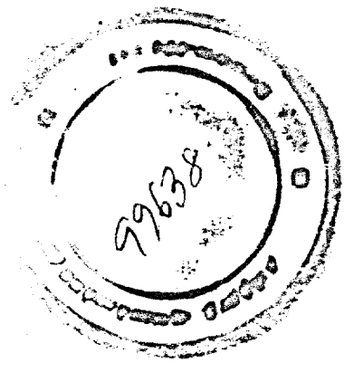
TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW (TCMR)

JANUARY 1962—No. 177

INDIAN ROADS CONGRESS, NEW DELHI.



TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

JANUARY 1962—No. 177 SPECIAL NUMBER

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Shri N. G. DEWAN, I.S.E.,

(New President, Indian Roads Congress, 1962)
CHIEF ENGINEER C. P. W. D. New Delhi.

Shri N. G. Dewan, I.S.E. unanimously elected President, Indian Roads Congress for 1962 is Chief Engineer, Central Public Works Department, Government of India.

Born in 1909 Shri Dewan passed out as Civil Engineer from Thompson College of Engineering, Roorkee in 1930, joined the Indian Service of Engineers in 1931 in the Punjab Irrigation Department. In the 1935 he was permanently transferred to the Central Public Works Department. The C.P.W.D. being in charge of very important works in the country, Shri Dewan has very important role to play. He is actively connected with all forms of building construction, road construction, aerodrome construction including runway pavements, line development, Water and Sewage Disposal works, etc. etc.

Shri Dewan is an old member of the Indian Roads Congress and has been taking keen interest in its activities.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

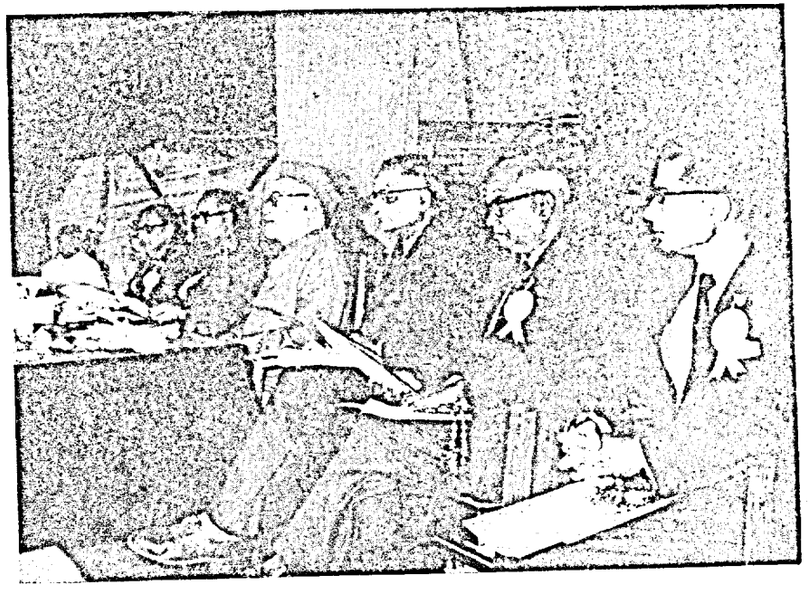
JANUARY 1962

26TH SESSION OF THE INDIAN ROADS CONGRESS

PATNA was the venue of the 26th Annual Session of the Indian Roads Congress, held there from 13th to 20th December, 1961.

In 1949, the Indian Roads Congress held its 13th Annual Session at Ranchi in Bihar.

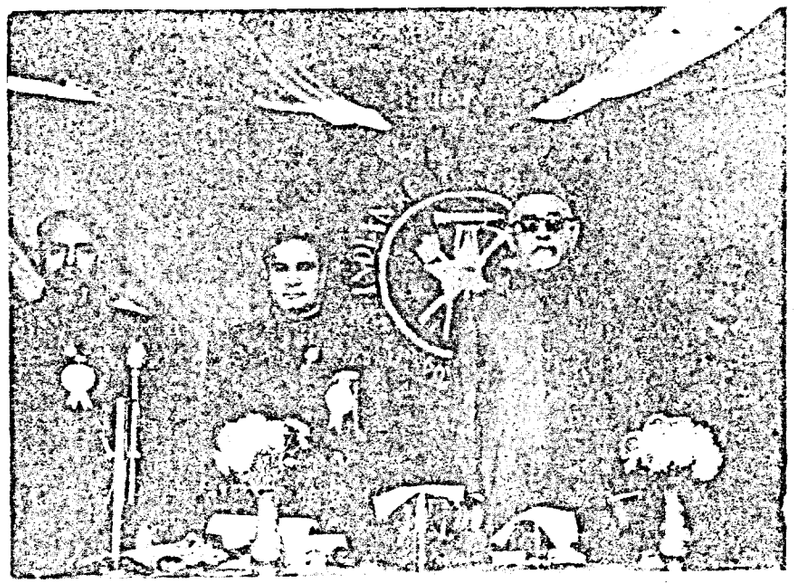
Both the 13th Session 1949 and 26th Session 1961 held in Bihar surpassed the number of delegates attending the previous Sessions. At this 26th Session nearly 500 delegates attended the Session.



The Governor of Bihar and others at the stage at the Inuguration function of the I.R.C. Session at Patna on the 14th December, 1961

Delegates were housed in the newly constructed flats for the officers on Bailey Road. The Session was held in well designed, tastefully decorated and well serviced Pandal erected in open space between the above mentioned officers' flats. In this Pandal, Papers were presented and discussed. Some social functions were also held there. Meeting of the Council of the Indian Roads Congress, Chief Engineers' Meeting as well as that of the IABSE were held in an other commodious Shamiana erected in that area.

The Session was inaugurated on the 14th December, 1961 by Dr. Zakir Husain the Governor of Bihar.



The National Anthem being sung at the Inauguration function

The Governor in his Address said, that it is no consolation to know that our National Highways are deficient by 80 major bridges and out of 15,000 miles length only 2,300 miles have two lane pavement, 1000 miles have water bound macadam surface and that the thickness of road crust is insufficient for the road traffic, the roads are called upon to carry. With terrific pressure on the railway transport that has been developing, the specific advantages of the road transport are being more and more widely recognised and it was more likely than not that plans for road expansion will assume large proportion.

Transport has to be arranged for the requirement of the industry and trade (transport of raw-materials, goods and finished products) and for the people to get them to and from work places and enjoy leisure. Problems inside the cities are developing into intolerable condition of congestion during peak hours and conflict with the pedestrians etc. In the face of expanding economy of our country, the engineers are charged with the work of the highest significance.

His Excellency supported the demand of the Indian Roads Congress for the establishment of the Road Board with a view to facilitate the co-ordinating development of the road and road transport to cater for the Road and Road Transport needs of the country's expanding economy.

Mr. Barua, Chief Engineer and Secretary P.W.D., Assam, in his Presidential Address said that our country through planned efforts is trying to achieve high degree of productivity, large scale industrial and agricultural expansion, with a view to increase the national income three-fold from Rs 9,000 crores in 1950-51 to Rs 27,000 crores in 1975-76. This is not possible without adequately expanding our road system, road facilities and providing sufficiently large number of heavy vehicles of suitable type and capacity for the carriage of raw materials, goods and finally manufactured articles. Road transport in India was still operating within the confines of contractionist philosophy of the thirties and needs specialisation, standardization and mechanization. The multifarious advantages inherent in good road transport call for assignment of a very high priority to the development of road and road transport industry which will also provide a link to the remotest areas of our country.

The President also pointed out that the existing thicknesses of road crusts were quite inadequate to stand the heavy traffic coming over them. In certain areas, the position has been further aggravated by water logged conditions as a result of expansion of irrigation facilities. It was, therefore, high time that thickness of such pavements is increased suitably and quickly to save the roads from irretrievably getting damaged. But this calls for more funds for roads and unless the allocations are augmented, road surfaces will deterioriate so much that heavy expenditure would be needed for reconstructing them in the Fourth Plan.

In order to have effective returns for the investment in road system of our country, we should do everything possible towards the development of suitable types of heavy goods vehicles and their manufacture in very much greater number to cope with our requirements.

According to the Road Development Plan 1961-81 prepared by the Chief Engineers of States, provision of Rs 590 crores for the Third Five Year Plan was made; against this, an inadequate amount of Rs 271 crores (excluding Rs 29 crores from the International Development Association aid) were allotted. This should be increased to meet the very legitimate demands of our roads and road transport. In the face of the recent failure of the railways to meet the heavy traffic demand for the movement of coal and other raw materials and the delay in the supply of other products and recognising the benefits of the roads in an under-developed economy, it is necessary that more funds are allotted for roads and road transport to supplement the carrying capacities of Railways.

He further said that for achieving co-ordinated development of the road transport to cater to the needs of the country's expanding economy, the formation of a Road Board is an immediate necessity.

He added that in order to check the fast growing ribbon development on roads and National Highways, the Central Government prepared a Draft Bill for the purpose of enacting a Highway Act on behalf of the States under Section 252 (1) of the Constitution of India. This Bill was circulated to the States to pass resolutions in their legislatures empowering the Central Government to enact the Highway Bill. The State Governments should take immediate action in this matter so that the fast growing evil of ribbon development is stopped or curbed.

EXHIBITION

A technical exhibition displaying the latest progress made in the field of road and bridge construction techniques, road materials, equipment and machinery dealing with road and bridge construction, etc., was tastefully arranged. The exhibition was very kindly opened by Shri Zawar Hussain, Transport Minister, Bihar.

TECHNICAL COMMITTEES

Various technical committees of the Indian Roads Congress met during the Session, brief account of the Committee meetings is given below:—

i. **Bituminous Pavements Committee** considered drafting specifications for single coat or two coat bituminous surface treatment for which questionnaire was circu-

lated and replies received, the committee also considered framing of draft specification for priming coat, design of flexible overlays over rigid pavements, etc.

ii. **Bridges Committee** at their meeting considered further developments regarding the draft Indian Standard Code of Practice for steel bridges, aseismic (earthquake resistant) design of structures, metric dimensions of road widths on road bridges and finalising the draft criteria for prestressed concrete bridges.

iii. **Cement Concrete Road Construction Sub-committee** noted that the draft code of practice for construction of concrete roads in the country has since been referred to the Specifications and Standards Committee. This sub-committee also agreed that a section on precautions regarding concreting in hot weather be incorporated in the Code.

iv. **Cement Concrete Road Surfacing Committee** at their meeting held on the 13th December, 1961 after considering limiting factors in our country to adopt thickness of Cement Concrete pavement, only as worked out by rational methods, decided that the proposed table of thickness under preparation with the committee should clearly indicate the scope of using thickness less than that by maximum wheel load basis, so that sub-standard designs are not employed in heavier trafficked roads.

v. **Community Projects Roads Maintenance Committee** considered the question of the maintenance and construction standards of roads under community projects and National Extension schemes and decided to collect up-to-date information from all Chief Engineers of the States and the details of system adopted in Madras State.

vi. **Education Committee** decided to request the Executive Committee to send the syllabii prepared by them for the Diploma course for overseers and supervisors to various universities and institutions for introduction in their curriculum. The Committee noted that the details of the Postgraduate courses being conducted in certain important technical institutions had been passed on to the Director, Central Road Research Institute who had kindly agreed to finalise the syllabii for the Postgraduate courses in Highway Engineering.

It was decided that the finalised syllabii for Refresher Courses in Highway Engineering both for Senior and Junior Engineers be placed before the Council and request the Chief Engineers for nomination of officers for the course which may be started at the Central Road Research Institute, New Delhi.

vii. **Manufacture of Road Making Machinery and Mechanization Committee** considered ways and means to create interest in the manufacture of road making machinery in the country and evolving methods for encouraging the use of machinery in the country.

viii. **Prevention of Ribbon Development Committee** considered and agreed to the right of way widths for various categories of roads and the width of strip of land on its either side to be kept free of building activities both in the case of urban as well as rural areas. It was also decided to study Acts passed on the Prevention of Ribbon Development in other countries.

ix. **Road Transport Development Committee** reviewed the progress made in regard to the survey of National Highways for determining their suitability for carrying higher loads, popularising truck trailer combinations, popularising Indian Roads Congress bullock cart wheels, laden weight restriction on roads, framing model rules for licensing and booking agents, maintenance of Katcha roads. The Committee also discussed the proposal for providing two axial roads, viz., one from Delhi to Cape Comorin and the other from Bombay to Calcutta with two lane pavement, laden weight restrictions on roads in the various states and the recommendations of the Transport Ministries in Europe in this regard, progress made in the revision of laden weight restrictions in the various states, scheme for truck terminals, scheme on 'Controlling Drivers'.

x. **Soil Research Committee** at their meeting held on the 15th December, 1961 considered a method of soil cement pavement construction, specifications for the

construction of stabilized soil roads with soft aggregates in dry areas, procedure for the construction of stabilized soil roads with soft aggregates in wet areas, a method of stabilization of black cotton soil with lime, road construction in sandy areas and similar other subjects with a view to evolve methods of cheap road construction in the country.

A meeting of the Road Transport Development Committee

xi. **Specifications and Standards Committee** discussed type designs for toll, octroi or check barriers on roads, specifications for (i) 3/4 in. thick bituminous carpet (precoated surface dressing), and (ii) 3/4 in. thick tar carpet (precoated surface dressing), draft I.R.C. Code of Practice for construction of concrete roads, standards for vertical and horizontal clearance of over-head electric power and telecommunication lines as related to roads.

xii. **Stabilized Soil Road Committee** finalised their programme of inspections of stabilized soil roads in Andhra Pradesh, Bihar, Gujerat, West Bengal etc., and discussed standard procedure for condition surveys of stabilized soil roads, specifications for construction of stabilized soil roads in areas of heavy rainfall.

xiii. **Traffic Engineering Committee** among other things, discussed nomenclature of Traffic Engineering terms and the subjects of Traffic Signals, regulation of Mixed Traffic, provision of adequate parking places in new layouts and provision of parking and garage accommodation proportionate to the type and size of a building.

COUNCIL MEETING

The Council at their 59th meeting held on 13th December, 1961 approved the audit report, budget, draft report to the General Body, draft recommended practice for the design and layout of cycle tracks, draft recommended practice for location and layout of roadside motor fuel-filling stations, etc. The Council also decided that the Government of India should be approached to organize the refresher course as early as possible. The Chief Engineers were requested to nominate their engineers to the proposed refresher

courses. A Committee to consider the question of setting up separate Highway Departments in states and to make necessary recommendations was set up. The Council while noting that the State Governments were considering transfer of certain categories of roads to Local Bodies, Zila Parishads and Panchayats, expressed the view that all National and State Highways, Major District Roads and important other District roads should remain with the P.W.Ds.

The Council at their 60th meeting held on the 18th December, 1961 elected the new office bearers. Shri N. G. Dewan, I.S.E., Chief Engineer, C.P.W.D., New Delhi was elected new President, Sarvashri M.P. Apte, K. V. Joglekar and Y. K. Lall were elected as Vice-Presidents, Shri H. P. Sinha and Shri N. Sen continued as Treasurer and Secretary respectively. The Council also appointed the following Convenors of technical committees :—

Name of the Committee	*Name of the Convenor*
1. Bituminous Pavements Committee	Shri Sujan Singh
2. Bridges Committee	Shri S. L. Bazaz
3. Cement Concrete Road Surfacing Committee	Shri Erach. A. Nadirshah
4. Community Projects Road Maintenance Committee	Shri K. K. Nambiar
5. Education Committee	Shri Erach. A. Nadirshah
6. Local Committee of the Test-Track Committee to Supervise Delhi-Mathura Road Tests.	Director, C.R.R.I.
7. Papers Committee	Shri H. P. Sinha
8. Prevention of Ribbon Development Committee	Shri H. P. Sinha
9. Provincialisation of Local Bodies Engineering Services Committee	Shri P. Sirajuddin
10. Research Organization Committee	Shri S. R. Mehra
11. Road Transport Development Committee	Dr. F. P. Antia
12. Road Transport Operation Cost Committee	Shri Jagdish Prasad
13. Specifications & Standards Committee	Shri Goverdhan Lal
14. Stabilised Soil Roads Committee	Shri K. K. Nambiar
15. Test Track Committee	Chief Engineer, Road Development Department, West Bengal.
16. Traffic Engineering Committee	Shri D. G. Bhagat

The Council decided to hold the next Session of the Indian Roads Congress at Chandigarh sometime in November or December 1962 depending upon the convenience of the host Government.

CHIEF ENGINEERS MEETING

A meeting of the Chief Engineers of the States, C.P.W.D., representative of E-in-C Branch was held on 17th December, 1961.

INDIAN NATIONAL GROUP OF I.A.B.S.E.

Held their meeting during the Session. A symposium on "Trends in Modern Bridge Design" was arranged.

INDIAN NATIONAL SOCIETY OF SOIL MECHANICS AND FOUNDATION ENGINEERING

Held their meeting during the Session and discussed several papers.

FILMS

Several interesting technical films relating to Roads & Bridges were shown.

DISCUSSION OF PAPERS

Six Papers were discussed during the Session. Brief synopsis of the each is given below:

1. "Load Test on the Masonry Arch Bridge Across Uppodai" by K. Ramaswamy Reddy and K. Srinivasa Rao

The Paper deals with the various tests conducted which can be broadly classified (i) superficial tests and (ii) load tests to destruction. It has been generally concluded that elastic method of arch analysis can be adopted for assessing the strength of old arches. It has also been indicated that special heavy test vehicles can be made use of, for developing a test criteria and for confirming the findings of this test.

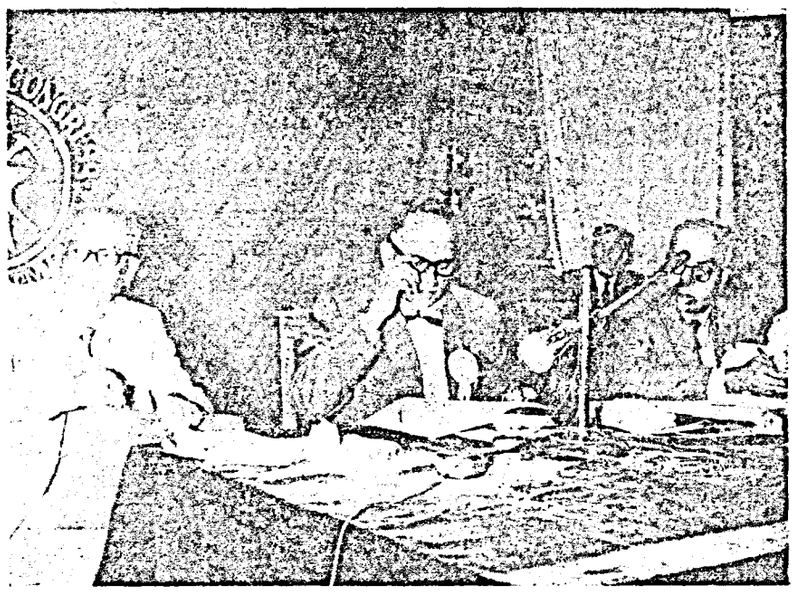
2. "Parking in Mount Road" by R. Thillainayagam

The Paper gives the details of the survey conducted to evaluate parking requirements. The survey was conducted to establish both quantity and character of potential demand of the parking facilities on this road and to meet that demand with economic justification. The survey also aimed at revealing the nature of parking habits. The parking facilities provided now by public and private buildings were generally found to be inadequate. The location of taxi stands, bus stops and cycle parking also needed a change.

