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ROAD TRANSPORT AND PRODUCTIVITY

(Extracted from 'The Journal of the Institute of Transport'—November, 1952)

THE level of productivity is partly a function of industrial equipment, partly of managerial "know-how," partly of the will to work effectively, and partly of natural advantages of geography, soil, or climate. Other things being equal, the more efficient the equipment, the greater is the output per man employed, and, consequently, the higher the standard of living. Better industrial equipment, using the term in its widest sense can be achieved only by capital expenditure.

Capital Expenditure on Transport is Productive

It would be unfair and untrue to suggest that those responsible for our economic policy are unaware either of the need for greater industrial productivity or of the close link between this and capital expenditure by industry. It would, however, be neither unfair nor untrue to suggest that their approach has lacked vision and that they have regarded industry as being in the main restricted to manufacturing industry, mining, building, and power stations. There has certainly been no admission of transport to its proper place as an essential element of British industry, accounting for no small part of the total cost of every article produced.

A very important piece of work by Mr. E. Rudd of the Road Research Laboratory, recently presented as a Paper to the Royal Statistical Society, established that inland transport, excluding dock charges and warehousing of all kinds, accounted in 1950 for no less then £ 1,600 million (Rs 2,160 crores), or 14 per cent of the total value of all goods and services produced in Great Britain. This of course includes the movement of raw materials to the factories as well as the transport of finished products. Of this sum £ 775 million (Rs 1,046 crores) related to the transport of goods and £ 825 million (Rs 1,114 crores) to the transport of people.

There is a tendency sometimes to think of the transport of people as something unproductive, or at any rate as of little industrial significance; this, of course, is wrong. Goods would not be produced if those producing them could not be carried to the points where their labour was necessary. Transport is in the nature of a process or a series of processes in industrial production; the constant need is at all times to keep the transport unit, be it lorry, ship or train, moving—and moving fast.

Any improvement in productivity which can be secured by modernising the capital equipment of transport is just as desirable as improvements in the productivity of other industrial processes which can be obtained by the provision of better capital equipment. The only logical yardstick is to compare capital expenditure on transport with capital expenditure on other industrial processes and to favour the expenditure which gives the greater return on the investment.

The burden of complaint is that in Britain today capital expenditure for industry and transport receives far too small a share of the national income if the economic objective is to increase industrial productivity. Of the industrial capital expenditure which is undertaken, the proportion devoted to transport is much smaller than would be justified if the aim were to obtain the maximum productivity possible from a given amount of capital expenditure.

Under present conditions, virtually all capital expenditure is subject to official control, in that licences are required both from the point of view of finance for schemes of any magnitude and also from that of materials such as steel and cement. Transport is even more subject to official control then are most other sectors of the economy because of the Government's

special interest in those very important parts of it which are nationalised, while the roads themselves have for the most part always been a public responsibility. The problem of securing an adequate capital expenditure on transport is, therefore, one which, in the main, must be solved at Government level.

Human Factor in Increasing Productivity

The total labour force employed in inland transport is in the region of 1,950,000, which compares with 8,600,000 in manufacturing industry and 875,000 in mining and quarrying; these figures are sufficient to show that the target for greater productivity offered by the transport industry is impressive. It is relevant also that the transport industry, including transport not undertaken for hire or reward, has been tending during the past twenty or thirty years to employ an increasing proportion of the working population: the reductions in labour requirements due to such improvements in productivity as have been achieved have been very much more than offset by an expanding demand for transport services.

Developments during the last generation, more particularly in road transport, have stimulated a great dispersion of population and industry away from the congested centres of our cities and, in general, greater dispersion calls for more transport.

Main Requirements for Increasing Productivity in Transport

On the general question of increasing productivity in transport four considerations are indicated. The first is that the Government should pursue policies calculated to lead to the spending of a great proportion of the national income than at present on capital goods for industry, i.e. on equipment designed to increase productivity; the second is that the transport industry as a whole needs, in the interests of greater national productivity, a bigger proportion of the nation's total industrial capital expenditure than it at present receives, and can justify this because it can offer a better return on the investment than can most rival claimants; the third is that the allocation of capital expenditure within the transport industry should be based on the relative profitability of different projects: great profitability should command a high priority; and the fourth is that, without the fullest and most intelligent co operation in the task of increasing productivity by the men and women employed in transport, whether in managerial or in other capacities, the effect of any increased capital expenditure will be nullified.

