TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW (TCMR)

APRIL 1961—No. 168

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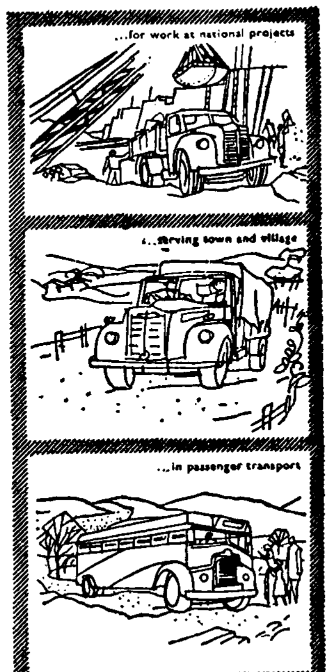

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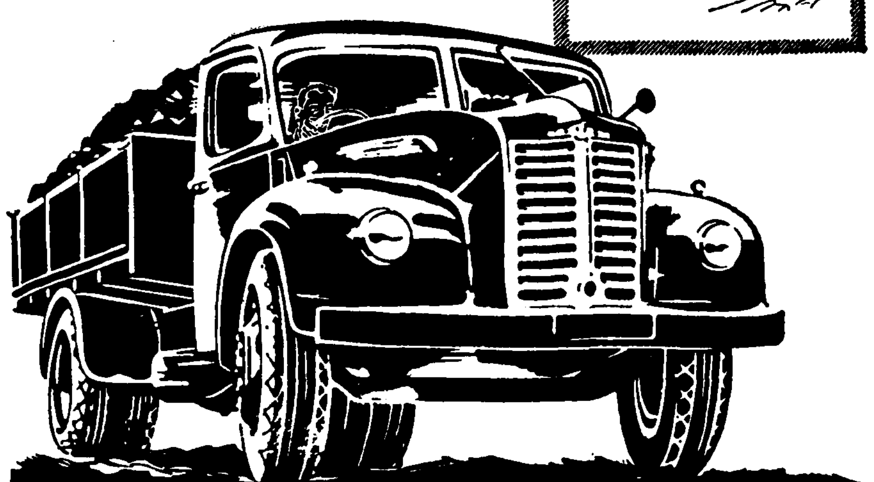

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TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

APRIL 1961—No. 168

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TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

APRIL 1961

Major-General HARKIRAT SINGH

ENGINEERS AND ADMINISTRATION

By

Major-General HARKIRAT SINGH*

From the Presidential Address to the 41st Annual General Convention of the Institution of Engineers, India, at Bombay on 4-2-61

A BRIEF study of our five year plans will show that nearly 70 per cent of our activities require engineer appreciation, planning and execution. It is apparent, therefore, that the success of our plans depends largely on our engineers. They are our first-line troops. It is vital to ensure that they are capable and their morale is high. It is, therefore, vital that management of engineering enterprises is of the highest order.

In a lecture given to a joint session of the Institution of Civil, Electrical and Mechanical Engineers in England, Sir Ewart Smith dealt with the subject of "Management and the Engineer". Defining Management as the organisation and control of human activity directed to specific ends, he said:

> "It would appear that the basic training and subsequent experience which are normal for the professional engineer should be pre-eminently suited to the development of good managerial qualities. Every engineering activity has a clear and immediate purpose, the achievement of which demands planning, decision, and control. The engineer is brought up on the idea of change and progress. He has to carry responsibility for his work and results more directly than in almost any other profession; his mistakes are there for all to see, he has either to correct them or to live with them—a most salutary fact. Engineering, too, always depends on co-operative action with other people. The engineer is exceptional also in having the opportunity to see management from the under-side, and to gain experience of rank and file reactions during his period of practical training. Thus, the professional engineer should be well-equiped to undertake wide managerial responsibilities. It is beyond question that he normally does so with success in his own field."

Yet in spite of these inherent advantages, we find that in India very few engineers are being utilised in the field of senior management in either the private or the

*Engineer in Chief, Army Head Quarters, India.

public sector. In the last few years, I have met a large number of engineers from Trivandrum to Srinagar and from Amritsar to Imphal. According to their general opinion, leaving aside exceptions, our engineering and industrial activities are not working at more than 75 per cent efficiency. Some consider even this figure to be optimistic. If with proper management we could make the effort of our material and human resources go 20 to 30 per cent farther than it is now, we may have a better chance of going towards our goal of achieving higher economic growth.

Industrial expansion is only one part of economic growth. The other part where engineers are closely concerned deals with the development of our water resources, transport facilities, including railways, roads, ports and civil aviation, building activities, generation and distribution of electric power, tele-communications and so on. Expansion of these facilities is the essential pre-requisite for any increased activity to carry out a planned programme aimed at betterment of the masses. These facilities are provided by State P.W.Ds., B/R Branch, Irrigation Branch, Electricity Branch, and Central Services like the Railways, Posts and Telegraphs, Civil Aviation and other similar departments. With the exception of railways in all these departments both at the Centre and the State level, the top management, that is, secretaries to Government, are generally I.C.S. or I.A.S. officers. In many States even the Chairmen of the State Electricity Boards are drawn from these services. In some places even technical education and training is not in the hands of engineers.

After tracing the history and development of the Civil Services in India ever since Macaulay laid down the principles of recruitment and promotion of the I.C.S. in 1834, Shri S.B. Joshi in his presidential address to the Institution of Engineers at Hyderabad in 1955 described the duties of a secretary to a Government Department and the relationship between the Minister and the secretary. After giving the full case in favour of the I.C.S. and the I.A.S. regarding their claim to occupy the key position of the secretaries to technical departments, he said:

> "It will be seen that the whole theory of the Administrative Service is based upon conditions which existed a hundred years ago. In those days the State was more concerned in maintaining law and order. The State has now undertaken the functions of a welfare state which include the management of industries and other enterprises."

An imperialist power primarily interested in law and order has to have strong and centralised civil and police services. But we feel that a nation interested in economic growth and industrial development needs strong and centralised engineering, educational and medical services. The opportunities that a centralised service offers will give engineers that wide experience and broad outlook so essential in top management. Moreover as our main rivers, our roads and communications, our power distribution systems have to cross State boundaries, it is important that engineers who have to deal with these matters should belong to an inter-State cadre and should develop a national outlook.

The argument of relieving engineers of administrative duties because their is a shortage of engineers does not stand the test of arithmetic. For about 50,000 engineers in the country the key posts that we are talking about number hardly one hundred or so, but they effect the work of these 50,000 engineers. Against this we are training about 6,000 engineers per year. There is a collossal waste of time of the senior engineers under the present system. I have heard many Government Chief Engineers say that they could double their output if they took on the duties of secretaries over and above their own duties. And, if there is a shortage of engineers, surely we should not thus waste their time.

Engineers have been accused that they want to give up the creative work for which they have been trained to take up the uninspiring work of secretaries and pen pushers. Do not get us wrong on this point. If engineers want to take on the secretaries' duties it is in addition to their own duties because then they would have the necessary authority commensurate with their responsibility. As time and effort now consumed in secretarial discussions would be saved, they could do more creative work for the economic and industrial growth of the country.

Another argument that has recently been advanced is that many States have a

number of Chief Engineers and, therefore, it is necessary to have a non-technical secretary to co-ordinate their work. Being non-technical he would be impartial. It is also stated that as there are a number of specialists in almost every department, no single engineer could be found who would know enough about all technical subjects dealt with in that department and hence an engineer-secretary would be no better than a non-technical officer. One might as well say that as musicians in an orchestra play so many different instruments and as the pianist cannot play the violin it would be just as well to have a layman conduct the orchestra. All I can say is that I might admire the courage of such a layman who with the co-operation of the musicians might succeed for a while, but I would not expect any great musical achievements from him. I would prefer the conductor to be a musician.

I have a suggestion to make on the organisational aspect of the technical departments of the State Governments. In view of the fact that all States have a number of Chief Engineers, I recommend that each state should have a whole-time Chairman of an Engineer Board of which the various Chief Engineers should be members. In addition to co-ordinating the work of various Chief Engineers and of other engineering and technical enterprises in the State he should have the following directorates under his control:—

(a) Personnel administration and training
(b) Centralised planning
(c) Works study
(d) Research, development and standardisation
(e) Engineer stores and plant.

I am convinced that such an organisation will revitalize our engineering departments and would give them a dynamism that modern engineering practice needs and which is necessary for the development of our country. There is a Greek saying that "Even gods do not fight against necessity".

It is important to know how the great political leaders of our country, who rank amongst the great men of this century, view this problem of the engineer, manager and administrator.

You, Mr Vice-President, stated in your report of the University Education Commission in 1949:

> "As civilisation grows more and more complex and new discoveries in science and technology are being put to large scale use, great engineering adventures are being undertaken in every country, for example, the Tennessee Valley Schemes and the Atomic Energy Projects in the U.S.A. and the great hydro-electric and river development projects in different countries of the world, including our own. Earlier we had the great Railway and canal projects. The organisation of large factories like the Tata Iron and Steel Company falls in the same category. The ideal head of such an organisation should be an executive who is also an engineer, scientist or technician and who has an intimate knowledge of the science and technique of the particular undertaking, both on the theoretical and practical side: and besides has knowledge of finance and business administration and can handle large bodies of men. Such combinations are rare among professional engineers or scientists and therefore very often such posts were filled by lawyers, financiers, or even political leaders. Though some of these administrators have done their job well, there have been many failures or cases of gross mismanagement. It is preferable that engineers and scientists are put in charge of such jobs."

At the inauguration of the Indian Science Congress at Poona in 1950, Pandit Jawaharlal Nehru said:

> "Today unexpected pressure has come to bear upon us in the economic and other spheres with the result that we have to think entirely in terms of a rigid economy. All these difficulties have come when we thought of a vast number of schemes to raise the standard of living.
>
> We are dominated by a lawyer's mentality and more lately by a classical scholar's. Latest in the picture is the businessman's mentality. The lawyer still plays a fairly

(Continued on page 29)

THE IMPACT OF THE MOTOR CAR ON PUBLIC TRANSPORT

By

J. M. A. Smith

The Sixteenth Henry Spurrier Memorial Lecture delivered in London on December 12th, 1960. The Author is a Director, Ford Motor Co. Ltd. and Deputy President, Society of Motor Manufacturers and Traders.

We all spend a sizable part of our lives in travel, and we are constantly making decisions in respect of the alternative means of travel which are available to us. Each of us is conscious from his own personal experience of the infinite variety of considerations which determine whether a journey is to be undertaken, or if a letter or telephone call will do, and if it is to be a journey, what is to be the means of conveyance, route and timing.

I propose first to look at the impact which private vehicles have already had upon public transport in this country; then to examine the reasons for the changes which have taken place; and finally to hazard some opinions as to the course of future developments. In this all forms of inland public passenger transport will be considered, but air travel only briefly; private vehicles will include motor-cycles and scooters where appropriate.

The Extent of the Impact

Until the turn of this century railways had reigned supreme in the field, supplemented by the horse bus and cab for short local journeys. Private transport by horse and carriage was also local, but statistically unimportant; private trains were the prerogative of royalty and millionaires.

Since the coming of the internal combustion engine there have been tremendous changes. Table I indicates these broadly in rather crude terms of vehicles in use, with 1939 as the base year.

For the railways a decade of growth was followed by a long period of slow contraction. For public service vehicles we see 20 year of rapid expansion, and then a slow decline; a post-war peak is followed by a reversion to pre-war levels.

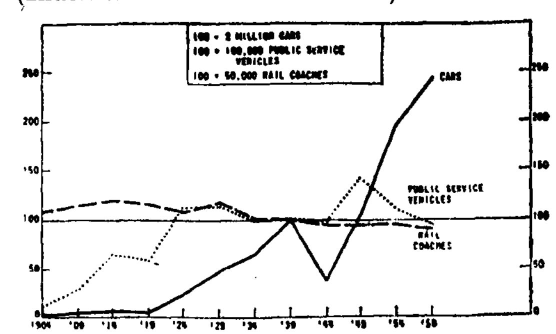
For private vehicles—on this chart cars only—we see the steady growth between the wars and then, after the car population was halved during the last war, a much steeper rise.

But we learn little if we know only how many vehicles there are without something also of their usage.

Table I

Passenger Vehicles in the 20th Century

(Index of Total Numbers in use) 1939 = 100



Only for British Transport Commission undertakings do we get official estimates of passenger miles travelled. For other public transport services and for private cars it has been necessary to make a number of broad estimates in compiling Table II. I believe, however, that it is sufficiently accurate to illustrate relative developments in various types of inland travel in this country in the past decade.

It is perhaps easier to understand these astronomic figures if expressed in terms of miles travelled daily by each inhabitant in this country—in 1951 six miles and now eight miles.

Within the past decade all travel increased by 27 per cent. In 1951 public transport accounted for more than two-thirds, but only half to-day; private transport has more than doubled, while public transport has declined by 6 per cent. Rail travel accounts for only about one-third of public transport; overall, it has improved its position slightly, but road travel has declined significantly more. However, in the London Transport area both rail and road have declined, road travel the more seriously—by 28 per cent. Outside London, rail has done comparatively well in contrast to a 8 per cent decline in public road transport.

Air travel has had the most dramatic growth—by 200 per cent—though as yet negligible in the total picture. (It is unlikely to be significant in the foreseeable future as our distances are so short, our rambling cities make airports so remote, and our weather conditions are so limiting: it will therefore not be considered further in this paper.)

