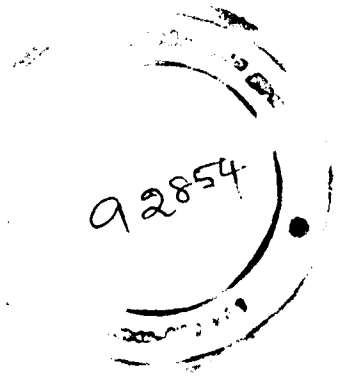
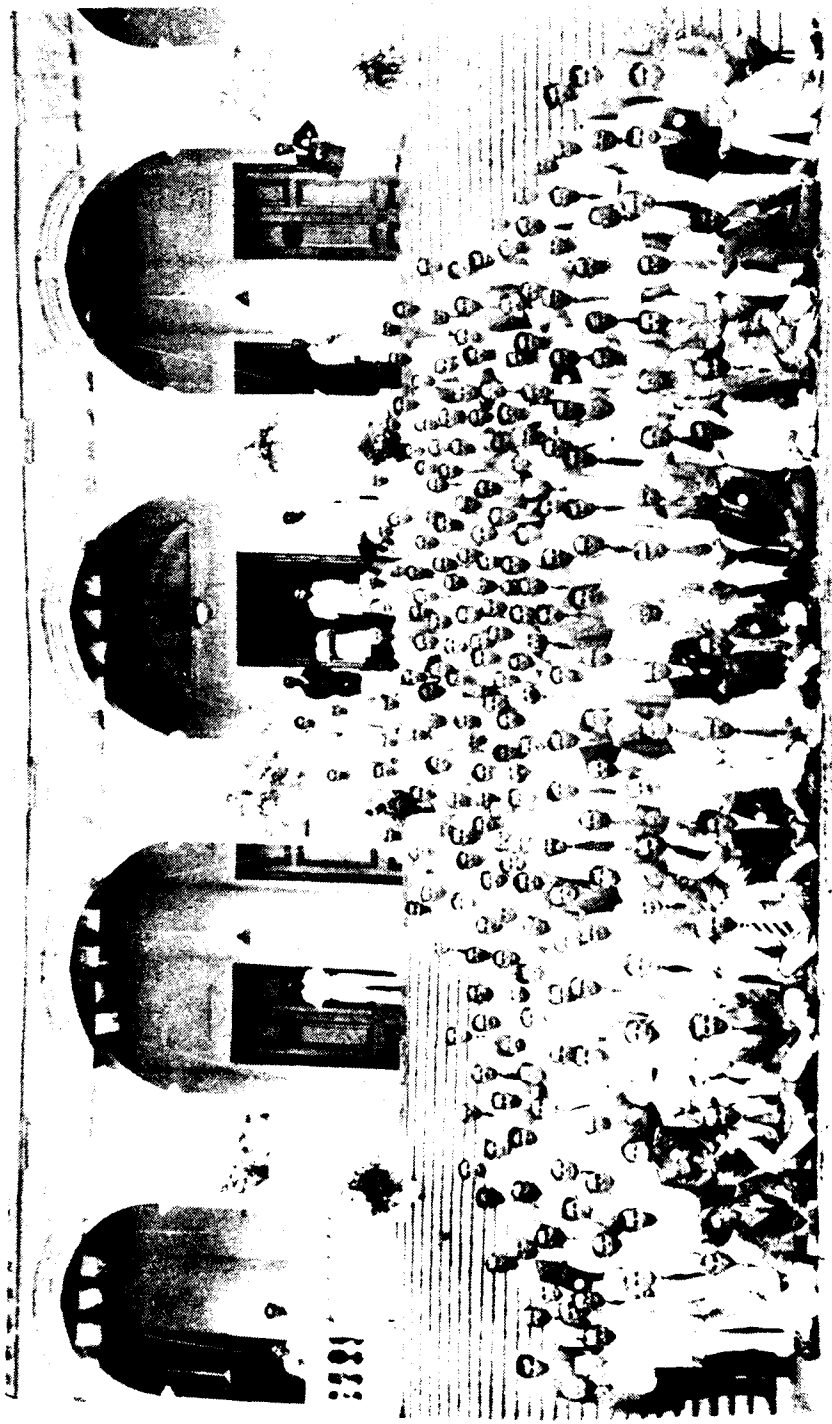
LIST OF MEMBERS OF THE COUNCIL FOR 1952-53.

1. F. P. Antia.
2. M. L. Bahl.
3. R. K. Batra.
4. C. M. Bennett.
5. U. J. Bhatt.
6. M. S. Bisht.
7. Brijmohan Lal.
8. S. N. Chakravarti.
9. P. V. Divatia.
10. N. Durrani.
11. G. N. Dutt
12. C. J. Fielder.
13. D. N. Gupta.
14. R. N. Joshi.
15. K. K. Kartha.
16. G. C. Khanna.
17. Kishore Lal Mathur
18. U. N. Mahida.
19. M. S. Mathur.
20. G. M. McKelvie.
21. M. Meeran.
22. C. P. Misra.
23. A. C. Mukerjee.
24. E. A. Nadirshah.
25. D. P. Nayar.
26. Brig. Partap Narain.
27. L. R. Patel.
28. Raghbir Singh.
29. D. V. Rao.
30. Romesh Chandra.
31. B. N. Roy.
32. R. C. Roy.

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





Indian Roads Congress, Seventeenth Session, Madras, February, 1953.

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SHRI T. MITRA, I.S.E., President, 1952 53.

Shri T. Mitra was born at Calcutta on 20th January, 1900, and received his early education there, attaining a brilliant record in Scottish Churches College. He was educated at the Bengal Engineering College from 1918 to 1922 and passed his B.E. from the Calcutta University in the latter year. He was appointed to the Indian Service of Engineers in 1923.

He rose to the rank of an Executive Engineer in 1929 and was promoted to the rank of Superintending Engineer in the year 1942. He was specially selected in 1945 to be the Special Officer, Roads, Bengal to draw up a comprehensive plan for Road Development in Bengal and to set up an Organisation for planning and execution of this Road Plan. Now he is serving the country as the Chief Engineer, Government of West Bengal, Works and Buildings, Calcutta, since 5-8-1948.

He was elected as a member of the Indian Roads Congress in the year 1939, and became the President of the Society for the year 1952-53. He has been actively associated with the work of the Road Test Track, Calcutta. He is a member of the Institution of Engineers (India) and a member of the Faculty of Engineering of the Calcutta University. He is also a member of the Indian National Society for Soil Mechanics and Foundation Engineering.

NOTICES AND ANNOUNCEMENTS

CONTRIBUTION OF PAPERS FOR THE EIGHTEENTH SESSION OF THE INDIAN ROADS CONGRESS

The next General Session of the Indian Roads Congress is likely to be held sometime in January—February 1954. 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 five months.**

From past experience it is observed that most of the 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 their contributions **within the next five 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. All Members are eligible for the award of the Medals.

7. Rules and Regulations for the contribution of Technical Papers and the Award of Medals are published on pages 8 to 13 of Volume XVII-1 of the Journal of the Indian Roads Congress—December 1952.

II. NEW ADMISSIONS

LIST OF MEMBERS OF THE INDIAN ROADS CONGRESS ENROLLED FROM 6—12—1952 TO 27—3—1953

Serial No.	*Roll No.*	*Name.*	*Address.*
1303	1700	D. R. Sikka.	Assistant Engineer, P. W. D., C. R. P. Lines, Indore. (Madhya Bharat).
1304	1701	T. O. Jacob.	Junior Engineer, Highways, Karur East, Karur. (Madras State).
1305	1702	A. Mukerjee.	Assistant Engineer (Consultant), Ministry of Transport (Roads), Jamnagar House, Shahjahan Road, New Delhi-2.
1306	1703	M. S. A. Rao.	Sub Divisional Officer, P.W.D., Chanda. (Madhya Pradesh).
1307	1704	V. V. Kale.	Executive Engineer, P.W.D., Dharwar Division, Dharwar. (Bombay State).
1308	1705	Tufani Rai.	Assistant Engineer, District Board, Sassaram, District Shahabad. (Bihar).
1309	1706	N. N. Rohatgi.	P. A. to Superintending Engineer, C. N. C., P.W.D., Ranchi. (Bihar).
1310	1707	B. N. Gupta.	Assistant Engineer, B. & R., P. W. D., Rajasthan, Bundi.
1311	1708	S. N. Sahay.	Assistant Engineer, P. W. D., C/o. Shri S. N. Sahay, Bar-at-Law, Budha Marg, Patna-1. (Bihar).
1312	1709	S. L. N. Moorthi.	Municipal Engineer, Coimbatore. (Madras State).
1313	1710	C. H. Sanghvi.	Superintending Engineer, P. W. D. & Irrigation, Northern Circle, Lashkar. (Gwalior).
1314	1711	M. R. Natu.	Engineer, C/o. Messrs Greaves Cotton & Co., Ltd., 19, Second Line Beach, P. O. Box No. 207, Madras.
1315	1712	M. P. Subramonia Iyer.	Supervisor, P.W.D., 108, College Lane, University Ward, Trivandrum. (Travancore-Cochin).
1316	1713	K. Krishna Mohan Rao.	Assistant Engineer, Highways, Bapatla, District Guntur (Madras State).

Serial No.	Roll No.	Name.	Address.
1317	1714	K. C. Mital.	Assistant Engineer, B. & R., P.W.D., City Sub-Division No. 4, Jaipur. (Rajasthan).
1318	1715	Achyutananda Choudhury.	S. D. O. (P.W.D.) Mawphlang-Balat Road, P. O. Mawphlang, District Khasi-Jaintia-Hills. (Assam).
1319	1716	T. M. Menon.	Engineer, C/o. Concrete Association of India, 1-2 Queens Road, Fort, Bombay-1.
1320	1717	S. H. Mahadevan.	Assistant Engineer (Highways), Noyyal Bridge Sub-Division, Coimbatore. (Madras State).
1321	1718	G. S. Gnanaprakasam.	Divisional Engineer, (Highways), Chingleput Division, Saidapet, Madras.
1322	1719	G. S. Sastry.	Executive Engineer, Rajasthan P.W.D., Bhilwara. (Rajasthan).
1323	1720	K. S. Sankaran.	Junior Scientific Officer, Central Road Research Institute, P. O. Okhla, New Delhi.
1324	1721	C. S. Parthasarathy.	Technical Officer, Planning Commission, New Delhi.
1325	1722	S. Mumtaz Ali.	Assistant Engineer, P.W.D., Ali Manzil, Manglabagh, Cuttack. (Orissa).
1326	1723	S. V. Natu.	Executive Engineer, Design Division, P. W. D, Poona-1.
1327	1724	N. V. Joshi.	Divisional Engineer, P.W.D., Roads Division, Hyderabad-Deccan.
1328	1725	N. M. Andhare.	Executive Engineer, P.W.D., Sagar. (Madhya Pradesh).
1329	1726	M. Krishna Murti.	Executive Engineer, Madras Aviation Division, C P.W.D., No. 3, College Road, Nungambakkam, Madras-6.
1330	1727	Deba Prasad Sen.	Assistant Engineer, (W. & B.), West Bengal, Kalimpong Sub Division, District Darjeeling.
1331	1728	Shiba Kinkar Patapatra.	Assistant Engineer, (W. & B.) Dept., Govt. of West Bengal, 75, Baburam Ghosh Road, P. O. Tollygunge, Calcutta-33.

Serial No.	Roll No.	Name.	Address.
1332	1729	Debapriya Ghosh.	Assistant Engineer, (W. & B.), Govt. of West Bengal, 9, Satyen Datta Road, Calcutta-29.
1333	1730	M. A. Thirunavukarasu.	Divisional Engineer, Highways, Agency Division, P.O. Rajmundry, East Godavari District.
1334	1731	Hari Shankar.	Executive Engineer, P.W.D., Indore. (Madhya Bharat).
1335	1732	K. Namasivayam.	Divisional Engineer, (Highways), No. 8, Coats Road, T/Nagar, Madras.
1336	1733	G. H. Vaida.	Assistant Engineer, P.W.D., Anantnag. (Kashmir).
1337	1734	R. S. Melkote.	Junior Research Officer, Hyderabad Engineering Laboratories, A/10/225, Himayat Nagar, Hyderabad, Deccan.
1338	1735	A. K. Sen.	Assistant Engineer, Road Development Deptt., P. O. Contai. (Midnapore). West Bengal.
1339	1736	J. T. Dikey.	Assistant Engineer, P.W.D., Gondia. (Madhya Pradesh).
1340	1737	N. G. Morarji.	Engineer, Pashabhai Patel Co., Ltd., Rajjab Mahal, Churchgate Reclamation, Fort, Bombay.
1341	1738	K. Pattabhi Rama-Reddy.	Special Junior Engineer, (Highways), Gudur. (Madras).
1342	1739	I. C. Desai.	Engineer, District Local Board, Broach. (Bombay State).
1343	1740	S. Das Gupta.	Assistant Engineer, S. D. O., P.W.D., Madhipura. (Bihar).
1344	1741	P. B. Bhattacharya.	Executive Engineer, P.W.D., Rewa, (Vindhya Pradesh).
1345	1742	S. H. Abhyankar.	Executive Engineer, Central P.W.D., Mercara. (Coorg).
1346	1743	A.M.V. Prasada Row.	Managing Director, Ram Prasad Ltd., 5, Sri C. V. Raman Road, Alwarpet Madras.
1347	1744	M. L. Narayana.	Divisional Engineer, Highways, Nellore. (Madras State).

Serial No.	Roll No.	Name.	Address.
1348	1745	P. Rama Rao.	Assistant Engineer, Corporation of Madras, Ripon Buildings, Madras.
1349	1746	N. P. Das.	Assistant Engineer, Roads and Buildings, Chief Engineer's Office, Bhubaneshwar. (Orissa).
1350	1747	Madan Mohan Bhanja.	Assistant Engineer, P.W.D. Municipal Road Sub Division, Cuttack-1. (Orissa).
1351	1748	Gokal Chand.	Superintending Engineer, P.W.D., Jabalpur Circle, Jabalpur. (Madhya Pradesh).
1352	1749	L. J. Chauhan.	Deputy Engineer, Sabarmati Bridge Sub Division, Dholka, District Ahmedabad.
1353	1750	T. N. Rajaram.	Assistant Engineer, Highways, Ariyalur. (Madras State).
1354	1751	V. N. Calla.	Assistant Engineer, B. & R., P.W.D., Mangaliawas House, Calla Street, Jodhpur. (Rajasthan).
1355	1752	K. G. Shah.	Assistant Engineer, B. & R., P.W.D., Jhalawar Sub Division, Jhalawar. (Rajasthan).
1356	1753	K. Madhavan Nayar.	Assistant Engineer, P.W.D., Sub Division, Thiruvalla. (Travancore-Cochin).
1357	1754	N. Ramachandran.	Junior Engineer, Highways, Karur West, Karur. (Madras State).

ASSOCIATE MEMBERS

1	49	Messrs Garlick & Co. Ltd.	26, Errabalu Chetty Street, Madras-1.

III. DEATH

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

1	543	K. Venkatachallam.	Executive Engineer (Irrigation), Warangal District, Hamamkonda Post, Via Kazipet. N. S. Rly.

IV. ADDRESSES OF MEMBERS WANTED.

Communications addressed to the following members have been returned unclaimed by the Post Office. Members able to give information regarding the present address of any of those concerned are requested to forward particulars to Secretary, Indian Roads Congress.

Serial No.	Roll No.	Name of Member.	Address.
1	1394	Anand, R. M.	Sub Divisional Officer, Development Sub Division I, Model Town, Jagadhri, Ambala District.
2	887	Chari, T. V. R.	Assistant Engineer, Puttur Sub Division, South Kanara Division, Puttur. (Madras State).
3	1184	Damodar Das.	District Engineer, P. W. D., B. & R., Orai, District Jalaun. (U.P.).
4	125	Gupta, N. Das.	C/o. Mr. K. R. Sen, Calcutta Insurance Co. Ltd., Connaught Circus, New Delhi.
5	1315	Gupta, Ranjit Kumar.	Assistant Engineer, (W. & B. Deptt.), C/o., K. K. Biswas, 29—C, Creek Row, Calcutta.
6	652	Guruswamy, S.(L.M.).	No. 9, Appaswami Koil Street, P.O Mylapore, Madras.
7	1253	Hasan, S. M. I.	Assistant Engineer, P. W. D., I/c. Ranchi No. 3 Sub Division, Ranchi. (Bihar).
8	1026	Hege, W. D.	Asphalt Sales Engineer, C/o. Caltex (India) Ltd., P.O. No. 155, Ballard Estate, Bombay.
9	465	Jha, B. K.	Village Banu Chopra, P. O. Bettiah. District Champaran, (Bihar).
10	984	Mathew, K. M.	Executive Engineer, P.W.D., Sinculam Division, Munnar. (Travancore-Cochin).
11	1256	Mazumdar, J. P.	Consulting Engineer, Architect Builder, 52-B, Kailash Bose Street, Calcutta-6.
12	90	Mohd Abu Turab.	Superintending Engineer, (Retired), A/8 No. 220, Lane Opposite Raj Mahal Talkies, Lingampally, Hyderabad-Deccan.
13	935	Naidu, S. R. M.	Garrison Engineer, Dehu Road.

Serial No.	Roll No.	Name of Member.	Address.
14	702	Rathod, G. D.	Executive Engineer, C/o. Palji Mistry, Quarter No. 26, Mall Road, Delhi Cantt.
15	1238	Resham Singh.	C/o The Principal, Central School of Drilling, Dhanauri, P. O. Roorkee-Cantt.
16	726	Shafiqual Haq.	Assistant Engineer, Design Division, (Irrigation), Eden Building, 17, Dacca. (East Bengal).
17	1325	Sharan, Raghunath.	Assistant Engineer, Waterways, Chaibasa, Singhbhum. (Bihar).
18	1117	Sundaraj, B. K.	Assistant Engineer, Now United Construction Co. Ltd., Khaperkheda, via Nagpur G.P.O.
19	33	Syed Arifuddin.	Retired Chief Engineer, 1246 Chaderghat High School Lane, Abid Road, Hyderabad-Deccan.
20	1366	Varma, K. N.	Sub Divisional Officer, P. W. D., Mokamoh. (Bihar).
21	1120	Wadia, K. C.	Officer-on-Special Duty, Finance Department, Hyderabad Government, Hyderabad-Deccan.
22	236	Zutshi, M. N.	Valab Hotel, Kulri, Mussoorie. (U.P.).

ASSOCIATE MEMBERS

23	20	Garewal Sapuran Singh.	C/o. The Master Construction Company Ltd., Engineers, and Contractors, Cosy Cote, Kathiar. (Bihar).

PROCEEDINGS OF THE SEVENTEENTH SESSION OF THE INDIAN ROADS CONGRESS

Vol. XVII-Part 4 MADRAS February 1953

PRESIDENTIAL ADDRESS

The Seventeenth Session of the Indian Roads Congress was held at Madras from the 7th to the 14th February 1953, and was formally opened by Shri N. Ranga Reddi, Minister for Public Works, Madras State, at 11.00 a.m. on the 8th February 1953 in the Rajaji Hall. The proceedings opened with an Address by Shri T. Mitra, the President, the full text of which is given below :

It is the pleasant duty of the President to welcome each year in our midst, besides our own Members, distinguished guests whose presence has always been a source of inspiration to this Society. When we meet together in such company, we naturally feel lifted from the sense of isolation that would otherwise afflict an exclusive professional organization such as ours. It is this presence of our guests—persons distinguished in various spheres of public life—which greatly helps us to put our deliberations in proper perspective and makes us realize that ours is an effort which must find fruition as a part of the social whole. We therefore extend our grateful welcome to you, Sir, and to our other guests who have graced this occasion with their presence. To members and delegates we wish happy re-union for years to come.

OUR HOSTS

It is eight years since we met last in Madras in February 1945, with Mr. J. Vesugar in the chair. Great changes have occurred in India since then and Madras has also partaken of the fruits of such changes. This Congress is now meeting in Madras for the first time since Independence; but Madras has not meanwhile lagged behind any of her sister States in her solicitude for "roads" Of all the States in India, Madras collects the largest revenue from her road user taxes; and it must be said to her credit that she spends the largest amount on the maintenance, improvement, and new construction of roads in the State. She has also been the first State to create a separate Highways Department in her administration. Madras is an

advance mile-post in our highway to progress. To the Government of Madras we convey our warm appreciation of the hospitality they have extended not only to this Society but to its cause as well.

OURSELVES

It is customary for the President every year to say something to remind ourselves of the cause which the Indian Roads Congress stands for, namely, the promotion and encouragement

The President's Address to the Congress was heard with rapt attention.

of the science and practice of the building and maintenance of roads in India. This Society exists to provide opportunities to its members to pool their collective experience and ideas on matters relating to highway engineering. Discussions at our annual meetings and deliberations in the various committees and in the Council have enriched our experience. Our Congress has interested itself in research activities connected with highway engineering, in designs, standards, and specifications; it has looked forward to the training of our engineers in advanced techniques in the construction and maintenance of roads and also to the improvement and rationalization in the methods of highway finance.

We have also interested ourselves in various legislation relating to the improvement, co-ordination and regulation of inland transport. Through the I. R. C. Journal and the Transport-Communications Monthly Review, we have been trying to explain our task to engineers and laymen alike. It is a matter of special pride to us that this Society was the first in the field to put forward a development plan in 1943, even before similar plans in other spheres came to be discussed. The first Five-Year Plan recently published by the Government of India has many facades of which the part relating to the development of roads is a direct outcome of what this Congress proposed at its Gwalior Session in October, 1943.

As in all previous Sessions we shall be discussing interesting Papers on different subjects of highway engineering. Many of our Members, I am sure, will exchange a lot of useful ideas and our junior members will listen in and benefit from this contact with their elders. Ours is a subject of perennial interest not only to engineers but to civilization itself. Roads have been the most important means of communication from the dawn of civilization. The steamship, the railways and the aeroplane have in recent times evoked justified admiration for the inventive genius of man and they have revolutionized our concept of mobility through the space. But when all is said and done, these new inventions have not obviated the use of roads. On the contrary, they have only increased the demand for roads and in many ways contributed to the improvement of roads themselves and of road transport.

INDIAN ROADS

In India throughout the ages the insular local economy of the village has been the characteristic social organization. A village or a group of villages used to form a closed economic unit producing all that it required with little need for outside contact. This insular economy of the village laid down the conditions of communication and transport in India. While the village remained the "unconnected atom", inter-communication was necessarily fragmentary and primitive. The extreme self-sufficiency of the village communities and the absence of inter-communication amongst them reacted on each other. The isolation of the village was at once the cause and the effect of the absence of communications.

Village self-sufficiency rendered long-distance communication unnecessary, and lack of communication facilities perpetuated the exclusiveness of the villages. On this plan, the community existed on an unalterable scale of low conveniences and lacked the necessary urge for social advance. Occasionally, an ambitious emperor would build trunk roads effectively to control his sprawling dominions. But when dynasties broke up, the lines of communication were fragmented to suit the limits of the mutually exclusive principalities.

The trunk system built by an Asoka, a Sher Shah, or an Akbar would then degenerate into patches of cart-tracks incommunicable in stretch. Locomotion was also slow; the quickest means of transport was riding on horseback or in the horse-drawn carriage, so that the speediest movement in distance recorded in the history of pre-British India was the movement in 1573 of Akbar's army which "with hurricane speed traversed a distance of six hundred miles from Sikri to Ahmedabad in eleven days."

ADVENT OF THE RAILWAYS

Things, however, began to change with the rise and growth of the British empire in India. New conditions were now laid for the improvement of inland communications: firstly, as a vehicle of commerce; and then, as a means of sustaining a unified, centralised administration in a country of continental dimensions. Simultaneously, however, with the consolidation of the British Indian empire in the middle of the nineteenth century came the advent of the steam engine and the railways. In his minute to the East India Company's directors in 1853, Lord Dalhousie argued his case for the establishment of railways in India in the following words:—

> "England is calling aloud for the cotton which India does already produce in some degree and would produce sufficient in quality and plentiful in quantity if only there were provided the fitting means of conveyance for it from the distant plains to the several ports adapted for its shipment."

On the obverse side, Lord Dalhousie also noted the part that the Indian Railways were expected to play in the marketing of industrial goods from England:—

> "Every increase of facilities for trade has been attended with increased demand for articles of European produce in the most distant markets of India.....New markets are opening to us on this side of the globe under circumstances which defy the foresight of the wisest to estimate their probable value or calculate their future extent."

The primary duties of the railways in India were therefore to get, at diminished expenses, the raw materials for the manufacturing interests in England in exchange for imported industrial goods from that country. Whatever the purposes behind the introduction of railways in India, the steam engine, however, broke the self-sufficient inertia of the Indian economy. In a country possessing large natural resources for industrialization on her own account, the railways laid the material premises for a change in the socio-economic pattern of the country from the *local* economy of the isolated village to an expanding *national* economy.

Internally, the railways opened up the country-side and connected distant places: big towns and cities grew up at the terminal points and along the main lines; trade and commerce of the country and the whole organization of its social life underwent a revolutionary change. If the railways, tearing through the length and breadth of the country, helped to integrate the loose sub-continent into a single economic whole, the needs of internal economy soon cried out for other means of communication to sustain it. When the isolated village came out of its shell, it looked up to its neighbours and wanted to reach them. Roads, and more roads became the economic urge of this process itself.