If the urgency of the need were better appreciated such co-operation would no doubt be more readily forthcoming. Much of the difficulty arises from the very human tendency to view innovations designed to increase productivity from a selfish and short-sighted angle. This attitude can perhaps be submerged only in times of national emergency, and too little has been done to explain that the present is such a time, or indeed to pursue policies in keeping with the country's needs.

Low Productivity of British Road Transport

Mechanised road transport, although a comparatively recent and – technically – still a rapidly developing form of transport, suffers outstandingly from a failure to achieve a high level of productivity per person employed, due in part to grossly inadequate capital expenditure and in part to faults in the human sphere, deriving from dislike of change and resistance to letting the road haulier fulfil his proper role. In a competitive world it is important that standards of productivity should compare favourably with those of other countries, and here British road transport shows up rather badly.

Most other industrial countries, and particularly the neighbouring countries of Western Europe, are showing a much more dynamic approach in the matter of improving their road systems, especially by the building of new roads; their attitude towards the freeing of road transport from obsolete restric- is also much more progressive.

British road transport employs directly some 1,225,500 people and, by promoting the manufacture of motor vehicles, has

contributed greatly to the growth of Britain's biggest export industry. It, therefore, merits much better treatment from the legislature than it has hitherto received.

Insufficiency of Capital Expenditure on Roads

The total expenditure on new road construction and major road improvements has amounted only to some £400 million (Rs 540 crores) since the beginning of this century, although the roads are the permanent way of a new form of transport which within that period has revolutionised the life of the community. This very modest expenditure on road improvement over the last 50 years compares with £600 million (Rs 810 crores) spent on the capital development of the electricity industry in the first six years since the end of the war.

The result of inadequate capital expenditure on roads is that the vehicles which use them are denied the ease of movement needed for reasonable point-to-point speeds, for safety and for low running costs. A good deal of attention has been drawn to this during the past few years, and, although much remedial action has been planned by the Ministry of Transport, very little has actually been undertaken due to the diversion of labour and materials to other purposes. There is, however, no lack of equipment available for road making, yet much of it is allowed to remain either underemployed or even idle.

Roads have in fact been given an extraordinarily low priority in the country's capital expenditure programmes both on strategic works and on new industrial projects.

The reason is not far to seek. The operators of road transport, who have the biggest stake in the provision of a modern road system, have no say or influence in the matter except as ordinary citizens and voters. The initiative of local authorities has become increasingly circumscribed as their finances have grown more and more dependent on block grants from the Central Government.

This separation of the providers of the finance for the roads from the users is without doubt the main reason why so little has been done. A clear illustration of this is the sharp contrast between the modern road systems within some of our newer industrial plants and the antiquated network of narrow roads and streets outside the gates.

It would not be unreasonable to suggest that, whereas the management of the plant fully understands the importance of roads as an intrinsic part of industrial capital equipment, the authorities responsible for financing the public roads regard them not as industrial equipment but rather as a kind of social amenity provided mainly for "pleasure" motorists.

Their view is that it would only be proper to spend money on roads, either if the country were so rich that difficulty were experienced in finding sufficient outlets for Welfare State expenditure, or if unemployment were so acute that it was necessary to provide public works of various kinds, which might even include road works.

The first hurdle to cross is to educate those responsible for the road system to appreciate that, whatever their other uses, the roads are, from the economic point of view, a most important class of industrial equipment. It is difficult to see how this can be achieved unless steps are taken to link the road transport industry, much more closely than has heretofore been attempted, with the provision of such an important part of its capital equipment.

After all, the principal economic purpose of improving the road system is to reduce transport operating costs. The only rational economic approach to any proposed road scheme is to estimate the saving which would result from the road improvement and to compare it with the capital cost. It is a fundamental proposition in economics that the process of production is not complete until goods are in the hands of the final consumer. It is no picturesque metaphor to regard the permanent way of the transport system as an extension of the factory conveyor belt along which all goods must pass in their journey from the raw material stage to the finished product.

