Indian Standard specifications and already the Institute is receiving regularly a large number of samples of soils, stone, brick, brick ballast, sand, cement, lime, concrete, mortar, bitumen and tar for tests. The Institute is also rendering useful service to other Departments of the State, local bodies and to other States in matters of testing materials and in carrying out investigations on problems referred to it. The Institute has been carrying out research and investigation work on various problems, of reports which are published in various papers in technical journals.

The work in the Institute is being carried out under the following Sections :

(1) **Soil Section :** Two laboratories, viz., soil mechanics laboratory and soil stabilization brick laboratory are functioning and dealing with various problems.



A view of Soil Mechanics Laboratory

(2) **Materials Section :** Under this section, cement-concrete laboratory, bitumen-analytical laboratory and aggregate geological laboratory are included.

(3) **Field Section :** In order to correlate laboratory and field results, semi-field experiments are carried out in the premises of the Institute and the behaviour is observed regularly. For carrying out full scale field experiments, the Institute has taken over some roads directly under its control and various test lengths in connection with the stabilised soil and bituminous road construction have been laid and are under observation. The Institute is also supervising, wherever possible, experimental stretches laid on other roads under the control of various Divisions and obtaining reports of the same regularly.

The Institute has investigated and carried out work on many problems in the field of road research. Work on some of the important problems may be summarised as follows :

(1) **Properties of kankar for road work :** A large number of kankar samples have been tested at this Institute both under dry and wet conditions. The test results indicate that fairly hard quality kankar is available almost every where in U.P. and it is necessary that, in case of doubt, the kankar should be got tested for its physical properties.

(2) **Use of overburnt brick ballast and grit :** A large number of brick ballast from different locations has been tested and the test results show that the brick ballast burnt from overburnt bricks is quite suitable for road work. It is, however, necessary to exercise strict control over the quality of brick ballast.

It has also been seen that good quality brick grit can be used for surface dressing in bituminous road construction where the cost of stone grit is high and its use may result in considerable economy. Trial lengths using brick grit have been laid on Lucknow-Sultanpur road and are under observation.

(3) **Expansion jointing material for concrete roads :** The use of proper quality of expansion jointing materials is of great importance in concrete roads. Various types of preformed fillers are being marketed and one of these (Shalitex) expansion jointing material tested in the laboratory and found satisfactory, was recommended for adoption by field engineers.

(4) **Foaming and frothing of tar and bitumen :** Tar and bitumen are normally stacked in open with the result that water often finds its way inside the containers and causes frothing of the contents. Experiments conducted in the laboratory indicate that the frothing can be stopped by adding small quantity of white lime or cement.

(5) **Improving adhesion qualities of stones with binders :** Some stones have been observed to possess poor affinity with binders, viz., tar and bitumen, with the result that blacktop surface laid with these stones has to be renewed at shorter intervals. Adhesion of such stones can be improved by addition of various products. At present lime, cement, Adhevia-T, and Wetfix have been tried and found successful.

(6) **Use of precoated grit in surface dressing :** It has been shown by field trials that stone grit precoated with 0.8 per cent of bitumen, when used in surface dressing, sticks very well to the surface and is not dislodged by the fast moving traffic. This results in saving of grit as well as better surface than normal brick grit. Laboratory experiments on precoated brick grit have also given encouraging results.

(7) **Use of bricks in road pavement :** Laboratory experiments had proved that by increasing the duration of firing or temperature, the strength of the bricks is increased.

A pilot kiln was established on Lucknow-Sultanpur road for producing good quality bricks, which were used in laying brick pavement. These experiments have shown that the bricks can safely be used for paving purposes on roads and that with bituminous treatment, brick pavement can be used even on roads carrying fairly heavy traffic.

(8) **Soil stabilisation for road and patri work :** It was found by laboratory investigations that for maximum stability, the percentage of kankar aggregate for soil stabilised crust should not be less than 35 per cent and not more than 40 per cent.

Some experiments on use of stabilised soil using different specifications have been carried out on Bani-Harauni road. Lengths have been laid using overburnt brick ballast as coarse aggregate in wearing course varying from 30 to 40 per cent, the soil having plasticity index of 8 to 11 and sand content of more than 30 per cent. Grafting with 1 in. size stone grit as well as overburnt brick grit was provided in some stretches. The surface was painted with road tar (RT 2) using grit in first coat and coarse sand in the second coat. In other lengths, kankar was used as coarse aggregate with and without stone grafting. Some portions were painted and some left unpainted. These lengths are under observation.

In a length of 4 furlongs, on a base course (3 in. compacted) of stabilised soil having P.I. 5

to 7 and sand content of more than 50 per cent, a wearing course (3 in. compacted) of soil cement was given using 7 per cent by weight. Three furlongs were given surface painting using tar and one furlong was left unpainted. The unpainted length could not stand bullock cart traffic and failed. In painted length also, patches were formed in the beginning showing lack of adhesion between soil-cement surface and tar coat (no primer was used). After patch repairs, another coat of painting using Mexphalt was given which is now behaving satisfactorily. Some more lengths of road with stabilised soil are proposed to be laid in future using different specifications. It is also proposed to lay side by side with the stabilised soil crust, lengths using other comparable specifications including brick pavement.

Use of stabilised soil in construction of pat-ries (berms) of road has also been made. Different specifications using overburnt, first class and second class brick-ballast as coarse aggregate and also with lime/molasses have been tried and are under observation.

Stabilised soil has also been used in some stretches of roads as soling and inter-coat.

(9) **Causes of road failures:** Many roads in the State have recently failed or broken up. Investigations to find out the causes of such failures on Grand-Trunk Road in Bulandshahr District, Meerut-Baghat road and Lucknow-Kanpur road, revealed that at some places the thickness of pavement was insufficient for the increased heavy traffic and, at other places, increase in moisture in the subgrade due to capillary rise of water was responsible for the failure, and at places, the sub-grade soil had been poorly compacted on account of the soil being not properly graded. Suggestions for improving these roads made to field engineers have been adopted in many cases.

Many miles of National Highways, e.g., Ghaziabad-Hapur-Garh road, Lucknow-Bareilly road (Sitapur District), Agra-Etawah-Fatehpur road have also broken down and failed. Investigations to determine the C.B.R. values of these

roads for determining the thickness of pavement required under present day increased traffic intensity are being carried out.

Besides the above field and laboratory experiments on simultaneous coat of tar and bitumen for surface dressing of roads, use of diluted emulsion in water-bound road construction and membrane curing of concrete have been carried out.

Investigations on local problems encountered during bridge construction have also been taken up. It has been found by tests that in some cases, use of local sand available near the bridge-site can be made use of as it is, or by mixing with other sands. Design and testing of concrete mixes for use in prestressed concrete bridges has been done in case of various bridges constructed or under construction in the State.

For road work, at present no limits have been prescribed for evaluating the suitability of stone metal in different courses. Tentative limits have been fixed based on results obtained from testing of a large number of stones in the laboratory. A research scheme has been sanctioned by the Council of Scientific and Industrial Research for standardisation of properties of stones for use in road work under Indian conditions, and the work has been started. It is proposed to observe field behaviour of different stones used on different roads and to correlate these results with laboratory findings. Work on another scheme on stabilisation of pat-ries (berms) in Usar areas sanctioned by C.S. & I.R. is also going on.

This Institute has also helped the Department in undertaking geological investigations of the causes of landslides and slips in hilly regions and in the geological study of alignment of roads and sites of bridges in hilly areas.

To cope with the increased amount of work, it is proposed to expand the Research Institute. A section for pavement design, a structural laboratory, and a separate field section for carrying out experiments are envisaged in the future expansion.

ROAD AND BUILDING RESEARCH INSTITUTE, GOVERNMENT OF WEST BENGAL, CALCUTTA

1. Introduction

History

After the partition of India in 1947, the necessity of quick development of the road system of West Bengal was keenly felt, more so when the First Five Year Plan was drawn up in 1948 for the execution of road development works in the State. The task was so big, the time so short and the resources so limited that dependence on the traditional methods of construction was felt not adequate. This resulted in the idea of soil stabilised roads as soil is the most easily available cheap material of construction.

The first nucleus of soil testing for stabilised soil road construction in West Bengal was formed with the opening of a small Soil Laboratory in April 1950 with only one Assistant under the guidance of the then Executive Engineer, 24 Parganas Construction Division. Several experimental stabilised soil roads were constructed under the supervision of this Laboratory and the success of these experiments encouraged the adoption of this method of construction for the base course of road as a substitute for the conventional brick soling. This led to establishment of a well equipped Road and Building Research Institute in April 1952.

Stages of Development

Initially, only two sections, viz., Soils Section and Cement and Concrete Section, started functioning in two rooms at Anderson House, Alipore, with one Research Assistant in each section but the pressure of work led to the starting of two other sections, viz., Materials Section and Chemical Section (including Tar and Bitumen) with limited facilities.

During the period 1952 to 1958, the Institute gained importance by helping in the design of specifications, testing of materials, introducing new materials and methods of construction, solving technical problems and in various other ways

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as well as providing results of several applied research works. The growing importance and achievements of the Institute recently led to some expansion of the Institute as regards technical personnel. The Institute is now under the charge of a Deputy Director. Besides him there is one Assistant Director, two Research Officers, two senior Research Assistants, and three Research Assistants.

Future Expansion

The present strength of technical personnel is quite inadequate for the ever increasing pressure of work relating to testing, investigation and research referred to this Institute. The present accommodation is also inadequate for any further expansion, and so proposals for the construction of a new building for the Institute are under consideration of the State Government.

2. Soils Section

General

This section is functioning from the very inception of the Institute and is now fairly well equipped to carry out all the essential tests and investigations on soil as required for highway and foundation engineering, including soil exploration for deep foundations. The Institute has



General view of soil section of the Institute

recently organised several Divisional Field Laboratories for the proper control of works at

site. A Mobile Soil Laboratory was also set up sometime back, but continuous use of the same had to be postponed due to some difficulties and several sets of portable field testing kits replaced the same.

Mechanically stabilised soil base courses

The first series of works undertaken by this Institute related to the application of mechanically stabilised soil as base course for roads to replace the conventional brick soling. The general type of soil in Gangetic West Bengal ranges from silty (A_4 type) to highly plastic clay (A_7 type) and suitable admixture of granular material (mostly sand) is required to render the natural subgrade soil suitable for stabilisation. The



Determination of pH-value of soil

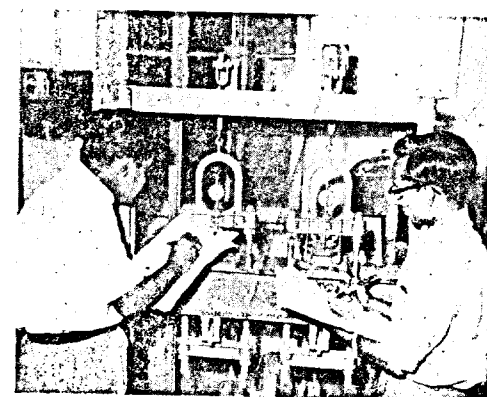
guiding factors in determining the suitability of a soil-sand mix are (i) Sand content (this is generally kept between 33 to 66 per cent), (ii) Plasticity index (kept between 4 to 9), (iii) Dry density under Proctor's compaction (to be above 1.84 gm/cc). The thickness of the stabilised soil base course and of the hard crust over it are based on the results of C.B.R. tests on the subgrade and on the compacted stabilised soil. Moorum, available in the district of Birbhum has been satisfactorily used with admixture of sand, where necessary, in mechanically stabilised base course. River shingle has been used in North Bengal as coarse aggregate.

A total experimental length of about 30 miles of roads has so far been constructed adopting

mechanically stabilised base course which has replaced the double brick flat soling. These experiments have been conducted in the districts of 24-Parganas, Hooghly, Burdwan, Midnapore, Birbhum, Nadia, Murshidabad and Cooch Behar. In most of the cases the experiments have proved successful and the saving in cost has been in the range of Rs 6,000 to Rs 12,000 per mile depending on local conditions.

Soil-cement roads

The success of the use of mechanically stabilised soil for the base course of roads led to further trials on cement stabilised soil road construction. Laboratory experiments indicated that locally available soil, graded with local sand where necessary, could be satisfactorily stabilised with as low as 5 to 8 per cent cement. The percentage of cement required was determined on the results of compressive strength of soil-cement test blocks, a compressive strength of 250 lb per sq. inch or above being taken as satisfactory depending on conditions. For economy a sub-base course is sometimes laid with lesser percentage of cement ($2\frac{1}{2}$ to 3 per cent) on which the base course with 5 to 8 per cent of cement as required is laid. In certain experiments on cement stabilised roads, the intermediate courses of jhama and stone metalling were omitted.



Soil consolidation test in progress

A total length of about 5 miles of soil-cement roads has been constructed on experimental basis on 7 different roads in the districts of Midnapore, Burdwan, Birbhum, 24-Parganas and Nadia. Earlier experiments revealed one

defect, viz., that the premix carpet did not stick well to the soil-cement layer and slid or spread out under traffic. Attempts are, therefore, being made to remedy this defect by providing stone grafting, at the rate of 7 to 12 cu. ft. per 100 sq. ft. area, during the compaction of the soil-cement layer. Some such experimental sections have been laid and they are now under observation.

Use of other stabilising agents for road

Laboratory experiments have been conducted on the use of other stabilising agents like diluted bitumen emulsion, lime, etc. Small quantities of lime (3 to 5 per cent) mixed with clayey soils have been found to be very effective in reducing the plasticity index and increasing the C.B.R. values of highly clayey soils in cases where other methods of stabilisation are costly.

Experiments on the use of soil-cement for low cost housing or for river protection works

A series of model experiments on the use of soil-cement blocks or soil-cement compacted walls (Pise wall) and various plasters on them have been tried. It has been found that suitably selected soil, stabilised with 6 to 8 per cent cement, can be used as building blocks or for river protection works under conditions prevailing in this State. Among the various plasters tried, cement-cinder (1:6) has proved very satisfactory as regards its adhesive property on soil-cement walls and protection against the weathering action of rain. An ingenious method of constructing mechanically stabilised 'pise' wall with cement stabilised skin by compacting the core and the skin integrally has been found to be satisfactory.

Soil exploration and testing for the design of foundations for bridges & buildings

For the design of all important bridge and building foundations, evaluation of the bearing capacity and probable settlements of the soil under foundation is made based on proper soil exploration and sampling and testing of the soil in the Laboratory. There are arrangements for the collection of undisturbed soil samples upto depths of 80 ft. The Laboratory tests conducted in this connection include classification of soil,

moisture content and density, direct and triaxial shear tests, unconfined compressive strength and consolidation tests. Field plate load tests and pile loading tests have also been conducted in some cases.