THE PUBLIC WORKS DEPARTMENT

In the early decades of the East India Company's rule, public works policy of the Government confined itself to the construction and repairs of military buildings and some roads of military importance. Indeed, till the time of Lord Dalhousie, the authority for construction of roads and buildings was vested in a Military Board in each Presidency. Even after the setting up of a Civil Department of Public Works in 1854, 'roads' was a subject still regarded as only of local importance fit to be disposed of by devolution to subordinate authorities. The Central Government transferred the responsibilities to the provincial governments, who, in their turn, passed them on to the various "local bodies." With the development of representative institutions in India, however, this country's needs, rather than the colonial requirements of British rule in India, began to be considered.

As the economic organization of the country outgrew the extreme isolation of the village, localisation of industrial efforts

necessarily ensued. Organization and growth of such localised industries depended for their very sustenance on the existence of an adequate system of roads which alone could make available to a community goods that where produced in large-scale under conditions of concentration. Even after several decades of intensive railway construction in India, the country had, after World War I, barely 2 miles of railroads for every 100 square miles of its area and 12 miles for every lakh of its population. It was increasingly felt that in the continental dimensions of the country, the railways could at best serve the purpose of trunk communication over large distances and could not by themselves satisfy the entire needs of transport in this country. They could only form the larger framework leaving the roads to reach into the depths.

ADVENT OF THE MOTOR VEHICLE

The emergence of the motor vehicle in the present century and its mass production for public use revolutionized the outlook for road transport. Motor transport became as rapid, if not more, on short hauls, and had the advantage of being more tractable than the railways. It was also capable of being worked by small and cheap haulage units.

Prior to World War II, however, the question of road-rail competition had continued to trouble many serious minds and successive meetings of the Transport Advisory Council had been stalled by an interminable controversy about the respective claims of road and rail transport. Despite the deliberations of the Mitchell-Kirkness Committee, the Wedgwood Committee, and a host of other official inquiries, apprehensions had been shown alround that a considerable part of the "legitimate" custom of the railways was being lost to road transport.

As "railways" was a Central subject and "roads" provincial, the consequent emphasis of administrative policy laid down by the Government of India in these circumstances was on a restriction of road transport wherever it seemed to compete for custom with the railways. Such a policy also affected indirectly the interests of road development in the country, as roads came to be looked upon by the railway interests (and therefore, in a way, by the Government of India) as a sort of equipment in the hands of an "enemy." Transport conditions in the country during World War II and after have changed the emphasis in this matter. Transport needs of the country have in recent years increased to such an extent that the combined resources of the railways and the roads have been extended to the utmost and yet failed to catch up with the requirements of traffic.

The railways have not been able to accept all the traffic offered and have therefore had no cause for complaint against roads as trying to poach on the railways' preserves. Road-rail competition, as it had been known in the thirties, has ceased to exist. Development of roads, even roads running parallel to railway lines, would not now be regarded as hostile to railway interests. The Motor Vehicle Taxation Enquiry Committee, 1950, have now gone on record with a full recognition of these conditions and have recommended that short-haul railway traffic, where it is not required for heavy industrial purposes and where other means of transport are available, should be discouraged and that many existing short-distance feeder and link railway lines that are not paying their way should be dismantled unless they are required for purposes of defence.

CENTRAL ASSISTANCE

Ever since the Jayakar Committee reported in 1928 calling for a change in the whole road policy of the Government, road transport has been recognised as a matter of wider national importance and Governments, Central and Provincial, have been taking greater and more active interest in them. This interest, as has already been noted, gained special significance during World War II and after. If the institution of the Central Road Fund was the humble beginning for a planned road development in the country, the Nagpur Conference of Chief Engineers, in 1943 was a great landmark in this direction. We have not had to look back since then and the horizons of our forward vision have been gradually extending.

It is gratifying to note that the principles of the Nagpur Report have since been accepted by the Government as the basis for a planned development of the road system in India. The Government of India have now accepted direct responsibility, financial and administrative, for the development of a system of "National Highways" which had first been proposed by this Congress at its Gwalior Session in October 1943.

The final Five-Year Plan, just published, indicates a layout for 12,500 miles of National Highways, besides 20,600 miles of State roads of various categories. Actual plan of work for the National Highways during the five years ending 1955-56 provides for the construction of 450 miles of new roads and 43 very large bridges, besides a large number of small bridges. In addition, about 2,200 miles of roads will be improved. Besides such original works, nearly 10,000 miles of existing roads will be maintained in the country's system of National Highways. A sum of Rs 27 crores over a period of five years has been provided

in the Central Government's plan for the development of National Highways.

A separate provision of Rs 4 crores has also been made in the Central sector for the development of certain selected roads (other than National Highways) for which financial liability has already been accepted by the Centre. Further, a sum of Rs 21.15 lakhs will be spent on the Central Road Research Institute. The total provision for road development in the Plan in the States' sector is Rs 73.54 crores out of which Part 'A' States account for Rs 50.59 crores, and Part 'B' States for Rs 16.68 crores, the balance being for Part 'C' States. Roads' share of expenditure in the Rs 2,069 crore Plan thus works out at Rs 104.75 crores, or a little more than 5 per cent.

The Nagpur Report envisaged improvement and construction of roads making for a total of 1,47,000 miles of hard crust roads and 2,53,000 miles of earth roads as against the existing milage of 79,000 and 1,63,000 respectively and estimated the total cost, at the 1943 level of prices, at Rs 450 crores. The Nagpur estimate of costs was computed at 50 per cent above the pre-war prices : at the present level of prices the estimate of works envisaged in the Nagpur Report would be in the neighbourhood of Rs 1,000 crores. Making allowance for the parts of the country now falling in Pakistan, the Five-Year Plan, as now formulated, would cover only one-eighth of what the Nagpur Report recommended.

Financial considerations have limited the scope and extent of the Plan and we cannot but feel a little disappointed that 'roads' had to bear more than their proper share of the cut. Having said so much we should also take note of the other side of the picture. Between 1914 and 1949, in 35 years, the total expenditure incurred in Part 'A' States on new construction and improvement (as apart from maintenance) was Rs 75 crores, against which must be seen the Part 'A' States' share of proposed expenditure of Rs 50.59 crores on road development during five years from 1951 to 1956. While in 18 years, between 1928 and 1946, the total credit to the Central Road Fund, the sole source of Government of India's road expenditure, amounted to Rs 25.31 crores only, and while even after the assumption of responsibilities for the National Highways, the Government of India spent in three years upto March 1950 Rs 3.90 crores only on original works on National Highways, the Government of India have now undertaken to spend Rs 31.21 crores in five years in the Central sector alone. This is a large progress indeed, much though we might hope for larger things.

ROAD FINANCE

Now that the *necessity*, as such, for the maintenance and development of an adequate system of roads has been recognised on all hands, our present problem is how to carry out the tasks set before us and how to find the necessary funds for the purpose. Since the Nagpur Plan was formulated in 1943, the scope and magnitude of the works proposed and the costs involved have "appalled" many who looked at the problem through financial considerations alone : they called the Plan "too ambitious." When a country has to build almost from scratch and make good the deficiencies of hundreds of years, the plan for construction must necessarily be ambitious. The realization of such ambitions is, however, limited by considerations of available resources, technical and material, most of all financial.

Roads in India are in dire need of funds for their maintenance to proper standards and for improvement. Money is also needed for the construction of new roads. With the growth of motor traffic and rise in prices of labour and materials, the "road bills" of the country have increased considerably in recent years. Types of pre-war surfaces have become inadequate and efforts made to maintain inferior surfaces have entailed too frequent renewal.

Upgrading of surfaces would be more economical in the long run if requisite funds could be found for this purpose. The Motor Vehicle Taxation Enquiry Committee, 1950, assessed that the total annual requirement of funds for the maintenance of India's roads to reasonable standards and for *normal development* (i.e., small scale development works not involving new construction) would be about Rs 35 crores at the present level of prices. This amount excludes new construction to be done on a planned basis for which works envisaged in the Nagpur Report would require an outlay of Rs 1,000 crores as against which funds provided in the final Five-Year Plan now amount to Rs 104.75 crores from 1951 to 1956. Financial eyebrows would at once be raised at this "appalling" demand. But with the phenomenal growth of motor transport as a source of taxation since 1920 funds for road works have already suggested themselves.

MOTOR VEHICLE TAXATION

The Jayakar Committee (1928) had recognised that motor taxation was "a source of revenue for road development." In the year 1948-49 the Government of India and the Governments of part 'A' States taken together collected Rs 28 crores—such

collections have further increased in the following years from various taxes on motor transport factors including customs duties on motor vehicles, parts and accessories, customs and (countervailing) excise duties on motor fuel, motor vehicle taxes, and a host of other imposts.

The total road expenditure of the Governments, Central and Provincial, during this year was Rs 21.68 crores only. While the States Governments collecting Rs 6.77 crores from motor vehicle users spent Rs 14.00 crores on road works, the Central Government collecting Rs 21.05 crores from taxes on motor vehicles and commodities required for their working and maintenance spent only Rs 5.78 crores including contributions to the Central Road Fund. It will thus appear that while the Part 'A' States spent on road works from their revenues more than double the amount collected from their "road-user" taxes, the Government of India who collected 75 per cent of such "user" taxes diverted more than 72 per cent of these tax receipts to non-road purposes.

GOVERNMENT A PARTNER IN THE ROAD-TRANSPORT INDUSTRY

The Motor Vehicle Taxation Enquiry Committee, 1950, recommended that Government should regard themselves as partners in road transport undertakings as a national industry irrespective of whether particular forms of transport were state-owned or not. Government in the exercise of their public functions, supply and maintain the roads which constitute the main capital assets for transport undertakings. Government spend money from public funds for supplying good roads to the community and charge the other partners, the transport users, equitable rent in the shape of various "road-user" taxes on motor vehicles and motor fuel, for the use they make of the roads. Looked at from this point of view, such taxes on motor transport factors are composed of two separate elements:

(i) an element of 'rent', or requited tax, which is paid by the transport factors as a charge, *quid pro quo*, for the use they make of roads supplied and maintained by the Government; and

(ii) an element of 'tax' proper or unrequited payment, which every constituent in the community has to contribute to the general revenues of the Government. It is only plausible and reasonable that this 'rent' portion of the taxes on motor vehicles and commodities required for their maintenance and working should be ploughed back in full for the benefit of the road account by spending it specifically on road purposes.

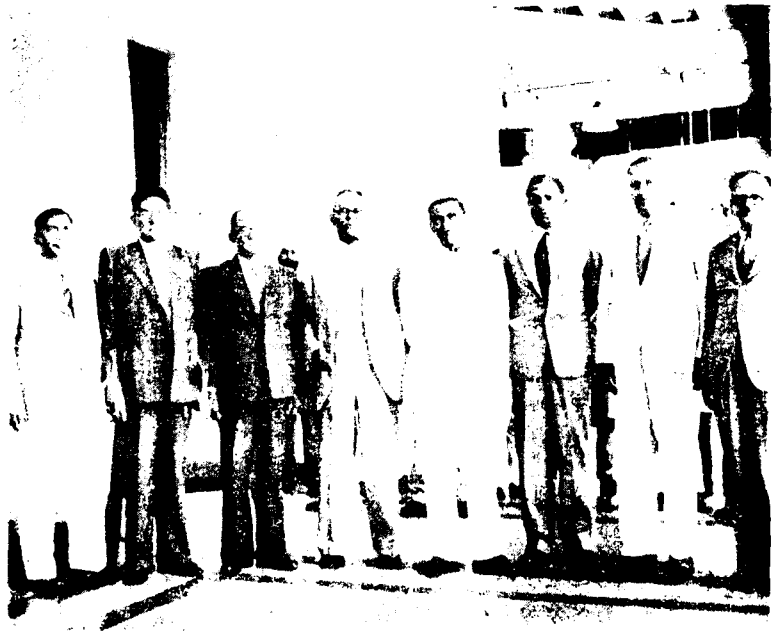
In addition to the share of the road-user taxes, representing the "road-rent" portion of such taxes paid by motor transport factors, additional contributions are also required from the general revenues of the Centre and the States as *quid pro quo* for the "community use" made of the roads (apart from the use made of them by the motor transport factors).

The Salter Committee in the U. K. (1932) had laid down the principle that motor transport factors should pay for two-thirds of the "road bills" of a country, the remaining third being contributed by the general revenues. If these principles were accepted, the "road rent" portion of Rs 30 crores "user" taxes, together with a third as much from the general revenues, would form the basis of a road fund which might be utilized for the maintenance to proper standards of the existing roads and their normal development.

THE FUTURE

For new construction envisaged in the Nagpur Report, or provided for in the Five-Year Plan, further funds would be necessary. The Motor Vehicle Taxation Enquiry Committee, 1950, suggested that finances for this construction programme should be found from a "ways and means fund" made up of savings and surpluses, additional "development" grants from the general revenues and of loans raised for the purpose. The execution of a construction programme of the magnitude envisaged in the Nagpur Report, the beginnings of which have been made in the Five-Year Plan now under way, cannot be financed entirely from revenues however husbanded: resort to capital sources outside the revenue account will be necessary.

The Royal Commission on Agriculture in India, 1931, were of opinion that road development in India should look to capital sources for necessary funds instead of relying solely on current revenues. The Jayakar Committee, 1928, while deprecating large schemes for road expansion financed from loans for the servicing of which the revenues might have to be mortgaged for long periods, recommended that construction and reconstruction works might be suitably financed from short-period loans against revenues clearly in sight to cover interest and sinking fund charges. The Nagpur Report expressed the view that "if national debt could be incurred for war, it could be incurred for more constructive ends," and suggested that the amortization of loans for road construction might be "extended over the longest period economically possible."



On arriving to inaugurate the Session the Minister Shri N. Ranga Reddi was received by the Executive Committee of the Congress, in the centre of the photo are Shri T. Mitra & the Minister.

Objections are often raised to the financing of road construction works from capital sources. Road works, it is said, are unproductive expenditure in as much as they do not produce goods themselves. This view, if fallacious, needs examination and refutation. As Mr. McKelvie, last year's President of the Congress remarked, "We are too apt to take roads for granted as we take mountains and rivers and the air we breathe," and as such we too often fail to see the obvious benefits arising from good roads. If good roads cost money, an effective system of roads can very well be likened to a well-planned business.

It is a long-term investment. The Indian Road and Transport Development Association, some years ago, conducted a survey in certain areas of Bombay. The investigations revealed that the financial benefits from road development in the area examined amount to Rs 11.97 lakhs a year, whereas the roads so developed would cost, including construction and maintenance, something like Rs 4.32 lakhs annually.

This would indicate that for every Rs 100 spent on roads the return to the community in various benefits would amount

to Rs 277. Better communications would undoubtedly bring about a direct increase in national wealth and a considerable increase in revenues. Roads pay for themselves after they are built, not before or simultaneously, and in the end they show up as the triumph of many hands. "**A country pays for its roads whether it has them or not, and it pays more when it does not have them.**" How many times these words have been uttered from the platform of our organisation and elsewhere. A belief gained currency sometime ago that a lie repeated a hundred times could assume the plausibility of truth. But no one would suppose for the matter of that, that a truth repeated a thousand times can ever depreciate into its opposite.

COMPARISONS

I would quote here a few passages from an authoritative publication on the American Highway Policy which describes the condition of roads in that country at the end of the nineteenth century in the following words :—

> "Of all the great nations of the world America had the worst roads.....The American rural community permitted itself to remain literally mired in the mud, seasonally isolated from the energizing currents of social and economic life.....It was a pattern that had grown out of community self-sufficiency....."With respect to transportation rail-roads largely monopolised the popular imagination.....With the trend toward urbanism, it became apparent that wide disparities had arisen in the rates at which improvements were being made in the different media of transportation. Rail-road service was being extended and technically perfected; highway service, constituting an integral part of practically all traffic movement, had undergone little if any net improvement for fifty years. The rural economy was restricted by eighteenth century standards of mobility in an era when the urban population was reaping the direct benefits of modernised technology and organisation. There arose a national undercurrent of pressure for adjustments that would enable the rural population to share in the new ways of life emerging from industrialisation. Road Reform was hit upon as one of the most direct and obvious methods of achieving this objective."

This description of the American highway system, fifty-five years ago, reads strangely similar to conditions obtaining in India to-day. Yet, America was able by persistent application of the "road-user" taxes to road expenditure completely to

transform these conditions: at present she has the best developed highway system in the world. This rapid growth of the highways in the U. S. A. is attributable to two factors: firstly the enormous increase in motor traffic in the country bringing with it large revenues on account of registration fees and the "gasolene taxes," and, secondly, the determination of the State and Federal Governments to devote the proceeds of such special "user taxes" to the improvement of the highways over which the motor vehicles operated.

In the U. S. A. these "user taxes" are mostly collected by the constituent States and all but 10 per cent of such collections are spent for highway purposes. In 21 States the use of any part of these funds for non-highway purposes is prohibited by law. Even then, with the present level of development of motor traffic in the U.S.A., these "user taxes" pay for 61.8 per cent of all highway expenditure, the balance of funds being found from the general revenues of the Federal Administration and of the States. Methods of highway finance in the U.S.A. have amply demonstrated the proposition that the main highways can be made self-supporting if the revenues from road users are devoted exclusively to highway improvement.

THE CHIEF PROBLEM

A former Chairman of the Highway Transport Committee of the International Chamber of Commerce once remarked that "the chief problem in the highway field at present is one of finance." In India, especially, such considerations of finance have clouded the horizons of the most imaginative of our planning enthusiasts. The number of motor vehicles in India has not yet reached the figure that the U. S. A. passed nearly forty years ago. Multiplying the number of motor vehicles will not avail while roads do not for the most part exist and while, even where they do exist, they remain incapable of bearing any appreciable volume of motor traffic.

Total revenue receipts from "user taxes"—till now such special "user taxes" are paid only by motor transport factors—will therefore not be nearly enough to feed the funds for our roads. But even to the extent to which they are available, diversion of these "user taxes" to other than road purposes thwarts the interests of transport planning in the country. Urban traffic congestion remains unrelieved: village roads remain unbuilt; and sound long-term road planning suffers in consequence. Such diversion frustrates the country's programme for road development which works under constant inhibitions in having to depend on the vagaries of annual legislative sanctions instead of being fed from "road user" taxes which can be foreseen with a fair degree of accuracy.

Speaking of highway finance, we have always felt that it is not enough to provide requisite funds for our road works. The present budgetary system pursued by the Government also needs revision. At present grants are given for road works on a yearly basis, unspent moneys lapsing at the end of a financial year. Such yearly grants, moreover, are subject to curtailment before allotments are actually handed out, and allotment of funds made late in the year would often entail wasteful and uneconomical working for fear of lapse.

We in Bengal have experienced especial difficulties in this financial procedure which cuts across our working season from November in one financial year to June in the next. The Nagpur Report had recommended that, in the interest of continuous road development in the country on a planned basis, the Road Plan should be enjoined as a statutory authority. The Motor Vehicle Taxation Enquiry Committee, 1950, endorsed these recommendations and suggested that funds for this Road Plan should be set apart by a statute and made over into non-lapsable Road Funds, so that expenditure at an even minimum pace might be ensured and violent fluctuations from year to year might not occur.

The Motor Vehicle Taxation Enquiry Committee cited the example of the U. S. A. where the State authorities knew, two years in advance before work on a project commenced, as to what Federal grants would be available for the purpose. Such grants, once announced, could be taken on a "matching" basis (the State authorities undertaking to raise equivalent funds from their own resources within three years after constructions actually commenced: and the grants would not lapse but would be available for expenditure till the particular project was completed.)

This Congress has been urging for years past that the Central Highway Fund and the States Road Funds be instituted on the same non-lapsable basis, and that all moneys to be made available for road expenditure of the various administrative authorities be credited to such non-lapsable Road Funds. The authorities responsible for the roads will then be tolerably sure within reasonably close limits as to what funds will be available for roads in their budgets for a number of years ahead. It is gratifying to learn that the Government of India is now considering legislation embodying these very principles.

Before I close I must apologize to you for the length of my address and thank you for giving me a patient hearing. I now request you, Sir, to inaugurate this, the 17th Session of the Indian Roads Congress.

—o—

INAUGURAL ADDRESS

In declaring the Session open Shri N. Ranga Reddi said :

Mr. President, Ladies, and Gentlemen,

I am very grateful for the great honour done to me in asking me to inaugurate the 17th Session of the Indian Roads Congress.

When I look at the list of the great men like the Governors of Provinces and the Chief Ministers who have inaugurated the previous sessions of the Indian Roads Congress, I feel very diffident whether I can successfully perform the duty allotted to me. But with your co-operation and goodwill, I feel that my task can be considerably lightened.

The Minister inaugurating the Session

Before I begin to say a few words, I would like to extend a hearty welcome to the President and the Delegates of this

Conference. We have all listened to an interesting and instructive address of the President of this conference. The President has told you that the Indian Roads Congress met last time in Madras in the month of February 1945 and I hope that between then and now you would find much in Madras State which would justify the creation of the Highways Department. I find from the records that the Indian Roads Congress was started in 1934 and that the membership of the Road Congress has risen from 73 in 1934 to 1672 in 1952. This increase in the membership testifies to the popularity and usefulness of this Institution, though the membership does not hold out any material rewards. I find that the organisation advises the Government on technical matters connected with roads. It is really gratifying to note that the Nagpur Report of 1943 really a very valuable document connected with the improvement of roads, is the result of deliberations in these conferences. As you all know, the roads had been under the control of either the District Boards or the Taluk Boards and the Engineers who were in-charge of roads upto the district level were under the control of the local bodies. It was felt by many that when there were slow-moving vehicles on the roads, the roads did not require much attention; at any rate not as much as they require now. But after the advent of the motor vehicles, better roads were required for plying motor vehicles and everyone has been asking for a better road. The State has been expending considerable sums of money over the making of new roads like cement concreting, etc. and maintenance of roads, taking into consideration the intensity of traffic on the particular roads. Every effort is made to give a better kind of road, consistent with the allotment made by the State. The Highways Department comes in for a great deal of criticism for the simple reason that most men use the roads every day and therefore they come under the fire of public criticism. Very often adverse criticism on the condition of roads is not justified. The ignorant layman without knowing the real cause for the condition of the road blames the engineer for the bad condition of the road. Lack of finance is rarely accepted little knowing that the maintenance of roads is only one of the many duties and obligations that this State has to discharge. Projects in Irrigation and Electricity are given top priority to make up the food deficit and provision for Highways is considerably cut. That is so in the Five-Year Plan relating to the Madras State.

I am grateful to the President for the compliment paid to the Madras State that Madras is an advanced mile-post in our Highway to progress. Let me in this connection pay my tribute of praise to the engineers working in the Highways, Irrigation and Electricity in the Madras States for the good work they have been doing and for the efficient discharge of their duties and the very high standard of proficiency and integrity they are maintaining

As Minister for Public Works, I get requests from the Centre as well as from other States that the services of the Madras Engineers might be loaned to them on higher salaries. Very often I have to displease the engineers by refusing to lend them as this State can ill-afford to part with any of its trained engineers in view of the large projects that this State has undertaken. Very soon this State would be confronted with a serious problem of how best to continue the engineers working in projects which are nearing completion.

You have paid a compliment in your Presidential address that Madras has been the first State to create a separate Highways Department. The Madras State has taken into account the views expressed by organisations like yours and has created that department and it is up to the department to justify its continuance. Let me assure this conference that the resolutions passed by you will be given the greatest consideration by this Government.

Madras has been spending a considerable sum over roads. The expenditure has risen from Rs 375 lakhs in 1946-47 to more than Rs 800 lakhs in 1951-52. This amount has been found inadequate to meet the needs of the roads. Madras State has got the largest mileage of roads (i.e., 43,498 in 1951). Still it must be observed that most of the villages are not accessible for want of roads. There are 36,000 villages in the Madras State and only 12,000 villages containing about 64% of the population is being served by the existing road system. A very large number of villages is still away from the road system. Even the so-called rural roads in most cases are passable only in dry conditions. I should like to mention in this connection that there are large tracts in our State known as REGADU or black-cotton soil and this soil presents a very difficult problem for engineers in road-making. When the soil is dry it can stand a very high pressure and presents a very smooth surface which can carry even very heavy motor vehicles; but after rains, the soil becomes so soft, when it is wet that even a man cannot walk without sinking his feet in the mud. It is very gratifying to note that our engineers are tackling this problem and there is a Soil Laboratory established in Madras State which is carrying out tests and experiments to maintain roads satisfactorily in black-cotton tracts with sand admixture to correct proportions. The lack of bridges and crossings is also a serious obstacle to traffic of all kinds in Madras State. There is a great need for providing suitable crossings and we have been taking up number of bridge works: but we have not been able to provide bridges over all streams and rivers wherever necessary as our finances are limited. During the short period that I have been as Minister of P.W.D., I have been faced with the problem of eliminating expenditure

which the public criticise as wasteful. It is not that I always accept their criticism, but in certain cases there is some ground for justification. In the highways Department in the Madras State all works big or small with very rare exceptions have been entrusted to contractors for execution and very often the contractors quote much above the estimate rates and the Highways Department is compelled to entrust the work to a contractor not having any other method of execution. Under similar circumstances, the Irrigation Department in the Madras State undertakes to execute the work departmentally. It has yielded very good results. It has provided an opportunity for gaining experience to our young engineers and it has also saved some money to the State. We are not at the mercy of big contractors and I would like you to discuss this question, viz., whether departmental execution of works cannot be undertaken in the Highways Department also. There is also another point which I would like you to consider. Very often on the floor of the Legislative Assembly I have been faced with questions relating to the revision of estimates—one estimate going higher than the other for the same work and sometimes the estimate is revised thrice. It is very necessary that both in the interests of the State and the people it should be known definitely what the State has to spend when it embarks on a particular project. These two problems might appear to be simple to you; but to a layman when he undertakes to justify the actions of the engineers in public or on the floor of the Assembly, they are all difficult. It will be good if an authoritative solution can be given by the Indian Roads Science Congress.