Road Improvement Abroad

It is not necessary to look very far afield to find a much more advanced approach to capital expenditure on roads as a means of improving industrial productivity than that prevailing in Britain. Belgium, for example, a country whose industrial realism and ability to adjust her economy to changing circumstances have been outstanding since the war, is currently undertaking a five-year road modernisation plan of 1,000 miles of route at a cost of £ 53 million (Rs 71.6 crores). Belgium is also engaged on a 15-year programme for building 580 miles of motorways, linking up her principal cities and providing international links with neighbouring countries, at a cost of some £ 136 million (Rs 183.6 crores). The purpose behind this scheme is to raise the level of industrial efficiency by providing a better transport system.

A 10-year plan for British roads was announced by the Minister of Transport in 1946. This plan included the construction of 1,000 miles of motorways, the bringing of all the most heavily trafficked trunk roads up to a double-carriageway standard, and also improvements to the flow of urban traffic, but, more than six years later, not even a modest attempt has been made to implement the plan.

Other countries, notably Holland and France, have done much over the same period to modernise their road systems; it is particularly significant that, in France, a new law has been passed by the National Assembly authorising special capital expenditure on road development and setting up a committee, including representatives of road users, to administer the highway funds allocated. It is a matter of grave concern that in Britain no proper steps are taken to keep abreast of modern standards in all aspects of capital equipment, including roads, which are pertinent to the improvement of industrial productivity.

Economic Justification of Expenditure on Road Transport

In what we are still inclined to call a "normal" economy, capital expenditure on roads would, in theory, be undertaken if it produced an annual saving in vehicle operating costs greater than the annual cost of the road works. Unassailable in theory, this principle is not, however, of much practical value. Far from living in a so-called "normal" economy, British economy of recent years has moved from crisis to crisis, and the short-term expedients for dealing with each immediate crisis have invariably included economy in road expenditure.

It is obviously necessary in a "crisis" economy, in which the price of capital is fixed at such a level that the Government can permit only a proportion of the economically justifiable capital expenditure projects to be undertaken, that some system of priorities should be drawn up for determining what capital expenditure should be undertaken at any particular time. This is a problem which might well occupy the thoughts of the professional economists to a much greater extent than hitherto.

If capital were available at, say, one per cent over the Bank rate, and if there were no restrictions, either direct or indirect, on capital expenditure, then any project which could be paid off within 20 years would be economically justified. If the Government's crisis policy involves cuts in what might be termed the natural level of capital expenditure, how ought these cuts to be made? If a 20 years' pay-off is not favourable enough, then what is? Fifteen years', 12 years', 8 years'? No light has been shed on the proper answer to this all-important question. Many road projects can show a pay-off over an 8-year period or less. At what point is it in the national interest for these to be undertaken? The argument applies with equal force to expenditure on new vehicles and improved equipment. Given a proper priority for scarce materials, the initial outlay on new vehicles and equipment could be offset by savings in operating costs within a very short time.

Turnpike Roads are a Success

Those directly concerned are much more acutely aware of the importance of action than is the Central Government. Turnpike

(*Continued on page 22*)

SPECIAL ARTICLE NO 10

PREVENTION OF RIBBON DEVELOPMENT

Standards for Land Widths, Building Lines and Control widths.

(Contributed)

RIBBON DEVELOPMENT, as the name implies, is the development of buildings, orchards, etc., in a linear direction resembling a ribbon along a highway. If buildings are erected close to the road it will not be possible to widen the carriageway to suit needs of traffic at a future date. Also, residents of the houses, particularly children, are liable to accidents. Therefore, it is essential that proper control of land development along highways is exercised, as otherwise, the investment on the road would be wasteful because the road cannot efficiently serve the traffic needs.

Realising the importance of adequate land widths, the meeting of Chief Engineers held at Nagpur in December 1943 had recommended the following standards for land widths for roads:

Land Width	*Widths in feet*		*Remarks*
	Normal	*Minimum*	
National Highways	250	150	Approaches to or bypasses at large towns require special treatment.
State Hghways	250	100	
District Roads	100	66	
Village Roads	—	25	

The Nagpur Report also envisaged that it might legally be possible to control roadside land without actually acquiring the land through a Highway Act. The appointment of a Legal Committee to examine the question of land acquisition and the anti-encroachment measures and demarcation of boundaries was also recommended.

Accepting the above recommendations, the Government of India appointed a "Road Lands Enquiry Committee" in December 1945. The main recommendations of the Committee were:

1. The highway authority should be empowered to determine standard widths of different sections for roads and to vary them according to traffic necessity.