Table II

Inland Travel in the United Kingdom

(in 1,000 million passenger miles)

	1951	1959	*Percentage change* 1951—1959
PUBLIC TRANSPORT			
Rail:			
London Transport	3.7	3.2	− 15
British Railways (London Lines)	4.6	4.8	+ 5
	8.3	8.0	− 4
British Railways (other)	16.0	17.5	+ 9
	24.3	25.5	+ 5
Road:			
London Transport	8.7	6.3	− 28
Other	42.6	39.0	− 8
	51.3	45.3	− 12
Air	.1	.3	+ 200
TOTAL PUBLIC TRANSPORT	75.7	71.1	− 6
TOTAL PERSONAL TRANSPORT	33.3	67.4	+ 102
	109.0	138.5	+ 27

The growth of private travel reflects the fact that in the period cars, motor-cycles and scooters in use have more than doubled (from 3.2 millions in 1951 to 6.7 millions last year, and over 7.0 millions today), whilst intensity of usage has remained approximately constant.

However, this only takes us part of the way towards an understanding of the nature of the forms of travel and journeys undertaken. We need to know more about the usage of vehicles, length of journey, purpose, regularity, etc., in the various parts of the country. For London information is good, but elsewhere it is far from complete.

Table III tells us average lengths of journeys and their frequencies.

Table III

Public Passenger Traffic Data (1959)

83

	Average Journey (miles)	*Average Journeys per annum*
RAIL:		
London Transport	4.8	67
British Railway (London Lines)	9.5	50
British Railways (other)	31.0	14
ROAD:		
London Transport	2.3	275
Tillings and others	3.4	300
Scottish ...	4.9	149

The frequencies suggest that there is a very high content of season ticket (commuting) journeys.

Information about traffic flow, obtained from automatic traffic counts at many points throughout the country is shown in Table IV.

Table IV

Traffic Flow Trends

(1951 = 100)

	1959
Motor-cycles	173
Cars and taxis	213
Public service vehicles ...	98
Goods vehicles	142
Pedal cycles	66
All motor vehicles ...	179

This confirms the doubling of car travel and the falling off .n public road transport. We s:e also the very sharp decline in pedal cycle traffic, a large part of this being lost to motor-cycles and scooters.

On average, each private car travels just over 8,000 miles per annum, or rather over 150 miles per week. This may seem high in relation to our personal experience, but we must remember that probably at least 40 per cent of private cars are used more or less intensively for business purposes. Motor cycle annual mileage is less—only 3,500. Public service vehicles are of course most intensively used, averaging 31,000 miles per annum.

Table V gives the result of a survey of weekday travel in the London district.

TABLE V

PERCENTAGE DISTRIBUTION OF TRAVEL ACCORDING TO PURPOSE OF JOURNEY

(8 a.m. to 6 p.m. weekdays)

Purpose of Journey	*Method of Travel*			
	Bus and Trolley-bus	*Cars*	*Taxi*	*All motor vehicles**
Work (in official time)	4	29	22	10
Work (in own time) ...	56	47	24	54
School ...	12	3	2	9
Shopping ...	11	4	4	9
Recreation and other reasons ...	17	17	48	18

* *Excluding solo motor-cycles*

More than half is peak-hour travel to work.

Household and school travel is mostly by public transport, in contrast to business travel (work in official time) where private cars are much more intensively used.

Another London survey also showed that of journeys made by public service vehicles under $3\frac{1}{2}$ per cent were over five miles, but no less than 23 per cent of all journeys by car exceeded that distance.

Within recent weeks we have heard more of London's commuting habits. Trends are shown on Table VI.

TABLE VI

PEAK TRAFFIC TO CENTRAL LONDON AREA

(thousands of passengers)

	1952		1959	
Public Transport				
British Railways ...		382		438
Underground ...		453		489
Road Services ...		286		222
		1,121		1,149
Public Transport				
By cars ...	45		85	
By other vehicles ...	24		31	
	—	69	—	116
		1,190		1,265

Although many more people are travelling into London by private transport at morning peak hours, they still represent only one-tenth of those using public transport at that time. Public transport has in fact held its own, the loss in road services having been more than compensated by increased rail travel, both underground and surface. The latter is remarkable in view of the decline of 4 per cent overall in London rail travel (Table II), suggesting that the loss in non-peak rail travel must have been greater. This may be explained, at least in part, by the fact that, after peak hour each weekday, over 150,000 people travel into London by car, and a further 50,000 each evening. In all, it seems that well over 300,000 people travel daily into London by private transport, and that this traffic may well have doubled in the past ten years.

Even if all this additional private travel has been at the expense of public transport, it can only account for a small proportion of the 2,700 million passenger miles they have lost (Table II). It can only be concluded that the balance of this loss of traffic must be attributed to other factors such as the 10 per cent loss of population in Central London in recent years; more stay at home because of television, etc.

A recent London traffic survey tells us also that over 40 passengers per bus are carried during peak hours. This has obvious advantages in economy of road space, compared with about 25 cars to carry the same number (at the effective week-day average of about $1\frac{1}{2}$ persons per car). Motor-

cycles and particularly scooters are, of course, virtually proof against traffic jams and as such their popularity and use in city centres has increased greatly in recent years.

In provincial cities and large urban districts traffic conditions at the centre are not dissimilar to those in London. However, the congested area is less and the approach journey is generally easier. It is therefore probable that a higher proportion of car owners use their cars for city journeys. Even so, public transport probably continues to carry the bulk of traffic at peak hours. The pattern of car usage is probably not unlike that of London (see Table V).

In the country, with its greater dispersion of population, public transport services of necessity are less accessible and less frequent. Private cars with their greater flexibility have made faster inroads. For example, there is one car per seven inhabitants in Cornwall and Rutland compared with one in eighteen in Liverpool, and a national average of one in ten. T..is is not inconsistent with a Ministry of Labour survey some years ago which stated that, on average, households in rural districts spent nearly twice as much on private transport as those in towns.

The closure of certain branch railway lines and stations has added to rural transport problems, and this process will continue. This will give opportunities to the bus services, but at the same time is bound to add to the social problems which a public transport vacuum creates.

British Transport Commission commentary on their road passenger services in their 1959 report is interesting :—

Prospects for the road passenger services are less promising. In spite of continuing technical improvements, the buses are gradually losing passengers because they cannot provide, except perhaps at peak periods, as convenient a service as the private car for the relatively short journeys for which the bus servic:s mainly provide. Except in large towns, the volume of bus travel outside peak hours is too small to support frequent interval services which free the passenger from the discipline of the timetable. The cheapness of bus travel is not enough to offset this disadvantage. Moreover, increased road congestion raises operating costs, still further reducing the attractiveness of bus services to the public. Reductions in frequency and other economies will help to maintain the services needed by members of the community who have no alternative means of transport, but such measures tend to discourage those who are better off from going by bus. In many country districts, the downward trend has recently become more pronounced.

The Jack Committee appointed to review the adequacy of rural bus services, will report shortly, but meantime from local surveys we hear that :—

(1) Where railway branch lines and stations have been closed, only about half the former train passengers then used buses regularly, the remainder buying cars, arrangıng lifts or changing their place of work or travel habits.

(2) When bus services become infrequent more cars and bicycles are bought, and once people buy a car they use it for nearly all purposes.

(3) A small increase in the number of cars may lead to a disproportionate loss of bus traffic because car owners in the country always arrange lifts for friends.

From this miscellaneous data we can begin to piece together what has happened in the field of passenger travel :—

(1) At week-day average of $1\frac{1}{2}$ persons per car, over 8 milion people could travel daily by car, and about $2\frac{1}{2}$ millions by motor-cycle, or in all one-fifth of the nation.

(2) Only a proportion—probably less than half—elect to do so in the cities where public transport retains a strong hold for commuting, shopping and household travel. Substantial use is made of private cars for business purposes, and public transport has little part in this.

(3) In the country however private transport has made greater inroads, and is used intensively for all purposes throughout the week.

(4) At week-ends and on holidays, when families are united, probably one-third of the nation can travel by private transport. This is mainly for pleasure and, although some of this represents loss to public transport, the greater part undoubtedly is additional pleasure travel made possible by car ownership.

(5) Passenger traffic by train between cities, mainly for business, has been well maintained.

It is evident that there is a very powerful urge towards private vehicle ownership. It is as well therefore, before going on to consider future transport development, to understand first the motives which lead to the purchase of a private vehicle, and secondly the circumstances under which, even if a car is owned, public transport might be used.

Reasons for the Change

The dominant advantage of car ownership is the freedom and independence which it confers—freedom in one's leisure hours, at week-ends and at holiday times; freedom also from the tyranny of the timetable, of luggage problems and of weather. It lightens household duties, conveys children to and from school, and brings home the bulky shopping parcels. It makes easy the visit to relatives and friends, which otherwise might never take place. It opens up new vistas, countryside and sea. A car facilitates travel to work, choice of work in relation to one's home, and eases travel problems with the certainty that under all conditions—independently of weather and of strikes—one can step into the car, choose one's route, and get to one's place of work dead on time. Travel by private car wastes no time, and has an even more potent attraction for business-men, salesmen, inspectors, buyers and all whose livelihood depends upon the urgent use of every minute of the day.

This freedom and independence does however presuppose that the road will be clear and that the car can be readily parked at the end of the journey. Where the road is congested, or where parking or garage space is uncertain or too expensive, public transport may be preferred, or even a necessity. Also, particularly on long journeys, public transport with facilities for work, rest or refreshment may be preferred. Thus, even after acquisition of a car public transport, and particularly trains, will have wide appeal in many circumstances.

Car ownership obviously has high priority for the spending of marginal incomes. Last year 5.5 per cent of total personal expenditures in this country was spent on private motoring, and only 3.4 per cent on public transport. In the U. S. A., the most motorised country of all, the rate of spending on private motoring was almost double that of this country.

Now consider the financial implications of car ownership upon a typical family. At first income may be sufficient only for basic needs and essential but very limited travel; later money may be enough to permit some travel for pleasure, and at this stage holiday travel by public transport—excursion or tour—becomes a reality; ultimately car ownership may become a real possibility. It is evident that already one-third of the nation has passed this point; another third will cross this Rubicon well within the next decade, and most of the remainder will do so within 20 years.

The acquisition of a car by most families is a momentous decision, probably second only in importance to house purchase. In most cases it is an ambition planned for over a long period, and perhaps achieved only when dependants within the family start to earn. Usually the first car is secondhand, perhaps of fairly early vintage. The financial position may be eased by the prospect of sharing running costs of journeys to work with fellow workmen. For each family the calculation is different, but the common factor is the incessant urge towards car ownership, involving heavy sacrifice in many cases and assumption of liability by hire purchase, mortgage or otherwise. The first car purchase, with nothing to exchange, is of course the biggest "hump" of all. Fixed charges for registration and insurance and an unexpected heavy repair bill may present minor crises, but after these are surmounted it is probably only the direct cost of petrol (between 1d. and 2d. per mile) which enters into the choice of making a journey or not, and how far to go. Once a family has a car public transport seldom competes on cost alone; with the driver only the cost calculation may be marginal, but with one passenger or more it is predominantly in favour of car travel.

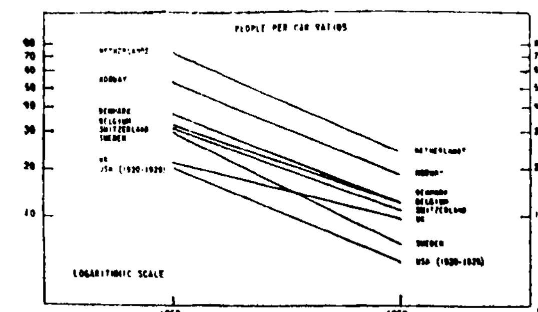
Future Developments

Now looking into the future, we have first to consider how large the car population will be. The Industry's forecast indicates that by 1975 the number of cars in use will be 13.5 million; adding the 3 million

motor-cycles and scooters then estimated, we get 16.5 million private vehicles in all. Cars alone in those 15 years will have increased by nearly two and a half times.

There is nothing novel in this prospective rate of growth for we are simply following, in company with other leading Western European countries, the path trodden by the U.S.A. 30 years ago. In the table which follows the trend for the United States is that which took place between 1920 and 1929; for all other countries the trends are those which took place between 1950 and 1959.

TABLE VII



One person out of three in the U.S.A. has a car, and in the main Commonwealth countries about one in five. It is one in seven in Sweden, and one in ten in France and in this country. Western Germany, a late starter, has one car in fourteen people, and is fast over-taking us.

TABLE VIII

PRIVATE AND PUBLIC TRANSPORT IN WESTERN EUROPE

	Percentage of Total Passenger Transport		*Total Passenger Transport (in 1,000 million passenger kilometres)*
	Private	*Public*	
Sweden ...	70	30	32.3
France ...	60	40	113.0
Western Germany ...	55	45	228.0
Itlay ...	52	48	118.5
Belgium ...	49	51	28.5
United Kingdom	48	52	220.0
Norway ...	32	68	6.8

In Western Europe generally, the motor car has made a far greater impact upon public transport than as yet in the United Kingdom.

But is the indicated rate of growth of car population in this and other countries inevitable? Will incomes grow to the point that car purchase will come within reach of every family budget in the land, and will this not impose too great a strain upon our economy?

I can see no reason why the growth in demand for private transport should level off. It is directly related to the rate of growth of national income and, in spite of inevitable short-term fluctuations from time to time, the trend must be steadily upward. A distinguished economist has recently arrived at independent estimates which, while indicating a slower rate of growth in the next decade or two, visualise an ultimate car population far in excess of the Industry's estimate. He points out that the growth in car population in recent years has run very close to the growth in the number of people with an income over 850 pounds a year at current prices.

Between the 700 pounds and 800 pounds income level there are over $2\frac{1}{2}$ million people in this country, and in each 100 pounds income bracket below that there are nearly 3 million people waiting for the day when the growth in their real income level will make car ownership possible. Increase in car ownership has been supported by the fact that real motoring costs have dropped by about 10 per cent in the last decade.