I have detained you for a very long time. I hope that you will find your stay in Madras very comfortable and congenial for your discussions.

Let me once again thank you for having asked me to inaugurate this Session.

MESSAGE FROM

Shri O. V. Alagesan,
Deputy Minister for Transport & Railways,
Government of India

I send my greetings to the Highway Engineers who have gathered at Madras for the 17th Session of the Indian Roads Congress.

India has embarked upon her first Five-Year Plan with high hopes. The success of almost every phase of the Plan depends to a large extent on India's Engineers. The Central and State Governments of India place great reliance on the country's engineering talent and are confident that it will bring to fruition the plans on which the future of the country largely depends.

India's Highway Engineers have been in the vanguard of planners: it is they who showed the way by producing the Nagpur Plan. I have full confidence that they will also lead the way in executing the Five-Year Plan.

Message From His Excellency Shri K. Santhanam
Lieutenant Governor, Vindhya Pradesh.

I have great pleasure in sending my good wishes for the success of the Session.

I am well aware of the significant role played by the Indian Roads Congress in stimulating thought and research regarding the construction and maintenance of roads and bridges. I consider that the roads programme of the Five-Year Plan is its most important part. I hope this Session of the Indian Roads Congress will discuss the means and ways of executing this programme as speedily and efficiently as possible.

Message from the President, the Institution of Engineers (India).

On behalf of Institution of Engineers (India) I send most cordial greetings and good wishes to the Seventeenth Session of the Indian Roads Congress.

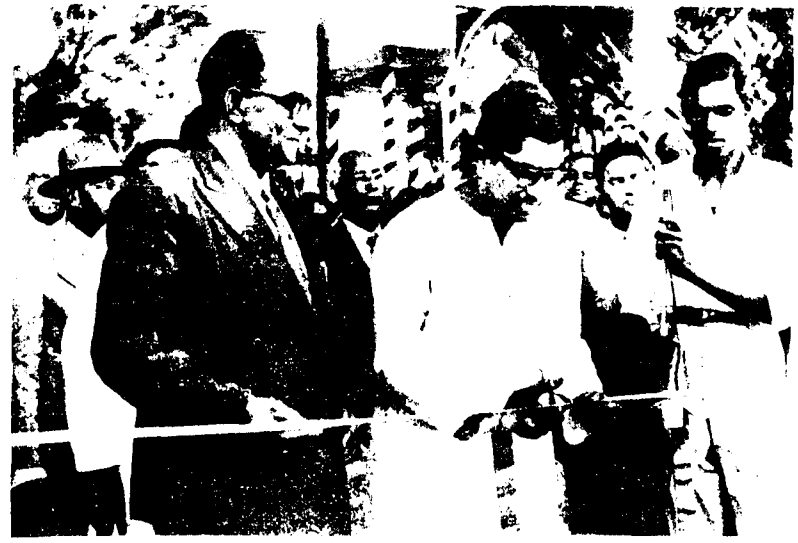
TECHNICAL EXHIBITION

Seventeenth Session

Madras, February, 1953.

A technical exhibition was organised on the Government House Estate where the Session was held.

The exhibition which is now a regular feature of the Annual Session is organized to bring home to the layman the importance of roads in the national economy of the country and to educate the engineer about the latest methods and machinery used in road and bridge construction.



Shri C. Subramaniam, Minister for Finance, Madras, opening the I. R. C. Exhibition at Madras.

The exhibition was opened on the 8th February 1953 by Shri C. Subramaniam, Minister for Finance, Madras, who went round all the Stalls.

Speaking on the occasion, the Minister said that the State Government was vitally interested in road development. He observed that communications were the nerve centre of the various developmental activities and naturally they were greatly interested in the development of these communications. In this connection he stressed the duty of the engineers in making the Five-year Plan a success, as far as communications were concerned.

Shri C. Subramaniam, addressing the delegates when he inaugurated the exhibition

He expressed the hope that the public at large would take advantage of the exhibition and get therefrom an idea of the intricate processes involved in road-making. In these days of democracy, the Minister remarked, it was necessary that the people should know what the experts were doing. "We have to satisfy the taxpayer that he is getting his money's worth."

The Minister further said that at present they were importing raw materials like bitumen at a high cost for road-making. No doubt bitumen roads were better and lasted longer. But there was great need for developing local materials of construction. In this connection, he referred to the lignite mines in South India and said that if they were successfully exploited, it might be possible to manufacture bituminous binders locally and at cheaper costs.

The exhibition remained open throughout the Session week and attracted large crowds. Many educational institutions

Watching a Practical demonstration.

of Madras brought their students to see the exhibits which were highly educative and informative.

The exhibits included models, photographs and explanatory charts of roads and bridges, and machinery and materials used for the construction of the modern roads. Demonstrations of the actual working of the equipment were given.

The following organizations took part in the exhibition.

1. **Government of India, Roads Organization**

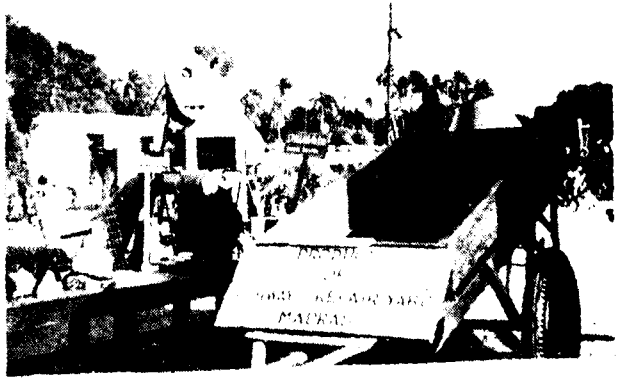
   Statistical and graphical presentation of data regarding road development, vehicles, etc. Broadsheets entitled "Roads for To-morrow" as programmed in the Nagpur Plan. Proposals for road development under the Five-Year Plan. Sample copies of periodicals received in the library of the Roads organization.

2. Buildings and Roads Research Laboratory, Karnal, Punjab.

3. Highways Deptt. Research Laboratory and Highways Deptt. Workshops, Madras.

After inaugurating the exhibition the Minister went round the stalls. He is seen inspecting the stablised soil models in the Karnal Laboratory stall.

4. Some State Governments contributed charts and maps depicting their road development plans for the future.



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5. Firms

1. M/s British Insulated Callender Cables.
2. M/s Burmah Shell Oil Co.
3. M/s Insulated Cables.
4. M/s Concrete Association of India.
5. M/s Dalmia Cement (Bharat).
6. M/s Dunlop Rubber Co., Ltd.
7. M/s Garlick & Co., Ltd.
8. M/s Greaves Cotton & Co., Ltd.
9. M/s Heatly Gresham Ltd.
10. M/s James Engineering Co.
11. M/s Kailash Bros.
12. M/s Kamani Engineering Corporation Ltd.
13. M/s Larsen & Toubro Ltd.
14. M/s Marshalls Sons & Co. (India)
15. M/s Millars Timber & Trading Co., Ltd.
16. M/s Shalimar Tar Products (1953) Ltd.
17. M/s Simpson & Co.
18. M/s Standard Vacuum Oil Co.
19. M/s Stressed Concrete Construction Ltd.
20. M/s Turner Hoarse & Co.
21. M s William Jacks.

LECTURES, PANEL DISCUSSIONS, AND TECHNICAL FILMS

Lectures

An interesting talk on the "New Punjab Capital at Chandigarh" was given by Shri P. L. Varma on the 11th February. The same afternoon, Shri B. D. Puri, Secretary, Board of Engineering Research, spoke on the functions of his Board.

Panel Discussions

In order to exchange view on the practice adopted in India for the construction of cement concrete pavements and to take stock of the experiences of various members, a "panel" discussion was arranged on the 11th February. Earlier a brief questionnaire to indicate the basis for discussion and a summary of the replies received from the States were circulated. Information collected by the Concrete Association of India was also circulated. The Panel discussion proved to be very popular and attracted many speakers.

Technical Films

In the evenings technical films connected with highway engineering were shown. In spite of the many attractions of the City of Madras, the shows were well attended by many local people besides the delegates.

Minutes of the 40th Council Meeting of the INDIAN ROADS CONGRESS Held at Madras on the 7th February, 1953.

Present

T. Mitra—President

F. P. Antia	U. N. Mahida
M. L. Bahl	H. P. Mathrani
C. M. Bennett	M. S. Mathur
U. J. Bhatt	G. M. McKelvie
P. V. Divatia	M. Meeran
N. Durrani	C. P. Misra
C. J. Fielder	E. A. Nadirshah
Goverdhan Lal	K. K. Nambiar
W. A. Griffiths	K. Ramaswamy
R. N. Joshi	B. N. Roy
K. K. Kartha	R. C. Roy
G. H. Khan	Lt. Col. K. C. Soni
D. N. Khurana	P. L. Varma

J. M. Trehan—Secretary.

The following Co-opted Members attended

M. F. Beg	Sri Krishna
N. V. Modak	E. Zipkes

The following attended by invitation

K. F. Antia	B. N. Shenoy
A. K. Sen	H. Sunder Rao

1. Confirmation of the Minutes of the 39th Council Meeting.

The Minutes of the 39th Council meeting held at Simla on the 30th April 1952 as published at pages 476 to 478 of Volume XVI-4, October 1952 of the Journal of the Indian Roads Congress were confirmed.

2 Approval of the Minutes of the Executive Committee Meetings.

The minutes of the meetings of the Executive Committee held at New Delhi and Madras on the 21st October 1952 and the 7th February 1953 respectively were approved.

3. Audit Report for the year 1951-52.

The Report of the auditors for the year 1951-52 was recorded.

4. Draft Report of the Council to the General Body of Members for the period 1st January 1952 to the 31st December 1952.

The draft report was approved.

5. Budget.

The budget estimate for 1952-53 and the supplementary budget estimate for the period 1st December 1952 to the 30th September 1953 were approved.

6. Papers for the Journal of the Indian Roads Congress.

The Council discussed the question of securing Papers for the Journal of the Indian Roads Congress. It was explained that this question will be discussed by the Chief Engineers in their meeting also. It was suggested that every State P. W. D. should send **at least one** (and if possible two) Papers for each Session. The engineering firms who are Associate Members of the Congress were also requested to advise their engineers to send contributions.

The following members promised to obtain Papers for the next Session.

1. M. L. Bahl	6. M. F. Beg
2. C. M. Bennett	7. N. Durrani
3. M. S. Mathur	8. E. A. Nadirshah
4. K. K. Nambiar	9. A. K. Sen.
5. Shri Krishna	10. R. N. Joshi

11. U. N. Mahida

7. Amendment to the contributory Provident Fund Rules of the Indian Roads Congress.

The Council agreed with the recommendation of the Executive Committee that the following revised rule should be substituted for the existing rule No. 11 (1) of the Contributory Provident Fund Rules of the Indian Roads Congress.

Revised Rule 11 (1). "The interest accruing on the balance at the credit of a subscriber shall be calculated when the balance is made at the end of each year or when the account is closed. The interest will be at the rate of three per cent per annum, compounded annually, on the average sum, calculated on every complete sum of ten rupees, standing at the credit of the subscriber during the year.

The rate of interest may be modified as and when the Executive Committee deem fit. The profit or loss arising from this method of calculating the earnings of the Indian Roads Congress Provident Fund will be credited or debited to the Indian Roads Congress General Account".

8. Building, Museum and Technical Fund.

The Council noted that the Executive Committee had agreed to the change of the head "Surplus Account" in the Balance Sheet to "Income and Expenditure Account" and to the transfer of a sum of Rs 1,26,003-14-9 to a new head "Building, Museum, and Technical Fund" This includes the amount of Rs 6,932-1-0 standing in the Life Membership Reserve.

Further, the Council agreed that future contributions under the head "Life Membership Reserve" should also be credited to the new head "Building, Museum, and Technical Fund".

9. Formation of a National Group in India of the International Association of Bridge and Structural Engineering.

The Council agreed with the recommendation of the Executive Committee that the Indian Roads Congress should take up the work of organizing the National Group of the International Association of Bridge and Structural Engineering when it is decided to set up such a Group in India.

10. Award of Medals for Papers to Council Members.

The Council agreed with the recommendation of the Papers Subcommittee and the Executive Committee that papers written by Council Members should also be eligible for the award of Medals. It was decided to refer this matter to the General Body.

11. Additional office accommodation for the Museum of the Indian Roads Congress.

The Council agreed with the recommendation of the Executive Committee that the Government of India, Ministry of Transport, should be requested to build some rooms for the proposed museum of the Indian Roads Congress in the Jamnagar House compound in addition to meeting the requirements of the Ministry of Transport, Roads Organization for more accommodation in the same place. After Government agrees to the proposed extension of the existing buildings, the Indian Roads Congress will offer to pay rent for the additional accommodation provided for them or to pay the cost of the additional rooms needed by the Congress.

Minutes of the Business Meeting of the INDIAN ROADS CONGRESS held at Madras on the 11th February 1953.

The Seventeenth Annual General Business Meeting of Members was held at Madras on Tuesday the 11th February, 1953, at 10-30 A.M. In all 226 Members and 5 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 Simla on the 29th April, 1952, as printed at pages 445 to 475 of the Journal Volume XVI–part 4–October 1952 were confirmed.

3. Audit Report.

(i) The Audit Report for the period 1st October 1951 to the 30th September 1952 (Annexure II) was recorded.

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

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. Award of Medals and Prizes to Council Members.

The General Body reviewed their decision taken at the Jaipur Session in February 1946 and accepted the recommendations of the Executive Committee and the Council that hereafter members of the Council should also be made eligible for the award of prizes and medals for Papers contributed by them to the Indian Roads Congress Journal.

6. Resolution of thanks.

The following resolutions were passed with acclamation.

(1) The Indian Roads Congress thank the Government of Madras for their kind invitation to hold the Seventeenth General Session at Madras and for the very efficient arrangements made in connection therewith.

(2) The Indian Roads Congress thank Shri N. Ranga Reddi, Minister for Public Works, Madras State, for inaugurating the Seventeenth Session of the Indian Roads Congress and for his permission to print his address in the Journal of the Indian Roads Congress.

(3) The Indian Roads Congress thank Shri O. V. Alagesan, Deputy Minister for Transport and Railways, Government of India, for his inspiring message to the Members of the Indian Roads Congress.

(4) The Indian Roads Congress thank His Excellency Shri Sri Prakasa, Governor of Madras, for his kind message and good wishes for a fruitful Session of the Congress.

(5) The Indian Roads Congress thank His Excellency, Shri K. Santhanam, Lieutenant Governor of Vindhya Pradesh, for his message of good wishes and encouragement to the Members of the Indian Roads Congress.

(6) The Indian Roads Congress thank Shri C. Subramaniam, Minister for Finance, Madras State, for kindly declaring open the Technical Exhibition organised by the Indian Roads Congress on the occasion of the Seventeenth Session and for his Address on that occasion.

(7) The Indian Roads Congress thank Sir Kenneth Mitchell, Past President, Institutions and other well wishers who have sent messages of goodwill and encouragement.

(8) The Indian Roads Congress thank Shri K. K. Nambiar, Chief Engineer, Shri K. Ramaswami Reddi, Deputy Chief Engineer, Shri K. Namasivayam, (in charge of exhibition arrangements) and Shri G. S. Gnanaprakasam, (Local Organising Secretary), officers and other staff of the Highways Department, Madras for the excellent arrangements made by them for the Session and for the convenience of the delegates.

(9) The Indian Roads Congress thank the firms and Governments who participated in the technical exhibition organised at this Session and offered technical films to be screened.

(10) The Indian Roads Congress thank the various authorities and Institutions who kindly afforded facilities to delegates to visit their works and Institutions.

7. **Scrutineers for the Election of Council of Members.**

Messrs C. J. Fielder, C. M. Bennett, P. L. Varma and Goverdhanlal, were appointed scrutineers for the election of Members to the Council under rule 9-i of the Rules and Regulations of the Indian Roads Congress.

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

"Only those members of the Congress who are not in arrears regarding their subscription are entitled to vote. Voting slips will be given to those Members who wear their badges and give their roll numbers".

8. **Elections:**

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	Sujan Singh

g. **Representative of District Board Engineers.**

S. Gupta.

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

M. Meeran.

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

W. A. Griffiths	S. C. Nayak
C. P. Misra	K. V. Thadaney

9. **Under rule 9-a, b, c and d the following were nominated by their respective administrations as Members of the Council:**

9-a Name of participating Administration	Name of representative
Assam	G. N. Dutt
Bihar	M. L. Bahl
Bombay	U. N. Mahida
Madhya Pradesh	R. K. Batra
Madras	K. K. Nambiar
Orissa	C. M. Bennett

	Administration	Name of representative
	Punjab	D. P. Nayar
	Uttar Pradesh	M. S. Bisht
	West Bengal	T. Mitra
	Hyderabad Deccan	D. V. Rao
	Jammu & Kashmir	G. H. Khan
	Madhya Bharat	P. V. Divatia
	Mysore	K. S. Gangadhara
	Pepsu	Raghbir Singh
	Rajasthan	Kishore Lal
	Saurashtra	U. J. Bhatt
	Travancore-Cochin	K. K. Kartha
9-b	Engineer-in-Chief Army Headquarters	Brig. J. S. Dhillon
9-c	C. P. W. D.	M. S. Mathur
9-d	Consulting Engineer (Roads)	H. P. Mathrani

Annexure I

LIST OF MEMBERS WHO ATTENDED THE SEVENTEENTH SESSION OF THE INDIAN ROADS CONGRESS HELD AT MADRAS IN FEBRUARY, 1953.

S. No.	Name of State etc.	No. of delegates who attended the I.R.C. Session.
	ABSTRACT	
1.	**Government of India :**	
	(a) Ministry of Transport, Roads Organisation.	20
	(b) Engineer-in-Chief's Branch ...	4
	(c) Central P. W. D. ...	3
	(d) Central Water & Power Commission ...	2
	(e) Planning Commission ...	2
2.	**Council of Scientific & Industrial Research** ...	6
3.	**Assam** ...	2
4.	**Bihar** ...	13
5.	**Bombay** ...	21
6.	**Madhya Pradesh** ...	7
7.	**Madras** ...	64
8.	**Orissa** ...	8
9.	**Punjab** ...	5
10.	**Uttar Pradesh** ...	11
11.	**West Bengal** ...	24
12.	**Hyderabad** ...	4
13.	**Jammu & Kashmir** ...	4
14.	**Madhya Bharat** ...	4
15.	**Mysore** ...	3
16.	**Patiala & East Punjab States Union** ...	2
17.	**Rajasthan** ..	6
18.	**Saurashtra** ...	2
19.	**Travancore-Cochin** ...	4
20.	**Bhopal** ...	1
21.	**Coorg** ...	1
22.	**Delhi** ...	3
23.	**Kutch** ...	1
24.	**Tripura** ...	1
25.	**Vindhya Pradesh** ...	2
26.	**Pakistan** ...	1
	Total ...	231

LIST OF MEMBERS WHO ATTENDED THE SEVENTEENTH SESSION OF THE INDIAN ROADS CONGRESS HELD AT MADRAS IN FEBRUARY, 1953.

S. No.	Roll No.	Name.
		GOVERNMENT OF INDIA
	(a)	**Roads Organisation (Ministry of Transport).**
1.	...	Gopalan, P. V. (Invited).
2.	879	Goverdhan Lal.
3.	1078	Gurusahani, R. L.
4.	785	Har Dayal.
5.	1288	Mathrani, H. P.
6.	54	McKelvie, G. M.
7.	1146	Menon, M. D.
8.	705	Mirchandani, N. D.
9.	1702	Mukerjee, A.
10.	950	Nagarsheth, M. P.
11.	885	Poonen, P. C.
12.	724	Rajagopalan, S. K.
13.	752	Ramaswamy, N. S.
14.	1280	Sadarangani, T.
15.	39	Shenoy, B. N.
16.	1210	Subbiah, C. P.
17.	723	Subrahmanyam, J.
18.	389	Sunder Rao, H.
19.	637	Surya, N. S.
20.	918	Trehan, J. M.
	(b)	**Planning Commission.**
21.	1721	Parthasarathy, C. S.
22.	...	Zaman, A. (Invited)
	(c)	**Engineer-in-Chief's Branch.**
23.	...	Bhagyan, G. D. (Invited)
24.	...	Deb, A. K. (Invited)
25.	1172	Raheja, M. L.
26.	16	Soni, K. C.
	(d)	**Central P.W.D.**
27.	1726	Krishna Murti, M.
28.	418	Mathur, M. S.
29.	1249	Rama Rao, N.

S. No.	Roll No.	Name.
	(e)	**Central Water & Power Commission.**
30.	1769	Hotchand H. Mamtani.
31.	1374	Kanwar Sain.
		2. COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.
32.	1625	Gonsalues, G. F. D.
33.	833	Iyengar, R. K. N.
34.	...	Puri, B. D. (Invited)
35.	1720	Sankaran, K. S.
36.	847	Uppal, H. L.
37.	1535	Zipkes, E.
		3. ASSAM.
38.	1715	Choudhuri, A.
39.	1140	Dutt, G, N.
		4. BIHAR.
40.	399	Bahl, M. L.
41.	1634	Chakravarti, A. C.
42.	1740	Das Gupta, S.
43.	471	Gupta, S.
44.	434	Misra, C. P.
45.	1250	Nand Kishore Prasad.
46.	1343	Nilkanth Prasad.
47.	1291	Nilkanth Sinha.
48.	733	Prasad, B.
49.	1635	Prasad, G.
50.	1299	Roy, B. N.
51.	1103	Sinha, S. N.
52.	836	Sircar, S. K.
		5. BOMBAY.
53.	1189	Amin, M. P.
54.	32	Antia, F. P.
55.	1241	Antia, K. F.
56.	1739	Desai, I. C.
57.	858	Gandhi, J. H.
58.	1248	Govindarajulu, S. P
59.	1129	Iyengar, C. L. N.
60.	1430	Joshi, R. N

S. No.	Roll No.	Name
61.	217	Krishnan, O. C. K.
62.	636	Macha, T. K.
63.	553	Mahida, C. N.
64.	1002	Mehta, S. A.
65.	1716	Menon, T. M.
66.	10	Modak, N. V.
67.	1737	Morarji, N. G.
68.	23	Nadirshah, E. A.
69.	1479	Narke, S. P.
70.	1723	Natu, S. V.
71.	163	Rege, D. Y.
72.	376	Sandhawalia, N. S.
73.	1148	Shivdasani, P. D.
	6.	**MADHYA PRADESH**
74.	1725	Andhare, N. M.
75.	1736	Dikey, J. T.
76.	63	Ghanekar, V. K.
77.	1748	Gokal Chand.
78.	1561	Khurana, D. N.
79.	1692	Oke, B. K.
80.	1329	Sethi, V. P.
	7.	**MADRAS**
81.	1673	Amirtha Rao, K.
82.	994	Chandrasekharan, E. C.
83.	1594	Damodaram Naidu, A. N.
84.	694	Devarajan, K. S.
85.	246	Durrani, N.
86.	1718	Gnanaprakasam, G. S.
87.	1284	Golikere, P. R.
88.	80	Griffiths, W. A.
89.	49	Jacob Peters (Garlick & Co.)
90.	1428	Jayaraman, B.
91.	1697	Kamath, M. N.
92.	664	Kethara Mudaliar, T. S.
93.	1713	Krishna Mohan Rao, K.
94.	681	Krishna Murty, B.
95.	605	Krishnan, K. S.
96.	1517	Krishnan Nayar, K.
97.	1246	Logavinayagam, K. S.
98.	869	Maddimsetty, R. S.
99.	646	Madhava, K. B.

S. No.	Roll No.	Name
100.	1375	Mahadevan, C. R.
101.	1717	Mahadevan, S. H.
102.	671	Meeran, M.
103.	762	Muthukumaraswamy, A.
104.	654	Naidu, S. R.
105.	1732	Namasivayam, K.
106.	268	Nambiar, K. K.
107.	1640	Nandagopal, G.
108.	1744	Narayana, M. L.
109.	1711	Natu, M. R.
110.	660	Nayak, S. C.
111.	1082	Padmanabham, Y.
112.	672	Patrulu, P. S.
113.	813	Prabhala, R.
114.	1743	Prasada Rao, A. M. V.
115.	1126	Punniah, P. B.
116.	628	Raj, P. V.
117.	1750	Raja Ram, T. N.
118.	693	Raja Ratna Mudaliar, K. M.
119.	757	Ram Mohan Rao.
120.	1113	Rama Natha Reddy, T. A.
121.	1745	Rama Rao, P.
122.	347	Ramaswamy Reddi, K.
123.	669	Rangaswamy, T. V.
124.	82	Rangaswamy, V. N.
125.	108	Rangaswamy, V. S.
126.	1013	Rao, B. K. V.
127.	876	Reddy, C. K.
128.	1232	Samad, M. A.
129.	1662	Satyanarayana, K.
130.	1610	Satyanarayana Rao, A. R.
131.	472	Seshagiri Rao, N.
132.	692	Sivaswamy, A. R.
133.	1098	Srinivasan, K. S.
134.	649	Subba Rao, K.
135.	1647	Subba Rao, M.
136.	1312	Subramaniam, P. S.
137.	791	Sundaram, S.
138.	1420	Sunder Naik, S.
139	1345	Swaminathan, C. G.
140.	630	Thadaney, K. V.
141.	873	Thimmaji Rao, R. R.
142.	685	Thirupuvanam, C. N.
143.	1758	Thiruvavakarasu, M. A.
144.	1173	Venugopal, C.