2. Powers should be taken -

   (a) to impose restrictions on use of land over a specified width on each side of the centre of the road;

   (b) to notify a **building line** along important roads and construction of buildings should be prohibited in front of the building line;

   (c) to **control the use of land** within a specified width on either side of and behind the building line for other than agricultural purposes; and

   (d) to **prohibit new access** to the highway except with the permission of the highway authority.

Building lines were defined as lines beyond the road boundary between which and the road boundary all buildings shall be prohibited. Buildings under access in the controlled width will be subject to the permission of the highway Authority. Fig. 1 illustrating building and control lines.

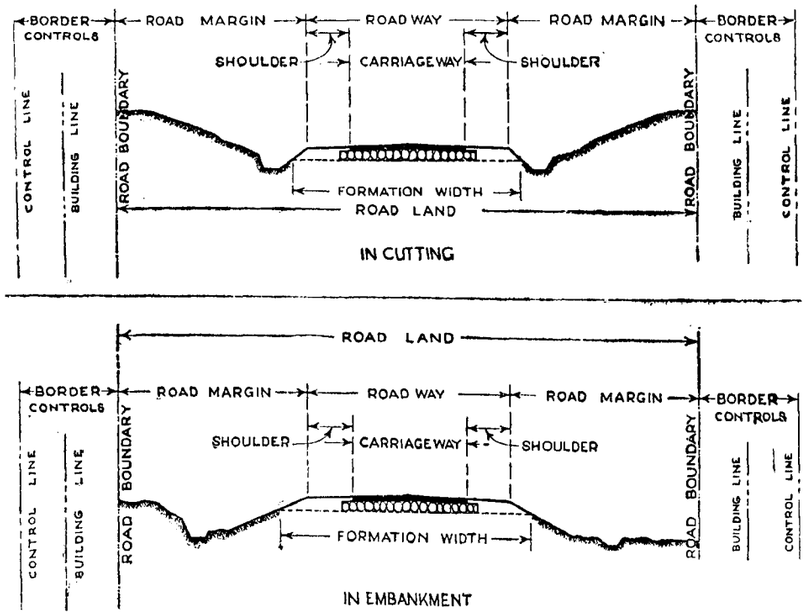


Fig. 1

this definition include erection, re-erection, or enlargement of any building, or the making of any permanent excavation, or the construction, formation or layouts of any works. Orchards, wells, enclosures, temporary or permanent, which obstruct visibility on the road were also included in this category.

Control lines were defined as lines beyond building line between which and the building line the use of land for purposes other than agriculture is controlled. Future building construction, structural development of existing buildings, formation or layout of any

The legal view on the above recommendations of the Road Lands Enquiry Committee was that it was possible to enforce a building line and a control line, but the recommended standards should be reasonable so that these cannot be challenged in a court of law as excessive and beyond the powers of legislature.

Considering the above legal opinion, the Specifications and Standards Committee of the Indian Roads Congress and the Council of the Indian Roads Congress reviewed the recommendations of the Nagpur Report. The recommendations are given below :

Recommended Standards
Land widths–Building line–Controlled widths–

(All dimensions in feet)

(The recommendations are primarily intended for new construction)

	Open areas and agricultural country				Urban (Built up) & industrial areas.		
Class of Road	Width of road land Normal	Range	Building lines (overall width)	Control lines (overall width)	Width of road land Normal	Range	Building or setback line width of strip beyond Road Boundary
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
National & State Highways	100	100 to 200	200 (240)*	400	80	80 to 200	10 to 20
Major District Roads	80	80 to 100	160	300	40	40 to 60	10
Other District Roads	40	40 to 80	80 (100)*	120	30	30 to 50	...
Village Roads	40	40 to 60	80	100	30	30 to 50	...

*See Note 2(i).

Explanatory Notes.

1. Land widths

(i) The standards for land width refer mainly to new construction. In the case of existing roads, standards for building lines and control lines are to be adopted and enforced as far as possible. This will prevent ribbon development and permit easy acquisition of extra land required for existing roads, as and when traffic warrants.

(ii) Land width to be acquired for new construction is to be the minimum consistent with traffic needs, topographic features, design requirements, and ultimate economy. This minimum width is indicated under the heading 'Land Width Normal' (Cols. 2 & 6). Increased width is to be proposed on approaches to towns and industrial areas, to provide for potential increase in traffic. Each case will have to be decided on its merits.