Investigation of pavement failure and design of pavement thickness

Several cases of pavement failures, mostly due to weak subgrade conditions, have been investigated and suitable remedial measures suggested. In case of important new roads, the required thickness of flexible and semi-rigid (e.g., soil-cement roads) pavement thickness is being designed based on the C.B.R. tests on the subgrade soil. For soil-cement pavements, a reduction in the thickness to the extent of about 25 per cent of that required for flexible pavements is being adopted. For the design of rigid pavements, the values of the modulus of subgrade reaction are being determined and taken into account.

Soil survey for important new roads

In connection with the proposed Calcutta-Durgapur Expressway, a soil survey along the newly constructed N.H. 2 was undertaken. This included the determination of the density and C.B.R. value of the subgrade and preparation of soil profile upto 10 ft depth at intervals of every half mile.

Research works

Besides the above works, which were undertaken in connection with definite projects, a few research items under investigation in the Soil Laboratory of the Institute are:

- Improvement of the quality of bricks. (Sponsored by C. S. & I. R.)
- Correlation between the results of field plate load tests and laboratory tests on consolidation, triaxial shear, and unconfined compression tests for the evaluation of bearing capacity of soil (Sponsored by C.S. & I.R.)
- Correlation between the C.B.R. value, density and lineal shrinkage of different types of soil as met with in the State.
- Studies on the partial replacement of cement by soil in cement sand mortar.



A study of base exchange capacity of a soil in connection with the research on the improvement of quality of bricks

- (e) Relative efficiencies of different stabilising agents, e.g., cement, lime, diluted bitumen, emulsion, etc.
- (f) Classification of highly plastic (black cotton type) soils available in the State to fit into the extended P.R.A. system.
- (g) Determination of friction for concrete and brick walls against different types of soil by simple laboratory tests.

3. Cement & concrete section

The magnitude of work in this section had originally been less than that in the soil section due to shortage of staff but recently the volume of work, both in routine testing as well as in applied research, is increasing.

Quality control in concrete construction

During the construction of all major concrete works in bridges or buildings, concrete test specimens of 6 in. dia. x 12 in. height or 6 in. cubes are prepared at site and these are tested for compressive strength after 28 days curing to ascertain whether the specified compressive strength has been attained or not. This enables the exercise of a strict control on the quality of concrete and the contractor is penalized if the specified strength is not attained. Besides the compressive strength, the proportion of the ingredients of concrete is also sometimes determined by chemical analysis.

Design of concrete mix

For important construction works, quality concrete of high specified strength is required and the design of such concrete mix is done based on

actual tests on the various ingredients and the strength attained in the concrete of the design mix is checked by test.

Modern electronic equipment for measuring the stress-strain relationship in different members of the structures and thereby to check the actual stress developed at a particular section of a member, when subjected to particular loading, has recently been purchased and preliminary work on the same is in progress.

Routine testing in this section includes (a) testing the quality of cement (b) determination of the proportions of ingredients in set mortar and concrete (c) testing suitability of sand and aggregate for concrete, etc.

The following research and experimental works have either been completed or are in hand:

- (a) Making and testing of R.C. rocker bearing model.
- (b) Effect of Lissapol-N on the strength of concrete.
- (c) Effect of time and weather on cement stored on bamboo dunnage.
- (d) Reduction in the volume of mortar with sand of different fineness moduli.
- (e) Experiments on lime-surki and lime-cement-surki mortar.



Universal Testing Machine—a compression test

- (f) Experiments on brick-bonded concrete for use in trackway.
- (g) Experiments on light-weight concrete aggregates.

4. Materials Section

This section started functioning at a later date and has now arrangements for testing road metals, bricks, steel, etc.

Quality of stone metals, as available in different parts of the State

An investigation has been taken up to find out the quality of stone metals found in different parts of the State and to ascertain their relative suitability for use as road metals. 19 samples have so far been collected from 12 different quarries located in the districts of Purulia, Midnapore, Birbhum, Darjeeling and the bordering districts of Bihar and subjected to tests in the laboratory. The essential tests conducted are (a) Los Angeles Abrasion tests (b) Specific gravity & absorption (c) Soundness (d) Adhesivity with tar and bitumen.

Compressive strength of different classes of bricks

A study was undertaken to find out the compressive strength and other properties of the different classes of bricks used in the State. The data so far collected reveal that the compressive strength of the 1st, 2nd and 3rd class bricks generally lies within 2000 to 2500 lb per sq. in., 1500 to 2000 lb and below 1500 lb per sq. in. respectively.

Study of clamp burning of bricks

Quite a large number of bricks are produced in West Bengal adopting the method of clamp burning by small scale private enterprises. A survey was undertaken to find out the quality of such bricks in relation to the type of clamp, general arrangement of the raw bricks and fuel in the clamp, the type of soil and method of moulding, etc.

* Paper No. 298—"Traffic Survey in and around Calcutta"—S. K. Laha, A. K. Das Gupta & S. Chatterjee, Vol. XXIII-2.

Testing of R.C. spun pipes

In connection with the use of R. C. Spun pipes of 3 ft dia. in culvert works, actual samples were tested conforming to I. R. S. Specification No. B-5/53 by method of direct loading.

Routine testing in this section includes the testing of bricks, stone metals, moorum and other low grade aggregates, steel, etc.

5. Chemical Section (including Tar & Bitumen)

The work in this section is mostly routine testing of tar and bitumen; chemical analysis of lime, cement, set mortar, sand, soil, etc.

6. Other Activities of the Institute

Traffic Survey in and around Calcutta

The tremendous increase in the intensity of traffic in and around Calcutta in recent years has caused a serious traffic problem. A detailed investigation was undertaken by this Institute into the different aspects of the traffic problem and remedial measures were suggested. The investigation consisted of two parts, viz., (i) the traffic intensity in the main thoroughfares of Calcutta and (ii) the traffic intensity in the main entrance roads into the city of Calcutta. In the former case, traffic census was taken for one week during the two peak periods of the day on all the important crossings and in the latter case, round-the-clock traffic census was taken for one week. A comprehensive Paper * based on this survey was published in the I. R. C. Journal and was discussed in the 23rd I. R. C. session held at Hyderabad.

Training of Departmental Technical Personnel

In order to meet the requirement of technically qualified personnel for supervising the field works where application of soil mechanics was concerned and particularly for the construction of stabilised soil roads, training courses on the principles of Soil Mechanics and the theory and practice of soil stabilisation are held in this Institute. These courses consist of theoretical lectures (3 hours daily) and practical demonstrations (3 hours daily) for 6 days with not more than 6 candidates in

each batch. So far 23 Assistant Engineers and 40 Overseers have been trained.

Museum and Library

The Institute maintains a small museum containing bridge and road models, maps, charts, photographs, etc. It has also a small library. The Institute produces a Cyclostyled Quarterly Bulletin for limited distribution amongst the Departmental Engineers only.

Photography

The Institute is preparing still photos and

movie films of major engineering works done by the Department for record and exhibition. The films prepared by the Institute as well as others obtained on loan from elsewhere are occasionally exhibited in presence of technical personnel of the Department.

Test Track

The Govt. Test Track at Calcutta is attached to this Institute for technical control and the laboratory testing works in connection with the various field experiments are conducted here.

MILITARY ENGINEER EXPERIMENTAL WING, COLLEGE OF MILITARY ENGINEERING, KIRKEE

Introduction

The present Military Engineer Experimental Wing of the College of Military Engineering, Kirkee, started in ESD Kankinara in the early part of 1944 as a result of the need for such an organisation for the Armed Forces. The unit was then named as "Airfield Experimental Section" and its work consisted mainly of conducting experimental work in connection with the construction of roads and runways in base and forward areas and also to analyse soils for use as construction material. "The Airfield Experimental Section" was later on redesignated as "Soil Engineering Station (India)". During the periods of war and its aftermath the SES(I) carried out assignment for the Army and subsequently for the civil authorities. Later on, it moved to Roorkee and was attached to School of Military Engineering, Roorkee. In 1947, as larger demands for investigations were made on the SES(I) on behalf of the services, its scope of work other than roads and airfields was broadened and it was redesignated as "Engineer Research Station" and moved to Kirkee.

In the year 1951, the Engineer Research Station was amalgamated with the College of Military Engineering and formed a wing of the College.

Charter

The duties of the Military Engineer Experimental Wing are :

- (a) Constant study of engineering practice and research with a view to their application to the special needs of the Corps of Engineers and the Military Engineer Services.
- (b) Laboratory and field testing of soil and the preparation of data for the design of pavements and structures.
- (c) Trials of stores, equipment or materials.
- (d) Special investigation of problems connected with the work of the Corps of Engineers or the Military Engineer Services.

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Sections

For facility of work, the Military Engineer Experimental Wing at the College of Military Engineering is divided into two sections :

1. **Soil Engineering Section** which includes a Soil Physics Laboratory, a Soil Chemistry Laboratory, and a Soil Mechanics Laboratory.
2. **General Engineering Section** which includes :
 - (a) Bitumen and Tar Testing Laboratory.
 - (b) Building and Road Material Laboratory.
 - (c) Cement Testing Laboratory.
 - (d) Concrete Testing Laboratory.

These laboratories are fully equipped with the most up-to-date testing equipments either obtained from abroad or manufactured locally in the workshop.

Staff

The Military Engineer Experimental Wing is a Wing of the CME. The Wing, as such, is headed by the Director who is assisted by two Assistant Directors with the necessary office staff. There are five Senior Research Assistants, four Laboratory Assistants and four Laboratory Attendants at present.

There is a small carpentry workshop but generally the manufacture of large equipments are carried out in the main workshop of the College of Military Engineering.

The Wing also includes a small library which contains periodicals, reports and other technical research papers looked after by an Assistant Librarian.

Work done

The work done by the Military Engineer Experimental Wing can be divided mainly into
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three broad headings :

- (i) **Materials:** their study and use in the construction of structures including roads and airfields.
- (ii) Field investigations for projects.
- (iii) Field trials of materials for use on roads and airfields as well as of special engineering equipments.

Among the various items of works, the following bearing on roads and airfields construction, may be mentioned :

- (1) Investigation on Tamu-Kalewa road (during the 2nd World War).
- (2) Investigation on various airfields in India.
- (3) Quick methods of construction and repair of roads in forward areas.
- (4) Investigation on the best type of pavement to suit tracked vehicles.
- (5) Investigation on the utilisation of materials for road construction purposes.
- (6) Study on the methods of snow clearance on the roads.
- (7) Investigation on methods of prevention of deleterious action of sulphate salts from roads and airfield pavements.
- (8) Investigation on the use of indigeneous materials as air-entraining agents in concrete.
- (9) Laboratory investigation and field trials on prefabricated bituminous surfaces, (P.B.S.).
- (10) Use of wet aggregates for construction of bituminous roads and airfields.
- (11) Stabilisation of soil, including black cotton soil.
- (12) Study of specific characteristic properties

of Indian soils with a view to obtain useful data for design purposes.

(13) Joint sealing compounds for concrete pavements.

(14) Engineering tests on tar and bituminous products.

(15) Membrane curing methods of concrete pavements.

Besides the above mentioned work, the Military Engineer Experimental Wing is also currently engaged on several other problems of interest in regard to roads and airfield construction.

TRADE & INDUSTRY SECTION

THE ROLE OF THE CEMENT INDUSTRY IN ROAD DEVELOPMENT IN INDIA

(By courtesy of the Concrete Association of India, Bombay)

Portland cement, as we know it today, is a comparatively new building material, which from small beginnings has now become a front-rank constructional material in every sphere of civil engineering activity. Only a few decades ago, cement and concrete were practically unknown in this part of the world, but today they have become household words. This phenomenal progress in the use of cement and concrete can be judged from the fact that the production of Portland cement has risen from a meagre 1000 tons in 1914 to 6.5 million tons in 1958. In considering this enormous increase in the consumption of Portland cement in India, which is symptomatic of the tremendous building activity taking place in the country, it would be interesting to note the increasingly vital role played by cement and concrete in the country's economy.

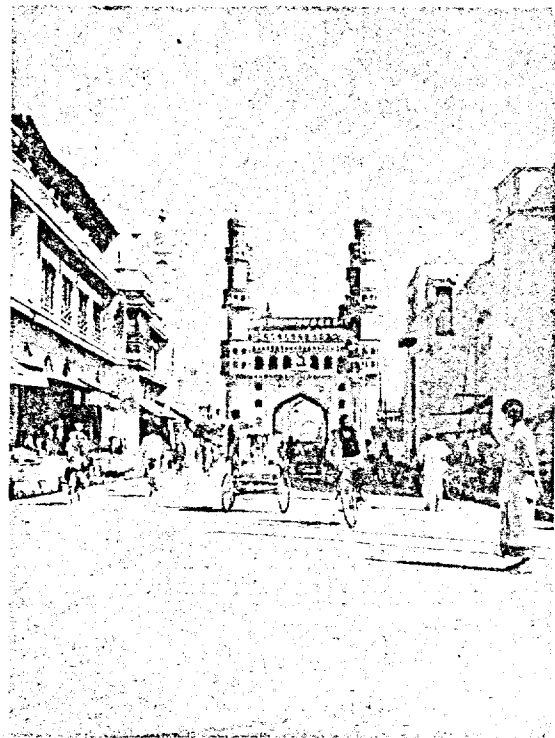
The story of the cement industry in India, and its early trials and tribulations make interesting reading. Progress of the Industry, in its early stages in a country like India was inevitably slow. Long distances, large tracts of sparsely populated areas, poor communications, and an instinctive distrust of innovation and new ideas were a few of the numerous obstacles in the path of the infant industry during the early years. Cement was still viewed with suspicion and disfavour. The prejudice in favour of brick and mortar was deep-rooted. It was an uphill task to educate the consumer in the use of cement and concrete and to train skilled workmen in the handling and control of concrete in order to build up public confidence in the use of this comparatively new building material. Though some of early ventures ended in failure, the industry survived these ordeals and gradually developed as the demand for cement increased. Today we have a sizable cement industry in India which contributes a good deal to the country's economy. The credit of building up this basic industry and of giving the country a quality building material of indigenous manufacture, which in some respects surpasses international standards, goes to the pioneering

efforts and the progressive policy and foresight of the Associated Cement Companies Ltd., while the credit of promoting and popularising the use of cement and concrete goes to the yeoman service rendered by the Concrete Association of India, which is supported and financed by the Associated Cement Companies Ltd.