S.No.	Roll No.	Name
		8. ORISSA.
145.	204	Bennett, C. M.
146.	1747	Bhanja, M. M.
147.	560	Das, K. C.
148.	1746	Das, N. P.
149.	285	Das, P. C.
150.	1772	Mumtaz Ali.
151.	564	Padhi, S. B.
152.	513	Parija, K. C.
		9. PUNJAB.
153.	892	Basant Singh.
154.	457	Dogra, R. N.
155.	1242	Gurcharan Singh.
156.	1400	Tandon, G. S.
157.	491	Varma, P. L.
		10. UTTAR PRADESH.
158.	957	Agarawala, D. R.
159.	877	Banerji, P. K.
160.	860	Bhatnagar, P. S.
161.	1524	Bishnoi, A. S.
162.	896	Charan, S. K.
163.	1525	Chaturvedi, D. C.
164.	1192	Goyal, S. L.
165.	1222	Mathur, K. C.
166.	1008	Raghavan, P.
167.	960	Sinha, K.
168.	45	Srivastava, M. P
		11. WEST BENGAL.
169.	15	Bhattacharyya, B. B. (Heatly & Gresham).
170.	43	Chatterjee, D.
171.	1426	Chatterjee, P. C.
172.	1505	Das, T. M.
173.	1556	Das Gupta, A. K.
174.	1202	Das Gupta, B. B.
175.	41	De, K. C.
176.	231	Fielder, C. J.
177.	1462	Ghosh, D. N.
178.	1729	Ghosh, D. P.

S. No.	Roll No.	Name.
179.	1550	Ghosh, M. B.
180.	1230	Guha, M. K.
181.	936	Gupta, S. N.
182.	1566	Laha, S. K.
183.	512	Marik, T. P.
184.	316	Mitra, T.
185.	46	Nambiar, A. M. (Associated Exports. Imports Copn.).
186.	21	Patel, L. R.
187.	1544	Ray, S. N.
188.	766	Roy, R. C
189.	1727	Sen, D. P.
190.	1500	Sen, R. B.
191.	1340	Sarkar, B. N.
192.	1728	Talpatra, S. K.
		12. HYDERABAD DECCAN.
193.	1724	Joshi, N. V.
194.	1734	Malkote, R. S.
195.	29	Narasimham, J. S.
196.	407	Ramaswamy, K.
		13. JAMMU & KASHMIR.
197.	337	Khan, G. H.
198.	1552	Narboo, S.
199.	1672	Qazi Mohd Afzal.
200.	1723	Vaidya, G. H.
		14. MADHYA BHARAT.
201.	1608	Divatia, P. V.
202.	1575	Ghatpande, G. S
203.	1731	Hari Shankar.
204.	1710	Sanghvi, C. H.
		15. MYSORE.
205	179	Gangadhara, K. S.
206	775	Kumar, A.
207	1668	Manchigiah, M. H.
		16. PEPSU.
208	1058	Gill, J. S.
209	1053	Jagdeva Singh Marya

S. No.	Roll No.	Name.
		17. **RAJASTHAN.**
210	826	Adaviappa, S.
211	1751	Calla, V. N.
212	800	Gopi Natha Rao, K.
213	834	Mathur, B. D.
214	1714	Mital, K. C.
215	1719	Sastry, G. S.
		18. **SAURASHTRA.**
216	214	Bhatt, U. J.
217	1600	Vibhakar, P. K.
		19. **TRAVANCORE-COCHIN.**
218.	801	Eapen, K. E.
219.	1654	Kartha, K. K.
220.	1021	Philipose, E. C.
221.	1659	Thomas, Jacob.
		20. **BHOPAL.**
222.	444	Mirza Fahim Beg.
		21. **COORG.**
223.	1742	Abhayankar, S. H.
		22. **DELHI.**
224.	448	Krishnaswamy, P. A.
225.	40	Shahni, T. C.
226.	1432	Sujan Singh.
		23. **KUTCH.**
227.	1471	Vora, P. K.
		24. **TRIPURA.**
228.	307	Sen, Anil Kumar.
		25. **VINDHYA PRADESH.**
229.	1741	Bhattacharya, P. B.
230.	953	Shri Krishna.
		26. **OTHERS.**
231.	1549	Doctor, P. K.

Annexure—II

BALANCE SHEET AS AT 30TH SEPTEMBER, 1952.

(Excluding Transport-Communications Monthly Review).

CAPITAL & LIABILITIES		Rs A. P.	Rs. A. P.
SUNDRY LIABILITIES			
Creditors for Expenses	...	5,261 4 0	
Subscription received in Advance from :			
Ordinary Members :			
1952 53 375 0 0			
1953 54 40 0 0			
Associate Members :			
1952 53 20 0 0	...	435 0 0	5,696 4 0
BUILDING, MUSEUM & TECHNICAL FUND	...		1,26,003 14 9
MITCHELL MEDAL FUND			
(Invested as per contra)	...		1,964 10 0
PROVIDENT FUND			
Deposits including interest earned	...		12,507 8 2
AMOUNT HELD IN SUSPENSE	...		80 0 0
T. C. M. R. ACCOUNT	...		2,930 4 0
INCOME & EXPENDITURE ACCOUNT			
Balance as at 1st October 1951	...	1,99,359 4 3	
Add : Balance being Excess of Income over Expenditure as per annexed Income & Expenditure Account	...	41,934 4 1	
		2,41,293 8 4	
Deduct : Amount transferred to Building, Museum & Technical Fund	...	1,26,003 14 9	1,15,289 9 7
TOTAL	...		2,64,472 2 6

(Sd.) J. SUBRAHMANYAM.
Secretary.

We have audited the Balance Sheet of the INDIAN ROADS CONGRESS (excluding Monthly Transport Communication Review) as at the 30th day of September, 1952, above set forth, and have obtained all the information and explanations we have required.

In our opinion, the above Balance Sheet set forth gives a true and correct view of the state of the affairs of the Congress according to the best of our information and explanations given to us and as shown by the books.

(Sd.) J. C. CHANDIOK,
B.A., A.C.A. (England & Wales), F.C.A.
for Walker, Chandiok & Co.
Chartered Accountants.

Kashmere Gate,
Delhi.
Dated, this 24th day of September, 1953.

PROPERTY & ASSETS		Rs A. P.	Rs. A. P.
EQUIPMENT			
Balance as per last Balance Sheet.	...	5,323 11 0	
Additions during the year.	...	1,118 2 6	
		6,441 13 6	
Less : Depreciation	...	604 10 0	5,837 3 6
LIBRARY BOOKS			
Balance as per last Balance Sheet	...	1,476 9 6	
Additions during the year	...	285 6 0	
		1,761 15 6	
Less : Depreciation	...	176 3 0	1,585 12 6
DRAWING MATERIALS			
Balance as per last Balance Sheet	...	27 14 0	
Less : Depreciation	...	1 9 0	26 5 0
STOCK-IN-HAND			
(Certified as to quantities & values by the Secretary)			
Journals	...	35,327 4 0	
Paper	...	1,528 12 3	36,856 0 3
SUNDRY DEBTORS			
Subscription in arrears from :—			
Ordinary Members	...	7,330 0 0	
Associate Members	...	360 0 0	
Outstanding on Journal	...	350 8 0	
Subsidies Receivable	...	43,000 0 0	
Advertisement Charges	...	1,345 4 0	
Session Expenses Receivable	...	816 8 0	
Transport Charges Receivable	...	295 0 0	
Delegation Fees Receivable	...	3,520 0 0	
Bad Debts (since written off)	...	9,108 2 6	66,125 6 6
ADVANCES	...		1,200 7 0
INTEREST ACCRUED ON INVESTMENTS	...		5,232 4 9
INVESTMENTS			
General Account			
Rs 10,500/- 5 years Post Office Certificates	...	10,500 0 0	
Rs 40,000 - National Savings Certificates	...	40,000 0 0	
Rs 50,000/- Treasury Receipts	...	50,000 0 0	
Rs 21,300 - 3% Loan 1963-65	...	20,271 10 0	1,20,771 10 0
Provident Fund			
12 Years National Savings Certificates	..	11,200 0 0	
Interest accrued	...	150 0 0	
With Imperial Bank of India	...	341 8 2	
Loans Advanced	...	820 0 0	12,511 8 2
Mitchell Fund			
Rs 1600 - 3% Loan 1963-65	...	1,652 14 11	
Interest accrued	...	16 0 0	
With Imperial Bank of India	...	295 11 1	1,964 10 0
CASH & OTHER BALANCES			
With Imperial Bank of India	..	12,360 3 1	
Postage Stamps in hand	...	0 11 9	12,360 14 10
Total	...		2,64,472 2 6

INDIAN ROADS CONGRESS

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30TH SEPTEMBER, 1952.

(Excluding Transport - Communications Monthly Review).

EXPENDITURE		Rs A. P.	Rs A. P.	INCOME		Rs A. P.	Rs A. P.
To Opening Stock of Journal as on 1st October, 1951	...	28,353 13 0		By Sale of Journal	...	8,670 1 0	
,, Cost of Paper	...	7,747 0 9		,, Advertisement	...	10,168 10 0	18,838 11 0
,, Cost of Printing	...	11,390 2 6					
		47,491 0 3		,, Government & States Grants	...		49,500 0 0
Deduct: Closing Stock of Journal as on 30th September, 1952	..	35,327 4 0		,, Subscriptions : -			
			12,163 12 3	Ordinary Members	...	23,276 0 0	
,, Establishment				Associate Members	...	2,940 0 0	
,, Local & other Allowances	...		21,637 7 0	Life Members	...	424 8 0	
,, Provident Fund Contribution	...		14,509 8 0	Members Restored	...	360 0 0	27,000 8 0
,, General Printing & Stationery	...		1,177 0 0				
,, Postage & Telegrams	...		1,656 15 6				
,, Uniforms to IV Class Servants	...		3,317 11 6				
,, Professional Charges	...		60 0 0	,, Entrance Fees : -			
,, Subscriptions to other Societies	...		450 0 0	Ordinary Members	...	2,475 0 0	
,, Miscellaneous Expenses (including Repairs & Telephone charges)	...		403 8 0	Associate Members	...	240 0 0	2,715 0 0
,, Bank Charges	...		1,109 11 9				
,, 16th Session Expenses	...		190 11 8				
,, Publicity	...		6,417 6 9				
,, Honorarium to Secretary	...		600 0 0	,, Interest accrued on Government Securities & Postal Certificates	...		6,189 4 9
,, Honorarium to Government of India Staff	...	1,200 0 0					
	...	300 0 0	1,500 0 0	,, Miscellaneous Income	...		2 15 0
,, Depreciation written off				,, Receipts on account of :—			
,, Bad Debts written off	...		782 6 0				
,, Loss of Loud Speaker	..		4,900 8 0	Delegation Fees	...	7,310 0 0	
,, Balance being Excess of Income over Expenditure carried to Surplus Accounts	...		162 4 3	Transport Charges etc.,	...	1,416 12 0	8,726 12 0
			41,934 4 1				
TOTAL			1,12,973 2 9	TOTAL			1,12,973 2 9

Kashmere Gate,
Delhi.
Dated, this 19th day of December 1952.

(Sd.) J. M. TREHAN,
Secretary.

In terms of our report appended to the Balance Sheet.
(Sd.) J. C. CHANDIOK,
B.A., A.C.A. (England & Wales), F.C.A.
for Walker, Chandiok & Co., Chartered Accountants.

Transport-Communications Monthly Review.

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30TH SEPTEMBER, 1952.

EXPENDITURE.	Rs A. P.	Rs A. P.	INCOME		Rs A. P.
To opening Stock as on 1st October, 1951 ...	1,648 13 1		By Sales & Subscriptions ...		3,112 6 0
,, Purchase of Paper ...	5,072 7 3		,, Advertisements ...		14,870 0 0
,, Printing Charges ...	6,708 1 3		,, Miscellaneous Income ...		5 0 0
	13,429 5 7				
Less: Closing Stock as on 30th September, '52 ...	567 10 11	12,861 10 8			
To Postage ...		1,453 7 0			
,, Miscellaneous Expenses ...		19 4 0			
,, Bank Charges ...		68 7 0			
,, Balance being Excess of Income over Expenditure carried to Balance Sheet ...		3,584 9 4			
TOTAL ...		Rs 17,987 6 0	TOTAL ...		Rs 17,987 6 0

BALANCE SHEET AS AT 30TH SEPTEMBER, 1952.

LIABILITIES	Rs A. P.	Rs A. P.	ASSETS	Rs A. P.	Rs A. P.
SUNDRY CREDITORS			**SUNDRY DEBTORS**		
For Expenses ...	50 0 0		Due for Advertisement ...	2,717 1 0	
Advances received ...	1,957 8 0	2,007 8 0	Due for Sales ...	213 4 0	
AMOUNT HELD IN SUSPENSE ...		11 0 0	Sundries-considered bad (since written off) ...	164 2 6	
SURPLUS ACCOUNT	1024 9 7		**DUE FROM GENERAL ACCOUNT** ...		3,094 7 6
Balance as per last Balance Sheet ..	20 0 0		**STOCK IN HAND**		2,930 4 0
Less: Amount wrongly credited last year adjusted ...	1,004 9 7		(Certified as to quantities & values by the Secretary) ...		567 10 11
Add: Balance being Excess of Income over Expenditure as per annexed Income & Expenditure Account ...	3,584 9 4	4,589 2 11	**STAMPS IN HAND** ...		15 4 6
TOTAL ...		Rs 6,607 10 11	TOTAL ...		Rs 6,607 10 11

Audited and found correct.
(Sd.) J. C. Chandiok,
B.A., A.C.A. (England & Wales). F.C.A.,
For Walker, Chandiok & Co., Chartered Accountants.

Kashmere Gate,
Delhi.
Dated, this 19th day of December 1952.

(Sd.) J. M. TREHAN *Secretary.*

Annexure III

INDIAN ROADS CONGRESS

REPORT OF THE COUNCIL TO THE GENERAL BODY OF MEMBERS FOR THE PERIOD 1ST JANUARY TO THE 31ST DECEMBER, 1952.

[The Report covers the period from the 1st January to the 31st December 1952, though a few matters referred to in it are carried beyond the latter date for convenience and completeness of record.]

1. GENERAL.

The Sixteenth Session of the Indian Roads Congress was held at Simla in April-May 1952 when 193 members and seven invitees attended the Session. The five Papers published in the Journal of the Indian Roads Congress Volume XVI-parts 1 to 3, were read and discussed. Three Committees and nine Subcommittees were reconstituted to deal with various engineering and administrative problems. The Soil Research Subcommittee was split up into the following two divisions :

(i) Field Experiments and General Division.

(ii) Laboratory Division.

The Executive Committee held two meetings at New Delhi on the 21st October 1952 and the 10th January 1953. (At the latter meeting there was not a full quorum. The proceedings will be considered by the full meeting at Madras in February 1953.)

2. ADMINISTRATION.

Shri T. Mitra, Chief Engineer, Works and Buildings Directorate, West Bengal, was elected President of the Indian Roads Congress at the Simla Session. Shri H. P. Mathrani, Consulting Engineer to the Government of India (Roads), continued as Honorary Treasurer. The Executive Committee at their meeting held on the 21st October 1952, re-elected Shri Goverdhan Lal, Deputy Consulting Engineer (Roads), as Honorary Deputy Treasurer.

Shri J. M. Trehan continued as Honorary Secretary. Shri T. N. Bhargava continued to work as Honorary Assistant Secretary till the 17th December 1952. In his place, Shri A. Mukerjee was appointed as Honorary Assistant Secretary with effect from the 17th December 1952 (afternoon).

The Executive Committee in their meeting held on the 21st October 1952 considered the proposal of the 38th Council meeting to expand the activities of the Congress. As a first step in this direction a paid wholetime Technical Secretary (Shri P. A. Krishnaswamy) was appointed with effect from the 2nd December, 1952.

3. OFFICE.

The office continued to function in New Delhi. During the period under report, the office disposed of 9,619 receipts and issued 20,855 letters against 6,945 receipts and 16,489 letters respectively in the previous year.

The staff worked satisfactorily.

4. MEMBERSHIP.

(1) **Ordinary and Associate**—The number of members on the rolls increased from 1292 (1265 ordinary and 27 associate) on the 1st October 1951 to 1314 on the 30th September 1952 (1286 ordinary and 28 asssociate). There were 103 new admissions to the Society and 81 removals from the rolls due to resignations (22), deaths (5), and non-payment of arrears of subscriptions for a long time by members who had retired from service, left India or for other reasons failed to pay.

(2) **Life Membership**—During the Congress year from the 1st October 1951 to the 30th September 1952, four members enrolled themselves as Life Members bringing the total number of such members to 111. This number is however, included in the total number of ordinary members. The fees received from them have been transferred to a separate reserve after deducting Rs 10 per member for initial expenses. The Life Membership Reserve amounted to Rs 6,932-1-0 on the 30th September, 1952. This reserve is to be utilized for such purposes as the Council may decide from time to time. The Council has not, so far utilized any part of the reserve.

5. DEATHS

It is with deep regret that the Council record the deaths of the following Members :

(1) M. A. Korni.
(2) R. L. Varma.
(3) K. A. N. Chetty.
(4) Manohar Nath.
(5) Sant Ram Sahgal
(6) N. V. S. Murty.
(7) Vepa Krishnamurthy.
(8) B. Krishna Iyengar.

6. FINANCE.

The budget for the year 1952-53 and the "Actuals" for 1951-52 were approved by the Executive Committee at their meeting held on the 21st October 1952. The estimate will be submitted to the Council at its 40th meeting. The "Actuals" for 1951-52 show a surplus of Rs 17,514 against an estimated surplus of Rs 6,091. The improvement in the budgetary position resulted from economy in expenditure, and increased income from advertisements as the value of publicity through the "Journal" and the "Transport-Communications Monthly Review" became more and more recognized by advertisers.

The total contribution received from the Centre and the States during the year ending 30th September 1952 was Rs 31,500. The outstandings from the centre and the States on the 30th September 1952 were Rs 46,000 out of which Rs 3,000 were written off as irrecoverable by the Executive Committee in their meeting on the 21st October, 1952 Efforts are being made to persuade the States concerned to expedite payments of outstandings. (Further sums amounting to Rs 10,000 were received after September 1952).

The arrears of subscription at the beginning of the Congress year 1951-52 were Rs 17,830-4-0, due from 368 Members of whom 98 had been in arrears for more than two years. The names of 54 Members who had died, retired from service, migrated outside India, or had been in arrears for a long time were removed from the rolls. Consequently a sum of Rs 4,777-8-0 standing as arrears against these members was written off last year by the Executive Committee at their meeting held on the 1st December 1951. A sum of Rs 3,800 was realised from 115 members.

After adding the arrears for 1951-52, the total arrears on the 1st October 1952 stood at Rs 13,707-12-0 due from 276 Members. Action has been taken regarding this and some further names have been removed from the rolls by the Executive Committee at its meeting in October 1952. Details of the action being taken will be reported in the next annual report.

7. AUDIT.

At the Sixteenth Session at Simla it was decided to appoint Messrs Walker, Chandiok and Co., Chartered Accountants and Auditors, Delhi to audit the accounts of the Congress for 1951-52. The report was examined by the Executive Committee and also by the Council at their 40th meeting on the 7th February 1953.

The Executive Committee agreed to the change of the head "Surplus Account" in the Balance Sheet to "Income and Expenditure Account" and to the transfer of a sum of Rs 126,903-14-9 to a new heading "Building, Museum, and Technical Fund". This includes a sum of Rs 6,932-1-0 of the Life Membership Reserve.

The matter was further considered by the Council at their 40th meeting on the 7th February 1953. The Council agreed that future contributions under the head "Life Membership Reserve" should also be credited to the new heading "Building, Museum, and Technical Fund".

8. PUBLICATIONS.

There was a steady demand for the publications of the Indian Roads Congress during the year under report.

In addition to bound volumes No. XII, XIII and XIV of the Journal, bound Volume XV also became available during the year. The Nagpur Report was also re-printed and made available for sale.

Circulars were issued to all State Governments, other administrations, and engineering firms bringing to their notice that bound Volume XV and the Nagpur Report were available. Announcements regarding these publications were also made in the Journal and the Transport-Communications Monthly Review. As a result, these publications received sufficient publicity. Particularly the Nagpur Report was in great demand. Out of 1,000 copies reprinted last year, 731 copies have already been sold out.

The balance of the publications as on the 31st December 1952 was as under:

Name of Proceedings	*Volume*	*Balance*
I.R.C. Proceedings	... I to VI, VII-1 & VIII	Sold out
Do.	... VII-part 2	46
Do.	... IX-part 4	124
Do.	... Bound Volume IX	174
Do.	... X-part 4	269
Do.	... X parts 1 & 2 (Bound)	Sold out
Do.	... X parts 3 & 4 (Bound)	Sold out
Do.	... XI-part 4	184
Do.	... XI-parts 1 & 2 (Bound)	82
Do.	... XI-parts 3 & 4 (Bound)	185
Do	... XII-part 1	12

Name of Proceedings	*Volume*	*Balance*
I.R.C. Proceedings	... XII-part 2	415
Do.	... XII-part 3	442
Do.	... XII-part 4	548
Do.	... XII-part 5	452
Do.	... XII-parts 1 to 3 (Bound)	411
Do.	... XII-parts 4 & 5 (Bound)	270
Do.	... XIII-part 1	304
Do.	... XIII-part 2	390
Do.	... XIII-part 3	737
Do.	... XIII-parts 1 & 2 (Bound)	615
Do.	... XIII-parts 3 & 4 (Bound)	190
Do.	... XIV-part 1	299
Do.	... XIV-part 2	397
Do.	... XIV-part 3	359
Do.	... XIV-part 4	432
Do.	... XIV-parts 1 to 4 (Bound)	558
Do.	... XV-part 1	810
Do.	... XV-part 2	352
Do.	... XV-part 3	417
Do.	... XV-part 4	452
Do.	... XV-parts 1 to 4 (Bound)	611
Do.	... XVI-part 1	91
Do.	... XVI-part 2	207
Do.	... XVI-part 3	239
Do.	... XVI-part 4	250
Road Research Bulletin No. 1.		223
Bridge Code (1937).		150
Nagpur Report.		269
Paper on 'Water Bound Macadam'.		63

It is noticed that there is a smaller demand for part 4 (Part 3 in 1948) than for the other Parts of these Journals. This may be because the last Part of each Volume does not contain any Papers. But the discussions on Papers are printed in the last Part of each Volume and the discussions are quite often as important as the Papers themselves since they correct mistakes in the Papers and bring out fresh points of view. It is hoped that with this explanation, the demand for these issues will improve.

Those Members who do not possess a complete set of the Proceedings of the Society are advised to complete their series before the old volumes are sold out.

On a reciprocal basis, copies of the publications continued to be supplied to several technical institutions in India, the United States of America, the United Kingdom, and Australia, and to the offices of the United Nations Organization in the Far East.

According to the agreement entered into with the Central Road Research Institute last year, the following **three Road Research Notes of that Institute** were published in the Journal of the Indian Roads Congress.

(1) " An Examination of Black-Top Surface Dressings laid for Field Tests in 1945 on the Bombay-Delhi Road, Mile 736 ", in Volume XVI-2.

(2) "Some Observations on Airfield Runway Surfaces ", in Volume XVII-1.

(3) " The Compaction of Some Alluvial Soils of India ", in Volume XVII-2.

The " **Transport-Communications Monthly Review** " has now become a popular publication and subscribers number nearly 300. As reported last year, two series of useful and informative articles were started in this publication. One series covered Highway Standards issued by the Indian Roads Congress in recent years. The other series, which is still continuing, gives salient features of the important bridge works executed in the last five years.

Two issues—viz., those of January and February 1952—were distributed free in large numbers to all States in India, and the Chief Engineers were requested to circulate the Review to all engineers and subordinates. Further it was decided to make this publication available to subordinate engineering staff in the country at the concessional rate of Rs 8 a year which is charged from the members of the Society.

As the articles on bridges were considered very useful, it was decided that all of them should be published together. Accordingly they have been published in Volume XVII-part 3 of the Journal of the Indian Roads Congress. Detailed papers on some of the bridges on which articles have been written, have already been published in various issues of the Journal of the Indian Roads Congress.

Complimentary copies of the Review are being issued to State Governors, Rajpramukhas, Chief Commissioners, Ministers at the Centre and in the States, the Chief Engineers concerned with roads, and others. Also complimentary copies of the issue for May 1952 were supplied to all the Members of the Indian Roads Congress.

The Council request Members and readers of the Review to send articles and other suitable contributions for future publication therein.

9. INFORMATION.

Enquiries from Members as well as non-members on problems relating to highway engineering and allied subjects were attended to. Some of the subjects on which information was sought are given below :

(1) I. R. C. bridge loadings ;
(2) Type designs for slab culverts ;
(3) Abutments, abutment piers, and piers for arches of various spans ;
(4) Load-carrying capacity of masonry arches ;
(5) Grading of aggregates ;
(6) Standards for mile and furlong stones ;
(7) Statistics about the milage of roads ;
(8) Standard road signs ;
(9) Specification for laying a cement concrete pavement ;
(10) Glossary of highway engineering terms ;
(11) Information about restriction on heavy vehicles on waterbound macadam roads ;
(12) Designing R. C. C. pipes ;
(13) Literature on landscape planning of road ;
(14) Bituminous road construction ;
(15) Road making machinery ;
(16) Details about suspension foot-bridges ;
(17) Road surfacing materials ;
(18) Cement concreting municipal roads with water mains running underneath ;
(19) Type designs for pipes for culverts ;
(20) Testiog of stone metal ;
(21) Testing bridges.