(iii) The selected uniform width is to be continued for a road or a section of a road subject to remarks in notes 1 (iv) and 1 (v).

(iv) In heavily embanked portions averaging 3 feet or more in height the land width should be correspondingly increased to allow for the reduction in the effective widths or road margins caused by the side slopes of the embankment taken over one furlong or less, if suitable. The extra width shall be to the nearest ten feet.

(v) In curves extra land width is also to be provided for, as required.

2. Building Lines

(i) Where the existing or proposed land width is equal to the width between building lines, as indicated in the statement, the building lines shall be set 20 feet from road boundary lines in the case of

(Continued on page 27)

The Government of the Phillippines Provide Effective Highway Administration

THE Government of the Phillippines Islands have recently passed an act called the PHILLIPPINES HIGHWAYS ACT 1952 "to provide for an effective Highway administration, modify apportionment of highway funds, and give aid to the Provinces, Chartered Cities, and for other purposes".

The Act is based on a study carried out in 1950 by the Phillippine Bureau of Public Works in co operation with the United States Bureau of Public Roads. The following facts about the Phillippines are interesting. The corresponding facts about India are shown for comparison.

	Philippines	*India*
Area sq. miles	1,15,600	11,38,814
Population in millons	22	357
Motor Vehicles	93,000	300,000
Roads in miles		
Concrete etc.	900	840
Black Top	1,530	11,011
Gravel (W. B. M.)	8,260	79,503
Total surfaced	10,190	91,354
Unsurfaced	2,220	1,38,606
Road Expenditure in Rs Lakhs	(1948)	(1951—52).
National Roads	420	955
Provincial Roads	455	3,062
Municipal Roads	58	300 estimated
	933	4,317
Revenue from Highway Users in Rs lakhs.	(1948)	(1951-52)
Motor Fuel	595	3,271
Registration etc.	210	2,839
	805	6,110

Road Finance.

The following interesting facts are gleaned from a perusal of the Phillippines Highway Act, 1952 :

1. All money raised from road users such as petrol tax, registration tax, tax on vehicles and spare parts is credited to a Road Fund for expenditure on roads.
2. In addition Government contributes 5 per cent of its general revenues for expenditure on roads.
3. The total highway expenditure is as much as 14 per cent of the total revenue from all sources. (Contrast with India where the percentage was 4·2 in 1951-52).
4. The revenue from road users is rising rapidly and in 1952 was nearly twice as much as it was in 1946.