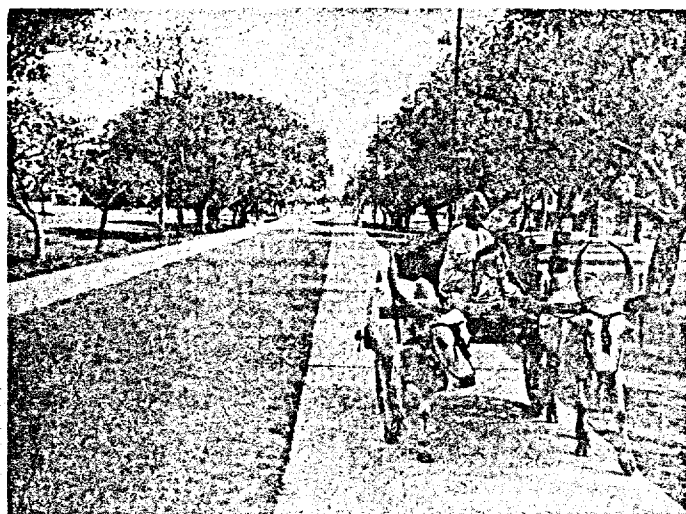
Early Concrete Roads

The use of cement and concrete as a road material in India is quite recent. The first stretch of concrete pavement in India was laid in 1914 over Law's Bridge near the Corporation offices in Madras. Not long afterwards concrete was used on the bends of the hill road leading to Nainital in the Uttar Pradesh and up to about 1927 various short experimental stretches of concrete road were laid in different parts of the country. In Bombay, for instance, the first all concrete road was constructed by the Port Trust in the year 1922 and in the municipal area the use of concrete for paving a main road was first tried in the year 1924, though earlier it was employed for paving narrow lanes and side streets. In Calcutta, a number of roads were concreted by City's Improvement Trust between 1922 and 1930. In U. P., the P.W.D. drew up specifications for the first modern cement concrete road in 1925 and the first cement concrete road was laid in Banaras on the Goodshed Road. The results were most heartening and to this day, after over three decades of service, these roads are in a first class condition and will give good service for many years to come.

Among the larger cities of India, the pride of place goes to Hyderabad which provides an example to the rest of India by its broad, well-kept concrete roads, some of them as wide as 100-ft having a 60-ft traffic pavement in the centre and 20 ft footpaths on either side. Over 70 miles of roads have been concreted in the city during the years 1928-53, the largest mileage of concrete roads in any city of India.



Charminar Road, Hyderabad
The 80 ft wide modern concrete paved road around this ancient landmark in Hyderabad was completed in 1931 by the Drainage Department of the Hyderabad State



Concrete haunches on the Poona-Sholapur road

Concrete haunches and creteways

However, roads outside the large cities presented as great a problem as those in and around them and considerable interest was shown in various methods of reducing the initial cost of concrete construction for stretches of secondary

but important roads and for rural roads. In some cases, concrete was laid on either side of the road with central strip of 'blacktop' to meet the requirements of mixed traffic. For rural roads, especially in Northern India, concrete wheel-tracks or creteways, were found satisfactory. Concrete haunches and creteways enabled the bullocks to move with ease, free from the strain imposed by unmade or broken roads.

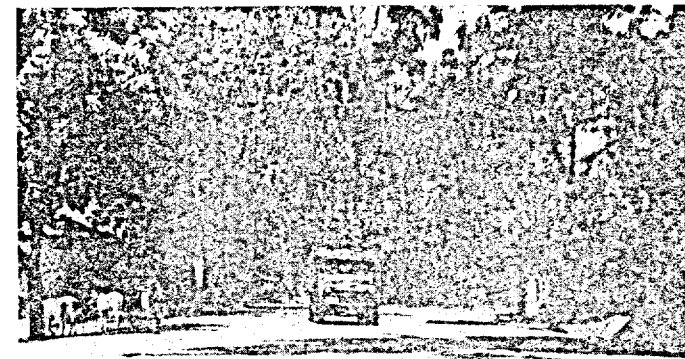
Slow progress

It was early realised that cement concrete was the best material for road surfacing under Indian conditions. Apart from its inherent advantages as a durable and safe road surface, cement is an indigenous product and good supplies of aggregate are available throughout most parts of the country. Yet, only 200 miles were concreted in India by 1938. This slow progress was mainly due to paucity of finance, which was somewhat eased by the creation in 1939 of the Central Road Fund. While the wisdom of building first class concrete roads was accepted early, as they gave the most satisfactory road surface and were in the long run the most economical, there were still obstacles in the way of translating theory into practice. During the second world war and the post war years, cement became a controlled commodity due to the large demand for development projects. Even under these difficulties, concrete road construction went ahead, mostly in cities, and more streets were concreted in Hyderabad, Bombay, etc.

Bonded concrete roads in U.P.

In the search for a more economical method of concrete road construction, experiments were carried out mostly in Uttar Pradesh, in the use of thin concrete pavements, 2 or 3 in. thick, on existing macadam surfaces. Concrete was bonded to the surface from which all loose material had first been cleaned. Between 1920 and 1940, approximately 100 miles of this type of road were laid in Uttar Pradesh.

These roads proved a considerable success under the moderate traffic which was prevalent between these years and gave satisfactory service ranging from 15 to 20 years. However, with the increase in the numbers and weights of trucks, many of these roads are proving to be inadequate

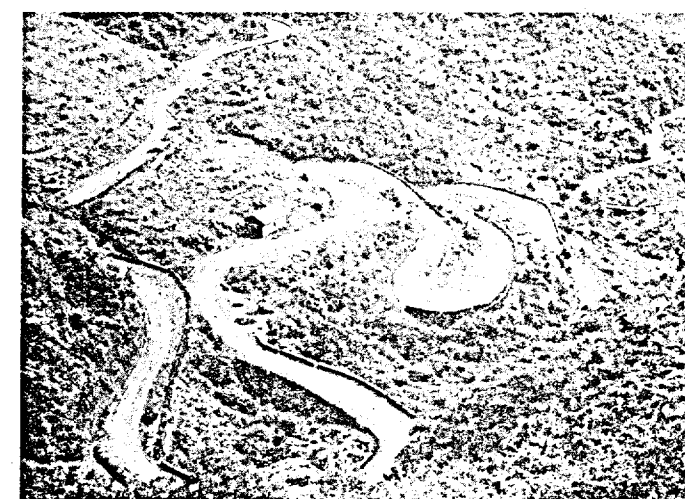
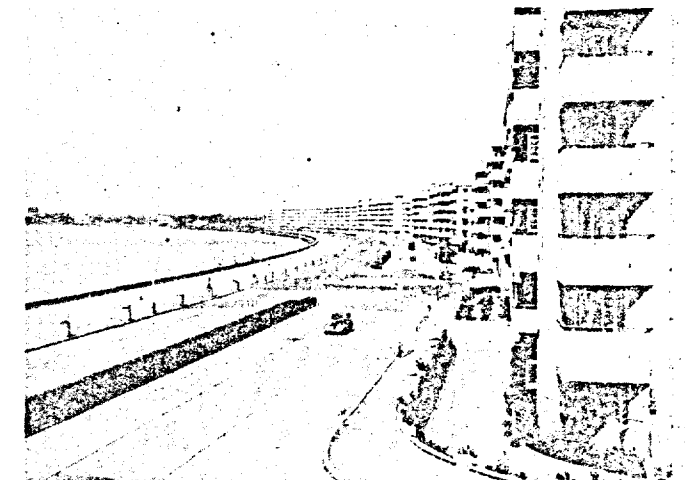


Banaras-Moghulsarai Road

This 8-mile stretch of the Grand Trunk Road between Banaras and Moghulsarai, paved with concrete in 1928, is still in a very good condition after nearly 30 years of service

Marine Drive, Bombay

This six-lane dual carriageway was built and paved in concrete in 1938 by the Bombay P.W.D.



Rajpur-Mussourie Road. A typical hill road constructed in concrete

for present-day traffic. But in view of the low cost involved in that construction, they have simply repaid their investments. It may be interesting to note that such construction averaged Rs 1.56 per sq. yd. (about Rs 4/- per sq. yd. at present rates), pointing to the fact that such methods of construction are applicable in the low cost field even today in areas subjected to large volumes of the slow moving traffic of the bullock-carts and not frequented by heavy motor vehicles.

Post-war progress

The outbreak of the war slowed down the tempo of road construction, but it served to emphasise once more the need for a nationally co-ordinated road network. The Nagpur Plan,



Bombay—Poona Road

formulated by a conference of Chief Engineers in 1943, was the first serious attempt at planned road development in India. The Plan was based on the twin principle: that every road construction should be able to carry the traffic forecast for a twenty-year period and that every road should be part of a systematically planned net-

work. The Plan envisaged that no village should remain more than five miles from a main road and proposed an expenditure of Rs 372 crores over a period of ten years, but this vast programme could not be implemented due to shortage of material, scarcity of trained personnel and, above all, paucity of finance.

One of the recommendations of the Nagpur Plan was the reclassification of roads into national and state highways, major and minor district roads, and rural roads. Madras was one of the first States to adopt this classification and, in 1946, the Government of Madras assumed direct responsibility for all main roads in the State and created the Madras Highways Department, the first of its kind in India. Next year, Madras embarked on a 5-year road development programme for roads other than national highways, principally directed towards opening up isolated rural areas, which included 194 miles of concrete roads. By March 1952, 149 miles of concrete roads had been built and what remained to be completed was incorporated in the work to be done in the State under the First 5-Year Plan.

Progress under the 5-year plans

The development of roads under the two national 5-year Plans is current history. Under the first 5-year Plan all roads except national highways became the direct responsibility of the State governments, while work on national highways, though carried out by the State P. W. Ds, was financed and administered by the Central Government. Amongst the notable achievements of the States in the building of concrete roads are those of the old Bombay State and the State of Saurashtra. Between 1951-56, the state of Bombay concreted nearly 680 miles of their state highways and the State of Saurashtra 190 miles. The total mileage of roads concreted by 1958 by these two States was 1,070. Countrywide, India had by 1956 nearly 700 miles of National Highways and about 2,400 miles of State Highways in concrete and a further 100 miles have been added to the system during the following 2 years, thus resulting in the construction of nearly 1,770 miles of concrete roads after 1950.

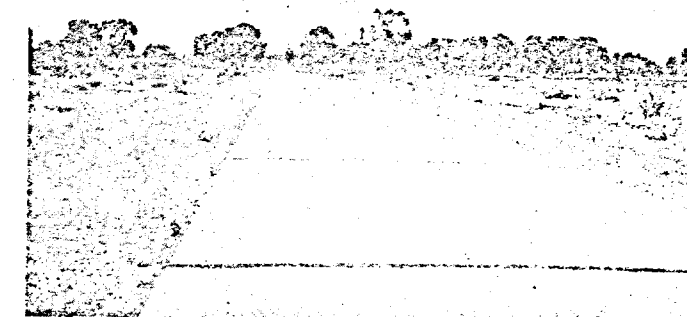
Soil-cement roads

The speedy construction and improvement of
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many miles of roads at low cost have now been recognised to be a real necessity for promoting rapid economic growth of the country. There is reason to believe that such a pace of development cannot be achieved or maintained by conventional methods of construction. During recent years, the construction of roads by soil stabilisation has received great attention. Also, soil-cement has emerged as a construction material with great possibilities. Yet, despite the remarkable developments that have taken place in the use of soil-cement abroad, its progress in India has been rather slow. To Madras rightly goes the credit of constructing the first soil-cement road in India—the 21-1/2 mile stretch constructed on the Ramnad-Mandapam section of the Madurai-Dhanushkodi Road, National highway No. 40, in 1954. The performance of the road during its five years of service has been quite satisfactory, though it is subjected to heavy traffic including iron tyre vehicles, and has been more than once submerged due to floods in certain stretches.

In the Bombay State, the first stretches of soil-cement were laid on the Jagudan-Mehsana section of the Ahmedabad-Kalol-Sidhpur Road, a moderately trafficked State highway. The cost of construction compared very favourably with the costs of conventional types of road bases constructed in the same locality. The success of this experiment with soil-cement has led the P.W.D. to plan the construction of other soil-cement roads in the near future and, in the same district, another State highway, the Mehana-Dhinoj road, is being constructed with soil-cement. In 1958, an experimental stretch of six furlongs of soil-cement base was constructed in the 67th mile of the strategic Bombay-Konkan-Goa road. The satisfactory performance of this stretch, which was opened to traffic immediately after construction, has encouraged the authorities to construct a further stretch of four furlongs on a different section of the same highway.

In West Bengal, five short lengths of soil-cement roads were constructed between the years 1955 and 1958: (i) the Jhargram-Tangra road; (ii) the Contai-Digha road (iii) the Digha Beach approach road—all in the Midnapur district; (iv) the Tali-Guskara road in Burdwan district; SILVER JUBILEE 1934—1959



Soil-cement base surfaced with concrete on the Jagudan—Mehsana section of the Ahmedabad—Kalol—Sidhpur Road, constructed in 1955—56. The thickness of the base is 3½ in. and the thickness of the concrete is 3½ in. and 4 in.

and (v) the Barasat-Basirhat road. These roads carry moderate to light traffic and their condition and performance have been very satisfactory. Thus there is a strong case for adopting soil-cement for road construction whose advantages are many and proven, not the least of which is its low initial cost and the substantially reduced cost of maintenance.

Road bridges

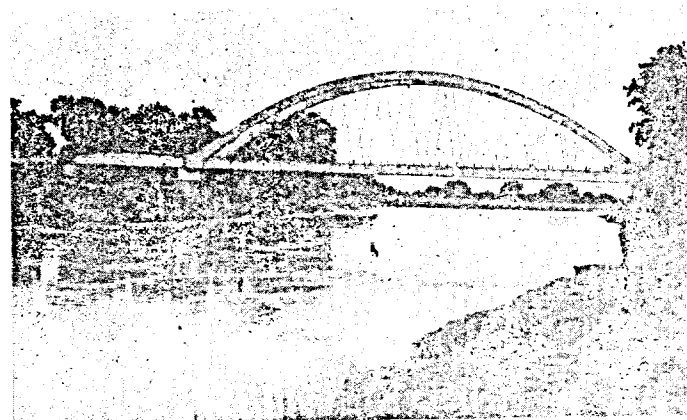
This brief survey of concrete road development in India would be incomplete if we do not mention the tremendous bridge-building activity in the country. Of all structures that man has built, concrete bridges are the most aesthetically satisfying and inherently functional. They span broad rivers, wide ravines and deep gorges and in India, where rivers abound, they are vital to the speedy movement of men and materials across the land. Most of our recent road bridges are of reinforced concrete and prestressed concrete and provide an excellent example of the use of concrete in the service of the nation.

