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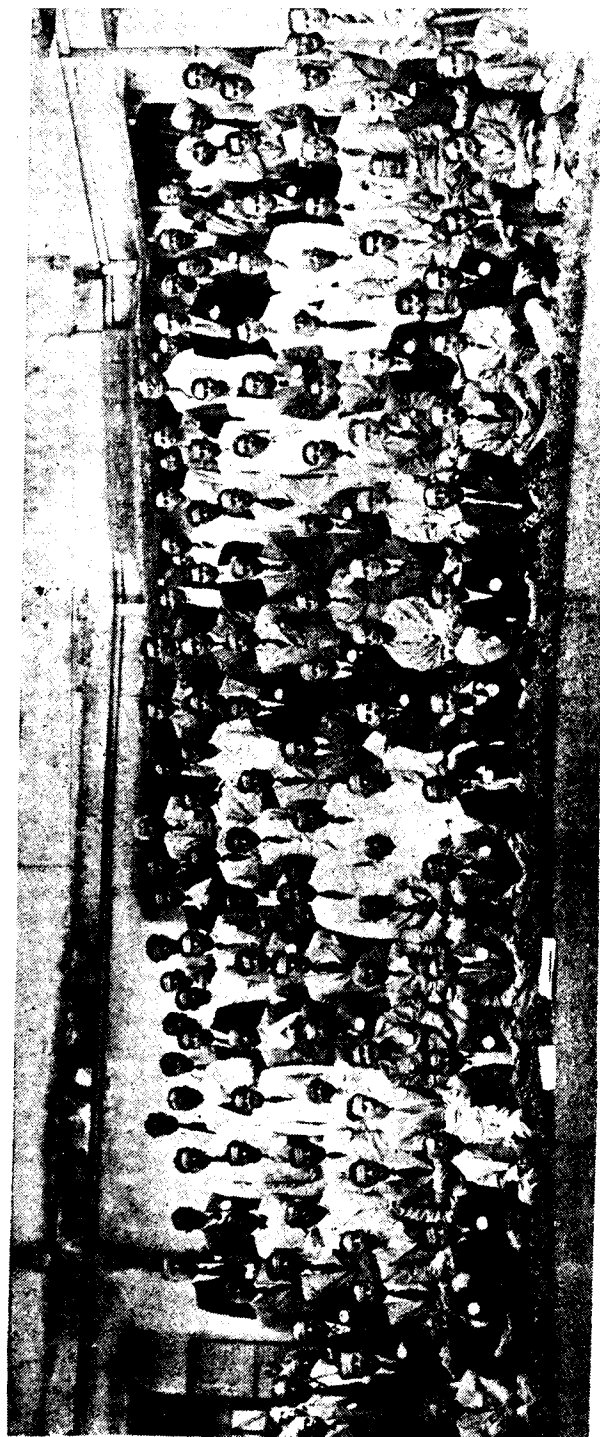
LIST OF MEMBERS OF THE COUNCIL FOR 1950—51.

- | | |
|-----------------------------|-----------------------|
| 1. M. L. Bahl. | 2. R. K. Batra. |
| 3. R. L. Varma. | 4. C. M. Bennett. |
| 5. M. S. Thirumala Iyengar. | 6. P. L. Varma. |
| 7. E. Sivaraman Nair. | 8. U. J. Bhatt. |
| 9. M. L. Saberi Yusuf. | 10. M. L. Champhekar. |
| 11. Brig. Partap Narain. | 12. B. S. Puri. |
| 13. C. G. Kale. | 14. Raghbir Singh. |
| 15. Brijmohan Lal. | 16. F. P. Antia. |
| 17. C. J. Fielder. | 18. E. A. Nadirshah. |
| 19. L. R. Patel. | 20. V. N. Rangaswami. |
| 21. Hari Shankar Sharma. | 22. K. G. Bhate. |
| 23. K. Narasimha Rao. | 24. C. P. Misra. |
| 25. D. B. Nagerkar. | 26. K. K. Nambiar. |

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The Indian Roads Congress as a body does not hold itself responsible for statements made, or for opinions expressed, in the Papers or discussions in its Proceedings.





Indian Roads Congress—Fifteenth Session, Calcutta, February 1951.



SRI A. C. MUKERJEE, I. S. E., President, 1950-51.

Sri A. C. Mukerjee was born at Jaipur in 1898 and received his early education there and subsequently at the Government College, Ajmer. He had a brilliant record in school and college finally taking his B. Sc. degree from the Allahabad University in 1918. He then, in the same year, joined the Civil Engineering class of the Thomason Engineering College at Roorkee and obtained a Higher Certificate as an Assistant Engineer in 1921. He was appointed to the Indian Service of Engineers in October 1921 in the Uttar Pradesh Public Works Department, Buildings and Roads Branch. He rose to the rank of Executive Engineer in 1927 and, in that capacity was subsequently responsible for a large number of works on roads, bridges, buildings, and airfields. He became Superintending Engineer in 1943 and Chief Engineer in February, 1947, in which capacity he is still serving. He was awarded the title of Rai Bahadur in 1939 and of O.B.E. in 1945 in appreciation of his services.

He is a member of various Engineering Institutions in India and abroad. He was the leader of the First Indian delegation of Highway Engineers to the United States of America in 1946.

INDIAN ROADS CONGRESS

NOTICES AND ANNOUNCEMENTS

Contribution of Papers for the Sixteenth Session of the Indian Roads Congress.

The next General Session of the Indian Roads Congress is likely to be held sometime in January-February 1952. The exact date, place, and programme of the Session will be communicated to Members in due course.

2. **PROCEDURE:** Members who intend to contribute Papers on any subject connected with Highway Engineering are requested to intimate the fact to the Secretary, Indian Roads Congress, and to send a short synopsis of their proposed Papers as early as possible.

On receipt of acceptance of the subject matter of the Paper, the Member concerned should send his contribution to the Secretary, Indian Roads Congress, complete in all respects and with original drawings, photographs, etc., **as and when ready**. At least **three** copies of the typescript matter should be sent, typed (double space) on one side of good stout paper of foolscap size.

3. The complete Paper, if intended to be read at the next Session, should preferably be submitted within the next four months, but not later than September, 1951.

From past experience it is observed that most Members send in their contributions at the last moment when the Congress Office is busy on work connected with the Session. As it takes a long time to get Papers printed in the Journal and as it is desirable that Members should have time to study Papers well in advance of the date of the Session, it is hoped that Members will make an effort to send in their contributions **within the next four months**.

Members may please note that Papers received late in the year are likely to be carried over to the next year.

4. The younger engineers are particularly requested to contribute Papers which, if required, will be suitably edited by the Indian Roads Congress Office before publication.

5. **MEDALS:** The following Medals are available for award :—

(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 connection 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.

6. The Council have reserved the right to award more than one Medal in any year or to withhold the award of a Medal in any year without assigning any reason.

7. Rules and Regulations for the contribution of Technical Papers and the Award of Medals are published on pages 8 to 13 of Volume XV-1 of the Journal of the Indian Roads Congress—August 1950.

To

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II. NEW ADMISSIONS

LIST OF MEMBERS OF THE INDIAN ROADS CONGRESS ENROLLED FROM 28-11-1950 TO 18-3-1951.

Serial No.	Roll No.	Name.	Address.
1390	1534	M. Rama Brahmam	Executive Engineer, Harbour, Kandala Port, Sardarganj, (Kutch).
1391	1535	Ernst Zipkes	Director, Central Road Research Institute, Western Court 53, New Delhi.
1392	1536	Chandra Bal Jain	Sub Divisional Officer, Central P. W. D., C/o L. Hari Ram Banker, 811 Pati Ram Street, Bazar Sita Ram, Delhi.
1393	1537	T. Prem Sagar	Assistant Engineer, Highways, 1, Venkatanarayana Road, Madras-17.
1394	1538	A. N. Dhar	Assistant Executive Engineer, Office of the Chief Engineer, H. Q. Eastern Command, Ranchi, (Bihar).
1395	1539	B. L. Khathuria	Consulting Engineer (Roads), Government of Nepal, Guest House No. 2, Tripureshwar, Indian Embassy P. O. Nepal.
1396	1540	K. V. Rao	Staff Officer 2, (Planning), Engineer-in-Chief's Branch, Army Headquarters, New Delhi.
1397	1541	D. C. Choudhry	District Engineer, Hazaribagh, (Bihar).
1398	1542	Harish Chandra Vijn	Commander Works Engineer, Fort William, Calcutta.
1399	1543	R. S. Gahlot	Executive Engineer, Lucknow Provincial Division, Lucknow.
1400	1544	S. N. Ray	Roads Engineer, Standard Vacuum Oil Co., 101-A, Vivekananda Road, Calcutta.
1401	1545	P. Krishnamurthy	Supervisor (Highways), Addanki, Guntur District, (Madras State).
1402	1546	S. B. Dubé	Executive Engineer, East Berar Division, Amravati. (Madhya Pradesh).
1403	1547	G. D. Agrawal	Superintending Engineer, P. W. D. Berar (Circle, Nagpur (M.P.))
1404	1548	Mohd. Abdul Khadir	Divisional Engineer, P. W. D., Bhir Division, Via Jalna Railway Station, Bhir.

Serial No.	Roll No.	Name.	Address.
1405	1549	Phiroze K. Doctor	District Engineer, The Concrete Association, New Habib Bank Building, Victoria Road, Karachi—3. (Pakistan).
1406	1550	M. B. Ghose	Technical Assistant to Superintending Engineer, Road Construction Circle 1, 58 Mansatala Lane, Kidderpore, Calcutta.
1407	1551	Manzoor Ali	Assistant Engineer, P. W. D., Bridge Investigation Sub-Division, Patna. (Bihar).
1408	1552	S. Narboo	Divisional Engineer, Ramban Division, Banihal, Jammu. (Kashmir).
1409	1553	S. K. Samaddar	Assistant Engineer, Design Division No. 1, Anderson House, Alipur, Calcutta-27.
1410	1554	K. Narayana Rao	Assistant Engineer (Highways), Eluru. (Madras State).
1411	1555	G. N. Reddy	Assistant Engineer, P.W.D. Raichur. (Hyderabad State).
1412	1556	A. K. Das Gupta	Assistant Engineer, W. & B. Department, 25/1, Guruprasad Chowdhury Lane, Calcutta 6.
1413	1557	A. Seshappa	Assistant to Chief Engineer, Mysore, P.W.D., Bangalore.
1414	1558	Abdul Jabbar	Assistant Engineer, Mysore P. W. D., Hunsur, Mysore District.
1415	1559	K. S. Chakravarthi	Executive Engineer, Mysore P. W. D., Bangalore Division, Bangalore.
1416	1560	K. V. Siddabasaviah	Executive Engineer, Chitaldurg Division, Chitaldurg, Mysore.
1417	1561	D. N. Khurana	Superintending Engineer, West Raipur Circle, Raipur. (Madhya Pradesh).
1418	1562	S. Subba Rao	Sales Engineer, C/o, Caltex (India) Ltd., 22 Chittaranjan Avenue, Calcutta.
1419	1563	A. C. Jayaraj	Municipal Engineer, Tuticorin. (Tinnevely District). (South India).
1420	1564	K. Baparas	Assistant Engineer, Highways, Bhimavaram. M. & S. M. (Madras).
1421	1565	M. S. Nerurkar	Assistant Engineer, Bombay Municipality, City Engineers Department, Bombay.

Serial No.	Roll No.	Name.	Address.
1422	1566	S. K. Laha	Executive Engineer, Works and Buildings Department, 24, Ritchie Road, Calcutta 19.
1423	1567	S. G. Yadav	Development Engineer, Poona Municipal Corporation, Poona.
1424	1568	K. I. Idiculla	Assistant Engineer, Chief Engineer's Office, Trivandrum. (Travancore-Cochin).
1425	1569	A. C. Mitra	Assistant Engineer, W. & B. Department Bengal, 6 Sura-First-Lane, Calcutta 10.
1426	1570	H. K. Sethna	Executive Engineer W. & B. Department, C/o, Imperial Bank of India, 3, Strand Road, Calcutta.
1427	1571	V. K. Paranjpye	Executive Engineer, Yeotmal Division, P. W. D. Yeotmal. (Madhya Pradesh).
1428	1572	R. Thillainnyagam	P. A. to Superintending Engineer, Highways, IV Circle, 10/1, Cowly Brown Road, R. S. Param, Coimbatore.
1429	1573	Guru Dayal	District Engineer, U. P., P. W. D. B. & R. Branch, Sitapur (U. P.)

ASSOCIATE MEMBERS.

1	44	F. J. K. Laurie	Director, Armco (India) Ltd., P. O. Box 8989, 21, Esplanade Mansions, Calcutta.
2	45	Debidas Chatterjee	Assistant Road Engineer, C/o Shalimar Tar Products (1935) Ltd., 6, Lyons Range, Calcutta.
3	46	Messrs. Associated Exports Imports Corporation	35, Chittaranjan Avenue, 1st Floor, Calcutta 12.

III. DEATH.

The Council have received with regret the intimation of the following death:—

1	35	H. G. Hughes	Managing Director, Messrs. Armco (India) Limited, P. O. Box 8989, 21, Esplanade Mansions Calcutta.
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PROCEEDINGS OF THE FIFTEENTH SESSION OF THE INDIAN ROADS CONGRESS

Vol. XV Part 4

CALCUTTA

February 1951

PRESIDENTIAL ADDRESS

The Fifteenth Session of the Indian Roads Congress was held at Calcutta from the 17th to the 23rd February, 1951, and was formally opened by the Hon'ble Dr. B. C. Roy, Chief Minister of West Bengal, at 11.00 a.m. on the 18th February, 1951 in St. Xavier's College Hall. The proceedings opened with an Address by Shri A. C. Mukerjee, the President, the full text of which is given below :

I feel greatly honoured at having been given the privilege of welcoming you, Sir, on behalf of the Indian Roads Congress to our Fifteenth Session which is being held in this, the premier city of our country and which you have so kindly consented to inaugurate in spite of the heavy pressure there must always be on your time. The Congress is very grateful to you and appreciates your keen interest in its activities and in the development and improvement of transport-communications generally.

Our grateful thanks are also due to the Government of West Bengal for inviting us to hold our Session in this great city and for affording us all necessary facilities. This is not the first time that we have been privileged to hold a Session in Calcutta. We remember with pleasure our Fifth Session held in 1939 in the hall of the Institution of Engineers (India), which they so kindly lent to us then, as now, for our meetings. We look forward to the discussions that will take place here during the next week and to the interesting and instructive programme of visits that has been arranged for us by the Road Engineers of this State.

Since we met last at Bombay an unkind fate has deprived the country of the help, guidance, and services of one of the greatest sons of the land who was a great leader and fighter and also a "great builder, unifier, and consolidator of New India"—Sardar Vallabhbhai Patel—who joined the immortals on the 15th of December last, in full ripeness of age but, unfortunately for us, at a time when a man of his calibre, experience, and sterling qualities was sorely needed by the country to complete the work that he had undertaken in the consolidation of our Independence. Let us pay our respectful homage to him and keep before us the

PRESIDENTIAL ADDRESS

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ideal of selfless service which was his ideal and which must be the motto of every engineer.

I shall now read with your permission, Sir, messages and good wishes received from the Hon'ble the Minister of State for Transport and Railways, Government of India and other distinguished Members. [Messages reproduced on pages 575 and 576.]

PRESENT SITUATION

We are passing through a very critical period in world history and also a very difficult period in our own history. The country is faced with a multitude of problems of exceptional gravity and complexity and its future depends in a large measure upon their correct appreciation and proper solution. It is not a period when we can afford to make mistakes and proceed in a complacent, happy-go-lucky fashion, without very sharply defined objectives or a clear cut policy embodying a fully well thought out plan and decided ways and means of implementing the plan. We cannot afford to bear any losses brought about by a lack of foresight or major flaws in planning, calculations, or co-ordination.

The country is at present in the severe grip of financial depression and it has become all the more essential that the choice of the objectives on which our financial resources are to be expended, should be as correct as it is possible to make that choice. In the co-operative effort to stabilise the economy of the country by increasing production so that we can attain self-sufficiency in many important directions, all with the object of developing our resources and improving the standard of living of the common man, the Engineer has an important place to fill. The Engineer is a fighter against difficulties and his training and outlook enable him to face these squarely, study them clearly, plan to attack them properly, and then go at them for all that he is worth with the firm will to overcome them and achieve success.

When called upon to do so, the Engineer must be ready to assist in framing the Master Plan of the Nation and to carry out to the best of his ability that part of the plan entrusted to him for execution. The Engineer must give the highest value of the money that he spends. It is for this Congress to deliberate and plan how these objects can be best achieved as far as the problems of road construction and maintenance are concerned and to advise the Government and the people accordingly. This body has a very grave responsibility resting on its shoulders.

THE INDIAN ROADS CONGRESS

Sir, my predecessors in office have described in fair detail, in their presidential addresses, what this Congress stands for and

what it has so far achieved. On this occasion I shall merely confine myself to mentioning that the Indian Roads Congress has among its members almost all the road engineers of the country, whether in Government service or outside.

Our Congress has by its efforts to promote and encourage the science and practice of road building and maintenance; by the opportunities it affords its members for pooling their collective experience and ideas on all matters concerning highway engineering problems, including those of research, organization, and administration; by giving expression to its professional opinion on such problems; by the service it has been rendering through its subcommittees of experts in preparing specifications and codes of practice for the use of road engineers; and, finally, by its care in disseminating up-to-date knowledge through its journals and its information and library service; by these and many other means, our Congress has been trying to be of as much utility as possible to road engineers and to the country.

Starting in 1934, it has held fourteen Sessions in different parts of the country at which about 150 Papers on many and varied matters connected with highway engineering have been read and discussed. Its various subcommittees and experts have tackled a number of important road problems and have given definite opinions and advice on their mastery. The Congress has also held some very interesting and instructive exhibitions at its annual Sessions.

The Indian Roads Congress can reasonably claim to represent the considered views of experienced highway engineers of the country and it can therefore be taken to be in a position to offer honest and straight-forward advice, based on the Government and to the country in all matters pertaining to road communications. It is a matter of gratification to us to know that the advice and recommendations of this body have in the past been given due consideration by the Government and that action has been taken on a very large number of its recommendations.

NEED FOR PUBLICITY

It is a constant source of surprise to many of us that although all over the world it has been accepted as self-evident that the first step in almost all forms of development and advancement is the building and proper upkeep of roads, in our own country the importance of roads is not yet fully realized so that they are given relatively low priority in the development programme of the country. If we want to grow more food, we must

provide roads to get that food to the market; if we want to spread education or culture, we must provide means of access to the villages so that education and culture may be made readily available; if we want to improve public health, if we want to develop industries, if we want good administration throughout the country, we must build roads and keep them in proper order so that these objects may be attained.

Is it because of a deficiency in road engineers, shared by other engineers, that they do not come out of their shells and devote themselves to the very necessary task of explaining their plans and ideas to the public? Is this why there is generally such lack of appreciation of the fundamental need for roads in nation-building? I believe that no important scheme, however inherently good, can really succeed unless it has full public support. At our annual sessions, we have tried to impress on the Government and the public the importance of ROADS in the economy of the country, but we can all take our share personally in discussing road problems with our friends and with all those we come into contact with. I shall return to this subject again shortly.

ROADS ESSENTIAL IN ALL PLANNING

A great deal of planning has been done in different directions and further planning is in progress. No doubt a vast amount of thought has been expended by the framers of these plans with a view to produce something that would meet the needs of the situation in the best possible manner. But can the engineer view with equanimity a state of affairs where, as has so often happened before our eyes in the recent past, plans have been put into execution with a sudden spurt on an unprecedentedly ambitious scale, in spite of the fact that the bases of the plans were contrary to accepted principles of sound policy? These spurts have too often been followed, owing to a lack of funds, by an abrupt contraction of activities before the projects were completed.

What would we advise as road engineers? We would probably say that priority should be given first to revenue producing schemes or schemes that would increase the general wealth of the country. Having worked out the rough costs of these schemes, we would add a percentage of services, such as roads, houses, education, and public health. No scheme would be complete unless the cost of these services were included in the total cost. Roads would be given first priority in any project, for without roads, the cost of other construction or activities would be needlessly enhanced.

We would also compare the cost of our schemes by adding to the capital expenditure the capitalized value of future maintenance. Thus, there may be two schemes involving a capital expenditure of Rs 5 lakhs and Rs 20 lakhs respectively, but the maintenance of the former might be Rs 4 lakhs a year and the latter Rs 1 lakh a year. The true relative cost of the schemes would be as 138 is to 53 and not as 5 is to 20.

A very good illustration is afforded by the unfortunate food shortage in the country. It is correct that all schemes, which are designed to make up the shortage of food, must have priority, but it will not do to lose sight of the fact that besides its cheap production food must be transported and distributed cheaply, so that it may be available for sale at economic rates. It is only then that a plan for producing more food can be of help in improving the lot of the common man. Culturable but uncultivated lands can function in the "GROW MORE FOOD CAMPAIGN" only when they are made accessible through easy communications and when it becomes commercially profitable for the peasant to cultivate them.

Similarly in all power schemes however cheaply the power may be produced and in whatever abundant quantities it may be made available, it can be utilised and can benefit the country only if there is scope for its utilization in industries. These industries can be set up and can flourish only if cheap communications and transport are available for bringing in the raw materials and for taking out the manufactured products to suitable markets.

Even the most essential services of providing education and medical aid to the common man suffer from a very heavy handicap if easy means of transport do not exist.

MAIN PROBLEMS

Gentlemen, I would now draw your attention to the principal problems of a general nature which, in my opinion, require to be tackled by us. I shall take a President's privilege of throwing out suggestions and it will be for this Congress to consider them and advise on an agreed policy to be followed by Highway Engineers in regard to these.

1. Publicity.—What steps should we recommend to the Highway Engineer for adoption to ensure education of public opinion and to arouse public interest to the need for and value of more and better roads?

- 2. Planning.**—What advice should we tender to the Highway Engineer of every State of the Union regarding the planning with which he is concerned and what representation should we make to the Government of India regarding planning in general and highway plans in particular?
- 3. Finance.**—What are the avenues that must be explored with a view to find ways and means for obtaining the necessary funds for implementing the plans for highway development?
- 4. Research.**—What should be done to co-ordinate research activities of the different States to prevent unnecessary overlapping and to ensure quick progress?
- 5. Specifications.**—Keeping in view the limitations imposed by finance on the implementation of an extensive programme of highway development, what should we recommend that would make it possible for every State to maintain as high a mileage as possible of serviceable roads in the present circumstances and what specifications should we lay down for adoption to ensure that our roads give the utmost value at every stage in the development of the ultimate highway programme?
- 6. Organization.**—What do we consider to be reasonable staff requirements for different jobs in highway organizations and to what matters concerning staff and administration should we draw the attention of Government?

I am aware that it is not possible to have an agreed and universal solution of every problem since in most cases local factors and circumstances may call for considerable adjustments in our methods of handling particular issues. But by discussing general problems and by bringing valuable experience and knowledge to bear upon a consideration of the diversities that exist, it should be possible to clear our ideas, determine a joint line of action, and present a united front backed by the weight of opinion of the best available highway engineering talent in the country. I am sure that any opinion given by this body after due study and thought will have everywhere the respect that it deserves. Our advice will also be of the utmost help to our members in the discharge of their individual functions as highway engineers,

Publicity

The importance of publicity cannot be over-emphasised in our country where practically no effort has been made so far to arouse the interest of the public to the need and value of road development. I suggest that :—

- (i) The highway department of every State in our Union should have a Public Relations Officer. It will be the duty of that Officer to keep himself fully posted on all matters regarding personnel, budget allocations for road work, projects sanctioned, projects in hand, methods and media employed in carrying out the projects, objectives of the highway programme, programmes for improvements of roads, highway safety, costs of works and general progress in the highway programmes in the different districts and to supply to the public necessary information as and when required. This function could probably be performed at first by the Personal Assistant to the State Chief Engineer.
- (ii) **Special road-signs** should be erected to indicate works in hand. These have been found to be of great service in advising the travelling public on what was being done in the matter of road development and thus have been of help in spreading among the public information regarding road development.
- (iii) **Pilot schemes** should be carried out in every State. They are very useful in educating the public as to what should be done in the way of road building and improvements and what results could be obtained by effecting these improvements. These schemes give a visual demonstration which is more effective than any amount of talking or explaining.
- (iv) **Visual education** through models, photographs, cinema pictures of works, maps, and drawings is very useful and necessary.

Planning

The Nagpur Plan, drawn up by the Chief Engineers of the different Provinces in 1943, placed before the public and the Government a plan for highway development indicating a target that must be attained in order that the country may have a

reasonably developed highway system to meet its **minimum** transport needs for the development of its material resources and productive capacity. It lays down a realistic target which **can be attained within a reasonable time provided the over-riding necessity of roads is realised** and action taken to ensure that the achievement of road development and maintenance in a year does not fall below a prescribed minimum to be based on our capacity and which must not be less than 6 per cent of the total expenditure.

As a matter of fact this target will have to be passed and left a long way behind before the country can have a road system which can be said to cover in a reasonably full measure all its road transportation needs. But a period of about seven years has already passed since the plan was framed and we have achieved only a small fraction of what it envisaged. Obviously, therefore, there is at present no point in putting up a more ambitious plan before the country. All the energies and available resources must be directed to carry out the Nagpur Plan to completion as early as possible.

But the Nagpur Plan gives only an outline of what is to be done for the country in the way of highway development. In order to fill up the skeleton, it is necessary to work out in detail the plans for each State and this has been done in a great measure or is being done. For this it is essential to make full use of such guidance as may be available from the experience gained so far in the different States. One of my predecessors had stressed the necessity of what has been termed an economic survey for a proper planning of a road system.

Economic and Traffic Surveys.—I think that economic survey coupled with systematic traffic surveys, and origin and destination studies on existing roads, aided by a study of statistics showing traffic development and its trends on the old as well as the new roads, will be of the utmost help to the road engineer in designing a scientific plan for the development of the highways in an area so that they may function properly to meet the traffic needs of the area and help in its all round development. We are discussing a Paper on this subject during the present Session and I hope out of this discussion some clear principles will emerge that will be of value to us all.