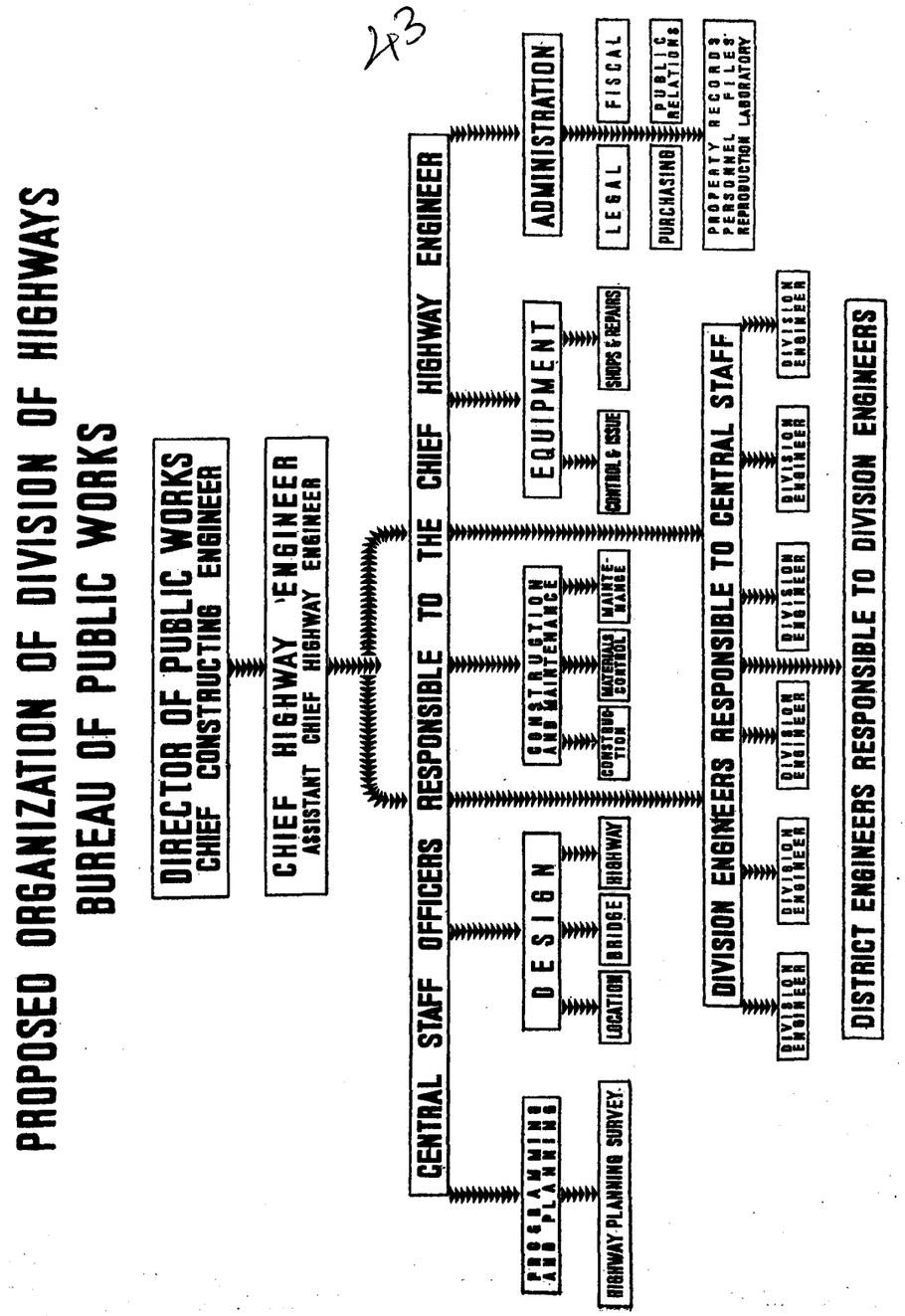
Road Administration - Proposals

The Administrative Organization proposed by the 1950 Commitee is shown in the chart at page 9. The Organization is explained by the Committee in the following words :

" The following recommended improvements in the administration of the Division of Highways are fundamental to the carrying out of the other recommendations of this report :

1. Five staff positions covering
   (i) Programming and Planning,
   (ii) Design,
   (iii) Construction and Maintenance,
   (iv) Equipment, and
   (v) Administration
   be created in the Division of Highways.
2. All National, Provincial and City highways be divided into control sections to facilitate orderly programming of improvements and maintenance cost accounting.

* Estimated at Rs 1.75 to the Pesos.



3. All improvements on National, Provincial, Chartered City, and Municipal roads and streets be programmed by the Programming and Planning Engineer.

4. A strong construction and maintenance section be established with adequate authority to carry out a large programme.

5. An equipment organization be started, financed in part from equipment rentals and in part from highway revenues.

6 Six regional or division engineers be given adequate authority to supervise highway work in the Provinces.

7. Highway administrative costs be obtained from highway revenues and be budgeted by the central office.

The following advice on the construction and maintenance activities of the proposed organization is of interest. "Two principles must be observed in discharging the function of the Construction and Maintenance Section.

(1) the affixing of responsibility; and

(2) administrative freedom to discharge that responsibility.

"The Construction and Maintenance Engineer should be responsible for all construction work and be accountable directly to the Chief Highway Engineer. All construction personnel must be strictly accountable to the Construction and Maintenance Engineer, whether in the central office or in the field.

"The Construction and Maintenance Engineer must be given the proper freedom to act within the scope of his responsibility. He must have power to enforce the engineering specifications on a given project; to accomplish this end he must be given an adequate number of staff engineers, supervisory engineers, and inspectors. As he is the official primarily responsible for detailed contract enforcement he must have a decisive voice in determining the eligibility of contractors....."

Road Administration under the 1952 Act.

The Act does not go into the details of the administrative set-up of the Division of Highways. The following extracts will, however, give some indication of the administrative functions of this Division:

"Section 4.....The proceeds of the tax on motor fuel prescribed in sub-sections (b), (c), and (d) of Section 142 of this Code shall be deposited in a **Special Trust Account** .....to constitute a **"Highway Special Fund"** to be apportioned and expended in accordance with the provisions of (this Act)..... ..."