At the moment credit restrictions in the home market are being suffered by car buyers. This restraint is imposed temporarily as part of general corrective action by the Government. In no way is there any suggestion of deliberate permanent restrictive policy to divert consumer choice away from car purchase.

A more serious and long standing burden to the industry is the continuance of purchase tax on cars at the present extremely onerous level of 50 per cent. The degree of handicap which it imposes upon the competitive power of the motor industry is now beginning to be more clearly recognised, but the tax is still retained on the grounds that no loss of revenue from that source can be accepted. I do not believe that this position can be maintaned indefinitely, in the light of the tremendously increasing revenues from this and other sources which are and will be derived from motor vehicles. I am convinced that motor taxation must be reduced to lower levels before many years have passed, and it is indeed upon this assumption that the car forecast of 13.5 million in 1975 is made.

Effect of Growth on Traffic Congestion

But even if people want cars and are willing and able to pay for them, will not an increase of that scale worsen the traffic problem to the point that our city centres and approaches seize up altogether?

Sir James Dunnett giving this lecture last year dealt most comprehensively with the Government problem of roads and road transport. He judged that, for the whole field of transport policy, it would be necessary to come to terms with the motor car. and preserve the balance between public and private transport: not only would this be desirable in itself, but it would be essential to any reasonable solution of the social problem imposed by the impact of new transport patterns on our small crowded island. He called for a combined operation by planners, architects and engineers, as the pattern of roads might well determine the pattern of cities in the future. He concluded by saying that the problem of transport in its widest sense would have a fundamental effect on the type of civilisation which will exist in these islands in 20 to 30 year's time. This is indeed an imaginative and challenging viewpoint and one which is receiving growing recognition among all concerned with the planning of our cities.

Mr. Brunner also has dealt in recent lectures with this problem. He has pointed out the causes of decay in city centres in the U.S.A., which are attributed to the motor vehicle, and how they can be avoided here. He considers that the ownership and use of motor vehicles, and especially cars, has created a crisis in the life of cities which demands a similar combined operation, and concludes "...... we must give up negative and passive attitudes to our cities' growth, cease to be overawed by the past and look confidently to the future with its exciting opportunities."

What have we to learn from America which is passing through a similar ordeal? Their experience must be of the greatest value to us, although there is an unfortunate tendency to discount it on the grounds that our conditions are dissimilar—that theirs is a country of wide open spaces in contrast to our own tight little island. We must realise however that there are large areas of the U.S.A., particularly in the East, where road and town traffic densities are quite as great as anything experienced in this country. The extreme example is of course New York City, hemmed in on Manhattan Island, which probably has the most acute traffic problem of any city in the world.

Quite different conditions are experienced in the new cities of the West which have grown since the advent of the motor car. There public transport is practically non-existent, and the motor car is supreme. Unplanned development and wide dispersal makes difficult the fullness of city life as we know it.

In the East, on the other hand, city centres have become progressively less accessible to vehicle traffic and has they are forsaken for new suburban shopping and community centres, several States and cities have been driven in desperation to subsidise their commuting railway services.

Recently, a prominent American railwayman has asserted that a single railroad track can transport 48,000 persons per hour, and that it would take twenty lines of express highway to carry the same number of people by car. Whilst emphasising that commuting tickets were absurdly cheap, he recommended public subsidy rather than fare adjustment. In conclusion he said that without rail subsidy the American city is doomed and "New York, Philadelphia, Boston, Los Angeles and our other great metropolitan centres, choked by traffic and smothered by parking areas, will become ghostly skeletons of cement and steel".

This indeed is a lesson to the extremists who would say that public transport has no part to play in a fully motorised country but I cannot agree that subsidy is the answer.

I believe that the key-stone to the replanning of our city centres and to the securing of a proper balance between public and private transport will be to charge a true economic price for the various services rendered. Public transport fares should be

based upon true cost and a fair return. Motorists should pay the economic price for their parking and garage accommodation on a full cost base related to land and construction values. They have of course paid for the roads many times over in excess taxation.

I visualise a car driver entering the London of the future having the choice of low-cost parking at railway stations in the outskirts: alternatively, of following an approach motorway until it joins the inner ring road where he will have another choice of garage at higher cost. If he insists on driving into the valuable central area, he will find garages there, but at higher cost still. Those motorists choosing the cheaper alternatives will travel by public transport to the city centre—by rail or underground from suburban stations, or by bus or underground in the central areas.

I believe that by such means city centres will be accessible and so remain in full active life.

Some New Towns are taking in both hands their wonderful opportunity of building cities for the car-owning citizens of the future—at Cumbernauld near Glasgow, for example, and at Farsta in Sweden where wide pedestrian concourses will form the heart of the city, with traffic moving on different levels, and with adequate garaging close at hand.

I said in my Presidential speech at the Society of Motor Manufacturers' Dinner last year that we must recognise the force and the pace of the tide which is flowing; that as a matter of high priority we should provide ourselves soon with safe and adequate roads; and that in all permanent constructional developments we should plan on the basis of universal car ownership, for this is not more than 20 years away. I am still of this view.

And is there any prospect of getting the necessary improved roads in time to relieve this deadlock, and will our Government and the British voter face up to the implications of the road programme necessary to ward off this menace? And, above all, how—so ask the pessimists—are we to accommodate all these masses of cars in London, Glasgow, Exeter, Blackpool and such notorious traffic traps?

I can only say that the position is very much better than it was only a few years ago. In recent years it is clear that the Government has been alerted to the need for a greatly accelerated road programme. A recent White Paper shows that road expenditure is to be increased from 97 million pounds in 1960-61 to 108 million pounds in 1961-62. Nonetheless, I think that a greatly increased tempo of road construction at double or even treble the present scale of expenditure is necessary if we are to get on terms with the problem and make our road system an economic traffic link worthy of our nation. I amsure that public opinion is prepared to accept the priorities and expenditures involved.

The Future for the Railways

Is there anything in the argument that Government should ease the pressure on our over-taxed road system by diverting traffic to the railways which are now so obviously under-employed?

There probably never was a more inappropriate time than the present to judge the relative responsibilities of rail and road transport. The railways have been the focus of public interest and debate. First we had their 1959 re-appraisal plan for modernisation and equipment which concluded that the economic position of the fast main line services between important centres was generally satisfactory, but that the stopping services on main lines and branch lines and the intensive services around London and other main cities presented a financial problem: that increased electric and diesel services on main lines and suburban areas would compensate for a substantial reduction of about one-fifth in the stopping train mileage, other than suburban; and that, after making full allowance for the growth in private cars and the effects of new motorways, it was anticipated that a greater volume of traffic would result from the improvements being made in the quality of passenger services, and in the greater reliability and cleanliness of diesel and electric traction.

In recent days the Low Committee Report on Railways was debated in Parliament (but the promised White Paper defining Government attitudes has not yet appeared). We heard that a Committee has been set up, under the Minister of Transport, to determine the shape and size of the railway system appropriate to future needs, and that yet another rivision to the modernisation plan is on the way. In the interim, capital expenditure on railways next year is to be cut by 20 million pounds to 140 million pounds.

It is safe, I think, to assume that commuting and long-distance main line rail traffic, which have held their own so well-continue to do so even better under the modernised system of the future. (Some of the new diesel and electric services are already yielding quite dramatic results.)

On the other hand, there has been further scrutiny of the modernisation plan, and some doubt expressed as to the economics of certain projects. Inevitably there will be further closures of railway lines and stations, but more intensive use of what remains.

The railways have been handicapped by the fact that their fares, particularly season tickets, have not kept pace with costs. I believe that the rigidity of the fares structure in relation to mileage has further handicapped them by failing to meet competition from road transport, both public and private, which so often is local in character both as to place and time. Greater flexibility, realism and courage in determining rail fares is, I think, essential if the railways are to be placed on an economic footing. Where their service is supreme, it will carry its proper price and the answer is not (contrary to the view of the American railwayman quoted above) in the subsidising of commuters from the public purse.

I believe then that there should be no attempt to divert traffic from road to rail or *vice versa*, but that the economic facts should speak for themselves.

Conclusion

It seems that the basic problems which result from the spread of car ownership are better understood today than even a year or two ago. We hear less from the pessimists who maintain that this country simply cannot sustain such a large car population. The cartoonists have had their fun. The facts have been paraded. The leaders have been written, and now public opinion is slowly beginning to realise that, with good sense and planning, public and private transport can be allies, each carrying out the tasks for which it is best suited.

The Prime Minister, opening the Motor Show a year ago, referred to the two extreme views—to destroy the heart of our cities to make way for the motor car, or alternatively, to exclude cars from our cities altogether; he declared firmly that the proper course lay between these two extremes, and his Government has since gone a long way towards sorting out the respective parts private and public transport have to play in the Britain of the future.

As we have seen, we are not alone in having to face these problems. There are many elements of similarity with those which the Americans faced over thirty years ago, and which have long been familiar also in Sydney, Johannesburg and Montreal. However, time is the essence of our problem. There are so many things to be done today, so many arrears to make up.

To summarise and in conclusion, for the railways I foresee a good future with increased and profitable traffic, but within a greatly reduced system. For passenger road services I am afraid that there will be a less promising future. In the country the opportunities for replacement of abandoned rail services will be more than counterbalanced by loss of traffic to cars. In cities, subject to traffic congestion difficulties, the bus will continue to be of great value for commuting and general traffic. Losses to the motor car will undoubtedly continue, but a sizable part of present traffic will probably be retained.

ROAD RESEARCH TRACK OPENED

Unique Facility

BUILT at a cost of 500,000 dollars at Crowthorne, Berkshire, the new track designed expressly for large scale practical road research was commissioned on October 25th.

By 1964 the new site will also house the entire Road Research Laboratory which at present occupies two different centres at Harmondsworth, Middlesex, and Langley, Bucks.

Speaking on the occasion Sir William Glanville, C.B., C.B.E., F.R.S., Director of Road Research, said: In common with all other highly developed countries, we are in process of transformation in which the motor vehicle is fast becoming everyman's means of transport, both for business and private purposes. Every ten years the number of vehicles on our roads doubles and congestion grows at an even faster rate. Roads are expensive to build and maintain and although we spend about 190 million dollars a year on them, that is, only a fraction of the money which the country is now spending annually on road transport and travel. Meanwhile vehicles become more powerful and travel faster and accidents are a growing problem.

The job of this research organisation is to find practicable ways of cutting down the number of road accidents, to save the country money by discovering the most economical ways of building roads and to save time and money by showing where and how best to build new roads and to improve existing ones so as to reduce the delays and congestion to a minimum.

Profitable Investment

Road research has proved very profitable investment for the nation and, in addition to the savings in human life from the accidents prevented, the sum saved annually as a result of applying the lessons of research are a great many times its cost. As an example of these benefits, I will quote the case of sites at which skidding accidents have been frequent. Every year the Road Research Laboratory deals with many such sites and helps the highway authority to remedy them, often by a very inexpensive treatment of the road surface. An estimate was made of the savings in accidents at a number of such sites and the economic savings equivalent to this work out at an annual net saving of 2,000 dollars at each site. We ourselves have detected over 200 such sites. This is equivalent to an annual saving of 400,000 dollars. We have also helped the highway authorities to find and treat other sites of this kind and the total savings must be many millions of pounds.

To give some idea of how small is the expenditure needed to achieve this result, I can mention one road junction controlled by traffic lights. There, the cost of resurfacing, which prevented about ten accidents a year was not more than what had formerly been spent annually in replacing traffic signals and bollards damaged in these accidents.

Similar work that the Laboratory does on airfield runways can also show improved safety, bearing in mind that overshooting on a wet runway is a great danger and that one such accident has been estimated to have cost half a million pounds.

In the past many decisions affecting expenditure on roads and the action to be taken in given circumstances had to be based on ad hoc judgments and on opinions formed from limited personal observation. Obviously errors were made, but with carefully conducted research, often of a statistical character, such decisions can be scientifically based. Thus, for example, it was thought at one time that a very rough looking surface was the best that could be put on a road to prevent skidding and hundreds of thousands of pounds must have been spent on resurfacing roads to make them knobbly. Research however showed that some stones polished very quickly and this has led to a complete reappraisal of the techniques for producing road surfaces.

Expensive

Much of this research requires work on a large scale under controlled conditions. Before the war a short experimental track was built at Harmondsworth, mainly with the object of providing a controlled site for skidding test. This proved invaluable, but after the war when research on traffic and safety was begun over a wider field, it proved quite inadequate. Since the war we have made extensive use of facilities made temporarily available at various airfields and by the Motor Industry Research Association on its test circuit. To do this work in scattered places proved very expensive and time consuming.

During the last five years or so we have had to use a disused runway 50 miles away to which large amounts of equipment and staff had to be conveyed, and where moreover the research facilities were by no means adequate. Worse still, many important experiments could not be done because facilities could not be found. For these reasons it was decided to build this special road research track. Without the track we have had, as I have said, to employ airfields and we have had the use of those at Northolt and Hendon for certain traffic experiments. On the apron at Northolt, for example, we carried out a few years ago full-scale trials of various roundabout layouts and controlled intersections, the results of which have since been extensively used in the design of new road layouts. At Hendon we studied and compared the virtues of various forms of road signs which led to the adoption by the Ministry of Transport of the signs now used on motor ways.

Now I would like to say a few words about the track and the objects we had in view in designing it for it is unique—there is no other track of its kind devoted to research into road traffic and safety problems in Europe, nor indeed in the world. The main objects in designing the track were:

(i) To provide large flat areas with suitable approach roads to enable the stability of vehicles performing manoeuvres involving steering, braking and accelerating at normal road speeds to be investigated.