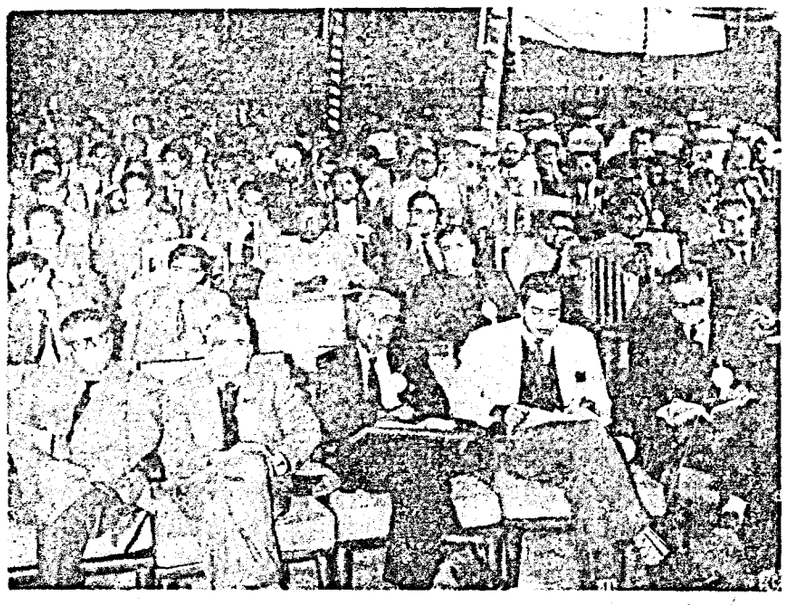
Recommendations made include thirty minutes curb parking, restriction, marking of stalls and signing of regulations, relocation of taxi stands and bus stops, and enactment of zoning ordinance prescribing parking space provision for the various types of buildings besides amplification of the Motor Vehicles Act as regards method of parking and allied matters.

3. "Analytical Study of Some Bridge Articulation Failures" by S. N. Sinha, B. Prasad and P. J. Prasad

The Paper describes the two recent failures, at articulation, of two important bridges in Bihar. One of the bridges was constructed hardly 9 years back while the other was constructed about 19 years back. The nature of failures, the various causes leading to failure and the remedial measures adopted have been discussed. General principles of design of articulation and certain suggestions relating to both design and construction were also discussed.



A Paper under discussion



4. **"Draft Standard Specifications and Code of Practice for Road Bridges" Section VI—by Bridges Committee of the Indian Roads Congress**

5. **"Design and Construction of Cement Concrete Pavement on Agra-Mathura Section National Highway No. 2" by Sarvashri H. G. Verma and D. C. Chaturvedi**

The Paper describes the various stages on design and construction of cement concrete pavement being laid on Agra-Mathura Section of National Highway No. 2. Determination of pavement thickness on basis of 'K' value and controlling wheel load have been discussed. Testing of materials, design of concrete mix and other relevant items connected with the construction have also been discussed. Testing of materials, design of concrete mix and other relevant items connected with the construction have also been discussed.

6. **"Design and Construction of Ajoy Bridge" by S. K. Samaddar and A. K. Roy**

The Paper describes the salient features of design of a prestressed concrete bridge built over Ajoy river in mile 14 of the Panagarh-Illambazar-Suri State Highway. The bridge consists of 10 spans of 148 ft each with two-end spans 119 ft each. For facility of erection the prestressed girder was cast on the river bed in two sections, erected in position and then jointed.

7. The delegates also discussed the GENERAL REPORT ON ROAD RESEARCH IN INDIA for the year 1960-61. The report was compiled by the Central Road Research Institute on the basis of the reports received from the ten road research stations in India A review of the road research carried out this year by the various research organizations in the country indicates that main emphasis has been laid on applied Highways Research. Many systematic investigations for improving the existing roads, as well as for the construction of new roads are reported to have been carried out. The study of soft aggregates for use in road construction has also received considerable attention. Some fundamental work too has also been reported by the CRRI to explain the chemical reactions of clays calcined at different temperatures.

On the 19th and 20th December, the delegates visited Mokameh bridge, Rajgir, Nalanda, Bodh Gaya, Tilaiya Dam, Dhanbad and Sindri Fertiliser Factory.

PRESIDENTIAL ADDRESS

TO THE

TWENTY-SIXTH SESSION

OF THE

INDIAN ROADS CONGRESS

By

SHRI K. BARUA

Patna, December, 14, 1961.

Shri Rajyapal, Ladies and Gentlemen,

It is my pleasure to welcome you to-day, Sir, on behalf of the Indian Roads Congress and to express our profound gratitude for the honour you have done us by kindly consenting to inaugurate this Session in spite of heavy pressure on your time. I am also grateful to our honoured guests for having graced this occasion with their presence.

It is a matter of great pleasure that we are once again holding our Annual Session in the State of Bihar. It was in 1949, that the Thirteenth Session of the Indian Roads Congress was held in the salubrious climate of the city of Ranchi. The courtesy and the kind hospitality lavished by your Government are still fresh in the minds of all those members who attended that conference. The venue, this time, has shifted to your capital at Patna, a historic city known for its learning and culture in the past. We could not have hoped for a better venue for our Annual Session than that provided by the scholarly tradition and environment of this ancient city. The Highway Engineers meeting here will have ample opportunity to see the great engineering works which have been completed or are in progress in your State and, I am sure, they will carry sweet and enduring memory with them.

The Congress is very grateful to you, Sir, and appreciate your keen interest in road development. It, therefore, can certainly look forward to your esteemed support in its cause of developing the country's communication system.

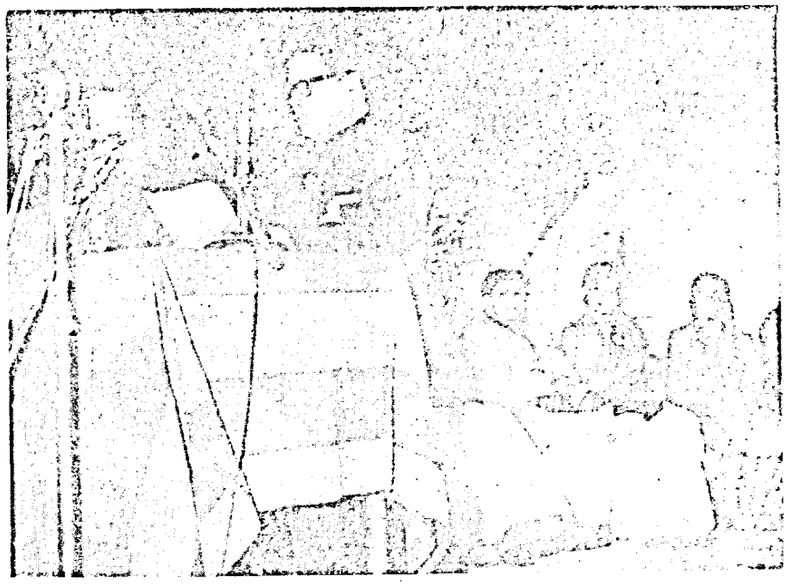
THE INDIAN ROADS CONGRESS

Throughout its history, the Indian Roads Congress has continued to evince keen interest in the construction and maintenance of roads. The "Proceedings" of the Society contain many important Papers dealing with subjects relating to roads and bridges in their manifold aspects. After 26 years of existence, the Society maintains its vitality unimpaired.

The membership of this Society has grown from 73 members in 1934 to 2,000 in 1961. But the number of Associate members has not risen equally well. There are many distinguished men, other than qualified road engineers, whose association with our work could be very valuable and of advantage to this important branch of engineering.

Training of engineers in various fields is receiving a good deal of attention at the hands of our Government. It will not be an overstatement if I say that there is perhaps no better facility for training of road engineers in this country than their association with

the activities of our Society. I would, therefore, urge upon all the Chief Engineers and others in similar position to bring to the notice of their road engineers the advantages of associating with the activities of this premier Society of Highway Engineers. May I add that the contribution this Society has made to the cause of road development has been recognised not only in our country, but it has also won recognition in other more



Shri K. Barua delivering the Presidential Address

advanced countries of the world. The Bureau of Public Roads of United States of America, in their message to the last Session of the Congress, expressed the view that the contribution of our Congress towards the advancement of technique and technology of highway engineering has been remarkable, and that our work has benefitted the development of highways not only in India but in many other countries as well.

PROFESSIONAL SERVICE

A great deal of technical work on highways and transport problems is being done by this Society through its various committees and sub-committees. During the Third Plan, one per cent of the total allocation for road development schemes is proposed to be spent on experimental specifications and new techniques. A special committee has been formed under the aegis of the Indian Roads Congress to assess the performance of those experimental works. Members of the committees are giving gratuitous service to the country, which constitutes a substantial technical contribution from the engineering profession. So is the service rendered by authors of Papers and articles who in spite of their various pre-occupations find it possible to add to the knowledge of the profession. I take this opportunity to congratulate all those who are serving the cause of the profession in general and the Society in particular, by their meritorious work.

It is realised that many members whose work and experience would be very beneficial to this Society are so pre-occupied that they have little time for writing Papers. I venture to suggest that such members may prepare brief notes on works regarding the difficulties faced in executing them and the remedies applied thereto. In this way, fruits of their experience and their suggestions will also be available.

ROAD AND ROAD TRANSPORT DEVELOPMENT

While inaugurating the ECAFE Seminar at Madras in October last, the Prime Minister of India said that the roads play an important part in the nation's life and economy and that there is vast scope for the development of the transport system in the country. He also felt that the growth of road transport did not conflict with the growth of railways.

It seems somewhat paradoxical that our country which, through planned efforts, is trying to achieve large scale agricultural and industrial expansion, should be handicapped by an overall bottle-neck in transport. No country can think of embarking upon ambitious plans of economic development, without simultaneously and adequately expanding her transport facilities. This not only helps economic progress, but also generates economic development by exploring new markets and expanding present ones.

To fulfil our objective of tripling the national income from Rs 9,000 crores in 1950–51 to Rs 27,000 crores in 1975–76, and raising our production from 130 million tons in 1950–51 to 760 million tons in 1975–76, careful attention shall have to be paid to develop various means of transport to cope with our ever increasing demand for transport. The weakness of the present transport system has been forcefully brought out by prevailing serious shortage of transport facilities for the movement of coal and other raw materials. It is time that we realise the vital role played by the transportation industry in accelerating the tempo of economic development, and make adequate provision for the same.

There are multifarious advantages inherent in road transport such as ability to move men and materials at high speed, door to door service, high potential to generate employment. This calls for the assignment of a high priority to the development of road and road transport industry, which will also provide a link to the remotest parts of the country and bring about a cultural and emotional integration without which our material prosperity will not produce the desired results.

ROAD BOARD

With a view to facilitating the co-ordinated development of roads and road transport to cater for the needs of the country's expanding economy, the Indian Roads Congress have stressed the need for the constitution of a Road Board at the Centre. Necessary recommendations about the composition and financial arrangements for the proposed Road Board were forwarded to the Govt. of India last year. I would, however, again emphasise that the need for the setting up of a Road Board is urgent and hope that this proposal will be given effect to as early as possible.

NEED FOR GOOD ROADS AND HEAVY VEHICLES

The problem before us is to ponder as to how to make road transport more efficient for moving men and materials at high speed and at cheaper cost.

The Indian Productivity Team on Road Transport has, in their report, pointed out that the productivity of road transport in India is extremely low due to the regulatory and other restrictions imposed on it. The report adds that our road transport is still operating within the confines of the Contractionist Philosophy of the thirties. The vehicles are costly to operate, because due to a variety of restrictions they cannot operate and obtain optimum milage. The whole road transport system is very wasteful and hardly any attention is paid to good maintence of vehicles and equipment.

To achieve a high degree of productivity in road transport, good roads and heavy vehicles with free flow of traffic are absolutely essential. The Indian Productivity Team on Road Transport which toured various Western countries has pointed out:

"As against a gross laden weight of 8 to 12 tons permitted for trucks in India, which enables vehicles to carry a pay load of 5 to 8 tons, the gross weight allowed for combinations in the U.S.A. and Germany is 32 tons so that a pay load of as much as 25 tons can be carried. Semi-trailers or articulated trailers which are extensively used in U.K. and U.S.A. usually carry 17 to 21 tons of consignments.

"The use of these combinations has cut road transport costs by as much as 77 per cent in the past two decades. Taking the 6-ton lorry now in use in India as the standard, the operating cost can be reduced by 40% by using a 13½ ton unit 47% by a 18-ton unit, 66% in the case of a 22½ ton combination, 72% by a combination carrying 27 tons, and 77% by a unit carrying 32 tons. It is these combinations that constitute the backbone of road transport productivity in the West".

We can hardly afford to ignore the modern trend in road and road transport development in the other advanced countries.

QUALITY OF ROADS AND VEHICLES OPERATION COSTS

It is now an acknowledged fact that the cost of operation of motor vehicles gets reduced with the improvement in road surface. Elaborate studies on this specific problem have been carried out in advanced countries like U.S.A., U.K., extending over several years. In order to have precise knowledge of the savings in cost of operation on the roads in our country, the Indian Roads Congress appointed a Committee to study the different aspects of the problem. In pursuance of the recommendations of this Committee, controlled experiments were conducted by the State Transport Undertakings of Uttar Pradesh and Bombay for 5 years. The findings of the Committee are as follows:

"The experiments conducted by Bombay and Uttar Pradesh State Transport Undertakings have already brought out the amount of reduction in the cost of operation of motor vehicles on different types of surfaces. All the facts taken together it is seen that the total variable cost per vehicle mile can be reduced to half by improving the road surface.

"For constructing a superior surface we may have to invest more initially but, in the long run, especially where traffic is heavy, there will be considerable saving in the cost of operation which will offset in due course the higher initial outlay. High grade surfaces have longer life. The life and optimum utilization of vehicles will also increase. It is, therefore, essential that sufficient funds should be allotted towards improvement of existing surfaces and construction of new roads with superior surfaces where the traffic density is high."

MORE VEHICLES ON ROADS

In the context of large scale agricultural and industrial expansion, population increase at the rate of 2.15% per annum and urgent need for bringing about a balanced development of different regions of the country, there is not only the need of construction of more roads for linking the different parts of the country but also for providing more vehicles on roads to meet the rapidly increasing demand for movement of men and materials. At present, the supply for motor vehicles falls far short of our requirements. The Planning Commission in its draft 'Third Five Year Plan' has also admitted that "on account of the shortage of foreign exchange insufficient supply of new vehicles has stood in the way of rapid expansion of road transport during the Second Plan period.

The ad-hoc Committee on Automobile Industry (1960) in their report has stressed that "the demand for automobiles has gone up considerably in recent years. Normally in such conditions it would have been desirable not only to allow the free play of competition among the domestic producers, but also to consider the possibility of allowing some imports to meet the excess of demand over domestic productions. Unfortunately, the foreign exchange crisis which intervened had made it necessary for Government to follow a much stricter import policy than is necessary or justified from the point of view of assistance to the domestic industry. Indeed, one of the results of the foreign exchange crisis was to reduce the level of domestic production in 1958 which led to conditions of extreme shortage".

In this connection, I need hardly stress that need for construction of more and better roads and improvement of existing roads is a national demand of very high priority. But it will not pay if the roads are built and motor vehicles production lags behind. A former member of the Planing Commission, late Dr. J.C. Ghosh, said in 1956 " In the existing roads of 2,50,000 miles we find on the most optimistic calculations that there are 1,25,000 trucks plying, i.e., half a truck per mile of road. This figure of 0.5 truck per mile compares very unfavourably with the figures of 5 to 10 trucks per mile in other parts of the world. This is a matter, to which the attention of Parliament and also State Governments should be drawn. We feel that roads in India are not being properly used. Empty roads may be a source of delight to foreign tourists or Indians enjoying excursions, etc., but obviously these empty roads are a question mark to the Indian tax payer who is persuaded to believe that all his moneys are being used to create utilities and not luxuries."

I, therefore, urge that in order to have effective return from the existing investment on roads, the country should pay urgent attention to the development of automobile manufacturing industry which would eliminate our dependence on availability of foreign exchange. Already there has been marked improvement in the proportion of indigenous contents of various types of automobiles manufactured in India, with the result that more vehicles can now be produced with less amount of foreign exchange. It is very necessary not only to increase the tempo of production of automobiles, but also to ensure that a satisfactory progress is maintained towards the increase in indigenous content of newly manufactured vehicles.

CREDIT FACILITIES FOR ROAD TRANSPORT

Of late, the unsatisfactory expansion of the road transport industry has drawn the attention of many expert bodies. All such bodies, including the Masani Committee on Road Transport Re-organization, have repeatedly recommended, that unless easy credit facilities are provided to transport operators, the industry would become neither dependable nor would it be able to expand adequately.

It is hoped that the Ministry of Transport and Communications will be able to draw up some suitable scheme whereby financial aid could be easily made available to the private operators for the purchase of vehicles, as also for the construction of workshops, garages, store houses, etc.

TRANSPORT OF RAW MATERIALS AND DEMAND OF ROAD TRANSPORT

Industries are now showing keen interest in using road transport for carrying different types of traffic, since it has been established that with proper organisation even raw materials can be carried in bulk by road at economic rates.

There is heavy concentration of some basic industries like coal, iron and steel in Bengal, Bihar and Orissa, while other industries like cement, cotton and textiles are widely scattered. During the last decade, the railways had to bear the brunt of phenomenal growth in these types of traffic. However, the expansion in the field of road transport to share the burden is also becoming perceptible.

Road Transport has endeared itself to industrialists by its quick transport service. According to a leading industrial concern, its innovation in changing over partly from railways to roadways, has led to a reduction in the average transit time from twenty-one days to five days reducing the period of the capital tied up.

It is because of these advantages of road transport and acute shortage of overall transport capacity that demand for road transport for some of the basic raw materials has started growing. Recently, the Chairman of the Indian Mining Federation stressed that " the existing roads in the coal-fields should be repaired and maintained in good condition for facilitating movement of coal by road and also for the transport of sand from the

river-beds to the collieries ". Speedy implementation of the scheme to construct an express highway from Calcutta to Durgapur has also been stressed and a demand made for its extension up to Asansol. As for iron-ore, it is understood that a 100 mile multi-lane road scheme is under active contemplation by the Orissa Cabinet to speed up transport of iron-ore by trucks.

Thus the day does not seem to be far ahead, when road transport will be playing an important role in the movement of some of the basic raw materials in this country.

DEVELOPMENT OF TRAFFIC IN BIG CITIES AND OCCURRENCE OF ACCIDENTS

While we are pleading for the development of road transport and are asking for more and more vehicles on the roads, we should not overlook the serious problem of mounting road accidents, and the loss of human lives. The following table shows how high is the rate of accidents and deaths due to accidents in respect of roads in India.

	Total No. of accidents	No. of accidents per 1,000 vehicles	Total No. of deaths due to accidents	No. of deaths per 1,000 vehicles
1. West Germany	2,79,233	36.44	11,703	1.5
2. France	1,34,713	11.79	8,126	0.7
3. Italy	1,21,182	22.85	7,137	1.3
4. Great Britain	2,37,265	31.83	5,970	0.8
5. India	36,000	81.27	4,069	9.2
6. U. S. A.	(Not available)		39,800	0.53

It will be seen that there are 81.27 accidents and 9.2 deaths per 1,000 vehicles in India even though the vehicle density is as low as 1.5 (approx.) per mile. This is mainly because we have the geometrics and other essential conditions on the road in the same state as when the roads were designed for the vehicles having much lower speeds.

If a few deaths are caused by accidents in other means of transport like rail, air or sea, there is a nationwide hue and cry and committees are appointed to investigate into the causes of accidents and devise ways and means to avoid their recurrence. But generally such is not the case with regard to road transport.

No doubt prosperity of a country leads to increase in traffic and in its wake more road accidents, but the incidence of accidents can be very much reduced by providing wide roads, adequate sight distances, proper gradients, properly designed curves and crossings, adequate illumination and by taking adequate measures to regulate the traffic.

PREVENTION OF RIBBON DEVELOPMENT

The haphazard growth of towns and cities which took place in the past has become a great hurdle in getting a good alignment for a road. The unrestricted development of property on both sides of the road by private persons is done with the main aim of getting more and more returns on the capital. They are not conscious of the congestion on the roads and economic loss suffered by the community. The unregulated and unplanned development of the towns and cities has to be checked in the larger interest of safety of the people and rapid flow of traffic. Secondly, there is a tendency on the part of the people to build their houses on the road-side without leaving sufficient space in between the road-side and the houses. With industrial and commercial growth and development of the area around that road, the volume of traffic increases, leading to congestion.

At that stage it becomes very difficult to acquire the built up property on the road-side for the purpose of widening the road. Even if a plan for their acquisition is chalked out, the cost of acquisition becomes prohibitive.