The future

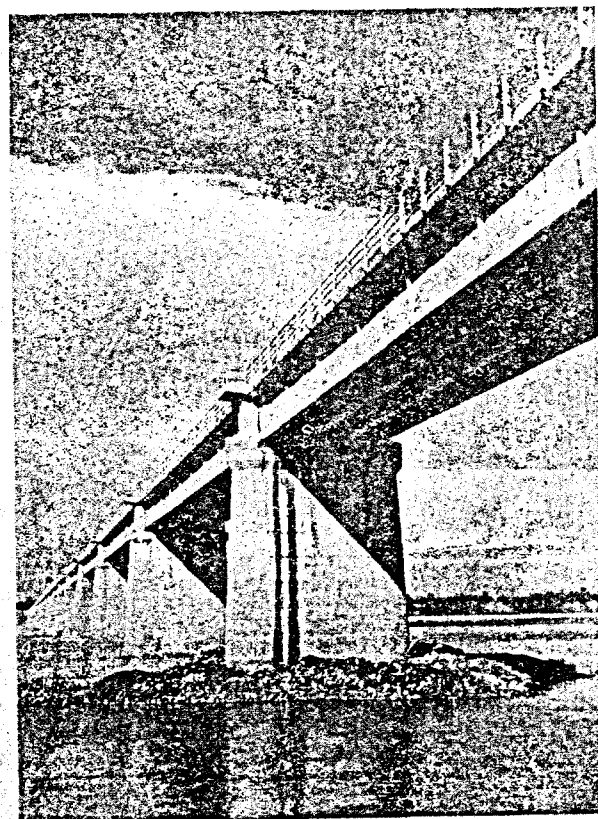
As we are approaching towards the end of the second 5-Year Plan, plans have already been prepared for a 20 year road development (1961-81) in this country, and the mileage target is set at twice the mileage of the roads in the country by



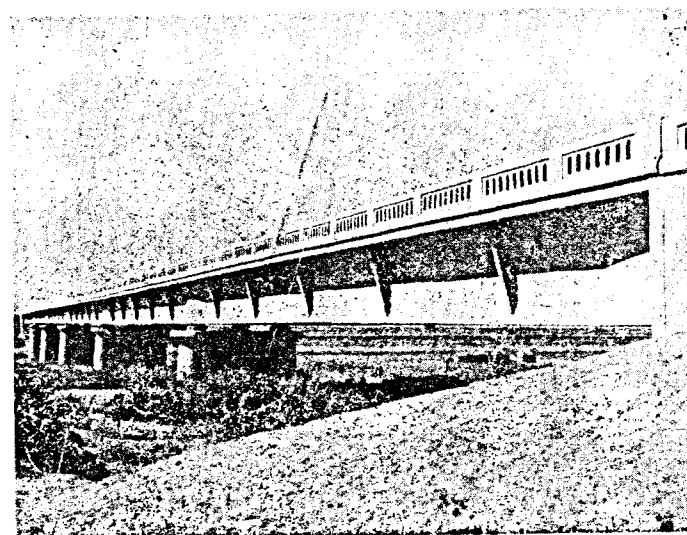
An Indian concrete arch bridge of unusually high rise. The Coronation Bridge over the Teesta in West Bengal has a span of 276 feet and a rise of 132 feet. The arch is of hollow box section and was built in 1941 by the Public Works Department of West Bengal.



The Durgavathi Bridge, Bihar. The single bowstring girder has a span of 197 ft 3 in. Together with two approach span, the total length of the bridge is 326 ft 6 in.



Concrete bridge over Sone river at Chopan, Mirzapur Dist., U.P.



A general view of the Rinza bridge across the Sabarmati. Precast prestressed concrete girders span 140 ft between piers. There are six spans in all.

1961. This plan, unlike the Nagpur Plan, provides not only for increased accessibility of the rural areas in the country but also provides for a much higher proportion of surfaced roads to unsurfaced roads in the country. As against the mileage of surfaced roads of 1,44,000 and unsurfaced of 2,35,000 anticipated in 1961, the plan by 1981 envisages these mileages to be 3,31,000 and 3,23,000 respectively. Thus the scope for increased use of concrete in road construction is by its own merits bound to get accelerated during the coming years.

Any road development plan for India must consider, therefore, the fact that the country needs not just more roads, but more and better roads. At present, out of a total road network of 3,10,000 miles of all types of roads in the country, only about 11 per cent have modern surface, either a concrete or a bitumen surface, and only about 3,200 miles (1958) are laid in concrete. Roads of inferior type, apart from being dusty and incapable of carrying the heavy traffic under modern conditions, are a constant drain on our limited financial resources and contribute to the high cost of motor vehicle operation which, in turn, inflates the cost of production of raw materials and finished products moved by road. A changeover from even a water-bound macadam surface to a concrete one can bring startling economies in motor vehicle operation costs, as is evident from the experience of the Bombay State Transport Corporation, which was able to save nearly 17 per cent in its operation costs following upon the concreting of the Nadiad-Dakor road. Considering that the operational costs of motor vehicles in India run into many crores of rupees annually, the economies and benefits that accrue from the provision of good concrete roads will be quite substantial. The fact that the new 20 year road development plan, if implemented, will increase four-fold, the existing mileage of modern surface is, in this context, truly welcome.

Technical know-how and advice

It is perhaps not easy to assess the role of the cement industry in all these developments in the construction of concrete roads in the country. The industry produces cement which compares

favourably for quality, uniformity and strength with the best cements produced elsewhere. But cement is rarely used as such in construction, the end product is concrete and the qualities of a good cement will not be utilised to the fullest if adequate care is not taken in the proportioning, mixing and placing of concrete. The manufacture of cement is factory-controlled at every stage, but concrete making is in the hands of the consumer. To overcome this difficulty, the industry has also to provide the technical know-how in the proper use of the material by the consumer. Thus the cement industry's contribution to progress and development of roads is two-fold: (i) it produces a quality construction material, and in addition, (ii) it provides, through the Concrete Association of India, the technical know-how.

The Concrete Association's services to the concrete road builder are varied. Ever since its inception in 1927, the Association has given technical advice on all aspects connected with the design, construction and maintenance of concrete roads and in recent years of soil-cement roads too. Detailed specifications for the construction of concrete roads are supplied, information on roads, tools and equipment is given, and soil and aggregates tested. The Association also deputes its trained personnel to supervise the construction of roads at site, at the request of the authorities. Its engineering staff periodically visit the site of road construction and inspect the condition of road, if required. Through its special publications on concrete roads and especially through the pages of the Indian Concrete Journal, the Association makes available to Indian Engineers and others interested in the construction of concrete roads, information about the latest developments in the design and construction of roads and results of research. Through brochures, charts and models, it has created an awareness in the public about the need and suitability of concrete roads for Indian conditions. It works in close co-operation with other national organisations engaged in the development of roads such as the Indian Roads Congress, the Central Building Research Institute and the Central Road Research Institute and has assisted in the development of new methods and materials of road construction such as prestressed concrete, soil-cement, etc.

In order to promote the use of soil-cement and to render efficient technical advice, the Association has set up a small soil testing laboratory.

The Concrete Association of India has done much to stimulate progressive and rational thinking among road engineers in India, towards the adoption of modern methods of concrete road design and construction, on the one hand, and towards the formulation of a progressive and adequate road policy for a more balanced road development in the country to cope up with the ever increasing traffic requirements. It is gratifying to note that the technical service of the Association is being increasingly utilised by highway authorities, municipalities and local boards and others interested in the planning, construction and development of concrete roads in India. Though its activities are entirely financed by the Associated Cement Companies Ltd., its technical

service is freely available to cement consumers of the entire industry.

Conclusions

From the foregoing review it is obvious that concrete and soil cement roads have a very significant role to play in the road development of this country. The wide variety of standards employed in their construction to this date permit a choice of concrete or soil cement surfacing for all kinds of roads from the lowest type roads to the motorways of today. The Cement Industry by its planned expansion is capable of providing adequate quantities of cement needed for the extensive use of such construction. The special characteristics of the mixed nature of traffic prevalent in this country point to the choice of concrete as the most suitable and durable surfacing for the country's road system. Dedicated to progress, the Cement Industry has pledged to play its part in the road development programme of the country in the years to come.

BITUMEN IN ROAD CONSTRUCTION IN INDIA

(By courtesy of Bitumen Manufacturers)

The need for roads grew with civilisation and man's struggle for survival. Progress brought faster modes of transport and fast moving traffic on unsurfaced roads spelt dust and mud. The

DEVELOPMENT OF SURFACED ROADS IN INDIA

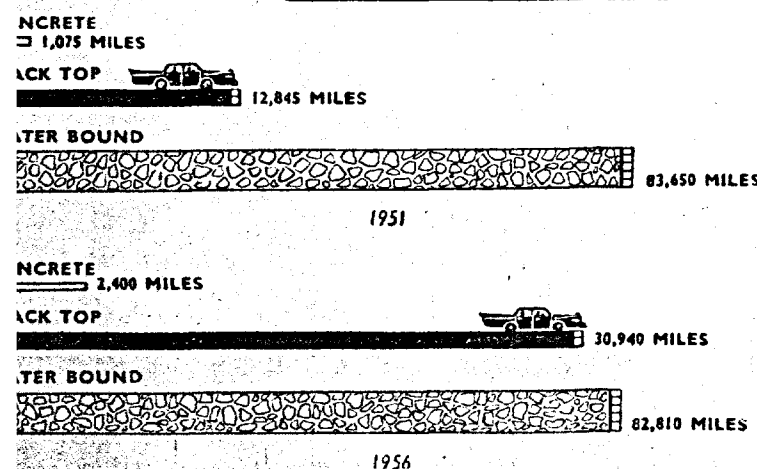


Fig. 1.

necessity for providing an all-weather surface saw the introduction of Bitumen or Asphalt.

The term asphalt has a different meaning in different countries:

1. In the U.K., it denotes a mixture of asphaltic bitumen and mineral matter.
2. In the U.S.A., it denotes an asphaltic bitumen, the pure refinery product.
3. In Europe, it denotes a rock asphalt.
4. In India, it denotes both asphaltic (petroleum) bitumen and the mineral mixture. In this article the refined product is referred to as bitumen to avoid any possibility of confusion.

What is bitumen? In simple language, it is a solid or a semi-solid black sticky residue obtained by the partial evaporation or distillation of petroleum crude. It is a natural constituent of many petroleum products in which it exists in solution. If lighter fractions like gasoline, kerosene, fuel oil, etc., are removed from petroleum, the final residue that remains behind is either bitumen or wax or a

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combination of the two depending upon the crude source. Further refining produces the required grade of bitumen.

Chemically, bitumen is composed of complex hydrocarbons, generally regarded as being colloidal in structure. When broken down into its constituents the Bitumen can be separated into asphaltenes, resins and oils. Asphaltene by itself is a hard brittle black substance. In the structure of bitumen the asphaltene particle forms the nucleus or centre. Around this is a protective coating of resin which when separated is glossy dark brown in colour. Asphaltenes and resins are suspended in oils and the combined product is black in colour with consistency ranging from soft sticky paste to hard solid depending upon the proportions of each constituent (asphaltenes, resins and oils) in the refined product.

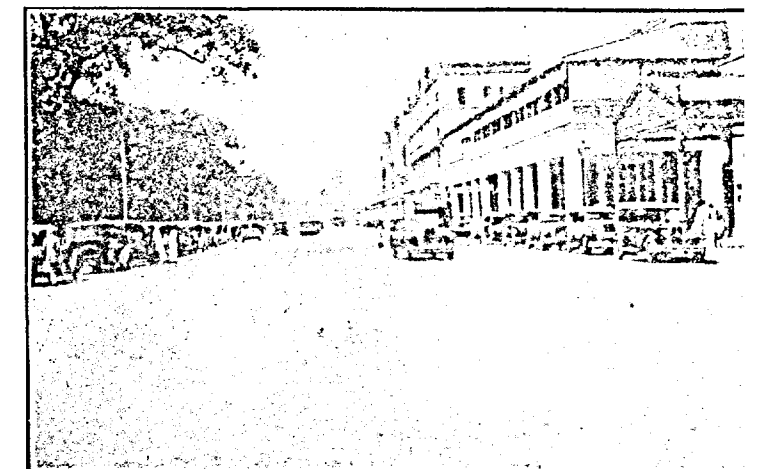
Initial discoveries of bitumen were made as the result of nature's work in the form of rock asphalt outcrops or natural surface seepage, (as in the La Brea pit, Los Angeles, California, or the famous Asphalt Lake in Trinidad). Now the result is accomplished by processing the crude at a refinery.

The use of bitumen dates back into antiquity. One of the earliest uses was made in the Indus Valley in Sind, Pakistan, at the city of Mohenjo Daro, where a layer of natural bitumen mastic was used to waterproof a storage tank. In the western countries, the Romans were pioneers of road building on a large scale. Since then its versatility has been recognised by its properties of adhesion and binding, waterproofing, ductility, high electrical resistance, high corrosion resistance, non-toxicity, odourlessness and tastelessness when cold. Its properties of flexibility and lack of temperature susceptibility particularly suit it to road surfacing in most extremes of climate.

The major use of bitumen is for black topping roads. Bitumen, produced from petroleum, has been established for many years, particularly in Europe and the U.S.A., as an engineering material, used in the construction and maintenance of roads and streets.

Bitumen was first introduced into India some time during 1916 for black topping works in cities. A form of premix was used and one of the

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Asphaltic concrete construction in 1916

first roads to be surfaced was Chowringhee, Calcutta. Five years later the Bombay Municipality adopted the same procedure. The surfacing consisted of a 1½ inch sheet asphalt wearing surface laid on a 1½ inch asphaltic concrete binder course.

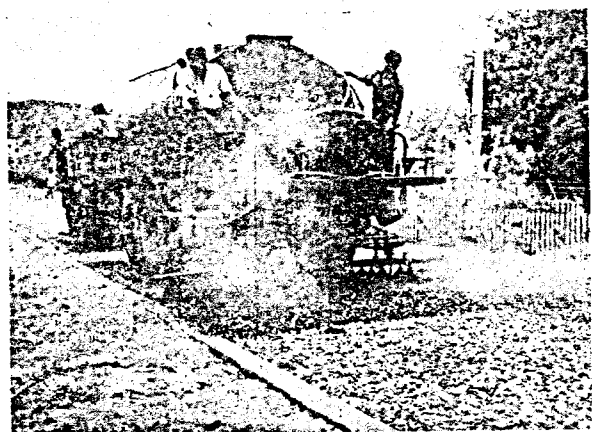
It was then found that it was possible to spread a thin coat of hot bitumen on to a prepared road surface and blind it with chippings to give an all-weather wearing surface. This was known as surface dressing and was first started in 1921. A development of this method to give greater penetration of the bitumen into the road structure was brought about by the grouting or penetration method, in which the voids or interstices between the road stone become filled with bitumen.

In the first instance, bitumen had to be heated to make it sufficiently fluid to apply on the road surface. Subsequently, two other methods of making bitumen fluid by either cutting it back or emulsifying it were developed. Cutback bitumens consist of ordinary straight run grades, thinned down or "cutback" with a volatile flux. Various grades with different rates of curing are available, one of the big advantages being a reduction in the application temperature. Bitumen emulsion consists of fine globules of bitumen dispersed in water with the aid of an emulsifying agent. There are various grades which differ in stability and make it possible to use the emulsion either for surface dressing or premix work. The two great advantages of an emulsion are that it can be applied cold and also on damp surfaces.