Traffic Flow.—It is very important for the highway engineer to be able to visualise how traffic would develop in the future on the routes that are taken in a highway plan. It is but natural that traffic must develop along routes which serve the largest percentage of the population of the area, give all weather

service and are free from natural obstacles, *viz.*, an unbridged river, difficult terrain, etc. It is also natural that roads which connect industrial centres to market places or to centres which serve as clearing houses to the produce of the area must have a relatively large traffic. Taking into account the natural resources of the locality and the facilities that exist in the production of certain commodities, it is possible to visualise the development of industries and to anticipate the markets that would be served and thence the channels of traffic. In planning a road system due consideration must be given to these channels of potential traffic.

Mixed Traffic.—In planning roads where much mixed traffic is expected to develop, the question of segregation of the slow traffic from the fast traffic has to be kept in view. This is necessary not only from the considerations of the efficiency of the highway and reduction of accidents, but it may give a road more economical to maintain. Trackways are useful for slow heavy traffic, while stabilised earth roads may do for light carts.

Existing Roads.—As regards planning improvements in an existing road system, I think that even though the call for new roads is very urgent with a view to meet the transport needs of the localities that are still deficient in this respect, it will not be advisable to abandon altogether a programme of improvements to the existing roads. In spite of the paucity of funds a certain percentage of the available finance must be devoted to the improvement of sections of high trafficked roads, where improvement makes maintenance more economical or where it reduces traffic hazards.

Records.—For drawing up a rational programme of improvements it is essential for the highway engineer to have a complete record of the existing roads giving all essential information about the road structure, levels, land widths, geometric standards, kind of terrain, soil, drainage, etc. This is fundamental record and all effort and expenditure required in compiling it are fully warranted by its utility.

Maintenance.—Side by side with the construction of new roads the State has also got to consider its capacity for the maintenance of its existing road system. The experience of other countries shows that a properly planned road system is bound to become self-supporting and it does not remain a burden on the general revenues. But the direct income from a highway system must depend upon the extent of transport that it serves. Consequently it is also essential that facilities must be planned for the development of the road transport system of the State along with the highway development.

As at present the largest amount of revenue from road transport is contributed by motor transport, this form of transport must be developed to the largest extent possible. If the motor vehicle receives encouragement, by the reduction to some extent of its crippling burden of taxation, and if through well-directed research and effort, it is possible to produce economical fuel for the propulsion of motor vehicles and proper roads are made available, this form of transport is bound to make rapid progress as it has done in the western countries.

Priorities.—This Congress has to impress the Government with all the force that it can command that the development of highways is a national 'must.' Consequently the road programme **must** have a much higher priority than it has been given and, whenever there is financial stringency, it **must not** be the road programme that should be amongst the first to be axed.

Finance

In the addresses delivered at the Sessions of the Congress in the past, nearly all our Presidents have taken pains to indicate the sources from which it is possible to obtain the necessary finance for building and maintaining our roads. The most important thing to stress in this connection is that the annual revenue derived from taxing the motor vehicle user must not be diverted by the Central Government or the States to other than road purposes.

It is true that even in the U.S.A. at the outset the revenue from motor vehicles used to be included in the general revenues and was not applied wholly to expenditure on road works, but the importance of roads and the beneficial results of road development have convinced the western countries that the highway industry is one of the most important industries to be developed and that funds applied to its development lead directly and indirectly to a much greater general development of the country than funds devoted to nearly any other purpose.

Road Revenue.—There is, therefore, an increasing tendency in the advanced countries to apply the whole revenue derived from taxing the motor vehicle user to road purposes. It is surely not essential for our country to pass through all these painful stages through which other countries have passed in order to realise that here too the entire tax revenue obtained from motor vehicles must be applied to the road.

Taxation.—I am glad to note that this proposition has been very forcibly endorsed by the Motor Vehicle Taxation Enquiry Committee whose report has recently been made public. But I

consider the Committee has been weak in accepting that four per cent of the capital expended on roads should be regarded as a contribution to general revenues out of the road transport revenue. In the present stage of road development in our country I consider that Government should not require even this contribution to general revenues.

With the development of transport, the revenue derived from road users is bound to keep on increasing. This revenue is now and will remain for long sufficient to provide for the proper maintenance of our roads and even to provide for some development. It will also pay the interest charges on loans raised for development chargeable to "Capital."

Capital Development.—In this connection, I would observe that development postulates financing from capital. Our Planning Commission appears to have been afraid to accept this fact but they would be hard put to it if asked to quote a single example of development in the world that has not been financed from capital.

In spite of the present financial gloom, it is not unrealistic optimism to say that road upkeep and development will not only be improved and speeded up but the improvement will quickly bring conviction to sceptic opinion if only the roads, like the railways, were permitted to finance themselves.

Road beneficiaries.—There is, however, no reason why the motor vehicle user should be the only person benefiting from roads that should be subjected to road taxes. The most destructive means of transport on roads, the bullock cart, should also contribute towards their maintenance and I feel we, as engineers, should support the recommendations made by the Motor Vehicle Taxation Enquiry Committee of 1950 in this matter. Inducement should be given also to the adoption of the rubber tyre by concession in taxation on rubber tyred carts.

Tolls provide a third means of revenue and, in my opinion, in the present state of development of road communications in our country, it is very desirable to consider the question of raising loans, funded on toll revenue, to finance the cost of constructing suitable major bridges, tunnels, and perhaps other large structures in our road development programme.

Toll-bridges, tunnels, and roads have been constructed in other countries and these became "free" roads when the toll realisations had liquidated the expenditure incurred on them. In India it is objected that the government have difficulty in raising

loans. But experience has shown that Port Authorities, for example, have no such difficulties and it is possible that, in a few localities where conditions are favourable, local loans could be raised to finance road structures provided the public were satisfied that these loans could be repaid from the revenue collected from the users of the structures. I would urge that our government should not be afraid at least to attempt to do in this direction what governments in many advanced countries have already so successfully done. We are also discussing a Paper on this this Session.

Betterment.—As suggested in some previous Presidential addresses, it is possible to raise funds for road purposes by levying a betterment tax on roadside lands, a road cess, and other similar taxes. Too often we find at present that some rich speculator has bought up land in an area being developed by public effort and has later sold that to the public at profits that might aggregate some thousands per cent on his investment. In the United Kingdom unearned increment on property is now a matter of the past: generally no undeveloped land has more than its 1939 value on the market and development is truly valued. We could do worse than adapt our policy to modern conceptions of equity.

Roads a Service.—Because of the inescapable necessity for roads inherent in every development project, it is only right that a part of the cost of every such project should be set aside for road purposes. This would mean a contribution to roads out of general revenues but such contributions are justified by the importance of roads in the general economy of the country.

Separation of Road Finances.—The main thing however, is the separation of road finances from general revenues so as to ensure that the revenue from road transport is made available for road purposes both at the Centre and in the States. The distribution of the revenue from the Centre to the different States could be based on well tried principles similar to those adopted in more advanced countries.

Non-lapsing Grant.—Finally I would draw the attention of Government once again to the necessity of accepting the principle of non-lapsing grants for road purposes and of making a minimum provision, which may be fixed for a triennium, for road upkeep and development so that the road engineer may be able to plan his work properly and go about it with confidence.

All the measures I have enumerated have been adopted successfully in most of the advanced countries. It is surely time that the long exploded canons of orthodox finance still, however, reg-

pected in our country, were modified to accommodate practices that are progressive and not less sound on that account.

Before leaving this question of finance, may I suggest that during this session we make a special study of the very excellent report published recently by the Motor Vehicle Taxation Enquiry Committee. Much of what I have suggested has already been advised by the Committee. Perhaps if we see our way to endorse some of the Committee's recommendations, they will be given added weight.

Research

Man has throughout the ages devoted himself to the search for truth as well as to an effort to enlarge the "boundaries of his mastery over his environment." Abstract reasoning and the urge to give practical effect to this reasoning have been said to be the "two principal activities of man, viz., thought and action." Science, as we understand it, embodies both these aspects of man's endeavour; these aspects are inter-dependent and inseparable in science and in scientific research.

India has made in past ages immense contributions to the world's store of knowledge, to mathematics and to philosophy, but as far as highway engineering is concerned, our contribution to the widening of the bounds of knowledge has so far been negligible—not because of any dearth of talent but because of a want of impetus and suitable opportunities.

It is therefore very gratifying to find that road research laboratories have been or are being set up in the States and at the Centre, to carry out the vast volume of research work that must be done not only for engineering efficiency by tests and quality controls, but also to provide the basic knowledge on which our future research work must be built for the solution of design and construction problems that exist and will keep cropping up.

With the growth of laboratories and the facilities afforded by them and the training that our engineers have had and are having in research methods, it is reasonable to hope that we shall make and keep on making progress in research, but in order to utilize all the laboratories to the best advantage and enable quick progress to be made it is essential that their work proceed unhampered. For this there must be an assurance of funds. One method would be to add 1½ per cent on the cost of every road project of a State or within the orbit of a research centre, and credit it to a research account, where it should be non-lapsable and be available for research work.

Again the work of all such laboratories should be properly co-ordinated.

All laboratories must publish the work done by them during the year.

Where necessary, all road research laboratories ought to be able to receive guidance in their problems from the Central Road Research Laboratory.

Specifications

It is of the utmost importance to devise designs and specifications for roads that can be constructed cheaply in such a manner that they are able to stand up to light traffic of say less than 500 tons in all weathers and serve as the substructure when, later on, the roads are improved. Stabilized earth roads containing coarse material in the top course and sprayed with tar or bitumen may provide a solution, while stabilized soil roads with maintenance through mechanised units may probably be a suitable solution for fair weather earth roads. With the labour conditions as they are or are tending to be today, it will be necessary to utilize machinery to an increasing extent in road work including road maintenance.

In certain situations improvement of drainage of the road-bed through suitable drains, raising roads to a suitable level, and stabilising the top layer may result in cheap construction, while in other cases, lowering of the road bed so that the moisture content of the top layer of soil may not fall quickly through the failure of capillary supplies, may be found to be useful. The correct fixation of the road level is important from these considerations, apart from those of traffic safety, flood level of the area, etc. Co-ordinated research will help solve such problems.

Development of rural communications is a crying necessity which must be met and so research in cheap road construction and maintenance methods must be given high priority.

Organization

Highway engineers charged with the responsibility of the construction and maintenance of roads often have difficulty in persuading government of the need for adequate staff for carrying out the jobs entrusted to them. It is not unusual to find the staff requirements cut down arbitrarily and the arguments of the engineer based on his experience and on practice elsewhere ignored. It is therefore essential for us to lay down rough guides on

the performance expected of different staff so that the demands of the engineer may find support from the authoritative opinion of this body. It is of course not possible to lay down any absolute yardsticks as the nature of the work and local circumstances may cause major variations, but it is possible to indicate average measures of performance.

Specialists.—With regard to the question of specialization, it is a very difficult matter to decide to what extent this should be encouraged. Undoubtedly, when an engineer shows aptitude for some specialized activity, it would be in the public interest to give him an opportunity to acquire greater knowledge and skill in his subject.

Chief Engineers.—I cannot turn away from the question of P. W. D. organisation without touching on the position of the Chief Engineer of a State as adviser to his government. 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 second hand, 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 often to waste a great deal of his time explaining why an order should be passed instead of simply passing the order promptly himself. The whole question is being studied by Sister Associations and we should do our part in helping to arrive at a solution.

All Engineers.—Before I close I must say a few words on putting our own house in order. I have been perhaps a little free with my advice to others but do we also not require advice? Are we all working wholeheartedly or with the zeal of patriots intent on getting our country to take its proper place among the nations of the world? How many of us spend our time in offices "spoiling paper" instead of supervising and even taking part in actual construction work?

FIRST DESERVE, THEN DESIRE

I think of the advice given us by the world-famous engineer-experts who visited our country in 1946. These gentlemen controlled between them (need I say without the intermediary of a non-technical Secretary) practically the whole of the Roads and Buildings work of the Federal Government of the United States of America. Their advice was that no one could be an engineer until he had had "all his finger nails broken" They put it

this way to impress on us that we must be prepared to do things rather than write about what should be done. How many of us have feelings of false prestige about living on the job instead of in an office? A good civil engineer is automatically a good administrator because civil engineering is administration and, when the time comes, he will be fit to take over administration with the best. But how many of us are fitting ourselves by real hard practical work for the positions to which we aspire? Let our motto be "First Deserve, then Desire."

Gentlemen, I have drawn your attention to many problems that are facing us. I have also indicated to some extent what should be done. It is not possible in an address of this kind to go into details: these must be examined by us at our meetings with a view to arrive at clear and agreed solutions. I have no doubt that our united voice will not be ignored and that what we say will be of decided help to the Government in determining their policy regarding road work in our country.

In my address I have laid special emphasis on road finance because without money we can do nothing. It is our duty to spend the money we get to the best advantage of our country, and I have stressed that we must strain every nerve to perform that duty. But we must also tell the Government and the people that we, with the exceptions of the States of Madras and West Bengal, are spending less of our resources on roads, **much less**, than any of the advanced countries in the world. We are spending less because our Governments, with the two notable exceptions I have named, and the people are not educated in this matter. We must try to educate them.

I do not want to tax your patience any longer. The present condition of our country requires of us a grim determination to put forth our utmost and to do whatever is required of us to advance India on the road of economic independence and to effect all-round improvement in the lot of the common man, and I have no doubt that our efforts will succeed.

I thank all who have graced this occasion with their presence and have favoured me with a hearing.

Sir, I request you now kindly to inaugurate this Session.

INAUGURAL ADDRESS

In declaring the Session open the Hon'ble Dr. B. C. Roy said :—

Mr. President, Ladies and Gentlemen,

Your President began his speech by welcoming me to this gathering but it is I who should welcome you on behalf of the Government of West Bengal to this City and State where you are to hold the Fifteenth Session of the Indian Roads Congress and it is with great pleasure that I welcome you. I am glad to see here so many engineers from all over the country who are interested in the construction and maintenance of roads.

Your President has stated two facts, which are evident to every one namely, that roads today do not have high priority in the nation building schemes of the Centre and of most States, and secondly, that no development is possible in India, such as we desire unless we obtain the valuable help that the construction and maintenance of good roads can give.

Before Bengal was divided, there was no proper planning so far as roads were concerned. By that I mean the objective and purpose for which roads were required in particular areas was not carefully studied in the past. It is true that this State, presents difficulties that hamper road construction. Its terrain is such that roads cannot be effectively built without the construction of many large bridges. The Governments of the past were more busy in collecting raw materials from different parts of the Province for trade purposes, and, therefore, they perhaps were more anxious to lay down communications through railways rather than through ordinary roads for road transport. In many places also, transport-communications were planned so cursorily that interference with natural drainage resulted in deterioration of health in many areas. In this connection I would refer you to the well-known report submitted by Sir William Wilcocks when he came here in the year 1926-27.

You all remember what happened during last year's storms in the Darjeeling area. The roads and the railway system simply tumbled down the hill sides. It was obvious that even in making roads connecting the plains up to the hill tops there was no plan behind it; they just had roads constructed on the edges of the hills for the purpose of carrying the railways as well as road traffic with-out, to my mind, taking much care to see whether such roads would be able to stand the strain of flood conditions such as occurred last year.

ROAD CONDITIONS IN WEST BENGAL

When this State was partitioned, the conditions of the West Bengal became very peculiar. Probably most of you have seen (and if you have not seen, I would request every one of you to see as quickly as possible) the map of West Bengal. On seeing this map you will realise that the West Bengal State was cut by partition into three separate parts. There is now practically no direct communication in the State between the top areas of Cooch-Behar, Darjeeling and Jalpaiguri and the middle portions consisting of Malda and Dinajpur. Those portions again have practically no connection with the rest of West Bengal.

I can assure you it took me at least eighteen months to convince the Transport Ministry of the Government of India that it was essential for the development of the State, for the safety of the State, and for maintaining services and supplies in this State, that there should be a connecting road between Calcutta and Darjeeling through the non-Pakistan areas. I am only giving this to you as an example to show that nobody realised even before partition the value of roads and their connection with social services.

THE HEALTH, FOOD, AND DEFENCE ASPECTS OF ROADS

I recall that in 1943-44 the Government of India appointed a Committee to make a survey of requirements for medical relief and to ensure the provision of health measures in different parts of India. One of the main propositions which this Committee laid down, and the proposition was accepted by the Government of India, was that there should be a means of communication between the centre of a State and main towns of each district. There should again be connecting links between the district centres and the sub-divisional centres. And for health purposes, particularly for ensuring health measures amongst the villagers all over the Indian States, it was essential that centres of the sub-divisional areas should be connected with all the primary centres of the villages. I ask you how is it possible to provide these connecting links? Unless a complete change comes over the people of this country, and the Government and the people all realise that, even for the purpose of health measures and medical relief, it is essential that there should be such communications, supervision and inspection of rural areas will be impossible.

There is another aspect of the problem which must be considered. Supposing I want to bring relief to a population of 50,000 people distributed over a wide area. If there are good roads, one

centre with suitable personal would be able to control and supervise and take appropriate measures for serving the whole of the area. But as it is today, I have to put a controlling centre in Union Board area and, if you sit down to calculate the capital and recurring cost of the present system, you will find that this costs us ten times more than what we would have to spend if we had good roads and one established health centre in each district instead of controlling from five or more sub-centres. The efficiency of service would also be better.

Ladies and Gentlemen, we experienced the difficulty in an acute form last year and the year before because of our not having roads to help us in distributing food. Bengal has, as you all know, always been a deficit State so far as food production is concerned, it produces practically no wheat, and yet nearly one-fourth of its population eats wheat. We must import wheat from outside. But even the food we produce is difficult to distribute to areas which are really deficit. Last year, and in 1949, there was a large surplus of rice and paddy in part of the district of Dinajpur but there was no communication between that part of Dinajpur and the railhead. The result was that for many months we could not reach that area except through Pakistan and Pakistan refused to allow transport of food through their territory to Calcutta or any part of West Bengal.

I feel I have said enough to show that there is an essential relationship between the development of a State and the progress, development, and maintenance of good roads. It is for this reason that we, at least in this State of West Bengal, have not only created a separate department called the "Roads Department" with a separate Chief Engineer, but also we have set apart as much as we can of our resources for the development of roads.

It is not merely the questions of food or medical relief that I am worried about. We have a border of 650 miles with Pakistan and, as you must have read in papers, in many of the areas along this border there are continuous skirmishes going on. People from both sides raid across the border very frequently at one point or another. We have therefore got to put in police on duty to protect our border. Yet we cannot connect one picket with another because of the lack of roads. We cannot even rush in relief when there is any serious trouble.

To give an instance, the headquarters of one district is 40 miles from a border area where incidents took place some time ago. You will be surprised to know it took us 14 hours to cover this distance of 40 miles. We have even had to provide air strips in one or two places to give quick access to danger points.

To get over our general deficiency in road communications, I feel that every State should create a department that will be concerned mainly with the construction and maintenance of roads. This department will study methods of constructing cheap roads and will seek to associate villagers and local people with enlarging the road system of every district. The department will also devise ways and means to make people understand the value of good roads.

Most of these points have been referred to in the speech of your President and I can only suggest that your Congress should keep in close touch with the road departments of the States at every stage, giving them advice and guidance and helping the State Governments to continue road construction as far as their means will permit.

ROADS ARE PRODUCTIVE UNDERTAKINGS

There is a misconception that road construction is not a productive proposition. I can think of few State undertakings that will be more productive in the long run. But your President has suggested (and I entirely endorse his suggestion) that as things are today, most of the States are not able to pay from their revenue resources for the construction of roads. In the State of West Bengal the total estimate for the roads we require immediately is about 37 crores. Our State came into being on the 15th of August 1947 with a MINUS reserve of 2.5 crores. Therefore it is not possible for us to draw upon this deficit reserve for the purposes of financing the construction of roads.

The only alternative for a State like West Bengal in such circumstances is to construct roads out of loans. The difficulty is that there are many people in the Government and outside who do not believe roads are a paying proposition. As I have said, I do not agree with them.

I am glad that the Motor Vehicles Taxation Enquiry Committee has suggested an increase in the taxes on motor vehicles, particularly those which are used for trade. I can assure you that we have accepted the report and intend to take advantage of it. We have already put a bill before our Legislature to enable us to increase this source of revenue. The proceeds of the new taxes will be used solely for the purpose of road construction and maintenance. That is absolutely necessary.

I have also approached the Central Government with a proposal for a loan and to set apart a portion of our total income from vehicle taxation and petrol for the purpose of meeting the charges of loans taken for road and bridge construction. Nobody

should say that it is not just to impose upon future generations the duty of paying for the roads we are constructing today. I am positive that future generations will realise the advantage of good roads in a difficult State like West Bengal and willingly pay the loan charges out of taxes. In doing so they will bless us for having provided good roads for them and bless the Indian Roads Congress for the lead given in the cause of road building.

I hope your Congress will help us in organising our road departments and furthering our road plans. You will also help us by pressing on with the research work you have in hand.

With these remarks, Mr. President, Ladies, and Gentlemen, I declare this 15th Session of the Roads Congress open. I wish you all success.

President's Concluding Remarks.

The President then thanked the Chief Minister for his illuminating speech, and requested him to present "Indian Roads Congress Medal" for Papers of more than average merit to :—

- (1) Shri K. G. Bhate for his Paper No. 142 on "Failure of a Five Span Masonry Arch Bridge across the Bhogeswari River near Pen, District Kolaba in the Province of Bombay."
- (2) Shri A. Nageswara Ayyar for his Paper No. 147 "An Adaptable Steel Centring for R. C. Bridges."

MESSAGE FROM

The Hon'ble Shri K. Santhanam

Minister of State for Transport and Railways,
Government of India.

I am glad to note that the Indian Roads Congress is setting up a high tradition of co-operation and co-ordination among the Road Engineers of India. The spirit of solidarity is particularly needed in these days when, for reasons of national economy, the expenditure on roads is sought to be reduced to less than the minimum needed for the maintenance of existing roads and the construction of the most indispensable ones. I would suggest to the Road Engineers of India that instead of lamenting over this unfortunate state of affairs, they should convert this period of adversity into one of lasting national advantage through concentrated research on the economies of road building and maintenance. If only we can find a way to tap the inexhaustible resources of manpower which is in all our villages for the construction of roads during the period of seasonal unemployment, great progress can be achieved.

I have great pleasure in sending my good wishes for the success of the 15th Session of the Indian Roads Congress.

Message From Sir Kenneth Mitchell

(*Founder of the Indian Roads Congress.*)

In sending his "best wishes for a very successful fifteenth Congress" Sir Kenneth adds :

"The Commonwealth group plans for development in South East Asia are a bold conception, to the execution of which India will, I am sure, bring much experience and wisdom. Industrial development without rural uplift and betterment must necessarily be unbalanced ; and all rural betterment will be dependent on the provision of good roads at a cost which can be afforded. I do sincerely hope that this basic fact will be realised and, moreover, that the Indian Roads Congress will be afforded and will embrace the opportunity to help with advice.

Conventional high-class roads and motor transport have become together very expensive for areas at present poor and backward and some original thinking will be necessary. For instance taking cost of road and transport together is it not possible that one stage in stage development should be much lower speeds for Motor transport ?

Whatever the answer may be, I am sure that much thought will have to be given to it and that the Indian Roads Congress will help.

One way might be for the Indian Roads Congress to take the initiative in promoting a regional International Roads Congress for South East Asia. I believe that the time is ripe for this.

Message from Shri E. A. Nadirshah

Shri E. A. Nadirshah sent his sincere wishes that the Congress might have a very successful and instructive Session so as to foster and further the laudable aims and objects for which it was working.

Message from Mr. P. M. Otway

Mr. P. M. Otway of the Ministry of Transport, United Kingdom sent his best wishes to the President and those taking part in the Congress.

Message from Shri U. J. Bhatt

Shri U. J. Bhatt expressed his sincere wishes for brilliant success of the Annual Session of the Congress.

Message from Shri Brijmohan Lal

Shri Brijmohan Lal wished the 15th Session of the Congress unqualified success, and hoped that with the efforts of the Congress, the various Governments would realise the importance of expansion of communications in the country and make adequate provision for it in their development programmes.

Minutes of the 36th Council Meeting of THE INDIAN ROADS CONGRESS held at Calcutta on the 17th February, 1951.

Present:

A. C. Mukerjee—President.

F. P. Antia	C. P. Misra
R. K. Batra	K. K. Nambiar
C. M. Bennett	K. Narasimha Rao
K. G. Bhate	V. N. Rangaswami
S. N. Chakravarti	M. L. Saberi Yousuf
G. N. Dutt	D. C. Sharma
C. J. Fielder	M. S. Thirumala Iyengar
Hari Shankar Sharma	J. M. Trehan—Secretary.
S. B. Joshi	

The following Co-opted Members attended :

H. S. Batliwala	K. S. Raghavachary
W. A. Griffiths	B. V. Vagh
G. M. McKelvie	E. Zipkes

The following attended by invitation :

K. F. Antia	S. K. Ghosh
R. S. Bhalla	H. Sunder Rao
M. S. Bisht	

The Council approved the action of the Executive Committee in co-opting and inviting the Members named above and also invited the following Members to attend the Council meeting :

H. P. Sinha	J. Chambers (Did not attend)
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1. Confirmation of the Minutes of the 35th Council Meeting.

The Minutes of the 35th Council meeting held at Bombay on the 17th & 18th January 1950 as published at pages 466 to 467 of Volume XIV-4 of the Journal of the Indian Roads Congress were confirmed.

2. Approval of the Minutes of the Executive Committee meetings.

The Minutes of the Executive Committee meetings held at New Delhi on the 29th September 1950 and the 16th January 1951 were approved.

3. (i) Audit Report for the year 1949-50.

The report of the Auditors on the accounts for the year 1949-50 was recorded.

(ii) Draft Report of the Council to the General Body of Members for the period 1st January to the 31st December 1950.

The draft report was approved after modification.

4. Budget.

The budget estimate for 1950-51 was approved.