10. LIBRARY.

A large number of technical journals of institutions in India and abroad were received in exchange for the Indian Roads Congress publications. Some new books and Standards of the British and the Indian Standards Institutions were added to the Library of the Congress. Members can borrow books from the libraries of the Congress and the Consulting Engineer (Roads) by writing to the Secretary, Indian Roads Congress. The rules regarding the loan of books are published in Volume XVII-part 1 of the Journal of the Indian Roads Congress.

List of additions to the library are published monthly in the "Transport-Communications Monthly Review". Members are requested to study these lists and ask for books which they wish to consult. One hundred and twenty books (against 75 last year) were issued on loan during the year under report. This is a very small number considering the Society has nearly 1,300 Members. **It is urged that Members should make more use of these libraries.**

11. MEDALS AND PRIZES.

The Executive Committee in their meeting during the Session at Simla accepted the recommendations of the Papers Sub-committee for the award of Medals for Papers read and discussed at the 15th Session. The following award was made :

"The Indian Roads Congress Medal"

Shri B. V. Vagh for his Papers on
"A Design for Bullock-cart Wheels".

Further the following two Papers were highly commended :

Paper No. 152 – "Organization of Bridging Activities" by G. R. Nangea.

Paper No. 154 – "Behaviour of Brick Metal in Tar Carpets" by K. C. De.

12. COLLECTION OF PARTICULARS OF BRIDGES.

The Indian Roads Congress have collected particulars of bridges of lengths above 100 feet for Publication in book form. The information collected is being compiled in proper form in the Roads Organization. As soon as compilation is complete, the question of its publication will be taken up.

13. MEMBERSHIP OF SOCIETIES AND INSTITUTIONS.

(1) The Indian Roads Congress is a member of the Indian National Society of Soil Mechanics and Foundation Engineering. Shri S. R. Mehra, Principal, Punjab College of Engineering, Roorkee, represented the Indian Roads Congress on the National Committee of the Society during the year.

(2) The 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.

(3) Shri H. P. Sinha continued to represent the Indian Roads Congress on the Engineering Division Council of the Indian Standards Institution.

(4) The following continued to represent as the Principal and Alternative representatives of the Indian Roads Congress on the Building Division Council of the Indian Standards Institution.

Principal representative :	Shri S. B. Joshi
Alternative representative :	Shri H. P. Sinha

(5) The other representatives of the Congress on the various Sectional Committees of that Institution are :

EDC : 2-Cement	Shri E. P. Nicolaides
EDC : 20-Drawings	Shri H. P. Sinha
CDC : 7-Bitumen & Tar Products	Shri K. K. Nambiar Shri Brijmohan Lal
BDC : 1-Terminology Notations & Drawings Sectional Committee	Shri H. Sunder Rao (Principal representative) Shri J. Subrahmanyam (Alternative representative)
BDC : 7-Structural Steel Sectional Committee	Shri D. S. Desai (Principal representative) Shri M. P. Nagarsheth, (Alternative representative).

(6) The following are the Principal and Alternative representatives of the Indian Roads Congress on the Road Tar Sub-committee of the Indian Standards Institution.

Principal representative :	Shri R. N. Chatterjee.
Alternative representative :	Shri G. C. Khanna.

14. REPRESENTATION ON OTHER ORGANIZATIONS.

Board of Engineering Research :-The Prime Minister in his capacity as President of the Council of Scientific and Industrial Research set up a Board of Engineering Research to co-ordinate research in various branches of engineering. The President of the Indian Roads Congress is a member of this Board.

15. TECHNICAL ACTIVITIES OF THE CONGRESS.

(1) Specifications and Standards Committee :

The Committee met at Simla during the Sixteenth Session of the Indian Roads Congress in April 1952 and considered the following subjects :

(1) Design of traffic rotaries :

(2) Recommended practice for siting and layout of petrol filling stations : and

(3) Recommended practice for road-side advertisement and hoarding control.

Notes on item (3) have been published in Volume XVII-part 2 of the Journal of the Indian Roads Congress.

Item No. (2) was referred to a small working Committee but it has not been possible for this Committee to meet so far. It is hoped that the Committee will meet during the General Session and finalize their recommendations.

The following recommendations of the Committee were accepted by the Executive Committee in their meeting on the 21st October 1952 and forwarded to the Government of India for implementation.

(1) a provision for controlling advertisements on private property abutting upon a road should be included in the Model Highway Bill :

(2) the display of advertisements hung across a road should be prohibited.

The following subjects have been under study with the Committee :

(i) Permissible load that a bullock can draw without undue strain.

(ii) Questionnaire on practices on surface dressing current in different States.

(iii) Best method of presenting legends on mile stones in English, Hindi and the local language.

(2) Bridges Committee :

The Committee met at Simla during the Sixteenth Session in April 1952, and discussed the draft Section V of the Bridge Code relating to steel Bridges. Part 1 of the section dealing with general matters and Part 2 dealing with 'Loads and stresses' were practically finalised at the meeting.

The Steel Bridge Code Subcommittee met at Bombay on the 2nd and 3rd June, 1952 and discussed Parts 3 and 4 of the code dealing with "Specifications of Materials of Construction" and

"Working stresses in Mild steel and other materials of construction" except the portions dealing with high tensile steel. These parts and a few clauses of Part 5 dealing with "Designs and Details of Construction" were finalised.

The Government of India have intimated that the recommendation of the Indian Roads Congress that arrangements should be made for carrying out tests of bridge structures and various types of modern bridge equipment should be purchased was receiving the attention of Government.

(3) Technical Subcommittee.

(a) *Test Track Division* :

The Subcommittee held their meetings on the 26th April and the 27th May 1952.

As recommended by the Subcommittee, the Convenor addressed the Chief Engineers of all the States on the 24th May 1952, requesting them to send to the Central Road Research Institute, at least one cubic-foot samples of moorums available in their States for classification and comparative study. It is understood that a large number of samples have been received and are being studied at the Central Road Research Institute.

As mentioned in the last report some surface dressing tests will be carried out on the Delhi-Mathura Road near the Central Road Research Institute as a sequel to similar experiments carried out on the Bombay-Delhi Road near Agra. A meeting of the members of the Test Track Division resident in Delhi was held on the 18th March 1952 to specify the details of the proposed tests. The specifications were later finalized in consultation with binder manufacturers.

The Government of India have agreed to meet the expenditure on the experiments and preliminary work has been taken in hand. A permanent diversion along the Delhi-Mathura road has been built for testing highway specifications under actual working conditions.

According to the recommendation of the Subcommittee meeting held on the 2nd January 1952 the Government of Uttar Pradesh were requested **not** to carry out extensive repairs to the experimental length near Agra but to allow it to deteriorate to the point of destruction, so that definite conclusions could be derived from the experiments.

To look after and guide the new experiments near the Central Road Research Institute, a Subcommittee of this Division was

appointed in May 1952. The Subcommittee will inspect the test surfaces near Agra finally during January 1953 before the test surfaces at the Central Road Research Institute are laid.

The lease of the land on which the Calcutta Test Track is located was due to expire on the 31st December, 1952 and a request has been made to the Calcutta Port Commissioners by the Consulting Engineer, Government of India (Roads), to extend the lease for another five years.

The present series of experiments at the Road Test Track, Calcutta relate to testing stabilized base courses of various thicknesses and specifications

(b) *Research Organisation Division:*

The Subcommittee held a meeting at Simla in April and another at Delhi in December 1952.

At its April meeting the Subcommittee recommended that attempts should be made to make known to each engineering research laboratory in India the problems that were being investigated at other laboratories. It was agreed that, to achieve this object, reports issued by each laboratory should be circulated to other institutions.

Regarding the question of publishing research reports in the Journal of the Indian Roads Congress the Subcommittee recommended that only such matters as were considered by the respective research organizations as mature enough should be published with the approval of the Subcommittee.

At the December meeting the Subcommittee discussed the reports of the Karnal Roads & Buildings Laboratory for 1950 and the first half of 1951, measures for co-ordinating and disseminating results of road research, and soil stabilized village roads with reference to community Project Schemes.

The Subcommittee considered that since soil stabilization needed specialist supervision at all stages of the work, an Assistant Engineer and some subordinate technical staff would be needed on each community project where such work was done on a large-scale. Testing equipment would also be needed. It was suggested that Road Research Laboratories should issue simple specifications for soil stabilization work

The Subcommittee recommended that all Road Research Organizations should be requested to send to the Indian Roads Congress half-yearly reports for exchange of information.

At this meeting the Director, Central Road Research Institute gave brief details of the work done at Central Road Research Institute.

(4) **Soil Research Subcommittee:**

This Subcommittee held a meeting at Simla during the Session in April 1952. Later this Subcommittee was split up into two divisions. The functions of these divisions, as prescribed by the Executive Committee in their meeting held on the 21st October, 1952, are given in **Appendix**.

The Subcommittee in their meeting held on the 2nd January 1951, had recommended that engineering colleges and universities in India be requested to include in their civil engineering curricula the study of the basic principles of soil science and soil mechanics. The Executive Committee at their meeting held on the 1st December 1951 decided that, before the engineering colleges and universities were addressed the results of the deliberations of the All-India Board of Technical Studies should be awaited. It is understood however that this Board has not had the opportunity to consider the subject so far.

The Subcommittee in their meeting held on the 17th December 1951 had set up a working committee to deal with the classification of Indian soils with respect to their engineering properties. This working committee met on the 3rd March 1952. The minutes of this working committee were considered by the Soil Reasearch Subcommittee at the meeting in April 1952. The Indian Agricultural Research Institute has been requested that characteristics of soil for highway construction purposes may also be recorded by them while carrying out soil surveys for agricultural purposes.

The Subcommittee had recommended that field experiments should be carried out on soil stabilization with lime sludge and sodium silicate. The Council of Scientific and Industrial Research had advised that field tests should pend till the experimental studies at the Buildings Research Institute, Roorkee, were completed. They have now intimated that the results are not satisfactory for road making.

On the request of the Indian Roads Congress, the Government of India had kindly agreed to provide funds for carrying

out experiments on surface dressing work with tar on stabilized roads in the Punjab and Madras. The estimates of the proposed work have also been received. The Field Experiments and General Division of the Subcommittee have now been requested to clarify whether asphaltic bitumen binders should also be tested or the tests should be confined to tar alone, as originally recommended.

(5) Education Subcommittee

The Subcommittee held their meeting at Simla on the 26th April 1952.

The Subcommittee expressed the view that the syllabi for and examination papers on highway engineering in the engineering Colleges were, by and large, satisfactory and that specialization in this subject was not necessary at the graduate stage. A draft model syllabus embracing the essential basic principles of highway engineering has been circulated and will be considered by the subcommittee in their next meeting.

The subcommittee is working out the details of a refresher course for engineers and its financial implications.

(6) Highway Layout Subcommittee:

The Subcommittee in their meeting held on 26th April 1952 discussed certain factors, affecting the layout of roads in urban and rural areas, viz., junctions and intersections, entrances to private property abutting on highways, improvement of foot-paths, painting of kerbs, location of bus stops, etc.

(7) Papers Subcommittee:

The Committee at its meeting held at Simla in April 1952 recommended the award of Medals for some of the Papers discussed at the 15th Session.

Six Papers were received during the year. Four were accepted for publication, one was rejected and one returned to the Author with suggestions for revision.

(8) Manufacture of Road Making Machinery and Mechanization Subcommittee:

The Subcommitcee met at Simla in April 1952. It was noted that the Government of India had taken steps to assess the total firm requirements of stone crushers during the next few years with a view to consider the possibility of placing bulk indents with the firms willing to manufacture them in India.

Information about the possibility of manufacturing tar and bitumen boilers, asphalt mixers, sprayers, concrete mixers, etc. was being collected by the Subcommittee and will be forwarded to the Government of India as early as possible.

16. MISCELLANEOUS.

(1) Research Problems.

The Executive Committee at their meeting held on the 29th September 1950 considered that, as the students in the engineering colleges were not likely to be familiar with practical problems on which research was needed, the Indian Roads Congress should compile a list of such problems and circulate it to the engineering colleges.

A list of research problems suggested by the Members of the Council and Convenors of Committees and Subcommittees was compiled and has since been passed on to the Research Organization Division for scrutiny. It will be placed before the Executive Committee when received.

(2) Need of Roads for the "Grow More Food" Campaign.

According to the recommendation made by the Executive Committee at their meeting held on the 29th September, 1950 it was recommended to the Ministries of Food and Agriculture at the Centre and the States that the development of roads was a necessity if the "Grow-More-Food Campaign" was to be a success and that they should finance road building projects in areas where the "Grow-More-Food Campaign" was to be launched. It was suggested that at least 15 per cent of the funds available for the "Grow-More-Food Campaign" should be set aside for this purpose.

As some of the replies indicated that under the rules governing the financial assistance for the "Grow-More-Food" scheme, no funds could be diverted for the construction or improvement of roads, the Planning Commission was requested to use their good offices with the object of getting the Grow-More-Food Rules suitably amended. The Planning Commission expressed their inability to do anything in the matter. The Executive Committee at their meeting held on the 21st October 1952, decided not to pursue the matter further. Educative propaganda would, however, be kept up.

Appendix.

Functions of the two Divisions of Soil Research Subcommittee

1. *Field Experiments and General Division:*

   (1) To study all reports of field experiments received by the Committee or printed in the Indian Roads Congress Journal and make suggestions for further research and experiments.

   (2) To suggest large-scale model tests or field experiments arising from reports of the Laboratory Division or the study of other literature, and make suggestions for further experiments.

   (3) To study the general problem of soil research and particularly large-scale model and field experiments with reference to their application to road works.

2. *Laboratory Division:*

   (1) To study all reports on soils of Road Research Institutes and research stations in India and make suggestions for further research.

   (2) To study all reports of field experiments received by the Committee or printed in the Indian Roads Congress Journal and make suggestions for further research and experiments.

   (3) To make suggestion regarding Soil Classification, soil research in the laboratory, and the general theoretical study of soil structures and their load bearing capacities, and generally on laboratory investigations of soil problems.

The work of the two divisions should be co-ordinated under the direction of the Consulting Engineer to the Government of India (Roads). It is expected that the Convenors will exchange notes and information as found necessary. Problems of common interest will be discussed at combined meetings of the two Divisions.

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Minutes of the 41st Council Meeting of the INDIAN ROADS CONGRESS Held at Madras on the 12th February, 1953.

The Council met with Shri T. Mitra in the Chair.

Present :

F. P. Antia
M. L. Bahl
C. M. Bennett
U. J. Bhatt
P. V. Divatia
G. N. Dutt
C. J. Fielder
K. S. Gangadhara
Goverdhanlal
W. A. Griffiths
S. Gupta
R. N. Joshi
K. K. Kartha
G. H. Khan
D. N. Khurana
U. N. Mahida
H. P. Mathrani
M. S. Mathur
G. M. McKelvie
C. P. Misra
E. A. Nadirshah
K. K. Nambiar
S. C. Nayak
L. R. Patel
K. Ramaswamy
Lt. Col. K. C. Soni
Sujan Singh
K. V. Thadaney
P. L. Varma

J. M. Trehan...Secretary.

The following co-opted Members attended :

K. F. Antia
G. S. Gnanaprakasam
N. V. Modak
Sri Krishna
E. Zipkes

The following attended by invitation :

A. K. Sen
B. N. Shenoy
H. Sunder Rao

1. Co-options & Invitations.

The Council approved the action taken by the Executive Committee in co-opting and inviting certain members to attend the Council meeting.

2. Confirmation of the Minutes of the 40th Council Meeting.

The Minutes of the 40th Council meeting held at Madras on the 7th February 1953 were confirmed.

3. Office Bearers.

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

President	R. K. Batra
Vice Presidents	K. K. Nambiar
	M. S. Mathur
	L. R. Patel
Honorary Secretary	J. M. Trehan

4. Venue of the next General Session.

The Executive Committee was authorised to fix the venue and dates of the next session of the Indian Roads Congress.

5. Committees and Subcommittees.

The Convenors of Committees and Subcommittees were appointed as under :—

(1)	Specifications & Standards Committee	Goverdhan Lal
(2)	Bridges Committee	H. P. Mathrani
(3)	**Technical Subcommittee** :	
	(i) Test Track Division	T. Mitra
	(ii) Research Organisation Division	H. P. Sinha
(4)	Road Transport Subcommittee	U. N. Mahida
(5)	Soil Research Subcommittee	E. Zipkes
(6)	Educations Subcommittee	E. A. Nadirshah
(7)	Provincialization of Local Bodies Engineering Services Subcommittee	B. N. Roy.
(8)	Papers Subcommittee	G. M. McKelvie
(9)	Manufacture of Road Making Machinery & Mechanization Subcommittee.	R. S. Bhalla
(10)	Organization Committee	G. M. McKelvie

The Soil Research Subcommittee which had been divided into two Divisions at the last Session was reconverted into one Subcommittee. The Bituminous Treatment of Wet Aggregates Subcommittee and the Highway Layout Subcommittee were abolished. The residual functions of the former Committee were entrusted to the Flexible Pavements Division and the work of the latter to the Geometric Design Division of the Specifications and Standards Committee.

6. Absorption of Local Bodies' Engineering Staff into the State Public Works or Highways Departments.

The matter was discussed by the Provincialization of Local Bodies Engineering Services Subcommittee at their meeting held on the 9th February 1953. The recommendations made by them were examined by the Organization Committee ; and later the Organization Committee and the Executive Committee discussed this matter in a joint sitting, on the 11th February 1953. The

recommendations were considered by the Council who **unanimously** passed the resolution given in the **Appendix**, and decided to forward that resolution to the Government of India with the request that they might advise the State Governments to adopt the policy advocated in the resolution as early as possible.

7. Honorary Deputy Treasurer.

The Council gave a directive that the Honorary Deputy Treasurer elected by the Executive Committee should be co-opted, ex-officio, to the Executive Committee and the Council of the Indian Roads Congress.

—o—

Resolution

Appendix

The Council of the Indian Roads Congress recommend that the Government of India bring to the notice of all State Governments the excellent arrangements existing for the control of local public works in Madras.

Under the Madras system, the local board public works services have been provincialised in all grades and works are executed under the guidance and control of the State Chief Engineers concerned.

The advantages of this system are manifold :

(1) Financial control is much better than when the local boards do the work independently because the Chief Engineers concerned can see that rules and regulations are properly observed initially and audit objections are dealt with promptly.

(2) Direct and effective technical control is ensured and the design and execution of works are much improved because the advice and guidance of senior officers are made continuously and directly available to the local engineers and other staff This staff is also subject to the disciplinary control of the Chief Engineer.

(3) The quality of the District Engineer staff is much improved because the officers are not compelled to spend their whole service in one district but get the opportunity to gain wider experience by service throughout the State and to pass on to many others the knowledge gained during their service.

(4) Pooling and development of the resources of tools and plant available with the State Governments and the different local or District Boards in the State is ensured. This leads to their efficient and continued use throughout the adjoining areas and to saving of expenditure and time on purchase of duplicate machinery and plant by the different agencies within one State.

(5) Policy making for and budgetary control of local works continue to vest in the local boards as elsewhere but the implementing of policy is in the hands of a capable executive free from local influences. This is the ideal democratic arrangement that has been aimed at by all democracies and largely achieved in the democratic "welfare" states.

The Council would urge that the excellent condition of district board roads in Madras is itself convincing evidence of the soundness of the policy advocated. The adoption of this policy is urgent in view of the increased importance given to villages and local roads of purely district importance in the Five-Year Plan.

Tour Notes of the
SEVENTEENTH INDIAN ROADS CONGRESS
Madras, February 1953

1. THE CENTRAL ASPHALT PLANTS OF THE CORPORATION OF MADRAS

Inspected by the Delegates on 12-2-53.

History of the Plant

The city of Madras has an area of nearly 50 sq. miles and a total length of 527 miles of roads and streets. The volume and the intensity of traffic on these roads increased phenomenally during World War II and the subsequent years. This heavy traffic brought in its wake the necessity for upgrading the surface of roads.

A start at providing superior surfaced roads was made in the year 1931 when a stretch of 4000 feet on the Mount Road from the old city limits was paved with hot mixed asphaltic concrete 2 inch thick. Inspite of the heavy traffic this has stood well. During the subsequent years 80 miles more of asphaltic concrete and 20 miles of cement concrete roads were laid. The Corporation has today a length of 388 miles of black topped Roads.

Concrete roads had to be given up as they were unsuitable at locations where underground services existed and all further upgrading was limited to asphaltic concrete only. It has also been found recently that the rendering of side walks with a $\frac{3}{4}$" bitumen sand mix gives a smooth and comfortable surface at a moderate cost for the use of pedestrians. There has been a very great demand for asphaltic i.e., concrete roads in the Corporation and to meet this demand a second-hand Iroquish asphalt mixing plant was purchased in 1947, at a cost of Rs 38,000/-. Its capacity is 8 tons per hour. This could not cope up with the intensive programme on hand for laying hot mixed asphalt roads and so the Corporation had to acquire another plant a Millers Asphalt Mixing Plant at a cost of Rs. 1,25,000/- with a capacity of 10 tons (or 200 cubic ft) per hour.

To facilitate surfacing work on roads located at different places in the city simultaneously it was found advantageous to instal these machines permanently at a central place even though they were of a semi-portable type. Moreover, installation of these machines on road sides near the work causes great obstruction to traffic. The shifting of the machine from one work to another is

a tedious job involving loss of time and labour. All these considerations indicated a permanent central location for the plant. The spur Tank which is a central place in the city with a wide open area was found most suitable and so the machines were installed there.

The machines are erected at such elevation that dump trucks can move under them for receiving the hot-mix for transportation to the work spot.

Plant Operation.

Both the machines are similar in operation and the main features are given below:

A cold elevator carries the aggregate to the dryer where it is heated for removing moisture and then carried through covered hot elevator to the storage hopper. Before the materials are delivered to the storage hopper they are passed through a screen which accurately grades the aggregate according to sizes. The hopper keeps different sizes of aggregate separated for accurate proportioning under the operator's direct control. The aggregates are then accurately proportioned by weight and dropped into the paddle mixer.

Meanwhile bitumen heated in boilers is weighed in asphalt scales and discharged into the paddle mixer along with the aggregate from the batcher. The paddle mixer thoroughly mixes the materials and the mixed stuff is lowered through the opening at the bottom of the mill to waiting dump trucks for carrying it to the worksite.

The dryer consists of a rotary drum, 4 feet in diameter and 13 feet long fittted internally with a series of blades and lifters which serve to propel and cascade the material through the drum in such a manner as to promote quick and efficient drying. The rotary drum carries necessary oil burners, which are mounted in refractory lined combustion chamber ensuring clean and complete combustion of the oil fuel. The paddle mixer has a twin shaft fitted with tips. The mixing principle combines stirring, heating and rubbing which results in the uniform distribution of various sizes of aggregate and a thorough incorporation of the bitumen resulting in a homogeneous mass. The mixing temperature is kept between 300°F to 350°F. A diagrammatic sketch of the plant is given in Plate I.

The Iroquish asphalt plant is run by steam. The Millars Asphalt plant is run by a diesel engine while coal is used for heating bitumen. The dryer is fired with an oil burner equipment

for high and low temperature. The low temperature burner can be used for mixes which are to be heated to less than 150° F. In addition, the plant is fitted with a cyclone type dust collector which serves to prevent dust and grit from being discharged into the atmosphere. This plant is also provided with a bitumen pump of rotary gear type, with necessary valves and piping for delivery of bitumen to the measuring tank in the mixer.

2. BARBER-GREENE TAMPING LEVELLING FINISHER

Uses.

The Barber Greene finisher will lay any type of hot or cold bituminous material used to pave streets, highways, runways, etc. It tamps, levels, strikes off simultaneously, automatically measures the correct amount of compacted material and produces a level surface with no ripples and with a uniform density throughout.

The Principles of Operation.

The Barber-Greene Finisher consists of two main units, the tractor unit and the screed unit. The tractor unit provides the motive power through crawlers travelling on the road base. The crawlers assure positive traction, manoeuvrability and large bearing area. The tractor unit includes the receiving hopper, spreading screws, power plant, transmissions, dual controls and operator's seat.

The screed unit is towed by the tractor unit. Long levelling arms extend forward from the screed unit and pivot on the crawlers of the tractor unit. The tamper, thickness controls, crown control, screed heater, and the screed itself are all parts of the screed unit. It rides on the finished surface.

Material Flow.

The mix is dumped into the receiving hopper from a truck which is pushed ahead by the finisher bumper rollers as paving continues without interruption. At the bottom of the hopper are two independently operated bar feeders. They convey the material to the spreading screws and also control the amount of material ahead of the tamper. The spreading screws uniformly spread the mix across the full width of the mat. The tamper compacts and strikes off the material, and the screed, immediately behind, completes the smoothing or ironing of the surface

Tamping.

The tamper has got a front inclined surface. The vertical travel of the tamper is 1/8 inch at approximately 1200 impact strokes per minute. The tamper in its lowest position is slightly below the bottom of the screed. This fixes the surface elevation just before the screed slides on to it. There is no variation in material density, for the tamper is the strike-off.