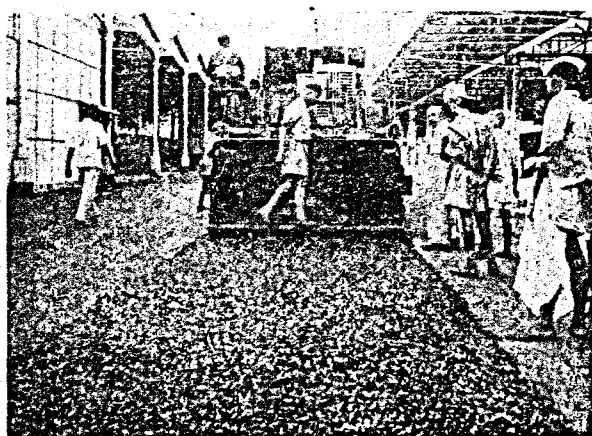
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Madras Fort St. George Wallajah Gate—
hand application method—1927



Application of bitumen by bulk distributor
in Bombay



Blowknox Finisher laying 1½ in. premix
at the rate of 80 tons per hour—work by M/s Recondos

The availability of cutback bitumen made the introduction of "cold" premix possible. The term "Cold" refers to the aggregates which are sun dried and not specifically heated. In 1931, the first cold premix surfacing was laid in Bombay. This was closely followed in 1932 by a similar premix surfacing in Lahore and Delhi. Other major cities throughout the country quickly adopted this method and there are premix surfaces still in service today, with negligible maintenance, which were laid over 20 years ago. One good example is the Rashtrapathi Road, Hyderabad, the venue of the 23rd Indian Roads Congress session.

Engineers were quick to realise the advantages of bitumen for road surfacing. They found that its good adhesive properties bound the aggregates together in the road structure providing a waterproof and dust proof all-weather surface that was flexible, and allowed for appreciable deformation in the substructure without cracking or disintegration. What is more, its durability stood the test of time and wearing surfaces of varying thicknesses could be provided in accordance with the economics of the projects.

In 1947, after partition, the simple ¾ inch chipping carpet was introduced as a considered improvement over surface dressing and yet requiring no more bitumen than a 2 coat surface dressing. It was found that roads carrying a volume of heavy bullock-cart traffic introduced a problem which the thin skin surface dressing was not designed to withstand. The higher percentage of stone in the chipping carpet was thought to provide a surface with greater resistance to the virtual point loads and tremendous crushing stresses exerted by the iron tyred wheels. Although a dense premix would have been more advantageous, economics would not allow it and the simple chipping carpet seemed to be an improvement. This method is preferred by some States but still not all; many realise advantages of the old surface dressing treatment, particularly those with a heavy monsoon rain problem, where an impermeable dressing is of the utmost importance.

Bitumen is particularly well suited to stage-by-stage construction, which the economy of the country demands to-day, with its vast road programme. Whilst it is accepted that thicker and higher

type surfaces are desirable for major roads and city streets, the justification is presently not there for the low traffic volume on rural roads. To get the most for our expenditure, the simplest type of surfacing has to be adopted. The most economical answer, therefore, for light traffic roads is surface dressing, which at a later date can provide the base (provided it is of sound construction) for a higher type surfacing when the traffic intensity increases.

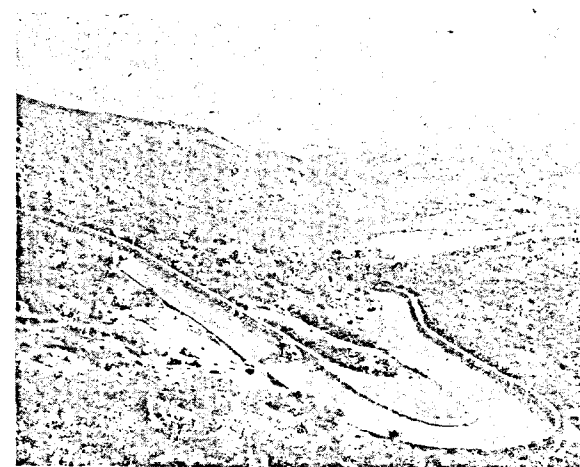


Photo 5. Nandi Hill road, Bangalore—single coat
surface dressing completed 1955–56

When bitumen was first introduced into India, it had to be imported from overseas, the only method of packing it was in wooden barrels. "Packed Supplies" still meet the bulk of India's demand for bitumen except that the packages are now steel drums. However unsatisfactory the method may appear, the vast distances and the many out-of-the-way places where road construction is carried out, still make packed supplies the most practicable method of overall distribution.

The commissioning of India's first refinery at Bombay in 1955, introduced the possibility of the delivery of bitumen in bulk. Initially this facility could only be put to use within the economic radius of Bombay by road. Then at the end of 1958 when, through the co-operation of the Railways, 30 bulk bitumen railway tank wagons were made available, the bulk horizon was widened. Although this can only represent 5 per cent of India's present bitumen demand, it is a start. Deliveries are currently being made to both Calcutta and Delhi.

BITUMEN/ASPHALT CONSUMPTION IN INDIA

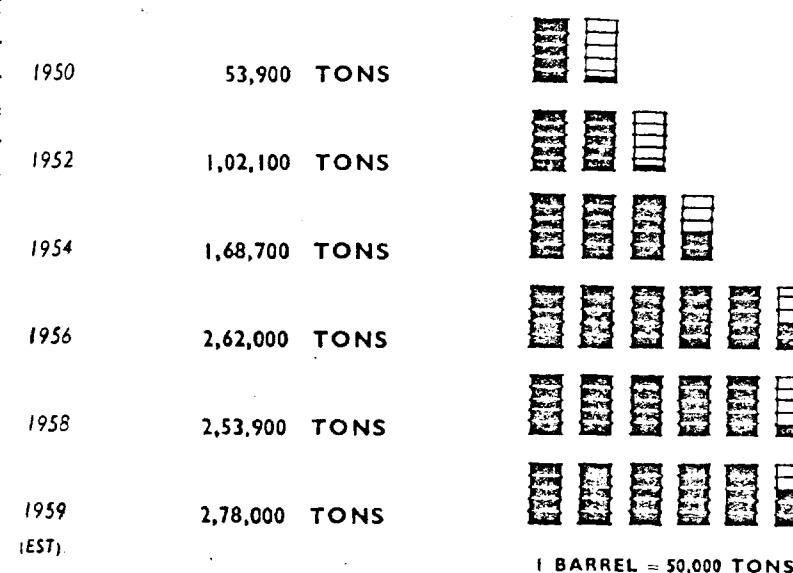


Fig. 2.

But the delivery of bitumen in bulk must necessarily place an additional strain on the Railways, particularly in view of the peak seasonal demand. The receipt of bitumen in bulk also demands the installation of storage facilities by States. However, engineers cannot help but realise that bitumen in bulk means improved application methods and increased mileage from the road fund. Our hosts to-day, Mysore State, lead the field by having sanctioned the construction of their own bulk depot, in this very city of Bangalore. Other States must surely follow.

Now that improved methods of supply are available, improved methods of construction must come. Bulk bitumen provides us with the opportunity of applying longer sections of road surfacing more evenly and economically, either by bulk distributor spraying methods or premix fabricated in centrally positioned plants at central quarries. For our cities, which demand a higher type of flexible surfacing at reasonable initial cost and low maintenance cost, bitumen provides the answer. Throughout the country, a network of engineers who specialise in the application of bitumen are available to ensure that the best use is made of this product of nature, to the advantage of India's roads.

ROAD TAR AND ROAD CONSTRUCTION IN INDIA

(By courtesy of Tar Manufacturers)

Introduction

The major coal and iron ore deposits in India are very localised and mostly occur in the adjoining states of West Bengal, Bihar and Orissa, within a radius of 100 miles.

Coking coal employed in the production of metallurgical coke for the manufacture of iron and steel is derived from one source only, the Jharia coalfield, situated at the eastern end of the State of Bihar, approximately 200 miles west of Calcutta. The first Coke Ovens were erected in the Jharia coalfield in 1908 and further installations followed during the ensuing ten years which witnessed the early development of the Iron and Steel Industry in India.

Road Tar is produced by the refining of Coke Oven Tars and until 1959, 90 per cent of the coke and coke oven tar production in India was concentrated at the two main steel works at Jamshedpur in Bihar, and Asansol in West Bengal. During 1959, coal tar production has commenced at the three new steel works of the Hindustan Steel Ltd. at Rourkela, Bhilai and Durgapur. Coal tar is despatched in rail tank wagons to distillers' works at Jharia and Calcutta.

Historical

The distillation of coal tar in India was first begun on a small scale in Calcutta in 1919, the primary products being creosote and pitch.

The installation of the first Pressure Sleeper-treating Plant in India by the North Western Railway in the Punjab in 1921 created a regular demand for creosote. This demand continued to act as the main stimulant for coal tar distillation until about 1928 when heavy accumulations of pitch, for which no steady market existed, made it obvious that a regular offtake in the form of road tar was essential for coal tar distillation to continue to operate in India on a sound economical footing.

The earliest essays in bituminous road surfacing in India were undertaken in the locality of

main ports—Calcutta, Madras, Bombay and Rangoon, on densely trafficked roadways requiring heavy maintenance. The technique first adopted was penetration grouting, using as binder either a blend of coal tar (or low viscosity road tar) with coal tar pitch mixed in situ, or bitumen. The first record of a road so treated in India with a coal tar pitch binder was Government Place East, Calcutta, in 1913. Tradition has it that the Mall in Lahore was first surfaced with road tar in 1916.

During the period 1920-1930, some progress in the surface treatment of roads in India was achieved but mainly in the vicinity of the large cities.

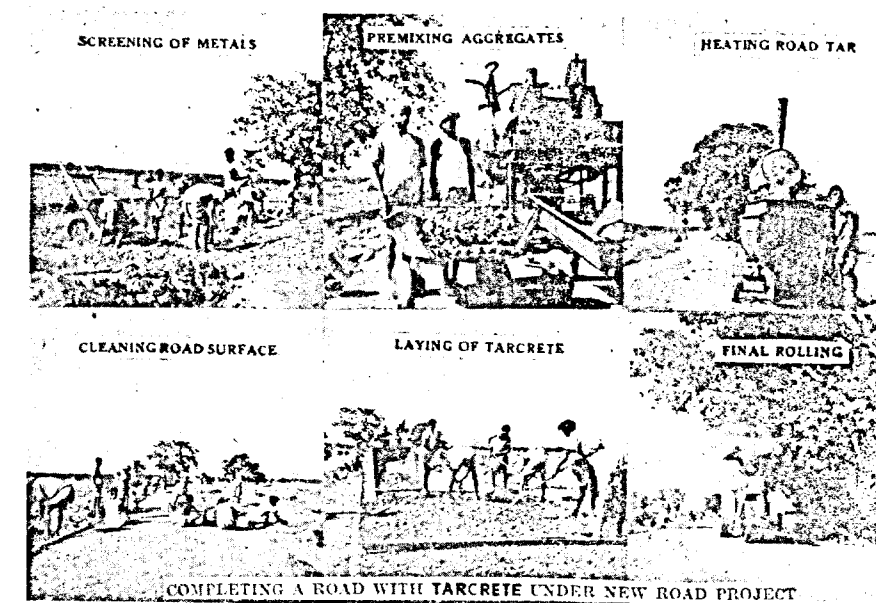
The roads of the famous Maidan in Calcutta were grouted with coal tar pitch blends and a start was made on the treatment of the Grand Trunk Road which runs from Calcutta to Delhi, a distance of 900 miles.

During this period, hot mix macadam plants were erected by the Calcutta Corporation and Bombay Municipality but no suitable grade of road tar for use in such plants was then being produced in India.

For the surfacing of the vast mileage of roads linking the cities and towns in India, it was obvious that a light and cheap form of surface treatment on water-bound macadam was essential. Road tars in India were first produced to the British Ministry of Transport Specifications and satisfactory trials were carried out during the period 1924-27 in Madras, Burma, North West Frontier Province, United Provinces and in the Punjab.

From 1930 the Punjab Province embarked on an ambitious programme of upgrading the surfaces of its main roads by spraying the water-bound macadam with road tars. Light applications only were given with gravel blinding but the saving in the maintenance charges which rapidly accrued enabled the surfacing of a very considerable mileage of roads to be completed in a period of about six years.

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During this period the output of crude tar in India had been steadily increasing and by 1935 was over 50,000 tons per annum, of which 30,000 tons were distilled and 25,000 tons of road tar produced.

By 1941, the production of crude tar in India had risen to 75,000 tons per annum of which 60,000 tons were available for distillation and 46,000 tons of road tar were produced. Owing to the necessity for large scale reconstruction of Coke Ovens, and the increasing use of crude tar as fuel in the Steel Works, the tonnage available for distillation thereafter fell to less than 50 per cent of the 1941 figure. Since 1950, there was a substantial revival and road tar production rose to 43,000 tons.

Since 1953, there has again been an upward trend in the consumption of coal tar as a fuel and in 1958 although over 1,00,000 tons were produced, the quantity of coal tar released for distillation fell to 30,000 tons only, with a corresponding fall in the production of road tar to 20,000 tons. Supplies of coal tar from the steel units in the private sector for distillation have now virtually ceased and it is entirely consumed as a fuel.

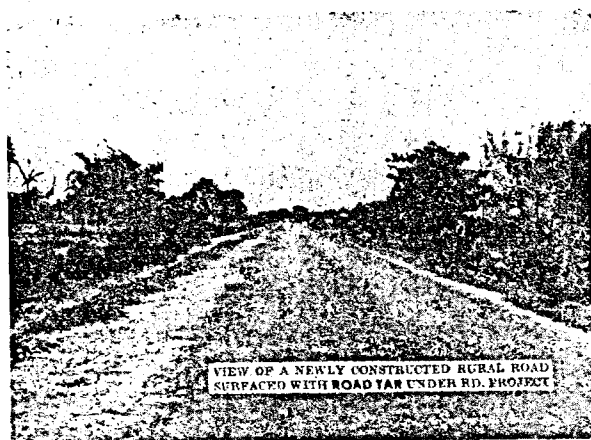
The production of Gas coal tar in India is limited to that produced by the Gas Companies
SILVER JUBILEE 1934—1959

operating in Calcutta and Bombay, which does not exceed 6,000 tons per annum only.

The consumption of bituminous binders on roads in India before the last war was of the order of 80,000 tons per annum of which road tar constituted one half. Considerable increased quantities were employed during the war years and the consumption is still increasing and is now estimated at 3,00,000 tons annually.

Coal tar will be produced on a large scale at the Rourkela, Bhilai and Durgapur Steel Projects of the Hindustan Steel Co., Ltd.





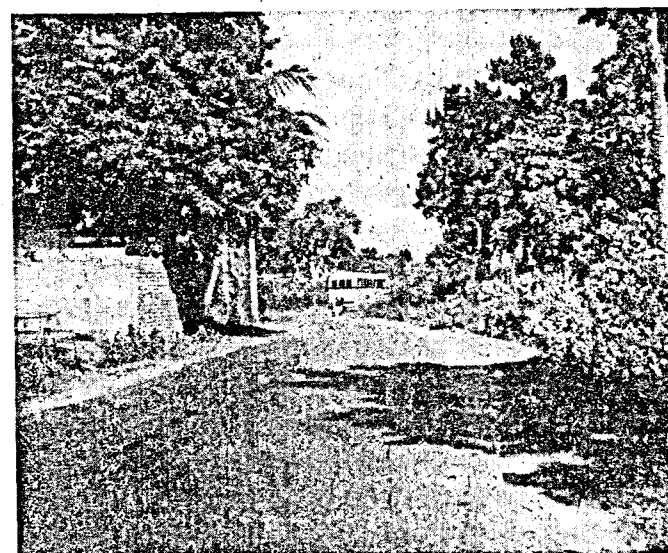
The quantity of road tar which will become available from the crude tar produced at these plants after meeting their internal fuel requirements is not yet known.