5. Medals.

The Council accepted the recommendation of the Executive Committee that the "Indian Roads Congress Prize Essay Medal" should be kept in being but that in future it should be awarded for Papers instead of for Essays and be called the Indian Roads Congress Medal. This will keep in being a fine medal designed in the early days of the Indian Roads Congress and will be symbolic of the desire of the Congress to maintain its traditions while adapting itself to changing circumstances.

6. Miscellaneous.

(i) It was considered desirable that Sections like a "Question Forum", "Students' Corner" etc. should be included in the publications of the Indian Roads Congress.

(ii) The following awards for Papers read at the 14th Session recommended by the Papers Subcommittee were announced:—

- (1) "Indian Roads Congress Medal" to Shri K. G. Bhate, Executive Engineer, Bombay for his Paper No. 142 on "Failure of a Five Span Masonry Arch Bridge across the Bhogeswari River near Pen, District Kolaba in the Province of Bombay".
- (2) "Indian Roads Congress Medal" to Shri A. Nageswara Ayyar, Retired Addl. Consulting Engineer to the Government of India (Roads) for his Paper No. 147 on "An Adaptable Steel Centring for R. C. Bridges".

**Minutes of the Business Meeting of the
INDIAN ROADS CONGRESS**

held at Calcutta on the 21st February, 1951

The Fifteenth Annual General Business Meeting of members was held at Calcutta on Wednesday, the 21st February, 1951, at 9.30 a.m. In all 211 Members and six invitees (names and particulars in Annexure I) attended the Session.

2. Confirmation of the Minutes of the last Business Meeting. The Minutes of the last Business meeting held at Bombay on the 17th January 1950 as printed on pages 435 to 465 of the Journal of the Indian Roads Congress, Volume XIV-4, June 1950, were approved.

3. (i) Audit Report. The Audit Report for the period 1st October, 1949 to the 30th September, 1950 (Annexure II) was recorded.

(ii) It was decided to appoint M/s. Walker, Chandiok & Co., Chartered Accountants and Auditors, Delhi to audit the accounts of the Indian Roads Congress for 1950-51.

4. Report of the Council to the General Body of Members. The Report of the Council (Annexure III) was taken as read and approved.

5. Resolutions of Thanks. The following resolutions were passed with acclamation :

- (a) The Indian Roads Congress express their thanks to the Government of West Bengal for their kind invitation to hold the Fifteenth General Session at Calcutta and for the efficient arrangements made.
- (b) The Congress express their thanks to the Hon'ble Dr. B. C. Roy, Chief Minister of West Bengal for his encouraging Address to the Fifteenth Session and for his permission to print the Address in the Journal of the Indian Roads Congress.
- (c) The Congress express their thanks to the Hon'ble Shri K. Santhanam, Minister of State for Railways and Transport, Government of India for his good wishes and message to the members of the Indian Roads Congress.
- (d) The Congress express their thanks to the Hon'ble Shri Bimal Chandra Sinha for kindly declaring open the technical exhibition organized by the Congress.

- (e) The Congress express their thanks to the Hon'ble Shri Bhupati Majumdar, Minister, Irrigation and Waterways, West Bengal, for showing his keen interest in the road development of the country and for kindly giving an "AT HOME" to the delegates.
- (f) The Indian Roads Congress express their appreciation and thanks to Shri S. N. Chakravarti, Shri T. Mitra, Chief Engineers of West Bengal and Shri S. K. Ghosh, (Local Organizing Secretary) for the efficient arrangements made by them for the convenience of the delegates of the Indian Roads Congress.
- (g) The Indian Roads Congress thank the firms and Government Departments who participated in the technical exhibition organized on the occasion of the Session.
- (h) The Indian Roads Congress desire to express their thanks to the authorities of the Institution of Engineers for the loan of their hall and compound.
- (i) The Indian Roads Congress desire to thank the authorities of the St. Xavier's College for kindly placing their hall at the disposal of the Congress for the inaugural ceremony.
- (j) The Indian Roads Congress express their thanks to Shri J. M. Majumdar for placing his building at the disposal of the Congress for the use of Committee meetings.
- (k) The Indian Roads Congress thank the authorities of the different concerns who kindly afforded facilities to delegates to visit their works.

6. **Scrutineers for the Election of Council Members.** Messrs. S. N. Chakravarti, C. M. Bennett, K. S. Raghavachary, H. P. Sinha and C. J. Fielder were appointed scrutineers for the election of Council Members under rule 9-i of the Memorandum of Association, Rules and Regulations of the Indian Roads Congress.

7. The following announcement was made from the Chair with regard to the elections:—

"Only those Members of the Congress who are not in arrears of their subscription are entitled to vote. Voting slips will be given to those Members who wear their badges, or can give their Roll numbers, or can otherwise be indentified as not being in arrears."

8. **Elections.** The following were elected as Council Members under Rule 9-f (i), g, h, & i:—

9-f (i) **Representatives of Associate Members other than Public Servants**

F. P. Antia	E. A. Nadirshah
C. J. Fielder	L. R. Patel
R. N. Joshi	V. N. Rangaswami

g. **Representative of District Boards.**

N. K. Sinha

h. **Representative of Municipal, Improvement Trust and Cantonment Engineers.**

M. Meeran

i. **Representatives elected by the General Body**

K. G. Bhate	K. K. Nambiar
C.P. Misra	R. C. Roy

The following were nominated by their respective administrations as Council Members under rule 9-a, b, c, & d:—

9-a. Name of participating administration.	Name of representative.
--	-------------------------

(PART "A" STATES)

Orissa	C. M. Bennett
Assam	R. L. Varma
Bihar	M. L. Bahl
Madras	M. S. Thirumale Iyengar
Madhya Pradesh	R. K. Batra
Bombay	M. L. Champhekar
West Bengal	S. N. Chakravarti
Punjab	D. C. Sharma
Uttar Pradesh	A. C. Mukerjee

(PART "B" STATES)

Saurashtra	U. J. Bhatt
Travancore-Cochin	E. Sivaraman Nair
Rajasthan	Kishore Lal Mathu
Hyderabad-Deccan	M. L. Saberi Yousuf
P.E.P.S.U.	Raghubir Singh

- b. Engineer-in-Chief's Branch Brig. Partap Narain
 c. Central P.W.D. B. S. Puri
 d. Consulting Engineer (Roads). H. P. Mathrani

9. The following members were co-opted to the Council :

W. B. Bakewell	S. B. Joshi
H. S. Batliwala	G. M. McKelvie
S. K. Ghosh	T. Mitra
W. A. Griffiths	K. S. Raghavachary

The following members were invited to attend the 37th Council meeting :

M. S. Bisht	G. Srirangachary
B. N. Shenoy	B. V. Vagh
E. Zipkes	

The following representatives of Part "C" and "D" States were also invited :

T. C. Gue	G. R. Nangea
N. R. Ramchandani.	

10. On behalf of the General Body Shri K. K. Nambiar, thanked the President, the Secretary, and the staff for the good work they had done during the year.

Annexure I.

LIST OF MEMBERS WHO ATTENDED THE FIFTEENTH ANNUAL SESSION OF THE INDIAN ROADS CONGRESS HELD AT CALCUTTA IN FEBRUARY, 1951.

S. No.	Name of State.	No. of delegates who attended the I.R.C. Session at Calcutta.
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ABSTRACT

1.	GOVERNMENT OF INDIA.	
(a)	Roads Organization	... 18
(b)	Engineer-in-Chief's Branch	... 4
(c)	M. E. S.	... 4
(d)	Central P. W. D.	... 9
(e)	Central Water-Power, Irrigation and Navigation Commission	... 2
2.	COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH	... 3
3.	INDIAN AGRICULTURAL RESEARCH INSTITUTE	1
4.	DELHI	... 3
5.	MADRAS	... 21
6.	BOMBAY	... 22
7.	WEST BENGAL	... 53
8.	PUNJAB	... 2
9.	UTTAR PRADESH	... 12
10.	MADHYA PRADESH	... 6
11.	ORISSA	... 6
12.	ASSAM	... 5
13.	BIHAR	... 18
14.	HYDERABAD-DECCAN	... 4
15.	MYSORE	... 4
16.	UNITED STATES OF TRAVANCORE AND COCHIN	2
17.	PATIALA & EAST PUNJAB STATES UNION	... 2
18.	SAURASHTRA	... 2
19.	VINDHYA PRADESH	... 1
20.	MADHYA BHARAT	... 3
21.	RAJASTHAN	... 5
22.	JAMMU & KASHMIR	... 2
23.	HIMACHAL PRADESH	... 1
24.	SIKKIM	... 1
25.	PAKISTAN	... 1
	TOTAL	... 217

**LIST OF MEMBERS WHO ATTENDED THE FIFTEENTH
SESSION OF THE INDIAN ROADS CONGRESS
HELD AT CALCUTTA IN FEBRUARY, 1951.**

S. No.	Roll No.	Name.
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GOVERNMENT OF INDIA.

(a) Roads Organization.

1.	322	Bazaz, S.L.
2.	1446	Bhalla, R.S.
3.	—	Gomes, J. G. (Invited)
4.	785	Hardayal.
5.	1288	Mathrani, H. P.
6.	54	McKelvie, G. M.
7.	960	Nagarsheth, M. P.
8.	890	Patel, B. P.
9.	87	Raghavachary, K. S.
10.	724	Rajagopalan, S. K.
11.	752	Ramaswamy, N. S.
12.	1515	Sen, N.
13.	39	Shenoy, B. N.
14.	191	Sinha, H. P.
15.	723	Subrahmanyam, J.
16.	389	Sunder Rao, H.
17.	637	Surya, N. S.
18.	918	Trehan, J. M.

(b) Engineer-in-Chief's Branch.

19.	...	Deb, A. K. (Invited)
20.	...	Pigott, F. B.
21.	1540	Rao, K. V.
22.	1542	Vijh, H. C.

(c) M E. S.

23.	1510	Basu, B. B.
24.	898	Ram Swarup Prasad.
25.	1287	Sil, K. S.
26.	1168	Tandon, S. N.

(d) Central P. W. D.

27.	948	Dutt, N. N.
28.	1091	Goel, H. C.
29.	1233	Gupta, S. N.

S. No.	Roll No.	Name.
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30.	1425	Jain, K. C.
31.	620	Malik, C. P.
32.	418	Mathur, M. S.
33.	717	Patel, C. B.
34.	1221	Rao, A. L.
35.	738	Vaish, V. R.

**(e) Central Water-power, Irrigation & Navigation
Commission.**

36.	...	Hira Nandani, M. G. (Invited)
37.	78	Khatrri, K. C.

**2. COUNCIL OF SCIENTIFIC & INDUSTRIAL
RESEARCH.**

38.	913	Chatterjee, P. K.
39.	1535	Ernst Zipkes.
40.	847	Uppal, H. L.

**3. INDIAN AGRICULTURAL RESEARCH
INSTITUTE.**

41.	—	Raychudhuri, S. P. (Invited)
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4. DELHI.

42.	39	Basil Gray.
43.	1183	Nazareth, C. V.
44.	82	Rangaswami, V. N.

5. MADRAS.

45.	1564	Bapa Rao, K.
46.	814	Basheer Ahmed.
47.	80	Griffiths, W. A.
48.	670	Janardan Rao, C.
49.	1563	Jayaraj, A. C.
50.	921	Lokanathan, P.
51.	671	Meeran, M.
52.	268	Nambiar, K. K.
53.	1460	Narasimha Rao, K.
54.	267	Narayana Murthy, B.
55.	1554	Narayana Rao, K.
56.	660	Nayak, S. C.
57.	628	Raj, P. V.

S. No.	Roll No.	Name.
58.	347	Ramaswami Reddi, K.
59.	876	Reddy, C. Krishna.
60.	240	Srinivasan, K.
61.	618	Srirangachary, G.
62.	1311	Subbaraju, Bh.
63.	1345	Swaminathan, C. G.
64.	1438	Thirumale Iyengar, M. S.
65.	—	Venketeswara Rao, K. (Invited)

6. BOMBAY.

66.	32	Antia, F. P.
67.	1241	Antia, K. F.
68.	383	Batliwala, H. S.
69.	329	Bhate, K. G.
70.	1527	Champhekar, M. L.
71.	343	Choksi, B. K.
72.	704	Chougule, Y. K.
73.	1336	Daftary, N. D.
74.	1497	Deshpande, D. V.
75.	357	Divatia, S. S.
76.	858	Gandhi, J. H.
77.	1180	Jategaonkar, V. L.
78.	315	Joshi, S. B.
79.	217	Krishnan, O. C. K.
80.	636	Macha, T. K.
81.	810	Mehta, D. J.
82.	1565	Nerurkar, M. S.
83.	1491	Patel, O. H.
84.	1528	Patkar, B. B.
85.	1575	Unwalla, B. T.
86.	84	Vagh, B. V.
87.	1567	Yadav, S. G.

7. WEST BENGAL.

88.	1293	Ashutosh Guha.
89.	10	Bakewell, W. B.
90.	962	Banerjee, J. K.
91.	1514	Basu, S. C.
92.	1383	Biswas, K. K.
93.	17	Chakravarti, S. N.
94.	323	Chambers, J.
95.	1324	Chanda, R. P.
96.	1426	Chatterjee, P. C.

S. No.	Roll No.	Name.
97.	1556	Das Gupta, A. K.
98.	203	Das Gupta, J. N.
99.	1505	Das, T. M.
100.	15	Datta, A. K.
101.	45	Debi Das Chatterjee.
102.	41	De, K. C.
103.	165	Desai, D. S.
104.	530	Dutt, P.
105.	231	Fielder, C. J.
106.	1503	Ganguli, H. D.
107.	501	Garr, B. L.
108.	1550	Ghose, M. B.
109.	1292	Ghosh, A. C.
110.	1030	Ghosh, A. K.
111.	808	Ghosh, S. K.
112.	440	Gupta, B. B.
113.	27	Gupta, L. K.
114.	936	Gupta, S. N.
115.	1566	Laha, S. K.
116.	6	Madden, W. J.
117.	512	Marik, T. P.
118.	837	Misra, L. P.
119.	1569	Mitra, A. C.
120.	1459	Mitra, S. K.
121.	316	Mitra, T.
122.	891	Mohury, B. D.
123.	22	Moss, G. L. W.
124.	488	Nagarker, D. B.
125.	46	Patel, K. R.
126.	21	Patel, L. R.
127.	648	Perry, R. G.
128.	1008	Raghavan, P.
129.	34	Ramsay, A. R. P.
130.	73	Ratnagar, R. D.
131.	944	Ray, K. C.
132.	1544	Ray, S. N.
133.	1447	Roy, J. K.
134.	1271	Roy, K. P.
135.	766	Roy, R. C.
136.	1553	Samaddar, S. K.
137.	863	Sen Gupta, P. N.
138.	—	Sen, S. (Invited, Represented the C. B. I.)
139.	15	Singh, P. N.
140.	1562	Subba Rao, S.

S. No.	Roll No.	Name.
8. PUNJAB.		
141.	1402	Bhasin, P. C.
142.	504	Sharma, D. C.
9. UTTAR PRADESH.		
143.	205	Bisht, M. S.
144.	1525	Chaturvedi, D. C.
145.	1543	Gahlowt, R. S.
146.	287	Jagmohan.
147.	248	James Harris.
148.	46	Mukerjee, A. C.
149.	264	Parmara, D. S.
150.	743	Partap Singh.
151.	115	Sharma Hari Shankar.
152.	960	Sinha, K.
153.	45	Srivastava, M. P.
154.	1385	Sur, A. K.
10. MADHYA PRADESH.		
155.	978	Batra, R. K.
156.	1455	Chopra, P. C.
157.	1545	Dube, S. B.
158.	1561	Khurana, D. N.
159.	1571	Paranjpye, V. K.
160.	1467	Sharma, S. A.
11. ORISSA.		
161.	204	Bennett, C. M.
162.	560	Das, K. C.
163.	1144	De, Anil Chandra
164.	304	Jootla, Baboo Singh
165.	1278	Misra, Bijoy Ram
166.	690	Padhi, R. N.
12. ASSAM.		
167.	889	Barua, K.
168.	941	Chowdhuri, B. B.
169.	1140	Dutt, G. N.
170.	1499	Inamul Hoque, A. B. Syed
171.	421	Ramchandani, N. R.

S. No.	Roll No.	Name.
13. BIHAR.		
172.	399	Bahl, M. L.
173.	1443	Bose, M. M.
174.	1541	Chowdhry, D. C.
175.	659	Datt, J.
176.	1286	Ghosh, T.
177.	627	Lall, B.
178.	1551	Manzoor Ali.
179.	434	Misra, C. P.
180.	1250	Nand Kishore Prasad.
181.	492	Ram, G. S.
182.	152	Rangaswami, M. A.
183.	1299	Roy, B. N.
184.	1321	Sahay, T. K.
185.	516	Sharma, P. N.
186.	1372	Singh, S. M. P.
187.	1291	Sinha, N. K.
188.	754	Sinha, S. K.
189.	856	Sirkar, S. K.
14. HYDERABAD-DECCAN.		
190.	1548	Mohd. Abdul Khadir.
191.	29	Narasimhan, J. S.
192.	1555	Reddy, C. N.
193.	365	Saberi Yousuf, M. L.
15. MYSORE.		
194.	1558	Abdul Jabbar.
195.	1558	Chakravarthi, K. S.
196.	1557	Seshappa, A.
197.	1560	Siddabasaviah, K. V.
16. UNITED STATES OF TRAVANCORE & COCHIN.		
198.	1568	Idiculla, K. I.
199.	982	Sivaraman Nair, E.
17. PATIALA & EAST PUNJAB STATES UNION.		
200.	1053	Marya, Jugdev Singh
201.	1449	Singh, J. P.

S. No.	Roll No.	Name
18. SAURASHTRA.		
202.	1313	Patel, N. C.
203.	973	Rathod, N. G.
19. VINDHYA PRADESH.		
204.	119	Gue, T. C.
20. MADHYA BHARAT.		
205.	588	Athawale, V. L.
206.	563	Inamdar, S. R.
207.	584	Patil, Y. K.
21. RAJASTHAN.		
208.	826	Adaviyappa, S.
209.	800	Gopinatha, Rao, K.
210.	547	Gupta, D. N.
211.	331	Kishore Lal Mathur.
212.	643	Rastogi, D. P.
22. JAMMU & KASHMIR.		
213.	974	Malhotra, D. P.
214.	1552	Narboo, S.
23. HIMACHAL PRADESH.		
215.	338	Nangea, G. R.
24. SIKKIM.		
216.	707	Jali, F. C.
25. PAKISTAN.		
217.	1549	Doctor, P. K.

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THE INDIAN ROADS CONGRESS
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30th SEPTEMBER, 1950.
Transport - Communications Monthly Review

EXPENDITURE	Rs. A. P.	Rs. A. P.	INCOME	Rs. A. P.
To stock of paper as on 1/10/49 ...	652 0 0		By Sales and Subscription ...	2,826 2 0
„ Purchases of paper ...	2,656 13 9		„ Advertisement proceeds ...	8,519 2 6
„ Printing charges ...	6,985 7 6			
	10,244 5 3			
Less : Stock of paper as at 30/9/50 ...	634 14 0	9,609 7 3		
To Postage Account ...		857 15 9		
„ Miscellaneous Expenses ...		811 13 6		
„ Balance, being Excess of Income over Expenditure carried to Balance Sheet ...		566 0 0		
		Rs 11,345 4 6		Rs 11,345 4 6

BALANCE SHEET AS AT 30th SEPTEMBER, 1950.

LIABILITIES	Rs. A. P.	Rs. A. P.	ASSETS	Rs. A. P.	Rs. A. P.
SUNDRY CREDITORS			SUNDRY DEBTORS		
Liability for Expenses ...	1,198 1 6		Due for advertisement ...	4,427 14 6	
Liability for other finances ...	5 0 0		Due from Mr. R. D. Gupta ...	39 1 6	4,467 0 0
Advertisement fee received in advance for 1950/51 ...	810 0 0	2,013 1 6			
A. GENERAL ACCOUNT			STOCK. (As certified by Secretary) Paper ...		634 14 0
Balance due to them ...		6,124 13 3	STAMPS ON HAND ...		32 11 3
			DEFICIT		
			Balance as per last Balance Sheet ...	3,569 5 6	
			Less : Excess of Income over Expenditure as per Income and Expenditure Account ...	566 0 0	3,003 5 6
		Rs 8,137 14 9			Rs 8,137 14 9

New Delhi,
22nd November, 1950.

Audited and found correct.
(Sd.) A. F. Ferguson.
CHARTERED ACCOUNTANTS AUDITORS

Annexure III.**INDIAN ROADS CONGRESS****REPORT OF THE COUNCIL TO THE GENERAL BODY OF
MEMBERS FOR THE PERIOD 1ST JANUARY 1950 TO
31ST DECEMBER 1950.****GENERAL.**

The Fourteenth Annual Session of the Indian Roads Congress was held at Bombay in January 1950, when 221 members and two invitees attended the Session. The six Papers published in the Journal of the Indian Roads Congress, Volume XIV, parts 1 to 3, were read and discussed. Two Committees and eleven Sub-committees were reconstituted to deal with various engineering and administrative problems. The Rules Committee appointed by the Council at their meeting held at Roorkee in April 1948, to suggest changes in the Memorandum of Association ceased to function in January 1950 after it had submitted its report to the Council.

The Council, at their 34th meeting held during the Session, reviewed the Memorandum of Association, Rules, Regulations and Bye-laws so as to widen the scope of the activities of the Congress to enable it to deal more effectively than in the past with various matters of technical and administrative importance relating to the promotion of road and road transport development.

The Executive Committee held two meetings on the following dates :—

29th September 1950	} at New Delhi.
16th January 1951	

2. ADMINISTRATION.

Shri Romesh Chandra, Chief Engineer, Assam, was elected President of the Indian Roads Congress at the Bombay Session but relinquished his office on the 26th November 1950, while on leave preparatory to retirement from service. In his place, the Council elected Shri A. C. Mukerjee, Chief Engineer, Uttar Pradesh, as President of the Indian Roads Congress to hold office under the rules until the Annual Session of the Society at Calcutta in February 1951.

Mr. G. M. McKelvie continued as Honorary Treasurer till the 14th June 1950, when he relinquished the post of the Consulting

are not being supplied the Journal nor are they being allowed any of the benefits or privileges of Membership of the Society.

7. AUDIT.

At the Fourteenth Session at Bombay it was decided to appoint M/s. A. F. Ferguson & Co., Chartered Accountants and Auditors, to audit the accounts of the Indian Roads Congress for 1949-50. Their report was examined by the Executive Committee in their meeting held on the 16th January 1951. The Audit Report will be placed separately before the Council for their consideration.

8. PUBLICATIONS.

There has been a steady demand for the publications of the Indian Roads Congress. The Journal now includes an Information Service Section and additional sections on Plant, Machinery and Apparatus, and also Reviews. Members of the Congress are requested to send contributions for publication in the Indian Roads Congress Journal.

Arrangements for issuing bound copies of Volume XII-parts 1, 2, and 3 and Volume XIII have been completed. Volume XIII which was lost on account of an accidental fire in the Press in March, 1949 has been reprinted free of cost by the Press and it is hoped that both Volumes will be available for sale soon.

The balance of the publications as on the 31st December, 1950 was as under:—

<i>Name of Proceedings.</i>	<i>Volume.</i>	<i>Balance.</i>
I. R. C. Proceedings	I, II, IV, V, VI, VII-1 and VIII	Sold out
Do.	III	36
Do.	VII-part 2	49
Do.	IX-part 4	127
Do.	IX (Bound)	221
Do.	X-part 1	32
Do.	X-part 4	305
Do.	X (Bound)	Sold out
Do.	XI-part 4	194
Do.	XI (Bound) (1 & 2)	174
Do.	XI (Bound) (3 & 4)	305
Do.	XII-part 1	66
Do.	XII-part 2	464
Do.	XII-part 3	509
Do.	XII-part 4	642
Do.	XII-part 5	512

<i>Name of Proceedings.</i>	<i>Volume.</i>	<i>Balance.</i>
I.R.C. Proceedings	XII (Bound) (4 & 5)	499
Do.	XIII-part 1	343
Do.	XIII-part 2	453
Do.	XIII-part 3	385
Do.	XIII-part 4	431
Do.	XIV-part 1	371
Do.	XIV-part 2	518
Do.	XIV-part 3	501
Do.	XIV-part 4	530
Do.	XV-part 1	828
Do.	XV-part 2	620
Road Research Bulletin No. 1		286
Nagpur Report		29
Water Bound Macadam Paper		127
Old Bridge Code—(1937 Edition)		248

The Council advise Members who have not kept a complete set of the Proceedings of the Society to make up the deficiency before the old volumes are sold out.

Copies of the publications of the Society are supplied free of cost to several technical institutions in India, the United States of America, the United Kingdom and the United Nations Organizations covering the Far East. In exchange the Society receives free copies of publications of these Institutions.

The publication "TRANSPORT - COMMUNICATIONS MONTHLY REVIEW" is becoming more popular now and subscribers number about 250. The Review, which was being published at a loss during the first two years of its life, is now on a sounder footing in spite of an expanded complimentary distribution list.

The Review contains useful literature abstracted from more than fifty technical journals received in the combined libraries of the Indian Roads Congress and the Consulting Engineer to the Government of India (Roads). Besides this, it contains many original articles. It thus brings to subscribers the latest information on roads and road transport. Other items included in this magazine from time to time are reviews of recently published books, lists of additions made to the library, a technical information service, interesting mathematical problems, particulars of works sanctioned on National Highways and so on.

Complimentary copies of the Review are being issued to State Governors, Rajpramukhs and Chief Commissioners, Ministers at the Centre and in the States. Members of the Standing Roads

Committee of Parliament, the Chief Engineers concerned with roads and others. Complimentary copies of the February 1950 issue were also supplied to all Members of the Indian Roads Congress.

The Council request Members to send popular technical articles and other suitable contributions for publication in the review.