The real tamping is done by the front inclined surface as it travels down, compacting the material to a uniform density and allowing the excess to push forward and upward. A continuous excess of materials in front of the tamper assures uniform compaction regardless of variations in the subgrade and resultant mat thickness.

Levelling.

Smooth riding surfaces are assured with the Barber Greene Tamping-Levelling Finisher, for its levelling principle depends upon time or distance instead of a mechanical ratio. A crawler may abruptly change level, but there is a time lapse before the screed reaches a new level. The greater the change the longer the time to lapse. On long bumps, the delayed screed reaction stretches out the variation in level. Thus the mat that may be placed over an irregular base has excellent riding qualities.

3. RUBBERISED BITUMINOUS WEARING SURFACE, MARINA, MADRAS CITY.

Bitumen becomes brittle in cold weather and bleeds and becomes soft in summer. When brittle, it cracks thus allowing surface water to penetrate and soften the foundation. When bleeding, it is soft, and its bearing capacity is also poor and the iron tyred traffic cuts into the wearing surface causing ruts and corrugations. The bituminous surface is also slippery. It has been found by laboratory research and actual full-scale experiment that these defects can be got over to some extent by the addition of rubber either in the form of powder or as latex. The effect of rubber in bitumen is to raise the softening point and reduce penetration. The rubberised wearing surface has got greater resistance to abrasion and an ability to absorb vibration. The surface is more resilient and the adhesive value of bitumen is also increased. The latter property is a very great advantage in surface dressing. The chips stick well to the road surface.

This improved surfacing is being laid on the Marina, an important road in Madras.

The proportion adopted is as follow :

Graded granite metal ¾ in–⅜ in.	...	185 lb
Sand	..	185 ,,
Bitumen	...	27 ,,
Rubber Powder	...	1.35 ,,

The aggregates are dried and heated up to a temperature of 330° F. and dropped into the mixer. Rubber powder is added to the aggregates and agitated for 15 seconds. Asphalt heated to 350° F. is then added mixed.

Madras Marina–Rubber Asphalt surface being rolled.

The mixed material is kept in a heaped condition for not less than one hour. This is necessary because rubber powder takes an hour to get properly incorporated into bitumen and for proper incorporation the temperature should be maintained at 320°F.

The mixture is then spread and levelled just like any asphaltic concrete.

The rubber powder is correctly weighed out and kept in paper bags so that each bag represents the correct quantity for one batch.

Costs.

Details of actual cost of various types of surfacing laid in the City of Madras by the Corporation are given below :

(A) Laying Cold Mix Asphaltic Concrete 2 in. Thick for 100 Sft.

Quantity	Description.	Rate Rs	A.	Per	Amount. Rs	A.
12 Cft.	Blue granite metal $\frac{3}{4}$ in. gauge	77	4	100 Cft.	13	15
6 Cft.	Blue granite metal $\frac{1}{2}$ in. gauge					
17½ Cft.	River sand	17	0	100 Cft.	2	15
157 Lb.	Bitumen	450	0	Ton	31	9
100 Sft.	Labour for mixing and laying	6	0	100 Sft.	6	0
100 Sft.	Rolling charges	2	0	100 Sft.	2	0
100 Sft.	Running charges for plant, transport depreciation on tools, plant, etc.		0		2	0
	L. S. Sundries			L. S.		9
				Rate per 100 Sft.	59	0

(B) Laying Hot Mix Asphaltic Concrete 1½ in. Thick with Filler for 100 Sft.

10 Cft.	Blue granite metal $\frac{3}{4}$ in. gauge	77	4	100 Cft.	7	12
11 Cft.	River Sand	17	0	100 Cft.	1	14
112 Lb.	Bitumen	450	0	Ton	22	8
90 Lb.	Cement	100	0	Ton	4	0
100 Sft.	Labour for mixing and lying	5	0	100 Sft.	5	0
100 Sft.	Running charges for plant etc.	6	0	,,	6	0
100 Sft.	Rolling charges					
L. S.	sundries	2	0	100 Sft.	2	0
				L. S.	0	10
				Rate per 100 Sft. =	49	12

(C) Laying Hotmix 1½ in. Thick Without Filler 100 Sft.

Quantity	Description	Rate Rs	A.	Per	Amount Rs	A.
10 Cft.	Blue granite metal $\frac{3}{4}$" gauge	77	4	100 Cft.	7	12
11 Cft.	River sand	17	0	100 Cft.	1	14
104 Lb.	Bitumen	450	0	Ton	20	14
100 Sft.	Labour for mixing and laying	5	0	100 Sft.	5	0
100 Sft.	Running charges for plant transport, depreciation to tools and plant etc.	6	0	100 Sft.	6	0
100 Sft.	Rolling charges	2	0	100 Sft.	2	0
L.S.	Sundries			L. S.	0	8
				Rate per 100 Sft. =	44	0
12½ Cft.	Cost of premix (with 3½" of bitumen per cft. of metal	197	12	100 Cft.	24	12
10 Lbs.	Bitumen for tack coat	450	0	Ton	2	0
100 Sft.	Labour for laying	2	0	100 Sft.	2	0
100 Sft.	Rolling charges	2	0	100 Sft.	2	0
L.S.	Sundries				0	4
				Rate per 100 Sft. =	31	0

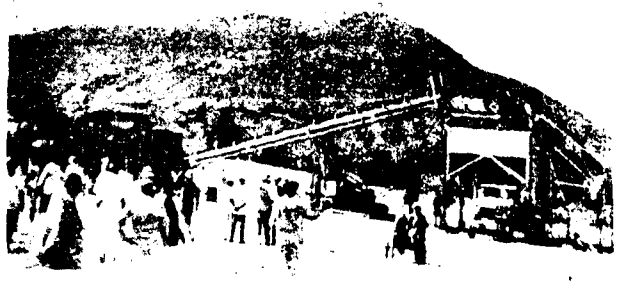
(D) Laying Bitumen-Sand Mix $\frac{3}{4}$" Thick Without Filler For 100 Sft.

9 Cft.	River sand	17	0	100 Sft.	1	8
60 Lbs.	Bitumen	450	0	Ton	12	8
100 Sft.	Running charges for plant	2	8	100 Sft.	2	8
100 Sft.	Labour for mixing and laying	3	0	100 Sft.	3	0
100 Sft.	Rolling charges	1	0	100 Sft.	1	0
L.S.	Sundries				0	4
				Rate per 100 Sft. =	20	12

4. STONE CRUSHING PLANT AT CORPORATION QUARRY, PALLAVARAM, MADRAS.

Inspected on 13-2-53.

Working of the Plant: This plant consists of 3 units, the Primary, the Secondary and the Screening and Loading unit. Stones not exceeding 9-in. in size in any direction are brought from the quarry face in wagons by a light railway and are tipped above a steel lined concrete chute leading to the Primary unit. These stones are fed into the Primary unit by an Apron Feeder. The Jaw Crusher of this unit crushes down the stones to a size not exceeding 3 inches. The crushed product then travels up a conveyor to the secondary unit. Here it is first screened by a vibrating screen. The screen separates the crushed metal into dust i.e., size less than $\frac{3}{8}$-in., metal between sizes 2 in. and $\frac{3}{8}$ in. and metal above 2 in. size. The dust is taken away by a conveyor on the right. The aggregates between 2 in. and $\frac{3}{8}$ in. are then fed to the third unit viz., the screening and loading Unit by a long

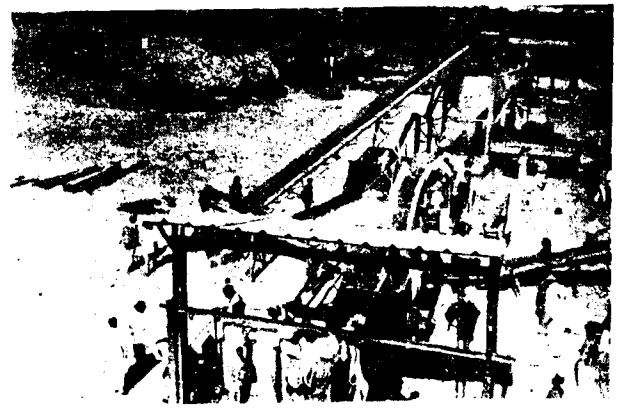


Crusher Plant Madras Corporation Pallewaram.

conveyor. The metal above 2 in. in size rejected by the screen in the Secondary unit is fed into a roller crusher having two corrugated rolls. This again crushes down the oversize metal to sizes between $\frac{3}{8}$ in. and 2 in. From the crusher it is taken by a short conveyor to the main stream of flow of crushed metal from the Primary unit. The screening and loading unit separates out the metal into three bins, the sizes being $1\frac{1}{2}$ in. $\frac{3}{4}$ in. and $\frac{3}{8}$ in.

Output of the Plant: The plant can supply about 30 tons (900 cft) of $\frac{3}{8}$ in. and $1\frac{1}{2}$ in. crushed aggregate per hour.

Power Consumption: A Diesel engine of 53 H. P. works the Primary Jaw Crusher Unit and another similar engine of 80 H. P. runs the Secondary Roll Crusher Unit. The Screening and loading Unit is operated by a third Diesel Engine of 45 H. P.



Madras Corporation Crusher Plant—Pallewaram (as seen from the loading ramp)

The contractors operating quarries by manual labour nearby are able to produce metal at a cheaper rate for the following reasons. The labourers working under them do not normally come under the Factory Act and the contractors save the amount which the Corporation has to pay for bonus etc. to the labourers. The labourers working in these quarries are engaged on daily wages and fluctuations in the wage rate of the labourers are taken advantage of by the contractors. Corporation labourers get a fixed wage.

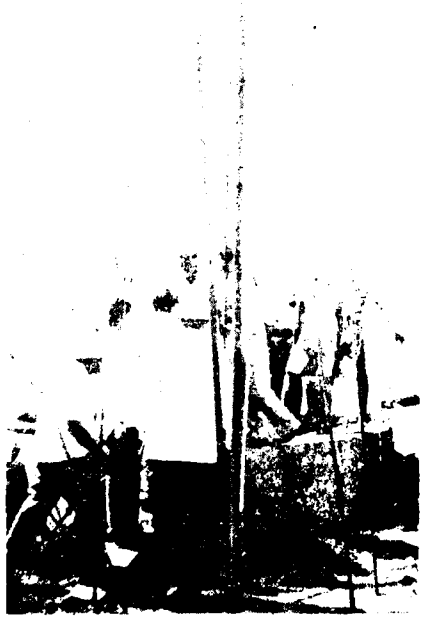
But Mechanisation will be helpful when the field of operation is limited and a large output is required.

5. PALAR BRIDGE UNDER CONSTRUCTION

Inspected by the delegates on the 13th February, '53.

The Palar River crosses the National Highway No. 45 (the Grand Southern Trunk Road) 39 miles south of Madras (see map at p. 575). The existing crossing is a low stone paved causeway with under vents. During rainy weather the traffic comes to a standstill

for many days, isolating the City of Madras from the South. To remedy this defect construction of a bridge across the river under the National Highway Scheme was taken up. The site close to the existing causeway was found most suitable. At this place the river is 2,200 ft wide between well defined banks. The bridge will consist of 23 spans of 90 ft clear each. It will have a clear roadway of 22 ft wide with no side walks.



Palar Bridge—Well sinking being inspected by the delegates.

The bridge superstructures is designed to consist of prestressed girders. A full size girder was load-tested to destruction in June 1952.

The design of the bridge and the details of the test have been described fully in I. R. C. Paper No. 164.

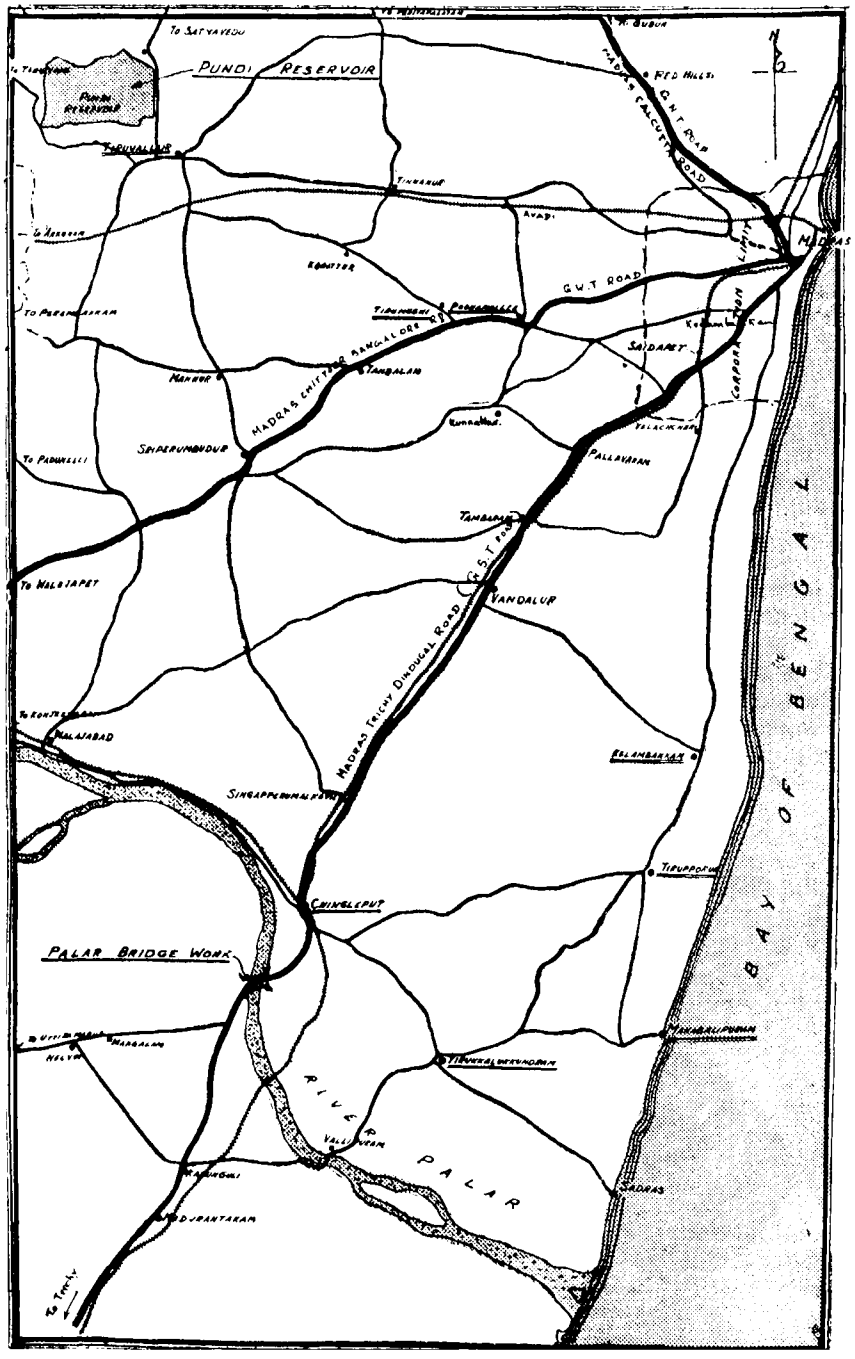
6. After the inspection of the Palar bridge the delegates visited two religious and historical places, viz., Thirukalukundrum and Mahabalipuram. The former is also known as Pakshithirtham on account of the sacred birds which are fed there by the priests everyday in noon.

7. IRRIGATION RESEARCH STATION, POONDI, MADRAS.

Inspected by the delegates on the 14th February, 1953.

The Irrigation Research Station at Poondi 37 miles from Madras was established in 1944.

The work of the research station relates mainly to investigations on small-scale hydraulic models.



The nature of studies conducted in the research station are given below :—

1. Projects ;
2. Maintenance work ;
3. Basic Research and
4. Materials tests.

Problems relating to projects such as Rampadasagar, Krishna-Pennar, Thungabhadra, Lower Bhavani, Pugalur bridge were investigated at this research station.

The station is also investigating problems connected with maintenance of existing irrigation structures such as scour protection below the anicuts of the Godavari, exclusion of silt from the Grand Anicut Canal in the Cauvery Mettur System, increasing the discharge through the head sluice of the Krishna Anicut, etc.

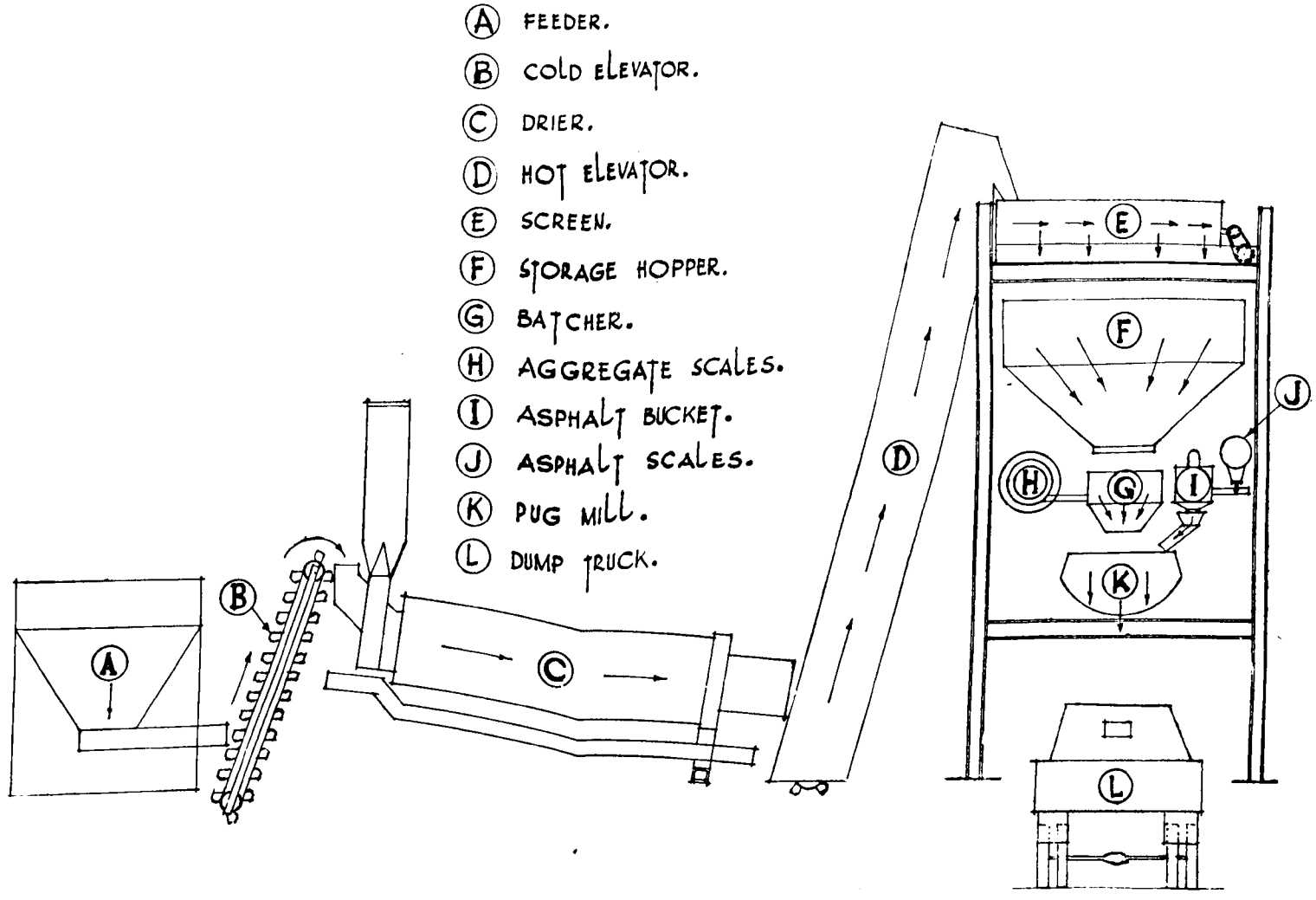
Research work of a fundamental nature is also carried out with a view to formulating working rules for design of future structures without recourse to model experiments every time.

The station draws its water supply from the Madras water works reservoir at Poondi. Normally when the reservoir is full water flows by gravity into the models and back to the river downstream.

Arrangements for pumping water when the reservoir level is low also exist. But during the abnormal draught last year there was no water at all in the reservoir, and to meet this contingency the station has been equipped with a circulating system of water supply by which the water from the models flows to a tank from where it is pumped back.

FLOW DIAGRAM OF HOT ASPHALT PLANT

PLATE I



Discussion on Paper No. 161.†

"The Investigation, Design and Construction of the Cauvery Bridge at Pugalur"

By

K. K. NAMBIAR AND K. NAMASIVAYAM

Sunday, February 8, 1953

Shri H. P. Mathrani (Chairman) called upon Shri Nambiar to introduce his Paper.

Shri K. K. Nambiar said that the object of the Paper which gives an account of the investigation, design and construction of the Cauvery bridge at Pugalur was to place before the Members of the Indian Roads Congress the problems met with during the various stages of the construction of the bridge.

The bridge had 40 spans of 60 ft each of reinforced concrete T-beam and slab type on solid masonry piers. Nine of the piers were built on open foundations and the rest on wells sunk to a depth of about 40 ft. The design was according to the Indian Roads Congress loading and specifications except for the height of the hand railing. Considering aesthetics and safety the height of 2 ft 2 in. above the curb was raised to 3 ft so as to give a height of 3 ft 9 in. above the roadway.

The difficulties of sinking the wells were detailed in the Paper. Where wells rested on sloping faces of rock the use of anchor rods by drilling holes in the rock was found to be cheaper than chiselling the rock to give a stable seating.

It was found that the angle iron cutting edge of the well curb which was pointing downwards buckled under the weight of the wells and was in some cases wrenched from the concrete when the wells touched rock. A sharp cutting edge was not necessary for sinking the well in sand. In clay it was possible to sink the well by the use of suitable tools for excavating around the cutting edge. When rock was encountered the sharp cutting edge was a disadvantage. So it was decided to have the vertical leg of the angle iron cutting edge pointing upward. Such an arrangement was adopted in the Palar Bridge.

† Published in the Journal of the Indian Roads Congress Vol. XVII-1-December 1952, pages 68 to 134.

The use of rapid hardening cement enabled the quick rotation of the centering from one set to another and consequently the bridge was completed fairly quickly.

In spite of the constructional difficulties and the expensive roller bearings used, the cost of the completed bridge worked out to Rs 965 per running foot. In his opinion sliding plate bearings were less costly and were adopted in other 60-ft span bridges.

Shri Sri Krishna enquired if borings were taken to the rock and the diameter of such borings. Referring to para 7.16.1 of the Paper, he said a sketch of the rods welded at the joints would be useful. He wanted to know if the vertical leg of the cutting edge should point upward under all conditions.

Referring to the use of concrete caissons used in the bridge, **Shri Basant Singh** said that hard wood available locally was used in one of the bridges in the Punjab. In the Bhimber bridge on Gujerat-Phalia Road hardwood cribs were sunk to the required depth nearly 20 ft from the bed level through plastic clay. Pumping was resorted to as the work had to be carried below the spring level. When the concreting and masonry was completed the planks were unbolted from the inside, taken out and used again resulting in considerable reduction in the cost. The 3 in. planks used were rebated so that flowing sand or mud could not enter the caisson.

The centering arrangement used in the Leh Bridge near Rawalpindi on the Grand Trunk Road was found cheap and convenient. The Leh river had flowing water throughout the year. The height of the piers were about 50 ft above the water surface and about 70 ft from the bed. Brackets 2 ft wide, one foot high and projecting 15 in. from the face were cast simultaneously with the pier. When the concreting of the pier was completed, 12 in. × 15 in. wooden bearing beams, were laid over these brackets. On the bearing beams specially prepared trussed-wooden beams prepared from locally available materials were erected to span the gap from pier to pier. The centering of the T-beams and the slabs were erected over wooden trusses. Before the concreting was done the centering and the trussed beams were subject to a test load of sand bags. After the span was concreted a hanging type of scaffolding was suspended from the bridge, the cantilever brackets were cut and the centering was used in the next span. It was found that the centering could be used after a number of years if properly stored. The same method was used in the Saraikella bridge near Taxila and the Ling river bridge near Kehata in the Rawalpindi Division. On the Ling river bridge the arch centering was supported on the trussed-wooden beams.

Shri T. Krishnamurthi desired information about:

1. The circumstances under which separate rectangular wells were preferred to circular ones. The latter would be amenable for easy rectification in case of tilts.
2. Whether capping slabs were provided with cut-waters.
3. Details of tests, if any, conducted on the river shingle used for cement concrete.
4. If the shingle found in the river was used for the R. C. work of the superstructure also.
5. Plate VIII on page 128 of the Paper showed the cross beams were provided only at the bottom of the Tee ribs. Was any extra reinforcement provided in the slab at the ends of the unit.
6. The exact shape of the cut for welding of the reinforcement since the V-shape mentioned in para 7.16 was not clear. Details of welding adopted and tests, if any, would be helpful.
7. The special steps that were taken to ensure that the joint between the rib of the Tee and the slab was perfect.
8. The places at which concreting was stopped in the Tee-beam and the slab at the end of a day's work and the method adopted to secure good compaction at the joints.

Shri S. R. Naidu was of opinion that the Nanniyur site for the bridge gave a route 7 miles shorter than that via Pugalur a saving of Rs 4 lakhs annually in the operation of cost of vehicles. He felt that the decision to build the bridge at Pugalur was influenced by the population of Velur and Pugalur.

He enquired if falling aprons were provided to protect the approach embankments on the right.