Standardisation of road tars

The first standard specification for road tar was published by the Indian Stores Department in 1929 and this was based on the Standard Specifications for Road Tars Nos. 1 and 2 then current in the United Kingdom. While these grades had given satisfactory results in initial treatments showing particularly effective penetration of water-bound macadam and good adhesion for such soft aggregates as 'kankar' and 'laterite', they were unfavourable compared with bitumen in respect of quick setting properties. Chippings were too easily displaced under fast traffic under the much higher temperatures which prevail for most of the year in India. Indian coal tar distillers therefore, evolved a wide range of more viscous road tars to suit the local climatic conditions.

The results obtained with these more viscous road tars have proved very satisfactory over a period of years and enabled road tars to hold their own in competition with other bituminous road binders.

In the Indian Standard Specification, I. S. 215-1951, there are now included five grades of road tar covering a range of E.V.T. (equiviscous temperature) from 32°C - 67°C, specified for surface dressing, tar macadam and grouting.



2 in. Tarcrete carpet on Diamond Harbour—Sarson Road, West Bengal

Coal tar distillers in India who manufacture road tars to the above Indian Standard Specification are :

- Messrs Shalimar Tar Products (1935) Ltd., Calcutta.
- Messrs Bengal Chemical & Pharmaceutical Works Ltd., Calcutta, and
- Messrs Bararee Coke Co., Ltd., Kusunda.

ROAD MISCELLANY

Roads are as old as mankind. Through the ages, man has strived to build and improve them and our road system of today is the outcome of the cumulative efforts of several generations. Is it of any profit to take a peep into the past? Yes, "there can be no basis for our society save its past. There is no guide to business decisions except that given by experience; there is no personal maturity that is not built upon reflection on the events of yesterday. The record of things to be recalled is contained in books, in universities and in business files. What are books but the thoughts of men of their time put down in type? There is one qualification, however, to be made; we must use only what is true, significant and applicable. We must as a famous statesman, philosopher and orator said: 'Take from the altars of the past the fire—not the ashes.' History inspires us to respect our forefathers' achievements, great in their day, and to strive to equal their resourcefulness and courage".

We take the readers not into the dim or distant past but only as far back as 1927 and these are the voices we hear on different aspects of road development and road transport.

Road development in India is passing beyond the financial capacity of local Governments and local bodies, and is becoming a national interest which may, to some extent, be a proper charge on central revenues.

—Indian Road Development Committee—1927.

* * *

"We feel that the road system in India has now become somewhat unbalanced owing partly to the large expansion in the other activities of the local bodies which has outrun the increase of their resources and has resulted in neglect of local roads; partly to the classification of roads, limiting the provincial purview to trunk and main roads, so that recent development and regular maintenance has been preponderantly in the field of provincial roads. We believe that, in order to restore the balance, a comprehensive plan will be necessary, but that the question of adequate provision for future maintenance should first be put on a proper footing."

—From "The Report of Mitchell-Kirkness Committee on Road-Rail Competition", 1933.

SILVER JUBILEE 1934—1959

"The ideal road is one in which the driver meets nothing unexpected. The building of such roads is more a matter of economics than of road engineering. We in India have not yet arrived at a stage when it has become a matter of imperative necessity to have such roads—roads having one-way traffic with a safety island separation, proper lighting, long radius of curves, clover-leaves and over-passes at intersecting roads. What the engineer in India is chiefly engaged is at present in the improvement of the road-surface. This in itself constitutes a problem, having regard to the different kinds of vehicles using our roads and to the paucity of funds provided for the purpose."

—Sir Mirza Ismail in his Inaugural Address, Second I.R.C. Session, Bangalore, January 1936.

* * *

"The necessity for the expansion of roads in India brings in its train a number of problems pertaining to finance and the technique of road construction. Roads are not only expensive to construct but they involve a large recurring expenditure by way of maintenance. If, therefore, our limited resources are to yield the maxi-

mum benefit, it is obvious that thoughtful consideration will have to be bestowed on the framing of a plan which will not only be based on the needs of the present but will also make provision for those of the future. It is due to the absence of such planning in the past that, in several parts of the country, trade and travel have come to adopt routes which have sprung up perhaps fortuitously in the course of time but do not quite fit into the framework of modern agricultural or commercial development. The waste involved in such haphazard transit is enormous and lays a heavy and unnecessary burden on the State exchequer."

—Hon'ble Raja Shamraj Rajwant Bahadur, Member, H. E. H. The Nizam's Executive Council, Fourth I.R.C. Session, Hyderabad, January 1938.

"I think, Mr. President, that you have done well to emphasise the importance to this country of the problem of unmetalled roads. I say this because there is a danger of the impression getting abroad that now-a-days road engineers are concerned only with making roads that are fit for motor transport, overlooking earth roads which are of such great importance in the transport of agricultural produce. The unmetalled road and the bullock cart, hard though the latter is on the former, are likely, for many years to come, to be the principal factors in goods transport for the millions of people who are engaged in the cultivation of the soil."

—Hon'ble Maharaja Sir Srischandra Nandy, Minister for Communications & Works, Bengal, in his Inaugural Address, Fifth Session, Calcutta, February 1939.

"I would remind you of the story of the Irishman and his donkey. The Irishman reasoned that the donkey, being a patient animal, would not notice a gradual cut in his food and could therefore be accustomed to have much less, and even, perhaps, none at all. He therefore reduced rations by ten per cent a week. The experiment was successful in that the donkey made no

complaint, but unfortunately at the end of ten weeks it died, and the owner had to buy another. Sir, that is a frivolous but apt parallel to arbitrary economy on road maintenance, particularly in India where roads are generally of a type which is cheap to construct but is dependent on regular maintenance and renewal. The effects of starvations may not be immediately apparent, but later on deterioration is rapid, and in the end your road may have to be reconstructed at greater cost than has been saved."

—Sir Kenneth Mitchell in his Presidential Address, Sixth Session, Bombay, December 1939.

"The importance of the subject with which the Congress is concerned is one which, in my estimation, it would be impossible to exaggerate. Communications are, in very truth, the arteries of the economic, social and political life of a country and in the active pursuit of your subject you are making no mean contribution to the building not only of roads and bridges but of a healthier, happier and more prosperous India."

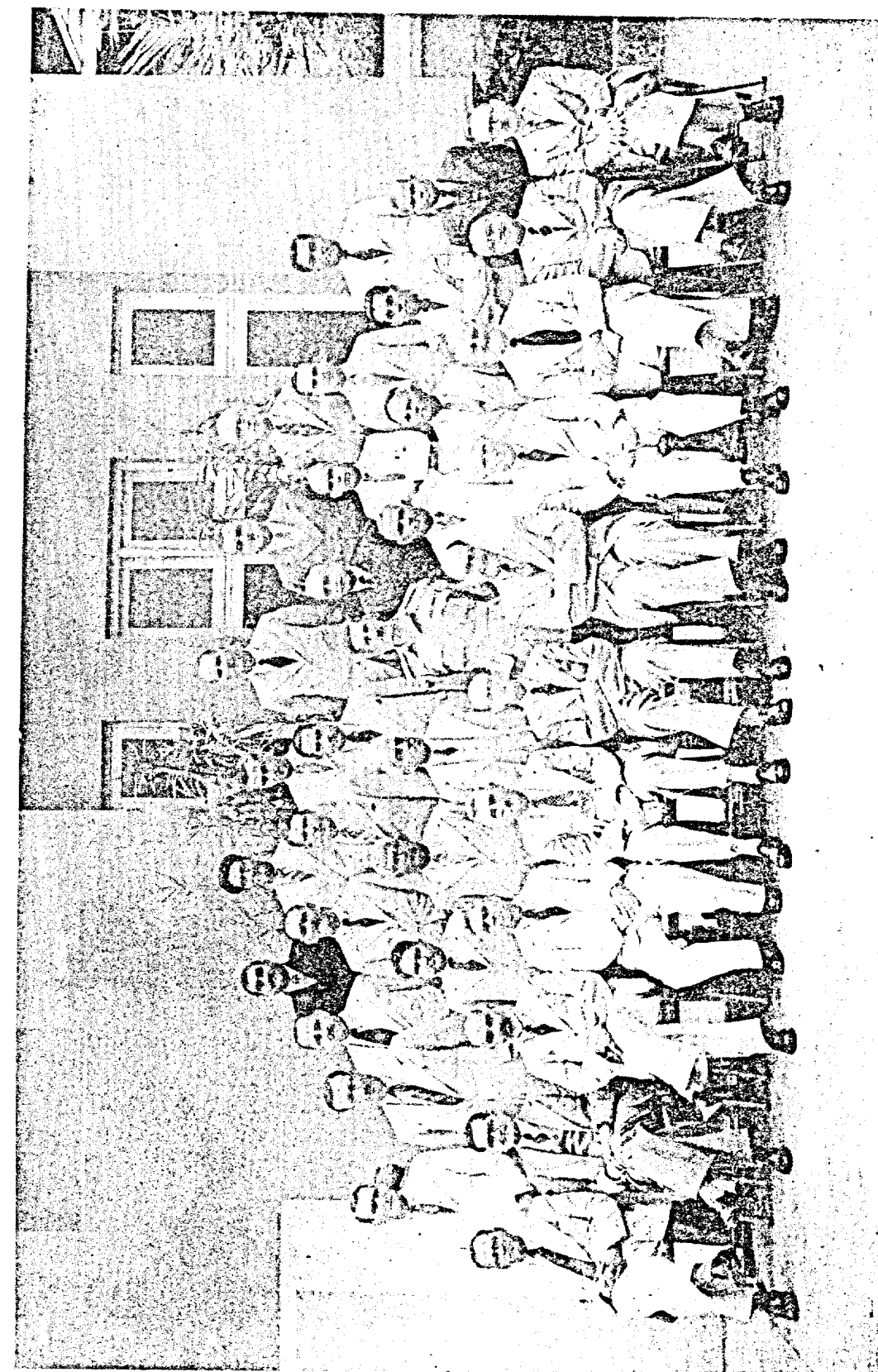
—H. E. Sir Roger Lumley, Governor of Bombay in his Inaugural Address, Sixth Session, Bombay, December 1939.

"Even greater than the difficulty of funds, was the intolerable dictatorship of the steel tyre on the Indian bullock-cart. This survivor of the dark ages in India is chiefly responsible for the almost complete stagnation of the development of our road technique, and it is the steel tyre that, if allowed to persist, will throttle all development of agriculture, education, and whatever goes to make a nation great."

—W. L. Murrell in his Paper on "Roads in India and Australia—our difficulties and some suggestions", December 1939.

"It was not the first time that attention had been drawn to the heart-breaking burden that the steel-tyred carts constituted on their road finances. He earnestly appealed to Provincial Governments to lose no time in taking measures to combat

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20th COUNCIL MEETING, MARCH 1944, BOMBAY

"this scourge" that was eating into the vitals of their communications system and holding up the progress of India. Isolated and patch-work measures would not be of any avail. What was required was a countrywide, Government-subsidised campaign to abolish the steel-tyred carts. Admittedly, the conversion of such carts into pneumatic-tyred ones would take time and cost money, but any expenditure incurred would be more than fully repaid by the substantial savings in their road maintenance bills in the years to come."

—Nurmahomed Chinoy on Murrell's Paper on "Roads in India and Australia," read at Sixth I.R.C. Session, December 1939.

"The fact is that the biggest Indian road problem did not start with the introduction of motor transport; they are not even now, in the main, problems of motor transport, and they will not in the future relate solely to motor transport. The villagers needed a good road long before the internal combustion engine was invented; and most of them are waiting for it still."

—Hon'ble Sir A. G. Clow, Member of Governor-General's Executive Council, in his Inaugural Address, Seventh Session, Delhi, January 1941.

"The conversion of the existing trunk roads in India into modern surface roads presents no engineering difficulty, but it is largely a question of policy and administration as well as of finance. Like Sir Kenneth Mitchell, I look forward to the day when India will have a National Highway system with central and provincial organizations to maintain and develop it to the utmost extent possible."

—Rajamantrapravina S. P. Rajagopalachari, Home Member & Vice-President of the Executive Council of Gwalior, Eighth Session, October 1943.

"The delegates were handicapped by the absence of any financial yardstick to apply to their proposals. They interpreted the instructions

to plan "underterred.....by financial considerations" not as a licence to plan a utopia, but merely as an instruction that they were not to be concerned with methods of finance. They were guided throughout by the obvious limitations of finance and their plan is based on what they deem to be the minimum needs, if India is to be provided with reasonable transport facilities and the amenities of civilisation. The resulting figure of capital and recurring cost does not appear to them to be beyond India's capacity, having regard to the direct and indirect revenue receipts that would follow from a development of the road communication system of the country.

—Report of the Conference of Chief Engineers held at Nagpur in December 1943.

"While recognizing that the aforesaid calculations embody a considerable amount of assumptions, we believe, that it is universally accepted that there is a crying need throughout the country for the immediate adoption of some such reconstruction scheme for roads as we have visualised. Whatever may be the direct return, it is recognised on every hand that the indirect returns are more than sufficient to justify expenditure of large sums of money in opening up the country, especially the villages, by reasonably good road communication.

Here are some of the more obvious examples for prompting national wealth and prosperity through road reconstruction:

- (1) The production and marketing of perishable articles such as fruits, vegetables, milk and eggs over larger areas in partial substitution of lesser value crops.
- (2) Improving the methods of agriculture by (a) giving the cultivator access to the outer world which enables him to obtain fertilizers, improved agricultural implements and selected seeds, and knowledge of improved methods, (b) enabling the Agricultural Department to tackle problems relating to seed distribution, plant disease, insect pests and the like, more expeditiously and effectively; also by

I.R.C. SOUVENIR

improving cultivation by direct encouragement of Well Irrigation owing to facilities for marketing better crops.