9. INFORMATION.

Forty enquiries received from Members on miscellaneous technical subjects were attended to. Some of the subjects on which information was sought are given below :—

- (i) Sieve analysis and the fineness modulus method of proportioning aggregates for concrete.
- (ii) Road signs and traffic signals.
- (iii) I. R. C. Bridge loadings.
- (iv) Design of foundation wells.
- (v) Maximum Gradients.
- (vi) Design of abutments, abutment piers, and piers for arches of various spans.
- (vii) Standard designs for vertical curves.
- (viii) Use of bituminous concrete or bituminous surfacing with burnt brick ballast.
- (ix) Standards for mile and furlong stones.
- (x) Bitumen and cement concrete road specifications.
- (xi) Selection of road alignments in plane and hilly country.
- (xii) Road and vehicle statistics.
- (xiii) Standard Specifications for road metal and Stone Chips.

10. LIBRARY.

In addition to a large number of technical journals of Institutions in India and abroad received in exchange for the I. R. C. Journals, a large number of books and Standards of the British Standards Institution, London, have been added to the library of the Indian Roads Congress. Members of the Congress can borrow books from the Congress library as well as the Roads Organization library by writing to the Secretary, Indian Roads Congress. The Rules regarding the loan of books are

published in Volume XV-part 1 of the Journal of the Indian Roads Congress.

The lists of additions to the library are published monthly in the "Transport-Communications Monthly Review". Members are requested to study those lists and ask for books which they wish to consult.

One hundred and twenty-five books were issued on loan during the year under report.

11. MEDALS AND PRIZES.

The Council at their 33rd meeting held at Ranchi in February, 1949 requested the Papers Subcommittee to study the Papers presented for discussion at the Thirteenth Session with a view to selecting those deemed suitable for the award of "Mitchell Medal" and "Indian Roads Congress Medal" and to submit their recommendations for the decision of the Executive Committee. It was also decided that the Papers read at the Roorkee Session (1948) should be considered for the award of the Indian Roads Congress Medal.

The recommendations of the Papers Subcommittee in regard to the selection of Papers for the award of Medals were considered by the Executive Committee in their meeting held during the Session at Bombay in January 1950 and the following awards were made :

The "Mitchell Medal" to Shri G. Srirangachary, for his Paper on "Low Cost Roads in India and the use of Soil Science for their improvement".

The "Indian Roads Congress Medal" to Dr. R. K. N. Iyengar for his Paper on "Well Foundations of the Kalabagh Bridge over the Indus".

Paper No. 141 on "Fundamentals of Highway Needs and Highway Planning" by Shri D. G. Bhagat and Shri Jagdish Bahadur was considered worthy of honourable mention.

The Papers presented at the 14th Session at Bombay will be considered by the Papers Subcommittee at Calcutta for the award of the "Mitchell" and "I. R. C." medals.

The Council, at their 34th meeting held at Bombay, decided to discontinue the Prize Essay competitions as suitable contributions were not being received.

12. COLLECTION OF THE PARTICULARS OF BRIDGES.

The Indian Roads Congress has been collecting particulars of bridges of lengths above 100 feet for publication in book form. The compilation work is still in progress. As soon as it is complete, the question of its publication will be taken up.

13. MEMBERSHIP OF SOCIETIES AND INSTITUTIONS.

(i) The Indian Roads Congress is a member of the Indian National Society of Soil Mechanics and Foundation Engineering. Shri S. R. Mehra, Superintending Engineer, P. W. D., Punjab (I), represented the Indian Roads Congress on the National Committee of the Society during this year.

(ii) The Indian Roads Congress is a Sustaining Member of the Indian Standards Institution and maintains close liaison with the activities of the Institution through representatives nominated to serve on their Councils and Committees dealing with subjects which have a bearing on Roads.

Shri K. S. Raghavachary has been nominated to serve as the representative of the Indian Roads Congress on the Engineering Division Council of the Indian Standards Institution for a further period of three years from the 1st April 1950. The other representatives of the Congress on the various Sectional Committees of that Institution are:

EDC: 2 Cement—Shri E. P. Nicolaides.

EDC: 20 Drawing—Shri K. S. Raghavachary.

EDC: 22 Bitumen & Tar Products—Shri K. K. Nambiar.
Shri Brijmohan Lal.

The following are the Principal and Alternative representatives of the Indian Roads Congress on the Road Tar Subcommittee of the Indian Standards Institution:

Principal representative Shri R. N. Chatterjee.

Alternative representative Shri G. C. Khanna.

14. TECHNICAL ACTIVITIES OF THE CONGRESS.

(i) Specifications and Standards Committee.

The Committee met at Bombay during the Indian Roads Congress Session and discussed the following subjects:

(a) Standard Abbreviations.

(b) Glossary of Highway Engineering Terms.

(c) Road-Rail Level Crossings.

The script of inscription on milestones was discussed at the Chief Engineers' meeting at Bombay and a note incorporating the recommendations of the Chief Engineers will be published in the Indian Roads Congress Journal in due course.

The Committee presented a "Standards for Sight Distances for Highways" which has been published as a Paper in Volume XV-part 1 of the Indian Roads Congress Journal. This Paper will be discussed at the forthcoming Session at Calcutta.

The progress in evolving "Standard Abbreviations" mentioned in this Report last year, has been comparatively slow as this subject is to be considered in collaboration with the Indian Standards Institution who are also interested in this subject.

The comments of the Railway Board on the note on road-rail level crossings, which was circulated to the Members of the Committee at the Ranchi Session, are still awaited.

A draft Paper on "Vertical Curves" is proposed to be discussed by the Committee during the meeting at Calcutta in February 1951.

(ii) Bridges Committee.

The Committee met at Bombay during the Indian Roads Congress Session in January, 1950 and discussed amendments to sections II and III of the Bridge Code.

Among other matters, the Committee proposes to discuss at Calcutta (i) the permissible stresses on various kinds of masonry in bridge works, (ii) a rational method for specifying safe bearing pressures on different types of subsoil, (iii) the methods of testing bridge structures.

It is hoped that draft Section III of the Standard Specifications and Code of Practice for Road Bridges in India dealing with Reinforced Concrete will be published as a Paper for discussion at the Sixteenth Session of the Indian Roads Congress.

(iii) Technical Committee.

(a) Test Track Division.

The Subcommittee met at Bombay during the Session in January, 1950 and drew up a programme of tests to be carried out at the Road Test Track as there was no likelihood of the track being closed before January, 1953. The lease of the land on which the test track is laid has been extended to January 1953.

A meeting of the Subcommittee was again held on the 11th April, 1950 at Calcutta and discussed among other matters the details for the "1949 series" of tests. These tests are now being carried out to ascertain the performance and economy of different kinds of foundations for roads. The tests are expected to be completed shortly.

(b) Research Organization Division.

As recommended by the Indian Roads Congress, the Government of India have established a Central Road Research Institute at Okhla (Delhi) with Dr. Ernst Zipkes, an eminent Research Engineer, as Director. The foundation stone of the Institute was laid on the 6th September, 1950 by the Hon'ble Shri N. Gopalswamy Ayyangar, Minister for Railways and Transport, Government of India.

The Research Organization Division propose to hold a meeting at Calcutta during the Session of the Indian Roads Congress where they propose to discuss the programme of research to be carried out at the Central Road Research Institute during the year 1951.

(iv) Road Transport Subcommittee.

In an interim report this Subcommittee made certain suggestions on the regulation of motor transport and the removal of restrictions on goods transport by road. These subjects were afterwards examined by the Motor Vehicle Taxation Enquiry Committee appointed by the Government of India in May 1950. The Committee have since submitted their report to the Government of India. The report will be discussed by the Chief Engineers of the States during the Calcutta Session of the Congress.

(v) Bullock-cart Subcommittee.

This subcommittee has for some time been considering the subject of evolving an improved design for bullock-cart wheels so as to increase the pay load on the carts without increasing the tractive effort and at the same time to decrease the destructive effects of the bullock-cart wheels on the roads.

Long research has been carried out by the Subcommittee and a final report on the tests is embodied in two Papers on "A Design for Bullock-cart Wheels parts IV & V" published in Volume XV-parts 1 and 2 of the Journal of the Indian Roads Congress. These Papers will be discussed during the Session at Calcutta.

Some field tests on various designs of improved types of bullock-cart wheels are now proposed to be carried out in the Central Road Research Institute.

(vi) Soil Research Subcommittee.

As the performance of stretches of soil stabilized roads surface-dressed with tar, but without any primer, gave encouraging results, the Soil Research Subcommittee in its meeting held on the 17th January 1950, agreed that further tests on this method of treatment should be carried out on a total length of about 4 to 5 miles of road in the Punjab and Madras, at an estimated cost of Rs 20,000 per mile. The Executive Committee accepted the recommendations and the Government of India have been requested to provide a sum of Rupees one lakh for the proposed experiments.

The Executive Committee considered the recommendations of the Subcommittee for providing a test track for slow speed testing of soil surfaces and decided to defer consideration of this proposal, till the Convenor, Shri S. R. Mehra, returned from his trip to Europe and the U. S. A., and furnished details of a design for the proposed test track which he had promised to do.

Certain recommendations made by the Subcommittee regarding the selection of personnel for training in soil stabilization were forwarded to the Government of India for necessary action when any fresh schemes for training engineering and scientific personnel were taken up.

The Government of India have been requested to arrange to obtain periodical progress reports of the various soil research laboratories for publication either in the I. R. C. Journal or as bulletins; this would be a great help in co-ordinating the activities of various laboratories.

They have also been requested to arrange for the collection of data of typical soils all over India by dividing up areas between the various laboratories working in India at present and to collate and co-ordinate the data for publication.

(vii) Education Subcommittee.

The Subcommittee has recommended that post-graduate training courses in engineering should be provided in India. Such courses should be open only to men of five years experience or more who have an aptitude for study and research. The candidates should be selected by the Chief Engineers of States.

The Subcommittee has also recommended that specialized training in highway engineering to young engineers should be imparted by the various administrations employing them, that research studies should be secured by attaching engineers to various research institutions when set up, and that the Director of the Central Road Research Institute be requested through the Government of India to organize lecture courses in highway engineering for officers nominated by the States.

These recommendations of the Subcommittee which were accepted by the Executive Committee of the Indian Roads Congress in their meeting held at New Delhi on the 29th September, 1950 have been forwarded to the Government of India for necessary action.

(viii) Bituminous Treatment of Wet Aggregates Subcommittee.

This Subcommittee is investigating methods designed to render the bituminous treatment of wet aggregates both feasible and effective under Indian climatic conditions. On their recommendation, many State Governments have already carried out experiments in accordance with the specifications supplied by various interests dealing in bitumen and tar products.

The reports received showed favourable results. All State Governments have therefore been asked to use wet aggregates under specified conditions. Further research continues. The results together with the recommended specifications have been published in the Indian Roads Congress Journal, Volume XIV-part 3.

(ix) Highway Layout Subcommittee.

The Subcommittee held a meeting at Bombay during the Indian Roads Congress Session. They did not consider it necessary to pursue the matter of seeking representation on Committees considering or likely to consider the master plan for Greater Delhi.

The Executive Committee in their meeting held on the 29th September, 1950 decided that the question of seeking representation on Committees considering similar plans in other important cities in India may also be dropped.

The recommendation of the Subcommittee that the Government of India should be requested to spare one officer for the preparation of a skeleton code for Highway Layout (Architectural)

was considered by the Executive Committee who decided that the Committee should be asked to prepare the code from within their own resources as the Government of India were not likely to spare an officer for this purpose.

(x) Provincialization of Local Bodies Engineering Services Subcommittee.

As the Convenor did not propose the names of any Members to constitute this Subcommittee, it remained dormant throughout the year.

(xi) Papers Subcommittee.

This Committee held its meeting at Bombay in January, 1950 and decided the award of Medals for the Papers received and discussed at the 12th and 13th Sessions.

A meeting of this Subcommittee is proposed to be held at Calcutta to decide the award of Medals for Papers presented at the 14th Session.

Eighteen Papers were received during the year but only eight were accepted. Five Papers, received late, have been kept pending for consideration after the forthcoming Session.

(xii) Manufacture of Road Making Machinery and Mechanization Subcommittee.

As decided by the Subcommittee at its meeting held at Bombay in January, 1950, the Convenor addressed the State Governments, the Engineer-in-Chief's Branch, and the Agriculture Departments of States to give their annual requirements of certain types of **earth moving machinery and auxiliary equipment** required both in road making and for agricultural purposes.

He also addressed various firms with a view to discuss the difficulties met with in the manufacture of certain types of road making machinery with a view to finding means to overcoming these difficulties.

A number of firms assured him that they were in a position to increase their present production of tar boilers, sprayers, and mortar mills provided the State Governments, placed firm orders with them and at the same time prohibited the import of similar machinery from abroad. As regards concrete and asphalt mixers, manufacturing firms generally complained of a shortage of diesel engines and of suitable steel alloys. Though the matter is being pursued with the firms, full details of their requirements of diesel

engines and steel and their manufacturing capacity have not so far been received.

It appears that the total demand for stone crushers is only 135 for the quinquennium 1951-55. This demand is too meagre to justify the setting up of a manufacturing industry in India at present for these machines. It is thought that the demand will be greater in the near future and the matter is still under investigation.

(xiii) Organization Committee.

At the 33rd Council meeting held at Ranchi in February, 1949 an Organization Committee was appointed to examine the question of re-organizing highway departments of the States and to submit its recommendations to the Council.

The Chief Engineers in their meeting held at Bombay during the Indian Roads Congress Session in January 1950 were of the view that this was not an opportune time to suggest any changes in the P. W. D. organizations of the States. It was, therefore, proposed to the members of the Organization Committee that this Committee might be kept in abeyance unless any members of the Committee had any further proposals to make. As desired by the majority of the members, the Committee was kept in abeyance.

15. MISCELLANEOUS.

(i) Maintenance of Earth Roads.

As desired by the Council in their meeting held at Ranchi in February, 1949, details of the practices adopted regarding the maintenance of earth roads are being collected from the States. As desired by the Executive Committee the literature will be passed on to the Soil Research Subcommittee for studying these details and for drawing up draft specifications to suit varying conditions of climate, soil, rainfall, etc.

(ii) Engineering Colleges and Research.

The Council have decided to issue their literature free of charge to various engineering colleges in India. They have also decided to look into the examination papers of the engineering colleges and make suggestions on their suitability and the standard of the teaching as revealed by the papers. It was also decided that the Congress should prepare a list of research problems which could then be suggested for investigation by the students in the laboratories of the engineering colleges.

(iii) Suggestions in the Presidential Address.

The suggestions made by the President in his speech delivered at the Bombay Session in January, 1950, were considered by the Executive Committee in their meeting held on the 29th September, 1950. Among other suggestions, it was recommended that the Government of India should take early steps for the establishment of non-lapsing funds for highways in the Central budget as well as in the various States. The Government of India were again requested to establish an independent Road Board to co-ordinate road development activities in the country. The President also made some suggestions about the ways and means of financing road projects. The various suggestions made by the President in his Address have been forwarded to the Government of India for necessary action.

Minutes of the 37th Council Meeting of the

INDIAN ROADS CONGRESS

held at Calcutta on the 21st February, 1951.

The meeting began with Shri A. C. Mukerjee in the Chair.

Present:

F. P. Antia	K. K. Nambiar
R. K. Batra	N. C. Patel
C. M. Bennett	F. B. Pigott
K. G. Bhate	V. N. Rangaswami
S. N. Chakravarti	R. C. Roy
G. N. Dutt	M. L. Saberi Yousuf
C. J. Fiedler	D. C. Sharma
Kishore Lal Mathur	J. P. Singh
M. Meeran	N. K. Sinha
C. P. Misra	M. S. Thirumala Iyengar
A. C. Mukerjee	J. M. Trehan—Secretary

The following Co-opted Members attended:

W. B. Bakewell	S. B. Joshi
H. S. Batliwala	G. M. McKelvie
S. K. Ghosh	T. Mitra
W. A. Griffiths	K. S. Raghavachary

The following attended by invitation:

M. S. Bisht	G. Srirangachary
G. B. Nangun	B. V. Vagh
B. N. Shenoy	E. Zipkes

Item 1. Confirmation of the Minutes of the 36th Council Meeting.

The Minutes of the 36th Council Meeting held at Calcutta on the 17th February, 1951 were confirmed.

Item 2. Office Bearers.

The following were elected to hold office till the next General Session:—

President	... G. M. McKelvie
Vice Presidents	... C. M. Bennett
	... T. Mitra
	... E. A. Nadirshah
Honorary Secretary	... J. M. Trehan

At this stage, the newly elected President, Mr. G. M. McKelvie took the Chair.

Item 3. Venue of the next General Session.

The Executive Committee was authorized to fix the venue and date of the next Session of the Indian Roads Congress.

THIRTY-SEVENTH MEETING OF THE COUNCIL

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Item 4. Committees and Subcommittees.

The Bullock-cart Subcommittee which had completed most of its work was dissolved. The Convenors of the remaining Committees and Subcommittees were appointed as under:—

- (i) Specifications & Standards Committee ... G. M. McKelvie
- (ii) Bridges Committee ... H. P. Mathrani
- (iii) Technical Committee:
 - (1) Test Track Division ... T. Mitra
 - (2) Research Organization Division ... K. S. Raghavachary
- (iv) Road Transport Subcommittee ... F. P. Antia
- (v) Soil Research Subcommittee ... K. S. Raghavachary
- (vi) Education Subcommittee ... V. N. Rangaswami
- (vii) Bituminous Treatment of Wet Aggregates Subcommittee ... W. A. Griffiths
- (viii) Highway Layout Subcommittee ... H. S. Batliwala
- (ix) Provincialization of Local Bodies Engineering Services Subcommittee ... N. K. Sinha
- (x) Papers Subcommittee ... G. M. McKelvie
- (xi) Manufacture of Road-Making Machinery & Mechanization Subcommittee ... H. P. Mathrani
- (xii) Organization Committee ... G. M. McKelvie

The following additions were made to the personnel of the Committees named:—

Bridges Committee	... K. C. Ray
Test Track Division	... { G. M. McKelvie P. K. Chatterjee W. B. Bakewell

Item 5. The Convenors of the Highway Layout and Road Transport Subcommittees gave accounts on the work done by their Committees in the course of the year. The Member-Secretary of the Bridges Committee also gave an account of the progress made in the compilation of the various sections of the Standard Specifications & Code of Practice for Road Bridges in India.

**Tour notes of the
FIFTEENTH INDIAN ROADS CONGRESS**

Calcutta, February 1951.

I. TEST TRACK AT MAJHERHAT

The Road Test Track at Alipore which started functioning in 1939 was visited by the delegates on 21. 2. 51. (The Test Track has been described in detail in Road Research Bulletin No. 1).

The general layout of the test track together with information on the series of tests now in progress is shown in Plate 1. These tests are being conducted—

- (i) to assess the relative performance of different types of base courses commonly in use in West Bengal, and
- (ii) to find out whether any reduction in the base courses could be effected by introducing soil stabilised courses to different specifications over clay embankments 3 ft high, in water-logged areas (like West Bengal) where the water table is sometimes about 1½ to 2 ft below the road level.

Some water level indicators made of 1½ in. diameter pipes, with wire gauze protection at the bottom, were sunk at different test sections for observing the subsoil water level.

Initial ironing out of the road surface consisted of one thousand trips made with a gross loading of 500 lb per inch-width of tyre for the steel-tyred cart and 1500 lb per wheel for pneumatic-tyred carts.

The actual tests were carried out by increasing the load intensities to double the above figures for the respective tests.

The first test had to be discontinued after only three days because the brick metal of the wearing coat got powdered and the level of water in the side drain was found to be much lower than the specified level. The monsoon was yet to arrive.

The test was again started when the water table in the side drain came up very close to the road level after the monsoon had set in. But, within a few hours of starting, it was found that the curved portion laid with brick metal macadam was being badly damaged. The wearing coat was so much affected in some places that the traffic was riding directly over the stabilised soil base course. The test had to be again suspended at this stage.

Careful investigation was made by cutting trenches in the worst affected portions but no detrimental deformation could be found in the stabilised base and sub-base courses.

No exact conclusion could be arrived at from these observations as, owing to the excessive load on the steel-tyred cart there was lateral displacement of the brick metal of the wearing coat, specially at the curved portions.

It was then decided to protect the wearing coat in such a way that it might not fail previous to the failure of the base courses.

The brick metalled water bound macadam coat was therefore picked up to a depth of 1½ in. and reconsolidated to 3½ in. thickness in place of original four inches. A bitumen carpet using various kinds of binder with brick aggregate was then laid to a thickness of two inches over this water bound macadam coat.

Tests have been in progress from the 16th December 1950 on these newly laid surfaces.

II. STRAND ROAD, CALCUTTA

Tarcrete with Brick Aggregate, Consolidated Thickness 2 in.

In view of the shortage and high cost of stone metal in West Bengal, experiments were carried out with the object of determining whether brick aggregate could be successfully used in tarcrete.

Following hopeful laboratory tests, field tests were undertaken by the P. W. D. on a public road carrying mixed traffic. The Strand Road was selected as it carried heavy traffic of all types and a strip on one side of the road was indicated as most suitable for the test as bullock-carts usually kept to that side of the road.

Date of treatment - November 1949.

Area treated - 760 ft by 15 ft = 11,400 sq. ft.

Existing base - Old bituminous macadam.

Specification :

Materials for 100 sq. ft.

- (i) Mixed broken brick aggregate 2 in.—1 in. 16 cu. ft.
- (ii) Medium coarse sand 9 cu. ft.
- (iii) High Viscosity Road Tar @ 6 lb per cu. ft. of brick aggregate and @ 5 lb per cu. ft. of sand 141 lb.

Preparatory Work: The old bituminous carpet at the top was removed to expose the stone macadam base. The exposed base was cleaned and the experimental carpet laid.

Construction: The materials mentioned were premixed in a mechanical mixer, laid to the correct cross-slope, and consolidated with a 10-ton roller.

Performance: The surface was kept unsealed for 14 months and was found to be in good condition on the day of inspection.

It would appear that this type of treatment, using brick aggregate, is capable of providing a surface capable of carrying heavy traffic, including a good proportion of laden bullock-carts, without undue signs of wear.

III. QUEENSWAY, CALCUTTA

Wet Sand Tar Carpet, Consolidated Thickness 2 in.

Several experimental lengths of sand carpets have been laid in Bengal during the last few years. From the experience gained, a specification was finally evolved which has been followed in resurfacing the portion of Queensway inspected by the delegates.

The specification was based on the use of wet sand incorporating lime as it was found that the initial setting took place more quickly than when dry sand alone was used.

Date of treatment—March-April 1950.

Area treated—143,417 sq. ft.

Base—Old water bound macadam with brick aggregate, surface painted with road oils.

Average consolidated thickness — $\frac{3}{4}$ in.

Specification :

Materials for 100 sq. ft.

(i) Road Tar No. 3A in tack coat	10 lb
(ii) Medium coarse sand	8 cu. ft
(iii) Road Tar No. 3-A for premixing sand at $7\frac{1}{2}$ lb per cu. ft.	60 lb

Preparatory work : Where the painted surface was flaking, it was peeled off. Potholes were repaired with premixed chipping and the surface cleaned.

Construction : The materials mentioned above were premixed in a mechanical mixer, laid to correct slope, and consolidated with a 10-ton roller.

A seal coat consisting of 10 lb of Road Tar No. 3A blended with $1\frac{1}{2}$ cu. ft of dry sand was applied 15 days after the carpet was laid.

The condition on the day of inspection was very good.

IV. ASPHALTUM PLANT OF THE CALCUTTA CORPORATION

1. The Corporation had two mixing plants, with capacity for producing, in a day of 10 hours, sufficient asphaltic or tar concrete mixtures to cover about 1200 sq. yd. of two inches thick pavement. The average output was about 7 tons per hour of asphaltic or tar concrete mixture from each plant when the moisture content of the undried materials was about 8.5 per cent and the temperature was raised to not more than 400 deg. F.

2. The different operations which took place in the mixing plant might be summarised as follows :

A drum with a fire box was placed in an iron chamber so that the hot gases entering the drum came into contact with the mineral aggregate and then passed into the chimney. The operation was regulated by a centrifugal fan placed over the chamber, forcing a draught through the fire-bars. The aggregate shot out of the drum at the requisite temperature was raised by an elevator into a screen box, where it was screened into three sizes and collected in three different compartments of the bin. It was then weighed in a weighing scale in predetermined proportions and charged into the mixing box.

After the aggregate had been placed in the mixing box, the mineral filler was added to the hot aggregate. Then the whole contents were thoroughly mixed in a twin-pug mixer and the required quantity of hot asphalt or road tar, measured by actual weighing was added. The mixing was continued until all particles of the mineral aggregates were uniformly coated. The mixture was then carried to different parts of the city where it was needed.

3. The materials generally used as aggregate were stone chips of different sizes, up to one inch, crushed from Pakur stone and slag chips from blast furnace slag. The sand used was coarse sand free from dust and foreign matter.

The binders used were asphalt, (30—40 penetration) and high viscosity road tar (H.V.R.T.). The types of binder used for painting and sealing were asphalt (80-100 penetration) and medium viscosity road tar (M.V.R.T.).

4. For the production of stone chips, there were five stationary crushers, three being 20 in. by 7 in. granulators. Besides these granulators, there was one 20 in. portable granulator driven by a vertical diesel oil engine attached to it, used particularly for crushing at site metal recovered from the roads.

Each of the granulators had an average capacity of 100 to 125 cu. ft. of stone chips per hour except one stone crusher, which had an average capacity of 40 to 50 cu. ft. of chips per hour.

There was a disintegrator, with a capacity of about 3 to 4 cwt. per hour, for producing fillers.

5. Twenty motor lorries (13 heavy and 7 light) worked for the plant, 18 were usually on duty, the remaining two being stand-bys.

6. There were altogether 20 portable asphalt or tar heaters, seven of 320 gallons capacity each, and thirteen of 250 gallons capacity each.

Besides the plant described above, there were two super-heaters for melting old asphalt pavements forming into waves, a portable concrete mixer with a $1\frac{1}{2}$ B.H.P. petrol engine, an air compressor with a 3 B.H.P. petrol engine for spraying bitumen on the road, a portable revolving screen, another tar spraying machine of 1,000 gallons capacity, and some drag spreaders for spreading chips or premix on the road surface.