(ii) To provide facilities for studying the skidding properties of wet surfaces, in particular, the material and texture used for the surfaces, the effect of the properties of the tyre and the type of vehicle, its speed and braking system.

(iii) To enable vehicle lighting tests to be carried out on straight and curved roads with surfaces of various types and colours.

(iv) To enable crash-injury research to be conducted under appropriate conditions.

(v) To enable comparisons of street lighting systems to be made under controlled conditions.

(vi) To provide a continuous circuit round which vehicles can be driven while the actions and reactions of their drivers are studied.

(vii) To provide facilities for traffic tests of intersection layouts, traffic signals, road signs, safety barriers and other aids to traffic flow.

(viii) To provide facilities for the study of vehicle guidance and the many other matters with which the Laboratory is concerned.

(From " British Road Federation Bulletin," December, 1960)

BRIDGING INDIA'S RIVERS

CHERANALLOOR BRIDGE

By

P. V. JOSEPH, B.SC., B.E.,

Executive Engineer, Bridges, Kerala P.W.D.

Introduction

THOUGH the palm-decked coastal areas of Kerala have got the highest density of population in the State, it is the least developed as far as road communication is concerned. Costly acquisition, large number of bridges required, have hindered the construction of new roads. During the Second Five-Year Plan period construction of several bridges in this coastal belt had been taken in hand, Cheranalloor bridge being one of them.

Location

Cheranalloor bridge, is located at, Vaduthala-Edappally road crossing over backwater stream at Cheranalloor where a ferry service used to operate. The Vaduthala-Edappally road forms part of the proposed link road from Parur to Ernakulam. Of the four major bridges required on this road, the Vaduthala bridge near Ernakulam end has already been constructed, the Cheriappilly bridge near Parur end is nearing completion and with the completion of this

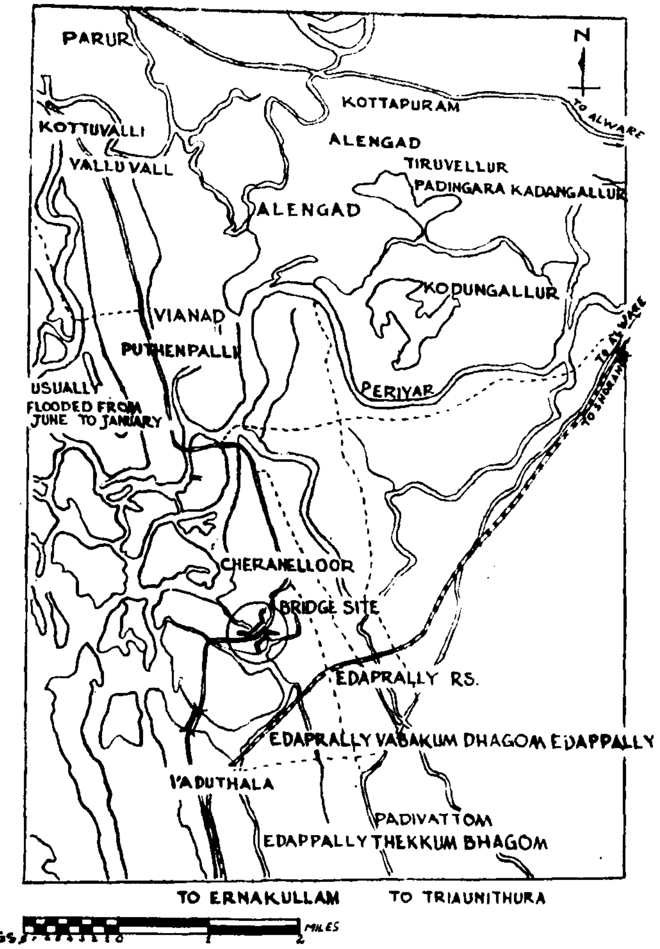


Fig. 3.

bridge the only remaining major bridge to be constructed is the Verapuzha bridge across the left arm of the Periyar.

Hydraulic Particulars

The width of crossing at the bridge site is 130 ft. The stream is tidal the difference between low tide and high tide being 4 ft. At the deepest place the bed of the stream is 14 ft below the H.T.L. Since the stream is navigable, clearance of 14 ft from the H.T.L. to the bottom of decking has been provided. The road way over the bridge is 33 ft above the deepest bed level.

General Features

The bridge has two central spans, each 40 ft clear and two end spans each 37 ft clear. Reinforced Tee-beam *cum* slab bridge was found to be most economical. Given below are salient particulars.

Total length of bridge	...169 feet.
Number of spans	...4
Width of roadway	...22 feet
Overall width of bridge	...24 ft 6 in.
Headroom above H.T.L. for navigation	...14 feet.
Type of foundation	...R.C.C. friction piles.
Maximum length of piles below pile cap	...45 feet.
Height of piers	...16 feet.
Live load design	...I.R.C. Class A.
Wearing coat	...3 in thick concrete.

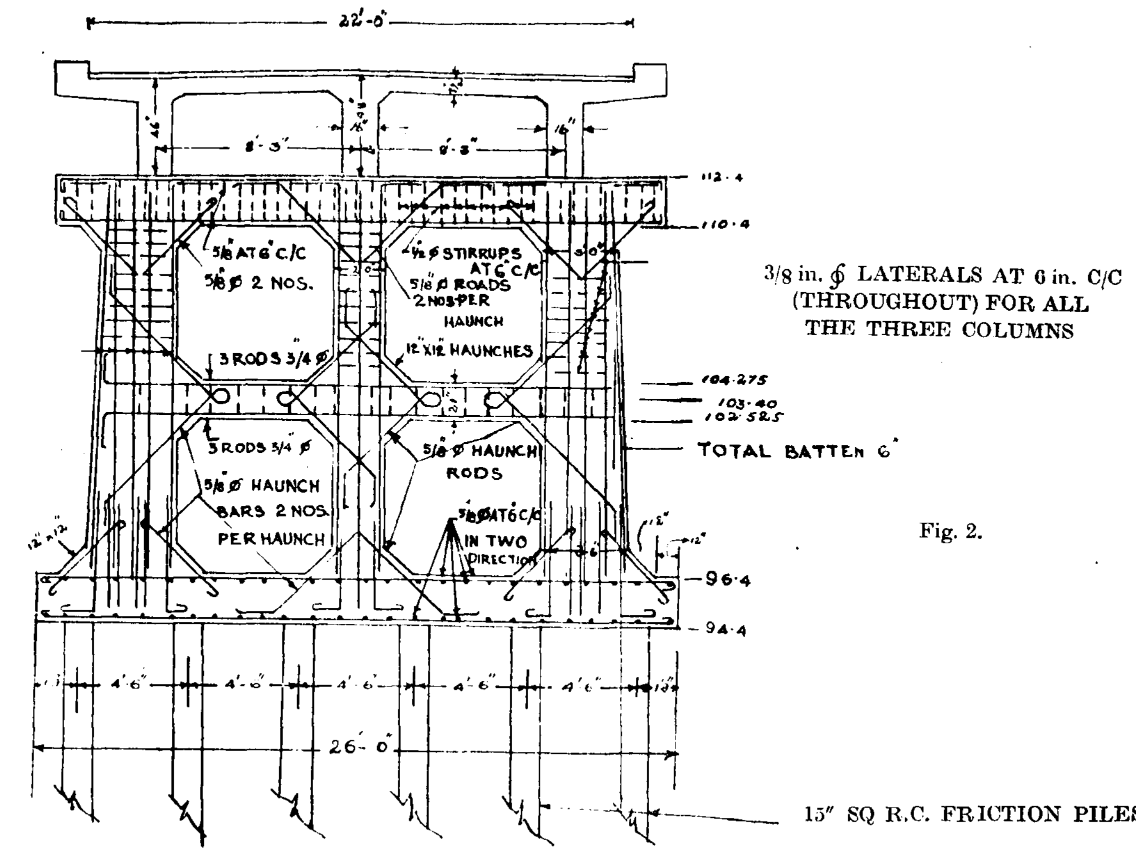
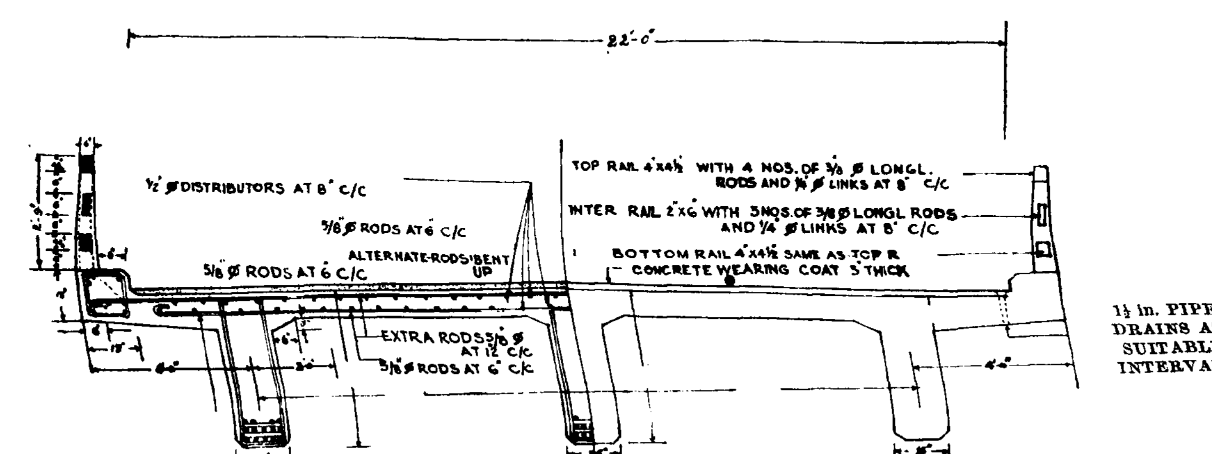


Fig. 2.

LONGITUDINAL SECTION OF THE PIER



DETAILS OF DECKING 22-ft ROADWAY

Fig. 3.

Foundation

Borings taken at the site indicated soft clay bed, the soil rock bed was not found by boring even at 60 ft depth at 35 ft depth from the bed of the stream, stiff clay was met. Therefore, R.C.C. friction piles were adopted for the foundation of piers as well as abutments. For each abutment and pier 8 number and 12 numbers R.C.C. 15 in. square piles were provided. The piles were driven 4 ft 6 in. centre to centre in two rows 3 ft 6 inches apart. Piles are designed to take 40 tons load on each pile.

The beams are designed as simply supported. Mild steel plate bearings are provided at the free ends. Sliding bearing for each beam consists of 2 numbers $\frac{5}{8}$ in. M.S. plates with 2 numbers $\frac{1}{4}$ in. lead sheets in between. The fixed ends of beams are anchored to the pier by means of 1 in. diameter dowel rods.

The superstructure of each span is separated from the adjoining span by 1 inch wide expansion joints. Bent copper plates $\frac{1}{16}$ in. thick is placed at the joints between

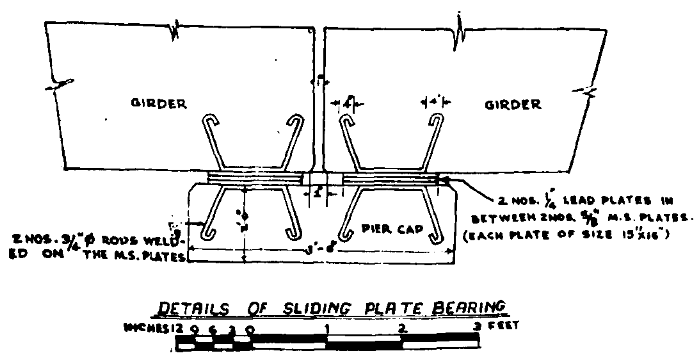


Fig. 4.

Piers

For piers R.C.C. trestle design was adopted to make the structure light and thereby reduce load on the foundation piles. The pile cap was 26 ft × 6 ft × 2 ft. Three numbers R.C.C. columns with intermediate bracing rest on the pile cap. On the top of these columns 2 ft thick 3 ft 6 inches wide reinforced concrete pier cap was provided.

Superstructure

The superstructure consists of reinforced concrete Tee-beams and slab. The deck slab is $7\frac{1}{2}$ inches thick and spans over three beams spaced at 8 ft 3 inches centres. The central beam is 2 inches deeper than the end ones to provide camber in the deck slab. The reinforcement for the slab consist of $\frac{5}{8}$ in. dia. main roads at 6 inches centres and $\frac{1}{2}$ in dia. distribution rods at 8 inches centres.

the slab and wearing coat. The one inch gap over the copper sheet is filled with resilient joint fillers.

The wearing surface consists of 3 inches thick 1 : 2 : 4 cement concrete laid over the deck slab; $\frac{1}{2}$ in. dia. drainage spouts are fixed at 10 ft apart to drain the surface water. The sides of the bridge are protected with R.C.C. posts and rails.

Approaches

The approaches on either side are 36 ft wide, are level with the bridge for 50 ft at either end and then have gradient of 1 in 30.

The carriageway of the approaches is 22 ft has got granite stone soling 6 in. thick.