- (3) The development of industries such as sugar, dehydrated vegetables, fruit products, milk products, tiles, bricks, handloom and cloth weaving, metal ware, coir products, wooden implements, cane and bamboo wares, paper pulp, strawboard, glue, etc.
- (4) The exploitation of forest wealth including timber, and mineral resources; the transportation and marketing of hill produce which is now going to waste.
- (5) Directly assisting the control of the soil erosion which is laying waste large areas of the country; new roads, in addition to improving agriculture and afforestation, themselves serve to restrict the flow of water at bridges and culverts.
- (6) The development of trade and commerce.
- (7) The mental and moral advancement of the population by extension of educational facilities, the opening of schools, better interchange of information through improving postal system and extension of travelling cinemas, libraries, etc., to the villages.
- (8) The extension of medical services—the lack of which levies a heavy toll on human lives—and prevention and relief of epidemics. Also the extension of veterinary services.
- (9) The improvement of facilities for and reduction in cost of administration and police protection and for the prompt transport of people and commodities during unforeseen national calamities, also reduction of hardships and loss due to famine and scarcity by facilitating anti-erosion projects such as contour bunding.
- (10) The development of inter-community life, spirit and tolerance.
- (11) The development of village uplift, social welfare and co-operative societies and the improvement in the standard of

living through increased national production and consumption.

—From the Report by the IRTDA on Pilot Surveys for Road Construction Scheme, 1943.

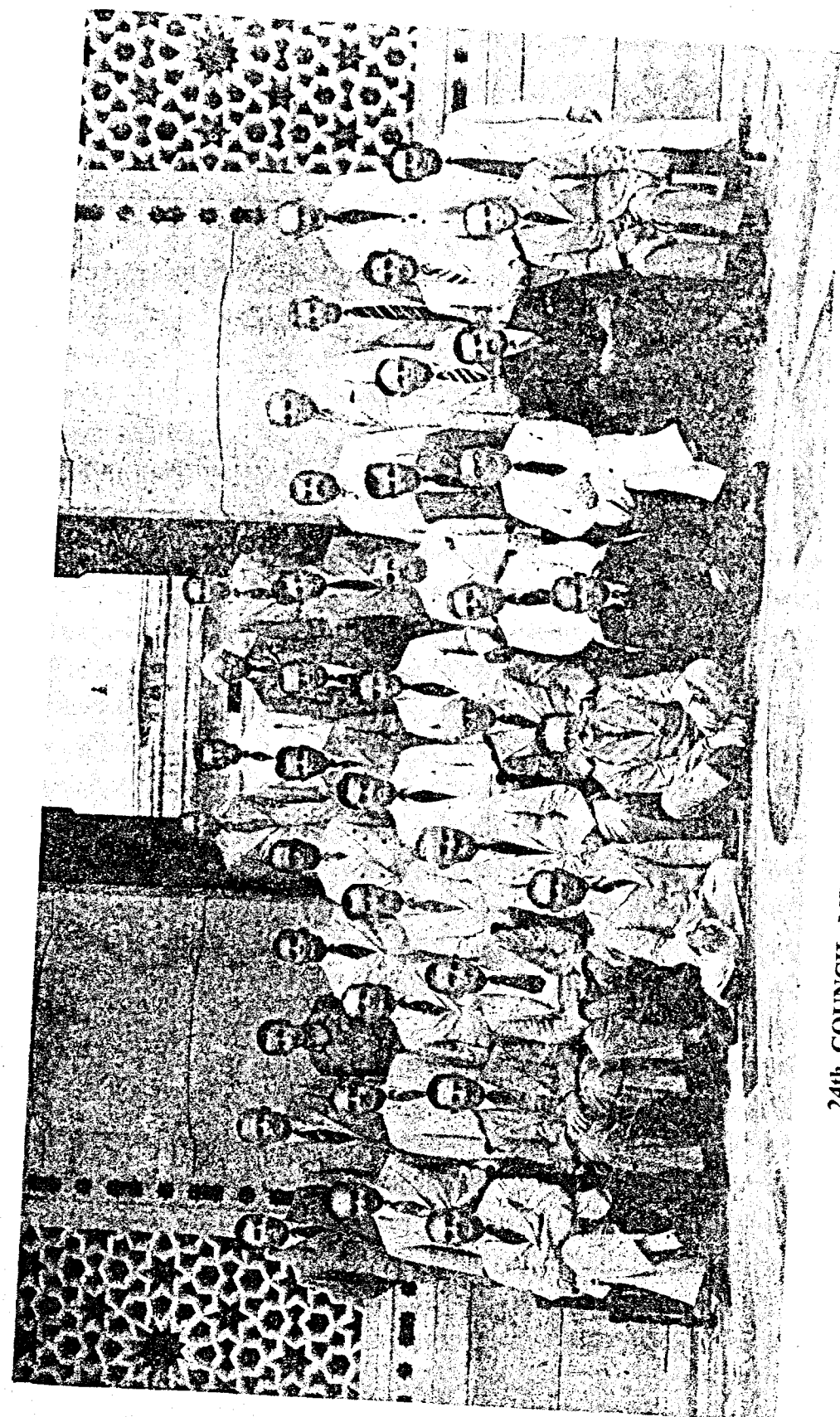
"India at present appears as a body lacking in necessary arteries and veins and in consequence vast spaces are practically dead. Further, India, without sufficient and good roads might also be likened to a house without a lift, staircase or passages. In the house of India, there are lakhs of these isolated rooms in the shape of villages scattered far and wide throughout the country. A country may have a good system of railways, a network of modern air communications, efficient shipping facilities and good canals and rivers, but unless roads connect these with the heart of the country, only the surface of rural development will be scratched."

—Shri T. R. S. Kynnersley in his Presidential Address to the IRTDA, August 1945.

"Taking the village as our starting point, everything that is grown by the villager has to find a market. The better the market the better the lot of the villager. It may be at present that villagers are dependent on nearby markets for lack of transport in which case the market prices are likely to be low. It may be that transport exists, but not very efficient transport, in which case costs will be high. It may be that the villager cannot get the best from his land owing to poor seeds and lack of facilities for getting good seeds. It may also be that he cannot get the best out of the land due to lack of manure or the use of fertilisers, or shortage of water."

—Shri H. E. Ormerod on "Pilot Scheme for Delhi", I. R. C. Journal, Vol. X-2, December 1945.

"The manifold post-war plans of reconstruction will fail in their objectives unless there is an adequate road system to enable their fruits to reach the large mass of the rural population. No scheme of health services will improve the health



24th COUNCIL MEETING AT NEW DELHI, SEPTEMBER 1945

of the people generally unless doctors and nurses can readily reach the rural population and unless the rural population can readily reach the centres of special treatment.

"No multiplicity of schools will raise the general level of education unless school children of rural India can reach them quickly and safely. No extension of railway and river services will provide the needed flow of commodities unless railway stations and river stations are served by an adequate system of feeder roads."

—I. A. T. Shannon in his Presidential Address to the IRTDA, July 1948.

* * *

"This brings me, Sir, to our oft-repeated demand for an independent Road Board. We believe that without the creation of such a Board, it would be impossible to push any road plan to completion. The Chief Engineers when formulating the Nagpur Plan were acutely aware of the need for drive and co-ordination if planning were to be effective and organized and their unanimous view was that some whole-time impartial and independent authority was required to proceed with the work of co-ordinating planning, and, above all, be responsible for effective progress of the plan."

—Shri Brijmohan Lal in his Presidential Address, Fourteenth Session, Bombay, January 1950.

* * *

"A scientific system of taxation of the motor vehicle user cannot be evolved unless the Union and State Governments accept a common transport policy. The transport policy recommended for acceptance is generally that recommended by the United Nations.

This recommendation may be amplified as follows :

- (a) The motor vehicle user as a general tax payer should contribute to general revenues only to the same extent as does the railway user and
- (b) The taxation policies of the Union and States should be so adjusted that the motor vehicle user as such is not called

on to pay the expense of implementing any extraneous Union or States' policy (defence, welfare, prohibition, etc.), nor to pay for the establishment of a motor vehicle manufacturing industry in India.

It follows from the acceptance of (a) above that :

- (a) The balance of the proceeds of taxes on the motor vehicle user after deducting the contributions to general revenues should be earmarked for expenditure on roads and
- (b) These proceeds should be paid into non-lapsing Road Funds."

—Report of the Motor Vehicle Taxation Enquiry Committee, 1950.

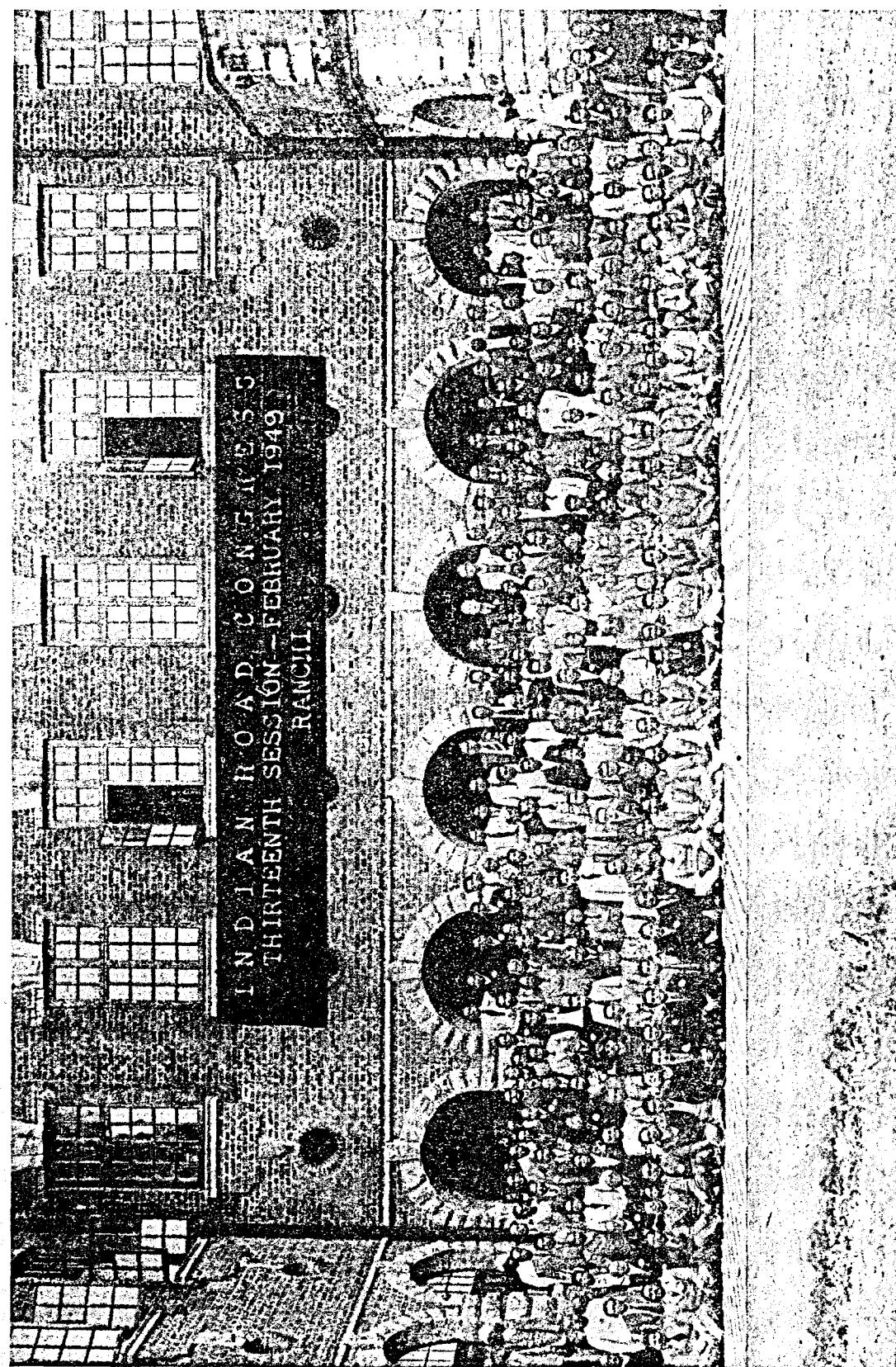
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"The primary needs of mankind are food, shelter, clothing and communications. It should be the first aim of any free country to make these easily, freely and cheaply available to one and all. As this body of yours is mainly concerned with the item of communications, I shall enumerate their vital necessity to this country. As regards communications, I envisage a great necessity for fourfold development, viz., (i) Roads, (ii) Railways, (iii) Waterways, and (iv) Airways. Roads amongst these require the foremost attention of the country".

—Shri B. G. Kher, Premier of Bombay, in his Inaugural Address, Fourteenth Session, Bombay, January 1950.

* * *

"For quite half a century, the Chief Engineer was also Secretary to his Government but now, in many States, the Chief Engineer's advice is communicated to his Ministers secondhand, often through a very junior and inexperienced Secretary. Only those Chief Engineers who have suffered in this matter know how much of their time is wasted in ensuring that his Minister is not wrongly advised. In general administration also, the Chief Engineer, who has to work through a Secretary having powers to over-rule him, has



THIRTEENTH SESSION, FEBRUARY 1949, RANCHI

often to waste a great deal of his time explaining why an order should be passed instead of simply passing the order promptly himself."

—Shri A. C. Mukurjee in his *Presidential Address, Fifteenth Session, Calcutta, February 1951.*

"How is there to be a common road policy when there are so many different authorities responsible for roads? This division of responsibility exists in most advanced countries. The problem has been solved by them and it can be solved by India. The American experts told us that they had learnt by painful and costly experience that the road plan should be statutory. This is what they said—

'An Act is necessary. In such a form the Plan becomes a Charter for action by a larger number of agencies and makes possible, what is not otherwise possible, a uniform understanding of the Plan.

'Also in this form the Plan becomes less subject to the vicissitudes of changing political philosophy.....The attainment of an adequate system of highways to serve all the requirements of so large a country as India is a time-consuming process'."

—Shri G. M. McKelvie in his *Presidential Address, Sixteenth Session, Simla, April 1952.*

"I need hardly stress the great importance of roads in this road-minded gathering. To Napoleon is attributed the saying that an army marches on its stomach. It would be, perhaps, equally true to say that in war a nation marches to victory, and in peace to progress, mainly on its communications, of which roads are a very important element."

—Sir Chandulal Trivedi, *Governor of Punjab, in his Inaugural Address, Sixteenth Session, Simla, April 1952.*

"It is necessary that the expenditure on rural communications should be expanded considerably. From the point of view of overall national development a very much larger programme than at present for the construction of roads, bridges, etc., in the rural sector is, in our opinion, so important as to need special financial provision in the form of an all-India Rural Communications Fund which should be both substantial and non-lapsable. Contributions from this Fund should be available to all States and the Central contribution should, in each State, be supplemented by the State Government itself as well as by local boards and (where suitable in the shape of free labour, free materials, etc.) by village panchayats. While it is not part of our recommendation that any additional duty on petrol or fresh motor vehicles taxation should be levied for this specific purpose, we suggest that an expert body should survey the technical and financial aspects of a vigorous and extensive plan for the development of rural communications, with a view, inter alia, to finding out the most appropriate manner of phasing the expenditure from year to year, and the approximate amount that will be required and could well be spent each year."