V. BELGACHIA BRIDGE

(Under Construction)

The steel over-bridge on the Jessore Road over the Chitpore Railway Yard at Belgachia had become inadequate for the needs of modern road traffic. Moreover, the condition of the steel bridge had deteriorated and it was proposed by the railway authorities to replace this bridge. Advantage was taken of this fact to design a road bridge to satisfy modern specifications as regards width of carriageway and load capacity. The old bridge had a carriageway of 22 ft and two very narrow footpaths or safety kerbs.

The new bridge was designed to have a road width of 42 ft to cater for four lanes of traffic in addition to 9 ft wide footpaths on either side. The bridge was designed for four lanes of Indian Roads Congress Class A loading or a single lane of Class AA loading, whichever produced the worst effect. The footpaths were designed as cantilevers with provision underneath for carrying electric cables. The bridge is at a skew of 25 deg. 30 min. with the railway lines below and has a total length of about 337 ft consisting of nine spans of 34 ft $3\frac{1}{2}$ in. each and two end spans of 24 ft $3\frac{1}{2}$ in. each (the measurements being along the skew).

Owing to the considerable vibration caused by railway traffic, a slight settlement of foundations was considered possible, even with pile foundations, and a balanced cantilever type of design was therefore adopted so that the stresses should remain unaffected even in the case of some settlement of the foundations. The structure is of solid slab construction, the thickness being 1 ft 6 in., except at the support where the thickness had been increased to 2 ft 6 in. by introducing straight haunches near the piers.

The 1 ft 3 in. thick reinforced concrete piers supporting the deck slab rest on Franki pile foundations driven to a depth of 60 to 65 ft. Each pile was designed for a load of 70 tons. Some of the piles were tested with a load of 105 tons on each and an initial set of $3/64$ in. was observed under this load but there was no permanent set. The approaches on either side had also to be widened to the full width of the bridge and, owing to anticipated traffic difficulties and the high cost of land acquisition in this congested area, the embankments in the widened portions were designed to be retained by reinforced concrete retaining walls.

The design adopted for this bridge is simple but construction was rather difficult owing to the restrictions imposed with respect to the clearances that had to be maintained for the railway traffic during construction. The road traffic over the existing bridge had also to be maintained uninterrupted during construction.

VI. STATE TRANSPORT GARAGES AND CENTRAL WORKSHOPS AT BELGHURRIA

On the nationalization of transport in West Bengal, adequate facilities for repairing and servicing vehicles had to be provided and two depots for 115 buses each were ordered to be constructed at Belghurria and Tollygunge. Each depot was designed to be completely self-sufficient as regards administration and maintenance.

A central workshop has also been opened at Belghurria to provide for repairs of the vehicles including complete overhauling body-building, etc.

Construction was started in February 1949, and was expected to be completed by March 1951.

The garages were designed according to the latest London Transport specification. Proper pressure fuelling, wash, and servicing bays have been constructed. A Central communicating pit has been constructed for quick repairs. Modern lighting arrangements have been made to facilitate night working as the buses will only be free for servicing at night.

Approximate Costs :

1. Structures :

- (a) Central Workshops — Rs 25 lakhs
- (b) Garages — Rs 13 lakhs for each depot

2. Equipment :

- (a) For Central Workshops Rs 8 lakhs
- (b) For Garages — Rs 1 lakh for each depot

VII. TARCRETE CARPET WITH JHAMA AGGREGATE ON THE MUSLANDPUR—HABRA ROAD (in progress.)

The surface of the water bound macadam road was cleaned to the usual specifications and prepared to receive the carpet.

Four cu. ft graded jhama metal, $1\frac{1}{2}$ in. by 1 in. size, was mixed for $1\frac{1}{2}$ minutes in a mechanical mixer with 24 lb of high viscosity road tar (H.V.R.T.), heated to a temperature of 250 deg. F. and two cu. ft dry sand was then added and the machine worked until the sand adhered to the premixed metal. Seven pounds of tar (H.V.R.T.) heated to 250 deg. F. was then added and the mixing continued until a complete coating of aggregates was achieved.

The premixed metal was spread to an average thickness of $2\frac{1}{2}$ in. to the correct camber and grade and rolled with a 10-ton power roller. Any unevenness of surface which showed up after the initial rolling was rectified with premixed sand (7 lb of H.V.R.T. per cu. ft of sand). The surface was then finally rolled.

Analysis for 100 sq. ft.

Jhama metal 16 cu. ft @ Rs 58 per 100 cu. ft	9	4	0
H.V.R.T. 156 lb @ Rs 240 per ton	14	9	0
Labour & Sand @ Rs 9/8/- per 100 sq. ft	9	8	0
	Rs 33	5	0

Say Rs 34 per 100 sq. ft.
or Rs 21,542 per mile of
12 ft wide carpet.

VIII. GAIGHATA BRIDGE ON THE YAMUNA*

General :—The bridge was built to replace a rickety pontoon bridge with sharp curves in the approaches. The new bridge is at a skew of 27 deg., the approaches having been straightened out.

Waterway :—The river branches out from the Bhagirathi and was previously one of its main channels. Owing to partial blocking up at its mouth, the discharge from the Yamuna is now much less than before but there is a likelihood that the old discharge will be regained on completion of certain development schemes contemplated by the Irrigation and Waterways Department of the West Bengal Government. This point was kept in view in fixing the waterway which now closely conforms to the waterway provided in the railway bridge about five miles downstream.

Width and Loading :—The bridge provides for a 22 ft wide roadway with 3 ft footpaths or "Safety Kerbs" on either side, and was designed for two lanes of Indian Roads Congress Class A loading or a single lane of Class AA loading. A crowd load of 84 lb per sq. ft on the footpath is allowed for in the design.

Brief Details :—The bridge is of the cantilever type, utilizing solid reinforced concrete slabs for the cantilevers. There are two anchor spans of 40 ft each with cantilever arms 36 ft long projecting into the main central opening of 90 ft and supporting a suspended span of 18 ft. The piers and abutments rest on brick wells reinforced with R. C. columns and bands. The wells have three chambers each, with octagonal ends, and taper towards the top to reduce frictional resistance during sinking. The piers are brick in cement stiffened with reinforced concrete columns and

* A deltaic branch of the Ganga; different from the Yamuna which joins the Ganga near Allahabad.

bands. The abutments are of reinforced concrete with counter-forts. The wing walls are of brick in cement.

Special Features :—The special feature of the bridge is the adoption of solid slabs for the cantilevered portions. In order to reduce the dead load, the thickness of the slab has been kept low by designing for a compressive stress of 1365 lb per sq. in. (in bending) in the cement concrete. A minimum strength of 4500 lb per sq. in. at 28 days on cylindrical specimens, 6 in. diameter and 12 in. high, was specified. The depth of the structural slab is one foot eight inches at the abutments, four feet five inches at the piers and only one foot one inch at the centre of the bridge. The adoption of the slab type of construction reduced the cost of shuttering and made it possible to keep the formation level low.

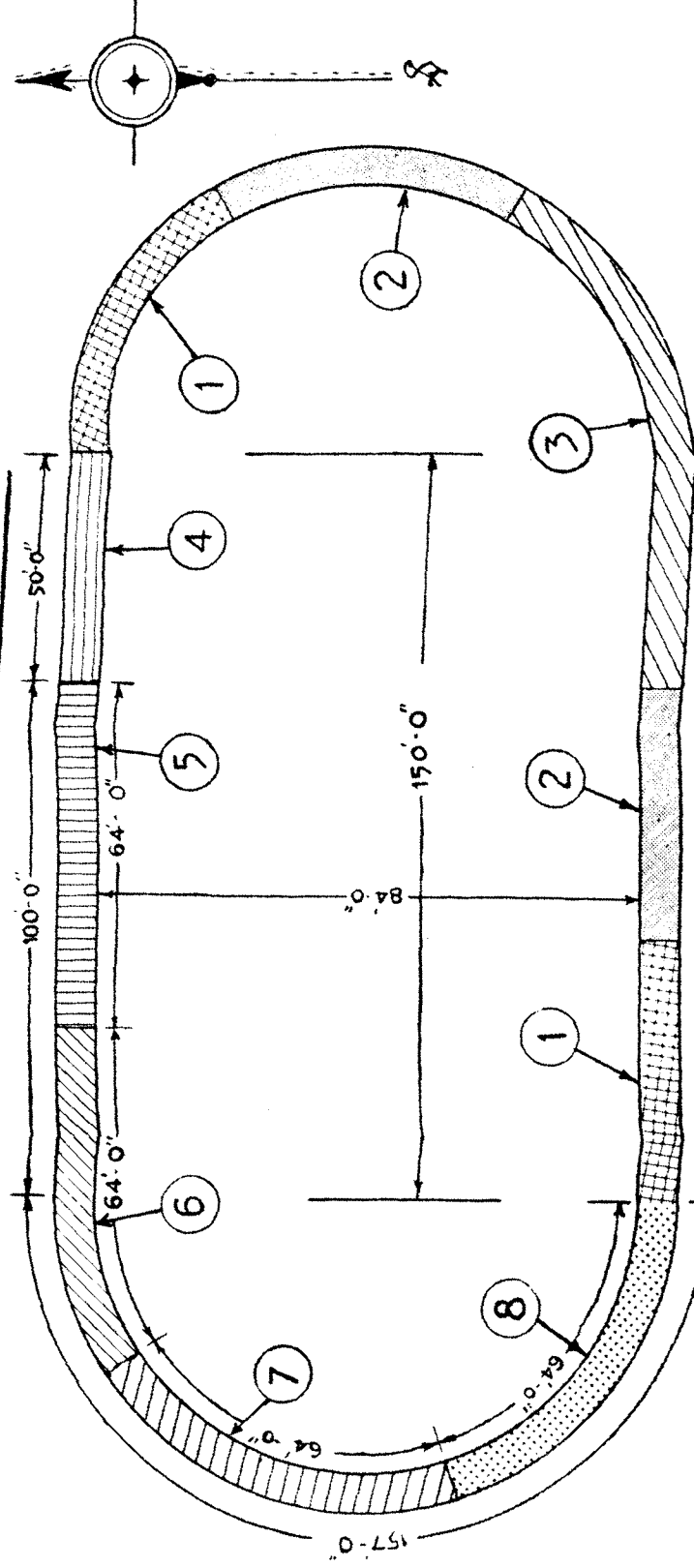
Cost :—The approximate cost of the bridge including the new approaches will be about Rs 6,33,000.

IX. BENGAL CHEMICAL & PHARMACEUTICAL WORKS AT PANIHATI

In addition to road tar, this factory at Panihati manufactures heavy chemicals, acids, tar products, ether, soap, and surgical dressings, etc. The delegates were shown all the processes.

PLATE I

TESTS FOR 1949-50



GOVT. ROAD TEST TRACK AT MAJHERHAT, CALCUTTA

LEGEND:-

MACADAM 4 IN: THICK (PAKUR STONE) OVER BASE COURSE OF

- ① 6 IN: THICK BOULDERS & 3 IN: MOORUM - - - -
- ② 6 IN: LATERITE & 3 IN: MOORUM - - - -
- ③ 9 IN: MOORUM - - - -
- ④ EXISTING BASE COURSE - - - -

MACADAM 4 IN: THICK (JHAMA BALLAST) OVER BASE COURSE &

SUBGRADE OF

- ⑤ (i) 2 FT. CLAY WITH TOP 1 FT. CONSISTING OF SOIL STABILISED WITH SAND & CLAY IN 2 LAYERS, TOP 4 IN: 1 CLAY: 2 SAND: BOTTOM 8 IN: 1 CLAY: 1 SAND.
- (ii) ONE LAYER OF BRICK FLAT SOLING - - - -

- ⑥ (i) 2 FT. CLAY WITH TOP 1'-2" CONSISTING OF SOIL STABILISED WITH SAND & CLAY IN 2 LAYERS, TOP 6 IN: 1 CLAY: 3 SAND: BOTTOM 8 IN: 1 CLAY: 1 SAND

- ⑦ (i) 2 FT. CLAY WITH TOP 1 FT. CONSISTING OF SOIL STABILISED IN TWO LAYERS, TOP 4 IN: 1 CLAY: 2 SAND: 1 AGGREGATE, BOTTOM 8 IN: 1 CLAY: 1 SAND.

- ⑧ (i) 3 FT. CLAY FILLING
- (ii) 2 LAYERS FLAT BRICK SOLING

**Fifteenth Session of the
INDIAN ROADS CONGRESS**

Technical Exhibition, Calcutta, February, 1951.

Thanks to the enthusiasm of the Local Organizing Secretary (Shri S. K. Ghosh) and the encouragement given by his Chief Engineer, the Indian Roads Congress Exhibition this year was on a much bigger scale than in the past. The venue of the Session—CALCUTTA—was perhaps a big factor in making the Exhibition the success it was. In a smaller place it might have been impossible to assemble so much plant and machinery as was on view at Calcutta.

The Exhibition aroused great popular interest and many schools brought their students to see the machines, the scale models of bridges, drawings and drawing instruments, safety—first stalls, and so on. The exhibition was both instructive and interesting for the engineer and laymen alike. Every stall had an individuality and there was sustained interest throughout for the spectator.

The Exhibition was declared open by the Hon'ble Shri Bima Chandra Sinha, Minister for Works and Buildings, West Bengal, on the 18th February, 1951 at 5-30 p.m. The Minister then visited every stall.

The following organizations took part in the Exhibition. Brief particulars of some of the exhibits are recorded below :—

1. Government of India : Roads Organization.

- (a) *Statistics*: Statistical charts and Graphical presentation of data of road accidents, etc. "Basic Road Statistics".
- (b) *Standards*: Nomograms; Pocket Discs of Curve Standards; Standards on Land widths, etc., and type plans of improvements to road junctions.
- (c) *General*: Charts entitled "Roads for Tomorrow" as programmed in the Nagpur Plan.

2. West Bengal.

Scale models of three bridges and of the Gandhi Ghat.

Map of West Bengal showing road development plan; map showing sources of road construction materials; samples of materials.

Architectural plans of projected buildings; models of Improvement schemes by the Calcutta Improvement Trust.

3. Bombay.

Forty-nine photographs of various bridge works in progress together with their details.

4. Orissa.

Road plan of Orissa: photographs of bridges and roads.

5. Punjab. (I).

Exhibits from the Soil Research Laboratory, Karnal.

Charts explaining mechanical analysis of soils, optimum moisture, shrinkage, moisture-density relationship, etc.

Charts describing stages of construction of stabilised soil roads and costs of different types of roads, etc.

Samples of different types of Indian soils.

Models of stabilised-soil roads, unsurfaced, surfaced, base courses, Crust samples from roads subjected to traffic for five years.

Soil-cement charts and test blocks.

6. Madras.

Models of stabilized soil roads painted and unpainted. Soil testing apparatus, photographs, charts, etc.

A booklet was distributed among interested visitors giving details of experiments carried out in Madras, the Specifications adopted, the apparatus used, and the cost of the experiments.

7. Madhya Bharat.

Road Map

8. Bihar.

Model of a proposed Bridge over the Ganga at Patna, photos of roads and bridges in Bihar.

9. Saurashtra.

Plans for Road Schemes showing existing and proposed roads: a model of R. C. C. Bow-String Girder Bridge over River Orat on Rajkot Veranal road State Highways.

Others.

The following exhibitors presented interesting displays:—

Public Bodies Institutions, etc.

- (i) Eighth Bengal Engineering Platoon of the National Cadet Corps. Models provided by the College of Engineering, Jadavpur.
- (ii) Bengal Engineering College, Sibpore.
- (iii) The River Research Institute of West Bengal.

- (iv) Mathematical Instruments Office, Government of India, Calcutta.
- (v) The Safety First Association of India, Calcutta.
- (vi) Corporation of Calcutta.
- (vii) Calcutta Improvement Trust.
- (viii) M/s. Automobile Association of Bengal, Calcutta.

Firms :

- M/s. Alsales Ltd., Calcutta.
- M/s. Arco Pump Corporation, Calcutta.
- M/s. Armco (India) Ltd., Calcutta.
- M/s. Associated Instrument Manufacturers (I) Ltd., Calcutta.
- M/s. Associated Exports Imports Corporation, Calcutta.
- M/s. Bengal Chemical and Pharmaceutical works Ltd., Calcutta.
- M/s. Bitumen Emulsions (I), Calcutta.
- M/s. Blackstone Products, Ltd., Calcutta.
- M/s. Calcutta Collapsible Gate Co.
- M/s. B. N. Chatterjee & Sons, Calcutta.
- M/s. Concrete Association of India Ltd., Calcutta.
- M/s. Concrete Construction Co., Calcutta.
- M/s. Dunlop Rubber Co., Calcutta.
- M/s. East End (India) Ltd., Calcutta.
- M/s. General Electric Co. (I) Ltd., Calcutta.
- M/s. Good Year Tyre & Rubber Co., of India, Calcutta.
- M/s. Govind Sheet Metal Works & Foundry, Calcutta.
- M/s. Heatly & Gresham Ltd., Calcutta.
- M/s. Jessop & Co., Ltd., Calcutta.
- M/s. Macadam (I), Ltd., Calcutta.
- M/s. Marshall Sons, Ltd., Calcutta.
- M/s. Mousell & Co., Ltd., Calcutta.
- M/s. Phillips Electrical Co., (I), Ltd., Calcutta.
- M/s. Phillips & Roy, Calcutta.
- M/s. Shalimar Tar Products, Calcutta.
- M/s. Tractors (I), Ltd., Calcutta.
- M/s. Unit Construction Co., Calcutta.
- M/s. U. P. Commercial Corporation, Calcutta.
- M/s. Western Manufacturing Co., Bombay.
- M/s. William Jacks & Co., Calcutta.

Displayed catalogues, charts, photos, models and in most cases actual machinery for the construction of drainage, roads and bridges, latest surveying and mathematical instruments, testing machines, etc.

The response had so far been small and it was now generally appreciated that pneumatic tyres for bullock carts would not come into general use at their present prices except perhaps in urban areas. The bulk of carts continued to be built as before. The *ad hoc* Committee of experts on Inland Transport of the Economic Commission for Asia and the Far East which met at Bangkok from the 24th October to the 4th November 1950 appeared to have accepted somewhat the same view since they had recorded their aims on this subject as follows:—

- (i) To improve the existing country cart by suitable alterations in the design of the existing wheel and axle, and
- (ii) To encourage conversion to pneumatic equipment of the carts belonging to professional carters as it was this class that constantly used made-up roads and caused the greatest damage.

As cart transport was diffused in the hands of small cart owners, a pneumatic tyred equipment was beyond the means of a large majority of them. It appeared that nothing short of a free gift, free maintenance, and free renewals of tyres, would induce carters to go in for a wholesale change of this nature.

This raised the question whether State expenditure on such a scale for providing free equipment and free service would be justified by savings in road maintenance. The answer was not easy since, firstly there was no data on the relative wear and tear of road surfaces by steel and pneumatic tyres. Then it could not be said that all carts used all roads or that they were similarly loaded or that the damage done by them was the same in all cases. Finally, if it came to a question of the State financing the whole project, he wondered which of the two alternatives would be better:—

- (a) to build cheap roads and finance the conversion of carts; or
- (b) to build good (and expensive) roads and leave the carts as they were.

Both alternatives had difficulties and, in any case, their cost was prohibitive, since the cost of converting all carts was estimated at nearly Rs 130 crores at pre-war prices and that of providing good roads was expected to be no less formidable.

That was the reason why opinion had gradually veered round to a more practical solution viz. to try and see what, if anything, could be done to improve the present wheel in a manner which would suit the present methods of manufacture and at a cost (initial and recurring) which an average carter could afford.

This course, if found feasible, had the advantages that:—

- (i) It would not upset the age-old wheel-making industry which had been entrenched firmly in the villages and which seemed to play an important role in the village economy.
- (ii) It would make use of the materials available locally.
- (iii) It would not upset the carters who for centuries were used to a certain type of wheel.
- (iv) It would make financing easier by reducing to a minimum changes in wheel design, the cost of which, if necessary, might be conveniently borne by the State at what might easily work out to a trifle as compared to the figure of Rs 130 crores mentioned earlier.
- (v) A scheme of **improvement** as against **replacement** was more capable of execution in stages: a point of considerable importance in dealing with about 86 lacs carts scattered over the 7 lacs of villages of India.

Shri Vagh concluded by pointing out that that was the proposition which formed the basis of the investigation that had now been completed with the submission of Papers No. 148 and 151 on which discussion was invited. He was of the opinion that the part of the existing wheel which really needed improvement and scientific re-designing was the axle equipment.

Shri E. A. Nadirshah, in his written comments, said that the Author had been studying the much discussed problem of reducing road repair costs by suitable improvements in the design of the greatest enemy of road surface in India viz. the steel-tyred bullock cart wheel. The patience and originality with which this question had been handled by the Author deserved due credit from the Members of the Congress.

Continuing Shri Nadirshah said that the Author had recommended tyre widths of 3½ in. and 4 in. for minimum wheel diameters of 36 in. and 48 in. respectively. The former dimensions were for rural carts and the latter for urban carts. He requested the Author to state the kind of road surface he had in view while making these recommendations.

For calculating wear and tear the Author had used the equation

$$\frac{T_1}{0.9 T_2} W_1 = W_2$$

where W_1 = the wear caused by a tyre of width T_1

and W_2 = the wear caused by a tyre of width T_2

This appeared to give fallacious results e.g. if the wear caused by 66 in. x 4 in. tyre = .11 in.

then the wear caused by 66 in. x 4½ in. tyre = $\frac{4}{0.9 \times 4.5} \times .11 = .11$ in.

and „ „ 66 in. x 5 in. tyre = $\frac{4.5}{0.9 \times 5} \times .11 = .11$ in.

On the other hand the Author had calculated the wear to be 0.10 in. This showed that the formula required some modification.

In deriving an expression for the variation of wear and tear with the variation in the diameter of the wheel of a cart, the statement in para 2 on page 89 of the Paper that "the chord representing the projected contact area being the same for the same load in case of both the wheels" was open to objection because actually the arcs should be of the same length rather than the chords.

Concerning the comments made by the members of the bullock-cart Subcommittee, Shri Nadirshah was inclined to agree with comment No. 3 on page 146. The explanation given by the Author in para (b) of his reply held good only if the wide tyre did not sink in the sticky clay. Once both the tyres sank down, the wide tyre even if sunk to a less depth than the narrow one should require more effort to permit the rolling of the wheel. Shri Nadirshah suggested that this should be verified experimentally.

Shri R. L. Raju, whose roller wheel was one of those which were tested, pointed out in his written comments that his wheels were tested without their bearings and therefore the results of the tests published as Annexure VI of Paper No. 148 were not representative.

He also pointed out a mistake in the formula $P = \mu W + \frac{1}{2}MV^2$ (in the same Annexure) which should read $P = \mu W + \frac{1}{2}MV^2$.

Shri Raju said that it was not difficult to fix rings made from ½ in. steel plate to a wooden roller 2 ft long and 1 ft diameter if three separate rings were used instead of one of the full width. After shrinking on to the wheel the rings could be welded together.

Axles made of 1 in. diameter tool steel instead of mild steel would stand the usual load coming on bullock cart axles.

The reason for the buckling of the chassis, in his opinion, was due to the frame not being fitted properly. He also said that the width of the carts in Mysore was about 2 ft 2 in.

The roller type of wheel, which was meant for good roads and not for bad country tracks, could negotiate pot holes and could go round sharp curves easily.

Shri A. Nageswara Ayyar, in his written comments, stated that in spite of a large expenditure of time, labour, and money, progress on the design of improved bullock carts had not been appreciable. The experiments so far conducted served only to confirm the obvious—that an increase in the tyre width reduced the wear on road surfaces.

In the wheel assembly designed by Shri Ayyar and described in paragraph 35 of Paper No. 151, this conclusion had been accepted as axiomatic by him and his design accordingly provided for a broad tyre (about 4 in. wide) which would secure the maximum area of contact with the road surface, irrespective of the camber or irregularities of that surface.

A standard mild steel channel 4 in. by 2 in., which gave the same strength and stiffness as the wooden felloe strengthened by a tyre, was adopted. This reduced the weight and cost of the wheel to those of an ordinary Madras type cart wheel (with a 2 in. steel tyre) while giving a tyre twice as wide.

The hub and the dumbbell shaped bearings were so designed that the wheel was capable of taking a limited inclination in any plane without the bearings losing contact. The design had been tried on a cart in Madras for nearly two years.

The results of the tests carried out on these wheels at Poona were not satisfactory because they were damaged in transit and were badly fitted at the time of the tests. The wheels were now at the Central Road Research Institute for further tests.

Shri T. K. Macha said that this problem of the design of bullock-cart wheel had been engaging the attention of the Indian Roads Congress over a period of 16 years and the conditions under which the problem was required to be solved in 1934 were entirely different from those in 1951. He considered that bullock carts persisted simply because there were no good roads for fast moving vehicles. The villagers might use bullock carts for limited purposes but the use of carts had been greatly reduced after the adoption of buses and trucks as a means of fast transport. He therefore suggested that the wheels of a bullock cart should not be a problem to worry about; it was the development of roads which should receive attention.

Shri N. D. Daftary also commented on the disappearance of the bullock-cart. There were not as many bullock-carts about as were found in this country before the last war. There was a shortage of bullocks and tractors were replacing bullocks even for agricultural purposes. Traffic surveys carried out round about Calcutta had shown that there were hardly any bullock-carts plying on the Grand Trunk Road. He therefore thought that the bullock-cart was no longer the problem it was 15 years ago.

The **Author**, in reply to **Shri Nadirshah**, said that the recommendation about tyres was based on the relative wear and tear caused by the existing and proposed tyre-widths on a water bound macadam road surface. The same relation should hold good for any road surface.

As regards the formula for wear in relation to tyre width, there was no fallacy in the results as they were mathematically correct. All they showed was that there was no point in widening a tyre by 1/2 in.

As regards the point whether arcs or chords of contacts should be considered, **Shri Vagh** said that the extent to which a body could sink in a soft surface depended on the distance between the points on its own periphery where it encountered resistance to sinkage. The nearer these points the greater was the sinkage and vice versa. For the same load the distance between these points on bodies of different sizes would be the same irrespective of the actual sinkage. In the case of circular bodies this distance represented the chord and the sinkage represented the arc. Therefore the chord was proportionate to the resistance while the arc was proportionate to sinkage.