In order to check this fast growing ribbon development along National Highways and for having a uniform procedure for the purpose of levy of betterment taxes on land benefitting from the improvement of such highways, the Central Government has prepared a draft bill to acquire necessary powers for the purpose under Article 252 (1) of the Constitution which at present falls within the legislative jurisdiction of the States. This draft bill was circulated to all States in December 1957 for their views and, if they agree to the Centre undertaking legislation in respect of National Highways, to have the necessary resolutions passed by the State legislatures as provided in Article 252 (1) of the Constitution. Some of the States have passed the requisite legislation in the matter, while the views of some other States are still awaited. It is very necessary that the State legislatures should consider this matter and pass the resolutions expeditiously so that the Central Govt. may proceed with the enactment of the proposed legislation without any further delay.

For releasing pressure of traffic, we should not only improve many of the existing roads and ban ribbon development but also embark upon a programme of planned development of expressways and super-highways in those stretches of our country, where traffic intensity is very heavy. The towns and neighbourhoods should be developed in such a manner, that sufficient space is left out for future road development. Moreover, there should be organised machinery to educate the public about the traffic rules. Then and then alone can we expect that the number of accidents on the roads will be reduced.

INADEQUACY OF ALLOCATION OF FUNDS IN THIRD PLAN

The transport requirements for the entire country, as worked out by the Chief Engineers of the States and the Centre, on the basis of production figures accepted for various commodities, come to 182 million tons of long distance traffic for an average lead of 300 miles during the year 1960-61, and roughly 800 million tons in 1980-81. At the end of the Second Five-Year Plan, the railways were expected to carry 162 million tons, leaving a gap of 20 million tons to be carried mainly by road transport. Similarly, the Chief Engineers assessed that at the end of 1980-81, the railways would carry 523 million tons and the roads would be required to carry about 246 million tons. This is in conformity with the trend of road transport in other developed countries of the world. On these grounds, the Chief Engineers recommended an allocation of Rs 5,200 crores for the development of roads and Rs 1,350 crores for their maintenance to be spread over a period of 20 years (1961-81). They also calculated that the revenue from motor transport taxation would be of the order of Rs 6,150 crores, and in this way the entire road development programme can be self-supporting. Their recommendation for expenditure for road development during the Third Five-Year Plan is Rs 590 crores.

The Indian Roads Congress was much concerned to learn that only Rs 250 crores had been provided for road development in the Draft Third Five-Year Plan. This amount was considered altogether inadequate and the Government of India was told that if road transport was to play its part effectively in the developing economy of the country, a sum of Rs 590 crores as suggested by the Chief Engineers in their Report on Road Development Plan (1961-81) should be provided for road development in the Third Plan. This demand was also supported by other organizations interested in the development of roads and road transport. The inadequacy of the allocation has also been rightly brought out by Shri M. R. Masani during his budget speech, the text of which is reproduced below :

"In so far as the provision of road is concerned, one would have thought that, as one plan succeeds another, the recognition of the importance of roads would increase, and the proportion of the funds allocated to the provision of roads for opening up the country to economic development would have also progressed. But what are the facts ; during

the First Five-Year Plan, the allocation for roads was Rs 156 crores out of 3,300 crores, or 4.6% of the total allocation. In the Second Plan we find that there are Rs 248 crores out of Rs 6,750 crores. The percentage has dropped to 3.7%. And now comes the anti-climax in the Third Plan where out of Rs 10,200 crores, only Rs 250 crores or so have been alloted, a miserable 2.5%."

The position was reviewed by the Govt. of India and a sum of Rs 271 crores was later provided for expenditure in the finalized Third Plan against a road programme to be undertaken for Rs 324 crores. The Govt. of India have intimated that efforts will be made to provide the requisite funds for implementing those programmes as far as possible subject to the annual budgetary position. In addition to the above mentioned funds, it has been possible for the Govt. of India to obtain an interest free credit of Rs 29 crores from the International Development Association. This will raise the total programme ceiling from Rs 324 crores to Rs 353 crores. This is some improvement over the provision of Rs 250 crores included for roads in the Draft outline of the Third Five Year Plan. But this too is not adequate considering the needs of the country.

The recent failure of the railways in meeting the increased demand for the movement of coal and other raw materials and the delay in supply of other products calls for placing sufficient emphasis on road transport facilities for supplementing the carrying capacity of the railways and thus avoiding a crisis which is feared in the wake of an all-round economic expansion. If at this stage the country does not rise to the occasion it is feared that our production and distribution programme will receive a great setback.

In recognition of the benefits of roads in an under-developed economy and for providing the maximum service to the public, the case for road construction and road improvement deserves greater attention than has been paid so far.

The present allocations in the Third Plan are regretfully inadequate to meet the demand of roads which will have to carry a considerable volume of goods traffic which is beyond the already strained carrying capacity of the railways. I earnestly hope that the country will realise this, and the demand for further increase in provision for roads and road transport in the Third Five-Year Plan will receive due consideration from the appropriate authorities.

INTERNATIONAL ASSISTANCE

As already indicated earlier, the International Development Association appreciating the immediate needs for the highway development in this country, have offered interest free credit of 60 million dollars, i.e., Rs 29 crores, repayable in 50 years.

The credit which is to be spent during the first $3\frac{1}{2}$ years of the Third Five-Year Plan period will eliminate some of the major deficiencies in the country's National Highways system.

Construction of about 600 miles of new roads will complete the missing links and upgrade the roads to full standard in the National Highway system near Calcutta, Barauni and Bombay. Nineteen major bridges will also be constructed in these regions. This includes the Sone Bridge at Dehri-on-Sone which is the only gap in the National Highway No. 2 from Delhi to Calcutta.

STRENGTHENING THE PAVEMENTS OF EXISTING ROADS

It has already been mentioned that on account of all-round development of our economy, heavy truck and bus traffic is increasing rapidly on our roads. The pavements are thus being subjected to larger number of repetitions of heavier wheel loads which have necessitated greater thickness of pavement than provided at present.

In certain areas, the position has been further aggravated by waterlogged conditions as a result of expansion of irrigation facilities. Unless the thickness of such pavements is increased suitably and quickly, the roads would be damaged beyond ordinary repairs in the course of a short period and will have to be entirely reconstructed.

The present meagre allocation for roads in the 3rd Five Year Plan does not permit funds to be set apart for strengthening the existing roads. Unless the allocation is augmented sufficiently to provide adequate pavement, many sections of the roads will deteriorate so much that very heavy expenditure would be needed for reconstructing them in the Fourth Plan.

BRIDGES

Communication becomes difficult without bridges. But bridges are the most expensive item in the communication system and, as such, their construction is usually postponed to a later date.

It has been roughly estimated that a sum of Rs 50 crores would be needed to construct bridges across the unbridged gaps in the National Highway system. A similar amount would also be necessary for bridges in the State Highway system.

Interruption to movement of vehicles at unbridged gaps greatly reduces the efficiency of road transport. Let us hope that a complete programme for bridging the gaps in National Highways and State Highways would be drawn with a view to completing them by the end of the Fourth Plan.

SPECIALIZATION

For our expanding programmes of road development, we need more Highway Engineers. The authorities have already opened a number of Engineering Colleges in the country to meet the growing demand for engineering personnel. But Highway Engineering has become a specialized field. The need for specialization in this branch of engineering in the country is keenly felt. It is, therefore, essential that facilities for post-graduate training in highway engineering are provided in some of the Engineering Colleges of the country.

It is also felt that refresher courses for senior engineers working in administrative capacities should be arranged in order to acquaint them with the latest developments that are taking place in the various fields of engineering. Such refresher courses are necessary as with the passage of time, engineers, not directly engaged in design works, get out of touch with the theoretical advancement. In this connection, I may mention that the Indian Roads Congress has already taken up this subject and their recommendations in regard to refresher courses are expected to be finalized very shortly.

While I advocate specialization in the field of Highway Engineering, I wish that some room is left in undergraduate career of an engineer for studies in humanities. The lack of general education and preparation in practical subjects such as business administration, labour relations and industrial finance, is unfortunately too common among engineers though frequently the success of an engineer depends as much on competence in these fields as in engineering technology.

The engineering colleges should, therefore, reconsider their syllabii with a view to create a new pattern of study for engineering education in order to make our engineers more competent in their profession.

SETTING UP OF SEPARATE HIGHWAY DEPARTMENTS

The tempo of road development in the country has already increased manifold since the attainment of Independence and it is increasing day by day.

Highway Engineering is now-a-days a specialised branch of Civil Engineering and it is absolutely essential for a Highway Engineer to keep abreast of the advancements taking place in his field of technology all over the world. It is, therefore, important that a department exclusively in charge of roads should be formed in each State so as to give undivided attention to all matters pertaining to roads, such as economic study of road development, planning and programming of road schemes, design and execution of projects and improvement and maintenance of the large milage of roads which have already been formed and the new milages that are constantly being added, collection and compilation of statistics regarding roads, etc.

In August 1958, the Council of the Indian Roads Congress expressed the view that the time was ripe for considering the setting up of the separate highway departments to deal exclusively with road construction and maintenance where the quantum of work likely to be handled by such a department was sufficiently high. The Govt. of India were requested to advise the State Governments to set up highway departments which, apart from looking after the works under the charge of the Central and State Govts., would also undertake the overall planning of road development and also guide and integrate the activities of various local and other authorities responsible for construction and maintenance of roads in the State.

The position has changed considerably since then. For efficient execution of IDA works alone, the concerned State Governments are already engaged in setting up separate units to deal exclusively with those works. I would, therefore, request that those State Governments who have not yet set up separate highway organizations may consider constituting them early so that there is no difficulty in fulfilling the task set out in the Third Five-Year Plan in respect of roads.

STANDARDIZATION

While our support for the work of standardization, which has its obvious advantages, is always there, we have to ensure that it does not stifle the urge for continued improvement, paralyse inventions or prevent advancement in design. Every possible step should be taken to encourage creative thinking, introduction of new ideas and progress.

MECHANIZATION

Quality control is impossible without mechanization with the result that we are not getting full return for the money spent on our road works executed through manual labour. The level of mechanization of road building in some of the more advanced countries has reached as much as 98%. But in India the employment of the mechanical equipment for road construction and maintenance has so far received insufficient attention. But there are reasons for this too. An all-out mechanization would not be welcome from the point of view of employment of vast population. Moreover, India is still in the infant stage of industrialization and it cannot produce all the required equipment for road construction. Besides, it is realised by every one that there is shortage of foreign exchange and, therefore the use of mechanical equipment should be limited as far as possible. But a stage has now come when use of machinery is inevitable for construction of certain types of roads of high standard. Items of road work like soil stabilization, laying of bituminous pavements, adequate compaction of embankments, etc., cannot be carried out on a large scale without some kind of mechanization. Every effort should, therefore, be made to get those machines manufactured in India, and till they are not manufactured, we should not be hesitant to import them.

We should also encourage the local manufacturers to take up the manufacture of as many items of road making machinery as possible. This can be done if the Central Govt. guarantee purchase of a certain specified number of manufactured items of machinery, particularly heavy type, for distribution to the States, as was done by them in the case of road rollers manufactured in the country under the Central Bulk Procurement Scheme. In addition, import of such items as may be manufactured in India should be restricted to provide the necessary protection to the indigenous industry.

About 40 years ago, the only machinery in general use by the road engineers was the steam road roller or an odd concrete mixer. The variety and number of road construction and maintenance equipment has increased considerably, and the highway engineer to-day is better equipped to employ them on his road works. While it is essential that greater use is made of machinery in road works, it is necessary that these machines are properly handled and maintained by trained personnel employed for this purpose. This aspect cannot be over-emphasised.

THE ROAD ENGINEER AND HIS STATUS

Finally, Sir I come to a very importants ubject, viz., " Engineer and his status ".

On many occasions, the President, the Vice-President, the Prime Minister of India and many other leaders have stressed the pre-eminent role of the Engineers and Scientists in the context of these Five Year-Plans. The president of India in his inaugural address to the Annual Convention of Central Board of Irrigation and Power in 1959 was pleased to state, " Your profession is indeed, a noble calling. But at the same time I agree with you that you must have conditions of service commensurate with the important role which you play in the country's life. I have, therefore, nothing but sympathy and support to offer in your efforts to a fair deal from the Government. I see no reason why technical personnel should not be treated on a par with administrative personnel and technical services should not be given the same emoluments and advantages as the country's administrative services. I am sure sooner or later, it is bound to happen as our Planning Commission and more than any one else our Prime Minister have repeatedly supported this view ".

Considering the engineers' pivotal position in the country's struggle to win the war against poverty and want, it is necessary that we should attract the best talent in the country to this profession. It should be borne in mind that the conditions in which the young engineer is to work, should be such that he is kept contented and that he gets full facilities and proper scope for his development and growth so that he can contribute his best with the skill, courage and fortitude he is capable of.

Yet it is unfortunate that very often the engineer's role is not given due recognition. Engineers do feel that their role is not at all inferior to the members of the Administrative Services. The Indian Service of Engineers has now practically died out. The class I cadres of the States and the Centre show wide disparities in emoluments and conditions of service between themselves and have been given pay scales and status incomparably lower than the pay scales and status enjoyed by the officers of Indian Administrative Services.

It is heartening to note that in the Conference of Chief Ministers presided over by the Prime Minister in August 1961, the proposal for revival of the All India Services of Engineers along with some other services has been accepted and now we look forward to seeing its early implementation.

Ladies and Gentlemen, our profession, viz., construction and maintenance of highways—which form the arteries of civilization—has a very vital role to play in the overall life and economy of the country, and it is our privilege to serve the nation.

With these words, Sir, may I request you to declare the Twentysixth Session open.

SPEECH DELIVERED

By

DR. ZAKIR HUSAIN,

Governor of Bihar, at the inauguration of the 26th Annual Session of the Indian Roads Congress held at Patna on December 14, 1961.

Mr. President and Members of the Indian Roads Congress :

I must thank you for the honour you have been pleased to do me by inviting me to inaugurate this Congress. I can't and don't wish to conceal from you my view that formal inauguration of Congresses and Conferences are an entirely redundant ceremonial. But I may as well tell you that I consider it a privilege to get near people who know their work and do it well. Contact with competence and excellence is a very exhilerating experience, indeed. Already, in the few minutes I have been with you, I have learnt, from your learned address, Mr. President, what I might perhaps never have known

Dr. Zakir Husain, inaugurating the 26th Session of the I.R.C. on the 14th December, 1961

otherwise. In the fast—expanding economy of these early years of our free national existence and its planned development, you, the members of this Congress, are charged with work of the highest significance, and I deem it a privilage, indeed, to be able to associate myself with you.

It was quite twelve years ago that you last met in this State at Ranchi. The late Dr. Sri Krishna Sinha, the then Chief Minister, inaugurated your Congress. Alas, he is

no more. After some four decades of unremitting devoted service to the people, both in the dreary wilderness of the life of subjection and in the exhilerating formative years of the life of freedom, now rallying the people to the call of freedom, now guiding them in the constructive and fruitful use of that freedom, he died in harness, leaving behind a grateful State in mourning. His life and work will be a permanent source of inspiration for generations of Biharis who will cherish his memory as one of the principal architects of their corporate life. If he were alive today, he could have told you with some degree of legitimate personal satisfaction that the picture of road communication in the State had very considerably improved against the background that he had so frankly and faithfully described to you at Ranchi in 1949.

The position then was very far from satisfactory. There were, by no stretch of imagination, enough roads in Bihar. During the period of the Second World War this meagre road system too had been very badly neglected and was in thoroughly bad shape. Something similar must have been happening in other places about that time, and so even before the War came to an end, the Post-War Road Development Plan, known as the Nagpur Plan, was conceived in 1943. As you know, that plan, with reference to post-partition India, envisaged the completion of a total length of 123,000 miles of surfaced and 208,000 miles of unsurfaced roads. During the decade covered by the First and the Second Five-Year Plans these targets have happily been exceeded. We have in the country today something like 144,000 miles of surfaced and 230,000 miles of unsurfaced roads. The targets have been exceeded. So also in Bihar. In Bihar, at the time of independence, there were only 1,315 miles of roads in charge of the P.W.D., out of which 897 miles were metalled. There were only 201 miles of road in North Bihar. By the time the First Five-Year Plan began, this mileage of roads had already increased to 3,025 miles, of which 894 were in North Bihar and only 1,938 miles were metalled. At the end of the First Plan period there were 5,544 miles of road, of which 1,804 miles were in North Bihar and 3,698 miles were metalled. At the end of the Second Plan there were about 7,946 miles of road, of which some 3,180 were in North Bihar and 5,300 were metalled. The overall mileage in the State has increased by about six times, the mileage in North Bihar by over 14 times. Of course, even 14 times of a small number is not a very big number! But it shows that we have been moving, and, perhaps, fairly fast. By the end of the Third Plan we hope to have 9,310 miles of road in the State under the P.W.D., of which 6,943 miles will be metalled and North Bihar will have 3,600 miles, 18 times of what it had at independence.

And yet, we are far behind many other States in the country. In 1961 the mileage of surfaced roads per lakh of population in this State is 143, against 445 miles in the country as a whole. Again, the mileage of roads per 1,000 sq. miles is 95 against 148 miles of the country. We know only too well that what we have has as serious deficiencies as anywhere else in the country in the way of unbridged river crossings, sub-standard surfaces, too thin crusts, and narrow carriageways. It is no consolation to us to know that on the National Highways themselves about 80 major bridges remain to be provided; or that of the total National Highway mileage of 15,000 miles only 2,300 miles have a two-lane carriageway; or that about 1,000 miles of National Highways have only one-lane waterbound macadam or low surface instead of cement concrete or bitumen surface; or that they have a crust thickness of 9–10 inches, which is inadequate for the traffic they will have to carry. Yes, it is no consolation to know this; but it is a clear call to a concerted endeavour in the State as part of the Indian Union. And we feel we have been assiduously at it. Upto the end of the Second Plan we had constructed no less than 53 major bridges, 125 submersible or minor bridges, and some 3000 culverts. The construction of the rail-cum-road bridge over the Ganga at Mokameh is, indeed, a landmark in the history of road development in Bihar. The construction of this bridge will greatly facilitate the movement of men and materials from South to North Bihar.

The period of the Third Plan will be one of considerable activity for you if the objectives of the 20-year road development plan drawn up by the Chief Engineers of the State and Central Government are to be attained; if, that is, no village in a developed and agricultural area is to remain more than four miles from a metalled road and more than 1½ miles from some type of road; if the country has to have by 1981,252,000 miles

of surfaced and 405,000 miles of unsurfaced roads; if on all arterial routes missing bridges are to be provided and the road surfaces improved at least to one lane black-topped specification; if the main roads in the vicinity of large towns are to be widened to two lanes or more; if the major arterial roads have to have at least two-lane carriage-way; and if the rural roads are to be improved to fair-weather standard. I need hardly assure you that Bihar will put forth a great effort to complete its share of the great task.

Recently the World Bank, in collaboration with the International Development Association, has allowed a credit of Rs 14.15 crores for the development of some of the selected highways in Bihar and for the construction of bridges over the Sone at Dehri-on-Sone and over the Mahananda at Dingraghat. We hope to complete these by 1964. When this has been accomplished, the picture of the State, specially of North Bihar, will have greatly changed.

The stupendous task of expanding the road system is, in my view, not unlikely to be further accelerated during the period of the Third Plan itself if the experience of the last decade is any guide. With the terrific pressure on railway transport that has been developing, and some of the specific advantages of road transport which are being more and more widely recognised, it is more likely than not that plans for road extension will assume larger proportions.

For the proper and co-ordinated execution of this expanding enterprise many a question of a technical nature, many a problem in the economic and organisational spheres will need careful scrutiny. Mistakes, by their sheer magnitude, can become very expensive. It is, therefore, only natural that you have stressed the desirability of the constitution of a Road Board at the Centre. It is encouraging to know that one per cent of the total allocation for road development in the Third Plan is to be spent on experimental specification and new techniques and that a Special Committee of this Congress will assess the performance of those experimental works. The very pertinent remarks which you, Mr. President, have made in your address regarding the efficiency of the road system, the need for better road surfaces and heavier vehicles in order to reduce costs of transportation, the need for more vehicles, show how many facets there are to the problems of road construction and road economy. They all need close study and research. The Central Road Research Institute would be engaged on some of them. There is one aspect of the matter which I as a layman would venture to place before you. It is the need for a co-ordinated transport policy. Transport has to be arranged for the requirements of industry and trade (the transport of goods, raw materials and finished products); and transport has to be arranged for people to get them to and from work and to enjoy their leisure. Between big centres of population the problem is a straight one and can be solved by a sensible combination of railways, a system of motorways, and improved trunk roads, internal air-lines, (and I think we will have more and more of them) and helicopter services (which may come sooner than we are inclined to anticipate), with good access from the airports to the towns. Even here the problems of economic and social costs have to be thoroughly studied, and, perhaps, in the routing and designing of motorways the possibilities of enhancing the beauty of the landscape may be given due consideration.