Construction

The construction of the bridge was started in January 1958 and completed in

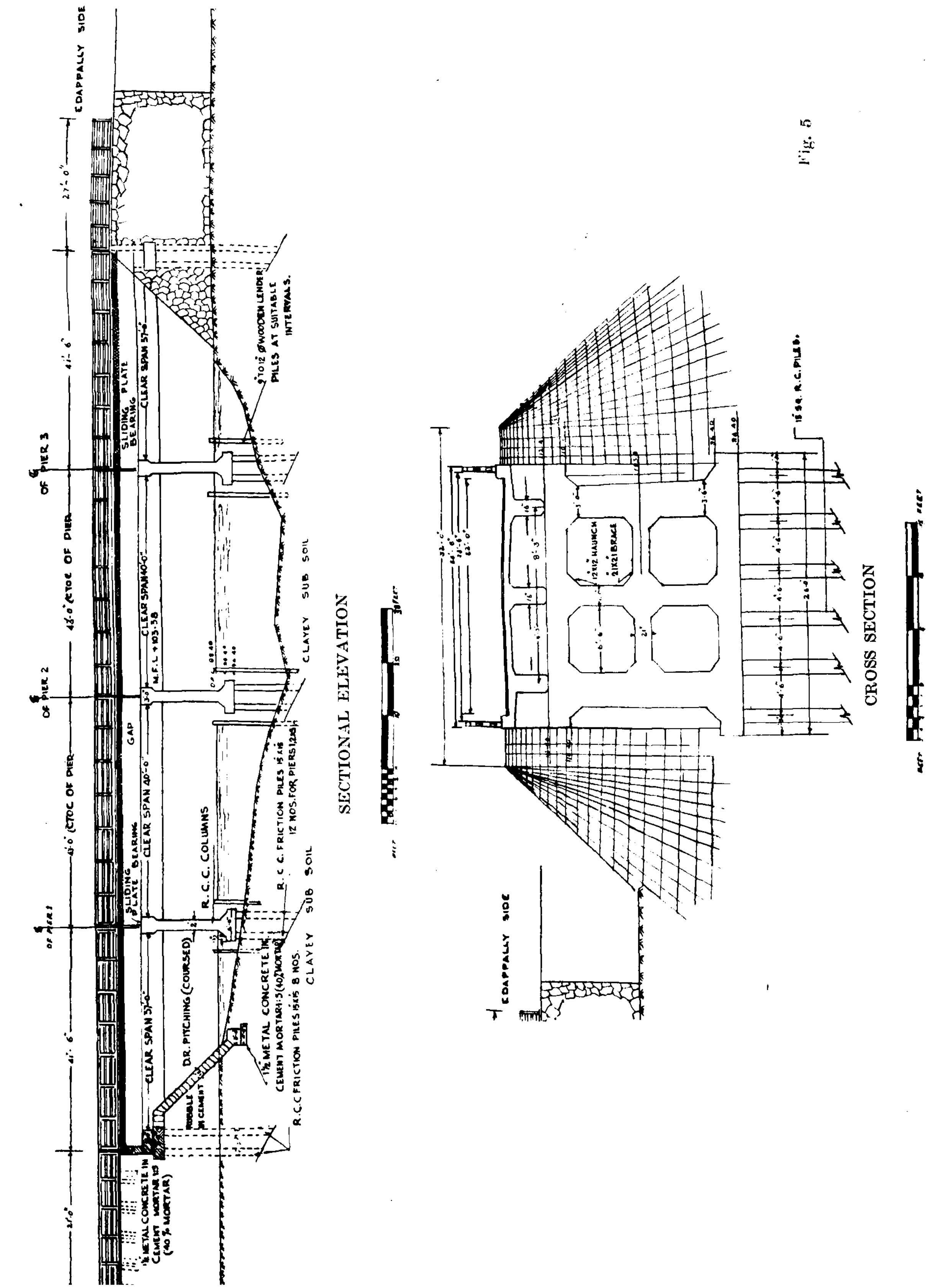


Fig. 5

May 1960. The work was arranged in two parts. Foundation and sub-structure being the first, superstructure and approaches being the second. 40 ft long R.C.C. piles required for the foundation of abutments and piers were pre-cast, hauled, hoisted and driven in position with a Delmag Diesel Pile Driving equipment mounted on a pontoon. Piles for the west abutment and other two piers required further to be lengthened 10 ft due to their being in capable of taking double the designed load.

During the driest months there was water in the stream. Therefore R.S. joists were placed to span over pile caps and timber cross beams placed over the joists at three feet intervals. The vertical posts of the centering 4 in. minimum diameter jungle wood posts with horizontal stiffeners and diagonal bracings at suitable intervals were seated on these cross beams.

The quantity of concrete for each span was 1,400 cu.ft. concreting of each span was completed in one day, one concrete mixer and 2 vibrators were put in use.

Costs

		Rs
Foundations	...	70,000
Sub-structure	...	39,000
Superstructure	...	56,000
Approaches	...	63,000
Total	...	2,28,000/-

Analysed Costs

	Rs
(a) Per running foot of the bridge ...	1,415
(b) Per square foot of carriageway excluding curbs	61
(c) Per square foot of entire elevation enclosed between the line connecting the lowest part of the foundation and the line connecting the upper most parts of superstructure ...	20
(d) Per cubic foot of bridge from the bottom of foundation to top of roadway	0.90

A judge once invited a colleague to join him for an afternoon of sailing. Unaccustomed to the sea, the guest pales noticeably as a brisk wind caused the vessel to pitch and toss.

"Is there anything I can do for you?" his host asked solicitously.

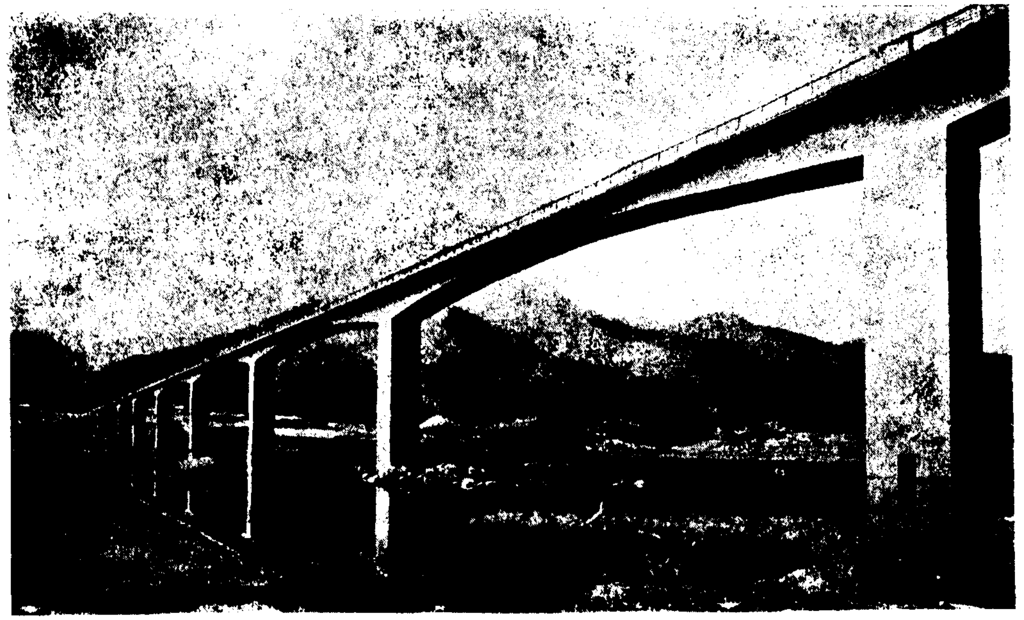
"Yes, Your Honour," was the reply. "Please over-rule this motion."

SAVINES BRIDGE IN THE PROVENCE ALPS

RISING IN THE SNOW-CLAD heights of the Alpes Maritimes, the river Durance flows down through the bare Provencal Alps, so beloved of Cezanne, to join the Rhone at Avignon—a glorious river course. One of the world's most noticable prestressed concrete bridges has now been set against this magnificent background—the long, high Savines bridge which carries Route Nationale 94 across the Durance and its valley.

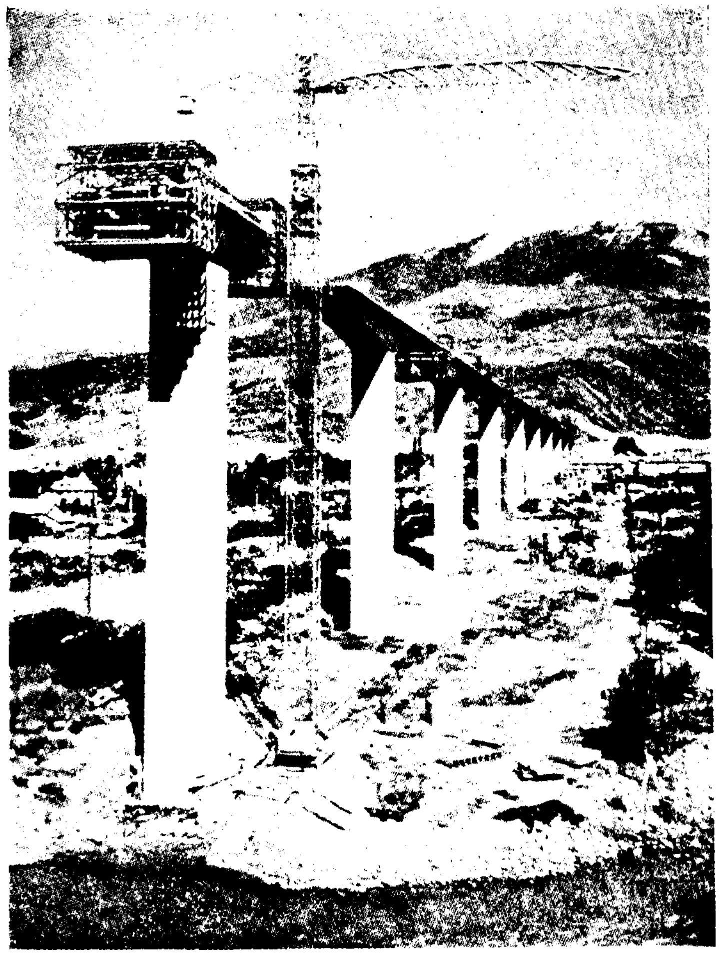
The bridge has eleven 253 ft spans, with a half span at either side; the length of span was largely dictated by the fact that the river had to be crossed in one span. The 30 ft wide roadway is carried 160 ft above the valley floor on a hollow prestressed box beam, supported by thirteen hollow prestressed concrete piers.

The bridge was built by the balanced cantilever method, with mobile cantilever scaffolding used to carry the beam forms. It is believed to be the longest and highest bridge so far constructed in this way. The cantilevers are balanced on each column



to form a T-shape, and each span consists of two cantilever arms jointed in the middle. The single cantilever end spans are each supported on a column. The load on the abutments is thus very light and massive abutments are not necessary.

Indeed, in spite of the size of this major bridge, its good proportions prevent it from appearing massive and the slender structural sections obtained through prestressing give a general appearance that is light and clear cut. The tall hollow columns are 16 ft 5 in. square, with walls 1 ft 4 in. thick; the vertical cables used to prestress the columns are placed in these walls and anchored in anchorage blocks at the bases of the columns. The two tallest columns, 141 ft on either side of the river, are founded on reinforced concrete caissons sunk to rock level. The caissons are filled with mass concrete and have at the top a 10 ft deep reinforced concrete slab which acts as the anchorage block for the prestressing cables. The other columns, not subject to possible erosion from the river, rest on concrete footings set in the alluvial floor of the valley.

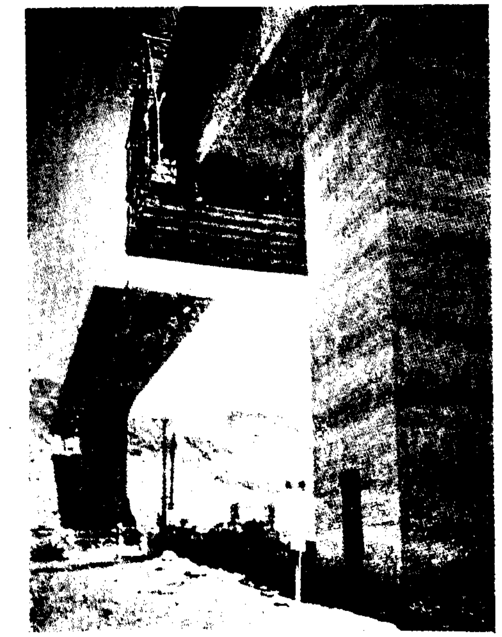


The bridge under construction, showing the mobile scaffolding, and the tower cranes in operation

The beam and deck are remarkably slender for a bridge of this size. The top of the 16 ft 6 in. wide box beam is only 7 in. thick; it forms the deck slab, which also cantilevers 6 ft 9 in. either side of the beam. The side walls of the beam have a uniform thickness of 1 ft 4 in., while the bottom flange tapers in thickness from 1 ft 6 in., at the column to 7 in. at the centre of each span. The beam's depth varies from 14 ft at the columns to only 3 ft 9 in. at the centre of the span, the two cantilever arms uniting to form a gracefully curved soffit arch with a radius of curvature of 313 yards. The bottom flange is cut out in trapezoidal form for a distance of 25 ft from the end of the cantilever, in view of the very slight compression in the concrete in this area. The beam is filled with mass concrete for a length of 16 ft 5 in. over the column head and a crosswall of reinforced concrete 12 in. thick unites the two side walls 18 in. from the end of the cantilever. The two cantilevers are joined in the centre of the span by a steel ball-and-socket joint.

The construction of this bridge has taken just under a year—well under the scheduled time. This speed is largely attributable to the cantilever method of construction, in which the mobile scaffolding moves the formwork forward as fast as the concrete can be placed, cured, and prestressed.

The steel scaffolding fits round the beam, and has a tail-piece that extends back about



A completed cantilever, with the mobile scaffolding in position on the other half of the span

25 ft along it. This tail section runs on rails on top of the beam and has a 35 ton counterweight at the rear end to balance the concrete in the forms.