Regarding the relative performance of narrow and wide tyres in sticky mud, the **Author** quoted figures of tractive effort in "spongy and muddy clay" from Bulletin No. 237 of the Agricultural Experiments Station, University of Missouri, U.S.A. entitled "The draft of farm wagons as affected by height of wheel and width of tyre."

	Wheel diam. inches.		Tractive effort (lb/ton)	
			1½ in. tyre	4 in. tyre.
38	(actual)	...	250	223
39	(Calculated)	...	239	210
40	(actual)	...	227	197
41	(Calculated)	...	220	192
42	(actual)	...	213	187

These figures did not support **Shri Nadirshah's** objection.

In replying to **Shri Raju** the **Author** said that a pair of standard roller bearings reduced the tractive effort by 35 to 40 per cent. But the tractive effort of **Shri Raju's** wheels was 70 per cent higher than that of the smallest bullock cart wheel. Hence the inclusion of roller bearings in **Shri Raju's** wheel would not materially alter the conclusions drawn.

As regards the formula, the **Author** accepted the correction.

In reply to **Shri A. Nageswara Ayyar** the **Author** said that **Shri Ayyar's** wheel had been repeatedly tested on the designer's suggestion and the **Author** had made detailed suggestions in his Paper No. 151 for removing the inherent defects of the wheel as designed by **Shri Ayyar**. The **Author** was of the opinion from the point of view of structural stability, expected life, weight distribution, ease of assembly, manufacture or repair cost, and maintenance, the existing wheel was superior to the **Ayyar** wheel.

In replying to **Messrs. Macha and Daftary**, the **Author** said that carts would continue so long as there were bullocks in the country and bullocks would continue so long as the country remained mainly vegetarian in its food habits. The tonnage handled by carts was about 100 million tons i.e. the same as that handled by the Railways. Even if it were possible to eliminate bullocks, it would take several decades to collect the number of lorries required to handle this load.

Over short distances a cart was more economical to operate than a truck. Hence carts were bound to continue.

As regards the suggestion that the roads rather than the carts should be improved, the **Author** said that no matter what type the roads were they were damaged by carts on account of their narrow tyres. Hence extra expenditure without improving the cart wheel was not justified. As funds were limited, a road engineer's primary duty was to develop ways and means to economise both in the construction and maintenance of roads and in the vehicles which caused damage to them. The Subcommittee had shown that a 35 per cent saving could be effected in the damage to road surfaces by adopting the recommended design, which entailed no extra cost either to the carter, or the State. In short the Committee's scheme was to enlarge the road engineer's budget by about 35 per cent without touching anybody's pocket.

Discussion on Paper No. 149.

"Standards For Sight Distances For Highways".*

By

THE SPECIFICATIONS AND STANDARDS COMMITTEE OF
THE INDIAN ROADS CONGRESS

Monday, February 19, 1951.

Shri R. K. Batra (Chairman) called upon **Shri K. S. Raghavachary** to introduce the Paper.

Shri K. S. Raghavachary introduced the Paper for general discussion on behalf of the Specifications and Standards Committee. He mentioned that the present Paper incorporated the suggestions received on an earlier draft of the Committee on the subject of "Vertical Curves and Sight Distances". This draft was circulated to various administrations, engineering colleges, and technical societies. The original draft had been divided into two parts, the first part dealing with the policy on Sight Distances, and the second dealing with the design and layout of Vertical Curves. The present Paper was concerned with the first part. The second part had also been finalised by the Committee on the previous day and would be presented as a Paper for consideration of the Congress at its next session.

Continuing he said that the most important requisites in the construction and improvement of roads were safety and comfort of travel. Many engineering aspects that contributed towards building safety into the road came under the category of "Geometric Design" as distinguished from "Structural Design". Geometric design would be concerned with adequate road space: safe and comfortable horizontal, vertical, and transition curves; superelevation; sight distances; and other such requirements for ensuring safety at the maximum 'design' speeds for which the roads had to cater. The Congress had already considered and approved standards for 'widths of pavements'; 'Horizontal and Transition Curves'; and 'superelevation'. The present Paper dealt with the road requirements which would enable the driver to maintain adequate control over moving vehicles on sighting an obstruction and when overtaking vehicles moving in the same direction.

The Paper discussed the various factors influencing the fixation of "sight distances" such as, perception time, brake reaction time, brake efficiency, friction between the tyre and the road surface under varying speeds and conditions of road surface and so on. Where adequate sight distances were not provided,

vehicles would either be exposed to unnecessary risks or would have to bunch together. In the latter case the "design speed" would not be attainable and the traffic carrying capacity of the road would be greatly reduced. The recommended standards for sight distances had been worked out for various classifications of road for the respective "design speeds" already approved by this Congress.

Concluding **Shri Raghavachary** drew attention to printing errors on page 166 Table 3 where v and V had been interchanged.

Shri E. A. Nadirshah in his written comments that were read out at the meeting said it was obvious the traffic-carrying capacity of a road would be greatly affected by the available clear sight distances ahead. The motorist had always a nervous feeling, for example, going up the steep approaches of over-bridges. The mathematical solution of the problem was simple, but in the matter of assigning proper values to the variables in the mathematical formula, such as 'design speed', perception and brake reaction time, and coefficient of friction, there might be differences of opinion. Design speeds for various classifications of roads had already been agreed to by the Congress, and he would therefore confine himself to the other two factors.

Regarding perception and reaction time, he felt that a decrease from 3 seconds at speed of 30 miles an hour to 2.5 seconds at a speed of 50 miles per hour on the ground of the increased alertness of the driver at higher speeds would not be acceptable to all road authorities. While driving a car with good springs and shock-absorbing devices, the driver might not be conscious of his high speed, unless he actually looked at the speedometer, and there might not, therefore, be the extra alertness referred to in the Paper. Also, because of numerous distractions on the road such as stray cattle, careless pedestrians, and cyclists, the motorist was constantly subjected to great mental fatigue which would possibly reduce his alertness. He would, therefore, prefer a uniform value of 3 seconds for all speeds.

He sought information about the reasons which led to the adoption of the value of 0.4 for the coefficient of friction and hoped that the Road Research Institute would furnish the necessary data applicable to Indian roads.

Shri K. K. Nambiar agreed with the recommendations of the Committee in respect of the values adopted for perception and reaction time, which were, if at all, on the liberal and safe side. The reaction time of 0.4 second also agreeably compared with his own experience in a test he had in the Road Safety Exhibition in London in January 1947

*Published at pages 155 to 183 of Vol. XV-1 of the Journal of the Indian Roads Congress, August 1960.

In addition to indicating on the roads the zones or stretches where overtaking could be permitted, he suggested that the road authority should have similar indications regarding the 'Non-passing' or 'Non-overtaking' Zones where overtaking would not be permissible. Also, in two-lane undivided highways, overtaking might be desirable for vehicles moving in one direction alone, as in the case of gradients in curves, and these might be indicated on the pavement by a broken yellow line along-side the median line as had been done in some States in the U. S. A.

Finally, he supported the recommendation that three lanes for undivided highways should be deprecated and stressed the urgency of providing such highways with four-lane pavements.

Shri S. B. Joshi desired that the correct significance of the skidding friction, rolling friction, coefficient of friction, braking force etc., mentioned in the Paper should be clearly explained. Also, in the definition of 'brake efficiency' on page 157, the word 'mass' should be replaced by 'weight' as correctly representing the gravitational unit of force.

He felt that in calculating the safe stopping distance, consideration should be given to non-stationary or moving objects such as pedestrians and cattle moving towards the vehicle. In his view, the sight distance should be a function of the width of the road. If the width of a road was narrow, the chances of a driver perceiving a moving object ahead would be reduced.

Shri K. S. Raghavachary in reply dealt first with **Shri Nadirshah's** point about adopting a uniform perception and brake reaction time of 3 seconds for all speeds. He explained that the values recommended for various speeds were based on experiments and might be regarded as reasonably safe, if not conservative. Even if a uniform value of 3 seconds were adopted, the final results would not be materially affected except in the case of a speed of 50 miles when the safe stopping distance would be increased from 400 ft as recommended in Table 3 of the Paper to 430. The experience of most drivers would confirm the view that alertness would psychologically be more at greater speeds than at lower speeds. The reasoning that due to numerous obstructions by pedestrians and stray cattle, there would be mental fatigue and consequent less alertness would not be valid, as under such conditions it would not be possible to maintain high speeds.

The safe frictional value of 0.4 g had been based on experimental data made on different tyre, road-surface, and weather conditions. With improvement in the brake design of present day vehicles, the value taken was very conservative, but had purpo-

sely been recommended to accommodate even a design speed of 70 miles an hour at a future date.

He welcomed the suggestion of **Shri Nambiar** regarding the "positioning of non-passing Zones" and the marking of 'non-passing' lanes. At present this would not be a 'live' issue except in urban areas due to the insignificant lengths of two-lane, non-urban roads.

Three-lane highways had been deprecated by the Congress. In the case of certain stretches of roads with pavement widths of 36 ft as in the case of National Highway from Madras to Dindigul, these were functionally 4-lane pavements with 2 concrete shoulders each 8 ft wide for slow traffic, and a central 2-lane bituminous pavement 20 ft wide for fast traffic.

Shri Raghavachary appreciated the useful and constructive suggestion of **Shri Joshi** to make the Paper more exact and precise. The substitution of the word 'mass' by 'weight' would be appropriate and scientific. The friction referred to in Table 2 on page 163 referred to skidding friction of two kinds, skidding straight ahead, and skidding sideways as indicated in the table. In the context of the subject the former friction had been used in the design. He agreed with the view of **Shri Joshi** that a movement towards the vehicle by pedestrians and stray cattle should be taken into account but in view of their relatively slow speed and the small time factor, there would not be any great variation in the final values which had been rounded off in Table 3 to higher figures in the case of high speeds. The width of the road would affect the perceptibility of obstructions ahead but, with the wide formation provided for roads carrying fast traffic, this factor would be considerably reduced. **Shri Raghavachary** assured **Shri Joshi** that all his suggestions would be carefully considered by the Committee before finalising the recommendations.

Discussion on Paper No. 150.

**"Construction of Approaches to the Malaviya Bridge
at Banaras."***

By

K. SINHA

Sunday, February 18, 1951.

Shri M. S. Bisht (Chairman) requested the Author to introduce his Paper.

Shri K. Sinha (the Author) said that the free ferry service which had been run in the monsoon during the construction of the bridge approaches cost about Rs 1.22 lakhs per year. Great importance was, therefore, attached to their early completion. To minimise the time of construction alternative designs other than earth embankment had been considered, such as R. C. trestles or masonry piers spanned over by R. C. slabs, or R. C. retaining walls adequately tied together and filled with earth and debris. But owing to the shortage of steel none of the alternatives could be adopted.

Shri E. A. Nadirshah **asked the Author to explain the principles by which he had calculated the thickness of the sides and the top of the cellular masonry foundation of the Kashi side abutment. He pointed out that in the sketch on page 224, the foundation appeared to be a hollow box of masonry supporting the 21 ft high abutment. The dimensions of the top slab and sides of the box appeared to be too small to support the massive abutment over a span of 22 ft. The same remark also applied to the bottom raft. He also wanted to know what precautions had been taken to make the whole masonry box including the concrete base a monolithic structure.

Shri Bh. Subbaraju asked whether any sort of compaction had been done besides that done by the constructional traffic. He also wanted to know whether in comparing the cost of work done by lorries and by manual labour, the compaction done by lorries was taken into consideration.

Another point which needed explaining was the basis for equating a 100 ft lead to a 5 ft lift. It was also not clear why the

* Published at pages 207 to 235 of Vol. XV-2 of the Journal of the Indian Roads Congress, November, 1950.

** Written comments received by post and read out at the Session.

earthwork on the side slopes had not settled even after one year when the top of the embankment was not considered ready even for surface dressing.

The speaker thought it a great pity that full data about the analyses of soil was not obtained during construction but was of the opinion that it might still be possible to investigate soils at various depths at some representative sections and have the results correlated with the actual behaviour in settlement under traffic.

In view of the lack of factual data on the subject in India, every opportunity should be taken to gather useful information by studying the behaviour of soils of known characteristics under known traffic conditions.

Shri P. Lokanathan said that to ensure proper consolidation earth should be laid in as thin layers as practicable, but in no case more than 9 inches at a time, the work being so arranged that the labourers had to tread over freshly laid earth. This could be achieved by proceeding from the edges towards the centre of the cross-section. A slight slope towards the centre in each layer would make it easy for the labourers and any rain which might fall during construction would be held ponded on top of the fill and help consolidation.

Shri Lokanathan further suggested that where different soils like sand, light loam, dense clay, kankar, gravel, etc., were available in the several strata of the borrow pits, care should be taken to lay alternate layers of light and heavy soil avoiding cumulation of any particular soil, thus achieving proper grading. Better soils might be reserved for encasing the embankment in preference to using them in the core.

The speaker appreciated the provision of a free ferry which was a temporary substitute for the toll free bridge that had existed before.

Shri R. P. Chanda suggested that the size of the job and the size (or extent) of the site to which the departmental method of work could be applied should be specified.

He contended that the control of labour by a contractor was better and more efficient than by departmental agency. This accounted for high costs in some departmental works. But then the profit made by the contractor balanced the extra cost incurred in departmental working. Considering all these factors a policy should be evolved regarding the execution of works through departmental working or through contractors.

Shri N. D. Daftary referred to para 6.1 (c) of the Paper wherein it was mentioned that some borrow pits were abandoned because they yielded sandy soil and enquired whether the sandy soil could not have been used in the core and whether other soil had been available at a lower rate. He also wanted to know what steps, if any, had been taken to prevent erosion of the banks and with what success.

Shri K. F. Antia wanted to know the reasons for adopting 0.8 ton per sq. ft. as the permissible bearing value of soil under the foundations of the abutments.

He also wanted to know why buttresses had been provided; the resultant would have fallen within the middle third even without the buttresses.

Shri B. B. Patkar dealt with the question posed by **Shri Chanda** regarding the size of the work which could be done departmentally and suggested that it was not the cost of a job but the organization and equipment available that determined whether a job should be done departmentally or through a contractor. The Bombay Municipal Corporation had done some very big works and some petty works through both types of agencies depending on the facilities at the disposal of the agency selected.

In reply to **Shri Nadirshah's** remarks, the Author said that the sketch at page 224 was a section along the road. A section across the road, given in Plate III on page 235, showed that the supports of the arches carrying the abutments were only 5 ft apart, centre to centre. No precautions were necessary to make the masonry monolithic with the concrete base as no tension was expected at the joint between them.

Replying to **Shri Subbaraju** the Author said that the compaction of the earthwork deposited by headloads had been done by wooden rammers and that the labour for ramming was included in the costs. Such compaction was not, however, as effective as compaction by lorries on account of the sandy nature of the soil. The earthwork done by lorries had, no doubt, the advantage of better consolidation.

Taking a lead of 100 ft as equal to a lift of 5 ft was according to the Uttar Pradesh P.W.D. Schedule of rates. This, the Author said, was an accepted proposition probably in other States also.

As regards consolidation, the top of embankment had experienced constructional traffic and had therefore been consolidated earlier than the sides.

Accepting the suggestion made by **Shri Subbaraju** the Author said that efforts would be made to determine the nature of the soil in the embankment and find out the relation between the settlement of the bank and the properties of the soil.

The Author agreed with the points raised by **Shri Lokanathan** and said that, to a large extent they had been followed during construction.

Agreeing with **Shri Chanda's** remark that control of labour was generally less efficient on works done departmentally than on those done by contract, the Author said that this could be remedied by fixing the daily task for each labourer or group of labourers and seeing that this was completed.

In the particular case of the Malaviya Bridge approaches, the site of work was confined to a length of about a mile. Supervision of labour was, therefore, both effective and comparatively cheap. The site was close to the Divisional Headquarters of the P. W. D. and the officers could inspect the work easily and frequently in addition to their usual routine work.

Another advantage was that the lorries belonged to the Department and hence their working could be controlled. The quantity each lorry should carry and the time necessary for loading and unloading had all been fixed and the daily work done by the lorries was carefully recorded.

Similarly the earthwork done by head-load and by donkeys also was measured daily at the borrow pits as well as on the embankment and recorded, and any tendency towards abnormal cost was immediately checked.

In the Author's opinion where such facilities did not exist or where tasks could not be fixed and checked daily it would be advantageous to get the work done on contract. Therefore the most important factor in determining the agency of work was not the size of the work. Other facilities such as the available equipment, adequate experienced supervisory staff, the possibility of a daily check, etc., were the really important considerations.

Replying to **Shri Daftary** the Author said that sandy soil had been utilized in the core of the embankment to some extent but some borrow pits yielding sandy soil were abandoned as better soil was available at only a very slightly higher cost.

The measures adopted to prevent the erosion of side slopes had been described in the Paper and were successful (vide para 11.2 of the Paper).

Replying to **Shri Antia** the Author said that the safe bearing pressure of 0.8 ton per sq. ft had been suggested by the Railways who had previously carried out tests and had constructed some trestles close by.

The buttresses had been provided to widen the base and distribute the load evenly on the widened base. This had been necessary in order to avoid any eccentricity of loading and reduce the maximum stress at the toe on account of the low bearing capacity of the soil.

Shri M. S. Bisht (Chairman), who had been associated with the construction work described in the Paper, wound up the discussion by mentioning the circumstances in which it had been decided to engage departmental labour. He said that the contractors who had been entrusted with the work in the first instance had failed to complete the work and the department was in a fix as to whether to call for fresh tenders or do the work by departmental agency. Fresh tenders were, however, called but before they were accepted allegations were made that the Government had not been fair to the previous contractors. The department was therefore advised not to accept tenders afresh until Government had examined the position carefully. Suddenly it was realised that while the order prohibited the acceptance of fresh tenders and the award of the work to new contractors there was nothing to prevent continuing the work by the departmental labour. The work was, therefore, resumed departmentally. This had saved considerable sums of money because the rate at which the work had been done departmentally was practically half of the new quotations.

Discussion on Paper No. 152.

"Organization of Bridging Activities."*

By

G. R. NANGEA

Monday, February 19, 1951.

Shri S. B. Joshi (Chairman) called upon Shri Nangea to introduce his Paper.

Shri G. R. Nangea (Author) in presenting his Paper commented on the unpleasant prospect of building toll-bridges which the country must now face and continue to face so long as economic conditions prevented the provision of adequate funds from current revenues for building the toll-free bridges that were so urgently needed. He described in some detail the low efficiency of a highway system in which the gaps were not fully bridged. No motorist would in his part of the country risk going in uncertain weather on a road where the river crossings were not provided with bridges.

His estimate of the cost of bridging all such unbridged gaps on the more important roads in India was about rupees one hundred crores. The whole of this sum could not be provided from out of the revenues of the country at present. He suggested that since the Governments in the country were unable to raise capital by means of general-purpose loans, all big bridges costing above a certain limit should be financed by raising local loans funded on toll-revenues, while the remainder, costing less than that sum, might be built from revenue grants.

Coming to the bridging programme, the Author mentioned that, unless there was a continuous bridging programme, the bridging talent of the country would be wasted and the special tools and plant collected for the few bridges actually constructed would remain idle after serving the immediate purpose for which they had been purchased and not yield an adequate return.

If a regular programme were decided upon, the next problem would be the selection of adequate plant and machinery for different bridging operations envisaged in the programme. The Author had made recommendations in his Paper about the formation of State and Central pools of plant and machinery and had given detailed lists of machinery he thought would be useful.

* Published at pages 281 to 313 of Volume XV-2 of the Journal of the Indian Roads Congress—November, 1950.

He also suggested hiring the plant and machinery loaned from the proposed pool at a rate of 2 to 3 per cent of their book value. The proceeds from the hire, instead of being credited to revenue, should be utilized for the maintenance and replacement of the machinery.

Shri K. K. Nambiar welcomed the Paper as very opportune on the ground that, at a time when capital work programmes were held up for paucity of funds, it was good to discuss the case for launching out on an organized bridge construction programme based on loans funded on toll revenues. This procedure was being followed in many advanced countries at the present time and was welcomed by the public there.

He also concurred with Author's suggestion that there should be separate bridging organizations in the highway departments of States. In his opinion a set of men having special aptitude for this kind of work, continuously engaged on investigation, construction, and maintenance of bridges, could deliver the goods much better than when the work was handled by nonspecialists. He was not, however, in favour of any further subdivision of work into investigation, construction, and maintenance, of bridges and recommended that all these functions should be entrusted to the same set of people.

Commenting on the Author's recommendation that open foundations were not economical for depths of more than 30 to 35 ft below the subsoil water level, he said that, even at lesser depths, open foundations had been found to be costlier than wells or piles. In the speaker's opinion 15 ft below subsoil water level would be a more reasonable figure in most of the soils met with.

He also suggested the inclusion, in the list of tools, plant, and machinery given by the Author, of a mile length of trolley lines, tipping waggons, and a sufficient quantity of sheet piles for shoring and cofferdam work.

Shri K. F. Antia believed that bridge engineering was a highly specialized job. The railways had recognised this long ago, and almost every railway had a separate "Bridge Department" to which the recruitment of engineers was made very carefully from among selected men. These engineers, who in course of time became specialists, were not ordinarily shifted to other branches.

As regards the 'Central Pool of Plant and Machinery' the speaker suggested that other Ministries might also be brought into the picture so as to have an effective pool. He revealed that two methods had previously been followed by the railways in the matter of specialised plant. In many cases such plant had been

retained at special depots for subsequent use, whilst in a few cases the plant had been sold immediately on the completion of a major project, particularly if another such project was not likely to be undertaken for several years. Both methods had their merits but in the present universal shortage of plant it was desirable to retain specialized plant to be used again and again.

Shri Antia considered the question of organizing bridge building on sound lines so important that he thought the Indian Roads Congress might set up a committee to investigate it.

Shri B. T. Unwalla suggested that in suitable cases the construction of bridges could be left to private enterprise with permission to construct bridges at selected sites and collect revenue by way of tolls. He felt sure that some enterprising people would be willing to take up the construction of bridges on such terms. To cite one example, he had been led to believe that the Narbada Bridge at Khalghat yielded a daily income of Rs 900 to Rs 1,000 from tolls.

Shri B. N. Shenoy was of the opinion that a bridge engineering section at the Centre would be a natural corollary to the establishment of separate bridging organizations in each State. This organization at the Centre could function as a repository and a "clearing house" for the latest information on the subject. The Roads Organization had already made a good beginning as they were dealing with all the important bridges on the National Highways and those financed from the Road Fund Reserve. The Central Office was thereby in a position to collect information about the different conditions and problems in the various parts of the country and advise on the way they should be tackled.

In the Railway Board, there was a separate Bridge Standards and Research Section and every railway again had its own Bridge Section with separate whole-time bridge engineers for investigation as well as execution. The latter got advice and orders on every major work from the Railway Board which had a research section of its own.

Bridge Sections, as envisaged, for the States should start with their organizations by recruiting men with special aptitude for this kind of work from among Assistant Engineers and Executive Engineers. The man at the top should not be merely an administrative officer as suggested in the Paper. He should be an experienced engineer who had had practical experience on many bridge works so that he could adequately instruct those working under him and so that the organization might be built down from the top as well as up from the bottom.

Shri K. G. Bhate supported the Author's plea for a specialized bridge building organization in each State and at the Centre. He revealed that his State (Bombay) had already established such an organization. The Centre also had made a beginning in the Roads Organization.

Continuing **Shri Bhate** said that there were localities where transport for want of bridges became very costly. He mentioned a site over a sea creek where the cost of transporting goods across the creek was Rs 50 per truck load. In such cases the public would be willing to pay this amount or even more as toll to save on the time and distance travelled. This might be cited as an instance which would make private enterprise invest money on such projects if they were authorized to collect tolls. One drawback would be that such bridges might not be built to recognized standards which are designed to allow for the passage of heavy army vehicles, tanks, etc. Some subsidy might be given to permit building to these standards. The extra cost would be comparatively very little.

The Author, replying, said it would be wrong for him to try to deal with the minor individual points raised by the different speakers during a discussion on a general Paper such as he had attempted. He thought that the best course would be to set up a committee competent to go into the details of what had been said and advise on the general policy to be formulated and the steps necessary for giving practical shape to the collective thoughts of all the speakers. Any dogged adherence to any particular detail of what had been said in the Paper or in the discussion might actually defeat the main objective.

Replying to **Shri Nambiar** he mentioned that open foundations were adopted where wells could not be sunk. In the Punjab, particularly in the hills, there were many streams with boulder beds where open foundations were the only possible solution. He spoke from his personal experience of taking open foundations to 30 to 35 ft depth in two or three cases. No one would like to resort to pile foundations or pneumatic sinking where open foundations were possible.

Dealing with **Shri Unwalla's** suggestion, which **Shri Bhate** had also repeated, **Shri Nangea** said that the Indian Roads Congress might consider the question and recommend a general policy on private enterprise being permitted to build bridges and collect tolls on them.

The Chairman (**Shri S. B. Joshi**), in winding up the discussion, mentioned that there was unanimity of opinion amongst the

road engineers in this country that bridging activities should be financed by some "pay as you go" method. The imposition of tolls was, in his opinion, perhaps the only available method if the large number of important bridges required on the country's roads were to be constructed at an early date. If a few bridges were actually constructed on the basis of financing them by public loans to be paid back out of income from tolls, the idea would be more easily appreciated by the public than by mere theoretical discussion. **Shri Joshi**, however, anticipated some difficulties in giving effect to the idea propounded by the Author.

Shri Joshi supported the point raised by **Shri Bhate** that a local authority set up for the purpose of financing and constructing a bridge would not readily agree to construct a bridge of a standard higher than that required by their own traffic conditions. In such a case, he suggested, the Government should pay the additional funds required for building a bridge to the standard demanded by the Government.

After dealing with the financial aspect of bridging activities the Author had dealt with the organization needed for the construction of bridges. The Author had given an outline which could be developed further in the light of experience gained.

Shri Joshi agreed that the work of designing and building bridges should, in the nature of things, be entrusted to a specialized branch of the P. W. D. in every State.

The Chairman concluded the discussion by thanking the Author.