The problems of improving communication inside cities are likely to grow with improvement in communication between them. Here congestion is not just a traffic thrombosis. It involves the consideration of the intolerable condition at the rush hours, exhaustive journeys to work, conflict between the pedestrian and the vehicle, the relationship between the investment in cars and in roads, the relationship between private and public transport. An improvement of roads alone will, perhaps, not solve these problems. The planning of roads will, perhaps, have to be related to the planning of the places of living and of work and to a reconsideration of the planning of our cities. Comprehensive plans for the movement of people by rail and road, by public and private vehicles will, perhaps, have to be devised; the possibility of separating vehicles from pedestrians will, perhaps, have to be considered. May be we then come to far-reaching conclusions about the shape of the future city. As a very influential body of eminent British architects, town-planners, economists, sociologists and administrators, concluded, after long discussions, the city may "consist of a series of pedestrian

communities and neighbourhoods...within which the principal way of travelling would be by foot. Each community or neighbourhood will be planned so that a reasonable range of services can be economically provided within easy walking distance for any of its members....Within these neighbourhoods, the way of life of the pedestrian—resident or worker—will be dominant : vehicles will be confined to a separate road system (often on another level) from which the buildings can be serviced. The need for private motor-cars will be substantially reduced. The normal short journey will be made on foot, and express public transport services or car-hire services would be available for longer or more awkard journeys. "This may sound to be the music of distant drums. But the music of events is moving fast, and it is wise to anticipate and not to wait till they are upon us. For then there is no time to prepare. And it appears to me that we are usually inclined not to be prepared. I have, even at the risk of appearing presumptuous, mentioned some of these things because I feel that a Congress like yours can do a great deal to encourage and initiate study and research on these and allied problems, so that we are prepared. It may be possible under your leadership to integrate the planning of major roads and transport arteries with land use, planning and town design and bring home to policymakers the utter necessity of integrating road planning with town and country planning, road engineering and road sociology. You can do it as you are clearly the body whose views on questions of this nature should be heard with attention and respect. You can help in considerable measure in evolving the future patterns of our living. You can bring our people closer together physically and, through that also spiritually. The future of human society seems to depend on builders of roads and bridges roads and bridges of the mind that would facilitate human understanding.

I have very great pleasure in welcoming you to the capital town of this State and hope your deliberations, will bear a rich harvest of useful results, and in inaugurating the 26th Annual Session of the Indian Roads Congress.

Jai Hind.

PRESIDENT'S CONCLUDING REMARKS

I thank you, Sir, for kindly declaring the Session open and for the kind words you have said about the roads. And now, Sir, may I request you to award the "INDIAN ROADS CONGRESS MEDAL" for the Paper entitled "Study on the stability of Well Foundations for Major Bridges" contributed by Shri Amitava Banerjee and Shri Sarankasekhar Gangopadhya, presented to the Congress at the last Session. This is a well merited award and I congratulate the Authors on this achievement. I will now request Shri Banerjee to come to the dais for receiving the Medal.

Shri S. Gangopadhya

Shri A. Banerjee

Shri Amitava Banerjee passed B. E. Examination of Calcutta, University from Bengal Engineering College in 1948 securing 1st Class. He entered P.W.D., West Bengal, in 1949 and was in charge of several important road and bridge engineering

works. He is at present working as Executive Engineer, Development Roads Department, West Bengal. He is also the Author of several other technical articles.

Shri Sarankasekhar Gangopadhya is not present here. He also passed B.E. Examination of Calcutta University from Bengal Engineering College in 1948 and was placed in the 1st Class. He was also in-charge of several road and bridge engineering works. He is now on deputation as an Executive Engineer, Designs and Planning, Durgapur Project Ltd., West Bengal.

I would like to announce that the Paper entitled "An Investigation for Evaluating an Airfield Pavement" by Dr. H. L. Uppal and Shri H. S. Bhatia, presented to the Congress at the last Session has been highly commended. Dr. Uppal is an Assistant Director, Central Road Research Institute and he is author of several Papers presented to the Congress and elsewhere. Shri Bhatia is working in the Central Roads Research Institute.

VOTE OF THANKS

By

SHRI P. D. SHIVDASANI,

Vice-President, Indian Roads Congress

I wish to thank you, Sir, most heartily for having spared the time to be amidst us today. This shows that an educationist of eminence as you are, are equally interested in the welfare of roads and transport as proper means of communication which also lead to the progress and development of culture and education. History tells us, how great were the difficulties and how long it took in ancient times for the students to reach the seats of learning. Heun Tsang recorded in his memoires that it took him several months to reach Nalanda, the one time famous seat of learning. In the recent past also, education was confined more or less to urbanised areas only, but now with the opening of the backward areas of the country by the network of roads, the cause of education has gained momentum, all the same much leeway still remains to be made towards providing the proper means of communication to the backward areas for spread of education and for providing other amenities and conveniences.

It is hardly necessary for me, Sir, to lay any more stress about the importance of roads and road transport. It is not only the Highway Engineers but the country as a whole demand better and rapid means of communication, and in this cause, Sir, we hope that you will support us at every possible opportunity to achieve what we justly believe is necessary for the improvement of roads and road transport.

Once again, I thank you, Sir, on behalf of the Indian Roads Congress for the honour you have done us by your presence.

MESSAGES

Dr. S. RADHAKRISHNAN

VICE-PRESIDENT OF INDIA

I am glad to know that the 26th Session of the Indian Roads Congress will be held at Patna from the 13th to the 20th of December 1961. Road transport is a very valuable factor in our communications and people must be educated in the use of roads with safety.

Dr. P. SUBBARAYAN

MINISTER OF TRANSPORT AND COMMUNICATIONS,
GOVERNMENT OF INDIA

I am indeed very happy to learn that the Twenty-sixth Session of the Indian Roads Congress is being held at Patna this month.

The importance of roads and road transport in the development of the national economy can be measured from the pressing demands of the people for provision of more and better roads. In fact, roads precede all forms of development.

I would particularly draw the attention of the Congress to the need for devising ways and means of accelerating the pace of road communications in our rural areas so as to connect all our villages by a network of roads. The task is no doubt a stupendous one but, I am sure, the Congress with the vast pool of scientific knowledge and technical-know-how at its disposal will be able to make useful suggestions to facilitate the achievement of this objective expeditiously.

I wish the Session every success.

SHRI RAJ BAHADUR,

MINISTER OF STATE FOR TRANSPORT & COMMUNICATIONS, GOVERNMENT OF INDIA

I send my good wishes to the delegates attending the Twenty-sixth Session of the Indian Roads Congress at Patna.

We are living in the age of planning and development. It is virtually impossible to develop natural resources, or improve the food situation, or even enjoy the benefits of industrial development without a pervading network of good roads.

The Central and State Governments are alive to the importance of road development and are doing their best to achieve the targets set in their plans. The Indian Roads Congress has made a notable contribution to the development of roads in the country and of late I have seen that the development of road transport is also engaging its attention. I am sure that it would be possible for the Congress to suggest ways and means of increasing the road transport capacity both on a long range basis and for the implementation of the Third Five-Year Plan. I wish the Congress a great success.

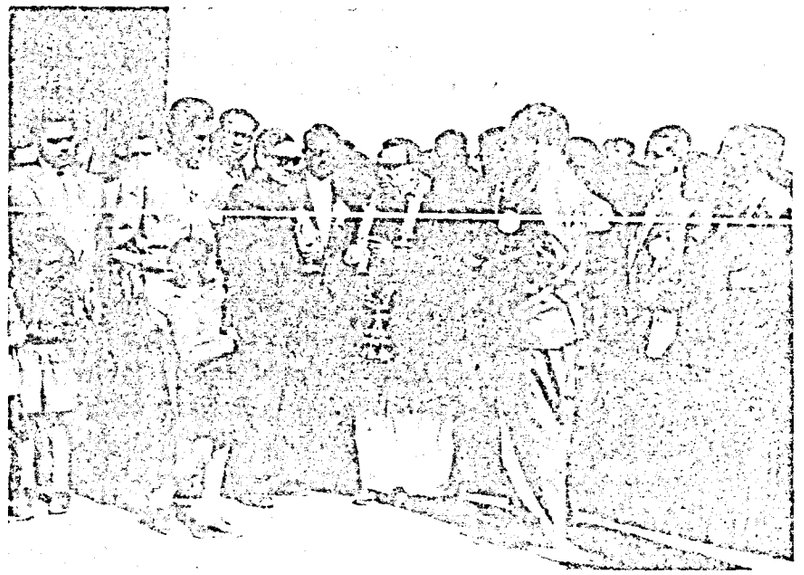
LIST OF GOOD WISHES FOR THE SUCCESS OF THE SESSION

1. Shri Jawahar Lal Nehru, Prime Minister of India.
2. Shri N. V. Gadgil, Governor of Punjab.
3. Shri K. C. Reddy, Minister for Commerce and Industry, Government of India.
4. Shri K. D. Malaviya, Minister for Mines and Oil, Government of India.
5. Dr. Humayun Kabir, Minister, Scientific and Cultural Affairs, Government of India.
6. Shri S. K. Dey, Minister, Community Development and Co-operation, Government of India.
7. Shri S. K. Wankhede, Minister for Finance, Maharashtra.
8. Shri M. S. Mannamwar, Minister for Buildings & Communications, Maharashtra.
9. Sir Kenneth Mitchell, Past President, I.R.C.
10. Shri H. P. Mathrani, Past President, I.R.C.

TECHNICAL EXHIBITION

TWENTY-SIXTH SESSION OF THE INDIAN ROADS CONGRESS PATNA, DECEMBER 1961

Shri Zawar Hussain, Transport Minister, Bihar opened the Technical Exhibition organized by the Indian Roads Congress on the occasion of their 26th Annual Session held at the Polo Ground Patna. The Minister declaring the exhibition open said that the bottlenecks in transport would be solved to a great extent if some of the recommendations of the Indian Roads Congress were implemented. The Minister while referring to the



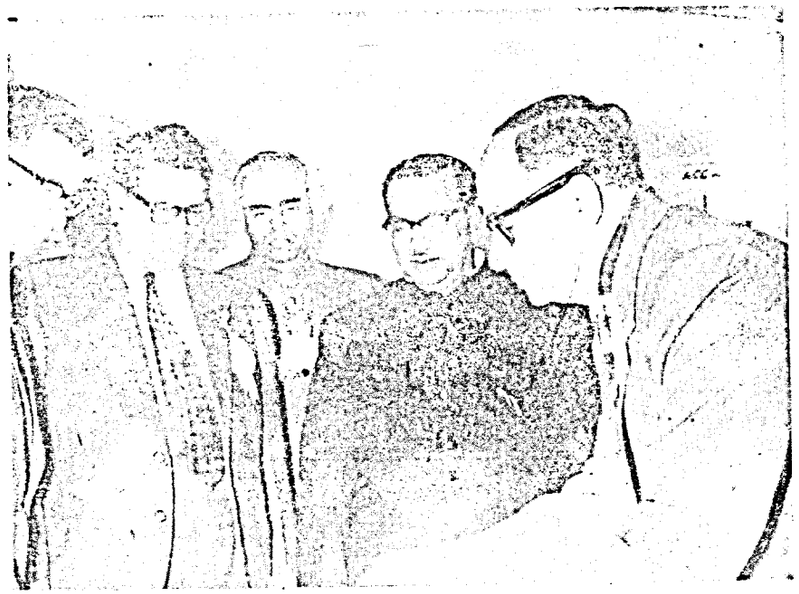
Shri Zawar Hussain, Transport Minister, Bihar, opening the I.R.C. Technical Exhibition on the 14th December, 1961

Nagpur plan thanked the Indian Roads Congress which was the source for the Nagpur Plan coming into being. Shri K. Barua, President, Indian Roads Congress thanked the Minister for his speech. The Hon. Minister accompanied by the President and some delegates visited various stalls and evinced keen interest in the various construction and engineering equipment.

The following Government Departments and Engineering firms took part in the exhibition:

1. Ministry of Transport and Communications, Department of Transport, Roads Wing, New Delhi.
2. Central Road Research Institute, New Delhi.
3. Bihar, P.W.D., B. & R. Branch.
4. Gujerat Buildings and Communications Department.
5. Madras, Highways Department.

6. Maharashtra Buildings and Communications Department.
7. Uttar Pradesh, P.W.D., B. & R. Branch.



A stall at the I.R.C Exhibition being visited by the Transport Minister, Bihar

Another stall at the I.R.C. Exhibition being visited by the Transport Minister, Bihar

(Continued on paye 35)

TWELFTH SESSION OF THE PERMANENT INTERNATIONAL ASSOCIATION OF ROAD CONGRESS IN NEW DELHI, 1963

SUBJECTS FOR DISCUSSION

At the last meeting of the International Commission of the Permanent International Association of Road Congress (P.I.A.R.C.), agreement was reached on the questions to be set for presentation to the Twelfth Congress in New Delhi in 1963. The subjects are as follows:

First Section

CONSTRUCTION AND MAINTENANCE OF ROADS AND RUNWAYS

Note: In connection with each subject the question of control of quality and construction will be specially considered.

First Question:—Design and Construction of Earthworks

Calculation of volumes—use of computers. Soil surveys: carrying out and interpretation. Preparation of projects: balancing the volumes of cutting and filling: effect of quality of the soil, time of year, delays, plant, etc. Quality and compaction required: effect of the nature of the sub-soil, quality of the soil, conditions of construction, etc. Particular problems encountered at formation level. Rock fills. Collecting and draining surface water, Internal drainage of roads. Particular cases of drainage, dual carriageway roads: air-field runways.

Second Question:— Flexible Roads and Road Bases

A. Design of pavement and layer thickness: Development of the methods of design calculations of road thicknesses over the past few years. Role of the various layers of the base. Thickness of the surfacing courses for the different types of traffic and the make-up of the crust of the road. Comparison of the methods of calculation with the results from experiments and observations. Influence of axle loads, their characteristics, characteristics of rubber tyres and of repetition loads, by number and over a period of time. Studies and observations concerning the deformation of roads; mechanical characteristics, admissible loading and failure of the different types of road courses; effect of climatic conditions. Frost; analysis of the problem; remedies and palliatives.

B. Properties and construction of base: Progress in the procedure of laying and spreading. Compaction of layers; modern methods of compaction. The techniques of stabilisation (cement, lime, bituminous binders, etc). Methods and plant used in the treatment of the layers (central mixing plants, mobile plants, in situ, etc.) 'Rigid' base layers (coated, cement stabilised, etc.) and their effect on the behaviour of roads.

C. Properties and construction of the surface courses of flexible roads: Improvements in the quality of binders; chemically treated binders, special binders. Specification of the composition of coatings. Dispersal of the proportions of binder and filler in the production of mixes and effect on the characteristics of the mixes. Compaction of bituminous carpets; modern compaction procedure and effect on the characteristic of the mix. Surface dressings.

Third Question:—Design and Construction of Concrete Roads.

Foundation courses of concrete roads. Workability and handling of concrete; air entrainers and various additives. Modern methods of making and placing concrete. Concrete roads with surfacings of bituminous materials. Problem of joints. Reinforced concrete roads without joints. Roads in prestressed concrete.

Fourth Question:—Surface Qualities of Roads

Improvement in the resistance to skidding in various kinds of roads; changes under the action of traffic, climate and the age of the road. Improvement of the riding qualities

of the different types of road; changes under the action of traffic, climate and the age of the road. Progress made in the measurement of resistance to skidding. Progress made in the measurement of riding quality. Icy roads; analysis of the phenomenon; remedies and palliatives.

Fifth Question—Reconstruction and Reinstating of Roads.

Strengthening of flexible roads. Strengthening of rigid roads. Providing new surfacings on existing roads. Grouting under existing roads. Retreatment of the existing surfacings. Localised repairs; treatment of cracks.

Sixth Question—Particular Problems of Lightly Trafficked Roads.

Rapid methods of acquiring knowledge of soils. Tropical soils, their properties and uses in road building. Stage construction. Choices of surfacing for lightly trafficked roads. The organisation of maintenance, and maintenace methods on lightly trafficked roads. Special problems of road building in desert areas.

Second Section:

ROAD TRAFFIC—ECONOMIC PROBLEMS—USAGE PROBLEMS, SAFETY

Seventh Question—Road Traffic and its Composition—Influence of Traffic on the Characteristics of Journeys and the Costs of Maintaining Roads—Geometric Features of Roads in Respect of Traffic Requirements.

Methods of evaluating traffic: Surveys; origin and destination surveys; surveys of commercial traffic. Counts; mechanical, manual, systematic sampling. Axle loading; methods and results. Other methods of assessing traffic volumes. Assessment of the average length of Journeys.

Long and short term assessments of the growth of traffic and the composition of traffic: Development of number of vehicles in service and their types. Development of the average length of journeys. Development of loads of commercial vehicles. Methods of assessment and results.

Influence of various layouts on traffic: Proportion of traffic due to the creation or development of centres of habitation or centres of industry. Effect on traffic of a new route or improvement of an existing route; influence of toll charges. Cases of large works; bridges, tunnels. Comparison of the assessment with the results. Problems of pedestrian traffic. Observed speeds and the average speeds arising from: The geometrical features of the road. The nature and the condition of the surface. The amount of traffic. The nature of traffic. Delays at junctions.

Fuel consumption and life of vehicle resulting from: The geometrical features of the road. The nature and condition of the surface.

Average Speeds: Rate and type of accident resulting from: The geometrical features of the Road. The amount of illumination. The amount of traffic. The nature and condition of the surface. Road side development.

Road maintenance costs resulting from: The nature of the road. The amount and composition of the traffic.

General characteristics; alignment—cross section—longitudinal section.

Junctions: Interchanges and road accesses—toll booths.

Eighth Question: Economic Studies Revenue—Methods of Study, Composition and Design of Road Plans.

Relation between general economic theories and economic study of road works. Assessment of traffic costs. Classification and choice of road investments.

Calculation of the factors to be taken into account in the case of under-developed economies; in the case of secondary networks.

(*Continued on page 60*)

SHORTAGE OF TRANSPORT

ANSWER LIES IN ROAD HAULAGE

By

B. V. Vagh *

IN 1956, the World Bank Mission drew the country's attention to the paramount need for maximising transport even where the cost of the service was comparatively high and to the need for revising railway rates promptly in order to provide incentive for the utilisation of other means of transport. But the old policy of the pre-Plan era of looking upon the railways as the sole agency for carrying all traffic in the country and of acquiescing in the railways' practice of evolving a freight structure based on that assumption still continues. Railway lines are being extended to carry traffic at uneconomic rates with the result that the railways' finances are going down and their depreciation and reserve funds have dwindled.

It may be useful to point out that out of the 4½ per cent dividend which the railways will be paying to the exchequer from 1961-62 onwards about 3.58 per cent will represent the average interest on borrowed capital and about 0.67 per cent their contribution to the general revenues. In the past decade it used to be about 0.82 per cent out of a dividend of 4 per cent. It will thus be seen that in addition to starving the country of the requisite transport this policy is impoverishing the railways also. At the same time, investment in roads is being neglected to such an extent that against an average of about 21 motor vehicles per mile of surfaced roads in the world and about 27 in industrially developed countries our roads carry only about 3.6.

The only way to stop further deterioration in this situation is to draw up a long-term programme say, for a period of 20 years as the Chief Engineers of the States have done in the case of their road development plans and to allocate traffic to various modes of communication according to the economic and other advantages of each and after taking into consideration public preference.

MAJOR PART

The main consideration in planning for transport for the economic development of a country is the capacity required to carry goods. In this the major part is played by surface transport, i.e., the railways and roads. While shipping and inland water transport should be provided for fully, their role in the country's total transport capacity will be small. Even in a maritime country like England the traffic carried in ton-miles in 1958 by coastal shipping and inland water transport was 20 per cent while the railways carried 35 per cent and road transport 45 per cent.