"*Section 5*.....Money collected under the provisions of (Act 3892) shall be deposited.....(as for Section 4 above)."

"*Section 6*. Deduction for Administrative Expenses.....So much as may be required but not to exceed three (3) per centum of all moneys accruing to the Highway Special Fund..... ...shall be deducted from the Highway Special Fund and made available until expended, for administering the provisions of this Act....."

"*Section 10*. Apportionment for improvement, reconstruction, and construction—

(a) **Regular share**. The sum set aside... .....shall be distributed as follows:

"Sixty (60) per centum in proportion to the potential area (uncultivated and undeveloped) available for agricultural and industrial purposes.....to be distributed exclusively to the provinces.

"Twenty (20) per centum in proportion to the amount of property assessment....."

(b) "**Additional share**. (This is to be a percentage of the regular share depending on the lengths of temporary bridges and unbridged river crossings).

(c) **Discretionary Funds**. (This is for "unforeseen factors" and is limited to 35 per cent of the regular share).

(d) **National Aid**. (The provisions of the Act are not clear on this in absence of knowledge of their financial methods)

"No "National Aid" shall be authorised.....unless the provincial board or city council concerned has adequately provided for the maintenance of existing unabandoned roads, streets, and bridges .....

"*Section 14*. The improvement, reconstruction, paving, and construction of "national aid" highways..... and all contracts, plans, specifications, and estimates relating thereto, shall be undertaken by the Director of Public Works.....

"All highways constructed or reconstructed under the provisions of this Act shall be free from tolls of all kinds.

"*Section 17*.....The costs of engineering which shall include surveys, preparation of plans, specifications, and estimates, inspections, and unforeseen contingencies shall not exceed ten (10) per centum of the total estimated cost of construction.

"*Section 21*.....(The) budget shall be prepared.....by the Director of Public Works.

"*Section 25*. Budget programmes shall set up anticipated highway funds apportionable.....against contractual and other obligations to be met out of the anticipated collections covering into the Highway Special Fund for a period in advance not longer than twenty four (24) months.

"*Section 26*.....(The) accounting section in the Division of Highways.....shall co-operate with the Budget Commission and General Accounting Office in fiscal accounting, but shall work independently of these offices in so far as cost accounting, statistical compilation and analysis thereof for purposes of engineering are concerned.....

"*Section 30*.....Any fiscal officer who withholds or causes the withholding of any moneys apportionable under Sections 6 (c), 7 and 9..... shall be punished by a fine of not less than one thousand pesos (Rs 1750) nor more than five thousand pesos (Rs 8750) and permanently disqualified from Holding Public Office or Employment" (The last few words are printed in capitals in the Act).

It is interesting to ponder over the reasons for including Section 30 in an Act "to provide for an effective highway administration". It is also interesting to note from Section 26 that accounting is part of the Division of Highways and that cost accounting is independent of fiscal accounting.

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FIRST PRIORITY

After a tour of India's north-eastern border **Shri Jawaharlal Nehru** *said in a Press Confenence at Delhi on the 2nd November 1952*:

The tribal folk are a very fine lot, very attractive, hard working and intelligent. What they want is,

first of all, communications,

secondly, schools,

and thirdly hospitals and dispensaries.

MACADAM

JOHN Loudon MacAdam, the Scottish engineer, with his contemporary Telford can be said to be the founder of modern road construction. He was born on 21st of September 1756 at Carsphairn, but was brought up at Ayr. The family came from the stock of Highlanders and belonged to the clan of MacGregor. When the clan was outlawed and its name forbidden, many of the members changed their names. One of the members settled in Ayrshire and adopted the name MacAdam, as he said that no one could deny that he was a descendent of Adam. ("Mac" means "son of" in Gallic).

John Loudon had his education in a parish school and in 1770, after the death of his father, went to New York for training in business. Returning to Scotland in 1783, he served as Deputy Lieutenant for the county of Ayr, raised a company of volunteer artillery for coast defence during the Napoleonic wars and devoted attention to improvement of local roads. His main hobby was travel through south-west of England to study roads and devise means for their betterment. He was elected trustee of British Turnpike Trust and was appointed Surveyor for the Trust in 1816. Under his administration the Trust reduced the upkeep costs, increased its income and repaid debts. This success resulted in his being consulted by many road authorities.