Discussion on Paper No. 153.

“Some Examples of Planning Surveys.”*

By

R. P. CHANDA

Monday, February 19, 1951.

Shri S. N. Chakravarti, (Chairman) who, as Special Chief Engineer, West Bengal, had been associated with the subject dealt with in the Paper began by giving details of the work which had been carried out after the Paper was written. He mentioned that Calcutta was hedged in by salt lakes on the east and by the River Hoogly on the west and therefore the only possibility of the expansion of the City was towards the North or the South. Traffic had, therefore, developed more in the north-south than in the east-west direction. The commercial centre as well as the official centre of the city was in the neighbourhood of Dalhousie Square and most of the traffic from all parts of the city during peak hours headed towards this area and caused heavy congestion on the Central Avenue, the main road from the north, and on the Russa-Chowringhee Road from the south.

For the purpose of the investigations several census posts were selected outside the Calcutta area and the number of vehicles that passed through these posts was nearly 16,000 per hour. The origin or the destination of most of these vehicles lay in the zones bordering on the Central Avenue and the Chowringhee. The conclusion was obvious that there should be an expressway running from north to south on which vehicles could travel at a faster speed than at present. The Central Avenue and the Chowringhee had been suggested tentatively as suitable for developing into expressways. This required further study which was being made but Shri Chakravarti wished to suggest that there should be grade crossings on the more important junctions on the Central Avenue, whether that could be done would depend upon the space available at those junctions. Another solution might be the construction of traffic islands.

The chairman then called upon the Author to introduce his Paper.

Shri R. P. Chanda (Author) in introducing his Paper mentioned that there were various kinds of road works and, consequently various kinds of surveys. Speaking in a broad way three cases might be considered:—

First came the rural areas. There the existing traffic was not an important consideration as, on developing the areas on a pro-

per basis, much more traffic would be generated. A survey of important economic factors had to be undertaken by teams of trained staff moving patiently and methodically from village to village, tabulating data in specially devised but simple forms, and presenting data suitably so as to make the drawing of conclusions easy and dependable. This data would help in fixing alignments and deciding priorities.

Planning surveys for trunk and main roads fell in a different category. The problem in such cases was not of location but of meeting the growing needs of traffic. The survey in such cases was intended to assess the benefits resulting from improvements in the terms of the time saved, the accidents avoided, the wear and tear of vehicles reduced, and so on.

Still another type of survey would cover all means of transport-communications in a region like railways, roads, navigable waterways and so on, with the object of developing a co-ordinated system of transport.

Shri N. D. Daftary stressed the importance of traffic surveys as an aid to the correct planning of a highway system but wondered whether collection of such detailed information as given in the Paper was really necessary and whether, as a result of experience gained, some of the requirements could not be cut out in order to expedite the survey work and to reduce its cost. He referred to Table 1 of the Paper wherein he thought columns 3, 5, 15 & 16 might be omitted and the details under column 6 curtailed. Table 2, he thought, was not sufficiently elaborate and information regarding import, export and passenger traffic should have found a place in it.

The speaker asked whether any idea of the time taken and the cost involved in the surveys described in the Paper could be furnished. He suggested a further subdivision of classification under lorries into light trucks, heavy trucks, and 6-wheelers.

While the Author considered a traffic volume of 200 to 250 vehicles per hour as a fair average capacity for a single lane highway, in another part of the Paper he had suggested that (on another road) with 150 vehicles per hour “congestion conditions definitely existed.” The figures seemed to need some explanation.

Shri B. B. Patkar said that some of the busy streets in Bombay carried very heavy traffic as for instance, Queen's Road carried about 25,000 vehicles a day (1800 per hour maximum), Hornby Road about 15,000 a day (1200 during the peak hour), and Hughes Road about 1500 in the rush hour. Congestion of traffic on all these roads was felt not because their width was insufficient but because there were obstructions like pedestrians, slow-moving

* Published at pages 365 to 392 of Vol. XV-3 of the Journal of the Indian Roads Congress, January, 1951.

bullock-carts and junctions. In fact, in Bombay the foot-paths appeared to be too narrow and carriageways too wide and that was the principal reason why pedestrians preferred to walk on the carriageways rather than on the footpaths. Moreover, footpaths had obstructions like hawkers, squatters, street traders, and so on. On the other hand, Calcutta seemed to have both carriageways and footpaths wide and there should be no traffic congestion on them. In any case the suggestion of turning any of them into an expressway did not seem feasible, as that would mean closure of all cross roads.

The principal cause of congestion in Bombay was the hold-up at junctions. To solve this problem grade separators were being considered so that the main stream of traffic could go along the high level roads and all cross traffic at a junction along the existing low level roads. On the wide roads of Calcutta, grade separators or high level roads appeared to be the solution.

Shri S. N. Gupta expressed the hope that traffic censuses started in West Bengal would be kept up systematically and become a regular feature in the State P. W. D. After some years a wealth of factual data would be available which would make planning easy. He suggested that a statistical section should be set up to maintain and analyse the census records so as to provide data in a useful form.

He was of the opinion that traffic engineering was a highway engineer's function rather than that of a policeman and highway engineers should play a more prominent part in deciding traffic problems.

Replying to **Shri Daftary** the Author said that the surveys described in the Paper being the first of their kind to be carried out in the area an attempt was made to collect as much information as was considered likely to be useful in the future for various purposes. Experience had shown that some of the information was not necessary. Such items would be dropped in future surveys.

The time required for a traffic survey depended on various factors like the volume and nature of traffic, the variety of information to be recorded, the intelligence of the average driver who had to answer the queries, the training and experience of the survey staff and so on.

Regarding the capacity of a single lane highway the Author said the condition of and the material constituting the berms determined the capacity of such a highway. If the berms were well maintained and consisted of good stable soils the capacity of the highway was higher than otherwise. Ribbon development and parking on the road also restricted the capacity of a highway.

Discussion on Paper No. 154.

"Behaviour of Brick Metal in Tar Carpets."*

By

K. C. DE

Tuesday, February 20, 1951.

Shri T. Mitra (Chairman) in introducing the Author said that **Shri K. C. De** had been engaged for some years in carrying out experiments on the use of brick metal in place of stone in tar carpets. The value of his investigations lay in the fact that if they proved even partly successful, the State of West Bengal would not be so dependent upon stone metal for their roads as they now were. Stone metal could then be replaced by the cheaper brick metal on roads where the intensity of traffic did not justify the use of the more expensive material.

Shri Mitra then called upon the Author to present his Paper.

The Author, **Shri K. C. De**, introducing his Paper for discussion, described the background which had led him in 1939 to start investigations using brick as a possible substitute for stone as road metal. During all these years he had carried out a large number of laboratory and field tests and it was these tests that made the publication of the present Paper possible.

The Author mentioned that further experiments were in hand to manufacture a type of brick metal harder than that available at present.

Shri J. S. Narasimham, in the light of his own research conducted on the stability of dense graded bituminous mixtures, suggested a few items for future investigation by the Author. He said that:—

- (1) the coarse aggregate should be suitably graded, fixing the maximum size at about 1 in. to 1½ in.
- (2) the percentage of fine aggregate or filler passing a 200 mesh should be not less than 10 to 15 per cent and for better results, this might consist of limestone dust as lime stone was "hydrophobic" in nature.
- (3) The optimum binder content should be determined theoretically and that proportion of binder only should be used for that particular gradation of aggregate.

* Published at pages 393 to 414 of Vol. XV-3 of the Journal of the Indian Roads Congress, January 1951.

- (4) A suitable stability test for the aggregate mixture should be carried out under conditions similar to those existing in the field.
- (5) Immersion Compression Tests on samples immersed in a hot water bath at 112 degrees Fahrenheit should be conducted and any stripping of tar under those conditions investigated. This temperature was suggested because road pavements often attained it in the summer months.
- (6) The binder selected should satisfy requisite conditions.

The speaker also wanted to know whether any laboratory tests had been conducted to measure the affinity of the burnt brick to the tar used or whether any data regarding the density to which the brick was compacted before burning was kept. He further asked whether the brick aggregate when completely soaked in tar would contribute to the maximum stability.

The speaker also felt that instead of comparing the depth of penetration with the degree of burning, the porosity of the samples and the depths of penetration of tar in them should have been correlated. He wanted to know how the Author had fixed the proportions mentioned in para 3.3.2 of the Paper viz., sand to be half the quantity of metal by volume and tar to be added at 6 lb per cu. ft. of metal and sand.

Shri P. K. Chatterjee asserted that in his opinion tar and bitumen, which were plastic materials, could not impart toughness to a rigid material like brick metal. They could only make the pavement more shock-absorbing. In a carpet, bitumen acted as a "filler," and a binding and waterproofing medium. Bitumen which was viscous was considerably affected by variations in temperature and could hardly impart structural strength to the road metal. The effect of heat was still more profound on tar.

In his opinion, the load bearing capacity of a bitumen-aggregate mixture primarily depended on the density of the mixture (which could be increased by controlling voids), the filler to bitumen ratio, and the fineness of the filler. This being so, he would be inclined to describe as hasty the Author's conclusion that the load bearing capacity of brickmetal soaked in tar and laid with a "Tar-Sand Mastic" would be almost equivalent to that of stone metal.

The speaker suggested that the effect of the atmosphere on tar should also have been investigated. Prolonged exposure to weather affected the properties of all bituminous road making

materials; tar became brittle even at low atmospheric temperature, and ultimately a tar bound pavement broke up under traffic and disintegration set in the road crust. Usually tars with heavy oils remained in a plastic state longer than tars having light oils.

Finally the speaker asked for the detailed specification of "H. V. R. T."

Shri K. K. Nambiar accepted that bricks impregnated with hot tar were more resistant to abrasion and attrition than untreated bricks and revealed that even in the State of Madras where stone was available in plenty bricks coated with bitumen were used as edging for black-top roads, being comparatively cheaper than stone edging.

The speaker was of the opinion that it would have added to the usefulness of the Paper if comparative costs of the different specifications had been given and if the traffic intensity had been worked out for ready reference.

Referring to the sequence of operations in the mixing process as described in para 4.6.1 of the Paper and agreeing to its utility in case of brick metal, the speaker wanted to know whether even in the case of granite metal this sequence of operations was superior to that generally employed in all batching plants, viz., mixing metal and sand together and then adding bitumen or tar and mixing again thoroughly. If definite advantage for the process described in the Paper could be provided it would mean a revolutionary change in the design of batching plants. The speaker, however, did not think there was any special advantage in the sequence of operations recommended by the Author.

Lastly, the speaker suggested that experiments be conducted on pavements built with sand, filler, and bitumen only. The specification had proved its utility even under very heavy traffic, of course pneumatic tyred, in America in the State of Nebraska where stone could not be easily had. The speaker expected that the specification would stand a fair amount of steel tyred traffic also.

Shri A. K. Ghosh wanted to know the kind of sand (coarse or fine) recommended for tarcrete with brick metal and also the minimum thickness of such tarcrete. He asked whether in view of the small increase in the strength of vitrified bricks by soaking in tar their use was recommended in this specification.

Shri B. B. Patkar suggested that when mixed with sand and tar, brick metal formed a concrete and there was no reason why only tar should be used as a binder. Cement and asphalt could, it appears, be equally effective. In Bombay asphalt had been used.

Brick was quite strong against crushing—it was only against abrasion that it had to be protected.

Shri M. S. Bisht described the use of brick metal in Uttar Pradesh where brick-earth was specially burnt (near the site of work) so as to yield overburnt bricks. Brick ballast consisting of about 95 per cent overburnt stuff was consolidated, and covered within a month with a bitumen or tar surfacing. He cited an example where this specification had been adopted in a portion of the G. T. Road side by side with a cement concrete road. For the last two years it had withstood very heavy traffic whereas the concrete road had cracked.

Shri R. P. Chanda suggested that research should be undertaken to find whether there was not some chemical, cheaply and easily available in India, which could be used in the manufacture of bricks for road metal, in order to achieve uniformity and more than average strength.

Shri T. M. Das said that a comparative statement of the costs of tarcrete with brick and stone aggregate, taking into consideration the frequency of repair in both cases, would be useful. He suggested that, as the laboratory conditions, like heating brick ballast in an oven could not be created in the field, some practical specifications should be evolved.

The Author expressed his gratitude for the valuable suggestions made during the discussion. These, he said, would be very helpful to him in his further investigations.

In reply to **Shri J. S. Narasimham** the Author said that no tests had as yet been carried out to find out the affinity between brick metal and road tar, but that this appeared to be good. Tests in this respect would be carried out in due course.

As regards penetration, the results published in the Paper showed that it was related to the degree of burning rather than to porosity. Vitrified bricks might have more voids and still be non-absorbent. Therefore, the degree of burning was more important for the classification of bricks in this case.

The immersion test was carried out to determine the water-proofing quality of the carpet by observing the change of volume, if any. Further tests in a hot bath would now be conducted as suggested.

Lime stone dust as filler had not been considered on account of its high cost.

The Author thanked **Shri P. K. Chatterjee** for his comments and said that the statements made in the Paper were all based on field and laboratory tests carried out over a number of years. The experimental roads laid to the specification had stood successfully for ten years and were still giving satisfactory service under heavily laden bullock carts and lorries.

The Author believed that road tar imparted toughness (which was different from hardness or strength) to the brick metal by penetrating into the pores and thereby binding the brick particles together. Brick metal could absorb shock only if it was toughened. The binder used had to be capable of penetrating into the bricks; otherwise it would not effectively toughen them. Owing to its dispersion into the very fine pores of the brick metal, road tar was not affected by ordinary temperature changes.

Speaking about the load bearing capacity which was dependent on the density of the carpet, the Author said that the carpet as specified was to all intents and purposes voidless. The voids in the sand were filled by H. V. R. T. and both together filled the voids in the brick metal.

The use of a filler might improve the character of the binder but it was omitted owing to economic reason as limestone powder of approximately 200 mesh B. S. S., which was acknowledged as the best filler, was available in Calcutta at an exorbitant cost (Rs 400/- per ton). The results even without the use of a filler were sufficiently satisfactory for the purpose in view.

The inference that a tar carpet with brick metal had the same general load bearing capacity as that with stone metal had been drawn from the results of the tests described in the Paper.

The question whether or not road tar was oxidised was immaterial in this type of carpet as weathering could be effective only on the skin and could not have any effect on the internal structure of the carpet. The weathering effect on the surface, if any, could be counteracted by a light seal coat with road tar and sand applied every two or three years, depending on the traffic intensity and weather conditions.

The specification of H. V. R. T. which had been used in the test was as follows:

Viscosity:

(a) temperature of test	55° C.
(b) viscosity in seconds	40-60

Equiviscous temperature (E. V. T.) 54° to 60° C
 Moisture (by volume) maximum per cent 0.5

Fraction (in G per 100 G) by weight, distilling at:

(a) below 100° C, maximum per cent 0.5
 (b) from 200° to 270° C „ „ 0.5 to 4
 (c) from 270° to 300° C „ „ 2 to 7
 [(b) plus (c)] total maximum per cent 10
 Phenols (by volume) maximum per cent 2.0
 Naphthalene (by volume) maximum per cent 2.5
 Matter insoluble in toluene, maximum per cent 24.0
 Specific gravity 1.18 to 1.28

Replying to **Shri K. K. Nambiar**, the Author said that when mixing binder with mixed aggregates, the finer aggregates took up the binder first so that sometimes the surface of the coarse aggregate remained uncoated. This led to segregation at the time of laying.

The Author undertook to supply the Congress with a comparative statement* showing costs of tarcrete carpets with stone and brick aggregates.

Dealing with the points raised by **Shri A. K. Ghosh** the Author said that all kinds of sand could be used but the quantity of binder would vary directly with the fineness of the sand.

The minimum thickness of carpet tried so far was two inches consolidated, the size of brick metal for which should be 1½ in. to 1 in.

The percentage increase in the strength of vitrified bricks by soaking in tar was less because these bricks were initially strong. Their use was recommended. The experiments only showed that the other classes of bricks (I & II) could also be made nearly equally strong so that the specification made it possible to use a mixed type of brick metal.

In reply to **Shri R. P. Chanda's** suggestion the Author revealed that experiments for the manufacture of hard bricks by using cheap chemicals were in hand.

Shri T. Mitra (Chairman) concluded the discussion by thanking the Author for his interesting Paper.

* The statement has since been supplied vide Appendices I & II.

Appendix I

Estimate For Laying 2 in. thick Tarcrete Carpet using
 Brick Metal and Sand in West Bengal.

Area to be covered: 63,360 sq. ft.

Item.	Quantity.	Rate	Per	Amount
1. Brick metal, size 1½ in. to 1 in. made out of over-burnt (vitrified) 1st & 2nd class bricks @ 16 cu. ft. per 100 sq. ft.	10150 cu. ft.	at Rs. 60	100 cu. ft.	Rs. 6090
2. Dry medium coarse sand @ 8 cu. ft. per 10 sq. ft.	5075 cu. ft.	at Rs. 50	100 cu. ft.	Rs. 2538
3. H. V. R. T. (High Viscosity Road Tar) for premixing brick metal & sand @ 6 lb. per c.ft. of brick metal & 5 lb. per c.ft. of sand.	39 tons	at Rs. 217	Ton	Rs. 8463
4. Labour for laying the carpet.	63,360 sq. ft.	at Rs. 5	100 sq. ft.	Rs. 3168
5. Hire charge of mechanical mixer for 21 days.	21 mixer-days	at Rs. 37/8	Mixer-day	Rs. 788
6. Hire charge of two tar boilers for 21 days.	42 boiler-days	at Rs. 3	Boiler-day	Rs. 126
7. Labour for rolling the carpet.	63,360 sq. ft.	at Re. 1	100 sq. ft.	Rs. 634
8. Coal for heating road tar.	63,360 sq. ft.	at Re. 0/5/0	100 sq. ft.	Rs. 198
9. Depreciation of tools & plant.	63,360 sq. ft.	at Re. 0/4/0	100 sq. ft.	Rs. 158
			Total	22,163

Cost per 100 sq. ft. = Rs. 34-15-0.

Appendix II

Estimate for Laying 2 in. thick Tarcrete Carpet using
Stone Metal & Sand in West Bengal.

Area to be covered : 63,360 sq. ft.

Item	Quantity	Rate	Per	Amount.
1. Stone Metal (Pakur) size 1½ in. to 1 in., at 16 cu. ft. per 100 sq. ft.	10150 cu. ft.	at Rs. 120	100 cu. ft.	Rs. 12180
2. Dry medium coarse sand at 8 cu. ft. per 100 sq. ft.	5075 cu. ft.	at Rs. 50	100 cu. ft.	Rs. 2538
3. H. V. R. T. (High Viscosity Road Tar) for pre mixing stone metal and sand at 5 lb. per cu. ft. of metal & sand.	33.9 tons	at Rs. 217	Ton	Rs. 7356
4. Labour for laying the carpet.	63,360 sq. ft.	at Rs. 5	100 sq. ft.	Rs. 3168
5. Hire of mechanical mixer for 21 days.	21 mixer = days.	at Rs. 37.8	Mixer = day	Rs. 788
6. Hire charge of two tar boilers for 21 days.	42 boiler = days.	at Rs. 3	Boiler-day	Rs. 126
7. Labour for rolling the carpet.	63,360 sq. ft.	at Re. 1	100 sq. ft.	Rs. 634
8. Coal for heating Road Tar.	63,360 sq. ft.	at Re. -/5/-	100 sq. ft.	Rs. 198
9. Depreciation of tools and plant.	63,360 sq. ft.	at Re. -/4/-	100 sq. ft.	Rs. 158
Total				Rs. 27146

Cost per 100 sq. ft. = Rs. 42-15-6.

Discussion on Paper No. 155.

"Construction of the Kuakhai Bridge in Orissa." *

By

SUDHINDRA NATH GUPTA

Monday, February 19, 1951.

Mr. C. M. Bennett (Chairman), called upon the Author, to introduce his Paper.

Shri S. N. Gupta (Author), in introducing his Paper, emphasized the importance of bridges in the system of transport-communications of the country.

Shri E. A. Nadirshah, in a written comment read out at the meeting, said that the detailed account of the construction of the Kuakhai bridge formed interesting and useful reading matter. It seemed to him, however, that the information given in Table 2, Appendix III of the Paper under the heading "proportion of Concrete Mix" was rather incomplete. Information regarding the consistency of the mix, the quantity of water used, etc., would have given a clearer idea about the mix. The strength of concrete of a nominal mix of 1: 2: 4 was shown in the Table to be varying from 3257 lb per sq. in. to 5413 lb per sq. in. The reasons for this considerable range needed investigation.

As regards the concreting of the abutment in lifts of 4 ft, Shri Nadirshah wanted to know whether dissipation of the heat of hydration had anything to do with the fixing of the height of four feet. He further wanted to know the season in which the abutment had been concreted.

Shri Nadirshah also requested the Author to indicate the position of the construction joints between the slabs and the beams and to give the quantity of sand used, which had been omitted in the schedule of quantities in Appendix II to the Paper.

Shri K. K. Nambiar wanted to know the reason for the large gap of 8 ft 6 in. left between the two wells under each pier and whether the wells could not have been spaced nearer. The sketches in the Paper showed that no extra reinforcement had been provided in the capping slab over this gap which fanned out to more than 20 ft towards the edges.

He referred to the Author's statement in para 4.22 of the Paper that an undisturbed interval of eight to twenty-four hours made for better strength in the case of vibrated concrete, and asked whether this did not apply to all concreting work.

* Published at pages 417 to 447 of Vol. XV-8 of the Journal of the Indian Roads Congress, January, 1951.

Shri Nambiar expressed the view that it was unusual to have shrinkage cracks in reinforced cantilevers (mentioned in para 3.10 of the Paper) and wondered whether it could not be due to inadequate reinforcement. He also wanted to know whether any investigation had been made on the subject.

The speaker also questioned the appropriateness of reinforcement in plum concrete work in the piers. He also enquired about the cost of substructure work.

Shri R. P. Chanda wanted to know whether the subsoil water level was higher than the well cap level and if so, how concreting was done in the well caps, and whether the contractor had been paid extra charges for this work.

Shri A. Guha pointed out that the end unit with one cantilever of 53 ft and another of 26 ft 6 in. would behave differently from the other units which had both cantilevers of 26 ft 6 in. He was of the opinion that this could have been avoided by a better distribution of spans.

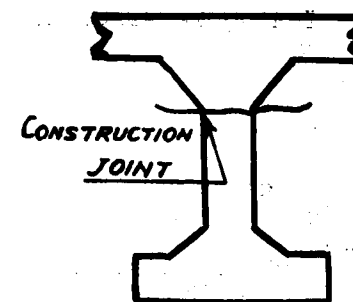
He also thought that a sufficient number of cross beams had not been provided in order to distribute loads equally on all the three main beams. He suggested investigation of the behaviour of each well where two separate wells occurred under one pier.

Mr. C. M. Bennett pointed out that the two maps in Plate I in the Paper showed two different alignments for the same road, and that in para 3.10 the thickness of the footpath slab had not been given. He also wanted the Author to tell the Members something about the load-testing of the bridge which had been carried out.

In reply to **Shri E. A. Nadirshah**, the Author said that the object of the field tests of the concrete was to find out whether the strength actually used conformed to the minimum design requirements. This purpose had been served and in all cases the minimum design requirement had been fulfilled. Further information about consistency, water-cement ratio, was not available for the samples tested.

The abutments had been concreted during summer. A lift of 4 ft for concreting the abutments had been fixed for facilitating work and for ensuring the proper compaction of concrete in the presence of a network of reinforcement. In fixing this height the question of the dissipation of the heat of hydration of cement had not been considered and no such considerations appeared necessary as the sections concreted were relatively thin.

The construction joints between the beams and the slab were provided at the position shown on the blackboard (reproduced in the marginal sketch). One full length of beam up to the level of the construction joint was cast in a day. The deck slab of a unit was concreted in two days, a construction joint being provided at the centre of the supported span.



Unlike other materials, the sand used had been collected from the river bed at the site of the work at very little cost and had, therefore, not been measured separately nor included in the schedule of quantities.

Shri K. K. Nambiar had, the Author said, raised questions concerning the design of the bridge while the Paper attempted merely to describe the construction of the bridge.

An undisturbed interval of a day was allowed before resuming vibrated reinforced concrete work because of the continuity of reinforcement into the previously finished work. This consideration did not apply when vibrators were not used.

The Author held the opinion that shrinkage cracks were not unusual, although he agreed that they could be minimized by providing sufficient temperature reinforcement.

The cost of the substructure was nearly Rs 645 per running foot of the bridge.

Replying to **Shri R. P. Chanda**, the Author said that the subsoil water level was higher than the bottom of the well caps and powerful pumps were used to lower the water level during concreting and to keep it depressed for at least 24 hours afterwards. As the contract was on a lump sum basis, the question of extra payment did not arise.

In reply to **Shri A. Guha**, the Author said that stiffeners and diaphragms had been provided to strengthen the beams and to distribute the load equally on all three of them according to the requirements indicated by the design calculations.

In reply to Mr. C. M. Bennett, the Author stated that the Index Plan in Plate I showed the old alignment of the National Highway which had subsequently been realigned.

The thickness of the precast footpath tiles was $1\frac{1}{4}$ inches.

In giving very briefly the details about the testing of the bridge, the Author said that the tests had been carried out with static loads only. All the spans had been load-tested, one at a time, with dead load (sand bags) equivalent to the live load and impact according to the Indian Roads Congress Class AA loading and the deflection produced was noted by two levelling instruments. The maximum deflection noted had been found to be $\frac{1}{2}$ in. in the case of the cantilever end span which was much less than the theoretically permissible deflection.

Discussion on Paper No. 147.

"An Adaptable Steel Centring for R. C. Bridges."*

By

A. NAGESWARA AYYAR

Tuesday, February 20, 1951.

Shri M. S. Thirumale Iyengar (Chairman) referred to the Author's original Paper and said that the Author had made a further contribution describing some aspects of the centring design in greater detail. He had also amended his design in the light of the discussion on the original Paper.

He then called upon Shri B. N. Shenoy to introduce the discussion as the Author was absent.