The columns were constructed with sliding forms. After a column had been built the part of the beam directly over it and extending 8 ft 5 in., either side was concreted and prestressed: formwork attached to the column was used. The mobile scaffolding was then attached to these embryo cantilevers, and the beams built out symmetrically in 11 ft 7 in. sections. After each pair of balanced sections had been concreted, cured, and prestressed, the scaffolding was moved, and the operation repeated—nine times in all—until the cantilevers were within 4 ft 9 in. of each other. This last section is in reinforced concrete. Concrete was mixed at several points along the line of the bridge, and raised to the forms by tower cranes.

In all, seventy-two cables of varying lengths, each made up of seven 7-wire strands, were used in the prestressing of the beams. As each 11 ft 7 in. section was completed, eight of the cables were stopped off and anchored, and this continued progressively until prestressing was complete. Transverse reinforcement consists of 'Tor' twisted steel bars.

(*From "Concrete Quarterly," 47—October-December, 1960*).

ROAD RESEARCH BULLETIN No. 7

REPORT ON THE EXPERIMENTAL PERFORMANCE OF DIFFERENT TYPES OF BASE COURSES FOR ROADS UNDER ADVERSE MOISTURE CONDITIONS TESTED ON THE ROAD TEST TRACK AT MAJHERHAT, ALIPORE, CALCUTTA (1949-1958)

CONTENTS

STANDARDS OF DESIGN FOR ROAD PAVEMENTS RECOMMENDATIONS FROM THE MINISTRY OF TRANSPORT AND ROAD RESEARCH LABORATORY OF GREAT BRITAIN

IN view of the considerable changes made in recent years in methods of construction and in the use of materials, it is desirable that guidance should now be given on the most important features of the structural design of road pavements to be used in conjunction with the M.O.T. Specification.

Recommendations on these matters are contained in the Road Research Note No. 29 " A Guide to the Structural Design of Flexible and Rigid Pavements for the construction of New Roads " which was prepared jointly by the Road Research Laboratory and the Ministry with the advice of a Panel of the Committee on Pavings of the Road Research Board.

For recommended bituminous surfacings, roads are divided into four types ranging from over 4,500 commercial vehicles per day down to under 450 commercial vehicles per day. For the higher category and for all motorways, hot rolled asphalt to B.S. 594 is recommended for both wearing and base courses. In no category is B.S. 594 recommended but alternatives are given as shown in the accompanying table.

For concrete roads, sub-grades are classified as very stable, normal, and very susceptible to non-uniform movement. There are five road types ranging from more than 4,500 commercial vehicles and motorways down to 15—450 commercial vehicles per day, and design thicknesses of the slab range from 9 in. to 6 in.

Design charts are given for all these categories, and the summarised table of recommendations is reproduced.

M.O.T. Comments

Commenting on the recommended standards, the Ministry says that it will be necessary to exercise discrimination in the choice of materials for the base of the pavement from the full range of methods of construction recommended in the Road Note.

Also, says the M.O.T., an adequate and thorough soil survey should be regarded as an essential prerequisite to the effective use of the standards. In particular, it will be seen that this depends very largely on the correct execution of laboratory and/or in situ California Bearing Ratio tests which should be made in accordance with the recommendations in Appendix I of the Road Note.

In addition to tests necessary for correct pavement design, adequate control testing in respect of all materials used in the various layers of the pavement is essential.

The importance of testing applies particularly to surfacing courses, especially the wearing course. In this connection, the value is stressed of specifying for wearing courses of all bituminous surfacings, aggregates having adequate polished stone coefficients and of ensuring by control tests that the specified value is obtained. Where such courses are laid with coated chippings superimposed, this limitation relates only to the aggregate chosen for the latter.

For surfacings which are required to comply with Charts 1 and 2 of Road Note 29 (heavy traffic), the wearing course should be laid as soon as practicable after the base-course and in any case not more than three weeks later. During this intervening period construction traffic, other than that used in connection with provision of the wearing course, is not to run on the surface of the base course.

Close textured bitumen macadam and tar macadam base-courses are not at present

Recommended bituminous surfacings for newly constructed roads

Type of road		Design chart 1 (more than 4,500 commercial vehicles per day and all motorways)	Design chart 2 (1,500–4,500) commercial vehicles per day)	Design chart 3 (450—1,500 commercial vehicles per day)	Design chart 4 (up to 450 commercial vehicles per day)
Thickness of surfacing	Wearing course Base-course Total	1½ in. 2½ in. 4 in.	1½ in. 2½ in. 4 in.	¾ in.-1¼ in. 1¾ in.-2¼ in. 3 in.	2—3 in.
	Surfacing material	**Wearing course** Rolled asphalt—B. S. 594	**Wearing course** Rolled asphalt—B. S. 594 Dense tar surfacing—B. R. T. A. specification	**Wearing course** Rolled asphalt—B. S. 594 Dense tar surfacing—B. R. T. A. specification Fine cold asphalt—B. S. 1690 Tarmacadam—B. S. 802 Bitumen macadam—B. S. 1621 Close-textured Bitumen macadam with slag aggregate as in M. O. T. Specification for Road and Bridge Works, Clause No. 904	**Single course** 2 in. Rolled asphalt—B.S. 594 2 in. dense tar surfacing—B. R. T. A. specification 2½ in. tarmacadam—B. S. 802, B. S. 1241 2½—in. bitumen macadam—B.S. 1621, B.S. 2040
		Base-course Rolled asphalt—B. S. 594	**Base-course** Rolled asphalt—B. S. 594 Close-textured bitumen macadam or tarmacadam (see Appendix 4)	**Base-course** Rolled asphalt—B. S. 594 Close—textured bitumen macadam or tarmacadam (see Appendix 4) Tarmacadam—B.B. 802, B.S. 1241; Bitumen Macadam—B.S. 1621, B.S. 2040 (See Note 1 below)	**Two-course** 3 in. coated macadam—B. S. 802, B. S. 1241, B. S. 1621, B. S. 2040 3 in. close-textured bitumen macadam with slag aggregate as in M. O. T. Specification for Road and Bridge Works, Clause No. 904; or ¾ in. fine cold asphalt—B.S. 1960, on 2¼ in. coated macadam—B. S. 802, B. S. 1241, B. S. 1621, B. S. 2040

Note :—(1) Under a wearing course of rolled asphalt or dense tar surfacing to be laid immediately on the base-course the base-course should consist of close-textured material in accordance with Appendix 4.

(2) When a surfacing of tar or bitumen macadam is used it is particularly important that the base should be sealed with a surface dressing before laying the macadam.

CONCRETE PAVEMENTS

TRAFFIC (Commercial vehicles per day) (see paragraphs 22—24)	More than 4,500* and motorways		3,000—4,500		1,500—3,000		450—1,500		150—450
DESIGN THICKNESS (in.) † (see paragraphs 27—35)									
(i) VERY STABLE SUB-GRADES									
Slab Thickness	9		9		8		7		6
Base thickness	0		0		0		0		0
(ii) NORMAL SUB-GRADES									
Slab thickness	10		10		9		8		7
Base thickness	3		3		3		3		3
(iii) SUB-GRADES VERY SUSCEPTIBLE TO NON-UNIFORM MOVEMENT (also sub-grades with a water-table rising within 2 ft of the formation and enbankment more than 4 ft high)									
Slab thickness	11		11		10		9		8
Base thicknsss	6		3—6		3—6		3—6		3—6
MINIMUM WEIGHT OF OBLONG-MESH REINFORCEMENT FABRIC (lb/sq. yd) (see paragraph 36) (a) For ordinary traffic; (b) For roads carrying 500 or more loads per year of 30 tons or greater	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)§
	6½	8½	6½	8½	5½	7½	5½	7½	4½
MAXIMUM SPACING OF JOINTS (FT) ‡ (see paragraph 37—40) (i) Expansion joints (ii) Dummy contraction joints (see paragraph 38)	240 (180) 60	240 (160) 80	240 (180) 60	240 (160) 80	240 (180) 60	240 (160) 80	240 (180) 60	240 (160) 80	160 (120) 40

* For traffic much in excess to 4,500 commercial vehicles per day it may be necessary to use a thicker slab.

† No base is needed where the sub-grade consists of a well-graded gravel which can be thoroughly compacted and maintained in a stable condition by surface dressing. An extra depth of base may be needed on sub-grades susceptible to frost heave.

‡ The spacings apply to concrete roads laid on smooth foundations. If desired, narrower expansion joints may be used at closer spacings provided that the total amount of expansion space remains the same. Concrete made with limestone aggregates expands less than other types and may need less provision for expansion. The figures given in brackets are to be used in cold weather only. It is not expected that roads with this traffic intensity would carry 500 or more loads per year of 30 tons or greater.

§ It is not expected that roads with this traffic intensity would carry 500 or more loads per year of 30 tons or greater.

included in any British Standard. Appendix 4 of Road Note 29 has, therefore, been included, giving suggested specifications for these two types of material.

All specified or recommended thicknesses should, unless stated to the contrary, be regarded as referring to minimum thickness after compaction.

The rates of traffic flow are those to be expected 20 years after the year in which the road is built. In using the results of the most recent census of traffic as the basis for the design, it is stressed that the formula in paragraph 8 of the Road Note relates to 24-hour counts. As most of the data available refer to 16-hour counts the compensation referred to in that paragraph will, generally have to be made.

Code of Practice CP.2006: Traffic Bearing structures-Pavings, published by the British Standards Institution, deals with the construction of Road Pavings and the recommendations of the Code should be followed, where appropriate, in works based on the standards of pavement design discussed.

Any departure from the recommendations in the Road Note, or the requirements of these standards, will be permitted only where the Ministry of Transport is provided with sufficient evidence of the need for, and the value to be expected from, such departure. Normally, any such modification to the standards will be considered only in relation to special local conditions and will, therefore, relate only to the scheme in respect of which it is proposed.

(From "Highways and Bridges and Engineering Works"—Oct. 1960)

(Continued from page 5)

important part in our politics. But neither the lawyer nor the classical scholar nor the businessman with his limited outlook can solve our problems. Only science can successfully be applied to solve the country's social and economic problems. I am more and more convinced that the tasks can only be done by scientists and engineers."

Economic growth can only be achieved by fighting a war against poverty and by making maximum use of our resources of men and materials. To do so we must have the highest standard of management and administration of engineering and industrial activities.

The Engineers of India believe that at present as a nation we are not achieving all that we are capable of and our productive efficiency is low.

We believe that the only way we can improve is to utilize the natural managerial abilities of our engineers and put them in the ranks of top management and administration of engineering and technical enterprises or departments.

This is a burning question of the day and a vital necessity as our very survival as a great nation depends on our winning this war against poverty.

"You claim", said the producer, "that you have every qualification of a first-rate actor?"

"I lack only one thing," was the blend retort. "I am slightly deaf—the result of so much applause, y' know!"

SPLIT-SECOND DANGERS OF NIGHT-TIME DRIVING

FIFTEEN research reports on night-time driving hazards and how to reduce them, were published in a single document here this week by the Highway Research Board.

Among the major findings were these:—

(1) That motorists who drive too close to the car ahead leave themselves less than a second to avoid an accident.

(2) That missing three hours of sleep while driving at night can produce uncontrollable drowsiness in nine out of 10 drivers.

(3) That the glare of bright lights may rob a motorist of his vision for five to seven seconds.

(4) That some highway and street lighting can reduce accidents by 50 per cent.

(5) That it takes about 20 minutes for the eye to adjust to darkness, but the adaptation can be shattered in a second by a bright light.

(6) That motorists at night sometimes pass another automobile only 200 ft or with only $1\frac{1}{4}$ seconds to spare—ahead of an oncoming vehicle.

Drivers frequently allow themselves less than one second to avoid an accident, by driving too close to the automobile ahead, T.W. Forbes, Assistant Director, Highway Traffic Safety Centre, Michigan State University, East Lansing, Michigan, reported in the new publication of research findings in night-time driving. Dr. Forbes wrote that many drivers on high-speed highways leave only one quarter of a second spacing between their vehicle and the automobile ahead.

It takes up to three seconds for a driver to make a difficult or complex response to a sudden crisis on the highway, Dr. Forbes said, under day light conditions, and even longer at night. So one-fourth second headway is far less than enough to avert an accident when darkness prevents drivers from perceiving a situation correctly and responding quickly.

This was cited as only one of several dangers of driving at night. Others included loss of alertness from loss of sleep and eye strain produced by headlights and other lights along the way. Both reduce a driver's efficiency considerably.

Dr. Forbes pointed out that three hours of driving during the night when drivers were missing their normal sleep produced uncontrollable drowsiness in nine out of 10 test cases.

Another author noted that night driving is particularly difficult after long driving during bright sunlight. Dr. R.H. Peckham of the Eye Research Foundation, Bethesda, Md., said that subjection to the glare of bright headlights reduce vision temporarily but dangerously for five to seven seconds among drivers with medium retinal sensitivity.

The papers have been published by the Highway Research Board in its Bulletin Number 255.

Four researchers from the Harvard School of Public Health, Boston, Massachusetts, reported that it takes at least 20 minutes for the eye to adapt to darkness. But this adaptation, built up over such a period, can be shattered by sudden bright lights. Their experiments also revealed that older people find it considerably more difficult to adapt to darkness than younger men and women. Test subjects in the oldest group (80 to 89 years) required 239 times more light just to notice a test object, even after 40 minutes of adaptation than did teen-agers.

Rose A. McFarland, Richard G. Domey, A. Bertrand Warren and David C. Ward reported that when other factors were held constant, night-time highway fatalities are

three times greater than day-time fatalities. Improvement of street and highway lighting has a dramatic effect on night-time accidents, they said. Boasting the illumination on 100 miles of streets in Detroit, for example, reduced accidents on these streets from 75 per cent of the city-wide total to 26 per cent. Similar procedures in Hartford, Connecticut, Atlanta, Georgia, and Kansas City, Missouri, cut accident rates in half.