The cost of laying a mile of a broad gauge rail line is over Rs 10 lakhs while that of laying a mile of first-class road 24 feet wide is about Rs. 3 lakhs. The average railway rate for carrying goods is about half that for carrying them by road. Against this, road transport has several adventages—a speed of about three times that of the railways saving in terminal charges on loading and unloading because of door-to-door deliveries, and a saving in packing charges since a door to-door delivery not requiring transhipment or double handling at originating and destination stations requires lighter packages than rail transport. The acceleration in speed renders unnecessary the holding of stocks and providing storage for them and it is on record that a big industrial concern in Bombay estimates that its saving on this head was nearly Rs 1½ crores in 1960 although it sent by road only about half its output.

* Executive Vice-President of the Indian Roads and Transport Development Association.

In industrially advanced countries road transport is employed to a larger extent than rail transport. In 1938, the railways' share of inland goods traffic in ton-miles carried by surface transport in Great Britain was 65 per cent; in 1960, it fell to 41 per cent. During this period the share of road transport went up from 35 per cent to 59 per cent. Against this the respective shares of road and rail transport in our country for the year 1960–61 on the basis of figures in the third Plan were about 16 per cent and 84 per cent respectively.

THREE TYPES

Road traffic consists of (i) originating traffic i.e. traffic from centres of production to destinations, (ii) feeder traffic i.e., traffic from production centres to railway stations and from railway terminals to destinations or ports, and (iii) local traffic for production used locally and traffic on constructional activities. At present road transport handles mostly (ii) and (iii). Of originating traffic roads carried nothing till 1955–56, about 9 per cent in 1960–61 and are expected to carry about 15 per cent in 1965–66. Water transport carries about 5 per cent while the rest of the traffic is carried by the railways. The Neogy Committee has given a list of commodities with their quantities which will be carried by the railways in 1965–66 and their percentage to production. From it it will be seen that in the case of 10 principal commodities, viz., coal, cement, iron and steel, iron and other ores, manganese, sugar, raw cotton, raw jute, tea and paper, the railways' share is as high as 75 to 100 per cent of production.

It is this concentration which has created a bottleneck. The pre-Plan originating traffic in 1950–51 was about 91 million tons which was developed over a period of about 100 years. Starting from the first year of the first Plan in 1951–52 to the year 1980–81 the originating traffic expected to be generated in the country is about 800 million tons, i.e., an increase of about 710 million tons in 30 years. It is obvious that this enormous increase can never be handled by any one agency no matter what it is. The difficulties which the railways experienced in handling only 114 million tons in 1955–56 and 154 million tons in 1960–61 should make this clear.

Then there is the case of coal, the bulk of which is produced in the eastern region and consumed in West Bengal, Bihar and Orissa. Most of the stations to which coal goes in these areas are within distances of two to three hundred miles on which road transport can operate both easily and quickly. Moreover, by employing the same type of road vehicles as are employed by other countries to carry cheap commodities like coal the cost of transportation by road can go down in some cases even below the concessional rate charged by the railways for coal. But these aspects have not been studied. On the contrary rail lines are being extended with the result that by carrying coal at a rate which is below the average rail rate for revenue-earning traffic the railways are getting a lower return on their investment.

Nearly 53 per cent of the railway milage which consists of metre and narrow gauges carries currently only about 15.7 per cent of the railways' goods traffic in ton-miles, while the remaining about 47 per cent which consists of the broad gauge carries about 84.3 per cent. There is no hope whatsoever of the metre and narrow gauges being ever made to carry traffic in proportion to their milage since their speed is about 8 m p.h. which is a little more than about two and a half times the speed of bullock carts. It will not also be economical to replace them by broad gauge lines since they will cost over thrice the amount required for 24-feet wide roads. In the circumstances, the only rational alternative is to improve roads and put on them the requisite number of trucks.

The broad gauge lines have practically reached the saturation point. By 1965-66 the rail traffic per track mile may well be near the highest in the world. Further capacity will mean extending the lines and/or augmenting the line capacity of the existing lines, but the initial cost will be high. It will be higher still if dieselisation and/or electrification is resorted to on a big scale.

THE REMEDY

The only solution is to complete as expeditiously as possible in a phased programme the system of 32,000 miles of National Highways which has been recommended by the Chief Engineers of the States as also the roads required in the coal areas. When completed they should be capable of handling more or less the same volume of traffic per mile as broad gauge rail lines.

The way in which the problem of the National Highways has been handled in our country so far hardly redounds to any body's credit. The Nagpur Road Plan recommended in 1943 that the Centre should take over about 20,000 miles of National Highways. But to-date only about 15,000 miles have been taken over. It is necessary to see that these 15,000 miles together with roads in the coal areas are completed not later than the middle of the fourth Plan and that thereafter the remaining 17,000 miles are completed by 1980–81. Unless this is done the bottleneck in our system of surface transport will not be removed. [*From Times of India 20-12-61*]

(*Continued from page 30*)

FIRMS

1. Associated Instrument Manufacturers (I) Private Ltd., New Delhi.
2. Burmah Shell Oil Co., Ltd.
3. Caltex (India) Oil Co., Ltd.
4. Cementation Co., Ltd.
5. Millers' Timber and Trading Co., Ltd.
6. Nagarath Paints, Patna.
7. Shalimar Tar Products (1935) Private Ltd.
8. Tractors (India) Ltd.
9. United Provinces Commercial Corporation Private Ltd.
10. William Jacks and Co., Ltd.

OTHERS

1. Concrete Association of India

DESIGN OF STEEL ROAD BRIDGE OF SPANS 20 TO 80 FT TOGETHER WITH THE WEIGHT OF STEEL WORK FOR I.R.C. CLASS 'A' AND 'AA' LOADING

By

D.S. DESAI*

SYNOPSIS

In this article, are given readymade designs of Steel Stringer Highway Bridges decked with concrete slab for spans varying from 20 to 80 ft to carry live load consisting of I.R.C. Class A and Class AA loading. Bending moments and shears for stringers and the sections required for rivetted mild steel, welded mild steel and rivetted high tensile steel construction are worked out; their weights, the weights of bearings, dead load due to concrete decking and the loads coming on abutments and piers are also furnished.

1. SLAB AND STRINGER BRIDGES

One of the most common type of road bridges for spans of 20 to 80 ft is the Slab and Stringer Bridge consisting of reinforced concrete slab supported on a number of parallel steel stringers equally spaced and extending in the direction of the traffic.

This type of bridge consisting of reinforced concrete carriageway slab continuous on steel stringers has found widespread application for road bridges and is likely to be greatly adopted in future due to its simplicity of design, ease of construction, and economy in cost.

In this type of construction, the principal load carrying elements are the beams and the slab. The loads act on the beams through the slab. The main reinforcement in the slab is in the direction transverse to the beams and longitudinal reinforcement is secondary reinforcement. The slab being stiff acts in the manner as a diaphragm and, therefore, it is not necessary to provide additional diaphragms except at ends and intervals of about 15 ft to 20 ft for construction purposes to keep the beams in position.

2. DISTRIBUTION OF LOADS FROM SLAB TO GIRDERS

To simplify the calculations for the design of the girders, the following percentage of bending moments and shears have been assumed in the design of stringers. These were based on the assumption that the slab is simply supported on girders.

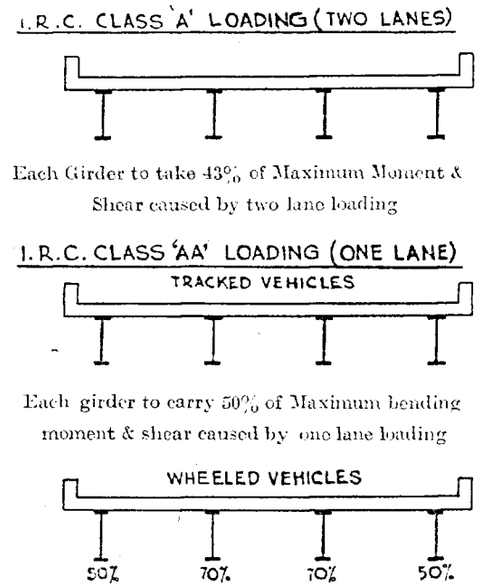
Live Load:

(i) For single lane traffic, i.e., for 12 ft wide carriageway, bending moment and shear due to live load will be shared equally between the two girders for I.R.C. Class "AA" loading, but in the case of I.R.C. Class "A" loading, each girder has been designed to take 60 per cent of total bending moment and shear.

(ii) For 24 ft wide carriageway with four girders: Sketch given below indicates the proportion of total bending moment and shear resisted by each girder.

Dead Load:

Bending moment and shear due to dead load have been assumed as equally shared



Note:—In final design, Max. Bending Moments & Shear for either A, B or C should be taken into consideration.

by all girders for 12 ft and 24 ft carriageway

Bearings:

Sliding plate bearings† are provided for spans 20 to 80 ft.

Tables and Graphs:

Table 1 gives the distance between centre of bearings, overall length and centre to centre distance of the piers.

Tables 2 and 3 give the maximum bending moments and end shear due to dead load, live load and impact per span and per girder.

Table 4A to 4D gives the maximum bend-moment and end shear per girder and proposed sections of various constructions of steel.

Table 5 gives weight of steel including that of bearings.

Plate II gives the graph showing the weight of steel including that of bearings.

Plates I, III and IV give the typical cross section, details of web splices, details of sliding bearings and details of handrails standard and expansion joints and cross bracing of girders.

Plate V shows details at expansion joints and gratings.

3. STIFFENERS

Stiffeners are of two types, namely:

(a) end or bearing stiffeners, the function of which is to transmit the end reaction to the bearings below.

(b) the intermediate stiffeners, the function of which is to prevent the failure of the web by buckling.

End or Bearing Stiffeners

In plate girder load bearing stiffeners are provided at points of support to transfer the end reaction to the abutment or pier through bearings. The function of bearing stiffeners suggests the following designing procedures:

(a) The stiffeners should act as a strut.

(b) There must be enough area of contact between the out standing legs of stiffeners and the flange to transmit the load in bearing.

(c) The connection between the stiffeners and the web must be sufficiently strong to transmit the vertical load.

Therefore, end or bearing stiffeners should be designed as a strut and the permissible stresses should be in accordance with the appropriate allowable values for a strut assuming the effective length equal to 0.7 of the length of the stiffeners and assuming the section to consist of a pair of stiffeners together with a length of web (where available), equal to 20 times the web thickness, on each side of the centre line of stiffeners.

Bearing stiffeners should have outstanding legs as wide as the flange angles will permit. Area of outstanding legs of each pair of stiffeners in contact with the flange

* Messrs. M.N. Dastur & Company Private Limited, Consulting Engineers, Calcutta.

† Note by Editor :—Some authorities in India require rocker and roller bearings for spans exceeding 40 ft. In the next issue, an article on " How to figure Steel Bridge" by Texas Transportation Institute will be published.

angles or flange plates in case of a welded girder, should be so determined that the bearing stress does not exceed the permissible stress.

Ends of all stiffeners should be machined and ground to fit tightly on both top and bottom flanges. Stiffeners should have in addition sufficient rivets or welds to transmit end reaction at the bearings. Usually, load bearing stiffeners are not joggled but are packed throughout because of its behaviour as a strut.

Intermediate Stiffeners

The primary function of the intermediate stiffeners is to prevent the failure of web by buckling as previously mentioned. The vertical intermediate stiffeners are provided throughout the length of the girder when the thickness of the web is less than $\frac{d}{85}$, where 'd' is the distance between flange angles or where there are no flange angles, the clear distance between flanges ignoring fillets. These stiffeners usually do not carry vertical loads and a few years back they were designed by empirical rules. The general rule was that the spacing between stiffeners should not be greater than the depth of the girder with a maximum spacing of 5'. These stiffeners were also proportioned according to sizes of the main angles of the girder as follows :

Leg of the main angles	Intermediate stiffeners in pairs
8 in.	6 in. × 4 in. × 3/8 in.
6 in.	4 in. × 3 in. × 3/8 in. or 4 in. × 3 in. × 5/16 in.
5 in.	3½ in. × 2½ in. × 3/8 in. or 3½ in. × 2½ in. × 5/8 in.
4 in.	3 in. × 2½ in. × 3/8 in. or 3 in. 2½ in. × 5/16 in.

Alternatively the most common requirements was that the outstanding leg should have a width not less than 1/30th of the depth of the girder plus 2 in. and the thickness of the angle should be not less than 1/16th of the width of the outstanding leg.

Recently, the design and spacing of intermediate stiffeners has become a subject of considerable study. The recent specifications have revised the clauses for design of intermediate stiffeners and its spacing. Indian Standard Specification IS: 800 gives the following clause :

"Where intermediate vertical stiffeners are required, they shall be spaced at a distance apart not greater than 1.5d and not less than 0.33d. These stiffeners shall be designed so that its moment of inertia is not less than

$$1.5 \times \frac{d^3 t^3}{c^2},$$

where 'd' = the distance between the flange angles in inches.

'I' = the moment of inertia of a pair of stiffeners about the centre of web or a single stiffener about the face of the web.

't' = thickness of the web in inches.

'c' = the clear distance between vertical stiffeners in inches.

The stiffeners usually extend from flange to flange and may be joggled over the vertical legs of the flange angles.

4. WEB AND FLANGE SPLICES

Splices in web and flange angles should be avoided wherever possible, since the splices increase the weight of the girder with a consequent increase in cost, because of limitations in the lengths of plates and sections obtainable from the rolling mills; the web and flange angles of plate girders longer than 40 feet require splicing at two or more points.

Web Splices

The web splice in welded plate girder is simple enough and the obvious solution is to employ butt-weld between two plates.

In case of rivetted plate girders, web splices consist of two shear plates one on each side and four moment plates two near the top flange angles and two near the bottom flange angles. The shear plates must have sufficient area to resist the maximum shear at the section. Moment plates should have sufficient area to resist the moment resisted by the web. The web splice marked A is generally adopted for shallow plate girders but the splice marked B is preferable for deep plate girders.

Shear plate

$$As = \frac{Aw \times d_1^2}{d_2^2} \quad \ldots(1)$$

Where As = Area of splice plate in sq. in.
Aw = ,, ,, web ,, ,, ,,
d_1 = Depth of web in inches
d_2 = ,, ,, splice plate in in.

Moment plate

$$A_1 = \tfrac{1}{8} \times \frac{Aw\, d_3^2}{d_4^2} \quad \ldots(2)$$

Where A_1 = Net area of 2 moment plates in sq in.
Aw = Area of web in sq. in.
d_3 = Effective depth in inches
d_4 = Distance, centre to centre, of moment plates.

Area in Shear Plate

$$A_2 = \frac{S}{fs} \quad \ldots(3)$$

Where A_2 = Area in shear plate in sq. in.
S = Shear at the section in tons
fs = Permissible shear per sq. in.

The number of rivets should be assumed and the load on the outer rivets computed by usual methods and the rivets' groups revised if necessary.

Flange Splices

The splice of the flange angles is made of angles or flats and the area in cover materials should be 5 per cent in excess of the area of the flange angles spliced. The splice materials may consist of angles or flats or both, and single flat at top. There should be sufficient number of rivets to resist the loads in the main angles.

Connection of Flange to Web :

The flange angles to web are connected by rivets in the case of rivetted plate girder, but in a welded plate girder, flange plates are connected to web by weld on each side. The number of rivets or size of weld required to connect flanges to the web depends upon the horizontal shear. The rivet pitch or weld size required at the ends of the plate girder must be determined before deciding finally the sections of the plate girder. If the pitch of the rivets is very small or size of the weld is large the depth of the girder should be increased.

Horizontal shear per inch $H = \frac{V}{d}$ ...(4)

Where 'V' = vertical shear at the section in tons

'd' = effective depth of the girder in inches.

If R is the strength of one rivet either in double shear or in bearing whichever is less.

Number of rivets required per ft.

$$= \frac{H \times 12}{R} \quad \ldots(5)$$

OR

$$\text{Pitch of rivets in inches} = \frac{R}{H} \quad \ldots(6)$$

In case of a welded plate girder when horizontal shear per inch is known the weld size can be determined easily from the table given below

Fillet size in inches Leg size = h	Throat thickness in inches 0.7 × h	Strength in tons per inch run at 6.5 T/Sq in.
1/8	0.088	0.57
3/16	0.131	0.85
1/4	0.175	1.14
5/16	0.219	1.42
3/8	0.263	1.71
1/2	0.350	2.28

It is usual practice in case of a welded plate girder to adopt weld continuous between the web and the flanges.

5. LOADS ON ABUTMENTS & PIERS

Tables 6 and 7 give the vertical loads on piers and abutments due to dead load and live loads for IRC class "A" and class "AA" loading including impacts. The transverse loads on piers or abutments can be easily worked out once the location of bridge and zone in which it is situated are known by taking appropriate velocity of wind and an intensity of pressure. The longitudinal loads due to tractive effort can also be worked out in accordance with the provision of the IRC specifications. After the vertical, lateral and longitudinal loads acting on the piers or abutments are known, their designs can be prepared.

6. COMPOSITE BEAM BRIDGE*

Composite I-beam bridge is an improvement on the ordinary slab and steel I-beam bridge.

In a composite I-beam bridge shear connectors are provided to ensure composite action to transmit the horizontal shear between the slab and the beams, thereby transforming the longitudinal load carrying member from a simple steel I-beam to a composite steel and concrete T-beam in which the concrete decking or slab acts as the top flange. In this type of construction, the slab serves the following two functions:

(i) It transmits the load laterally to the beams, and

(ii) It assists steel stringers in carrying the load longitudinally either to the piers or abutments.

In the first function, the slab in bending and in its second it acts chiefly in compression flange of composite T-beam.

Composite structure is stronger and safer than the non-composite structure made up of the same size beams and slabs, it uses about 10 per cent less steel, depth of the beam is less and permits the use of rolled steel standard sections for longer spans.

Recent tests in foreign countries have proved that the capacity of the slab to perform its primary function of acting as a roadway is not impaired by its action as a part of its composite T-beam.

In our country, such composite construction has been adopted for Rajendra Bridge at Mokameh and also for Brahmaputra Bridge under construction.

7. CONCLUSION

The information given in this article, it is hoped, will prove useful in working out quickly economical designs of steel highway bridges. The charts given will enable the designer to try out a few combination of spans for a given length of the bridge to arrive at the most economical span lengths. It is also felt that, instead of inviting tenders for competitive designs which results in a considerable delay in scrutinizing and selecting a particular design, these ready-made designs will make the task of building a bridge easier and faster.

* Published as a Paper "Standard Specifications and Code of practice for Road Bridges, Section VI—*Composite Construction for Road Culverts and Medium span Bridges*"—Bridges Committee—in Vol XXVI-2 of the Journal of the I.R.C.