Shri B. N. Shenoy stressed the importance of stocking adaptable centring in all States. He said that the tendency of late had been to suit the design of a bridge to the centring available often irrespective of the appropriateness of the design on other relevant considerations. An adaptable centring would remove this tendency and effect large savings wherever there was a big bridging programme in any part of the country.

Shri K. K. Nambiar considered that it was necessary for the Author to have changed the maximum permissible tensile stress of 8 tons per square inch for steel, which had been adopted in the original Paper to 7 tons generally and $6\frac{1}{2}$ tons in case of welded parts, only because some Members had objected to the higher figure for the reason that bolt holes would become loose by repeated use thereby giving higher actual stresses than the computed figures. In such temporary structures as a centring a reduced factor of safety was permissible.

These and other alterations had contributed to the increase of the total weight of the centring from 212 tons to 290 tons for a unit stockpile, the cost of which came to 2.4 lakhs. Three units recommended to be stocked would, therefore, cost 7.31 lakhs. The speaker was of the opinion that such a costly centring would pay its way only if its continuous use was assured for several years. The investment was considerable. Maintenance cost by way of painting one stockpile of three sets would be roughly Rs 10,000 every 3 to 5 years according to the conditions of use or storage.

* The Paper appears at pages 278 to 291 of the Indian Roads Congress Journal, Volume XIV-3 and the original discussion at pages 537-547, Volume XIV-4. Further contribution by the Author is at pages 449 to 466, Volume XV-3.

To transport the centring about also was not very easy.

To slide the centring along from span to span across the bed of a major river like the Godavari on vertical and longitudinal jacks or to swing them around by derricks supported on piers would be a major operation.

Even by adopting this centring, the use of the usual scaffolding and strutting was not completely eliminated. A good deal of timber trestles and scantlings would still be necessary.

In these circumstances it was doubtful whether there would be sufficient inducement to a firm of contractors to make such a large investment on such equipment. Till now contractors have been managing to erect centring for such large spans with materials available locally, casuanna posts, teakwood scantlings and planks, etc. If Government departments were to go in for such an investment they would have to tie themselves to this one type of bridge superstructure for several years to come to make use of this centring outfit. Of course, there was the advantage of being able to use it repeatedly for an indefinite number of times.

The speaker described how he had used timber centrings 10 times over on a series of bridges without serious damage or material replacements. On the whole, however, Shri Nambiar was inclined to give guarded support to Shri Nageswara Ayyar's proposal provided the country had a continuous bridging programme of more or less the same type of superstructure concentrated within a reasonable radius facilitating the transport of centring units from one bridge site to another.

Shri M. Meeran also doubted the justification for reducing the working stresses from 8 to 7 tons for the reason that the members were subjected to reversal of stresses. The failure of a member, he said, by fatigue on account of reversal of stresses took place only after a repetition of about 5 million cycles. In this case, even granting that a centring would be used continuously for about 20 years, the number of reversal of stresses would not be anything more than about 50 or 100. So, it was unnecessary to reduce the working stresses from 8 tons to 7 tons. The reduction of the working stresses had unnecessarily added to the weight of the centring which was an important factor.

Shri V. L. Jategaonkar wanted to know whether the Author had worked out the details of the main trusses with four or more tiers for spans bigger than 150 feet and if so whether he had found

any special disadvantage in them. He suggested that the trusses with four tiers would lead to lighter sections and lighter panels. The components could be welded at suitable junctions so that the work of assembling the trusses in the field could be reduced considerably leading to economy and speed in the erection of the centring.

The speaker was of the opinion that some main bridge types viz., arches in masonry, pre-cast blocks or reinforced concrete had been left out of consideration. He considered that by evolving an arrangement to give support from truss to truss, cross purlins at suitable intervals along the profile of the arch, and the provision of suitable packing blocks of wood or of cast iron wherever necessary, the utility of the centring would be greatly enhanced so that it would become universally useful. Trusses with four tiers would, in the speaker's opinion, be more convenient for the suggested improvement. This would also incidentally lead to a reduction in the timber scantlings required in the case of bridges of other types.

Shri B. N. Shenoy replying to the discussion recommended acceptance of Shri Meeran's suggestion for adopting the higher figure of 8 tons per sq. in. for the maximum permissible stress.

Replying to Shri Nambiar he said that whether it would be economical to use the suggested centring or not depended on the number of spans that would have to be tackled. Shri Nageswara Ayyar thought about this in the context of the Godavari and Krishna bridges which happened to be near to each other and for which similar designs for about 80 spans in all of 150 ft had been proposed. So, for such a number of spans a centring like that proposed by the Author, besides being useful, would be economical. In his opinion it was not the intention of the Author to present the design as complete and final in itself. He had only given some food for thought and further research. Some sort of universal centring, even one on a smaller scale, was sure to lead to ultimate economy.

Another point in the Author's argument in support of the proposal was that engineers who did not have sufficient capital to finance bridge contracts could enter the field as contractors if centring materials were supplied by the department out of its own stock piles.

The Chairman in his concluding remarks commended the idea of stocking adaptable centrings. Very often the cost of centrings in a bridge was as much as from 20 to 24 per cent of the

actual value of the reinforced concrete work. On special locations and in certain classes of bridges, the centring costs rose to as much as 40 per cent. The design of the adaptable centrings to be stocked could perhaps be further modified to make the centrings still more economical and to meet the other criticism that had been made.

He thanked the Author for the industry and the perseverance in the pursuit of knowledge exhibited in the compilation of the Paper and concluded by thanking Shri Shenoy for introducing the Paper.

The Author, in his written reply said that both **Shri Nambiar** and **Shri Meeran** had questioned the desirability of reducing the permissible stress in steel from 8 to 7 tons per sq. in. He, however, was convinced that, on account of repeated use, storage in the open, susceptibility to damage in transit from place to place, and possibility of rusting, the centring would be more heavily stressed than trusses permanently erected and maintained in position undisturbed. The reduction in the maximum permissible stress suggested by the Author was, therefore, desirable.

As regards increase in weight brought about by reducing the permissible stress the Author pointed out that, excluding the cross beams, floor plates and wind braces, the weight of two main trusses was 129 tons according to the original design (vide page 288-I. R. C. Vol. XIV-3) and 144 tons according to the revised design (vide para 16 of page 453 I. R. C. Vol. XV-3). The actual increase for the two main trusses was only 15 tons, a considerable portion of which was due to the increase in the road width from 22 to 24 feet.

The total weight of the centring for one span was, it was true, 270 tons against 212 tons in the original design. This increase of 58 tons was again due partly to the adoption of a lower figure for the maximum allowable stress, partly to the increase of road width, and partly to the substitution of steel sections for the timber scantlings which were a feature of the original design. In the present design, except for wedges, temporary stays, and a few supports for floor plates, timber was avoided. Further an extra 20 tons were added to the stock pile so as to facilitate adaptation for different kinds of structures.

The increase due to the adoption of 7 tons as the permissible stress would not be more than 12 tons. This, according to the Author, was negligible considering the increased factor of safety which was necessary in view of the rough handling the materials would receive.

The Author pointed out that the total load, coming on to the truss of 150 ft span was 1000 tons. A pair of economically designed trusses to carry this load, excluding cross girders, floor and wind braces, would weigh approximately 118 tons (by the empirical formulae of Unwin). Cross-girders, floor plates etc. were already of economical sections and much saving could not be effected in them. Thus, the saving in weight that could be effected even at the sacrifice of interchangeability or adaptability would not be more than 30 tons in a total of 270 tons, which was only about 10 per cent.

Regarding **Shri Nambiar's** doubt about the adaptability of the centring to various types of bridges, the Author referred him to Plates IV (page 466), and VI (page 468) and Appendix E in Indian Roads Congress Journal Volume XV-3 which illustrated how different spans and different types of structures could be built with the materials from stock pile.

Three stock piles had been recommended for a large bridging programme. One or two stock piles would do when the programme was not so big.

Regarding timber-supported formwork, the Author was of the opinion that such formwork was all right when timber was cheap and plentiful but now the material had become very costly. Timber formwork was suitable only in the conditions when supporting from the bed and blocking up a considerable portion of the waterway was permissible. In such a case, steel supports could be had from the stock pile and the trusses made much lighter. This had been specifically pointed out on pages 453 and 454 of the Volume XV-3.

The smooth finish of concrete obtainable with steel formwork was a further advantage.

Although it was not claimed that the design adopted was the best or the most economical, the utmost care had been taken in selecting the unit parts with this object in mind.

Replying to **Shri Jategaonkar** the Author said that trusses consisting of more than three tiers had not been considered as the longest reinforced concrete span likely to be built in this country might not exceed 150 feet for some time to come and for this three tiers were sufficient for a rise of $1/5$ span. Moreover, trusses with four tiers would be more than 50 feet high and would require heavy lateral bracing. It would also be difficult to keep them upright while moving them from span to span. The increase in

the number of parts, additional wind braces, and additional gusset plates, would practically wipe out any advantage got by increasing the depth of the trusses.

For arches it would be easy to build up a centring from the stock pile. In the revised design a special seating (Part 10, Plate I) had been provided at panel points, so that cross girders might be placed over them. The formwork for an arch could easily be built up over the cross girders.

Masonry arches were not likely to be adopted for spans of more than 60 to 80 feet so that their rise at $1/4$ span would not exceed 20 feet. Two-tier side trusses could easily carry the load of such arches. In the case of reinforced concrete arches, which would be much lighter the centring could be built up over cross girders resting over panel points.

Thus, the stock pile would provide materials for centring for any kind of bridge structure up to 150 feet span and 24 feet road way.

INDIAN ROADS CONGRESS

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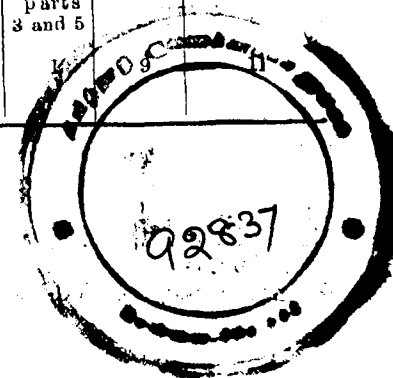
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BOOK REVIEW

THE INDIAN CONCRETE JOURNAL.

International Engineering Conferences Special Number.
Volume XXIV-December 1950—Number 12.

Published by the Cement Marketing Co. of India, Ltd., Bombay.
Pp: 1+57; Paper bound; price Rs 1-8-0.

On the occasion of the International Engineering Conferences held for the first time in India and attended by large number of foreign delegates—all specialists in their own branches of engineering the Cement Marketing Co. of India Ltd., brought out a special number of their monthly Journal, entirely devoted to the Irrigation & Power Project Development in India.

Many eminent engineers in the field of Irrigation and Power Engineering have contributed articles to this issue. Starting with the Mettur Dam, various hydro-electric projects in India—whether completed, under construction or being planned—are described in the Journal in interesting language, supplemented by well reproduced maps, charts, tables, and drawings. The Authors have endeavoured to supply as much detailed information as compatible with the limited scope of the Journal. Starting with planning and design, the various constructional difficulties have been described and the steps taken to overcome them, enumerated. All the articles are well illustrated.

There are many volumes describing the projects separately and in detail. But we have not so far seen any other book or paper giving in such an attractive form the salient features of so many big main projects in one issue. For this reason alone this special issue of the Indian Concrete Journal may very appropriately be termed a "Directory of Hydro-electric Projects in India",

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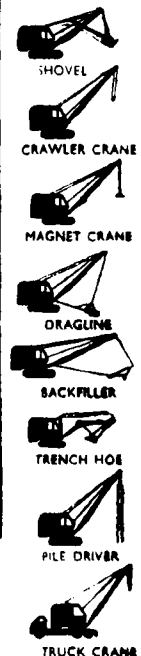
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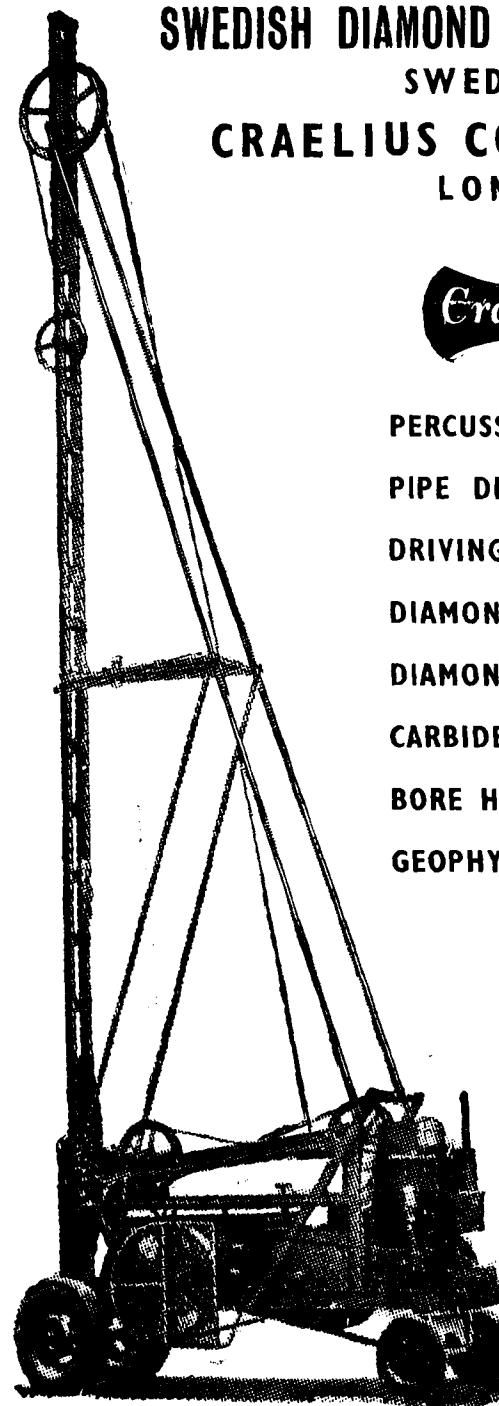
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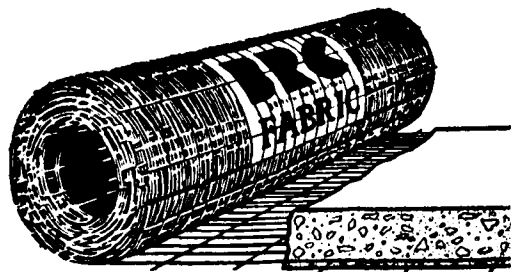
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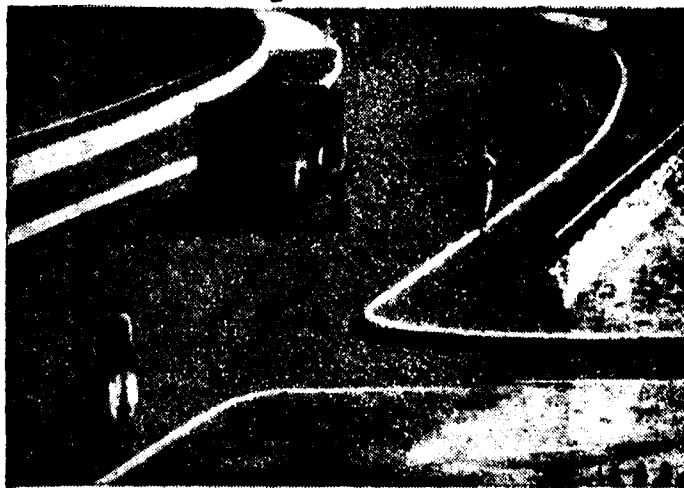
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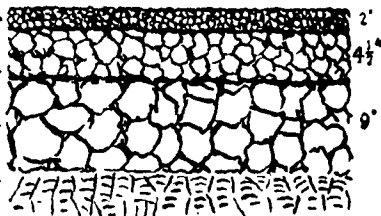
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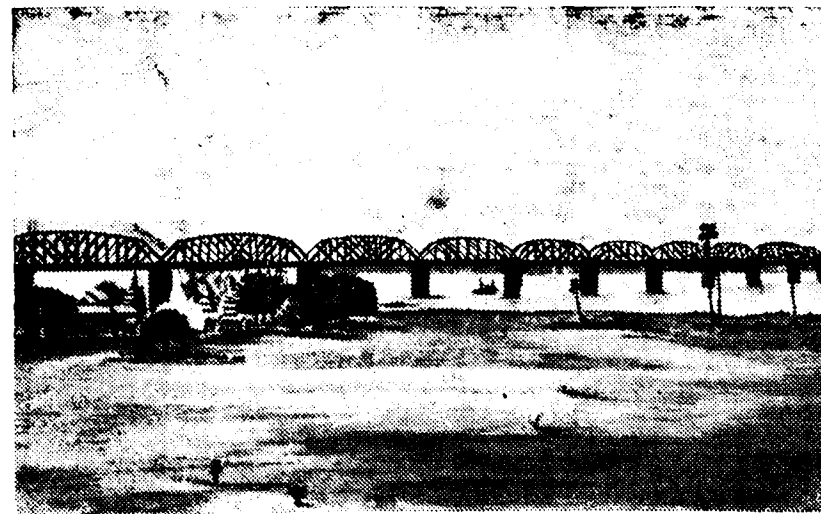
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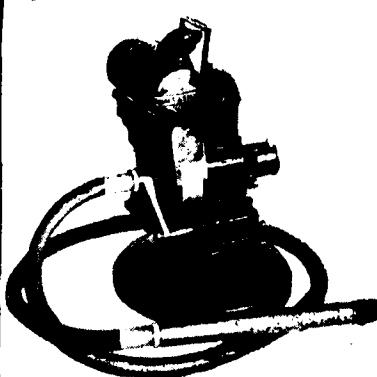
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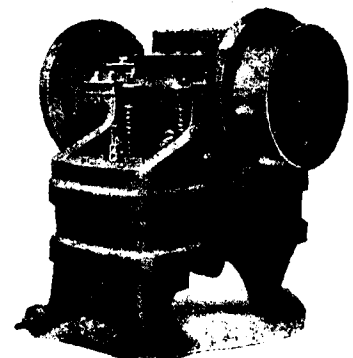
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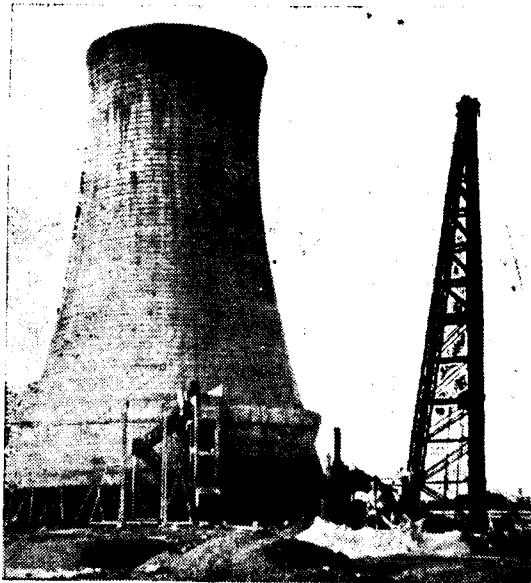
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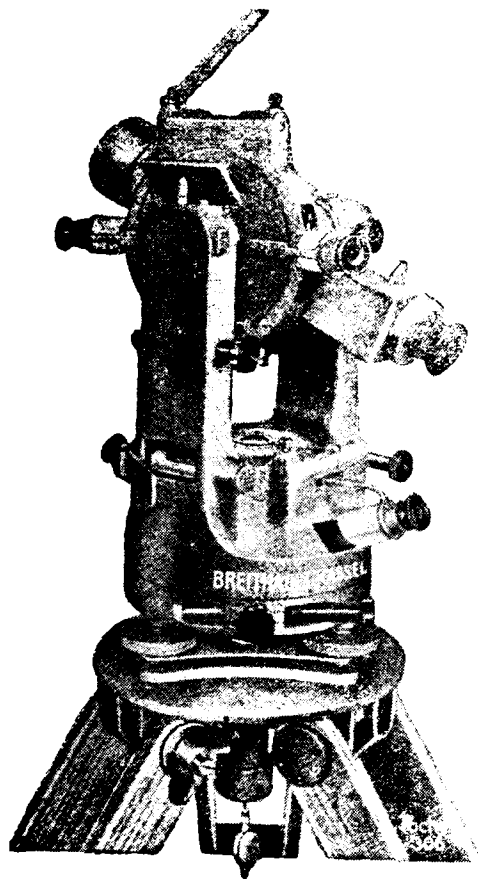
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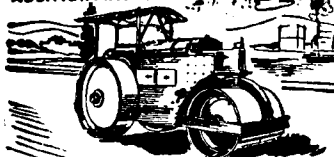
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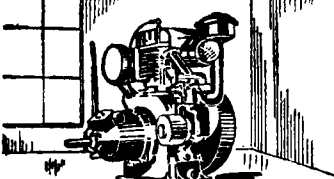
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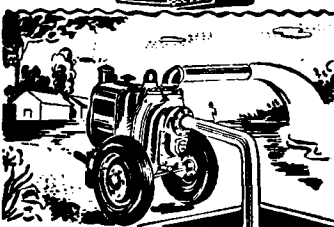
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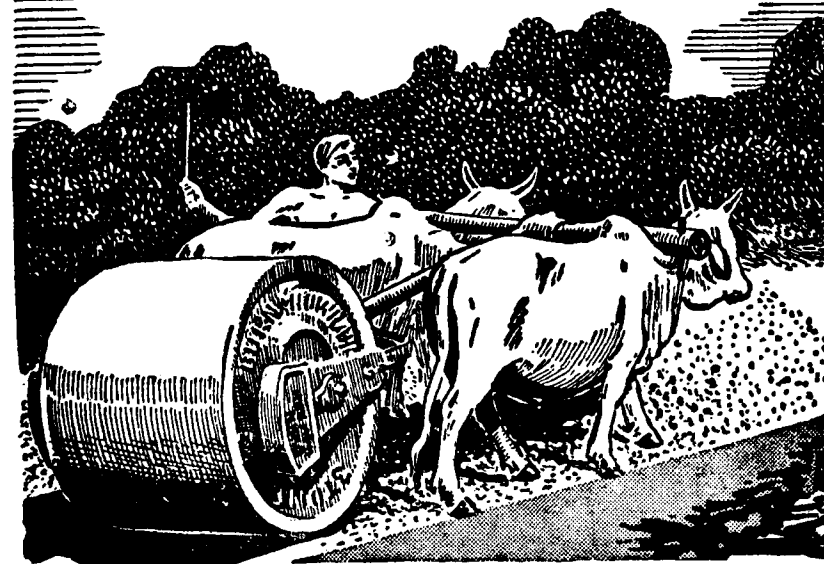


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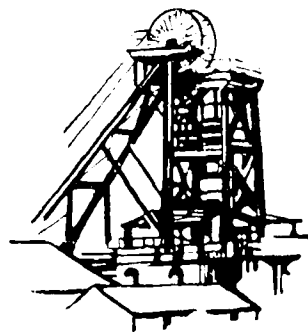
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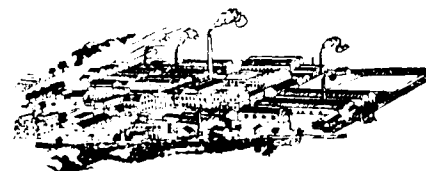
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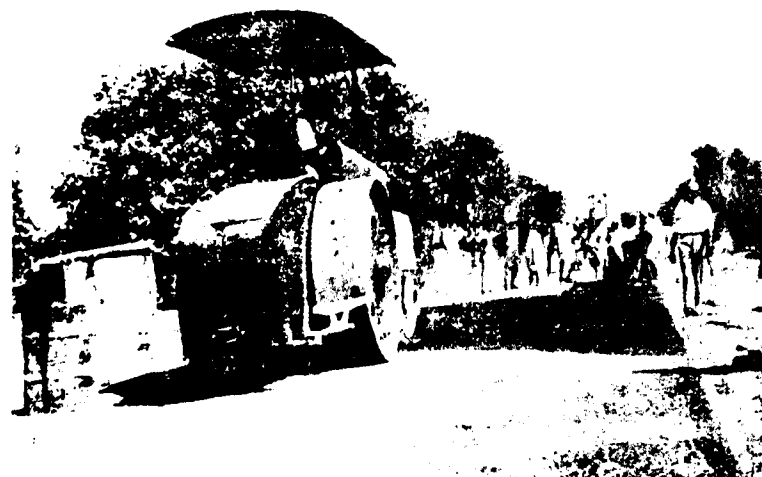
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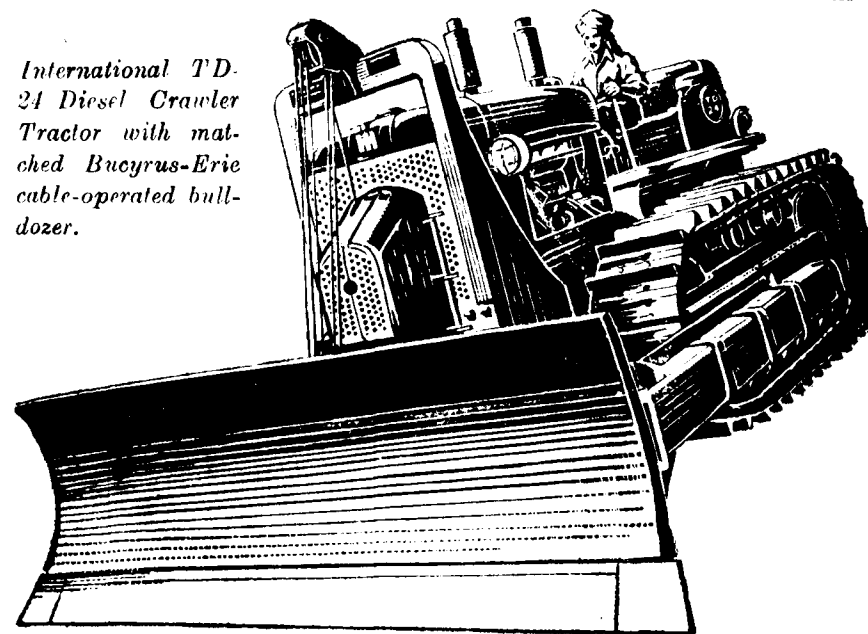
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