For the open foundations, caissons 48 ft × 16 ft had been successfully tried in other bridges for a depth of about 16 ft at a cost of Rs 4,000 each. The soil met with was sand, mixture of sand and clay, soft kankar and boulders.

The slump of 1 to ½ in. adopted for compaction with the pin vibrators was on the low side. The manufacturers of the equipment specified a slump of 1½ to 2 in. and good results were obtained with a slump of 1 to 1½ in. elsewhere.

Shri Naidu desired to know if rollers had been used for the launching and the exact purpose of the launching nose.

Shri B. N. Shenoy wanted to know the level at which shingle occurred.

Cross sections of rivers are generally taken where there was little or no flow. The discharge calculated from such cross-sections gave incorrect values because the bed material was scoured in high floods.

Pointing out that the borings supplied in the Paper were not along the line of the construction of the bridge, the speaker stressed the need for borings on the actual line of construction to avoid the danger of calling tenders on incorrect data.

Shri N. Durrani said that the design adopted was not a balanced one. The cost of the substructure including the bearings was Rs 11,07,000 plus Rs 2,39,260 = Rs 13,46,260 whereas the cost of superstructure was Rs 11,40;000. The continuous beam design which necessitated the use of costly bearings had its disadvantages.

The bearings of the bridge were housed in boxes open at top and were filled with a special lubricant called "Shell Cardium." There was the likelihood of the boxes getting filled with sand blown by the winds in the summer. So it was necessary to evolve a design which was leakproof and which can be opened for examination.

He suggested the use of R. C. pipes placed horizontally in the gap between the wells. These would act as distance pieces and help in sinking the wells without tilt. A taper of 1½ in. in fifty feet length of the well facilitated sinking and the reduction in the skin friction when the earth got set after sinking was negligible.

Use of I-sections for the cutting edge with the flange outside the well was desirable.

There was an urgent necessity to evolve a rational basis for the fixing of priorities for major bridges. There was difficulty in assessing the necessity of project when strategic considerations were involved, but the income from the ferry at a crossing is a good guide.

There were many important unbridged crossings in the Madras State where the cost of construction of a bridge and the interest thereon could be paid back if tolls were levied.

Shri R. N. Joshi described a cutting edge which he had successfully employed. It consisted of a vertical M. S. plate

about 8 in. × 3/8 in. at the outside periphery of the well and an inclined M. S. plate about 10 in × 3/8 in. on the inside, welded to each other at the bottom. Gusset connections at intervals on the inside of the triangular portion stiffened the triangular cutting edge. It was lightly reinforced and filled with cement concrete. The arrangement had the advantage of creating wedge action which helped the sinking operation.

Blasting in the wells described in para 7.3.4. was objectionable.

Pumping of the water from the well reduced the buoyancy and contributed to the kentledge.

Shri Joshi enquired about the amount of deflection in the Calendar Hamilton centering girders due to the load of concrete.

Shri D. N. Khurana said that sand blows in the Mahanadi bridge were effectively stopped by scooping out sand below the wells and building a curtain wall alround.

The superstructure with beams continuous over three spans is the cheapest when the middle span was 1.33 times the end ones. Thus when the total length was 180 ft, the most economical spans were 54, 72, and 54 ft.

Referring to Appendix II of the Paper, he said that the tensile test alone was not enough. His experience was that welded joints were not satisfactory in respect of ductility. A double bend test at about the welded joint was necessary. Shri Khurana enquired if any limits of ductility were specified.

Shri Ramamohana Rao sought detailed information about how the 4,85,000 cusecs discharge at the Erode bridge was arrived at. There was an urgent need for the collection of adequate data on the flood moderating influence of reservoirs.

Shri S. Sundaram, disagreeing with the suggestion of the Authors, that the vertical leg be turned upward, cited his experience in two bridge works where T-section and 4 in. × 4 in. angle iron used as the cutting edge had functioned satisfactorily. He attributed the buckling experienced in the Pugalur bridge to the vertical leg being not truly vertical because the horizontal leg of the angle iron could not be got perfectly plane — para 7.2.2.

Shri K. F. Antia felt that twin octagonal wells gave a little trouble in sinking. These had been extensively used on the Railways.

Keying between the well and the rock on which it rested was essential. In one case, piers on well foundations had toppled over due to scour reaching rock level after 50 years of service.

The use of controlled concrete was conducive to economy.

Reliance could not be placed on the technical information on the nature of the soil, etc., given by the divers. So it was advantageous if the engineer went down the well and got the information.

Citing the example of a pile bridge where he had used a concrete pile to carry a load of 40 tons, Shri Antia said that pile bridges might produce economy.

Shri P. S. Bhatnagar felt that considerable economy was possible if longer spans were adopted in the reach where foundations had to be taken deep.

Shri S. V. Natu mentioned that triangular a cutting edge was used in the Watrek bridge near Kaira.

Enquiring if the Inglis formula, viz., $Q = \frac{7000\ A}{\sqrt{A+4}}$ where A is the catchment area in sq. miles and Q is the discharge in cusecs was not applicable to Madras State. Shri Natu said that a discharge of about one million cusecs was obtained for the bridge across the river Tapti with a catchment of about 20,000 sq. miles.

Shri K. K. Nambiar (Author) replying* to the discussion said that the turning of the vertical leg of the angle iron upwards for the wells of the Palar bridge was made only after carefully considering the experience at Pugalur and the practice obtaining in other parts of the world. In most cases a sharp cutting edge was not necessary. In clay soils, sharp tools were required to loosen the soil. The horizontal leg of the angle iron cutting edge offered resistance to sinking. Turning the vertical leg up did not increase the area of resistance appreciably. In kankar and soft rock the cutting edge was an advantage. Therefore, it was necessary to decide on the type of the cutting edge after examining the soil conditions as revealed by the borings. In most cases sharp cutting edge might not be necessary.

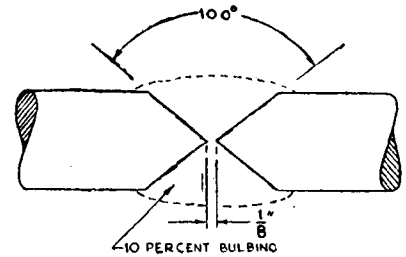
The triangular cutting edge with diagonal flats advocated by Shri R. N. Joshi and Shri S. V. Natu might be used if conditions were favourable for its use.

* Written replies by the Author received are also incorporated.

Referring to the shape of the well, Shri Nambiar said that single and twin wells had their advantages and disadvantages. In certain cases it was found that it was difficult to dredge in the central portion of the twin octagonal wells. It was suggested that in such cases the thickness at the centre should be reduced. This arrangement was an improvement. In the case of twin wells it was difficult to rectify the tilt or shift that might occur. In Madras State twin octagonal and twin rectangular wells had been used successfully. Engineers, in his opinion, should consider all aspects and adopt the well best suited to individual needs.

Referring to Shri Srikrishna's query, the Author said that 2 in. diameter borings were taken in the rock. The vertical leg of the cutting edge might be placed pointing upward when the sinking was mainly in sandy strata and when the wells rested on rock.

The ends of the rods welded were conical in shape as shown in the Figure below.



Answering Shri Krishnamurthi's enquiry, the Author said that the capping slabs were not provided with cut waters. But all the corners were chamfered to avoid sharp corners.

The shingle collected from the river bed was used for the full length of the well steining of all the piers and no tests were conducted on these as they were free from any deletrious substances.

Slight extra reinforcement was provided for the slab at the end of each unit.

The conical shape of cutting the rods was adopted to facilitate welding and give a uniform layer of steel alround. This

practice was in conformity with the British Standard Specifications for welding. The cutting of the ends of the rods was done by hand. No flame cutting was employed as it tends to harden the cut faces. During the test it was found that welding always increased the yield point. No X-ray observations were made on welded joints.

The cost of each weld ranged from Rs 5 to Rs 8 per joint depending on the size of the rod.

During the first stages of the work concreting was stopped either at the middle of the span or over the pier. Subsequently the beam was concreted without any stop. Wherever concreting was stopped, a rigid plank with horizontal grooves was used. Holes were cut in the plank for the reinforcement.

Joining old concrete with new was done after sand blasting the old surface to remove laitence and mortar.

Referring to Shri S. R. Naidu's remark, the Author explained that the longer route was adopted by the Govt. of India after very careful consideration of all the aspects.

Shri Naidu had enquired if the embankments were protected by falling aprons. These were not provided. But the slopes had been protected by revetment.

The slump of ½ to 1 in. adopted gave good results with the pin vibrators.

Launching nose and rollers were used for different purposes. Rollers were provided over the piers to facilitate dragging the truss. During the process of launching the whole length of the truss cantilvered out resulting in a sag at its free end. If no launching nose were provided, the end had to be lifted up to the level of the pier. The launching nose obviated the lifting up.

The experiment of Shri Khurana in stopping sand blows was valuable.

Shri Antia had suggested the use of pile bridges. In the opinion of the Authors, piles were unsuitable in sandy beds because during flood a good deal of the sandy strata was scoured. So reliance had to be placed on the skin friction of the pile below the scour depth. In clay soils, piles could be employed.

Shri H. P. Mathrani (Chairman) thanked the Authors for the interesting Paper and the various speakers for the high level of the discussion.

The discussion revealed that some engineers doubted the adequacy of the waterway. The bridge was designed for a flood discharge of 2,86,100 cusecs. The perimeter required, according to Lacey's formula, was 1500 ft while the actual length of the bridge was 2,634 feet. The discharge—perimeter relationship given by Lacey's formula, in his opinion, was not accurate but gave an approximate idea of the waterway. Therefore the length of 2,634 ft from abutment to abutment was ample even after allowing for the piers and the approximate nature of the Lacey's formula.

Referring to the point about the determination of the value of 'N' under high flood condition, he said that the coefficient of rugosity in the Kutter's and Mannings formula was based on: (i) the bed material suspended in water, and (ii) the roughness of the bed. Samples of bed material from within 2 ft of the bed gave an indication of the material carried in floods. So the value of 'N' determined on the basis of samples within 2 ft gave an approximate idea. The results were by no means exact. Great accuracy was not necessary considering the approximate nature of the formula.

Examination of the cross section at the bridge site showed that the general bottom level of the sand stratum was at about R. L. 310 and, surprisingly enough, this was the bottom level of the stream during a flood of 2,86,600 cusecs as worked out from Lacey's formula with a value of 1.5 for "f". Also on one side of the cross section the bottom of the sandy stratum was at R. L. 50. Again this reduced level of 50 repesented a depth equal to 1.50 D worked out from Lacey's formula for scour depth. Normally where there were no piers and where the river flowed in a straight reach, scour went down to a depth equal to 1.5 D.

The design of pier with a depth equal to 2 D provided for the scour due to the obstruction of the piers. The above showed that the bottom level of the sand represented the level to which scour reached at one time or the other in the past. The Pugalur bridge was founded on rock and the distance from abutment to abutment was much greater than that required by the Lacey's formula and hence the bridge was safe.

Citing the practice in Sind, he said that it was possible to record soundings in high flood. A powerful launch with an echo sounder mounted on it gave good results.

Speaking about the measures to prevent wells from leaning towards each other, he said that interlocked wells had been used by him for shallow depth of about 20 ft. Even though the sinking of the inter-connected wells might present difficulties, there were advantages in their use where solid continuous impervious

wells were necessary, e.g., cut-off wells of regulators and barrages. The procedure in sinking such wells was :

(i) all the wells and slabs were put in position before starting sinking any one well ;

(ii) sinking was started from one end ;

(iii) the depth of sinking of any one well was not more than 2 ft from that of the adjacent well ;

(iv) the R.C.C. slabs were sunk simultaneously with the wells.

In his opinion when there was heavy tilting, new wells should be sunk. Describing the case of a bridge of spans of the order of 150 ft, he mentioned that there was a shift of the order of 3 ft. The presence of a surcharge due to the bank very near the well was, according to him, responsible for pushing the wells. Giving particulars of the solution adopted, he said that the cardinal principles that were adopted were the elimination of tension and the even distribution of compression.

A point was raised as to why piles should not be used instead of wells. Where maximum depth of scour was not much below the bed, there was no heavy bending and the piles could be braced. That some of the pile bridges vibrate during high flood was due to the deflections when there was scour. If proper precautions were taken and the piles were made strong to withstand the deflections when the scour was maximum there was no objection to using piles. But heavy driving equipment was necessary and there were only few contractors who had the necessary equipment.

Twin wells of the shape of figure 8 with two circular dredge holes were adopted successfully in a number of bridges. They had the advantages of the octagonal and the circular wells. Keeping the central cutting edge one foot higher than the edge ones might minimise the difficulty of having to scoop under it.

When a beam had to be constructed in two stages the design should provide that the reinforcement at the joint was capable of taking the entire shear. When this was done continuity in the construction process was not essential.

Supporting Shri Antia that the use of controlled concrete was necessary for conserving cement and other materials under Indian conditions, Shri Mathrani was of the opinion that its use should be gradual because expert supervision was not available in plenty.

Discussion on Paper No. 162*

"Recent Examples of Prestressed Concrete Bridges"

By

A. E. HILEY, V. M. SILVERA AND B. B. GUPTA.

Monday, February 9, 1953.

Shri K. K. Nambiar (Chairman) said that prestressed concrete resulted in the conserving of materials like cement and steel in short supply and called upon Shri P. S. Subramaniam to introduce the Paper on behalf of the Authors.

Shri P. S. Subramaniam introducing the Paper said that prestressed concrete, as the name implied, consisted in creating stresses by mechanical devices in the body of the structure which are opposite in direction to those that might be obtained when the structure was loaded. Thus when prestress was applied to a beam compression is introduced to counteract tension at the bottom. The many advantages of the prestressed concrete had been mentioned in the Paper. The main advantage was the elimination of chances of cracks due to absence of tension. The steel was thus safe against rust.

The high working stresses adopted in the prestressed concrete resulted in considerable saving in the materials and ensured that the member was tested during the prestress before it was called upon to bear the load.

For road bridges prestressed concrete was suitable because concrete unit could be cast separately under controlled conditions and the assembly of such units prestressed in the field. A saving of about 10 per cent over that the conventional reinforced concrete was possible.

In order to secure the functioning of all the longitudinal beams of a bridge as one unit it was common practice to prestress laterally also.

Shri Subramaniam emphasised the need for efficient anchorages which depended not only on the friction between the wedge and the rod but also on the increase in the section of the rod when the jacks are released called "Prissions effect".

* Published at pages 175 to 204 of Vol. XVII-2 of I.R.C. Journal.

Shri E. A. Nadirshah discussed the advantages of prestressed concrete and emphasised that the saving in cost was greater in longer span. The Test at the Palar bridge near Madras revealed the high factor of safety and showed that cracks were completely avoided under normal load. Cracks appeared only when there was considerable overload. The cracks closed up when the load was less than that causing a stress equal to the elastic limit.

A stress of over 2,000 lbs per sq. in. was allowed for the concrete in the two bridges described. Concrete capable of withstanding stress of over 6,000 lbs per sq. in. could be produced if proper control, correct placing, thorough compaction by vibrators or other means were employed. Pointing out that the stress of 1,500 lbs per sq. in. adopted in India was very much on the low side, the speaker was of the opinion that higher stresses should be permitted in order to have full advantage of prestressed concrete.

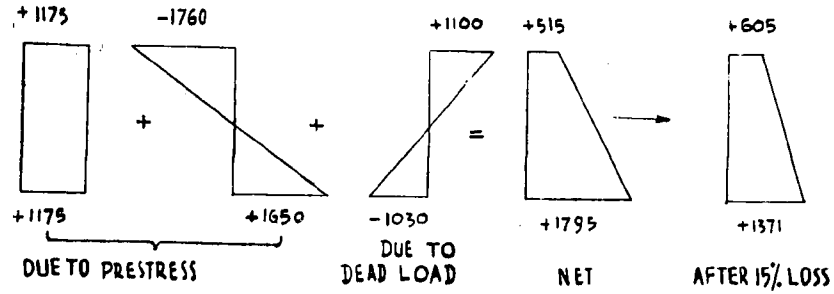
In para 5.7.3 of the Paper the Authors had said that the practice was to make a single batch of the stone element but the First Report on Prestressed Concrete of the Institution of Structural Engineers recommended that the coarse aggregate should be available in two sizes when the maximum size was ¾ in.

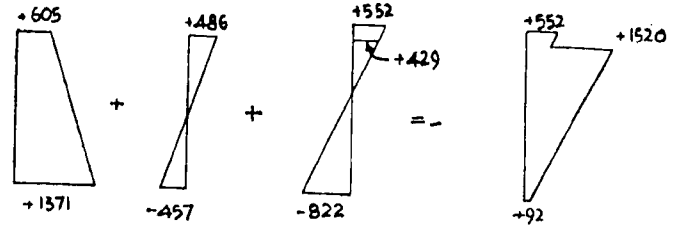
Prestressing had also been applied to continuous spans in the bridge over the Revse at Sclayn near Namur in Belgium which consisted of two main spans of 206 ft each and a third span of 52 ft.

It was doubtful if economy would result when prestressing was applied to spans below 30 ft. Prestressing when applied to spans of 30 to 200 ft would result in considerable economy. Comparison between simply supported R. C. and prestressed concrete bridges showed that while the span-depth ratios of 15 were usual for R. C. a figure of 30 was by no means unattainable with prestressed concrete.

Shri R. N. Joshi referred to the remark of the Authors that prestressed beams carried the dead weight of the structure free of cost and said that in R. C. beam a considerable portion of the allowable stress was used in sustaining the dead load of the structure. The stress distribution due to prestress dead load was given in the Figure on page 591.

The distribution of stress was uniform before putting the live load leaving full latitude for variation in stress conditions when the maximum live load was applied.





FINAL STRESS DIAGRAM
FIBRE STRESSES.

Due to prestressing the compression created before applying the live load was such that when the live load was applied the compressive stress was equal to the permissible stress at one face and zero at the other. As no tension was created at any stage the chances of cracks were completely eliminated.

Shri K. F. Antia pointed that short supply of high tensile steel wire was one of the causes preventing the furtherance of prestressed concrete in India. Steel manufacturers had been persuaded to undertake the manufacture of the material.

In reinforced concrete nearly half of the concrete does not take any stress and it was meet that it should be properly utilised.

The greatest advantage of prestressed concrete was that every member was automatically tested during the prestress because additional live loads only reduced the stresses.

In one case the girder failed while the prestress was being applied. It was found that the vibration of the shutter vibrater used did not reach the place where the cables were touched and honeycombing was the result. When vibrators were used the mixing water had to be reduced by about 20 per cent as otherwise segregation of the materials would result.

A prestressed concrete development group had recently been formed under the auspices of the Institution of Engineers (India) with the object of furtherance of the knowledge of prestressed concrete.

Shri H. P. Mathrani disagreed with Shri Subramaniam that the distribution of loads in the ribs of the beam was better in prestressed concrete than in R. C. The transmission of loads from the slab to the beam depended upon the stiffness of the slab and the cross girders. The stiffer the cross connections the lesser was the difference in the deflections of adjoining ribs and the better the distribution. Stiffer cross-connections were possible in both the prestressed and unprestressed concrete and so there was no difference between the two types of concrete in respect of their load distribution between the ribs of the beam.

Shri Shenoy wanted to know why the smaller factor of safety of 1·5 used for prestressed concrete could not be used for R. C.

Shri D. N. Khurana conceived of prestressed concrete as the result of transference of energy from the steel wires and wanted to know if the energy so stored in the concrete was of a permanent nature.

Shri P. S. Subramaniam replying on behalf of the Authors referred to Shri Joshi's remark about the prestressed concrete members carrying their own weight free of cost. In his view, the remark implied that centering which carried the dead weight was not necessary in the case of prestressed concrete.

Explaining Shri Shenoy's point about the lower factor of safety for R. C. he said that the adoption of greater working stresses for reinforced concrete would increase the quantity of steel resulting in difficulty in accommodating it in a reasonably economical sections.

While agreeing with Shri Mathrani that R. C. also could be made to distribute the loads in the ribs effectively by cross girders he pointed out the diaphragms formed an important part in prestressed bridge construction.

Answering Shri Khurana's query about the permanence or otherwise of the energy Shri Subramaniam said that the energy in steel was there permanently due to the presence of the anchorages.

Shri K. K. Nambiar (Chairman) was of opinion that the reinforced concrete was only the first step to the prestressed concrete and expressed the hope that reinforced concrete might be a thing of the past.

High tensile steel was not suitable for R. C. work as large cracks would develop on the tension side resulting in the corrosion of the concrete.

In prestressed concrete the concrete was actually tested while applying the prestress and so the need for a factor of safety was much less. The margin provided for certain losses in the prestress and for the stresses due to the live load.

Referring to para 3.1 of the Paper, Shri Nambiar enquired about the signs of shear failure mentioned. He enquired if any structural difficulty was involved in adopting the fish bellied girder mentioned in para 5.2.2.

Winding up the discussion Shri Nambiar thanked the Authors for their excellent Paper.

Discussion on Paper No. 163*

"Soil Cement in Road Construction"

By

K. F. ANTIA

Monday, February 9, 1953

Shri U. J. Bhatt (Chairman) called upon Shri Antia to introduce the Paper.

Shri Antia introducing the Paper said that soil cement enabled the maximum use of local materials. Roads built of soil cement withstood the test of time in highly trafficked roads as well as in city street.

In Shri Antia's opinion soil cement was a suitable material for use in constructing roads for opening up the country and for bringing up road to standard. For example soil cement to his mind provided a cheaper and better solution in cases where large amounts are spent on metal for reconstructing macadam roads.

Giving due consideration to the steel tyred bullock cart a thin layer of 2 to 3 in. was proposed to be bonded to the soil cement base in the Code of Practice recommended in the Paper. The cost of the proposed construction compared favourably with the bituminous full grout construction.

The mechanical equipment depended on the magnitude of the work and the speed of construction. He thought that simple farm equipment could be employed for soil cement construction.

Shri S. N. Gupta said that cement did not render the soil resistant to the abrasive action of traffic but helped the retention of the bearing strength attained under favourable conditions even under adverse moisture conditions. Also the addition of cement reduced volumetric shrinkage when subjected to variations in moisture content.

In Shri Gupta's opinion soil cement was suitable for medium traffic roads. For heavy trafficked highways increased thickness, depending upon the intensity of traffic, was a solution.

Soil cement construction had not been used for the surface course except for side walks, parking places, etc. The practice in the U.S.A. was to use soil cement for the base course and apply a

* Published at pages 205 to 270 of Vol. XVII-2 of I.R.C. Journal, Jan. 1953.

surface course above it. In his opinion, under Indian conditions of traffic with the steel tyred bullock cart, surface course of soil cement was not suitable as recommended in para 3.4.3 of the Paper.

Referring to para 1.5(e) it was pointed out that the surface had to be cured for fourteen days (para 4.5.8) and so the interruption to traffic when soil cement was used was the minimum.

The soil cement construction did not make much headway in India because of its cost and the short supply of cement.

Shri Gupta desired that the cost of the different experimental works enumerated in para 1.3 compared to other conventional types be given.

West Bengal had large areas where only clay or silty clay falling under the P. R. A. classification A–5 to A–7 was available. The water table was high. Although opinions about the life of the soil cement differed it was agreed on all hands that the addition of cement increased the bearing capacity and reduced the volumetric shrinkage. Preliminary experiments conducted at the laboratory of the Roads and Buildings Research Institute of West Bengal indicated that 5 per cent cement was required to be added to the soil for retaining its structure under fully soaked condition. Also it was very difficult to pulverise the clay. In the works mentioned in para 1.3.3 (b) addition of 2 and 4 per cent cement was possible because of the higher classification of the soil used. In the U.S.A. 8 to 10 per cent of cement was considered to be the economic limit for soil cement construction. He requested the Author to give specifications suitable for West Bengal conditions.

The step by step construction method recommended by the Highway Research Board was outlined in Fig. 3 of the Paper and was fully described in the publication of the Portland Cement Association of ths U.S.A. The method, in Shri Gupta's opinion, was too advanced for adoption to Indian conditions. He enquired if it was possible to employ only manual labour.

Shri Gupta advocated the setting apart of 1½ to 2 per cent of the National Highway allocations for experiment and research in soil cement construction in each State. He mentioned that Bulletin No. 137(1948) of the American Road Builders Association gave the "Know How" of soil cement stabilisation in the form of questions and answers.

Shri A. K. Deb referred to the recommendation in para 3.1.3 that pulverising was best done with a moisture content within 2 per cent of the optimum and pointed out that it was difficult

to obtain a good uniform mix under wet conditions. Cement formed into nodules in contact with the wet soil and uniform distribution of the cement so essential for good stabilisation was difficult to attain. Therefore, prewetting of the soil for pulverisation was to be used only in unavoidable cases.

In para 3.3.3 it was mentioned that a concrete mixer could be used for mixing soil cement. Shri Deb's experience with a sandy clay with about 20 per cent clay was that a thick crust was formed on the walls of the drum making further mixing difficult. Asphalt mixers with suitably bladed shafts moving in opposite directions might yield better results.

Dr. H. L. Uppal differed from the Author in the statement that the soil coated the cement particles, para 1.1.3-and said that the cement coated the soil particles. In support of his contention the following points were mentioned.

1. The resistance of soil to the softening action of water increased with increased content of cement. The behaviour of mixtures were governed by the nature of the outer surface. So cement soil mixtures behaved like cement as brought out by increased resistance with increase in the quantity of cement. If it were the other way viz. soil coating the cement particles, the increased resistance was not explainable.