Margins for safety at night are slim, the Boston researches said. It has been discovered that even on highways where passing sight distances range from 1,800 ft to 3,300 ft, drivers sometimes complete their pass around another automobile when an oncoming vehicle is less than 200 ft away. Two automobiles approaching each other at 50 miles per hour would cross 200 ft, in less than $1\frac{1}{2}$ seconds.

Authors of other papers in the publication concluded that the answer to the problems of slow adaptation to darkness and sudden subjection to bright lights lies in the development of very careful street and highway lighting systems. Some described the prospects of lighting critical interchanges and particularly dangerous places by gradually increasing the light intensity on the approach and reducing it past these points.

An English scientist, A.W. Christie, of the Road Research Laboratory, Department of Scientific and Industrial Research, Harmondsworth, England, reported that an experimental low-level lighting system along a $1\frac{1}{2}$ mile stretch of three-lane, undivided highway reduced accidents by 50 per cent while accidents for the country as a whole rose 20 per cent (1956 to 1959).

Another author noted that such systems might be economically justified by the degree to which they would make possible a step-up in the safe driving speed. Charles H. Rex, General Electric Company, Hendersenville, N.C., wrote that an increase in the average speed of 2,500 vehicles from 45 to 60 miles per hour, will produce time savings worth 6,000 dollars to 18,000 dollars per mile of highway per year. He based his computation on the assumption that a commercial driver's time is worth 2 c. to 6 c. per mile.

Reducing the problems of night-time driving has been a major concern of both automotive and highway engineers in recent years. These findings represent only a sampling of the research being conducted in this specialised field.

(From "The Surveyor and Municipal and County Engineer", 24th December, 1960.)

The ambitious door-to-door salesman had developed an irresistible sales pitch. When a housewife answered his ring, he would simply say, "You should have seen what I saw at your neighbour's. May I come in?"

HERE AND THERE

1. PRINCE PHILIP THE NEW PRESIDENT OF THE INSTITUTION OF HIGHWAY ENGINEERS, U.K.

● H. R. H. Prince Philip who was installed in December 1960 as the new President of the Institution of Highway Engineers, has always taken a keen interest in highway and motoring matters, and we are sure that he will do all that is in his power and province to stimulate interest in better highways.

Concluding a recent speech Prince Philip said: "Mankind will always argue about systems of Government, religion and justice, but you can be fairly certain that every man could do with modern systems of transport and agriculture".

(From "Highways and Bridges and Engineering Works", December 21, 1960)

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2. LET THIS BRAGGING STOP

● "THE RAILWAY Board is trying to assume the role of a martyr in its prolonged controversy over road transport. It has reacted adversely to the recommendations recently made by the National Council of Applied Economic Research in the course of its studies on the contribution of road transport to the public exchequer and its employment potential in the country.

"The hostile attitude of the Railway Board to the development of road transport raises a fundamental issue. It goes against the very genesis of the country's economic policy based on a co-ordinated development of both the public as well as the private sectors of our economy.

"The studies of the National Council of Applied Economic Research justify the fear that the present taxation policy of the Central Government in relation to road transport is inspired largely by this imaginary fear of the Railways.

"The Council has rightly stressed that any further taxation on diesel fuel is bound to affect the ecomomy of the road transport adversely or at least to prevent the fuel economy of dieselisation from being passed on to the consumers,".

(From TRANSPORT OPERATOR, November, 1960)

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3. SOVIET AUTOMOBILE INDUSTRY

By

ALEXANDER EZHEVSKY

Chief of the Automobile, Transport-Machine and Agricultural-Machine Building Department, USSR State Planning Committee

● IN 1965, the Soviet Union will produce more than 850,000 automobiles, i e., 70 per cent more than in 1958. Some readers may think that this is not a very "formidable" figure, since the number of cars produced in the United States, for instance, is much greater; it produces several million cars. Yet, it should not be forgotten that the United States, produces mostly passenger cars which need much less metal and money for their output than, let's say, a 4-ton ZIL lorry or a 2.5-ton GAZ lorry. The Soviet Union mostly produces trucks and lorries. This is necessitated by the development of the country's national economy and the economic policy of the Soviet Government aimed at promoting a rapid advancement of the heavy industry. In the future it is planned to change the assortment of the standard types of the cars produced, so that it should conform more to the demands of the national economy. However, the principle of priority development of lorry production will hold good for the coming years.

One can easily understand this from the fact that in the current seven-year period, automobile transport will play an ever growing role. Suffice it to say that the total volume of freight carried by automobile transport will increase almost two-fold in these years, and will reach by 1965 about 10,000—11,000 million tons. This includes more than 8,000 million tons of freight transport for the industry.

A Chaika convertible (produced by the Gorky Automobile Plant) on one of the streets of Moscow

Sharp Increase in Passenger Traffic

By 1965, there will also be a sharp increase in the number of passengers carried by automobile transport. The country's buses, for instance, are expected to carry about 22,000—24,000 million people in that year.

In these years, the Soviet Union will switch over to new standard models of automobiles. What we mean here is not only a radical modernisation of design, but also the introduction in serial production of absolutely new types of automobiles, which have never been produced in our country.

Thus, during the seven-year period, serial production will begin of Zaporozhets midget cars.

Another new feature of the Soviet automobile industry is the production of light lorries in several versions. The Ulianovsk Automobile Plant, producing these machines, will considerably increase its output. Moreover it is planned to start the output of light lorries and of van-type cars at the Gorky Automobile Plant and the Moscow Plant of Compact Cars.

The catalogue of new standard models of Soviet automobiles includes six new basic types of cars (with horse power ranging from 25 to 220), eight basic types of lorries (with freight-carrying capacity ranging from 0.25 tons to 25 tons) and seven basic types of buses (with accommodation ranging from 10 to 220 people). All these automobiles will be produced in a great variety of models.

Vast Programme

Besides the plans for light lorry production, there is also a vast programme for the output of medium lorries. The Gorky Automobile Plant, for instance, will manufacture 2.5 ton GAZ-53 and GAZ-52 lorries; the Likhachev Plant in Moscow will produce 4-ton ZIL-130 lorries; the Urals Automobile Plant (situated in the town Miass) will start the production of new 5-ton lorries with a V-8 180 h.p. engine.

The Kutaisi Automobile plant (Caucasus) has produced a very agile lorry with a shortened axle base which gives it a number of advantages for operation in mountainous territories. This new KAZ-605 lorry with a V-8 140 h.p. engine will serve as a prototype for a tow-car with a two-gear axle for the transportation of 8-ton half-trailes.

There will be an extensive development in the production of heavy lorries. Under the Seven-Year Plan, the output of KRAZ-type lorries (10-12 tons) will increase 4.3 times; the production of these machines will be concentrated at the Kremenchug Automobile Plant. The Yaroslavl Automobile Plant will change over to the manufacture of a new type of engines designed for the Yaroslavl lorries and for the 7-ton lorries of the Minsk Automobile Plant. There will also be a substantial increase in the output of super-heavy tip-lorries (25 tons and more) at the recently built Byelorussian Automobile Plant.

The Seven-Year Plan lays much emphasis on the production of automobile trailer trains, and on the increase of the output of tow cars and trailers for them.

As far as passenger cars are concerned, the increase in their output will be mainly due to the beginning of the serial production of Zaporozhets midget cars and a greater output of Moskvitch compact cars. Cars of the medium class, such as Volga, will annually undergo partial modernisation. Cars of the de-luxe class such as Chaika and ZIL-111, which are latest word in automobile engineering, will also be produced.

4. ESTIMATED CONSUMPTION OF CEMENT IN GREAT BRITAIN, 1959

By Type of Building

Power Stations ...	5%	Railways ...	2 – 3%
Houses and Flats ...	25 – 30%	Schools ...	3 – 4%
Factories ...	15 – 20%	Sewerage and Work ...	3%
Offices ...	15 – 20%	Asbestos Cement ...	3%
Roads ...	5 – 10%	Unaccounted ...	10%

By Type of Concrete

Reinforced ...	20%
Pre-stressed ...	5%
Plain ...	50%
Mortar ...	20%
Asbestos ...	3%

By Type of Purchaser

Precast (Factories) ...	20% ± 5%
* Ready Mix (1,000,000 cu. yd.).	5%
Site Mix and mortar	75%

* The figure quoted is for 1958.

(*From " The Structural Engineer "—Dec., 1960*)

5. THE SPECIAL FUND OF THE UNITED NATIONS

● THIS has to date approved 74 projects, requiring expenditure of 140 million dollars. 60 million dollars of this will be contributed by the Special Fund, and the other 80 million dollars by the recipient countries. This Special Fund money will be spent for resource surveys, training institutes and applied research institutes to assure better utilization of physical and human resources in underdeveloped countries. Surveys have been made in the fields of electric energy, transportation and communications and agriculture.

(*From " World Construction "—Jan., 1961.*)

6. FIFTY-SEVEN MILES OF TUNNELS

● THESE are being constructed to link mountain streams and glacial rivers in the Alps to form the Grande Dixence hydro-electric system. The system will produce 10 per cent of Switzerland's electric power. The main dam will be concrete 935 feet high, with a base 65 1 feet wide, and a crown 2,297 feet long, and will be S-shaped. The project will be completed by 1965.

(*From " World Construction "—Jan., 1961.*)

7. Mt. BLANC TUNNEL

● WORK on the Mt. Blanc tunnel is proceeding at a speed of about ten yards a day. It is expected that the seven-mile tunnel will be completed early in 1962, with 350 million cubic feet of rock having been excavated. It will cut the highway distance from Paris to Turin by 137 miles, and from Paris to Milan by 194 miles.

(*From " World Construction "—Jan., 1961.*)

8. POST-GRADUATE AND SHORT-TERM SPECIALIST COURSES

The University of Roorkee will be running post-graduate refresher and short-term specialist courses as per programme given below during 1961-62. Detailed particulars can be had from the Director, Refresher Courses, University of Roorkee.

Particulars of Courses	Period
1. Three months' refresher course in Civil Engg., comprising of—	
Part I—Foundation Engg. Concrete Technology and Structures.	11- 9-61 to 6-11-61
Part II—Buildings, Highways and Bridges.	20-10-61 to 10-12-61

	Particulars of Courses	Period
2.	Three months' refresher course in Mech., Engg., comprising of—	
	Part I—Production Engg. and Workshop Technology.	15-11-61 to 10- 1-62
	Part II—Construction Plant, Tube-wells, Towers and Gates.	26-12-61 to 14- 2-62
3.	Three months' refresher course in Civil Engg., comprising of—	
	Part I—Canals, Tube-wells, Concrete Technology and Structures.	9- 4-62 to 30- 5-62
	Part II—Soil Mechanics, Hydrology and Dams.	13- 5-62 to 7- 7-62
4.	Three months' refresher course in Elect. Engg., comprising of—	
	Part I—Transmission and Transformation.	1- 8-62 to 27- 9-62
	Part II—Generation.	9- 9-62 to 31-10-62
5.	Three months' short-term special course in Public Health Engg. for Engg. Subordinates.	1st Sept. to 30th Nov. 1961
6.	-do-	1st Dec. 61 to 28th Feb. 62
7.	-do-	1st March to 31 May, 1962.

Short-Term Specialist Courses

8.	" Air Conditioning and Referigeration "	11th Sept. to 10th Oct. 61
9.	" Transmission Lines & Towers "	18-12-1961 to 31- 1-1962
10.	" Foundation Engineering "	2- 1-1962 to 31- 1-1962
11.	Shell Structures	12- 2-1962 to 24- 3-1962
12.	System Protection	7- 5-1962 to 2- 6-1962
13.	Steam Power Generation	1- 5-1962 to 2- 6-1962
14.	" Erection, Commissioning & Maintenance of Hydro-Electric Power Stations "	4- 6-1962 to 30- 6-1962
15.	" Fluid Mechanics "	4- 6-1962 to 30- 6-1962
16.	" Photo-Elasticity "	11- 6-1962 to 21- 7-1962
17.	" Heavy Earth-moving and Construction Machinery "	1- 8-1962 to 31- 8-1962

9. INDIAN NATIONAL SOCIETY OF SOIL MECHANICS AND FOUNDATION ENGINEERING

A review of the 4th General Meeting of the Indian National Society of Soil Mechanics and Foundation Engineering

● THE Fourth General Meeting of the Indian National Society of Soil Mechanics and Foundation Engineering was held at Bombay on 3rd and 4th of February, 1961, along with the 41st Convention of the Institution of Engineers (India).

The 1st session held on 3rd February, 1961, dealt with administrative questions including amendments to the Constitution. The Technical Session on 4th February discussed two questions, viz., " Foundation on Black Cotton Soil and Properties of expansive clays."

Introducing the subject of foundation on black cotton soil, Shri Dinesh Mohan stated that the black cotton soil developed high swelling pressures and volume expansion when it came in contact with water. The horizontal stresses were partly relieved by vertical cracks in the ground, but vertical movement gave rise to several cracks in buildings resting on such soil. Studies on the relative merits of various types of foundations on such a soil carried out at the Central Building Research Institute showed that pile and safe method of construction gave satisfactory results. Referring to design and construction aspects of such pile foundations, he stated that piles should be carried to a depth of no movement zone which is ordinarily 12 ft for black cotton soil as found out by studies carried out at the Central Building Research Institute and raft beams should be continuous designed to carry the required superstructure loads.

Speaking on the subject of expansive clays, Shri Dinesh Mohan stated that even though clayey soils swelled or shrank with the entry and exit of water, yet some were classified as expansive type and such soils needed special precautions especially during road and building construction. It had now been fairly established that clay content was mainly responsible for the expansive properties of soils. He briefly reviewed the studies carried out at the Central Building Research Institute on the properties of expansive soils to establish methods for determination of consistency limits, shear strength, consolidation characteristics, swelling pressures and volume expansion etc.