TABLE 1

Centres of bearings overall length of girders and distance of centre of piers

Centres of bearings Ft	Overall length of girders Ft-In.	Centres of piers Ft-In.
15-0	17-0	17-2
20-0	22-0	22-2
25-0	27-0	27-2
30-0	32-0	32-2
35-0	37-0	37-2
40-0	42-0	42-2
45-0	47-6	47-8
50-0	52-6	52-8
55-0	57-6	57-8
60-0	62-6	62-8
65-0	67-6	67-8
70-0	72-6	72-8
75-0	77-6	77-8
80-0	82-6	82-8

TABLE 2

Dead load—Maximum bending moment and end shear

Centres of bearings Ft	12 ft Roadway				24 ft Roadway			
	Bending moment Ft./tons		Shear Tons		Bending moment Ft./tons		Shear Tons	
	Per span	Per girder	Per span	Per girder	Per span	Per girder	Per span	Per girder
15	33	17	8.8	4.4	60	15	16.0	4.0
20	59	30	11.8	5.9	108	27	21.6	5.4
25	93	47	15.0	7.5	170	43	27.3	6.8
30	134	67	17.8	8.9	242	61	32.3	8.1
35	184	92	21.0	10.5	334	84	38.2	9.6
40	242	121	24.2	12.1	440	110	44.0	11.0
45	311	156	27.6	13.8	566	142	50.3	12.6
50	377	189	30.8	15.4	688	172	56.2	14.1
55	474	237	34.5	17.3	864	216	62.8	15.7
60	569	285	38.0	19.0	1037	259	69.1	17.3
65	678	339	41.7	20.9	1226	307	75.5	18.9
70	790	395	45.2	22.6	1440	360	82.3	20.6
75	912	456	48.6	24.3	1664	416	88.8	22.2
80	1049	525	52.5	26.3	1893	473	94.7	23.7

TABLE 3

Maximum bending moment and maximum end shear caused by Live load and Impact

Centres of bearings Ft	For I.R.C. Class "A" Loading								For I.R.C. Class "AA" Loading			
	12 ft Roadway				24 ft Roadway				12 ft or 24 ft Roadway			
	B. M. including impact Ft./tons		Shear including impact Tons		B. M. including impact Ft./tons		Shear including impact Tons		B. M. including impact Ft./tons		Shear including impact Tons	
	Per span A	Per girder 0.6A	Per span B	Per girder 0.6B	Per span C	Per girder 0.43C	Per span D	Per girder 0.43D	Per span A	Per girder 0.5A	Per span B	Per girder 0.5B
15	95	57	29.1	17.5	190	82	58.2	25.0	197	99	52.5	26.3
20	132	79	30.8	18.5	264	114	61.6	26.5	306	153	61.3	30.7
25	170	102	32.0	19.2	340	146	64.0	27.5	415	208	66.5	33.3
30	209	125	33.6	20.2	418	180	67.2	28.9	462	231	61.6	30.8
35	260	156	35.3	21.2	520	224	70.6	30.4	559	280	63.8	31.9
40	313	188	36.7	22.0	626	269	73.2	31.6	655	328	65.5	32.8
45	347	208	38.5	23.1	694	298	77.0	33.1	751	376	66.7	33.4
50	422	253	40.1	24.1	844	363	80.2	34.5	836	418	67.9	34.0
55	482	289	41.9	25.1	964	415	83.8	36.0	944	472	68.6	34.3
60	544	326	43.2	25.9	1088	468	86.4	37.2	1040	520	69.3	34.7
65	603	362	44.3	26.6	1206	519	88.6	38.1	1136	568	70.0	35.0
70	667	400	45.1	27.1	1334	574	90.2	38.8	1232	616	70.4	35.2
75	736	442	45.9	27.5	1472	633	91.8	39.5	1331	666	70.8	35.4
80	804	482	46.5	27.9	1608	691	93.0	40.0	1425	713	71.2	35.6

TABLE 4-A

Maximum Bending moment and maximum end shear per girder and proposed sections

FOR I.R.C. CLASS "A" LOADING 12 FT CARRIAGEWAY									
Centres of Bearings in feet	Per Girder Bending moment ft. tons			Per Girder Maximum end shear tons			Proposed section		
	Dead load A	Live load & impact B	Total A & B	Dead load	Live load & impact	Total in tons	Mild steel rivetted	Mild steel welded	H. T. Steel rivetted
15	17	57	74	4.4	17.5	21.9	I. 20″×6½″×65 lb	—	I. 16″×6″×50 lb
20	30	79	109	5.9	18.5	24.4	I. 22″×7″×75 lb	—	I. 20″×6½″×65 lb
25	47	102	149	7.5	19.2	26.7	I. 24″×7½″×95 lb	—	I. 22″×7″×75 lb
30	67	125	192	8.9	20.2	29.1	I. 24″×7½″×95 lb 2 FL. 9″×⅜″	—	I. 24″×7½″×95 lb
35	92	156	248	10.5	21.2	31.7	PL. 39″×⅜″ 4 LS. 6″×4″×⅜″	PL. 42″×⅜″ 2 FL. 12″×½″	I. 24″×7½″×95 lb 2 FL. 8″×⅜″
40	121	188	309	12.1	22.0	34.1	PL. 45″×⅜″ 4 LS. 6″×4″×⅜″	PL. 48″×⅜″ 2 FL. 12″×½″	PL. 36″×⅜″ 4 LS. 6″×4″×⅜″
45	156	208	364	13.8	23.1	36.9	PL. 45″×⅜″ 4 LS. 6″×4″×½″	PL. 48″×⅜″ 2 FL. 12″×⅝″	PL. 42″×⅜″ 4 LS. 6″×4″×⅜″
50	189	253	442	15.4	24.1	39.5	PL. 48″×⅜″ 4 LS. 6″×6″×½″	PL. 57″×⅜″ 2 FL. 12″×⅝″	PL. 48″×⅜″ 4 LS. 6″×4″×⅜″
55	237	289	526	17.2	25.1	42.3	PL. 54″×⅜″ 4 LS. 6″×6″×½″	PL. 57″×⅜″ 2 FL. 12″×¾″	PL. 54″×⅜″ 4 LS. 6″×4″×⅜″
60	285	326	611	19.0	25.9	44.9	PL. 60″×⅜″ 4 LS. 6″×6″×½″	PL. 66″×⅜″ 2 FL. 12″×¾″	PL. 60″×⅜″ 4 LS. 6″×4″×⅜″
65	339	362	701	20.9	26.6	47.5	PL. 69″×⅜″ 4 LS. 6″×6″×½″	PL. 69″×⅜″ 2 FL. 12″×⅞″	PL. 66″×⅜″ 4 LS. 6″×4″×⅜″
70	395	400	795	22.6	27.1	49.7	PL. 72″×⅜″ 4 LS. 6″×6″×½″	PL. 72″×7/16″ 2 FL. 12″×⅞″	PL. 72″×⅜″ 4 LS. 6″×4″×⅜″
75	456	442	898	24.3	27.5	51.8	PL. 75″×⅜″ 4 LS. 6″×6″×⅝″	PL. 75″×7/16″ 2 FL. 12″×1″	PL. 72″×⅜″ 4 LS. 6″×4″×½″
80	525	482	1007	26.2	27.9	54.1	PL. 81″×⅜″ 4 LS. 6″×6″×⅝″	PL. 81″×7/16″ 2 FL. 12″×1″	PL. 78″×⅜″ 4 LS. 6″×4″×½″

TABLE 4-B

Maximum bending moment and maximum end shear per girder and proposed sections

FOR I.R.C. CLASS "A" LOADING 24 FT CARRIAGEWAY

Centres of bearings in feet	Per girder: Bending moment Ft/tons			Per girder: Maximum end shear Tons			Proposed section		
	Dead load A	Live load & impact B	Total A & B	Dead load	Live load & impact	Total in tons	Mild steel rivetted	Mild steel welded	H. T. steel rivetted
15	15	82	97	4.0	25.0	29.0	I. 22″×7″×75 lb	—	I. 18″×6″×55 lb
20	27	114	141	5.4	26.5	31.9	I. 24″×7½″×95 lb	—	I. 22″×7″×75 lb
25	42	146	188	6.8	27.5	34.3	I. 24″×7½″×95 lb 2 FL. 8″×⅜″	—	I. 24″×7½″×95 lb
30	61	180	241	8.1	28.9	37.0	PL. 39″×⅜″ 4 LS. 6″×4″×⅜″	PL. 39″×⅜″ 2 FL. 12″×½″	I. 24″×7½″×95 lb 2 FL. 8″×⅜″
35	84	224	308	9.5	30.4	39.9	PL. 45″×⅜″ 4 LS. 6″×4″×⅜″	PL. 48″×⅜″ 2 FL. 12″×½″	PL. 36″×⅜″ 4 LS. 6″×4″×⅜″
40	110	269	379	11.0	31.6	42.6	PL. 45″×⅜″ 4 LS. 6″×4″×½″	PL. 51″×⅜″ 2 FL. 12″×⅝″	PL. 42″×⅜″ 4 LS. 6″×4″×⅜″
45	142	298	440	12.6	33.1	45.7	PL. 48″×⅜″ 4 LS. 6″×6″×½″	PL. 51″×⅜″ 2 FL. 12″×¾″	PL. 48″×⅜″ 4 LS. 6″×4″×⅜″
50	172	363	535	14.1	34.5	48.6	PL. 54″×⅜″ 4 LS. 6″×6″×½″	PL. 60″×⅜″ 2 FL. 12″×¾″	PL. 54″×⅜″ 4 LS. 6″×4″×⅜″
55	216	415	631	15.7	36.0	51.7	PL. 60″×⅜″ 4 LS. 6″×6″×½″	PL. 63″×⅝″ 2 FL. 12″×⅞″	PL. 60″×⅜″ 4 LS. 6″×4″×⅜″
60	259	468	727	17.3	37.2	54.5	PL. 63″×⅜″ 4 LS. 6″×6″×⅝″	PL. 69″×⅝″ 2 FL. 12×⅞″	PL. 63″×⅜″ 4 LS. 6″×6″×⅜″
65	306	519	825	18.9	38.1	57.0	PL. 69″×⅜″ 4 LS. 6″×6″×⅝″	PL. 72″×$\frac{7}{16}$″ 2 FL. 12″×⅞″	PL. 69″×⅜″ 4 LS. 6″×6″×⅝″
70	360	574	934	20.6	38.8	59.4	PL. 72″×⅜″ 4 LS. 6″×6″×⅝″	PL. 75″×$\frac{7}{16}$″ 2 FL. 12″×1″	PL. 72″×⅜″ 4 LS. 6″×4″×½″
75	416	633	1049	22.2	39.5	61.7	PL. 81″×⅜″ 4 LS. 6″×6″×⅝″	PL. 81″×$\frac{7}{16}$″ 2 FL. 12″×1″	PL. 81″×⅜″ 4 LS. 6″×4″×½″
80	473	691	1164	23.7	40.0	63.7	PL. 81″×⅜″ 4 LS. 6″×6″×¾″	PL. 84″×$\frac{7}{16}$″ 2 FL. 13″×1″	PL. 81″×⅝″ 4 LS. 6″×6″×½″

TABLE 4-C

Maximum bending moment and maximum end shear per girder and proposed sections

FOR I.R.C. CLASS "AA" LOADING 12 FT CARRIAGEWAY

Centres of bearings in feet	Per girder: Bending moment Ft/tons			Per girder: Maximum end shear Tons			Proposed Section		
	Dead load A	Live load & impact B	Total A & B	Dead load	Live load & impact	Total in tons	Mild steel rivetted	Mild steel welded	H.T. steel rivetted
15	17	99	116	4.4	26.3	30.7	I. 22″×7″×75 lb	—	I. 20″×6½″×65 lb
20	30	153	183	5.9	30.7	36.6	I. 24″×7½″×95 lb 2 Flats 8″×⅜″	—	I. 24″×7½″×95 lb
25	47	208	255	7.5	33.3	40.8	Web PL. 36″×⅜″ 4 LS. 6″×4″×½″	PL. 36″×⅜″ 2 FL. 12″×⅝″	I. 24″×7½″×95 lb 2 FL. 8″×⅜″
30	67	231	298	8.9	30.8	39.7	PL. 39″×⅜″ 4 LS. 6″×4″×½″	PL. 42″×⅜″ 2 FL. 12″×⅝″	I. 24″×7½″×95 lb 2 FL. 10″×½″
35	92	280	372	10.5	31.9	42.4	PL. 48″×⅜″ 4 LS. 6″×4″×½″	PL. 51″×⅜″ 2 FL. 12″×⅝″	PL. 36″×⅜″ 4 LS. 6″×4″×½″
40	121	328	449	12.1	32.8	44.9	PL. 54″×⅜″ 4 LS. 6″×4″×½″	PL. 54″×⅜″ 2 FL. 12″×¾″	PL. 42″×⅜″ 4 LS. 6″×4″×½″
45	156	376	532	13.8	33.4	47.2	PL. 60″×⅜″ 4 LS. 6″×4″×½″	PL. 60″×⅜″ 2 FL. 12″×¾″	PL. 48″×⅜″ 4 LS. 6″×4″×½″
50	189	418	607	15.4	34.0	49.4	PL. 60″×⅜″ 4 LS. 6″×6″×½″	PL. 66″×⅜″ 2 FL. 12″×¾″	PL. 51″×⅜″ 4 LS. 6″×4″×½″
55	237	472	709	17.2	34.3	51.5	PL. 63″×⅜″ 4 LS. 6″×6″×⅝″	PL. 69″×⅜″ 2 FL. 12″×⅞″	PL. 57″×⅜″ 4 LS. 6″×4″×½″
60	285	520	805	19.0	34.7	53.7	PL. 66″×⅜″ 4 LS. 6″×6″×⅝″	PL. 72″×$\frac{7}{16}$″ 2 FL. 12″×⅞″	PL. 60″×⅜″ 4 LS. 6″×6″×½″
65	339	568	907	20.9	35.0	55.9	PL. 72″×⅜″ 4 LS. 6″×6″×⅝″	PL. 75″×$\frac{7}{16}$″ 2 FL. 12″×1″	PL. 63″×⅜″ 4 LS. 6″×6″×½″
70	395	616	1011	22.6	35.2	57.8	PL. 72″×⅜″ 4 LS. 6″×6″×¾″	PL. 81″×$\frac{7}{16}$″ 2 FL. 12″×1″	PL. 72″×⅜″ 4 LS. 6″×6″×½″
75	456	666	1122	24.3	35.4	59.7	PL. 78″×⅜″ 4 LS. 6″×6″×¾″	PL. 84″×$\frac{7}{16}$″ 2 FL. 12″×1″	PL. 78″×⅜″ 4 LS. 6″×6″×½″
80	525	713	1238	26.2	35.6	61.8	PL. 84″×⅜″ 4 LS. 6″×6″×¾″	PL. 84″×$\frac{7}{16}$″ 2 FL. 12″×1⅛″	PL. 84″×⅜″ 4 LS. 6″×6″×½″

TABLE 4-D

Maximum bending moment and maximum end shear per girder and proposed sections

FOR I.R.C. CLASS "AA" LOADING 24 FT CARRIAGEWAY									
Centres of Bearings in feet	Per girder Bending moment Ft/tons			Per girder Maximum end shear Tons			Proposed Section		
	Dead load A	Live load & impact	Total A & B	Dead load	Live load & impact	Total in tons	Mild Steel rivetted	Mild steel welded	H. T. steel rivetted
15	15	99	114	4.0	26.3	30.3	I.22″×7″×75 lb	—	I. 20″×6½″×65 lb
20	27	153	180	5.4	30.7	36.1	I 24″×7½″×95 lb 2 FL. 8″×⅜″	—	I.24″×7½″×95 lb
25	42	208	250	6.8	33.3	40.1	PL. 36″×½″ 4 LS. 6″×4″×½″	PL. 36″×⅜″ 2 FL. 12″×⅝″	I 24″×7½″×95 lb 2 FL 8″×⅜″
30	61	231	292	8.1	30.8	38.9	PL. 39″×⅜″ 4 LS. 6″×4″×½″	PL. 42″×⅜″ 2 FL. 12″×⅝″	PL. 36″×⅜″ 4 LS. 6″×4″×⅜″
35	84	280	364	9.5	31.9	41.4	PL. 45″×⅜″ 4 LS. 6″×4″×½″	PL. 51″×⅜″ 2 FL. 12″×⅝″	PL. 36″×⅜″ 4 LS. 6″×4″×½″
40	110	328	438	11.0	32.8	43.8	PL. 51″×⅜″ 4 LS. 6″×4″×½″	PL. 51″×⅜″ 2 FL. 12″×¾″	PL. 39″×⅜″ 4 LS. 6″×4″×½″
45	142	376	518	12.6	33.4	46.0	PL. 57″×⅜″ 4 LS. 6″×4″×½″	PL. 60″×⅜″ 2 FL. 12″×¾″	PL. 45″×⅜″ 4 LS. 6″×4″×½″
50	172	418	590	14.1	34.0	48.1	PL. 60″×⅜″ 4 LS. 6″×6″×½″	PL. 66″×⅜″ 2 FL. 12″×¾″	PL. 51″×⅜″ 4 LS. 6″×4″×½″
55	216	472	688	15.7	34.3	50.0	PL. 66″×⅜″ 4 LS. 6″×6″×½″	PL. 69″×⅜″ 2 FL. 12″×⅝″	PL. 57″×⅜″ 4 LS. 6″×4″×½″
60	259	520	779	17.3	34.7	52.0	PL. 72″×⅜″ 4 LS. 6″×6″×½″	PL. 72″×7/16″ 2 FL. 12″×⅜″	PL. 57″×⅜″ 4 LS. 6″×6″×½″
65	306	568	874	18.9	35.0	53.9	PL. 72″×⅝″ 4 LS. 6″×6″×⅝″	PL. 72″×7/16″ 2 FL. 12″×1″	PL. 63″×⅜″ 4 LS. 6″×6″×½″
70	360	616	976	20.6	35.2	55.8	PL. 72″×⅜″ 4 LS. 6″×6″×¾″	PL. 78″×7/16″ 2 FL. 12″×1″	PL. 69″×⅜″ 4 LS. 6″×6″×½″
75	416	666	1082	22.2	35.4	57.6	PL. 75″×⅜″ LS. 6″×6″×¾″	PL. 84″×7/16″ 2 FL. 12″×1″	PL. 75″×⅜″ 4 LS. 6″×6″×½″
80	473	713	1186	23.7	35.6	59.3	PL. 81″×⅜″ 4 LS. 6″×6″×¾″	PL. 84″×7/16″ 2 FL. 13″×1″	PL. 81″×⅜″ 6 LS. 6″×6″×½″

TABLE 5

Weight of Steel including weight of Bearings

Centres of Bearings Feet	FOR BRIDGES CARRYING I.R.C. CLASS "A" LOADING						FOR BRIDGES CARRYING I.R.C. CLASS "AA" LOADING					
	12′-0″ Roadway			24′-0″ Roadway			12′-0″ Roadway			24′-0″ Roadway		
	M. Steel rivetted Tons	M. Steel welded Tons	H. T. Steel rivetted Tons	M. Steel rivetted Tons	M. Steel welded Tons	H. T. Steel rivetted Tons	M. Steel rivetted Tons	M. Steel welded Tons	H. T. Steel rivetted Tons	M. Steel rivetted Tons	M. Steel welded Tons	H. T. Steel rivetted Tons
20	3.19	—	2.95	6.58	—	5.89	3.78	—	3.54	7.37	—	6.68
25	4.16	—	3.68	8.92	—	7.83	4.85	4.30	4.64	9.16	7.96	8.92
30	5.43	—	4.86	10.71	9.00	10.00	5.79	5.29	5.64	11.00	9.91	10.00
35	6.36	5.65	6.19	12.97	11.23	11.73	7.25	6.61	6.57	13.69	12.39	12.22
40	7.59	6.75	7.03	15.47	14.06	14.06	8.63	7.88	7.80	16.24	15.00	14.63
45	9.12	8.08	8.38	19.08	16.75	16.75	10.35	9.50	9.33	19.42	18.20	17.39
50	10.66	9.49	9.61	22.03	19.92	19.45	11.95	11.13	10.78	22.80	21.10	20.15
55	12.32	11.01	11.04	25.16	23.36	22.59	14.12	12.58	12.32	26.57	24.50	23.23
60	13.95	12.70	12.42	29.85	26.65	25.67	16.18	14.87	14.23	30.13	28.18	26.64
65	15.97	14.46	14.01	33.15	30.43	28.63	18.08	16.97	15.82	34.65	31.64	29.83
70	17.48	16.51	15.70	36.57	35.28	32.37	20.35	19.35	17.96	39.17	35.92	33.17
75	20.07	19.0	17.82	41.17	39.79	36.67	22.66	21.28	20.07	42.90	40.48	36.85
80	22.10	21.18	19.70	46.40	44.19	40.51	24.57	23.53	22.10	46.40	44.19	40.51