2. The compressive strength of cement-clay soil mixture was lower than that of cement-sandy soil mixture.

Sheepsfoot roller had been recommended for densification of clay soils (para 3.3.2). Tests on a semi-field scale at the Central Road Research Institute have shown that a sheeps-foot roller gave densities 2 to 3 lbs greater for 45 to 50 passes than that obtained with smooth wheeled rollers for 8 passes. In practice small increase so obtained was not worth the increase in labour.

In para 3.4.4 the Author had recommended the use of a Soil-cement mix for the wearing course. Good abrasive resistance was an essential quality for a wearing coat and it was necessary to specify a minimum value for it.

A four inch crust of 5 per cent soil cement required 1,000 bags of cement for one mile of 10 ft wide road. Since cement was in short supply preparation of cheap cement by burning clay lime and other materials at the road side was a solution. Even this type of cement was 25 per cent as effective as the standard material the construction would be economical.

Shri S. R. Naidu said that it was cheaper to use local metal or mooram within half a mile than soil-cement for the base coat.

While supporting experiments with the new material Shri Naidu advocated a cautious policy when large scale construction was involved.

Shri K. S Krishnan described in detail the various methods of stabilisation and the practice adopted in America. He advocated the use of lime for soil stabilization and said that the material was available in abundance in many places in India and cited the case of a road in a black cotton soil area where 2 per cent lime was proposed to be used for stabilization.

Shri E. C. Chandrasekharan remarked that soil cement was a rigid base and not flexible one as described by the Author. Speaking of the foot-walks on the Marina in Madras, he said that in his opinion the unsatisfactory result was partly due to the small thickness of the soil-cement used. The soil used was red laterite gravel with some fines and little or no intermediate fractions of sand. Proper grading was important for stabilization and elimination of cracks.

Laterite soils were peculiar in that well established standard tests such as mechanical analysis, liquid limit, plastic limit, etc., did not reveal their true engineering properties. Hence further research was needed on laterites.

Shri Morarji suggested experiments on the addition of chemicals such as triple-L seal to the cement. The manufacturers claimed that the compressive strength of cement concrete increased by 15 to 20 per cent by the addition of the compound. It was an advantage if the quantity of cement required for stabilization was reduced by such additives.

Shri E. A. Nadirshah* suggested that the I. R. C. should arrange to carry out field experiments using soil-cement as a wearing surface. He enquired about the details regarding :

1. The economical percentage of cement admixture for base course and wearing surface.
2. The necessity of joints and their methods of construction.
3. Precautions necessary for the prevention of shrinkage cracks.
4. The maximum traffic intensity which soil-cement wearing surface can safely withstand.

* This and the following comments were received in writing.

Shri D. C. Chaturvedi drawing attention to para 4.5.3 where it was stated that the finish of the soil cement should be completed within 6 hours of mixing of the cement, was of opinion that the finish should be done as quickly as possible. The initial set of cement started after 30 minutes and disturbance after the initial set affected the strength.

Shri J. S. Narasimham referred to the recommendations of the Author about the 2 in. wearing course in para 1.4.1 and said that capillary moisture raising from the water table and other conditions such as the type of berms and condition of the side ditches influenced the design of the thickness. In his opinion, the specifications might be useful where the intensity of bullock cart traffic was low and the possibility of the subgrade being subject to adverse moisture conditions remote.

The recommendation that a compressive strength of 450 lb per sq. inch at 7 days was a satisfactory requirement did not mention the type of the test specimen and the condition under which the test was to be carried. It was usual to test pieces 2 in. in diameter and 2 in. in height after soaking in water for one hour. The idea was that during the one-hour soaking the specimen attained moisture conditions that prevailed in the field. It was possible to evolve a rational test procedure stimulating the field conditions in respect of moisture and temperature. Unconfined compression test on 2 in. diameter samples soaked for one hour in hot water maintained at the temperature expected in summer gave the strength of the soil cement under worst conditions.

Experiments conducted at the Hyderabad Engineering Research Soils Laboratory showed that pre-wetting had a pronounced effect on the optimum density and optimum moisture of the soil. Experiments to determine the optimum size of the black cotton soil lump for pre-soaking to get the desired density were also in progress.

Shri K. K. Nambiar remarked that the soil cement construction in the Ramnad-Mandapam road and Chidambaram-Bhuvanagiri road, details of which had been given in the Paper, have behaved excellently.

In the Journal "California Highways and Public Works Review"—July-August 1951, an investigation on the condition of a soil-cement base after 30 years of service was reported. Examination of the cores revealed pure cement in thin lenses here and there, particularly where clay soil was used. It was very significant that there was no evidence of deterioration of the cement treated mixture where the cement had been properly

incorporated. In California a technique of mixing which made it possible to reduce the percentage of cement to as low as one half was evolved. Mix-in-place and plant-mix methods were both used for the process though the latter was found to yield satisfactory results. To ensure maximum strength with low cement contents it was essential that the time interval between mixing and completion of finish-rolling should not exceed 2 hours.

In South Carolina and Columbia in the U. S. A., there were a number of roads where soil cement was used as a base and topped over with a high bituminous surfacing for a wearing course. In one case a soil cement with a cement content as high as $16\frac{2}{3}$ per cent was adopted for a clay subgrade in preference to 1 : 2 : 4 concrete pavement because soil cement construction enabled quicker completion of the project.

In Shri Nambiar's opinion soil cement construction had a future specially where stone and moorum were not available within short distances.

Shri K. F. Antia (Author) answering Shri S. N. Gupta said that soil-cement roads were capable of carrying, light, medium and heavy traffic.

Production of cement was being increased to meet the demands.

The costs quoted in the Paper were for Bombay and was different in different areas.

When cement required was of the order of about 20 per cent it was uneconomical.

There was no objection to use manual labour if mixing and compacting was done properly.

Referring to Shri Deb's remark about the difficulty of formation of nodules when pulverising was done with wet soil the Author said that the Engineer-in-Charge might adjust the water content suitably.

Dr. Uppal had suggested the manufacture of cheap cement at the road side. Cement was manufactured under controlled conditions and tests were conducted every one hour to ensure uniformity of quality. There was no saving by the use of low grade cement because a large quantity would be required.

Answering Shri Naidu Mr. Antia said that when other construction materials such as moorum were cheaper they should be used.

Shri C. L. N. Iyengar replying to the discussion on behalf of Shri Antia referred to the remarks by Shri E. C. Chandrasekharan and said that the soil cement was a flexible base had been accepted by the Highway Research Board of the U. S. A. and the American Association of State Highway Officials. He agreed with Shri Chandrasekharan that soil cement used in the Marina was more a soil cement plaster than a soil cement pavement or base course.

Referring to Shri Morarji's suggestion about additives Shri Iyengar said that the addition of 1 to 2 per cent of calcium chloride was recommended to silty soils of high organic content to overcome the harmful effects of impurities.

Replies to Written Comments by Shri Antia

Answering Shri Nadirshah the Author supported the suggestion that experiments should be made to determine the limits of traffic intensities up to which soil-cement with a light duty wearing was suitable.

It was not usual to provide joints in soil-cement work except construction joints at the end of a day's work. The thin shrinkage cracks that invariably occurred were filled with a priming coat of bitumen when light duty surface finishes are adopted. When heavy duty toppings such as cement concrete or bituminous concrete were used, no attention was necessary.

The economic limit of cement content for soil-cement work depended entirely on local costs prevailing in the locality. For example, a 4-in. soil cement with 8 per cent cement compared favourably with a 6-in. macadam in Bombay. The limits recommended in the Paper were purely based on satisfactory performance.

Regarding Shri D. C. Chaturvedi's point about finishing all the operations within 30 minutes, in practice the setting time of cement was of the order of 90 to 100 minutes even though the specifications laid down that it should be not less than 30 minutes. In practice, it was found that finishing within 6 hours was satisfactory.

The argument by Shri Narasimham that capillary moisture was equally applicable to all types of bases. Good drainage was necessary for soil cement bases as for any other.

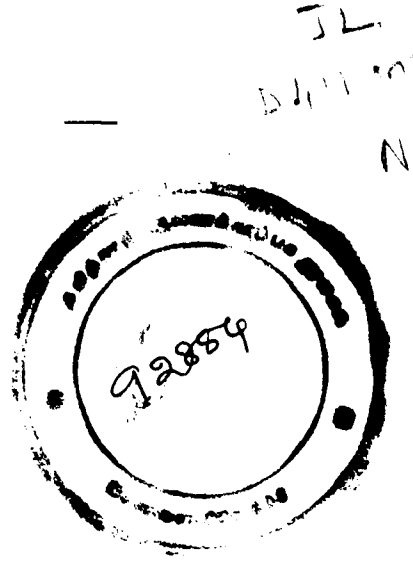
The tests for the compressive strength were carried out with cylindrical specimens having a height—diameter ratio of two. Three sizes of specimens were employed, depending on the particle size of the soil.

Size of spcimen	Soil
2 in. dia. 4 in. high	Fine grained soil containing not less than 80 per cent passing a No. 7 B. S. sieve.
4 in. dia. 8 in. high	Medium grained -do- $\frac{3}{4}$ in. B. S. sieve.
6 in. dia. 12 in. high	Coarse grained - do - $1\frac{1}{2}$ in. B. S. sieve.

The specimens were soaked in water for 4 hours prior to testing.

The object of the test was to determine the minimum cement content required. There was no need for reproducing field conditions, since it has been found by experience that specimens having a minimum compressive strength of 450 lb per sq. inch hardened satisfactorily and withstood the durability tests.

Shri Nambiar had raised a point regarding development of efficient mixing equipment which made it possible for low cement contents such as $\frac{1}{2}$ per cent to be used in the case of silty soil. The resulting material in such cases was what has been described in the Paper as cement modified soil and does not correspond to the soil cement having definite structural properties and durability, which could be predicted from tests.



Discussion on Paper No. 164*

"Testing to Destruction a 96-ft Prestressed Concrete Bridge Girder"

By

K. K. NAMBIAR AND P. V. RAJ

Monday, February 9, 1953

Shri Kanwar Sain (Chairman) called upon Shri Nambiar to introduce his Paper.

Shri K. K. Nambiar introducing the Paper for discussion said that the object of conducting the test was to gain first hand knowledge of the behaviour of prestressed concrete under severe loading. He believed that the Paper would enable engineers to judge for themselves the advantages of prestressed concrete.

Prestressed concrete construction had not made much headway in India due to lack of materials and skilled technicians to carry out works. The engineer while assessing the suitability of structural material ought to apply the following criteria, viz., whether there was a saving of material in short supply such as cement and steel, and whether there was overall economy. The test at the Palar Bridge and similar tests conducted in other parts of the world had clearly demonstrated the advantages of prestressed concrete.

Compared to the conventional reinforced concrete there was an appreciable saving of steel and cement and the design was cheaper than one of reinforced concrete.

Some engineers seemed to doubt the efficacy of the anchorages. As mentioned in para 4.2 at page 361 of the Paper the two cables, T7 and T8, were left ungrouted. It was found that the whole force due to prestress and deformation of the beam in these cables was borne by the anchorages alone without any slip. The bond between the wires and the grout within the end block was sufficient to carry the force in the wires.

Several experiments by Fressynet and Magnell on beams from which the end anchorages were removed demonstrated the fact clearly. The design of the Palar bridge provided for both the end anchorages and bond and so there was no apprehension about the permanency of the prestress.

*Published at pages 345 to 391 of Vol. XVII-3 of the Journal of the Indian Roads Congress—January 1953.

Measurement of the plastic deformation, the elasticity of the beam at intervals of time, and strain measurements of the longitudinal wire were under contemplation. Appendix III of the Paper gave the calibration of the jacks done after the tests.

On page 349 in line 2 of para 2.2.6, read 11,25,000 for 11,25,500. On page 356, in line 1 para 3.7.2 read cable B2 for cable B3.

Shri K. F. Antia mentioned that a test on a 40-ft prestressed concrete girder was carried out by him for dynamic railway load. It was found that the effect of the girder when a loaded wagon was intentionally derailed over it was slight.

That the lowest tenders were generally of prestressed concrete showed that it was cheaper in spite of the high cost of the imported high tensile wire. When the high tensile wire was manufactured in India there was scope for further savings.

Shri Antia enquired as to why parabolic variation had been assumed for the calculation of pair losses in para 3.6. He presumed that the elongation of $1\frac{1}{2}$ in. bars through which the reaction of the jacks was transferred to the girder had been taken into consideration in measuring the deflection of the girders.

Shri R. N. Joshi pointed out that during the test the water which had collected in the U-portion oozed out through the cracks. It was an advantage if in the future tests the U-portion could be filled with coloured water and connected to a hydrostatic head of 20 to 30 ft. The water oozing out through fine cracks which was not visible to the naked eye would indicate the presence and the pattern of the cracks. The weight of water so put in was only of the rate of 600 or 700 lb. against the dead load of 1,200 lb. per sq. foot of the wearing coat, handrails, kerbs, etc.

In his opinion a uniform distributed dead load of 1,200 lb. per sq. foot gave conditions conforming to actuals by producing the full shear at the supports. The four jacks used did not give the necessary shear even though they produced the necessary maximum bending moment at the centre.

Shri D. C. Chaturvedi* wanted to know (i) the details of the failure of the SR 4 strain gauges, (ii) the method of measuring strains by the use of metal studs buried in the concrete,

* This comment was received in writing.

and (iii) the necessity for using rapid hardening cement for the deck slab.

Shri P. V. Raj (Joint Author) referred to Shri Antia's remarks about the strains in the tie rods and said that the application of force in the rams of the jack reacted on the beam and together with the reaction of the abutment produced flexure in the beam. The measurement of the deflections of the beam with reference to the ground gave true results. The strains in the tie rods did not have any effect on the observed deflections.

The bending moment along the span was parabolic and the modulus of the section was constant. Hence the variation in the compressive stress was parabolic. That was why parabolic variation had been assumed for the pair losses mentioned in para 3.6.

In reply to Shri Joshi he said that a small quantity of water entered the girder through the shuttering placed for the deck slab. Four concentrated load points were taken instead of uniform distributed load for convenience. By the arrangement as mentioned in para 5.5, a shear stress of 800 lb per sq. inch was reached and there was no sign of shear failure.

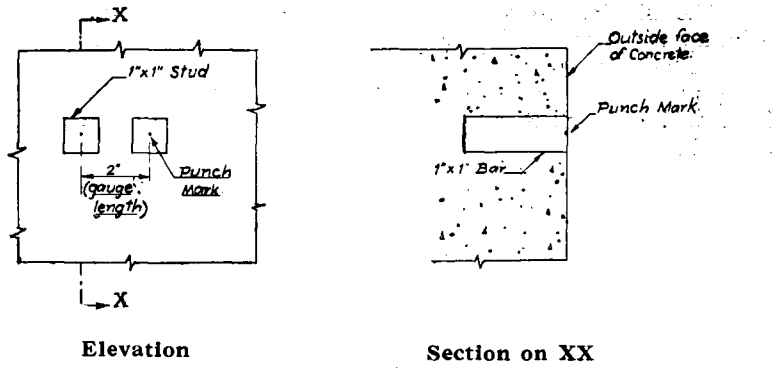
Replying to the written comments of Shri Chaturvedi, Shri P. V. Raj gave out that the S. R. 4 Strain gauges used for the test were of two types:

(1) A - 11 - Resistance 120.4 plus or minus 0.2 per cent ohms with a gauge factor of 2.05 plus or minus 1 per cent, and

(2) A—5—Resistance 120.0 plus or minus 0.2 per cent ohms with gauge factor of 2.01 plus or minus 1 per cent

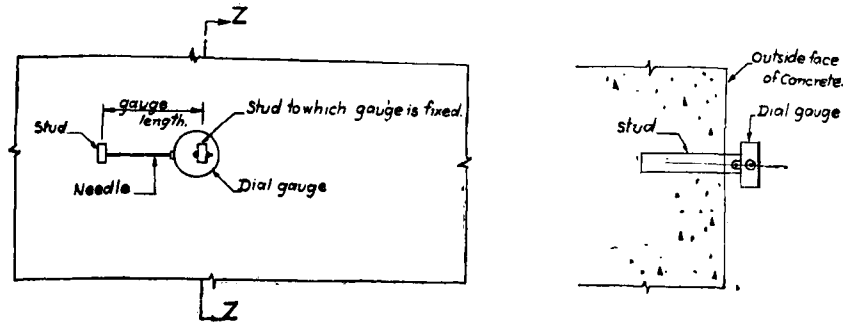
and were supplied by Baldwain (U. S. A.). The manufacturer recommended Bakelite base gauges, i.e., B-type for outdoor work but unfortunately they were received after the test was over. Another important factor in the use of the S. R. 4 gauges on concrete over long periods was the effect of plasticity of the adhesive used for the gauges.

Strains in concrete could also be measured fairly accurately by fixing say 2 metal studs in the form of plate or a bar 1 in. square fixed to the concrete surface spaced 2 in. centre to centre. Punch marks were made on the face of the studs and the distance between the marks measured by means of strain gauge such as "Whittemore Strain Gauges", Fig. A.

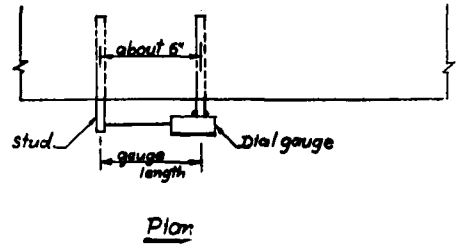


Elevation — Section on XX

Figure-A



Elevation — Section on ZZ



Plan

Figure-B

The strains could also be measured by fixing studs, say 6 in. apart. Ames or Mercer dial gauges were fixed to one stud and the needle pressed against the other stud, Fig. B. But the dial gauges were capable of measuring to an accuracy of 1/10000 of an inch while the S. R. 4 can record an accuracy of 1/200000 of an inch.

INDIAN ROADS CONGRESS

Classified List of Papers, etc., in the Proceedings I to XVII

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IV. Water-bound Macadam Roads, such as moorum, brick and other forms of trackways.
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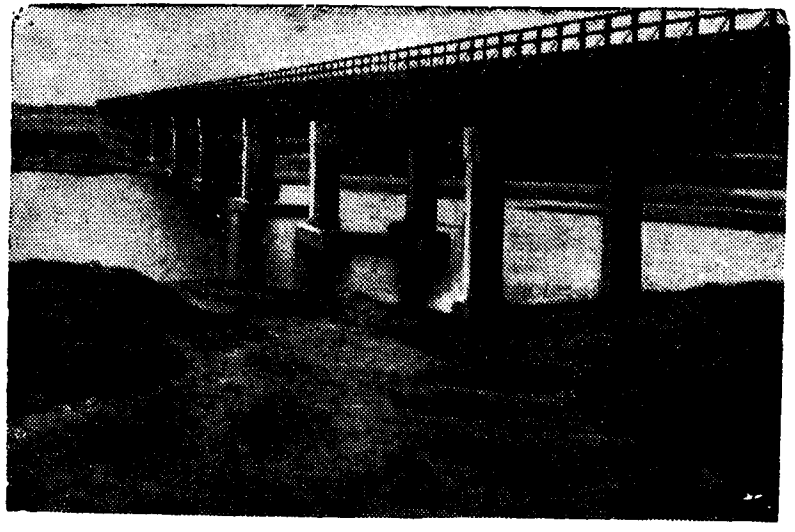

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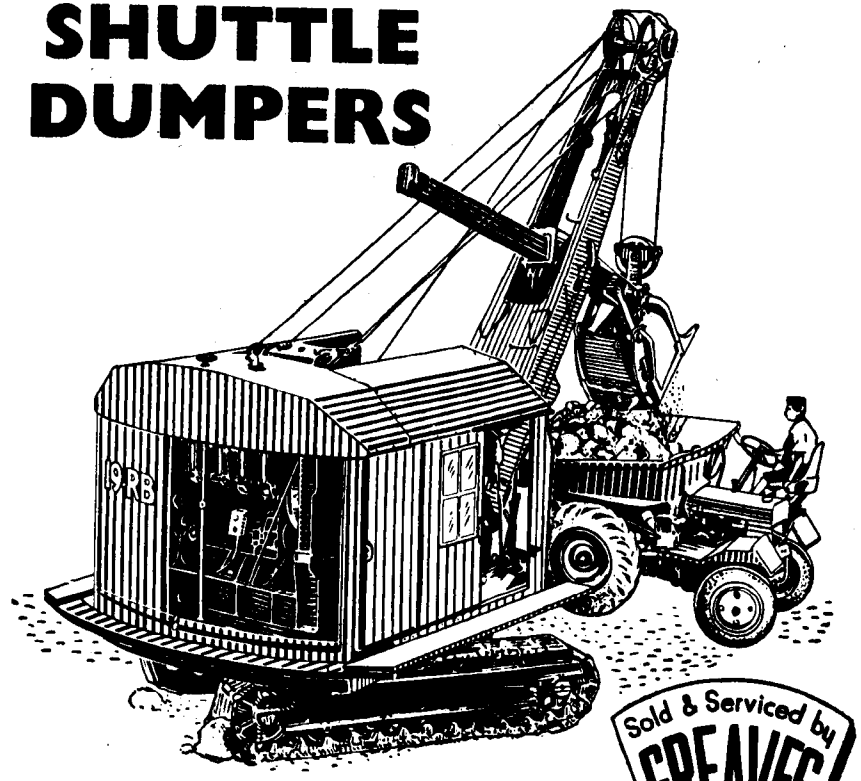

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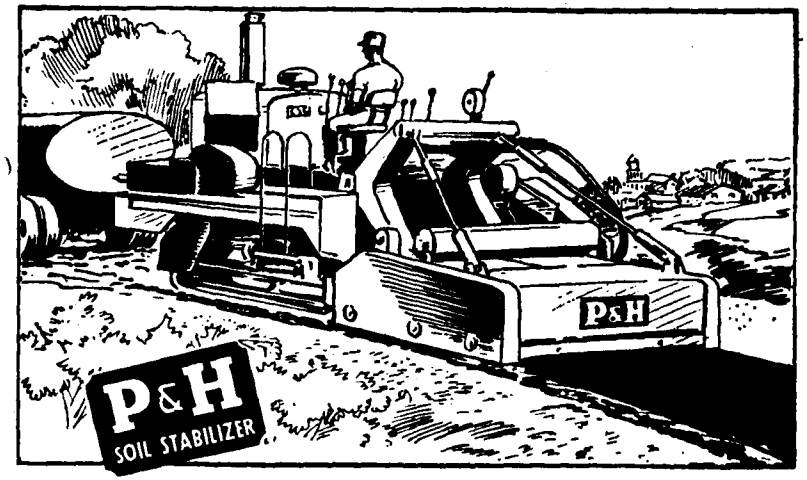

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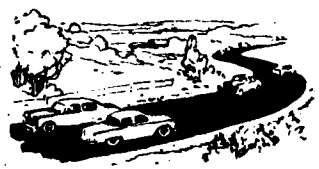

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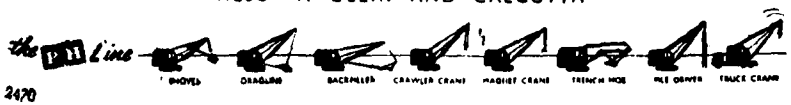

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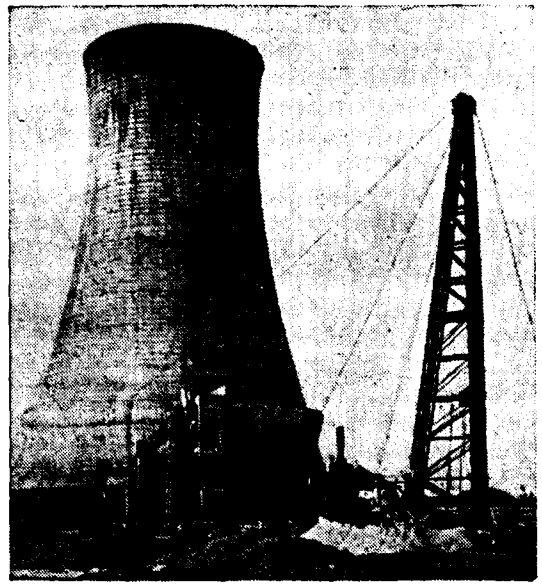

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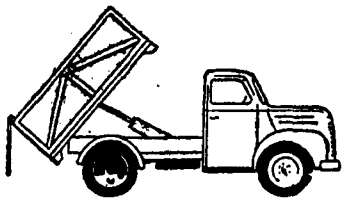

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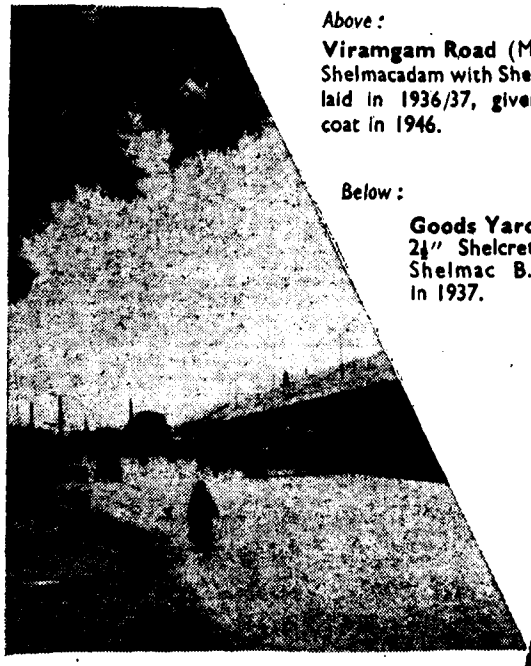

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