Both the subjects evoked very interesting discussion. It was suggested during discussions that the depth of 12 ft for no movement zone required further observations especially under conditions with structures constructed. This might result in reduction of pile depth. Suggestions were also made for the control of soil moisture or holding moisture constant by providing wide aprons or artificial irrigation. Stabilisation of soil through some additive like lime, etc., was also suggested.

The discussion was followed by a talk from Shri G G. Dhanak, Superintending Engineer, Irrigation Department, Gujerat, on his recent experiences abroad in the field of earth dam construction. He particularly drew attention to resorting of clay injections in the construction of coffer dams and also earth dams. He also showed a number of slides depicting dam construction techniques in the European countries.

Concluding the technical session, Dr. K. L. Rao emphasised that the question of clay injection had assumed importance in recent times. He drew a pointed reference to the clay injections adopted in the Kotah Barrage, these injections had been mainly responsible to reduce seepage by about 85 per cent. He called upon the research engineers in the country to carry out further studies in this field.

This meeting of the Society also decided that the next General Meeting should be held in conjunction with the Indian Roads Congress.

The Indian National Society of Soil Mechanics and Foundation Engineering is a National Body affiliated to the International Society of Soil Mechanics and Foundation Engineering whose Headquarters are at London. The International Society is organising a Congress at Paris in July this year preceded and followed by Study Tours.

The membership of the Society is open to all Institutions associated in the field of Soil Mechanics and Foundation Engineering and other individuals.

CURRENT LITERATURE

ABSTRACTS

REPAIR OF STRUCTURES AND PAVEMENT BY THIN CONCRETE PATCHING BULLETIN 260: HIGHWAY RESEARCH BOARD, 2101 Constitution, Washington, D.C., August 1960.

"LATEX-MODIFIED Mortar in the Restoration of Bridge Structures," by S. M. Cardone, M. G. Brown, and A. A. Hill, describes laboratory and field studies of the effectiveness of thin concrete patching of bridge structures using Portland cement mortars containing admixtures of water-dispersed resin of a styrenebutadiene copolymer or a new latex emulsion of a Saran Type.

"Bonded Resurfacing and Repairs of Concrete Pavements," by William G. Westall, discusses bonded concrete construction and its various applications to pavements, describes projects where this type of repair has been used, and illustrates the essential steps in surface preparation and construction. All the jobs discussed were constructed at airports.

REFLECTION CRACKS IN BITUMINOUS SURFACING: A field study of methods of preventing reflection cracks in bituminous resurfacing of concrete pavements.

Part I—Theory and Installation by M. M. Davis

REPORT No. 12, 1960, of an investigation conducted in the Deptt. of Civil Engineering, University of Toronto in Co-operation with the Ontario Deptt. of Highways as a part of the Ontario Joint Highway Research Programme.

It has become general practice in the years since World War II to resurface old concrete pavements, whose condition is no longer satisfactory because of scaling, cracking, roughness, inadequate width, or slipperiness, with bituminous concrete. Unless there is serious lack of structural strength, this bituminous resurfacing (with widening where required) usually constitutes a perfectly satisfactory rehabilitation.

However, one problem remains with this resurfacing. Within a few years most of the cracks and joints in the concrete pavement have broken through the bituminous resurfacing. No completely satisfactory method has been found for treating these cracks. Furthermore, particularly where traffic is heavy, the repair of cracks is not only hazardous, but also a nuisance to traffic.

Therefore, highway engineers have been searching for some method of preventing the cracking of the bituminous resurfacing. Experiments and trial sections in the United States indicate that the placing of steel reinforcing in the bituminous resurfacing can definitely mitigate the problem of crack reflection.

The Ontario Department of Highways decided to instal a test section of reinforced bituminous resurfacing to determine its feasibility under the climatic and service conditions existing in this Province. The University of Toronto, through the Ontario Joint Highway Research Programme, was asked to make the detailed study of this experimental project.

This report outlines the theory of behaviour, describes the test site and initial condition of the road, and outlines the construction techniques, problems, and recommendations. The effectiveness of the treatment will not be known for a period of years. Annual performance surveys will be conducted and will be reported later.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of the work	Amount Rs in lakhs
		ANDHRA PRADESH	
1.	2538-AH-7	Construction of a high bridge in place of an existing causeway across Palmakola river in mile 18/4 of Hyderabad-Kurnool Road—N.H. No. 7.	2.15
2.	2542-AH-7	N.H. No. 7 Widening the B.T. surface to 22 ft in miles 32/6 to 57/0 of Kurnool-Gooty section of N.H. No. 7.	3.91
3.		Nine works each costing less than 2 lakhs.	1.10
		ASSAM	
4.	2558-AS-37	Remetalling and surfacing certain miles in between 136 and 145 of Assam Trunk Road East, N.H. No. 37 in Devgaon sub-division.	3.46
5.		Two works each costing less than 2 lakhs.	1.89
		MADHYA PRADESH	
6.	2537-MP-3	Improvement to existing culverts in miles 122/8 to 153/8 of N.H. No. 43 in Dandakaranya area.	1.56
7.	2548-MP-26	Widening and blacktopping metalled width to 12 ft and formation to 38 ft from mile 66/0 to mile 88 of Narasinghpur section of N.H. No. 26.	6.95
		MADRAS	
8.	2540-MD-4	Reconstructing and strengthening the existing culverts in miles 5/0 to 54/0 of N.H. No. 4.	2.24
9.	2563-MD-46	Reconstruction of a bridge across Agaram river at mile 10/5 of Ranipet-Krishnagiri Road, N.H. No. 46.	8.60
10.		Seven works each costing less than 2 lakhs.	6.76

	Job No.	Name of the work	Amount Rs in lakhs
		MYSORE	
11.	2565-MY-4	Improvements to hairpin curve in mile 224 of Poona-Bangalore Road, N.H. No. 4 in Belgaum Distt.	2.12
12.	2562-MY-4	Improvements to Tavadighat in miles 172/0 to 173/5 of Poona-Bangalore Road, N.H. No. 4, near Nipani in Mysore State.	2.20
13.		Nine works each costing less than 2 lakhs.	8.55
		RAJASTHAN	
14.	2547-RJ-8	Improving miles 8 and 9 (Ghat Section) and providing retaining walls in high banks Udaipur-Nathdwara road, N.H. No. 8.	2.32
		UTTAR PRADESH	
15.	2543-UP-24	Widening the road to two-lane in Garhmukteshwar-Muradabad section of N. H. No. 24 (miles 59/0 to 66/6).	5.75
		WEST BENGAL	
16.	2564-BG-34	Construction of minor bridges (about 20 ft span) in Buhampur-Raghunathganj section of N.H. No. 34.	3.91

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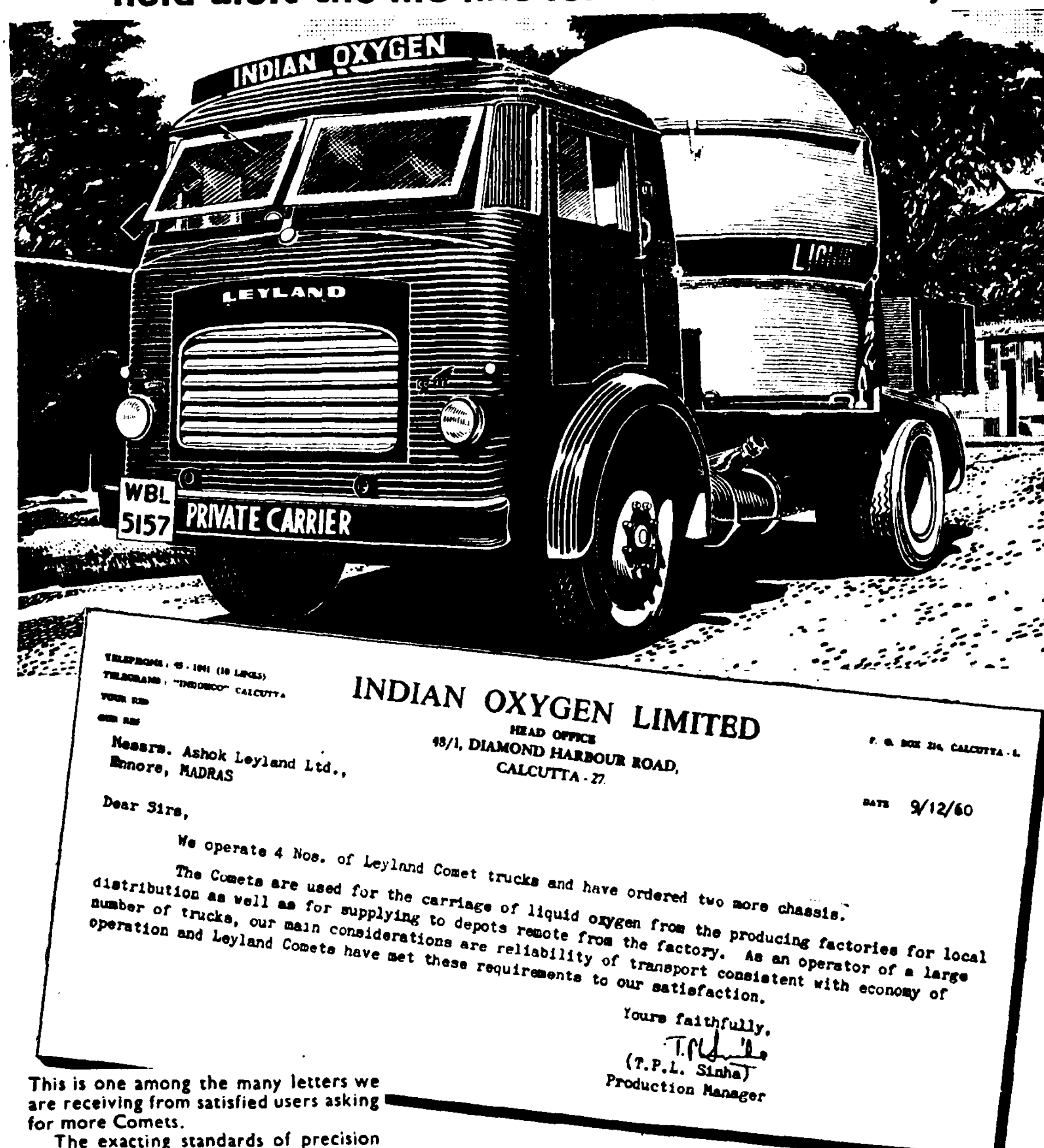

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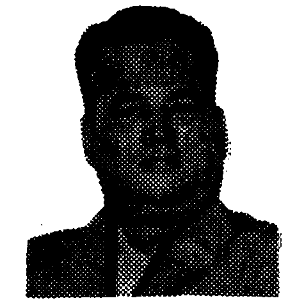

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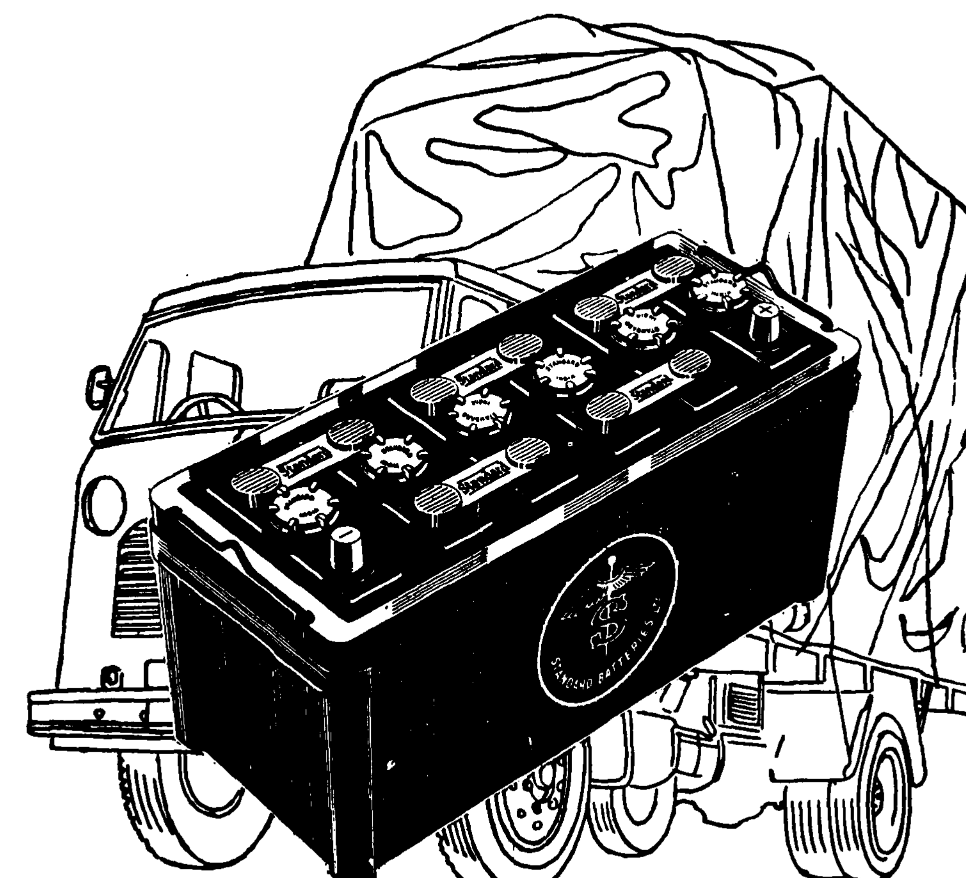

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