TABLE 6

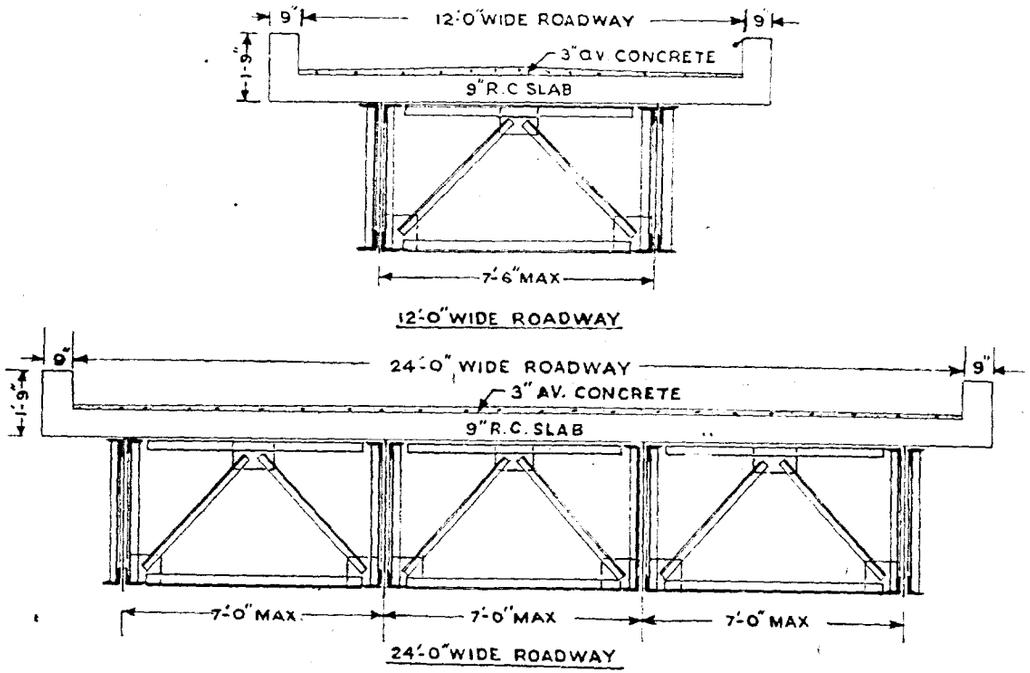
Vertical Loads on Piers and Abutments due to Dead Load and I.R.C. Class 'A' Live Load Plus Impact

Span Feet	PIERS						ABUTMENTS					
	12'—0" Roadway			24'—0" Roadway			12'—0" Roadway			24'—0" Roadway		
	Dead Load A	L. Load + Impact B	Total Tons A + B	Dead Load C	L. Load + Impact D	Total Tons C + D	Dead Load A	L. Load + Impact B	Total Tons A + B	Dead Load C	L. Load + Impact D	Total Tons C + D
15	9.9	31.2	50.1	36.2	62.4	98.6	10.0	29.1	39.1	18.1	58.2	76.3
20	26.0	34.6	60.6	47.4	69.2	116.6	13.0	30.8	43.8	23.7	61.6	85.3
25	32.3	37.5	69.8	58.9	75.0	133.9	16.2	32.0	48.2	29.5	64.0	93.5
30	37.9	40.1	78.0	68.8	80.2	149.0	18.9	33.6	52.5	34.4	67.2	101.6
35	44.4	42.3	86.7	80.7	84.5	165.2	22.2	35.3	57.5	40.4	70.6	111.0
40	50.8	44.4	95.2	92.4	88.8	181.2	25.4	36.7	62.1	46.2	73.4	119.6
45	58.3	46.3	104.6	106.2	92.6	198.8	29.2	38.5	67.7	53.1	77.0	130.1
50	64.7	48.3	113.0	118.0	96.6	214.6	32.4	40.1	72.5	59.0	80.2	139.2
55	72.0	49.7	121.7	131.3	99.4	230.7	36.0	41.9	77.9	65.7	83.8	149.5
60	79.1	50.9	130.0	144.0	101.8	245.8	39.6	43.2	82.8	72.0	86.4	150.4
65	86.6	51.8	138.4	156.7	103.6	260.3	43.3	44.3	87.6	78.4	88.6	167.0
70	93.5	52.6	146.1	170.5	105.2	275.7	46.8	45.1	91.9	85.3	90.2	175.5
75	100.5	53.2	153.7	183.4	106.4	289.8	50.2	45.9	96.1	91.7	91.8	183.5
80	108.2	53.6	161.8	195.2	107.2	302.4	54.1	46.5	100.6	97.6	93.0	190.6

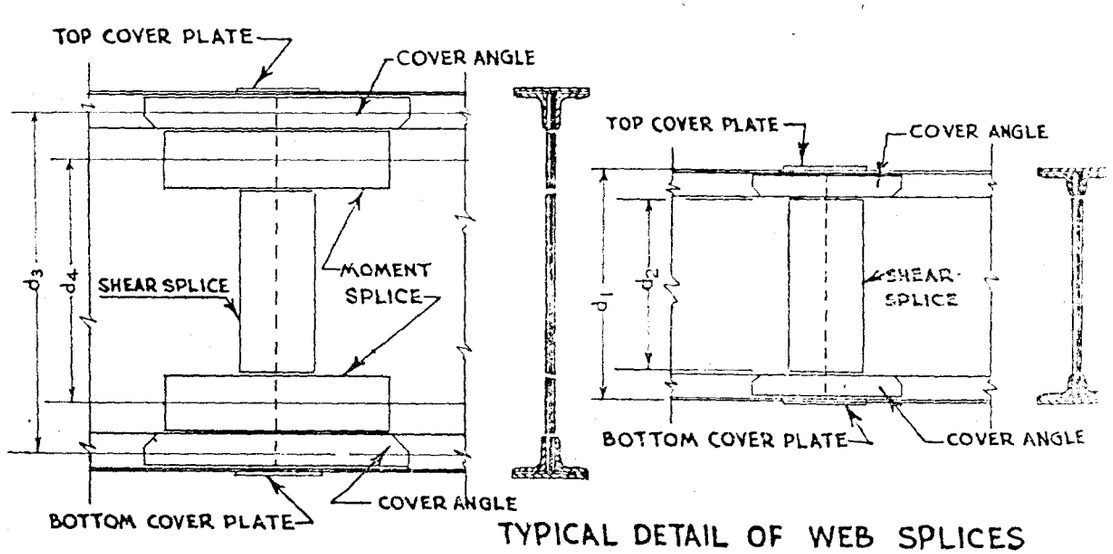
TABLE 7

Vertical loads on piers and abutments due to dead load and I. R. C. Class "AA" Live load plus impact

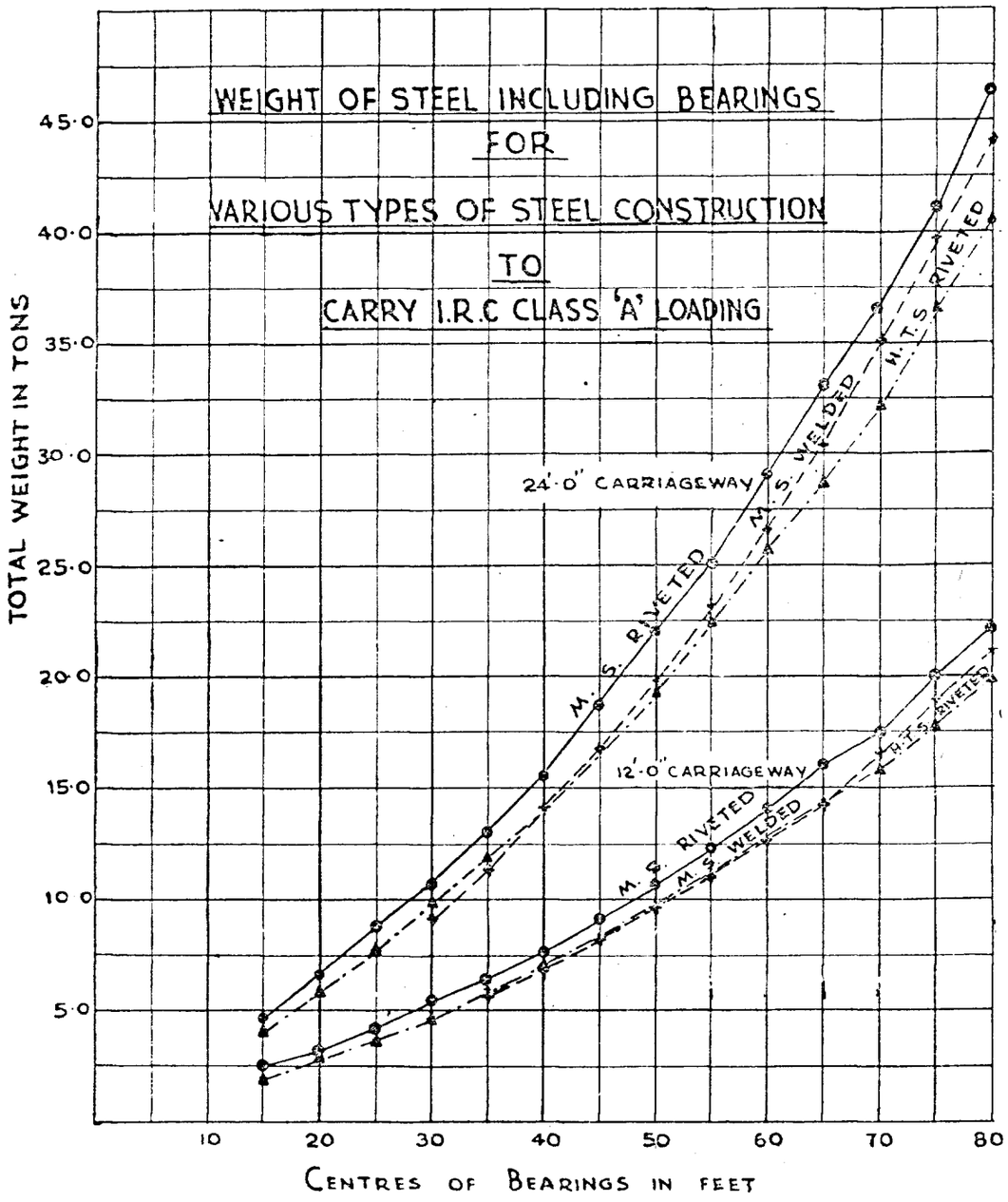
Span Feet	PIERS						ABUTMENTS					
	12'-0" Roadway			24'-0" Roadway			12'-0" Roadway			24'-0" Roadway		
	Dead Load A	L. Load + Impact B	Total Tons A + B	Dead Load C	L. Load + Impact D	Total Tons C + D	Dead Load A	L. Load + Impact B	Total Tons A + B	Dead Load C	L. Load + Impact D	Total Tons C + D
15	19.9	72.1	92.0	36.2	72.1	108.3	10.0	52.5	62.5	18.1	52.5	70.6
20	26.0	75.6	101.6	47.4	75.6	123.0	13.0	61.3	74.3	23.7	61.3	85.0
25	32.3	77.9	110.2	58.9	77.9	136.8	16.2	66.5	82.7	29.5	66.5	96.0
30	37.9	69.8	107.7	68.8	69.8	138.6	18.9	61.6	80.5	34.4	61.6	96.0
35	44.4	70.7	115.1	80.7	70.7	151.4	22.2	63.8	86.0	40.4	63.8	104.2
40	50.8	71.5	122.3	92.4	71.5	163.9	25.4	65.5	90.9	46.2	65.5	111.7
45	58.3	72.0	130.3	106.2	72.0	178.2	29.2	66.7	95.9	53.1	66.7	119.8
50	64.7	72.5	137.3	118.0	72.5	190.6	32.4	67.9	100.3	59.0	67.9	126.9
55	72.0	72.9	144.9	131.3	72.9	204.2	36.0	68.6	104.6	65.7	68.6	134.3
60	79.1	73.3	152.4	144.0	73.3	217.3	39.6	69.3	108.9	72.0	69.3	141.3
65	86.6	73.6	160.2	156.7	73.6	230.3	43.3	70.0	113.3	78.4	70.0	148.4
70	93.5	73.8	167.3	170.5	73.8	244.3	46.8	70.4	117.2	85.3	70.4	155.7
75	100.5	74.0	174.5	183.4	74.0	257.4	50.2	70.8	121.0	91.7	70.8	162.5
80	108.2	74.2	182.4	195.2	74.2	269.4	54.1	71.2	125.3	97.6	71.2	168.8

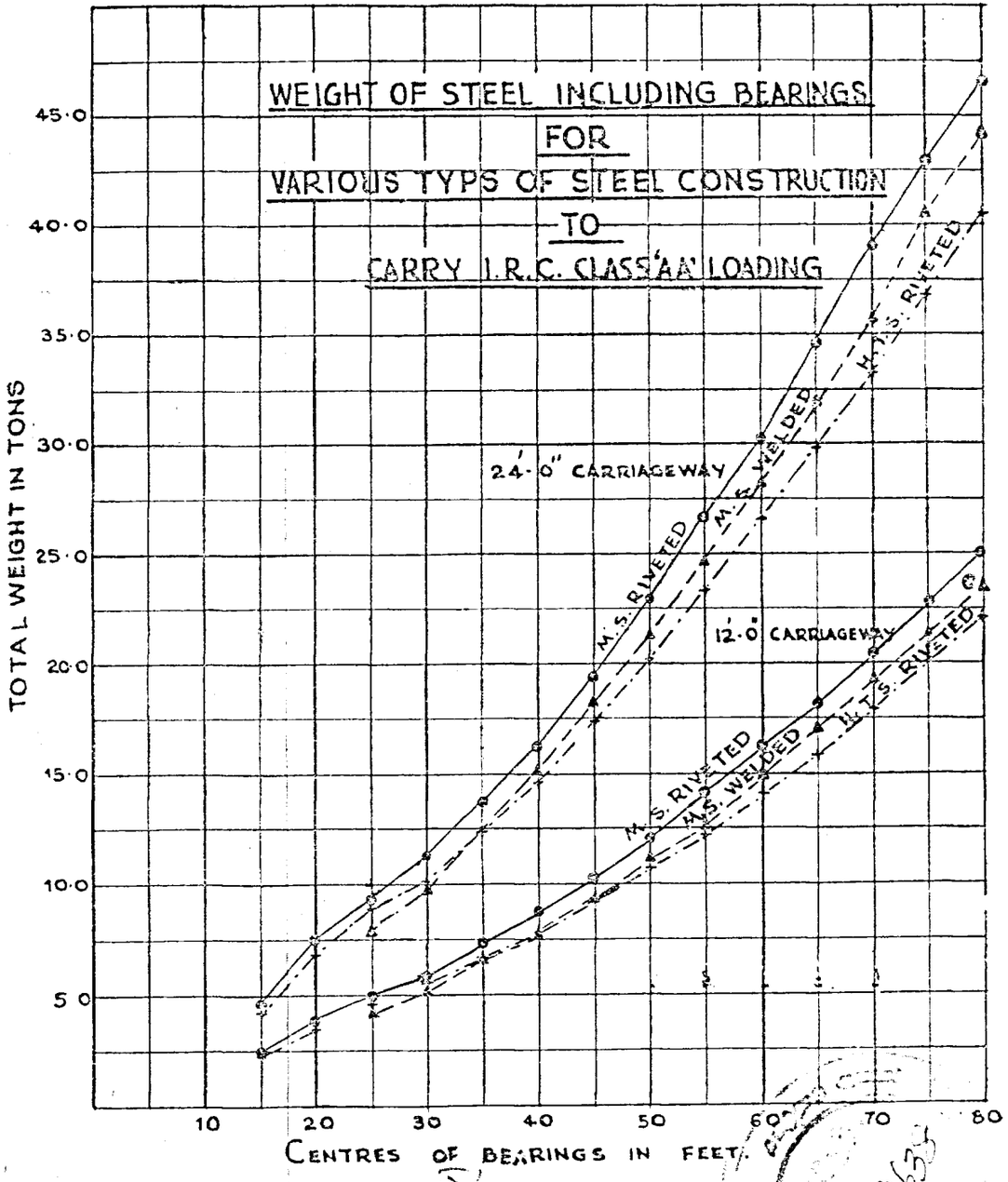


TYPICAL CROSS SECTION



TYPICAL DETAIL OF WEB SPLICES


WEIGHT OF STEEL INCLUDING BEARINGS
FOR
VARIOUS TYPES OF STEEL CONSTRUCTION
TO
CARRY I.R.C CLASS 'A' LOADING
TOTAL WEIGHT IN TONS
45·0
40·0
35·0
30·0
25·0
20·0
15·0
10·0
5·0
24'-0" CARRIAGEWAY
12'-0" CARRIAGEWAY
M.S. RIVETED
M.S. WELDED
H.T.S. RIVETED
10
20
30
40
50
60
70
80
CENTRES OF BEARINGS IN FEET


WEIGHT OF STEEL INCLUDING BEARINGS
FOR
VARIOUS TYPS OF STEEL CONSTRUCTION
TO
CARRY I.R.C. CLASS 'AA' LOADING
TOTAL WEIGHT IN TONS
45·0
40·0
35·0
30·0
25·0
20·0
15·0
10·0
5·0
24'-0" CARRIAGEWAY
12'-0" CARRIAGEWAY
M.S. RIVETED
M.S. WELDED
H.T.S. RIVETED
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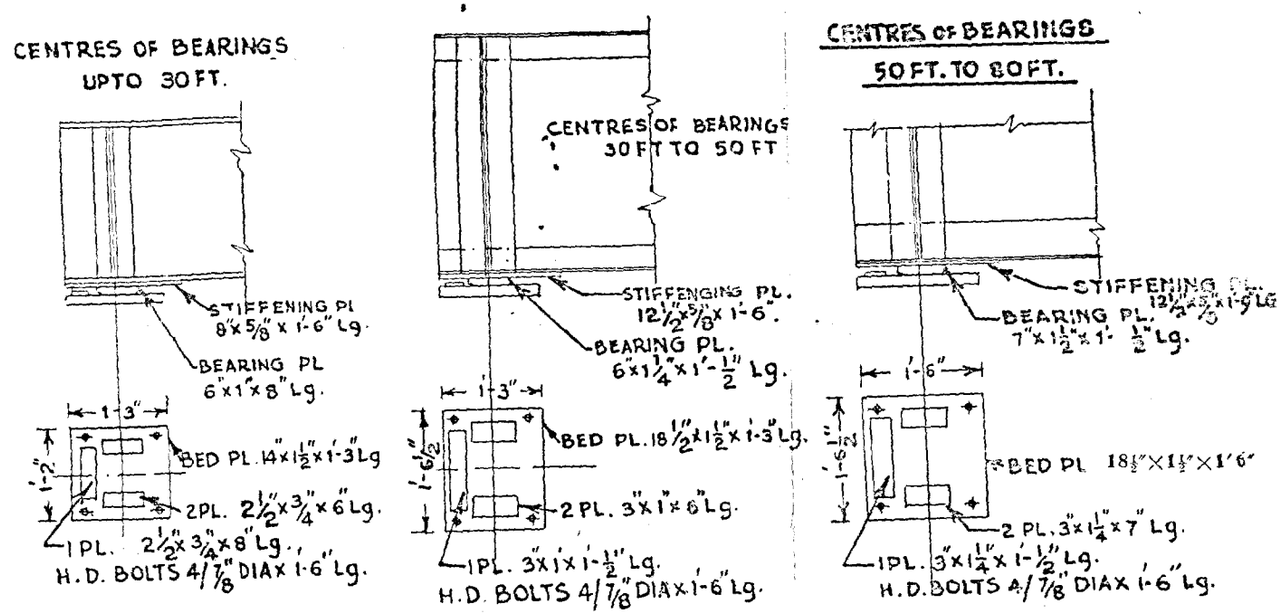
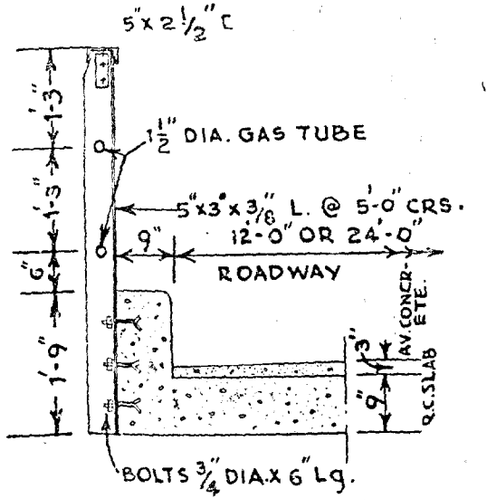
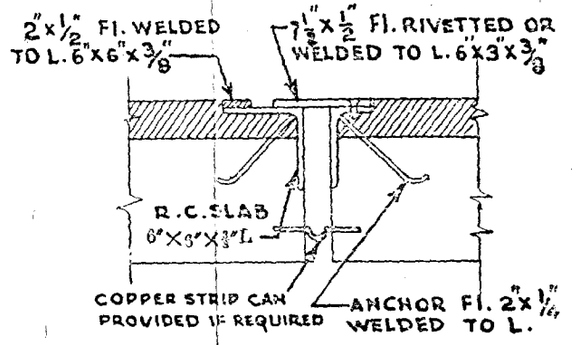
CENTRES OF BEARINGS IN FEET



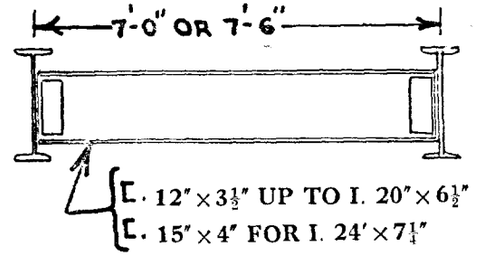
DETAILS OF SLIDING BEARINGS



DETAIL OF HANDRAIL STANDARD

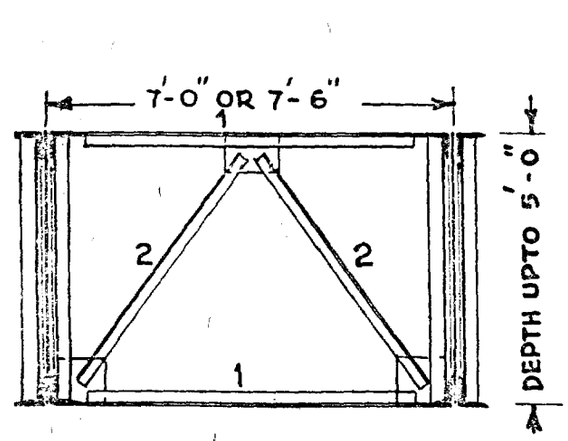


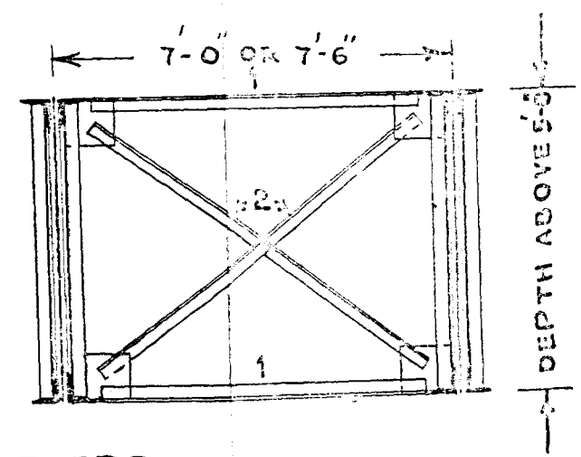
DETAIL BETWEEN TWO SPANS
EXPANSION JOINT.