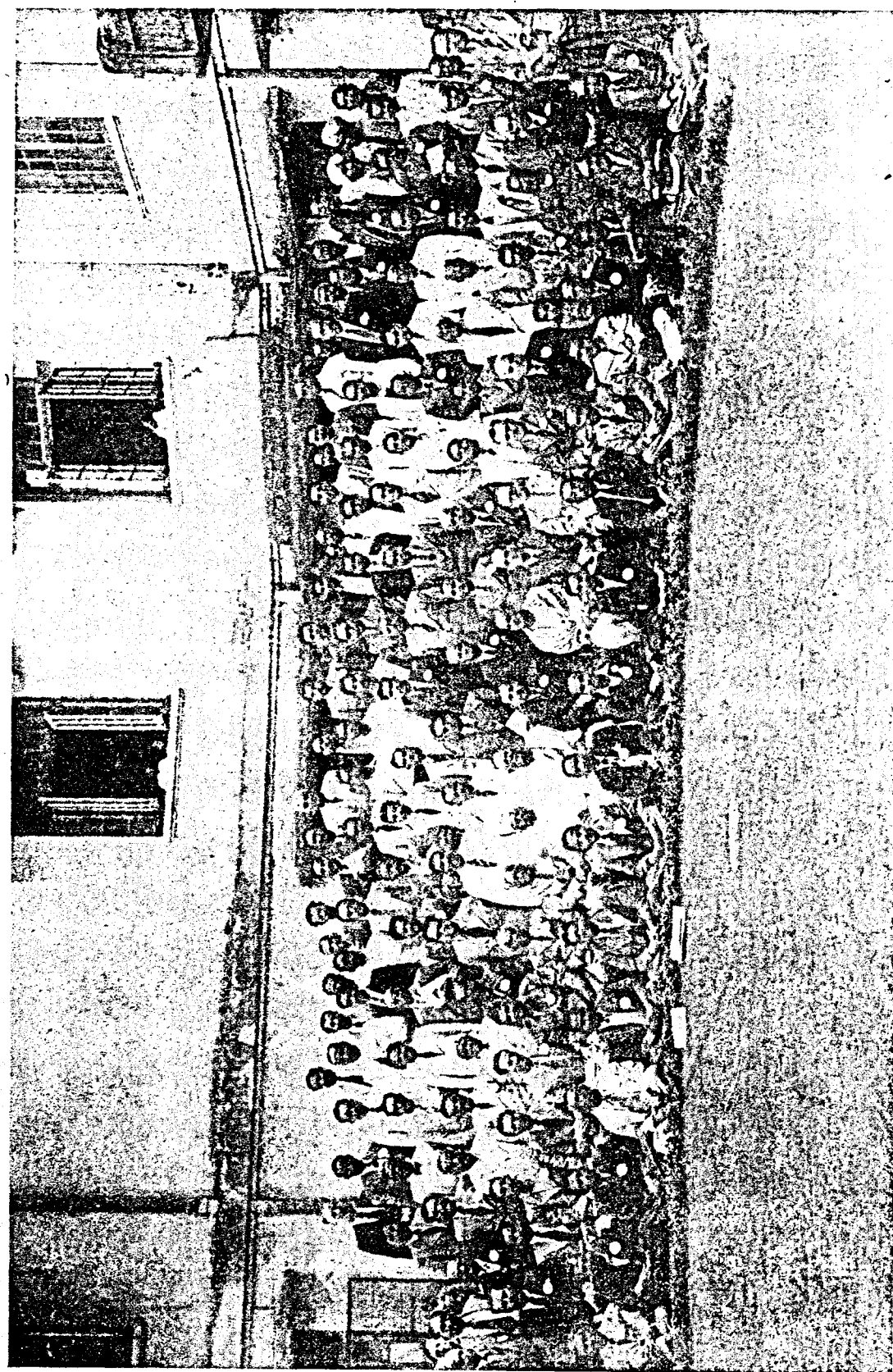
—*Report of the Taxation Enquiry Commission, 1953-54.*

"State Transport cost of operation on average bad and kutcha roads in 1953-54 amounted to Rs 5.80 crores. If all our vehicles were operating on modernized roads our saving in operating cost would have been Rs 98 lakhs approximately.

"If the vehicles in the entire State (Bombay) are considered, the amount will be approximately Rs 9 crores.

"In Bombay State we have 21,988 miles of metalled (w.b.m.) and katcha roads and the cost of concreting the entire surface would come to approximately Rs 130 crores.

"Thus if Government decides to float a loan for the amount the saving in operation cost will not only cover the interest but sinking fund charges also. Resulting benefits due to comfortable



FIFTEENTH ANNUAL SESSION, CALCUTTA, FEBRUARY 1951

travel, etc., are not taken into consideration in computing this."

—**Shri N. D. Daftary**, *General Manager, Bombay State Road Transport Corporation, in a Paper read before the Indian Institute of Road Transport, September 13, 1954.*

* * *

"We are now spending enormous sums of money on road development and have to aim at getting the best out of the country's money. This can be done by improving our standards and specifications so that the construction cost is lowered and the life of structures increased. These improvements have to be based on research—research inside the laboratory followed by experiments on models and then by trials on the field scale."

—**Shri H. P. Mathrani** in his *Presidential Address, Nineteenth Session, Srinagar, June 1955.*

* * *

"Our country is so vast and varied that it is important always to keep in mind its fundamental unity and to strengthen this in every way possible. It is time that we stop thinking of ourselves in provincial or regional terms, and begin to consider ourselves Indians first and foremost and, after that, as members of the great brotherhood of Humanity of which nations are after all but constituent units. In the development and strengthening of this national consciousness an improvement in the means of communications, particularly roads, will make a substantial contribution."

—**Yuvaraj Karan Singh** in his *Inaugural Address, Nineteenth Session, Srinagar, June 1955.*

* * *

"If today Madras has a good system of roads it is in no small measure due to the re-appraisal of the service conditions of her highway engineers from time to time and the reorientation of these conditions to match organisation with the needs. I commend the example

SILVER JUBILEE 1934—1959

of Madras to other States. Without such highway departments dedicated to the task of building and maintaining roads the preparation and execution of our road development projects are liable to be needlessly hampered."

—**Shri K. K. Nambiar** in his *Presidential Address, Twentieth Session, Nagpur, January 1956.*

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"The road is the next door companion to the house one lives in. And whichever route one may take, railway, marine, or aerial, a road butts in somewhere, at the beginning or the end of the journey or at both points. Sometimes you may have not dry, solid roads which demand a pair of stout feet to travel upon, the watery streets of a city like Venice which you pass on boats called Gondolas—may be an exception, but roads, solid or liquid, can be truly defined as the life-lines of civilization."

—**Dr. B. Pattabhi Sitaramayya** in his *Inaugural Address, Twentieth Session, Nagpur, January 1956.*

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"Every highway engineer's office should have a properly trained landscape architect attached to it. Sooner or later, the society will revolt against the poor surrounds of a road, but the cost of restoration of the damages done will be out of proportion to that spent on executing the work now. Landscaping is a slow process; it takes years to bring nature into a form that will prove satisfying. This neglect of the surrounds of roads to my mind, is unsocial, and sooner a beginning is made to arrest it the better it will be."

—**Shri P.L. Varma** in his *Presidential Address, Twenty-first Session, Shillong, May 1957.*

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"The benefits of highway transport are many and varied and they impinge upon several groups of beneficiaries in different ways and in different degrees. It is from these beneficiaries that revenues must be derived, and therefore it becomes necessary not only to evaluate total benefits but also to effect benefit segregation so that

revenue imposts may follow benefit distribution in an equitable manner."

—**Shri M. S. Bisht** in his *Presidential Address, Twenty-second Session, New Delhi, January 1958.*

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"I, therefore, consider the existence of good roads as a vital factor in determining whether our society can become an equalitarian homogeneous one or will continue merely as a conglomeration of social groups leading their own separate lives and maintaining different levels of social and economic development. This social and cultural aspect of roads is not in any way less important than the economic aspect. After all, it is not human beings alone who travel by roads. It is not goods or commodities of various kinds alone which are transported through roads. The traffic of ideas also takes place through social intermingling which is made possible by roads. This last aspect of roads is, in my opinion, of fundamental importance, particularly for a country like ours which is populated by communities and groups belonging to varying levels of economic and social development."

—**Dr. Rajendra Prasad**, *President of India, in his Inaugural Address, Twenty-second Session, New Delhi, January 1958.*

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"The extent to which the huge investment in our roads is being utilized can be gauged from the fact that in 1955 we had only about one 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."

—**Shri B. V. Vagh** on *'Roads and Road Transport in India — A Survey,' T.C.M.R., January 1958.*

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"Transport is an essential element in any Plan for the development of the country. Without adequate and efficient transport facilities the entire edifice of the Plan would come to the ground. Increased agricultural and industrial production may not reach the consumer, raw materials may not reach the factories—there would be gluts at the points of production and scarcity at the points of consumption and the entire production schedule of organized industries would be disrupted."

—*From a Speech by Shri R. G. Saraiya, President, Indian Institute of Road Transport at the Fifth Annual General Meeting of the Institute, March 31, 1958.*

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"An important factor to be taken into account, while formulating the future road development plan, is the great industrial and agricultural development taking place in the country. This is bound to generate a vast amount of additional internal traffic. Railways alone cannot cope with the entire traffic even along the main routes. The burden of the increase in traffic has to be shared by road transport in a considerable measure even on the arterial routes. For the subsidiary routes, roads are, in many places, the only means of transport and will have to carry most of the traffic. The road vehicles have, therefore, to be greater in number, larger in size, and faster in speed. This is possible only by providing roads of higher standards."

—*From "The Report of Chief Engineers on Road Development Plan for India 1961-81", May 1958.*

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"A reasonably efficient method is adopted in the construction of cement concrete pavements, but asphaltic carpets and asphaltic grouts are even today laid by such antiquated techniques, involving the use of the crudest and most rudimentary plant and machinery, that it is my belief that it is never possible to derive full value for the money spent. Quality control, which is an essential in dealing with asphalt as it is in dealing with cement, is only possible by the mechanization of the whole process of carpet making from crushing of metal down to mixing, laying and finishing of the road surface. This is one clear case where capital-intensive methods must be preferred to labour-intensive methods."

—**Shri W. X. Mascarenhas** in his *Presidential Address, Twenty-third Session, Hyderabad, January 1959.*

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".....In our country where we suffer from a grave inadequacy both of rail and road transport, we can ill-afford to have any waste or duplication of our resources. But this does not mean that any one means of transport is to be subjected to undue restrictions simply for the sake of a more rapid development of the other. So far as I know, the complaint of road transport interests has been that in the past and up to date road transport has been grossly neglected. Not only that, the feeling is that it has been cramped in such a way that it has been unable to play its full part in the economy of the country. In other words, the road transport industry is of opinion that the time has come for a policy of positive encouragement in contrast to that of 'mere tolerance' hitherto pursued, so that a vital contributory factor in economic development may be enabled to grow to its full stature."

"Everywhere it is being felt that with the coming of jet or atomic power, Railway and even Road Transport may in time both become out of date. I am not for one moment suggesting that the railways will have no place in our set-up. Indeed, the railways are our greatest national asset in which we have invested a huge amount of money. But the question before us is as to how both rail and road transport can be developed simultaneously in the best interests of public welfare. There should never be a question of un-

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healthy rivalry between the two. Here as elsewhere in the world there is plenty of room for both and will be for many years to come. I know that the Government is also fully seized of the situation and that our planners are giving serious thought to this problem. We can only plead that road transport may be allowed to develop unhampered and unrestricted. I do not mean that it should be absolutely free. On the contrary, I am for an ample measure of control of this industry by the Government because I feel that proper regulation will make for efficiency. I am using the term 'regulation' in contra-distinction to the word 'restriction'. If the public need in transport is to be fulfilled, as it should, then railways and road transport have to be complementary to each other. To this end, heart-to-heart co-operation and co-ordination are necessary. And I would like to say that road transport must always include passenger transport services."

—**Rajkumari Amrit Kaur** in her *Presidential Address at the "All-India Conference of Road Operators", Bangalore, February 1959.*

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"The fact is that, throughout the world today, road transport is overtaking railways as the progressive and modern form of transport. It is a technological change. Just as you move from the bullock cart to the horse and from the horse to the railways, we are now moving on as a world from railways to road transport or motor transport, and to try to stop this progress is to be like Mrs. Partington with a broom trying to sweep back the waves of the sea."

—**Shri M. R. Masani** in his *Speech in the Lok Sabha, April 3, 1959.*

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"Many people have been asking that question: is there really a kind of rivalry between the two systems - road transport and rail transport. I cannot understand this business of there being controversy or rivalry. Ours is an undeveloped country and both modes of transport have got to be developed. I dare say at least during the next 25 years there is no chance at all of any rivalry in this direction. Therefore, we should not talk in terms of any rivalry. We

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should surely protect their rights and I can understand that they should be protected and they will be protected. But apart from that, there is no difficulty whatsoever."

—Shri S. K. Patil, Minister of Transport & Communications, in his Speech in Lok Sabha on April 4, 1959.

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"Imagine our five hundred and sixty thousand villages have got to be connected by roads; if roads come, road transport will come and so on and all these things will come and they should come not only because roads have been considered to be symbols of civilisation and not only because they are forerunners of all development and economic prosperity; if we are wedded to ideal of improving and raising the standard of living of the people, we shall definitely have to take the road to the tiniest of villages. We are seeing dreams of a day that will be realised in our own life time when there will be a mighty highway of the type running from North to South and East to West and the pattern of road network is crossing the entire countryside and that will be a day when we can say that our country has developed and until that day comes, we cannot say that our country has developed; roads are really the symbols, if I may say so, of the truest kind of a developing economy. Therefore, let us not be scared by unfair competition; there is ample scope for

healthy competition. Let us realise here that whatever form of transport we might take, whether it be road, railways or airways, the determining factors in this struggle for supremacy or survival would be its speed, reliability and the convenience of the user."

—Shri Raj Bahadur, Minister of State for Transport, in his Speech at the first Annual Dinner of the Indian Institute of Road Transport, May 1959.

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"Whether it is from the point of view of industrialisation, of utilising the country's investment in roads, of providing employment on a substantial scale or from that of a return to the exchequer, the development of road transport is in the best interest of the country. It is hoped that the Planning Commission will take into consideration these facts and give the much needed fillip to road transport by making provision for all the required wherewithals therefor—the vehicles as well as the roads, including inter alia the additional capital required to be invested in the manufacture of vehicles and the requisite foreign exchange."

—Dr. F. P. Antia, Vice President, IRTDA, in a special article in the Indian Express of 16th October 1959.

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And so the road goes on. We could not find more appropriate words to end this review than the following:

"When a road is once built, it is a strange thing how it collects traffic, how every year, as it goes on, more and more people are found to walk thereon, and others are raised up to repair and perpetuate it, and keep it alive; so that perhaps even this road of ours may, from reparation, continue to exist and be useful hundreds and hundreds of years after we are mingled in the dust. And it is my hope that our far-away descendants may remember and bless those who laboured for them to-day."

—R. L. Stevenson

I.R.C. SOUVENIR