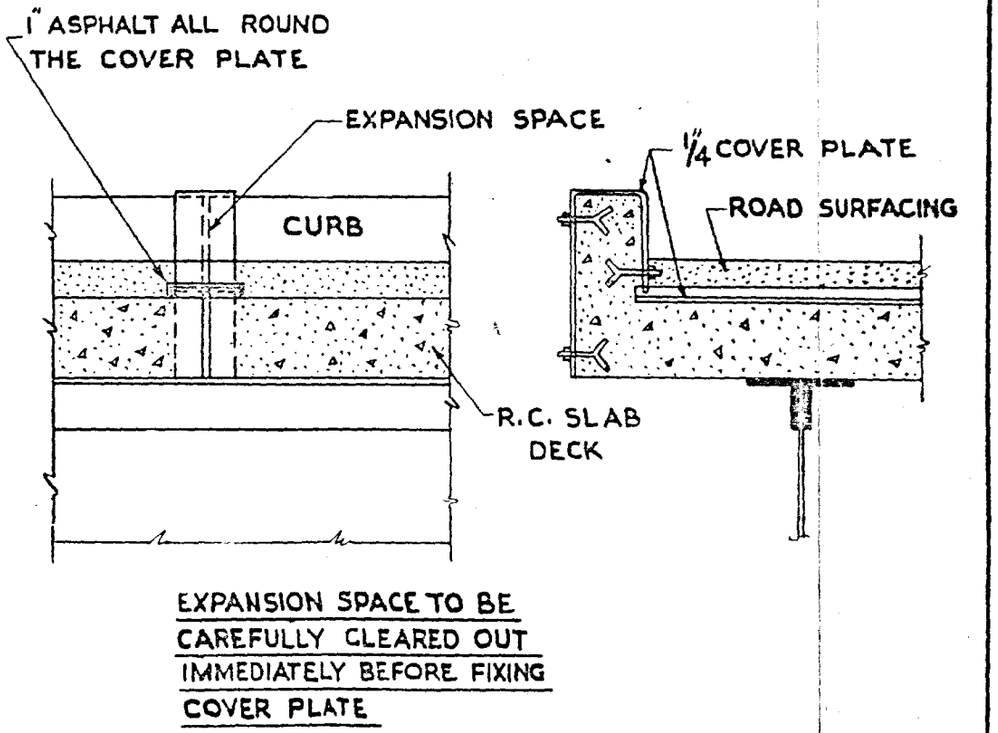
SECTIONS:-

1. IL. 3"×3"×$\frac{5}{16}$"
2. IL. 2½"×2½"×$\frac{5}{16}$"



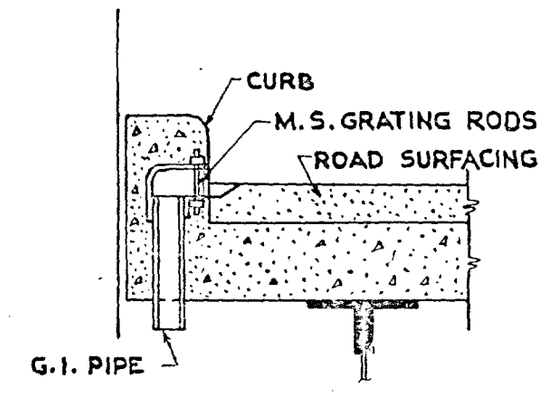


CROSS BRACING OF GIRDERS

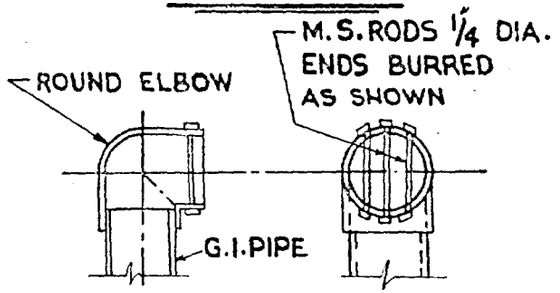


EXPANSION SPACE TO BE CAREFULLY CLEARED OUT IMMEDIATELY BEFORE FIXING COVER PLATE

PART SECTION AT EXPANSION JOINTS



PART CROSS SECTION AT CURBS



DETAIL OF GRATINGS

HERE AND THERE

1. YOU OWE YOUR EMPLOYER THIS

NO matter whether you are employed by a highway department, a contracting firm, a materials producer, a fabricator, a manufacturer, a banking firm, a college, an engineering firm, the Federal Government, or whoever, you owe your employer this, at least;

(i) A fair day's work, in output and quality.

(ii) A harmonious working relationship with your associates.

(iii) A willingness to accept constructive criticism and to seek to improve subsequent performance.

(iv) A sense of loyalty and the habit of speaking well of the organization in your relationships, with others.

(v) A respect for the organizational structure and therefore always staying within channels.

(From 'Highway Builder,' October, 1961.)

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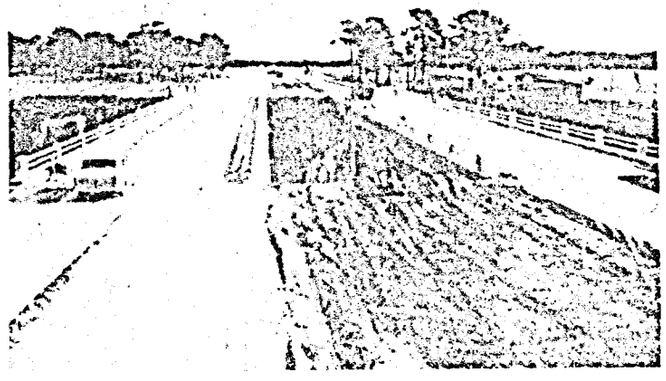
2. NEW TYPE RUBBERISED SEAL CHOSEN FOR AUSTRALIAN MOTORWAY

A NEW type of rubberised bitumen seal was used on the new Maltby by-pass, in Victoria, Australia.

The Australian office of the Natural Rubber Bureau states that the new additive consists of a solution of Malayan rubber and power kerosene (paraffin) mixed with bitumen. It was developed by the Victoria Country Roads Board in conjunction with the bureau.

The by-pass is on a section of the Prince's Highway connecting Melbourne with Geelong 45 miles away. This section was formerly a two-lane highway but had to be enlarged to a four-lane divided motorway owing to Geelong's rapid growth as an industrial centre. The by-pass consists of dual carriageways each 24 ft wide, is approximately seven miles long, and cost A944,500 pounds including the construction of bridges. Two lanes only are now



Twin bridges over the Werribee river before sealing

open to traffic but the other two are nearing completion and should come into use this month.

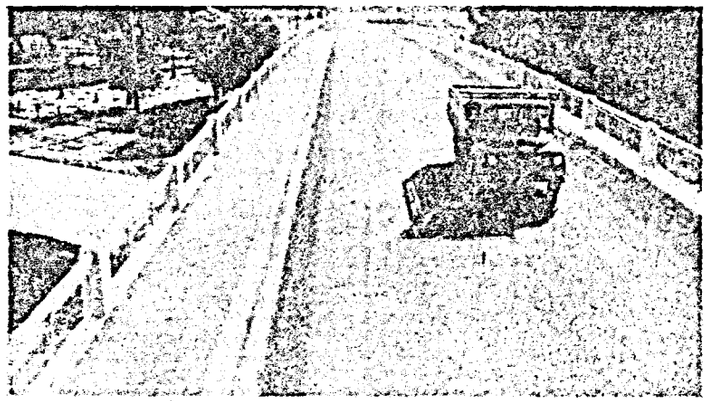
Specially Selected Rubber

Although work was interrupted by rain and temperatures varied considerably, a satisfactory result appears to have been achieved. The sealing was completed in less than two days.

The consolidated pavement was primed with a blend of vertical retort tar and tar oil before sealing with one-eighth of a gallon of rubberised bitumen per square yard and was then covered with three-eighths basalt chippings.

In earlier work carried out with rubberised bitumen by the Country Roads Board, the rubber additive has generally been in the form of a power added to the bitumen in heater kettles and then loaded to the sprayer and cut back with power kerosene. This method required approximately 40 minutes to dissolve and disperse the rubber powder.

Late in 1959, the Board working in conjunction with The Natural Rubber Bureau, began experiments with the development of a rubber solution which would disperse rapidly and readily in hot bitumen. This solution was made from a specially selected rubber of known physical properties treated to give a free flowing solution of standard viscosity when dissolved in power kerosene. Laboratory investigation and field tests indicated the practicability of such a solution.



Duncans road overpass at Maltby bypass, sealed with Rubberised bitumen

The benefits of using the rubberised solution are summarised as :

(a) Ready solubility in hot bitumen (as the rubber has already been dissolved in power kerosene).

(b) Flexibility of preparation.

The solution consists of approximately 20 per cent of rubber and 80 per cent power kerosene.

(From "Highways Bridges and Engineering Works," July, 1961.)

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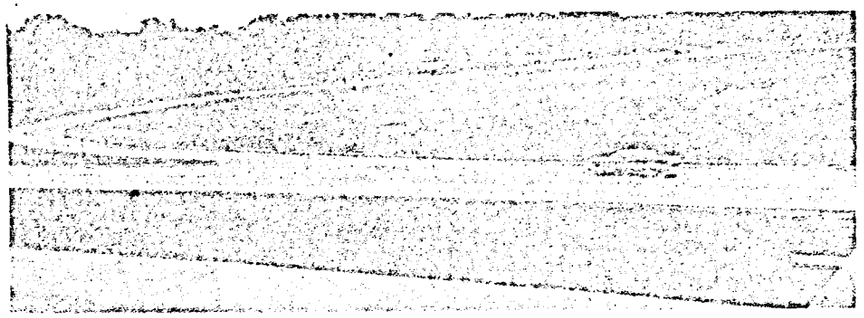
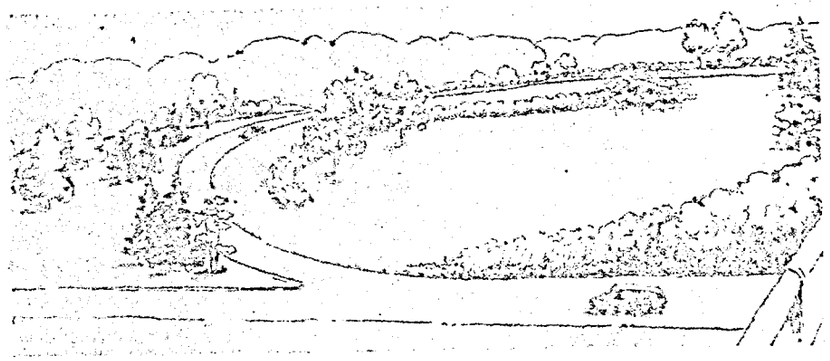
3. LANDSCAPING PLANS FOR MARYLAND EXPRESSWAY

● THESE PHOTOGRAPHS show what the Maryland State Roads Commission has planned for landscaping a section of the Baltimore Beltway. At the present time one of the quadrants of the Dulaney Valley Road and the beltway interchange looks like the top picture on the next page. It presents a large area of open grass to be mowed, permits drifting of snow on the highway and offers little delineation of the roadway.



Given below is an artist's conception of how the same quadrant will look after completion of the landscaping project. Planings will cut down on the mowing area, provide a living snow fence and delineate the roadway.

maintenance costs by reducing areas that require mowing during summer months and helps cut down snow removal cost by acting as a living snow fence in areas where drifting is prevalent.



The project is the biggest and most comprehensive landscaping job to be undertaken by the commission. The plans call for improvement of existing wooded land areas along the highway right-of-way. Trees called for in the specifications include maple, beeches, ash, sweet gum, tulip, plane trees, oaks, willow, linden, elms, dogwood, hawthorn, Carolina silver bells, crab apples, Japanese snow bells and evergreens.

Scientifically designed landscaping according to the commission, helps hold down

Some examples of scientific landscape design included in beltway projects are:

1. On the north-east quadrant on the Charles St. interchange plantings of trees to act as a sunshield for motorists turning into the west-bound lane are planned.

2. On beltway stretches adjacent to housing developments, plantings will include shields of evergreens to cut down distractions for motorists and highway nuisances for residents.

(From 'Better Roads,' October, 1961).

TENDERS ACCEPTED

State		Name of work	Name of Accepted Tenderer	Amount of work	Remarks
				Rs.	
Madhya Pradesh	1	Tenders for the construction of a submersible Bridge in mile 5/5of the Waraseoni Katangi Road.	Shri N. L. Garg, Contractor, Civil Line, Gondia.	2,25,000	
–Do–	2	Reconstruction of a breached portion of the Sheohari Causeway on the Jamini river in mile 45 of the Tikamgarh Orcha road.	S/S Gammon India Private Ltd., Hamilton House, Ballard Estate, Bombay-1.	1,15,250 (L.S.)	
–Do–	3	Tenders for the collection of metal, moorum and boulders for the improvement of miles 14 to 20 of the Bhopal Sehore road.	Shri Jaigovind Gopinath Contractor, 1600 Neem Street, Mhow.	1,40,622	
–Do–	4	Tenders for the work of construction of a submersible bridge across the Pahuj river on the Bhind Bhander road.	S/S R. N. Ghanekar &Co., 128, Bhandar Gully, Mahim, Bombay-16.	7,35,000 (L.S.)	
–Do–	5	Tenders for the construction of a high level bridge over the Urmil river on the Banda Sagar road.	S/S Shah Kantilal and Rasiklal, Gujrat Lodge Building, Jumerati, Bhopal.	2,30,622	
Kerala State		Improvements to Adivattu-Pareekanni road.	Sri P. K. George, P.W.D. Contractor, Kunnakkal, Muvattupuzhu.	27,132	
–Do–		Reconstructing the damaged wooden bridge across K. V. canal at Vaikom.	Sri C. B. Bhaskaran, P.W.D. Contractor, Vaikom	71,768	
–Do–		Widening and semigrouted sides of M. C. Road—Miles 117/2 to 120/0.	Sri P. K. Gangadharan, P.W.D. Contractor, Koothattukulam	34,864	

Tenders Accepted *(Contd.)*

State	Name of work	Name of accepted tenderer	Amount of work	Remarks
			Rs	
Karala State	Improvements to National Highway No. 47 Trichur-Vaniampara road. E. W. widening and Metalling the road from Miles 1/7 to 3/4.	Sri Paul Kallingal, P.W.D. Contractor, Kallingal House, Temple Road, Thotta-kattukara, Alwaye P.O.	44,534	
–Do–	Shelereting Edakunny Road Miles 0/0 to 4/3. Metal supply and remetalling.	Sri C. K. Govindan, Ezhuthassan—Vellu-kunnathussery, Avinissery	42,331	
–Do–	Constructing Deviation Road in 34th and 35th Mile—A. M. Road.	Sri E. M. Varkey, P.W.D. Contractor, Kolenchery.	79,984	
–Do–	Metalling the road from Koothattukulam to Pira-vom-Elanji Road.	Sri M. C. George, P.W.D. Contractor, Puthuvely, Koothattukulam.	41,971	
–Do–	Improvements—Vadanapally-Kandassankadavu Road.	Sri M. S. Sankara-narayanan, Vadanapalli P.O. (Via) Trichur.	32,096	
–Do–	Rubber Plantation Scheme—Chalakudy Area—Adira-pally block—Opening roads —Main road—1st Section.	Sri Kassim Rowther. Muvattupuzha.	88,275	
–Do–	Resurfacing Provincial High-way—Karupadanna Road —Flood damages.	Sri C. K. Govindan Ezhuthachan, Vallakunnathussery, Avinissery.	54,452	
–Do–	Rubber Plantation Scheme—Chalakudi area —Kanni-mangalam block—Opening road inside the Plantation (Main Road).	Sri K. P. Poulo. Peechanikad, Puliyanam.	79,670	
–Do–	Special surfacing Vazha-kulam - Kothamangalam Road—Miles 0/1 to 1/8 and Neerampuzha-Kaloor Road-Miles 0/1 to 1/3 semigrout-ing.	Sri M. C. Chacko, P.W.D. Contractor, Ayavana P. O.	37,555	

Tenders Accepted (*Contd.*)

State	Name of work	Name of accepted tenderer	Amount of work	Remarks
Kerala State		Ernakulam (B & R) Division Bridges Division, Alwaye Buildings Division, Trichur National Highway Division, Alwaye	Rs.	
Do.	Improvements to C. C. Road from Athani to Aroor.	Sri P. V. Mathew, Pandaliyil House, Keerampuzha, Kothamangalam P.O.	20,656	
Do.	Improvements to Thiruthypuram - Iyoor Road—Portion from Kandassankadavu up to Thondal Bridge.	Sri V. M. George, Contractor, Vilcanacherry House, Perumbavoor.	75,793	

(*Continued from page 32*)

Road investments and economic development influence of the road network on the economic development of a region or a country; use of the national accounts for the evaluation of that influence. Evaluation of the capacity of roads from the economic stand-point—calculation and principal results; comparison with the practical capacity. Planning road networks—general case. Under-developed countries. Planning road networks in built-up areas in—case of expanding towns and new cities; resultant human and social problems.

Ninth question:—PARKING—SERVICES, ETC.

Estimating the need for parking. Influence of number of parking places available. Revenue and financing of parks and garages for vehicles. Filling stations—telephones—road service areas—rest areas airport terminals. Lighting of roads. Boundaries and lateral protection of roads; verges fences and safety fencing. Restrictions imposed along roads, limitation of right of access.

Tenth Question:—ROAD AESTHETIC PROBLEMS.

Fitting the road into the landscape; case of tourist routes. Visual aids to driving. Roadside planting. Advertisement along roads.

(*From 'The Surveyor and Municipal and County Engineer,' 6th January, 1962.*)

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