In 1817, MacAdam had an opportunity to demonstrate his system by laying the approach roads to the Westminster and Blackfriars bridges in London. In 1823 he settled in London and secured the appointment of a House of Commons Committee to investigate his own methods. Parliament voted him £10,000, of which £8,000 was repayment of his expenditure in helping various road authorities. He declined a Knighthood, but secured the appointment of Surveyor-General to the Commissioners of Metropolitan roads. This post enabled him to secure the general adoption of his system throughout Britain.

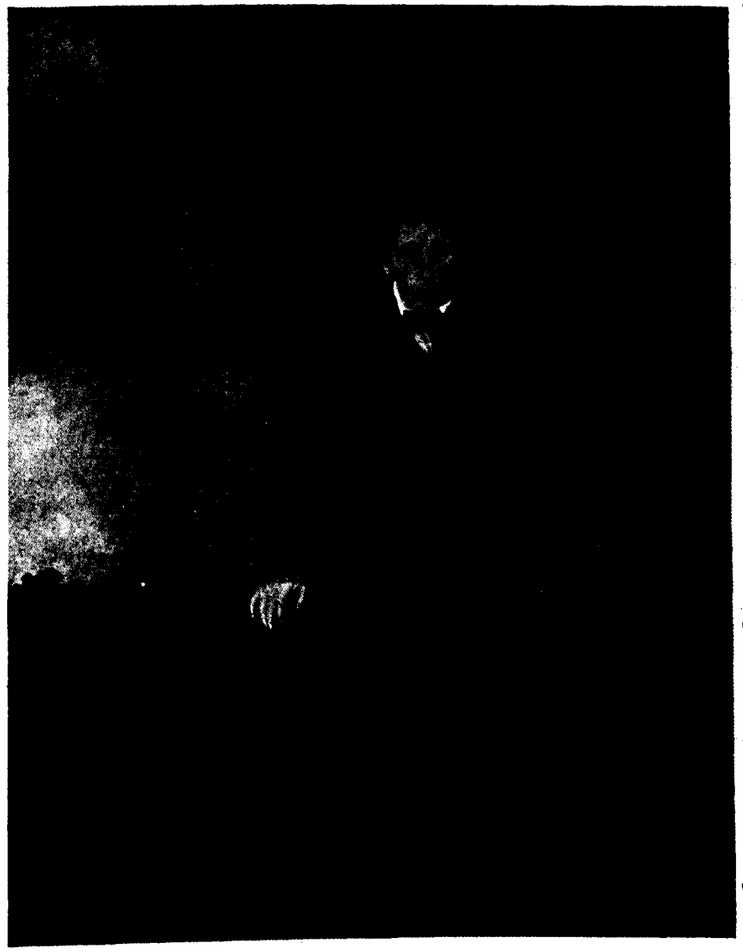
The MacAdam system of road construction is mainly based on the principle that if a road is made of suitable material and well drained, it can be laid on natural soil without the necessity of stone-paved foundations. He seems to have claimed that broken stone layer, if of properly prepared material and suitably laid, is nearly impervious to water. If the surface is given proper slope to throw off rainwater, would be stong enough to support traffic. He claimed that a road on elastic foundations showed much less wear than one on rigid foundations. MacAdam laid his broken stone loose on the surface and allowed traffic to consolidate it. He maintained that the pressure of traffic would combine the sharp angles of the stone into a compact mass.

In the present day construction, the combining of the sharp angles of the stone into a compact mass is termed interlocking and the roller supplies the pressure.

At the age of 81, in November 1836, he died at Moffat during one of his excursions

His name is immortalised in the term "Macadam" though he seems to have signed himself "McAdam."

The portrait reproduced on page 13 is from the National Portrait Gallery.



[With acknowledgments to Road International, Summer, 1952.

JOHN LOUDON McADAM (1756-1836)

"Who shall dispute thy name.
Insculpt in stone in every Street".

—o—

HERE AND THERE

1. PHILOSOPHY OF ADMINISTRATION

BY assuring that each member of the department has a definite assignment for which he is squarely responsible, a good plan helps to utilise the full energies and capabilities of each individual employee. For responsibility is an immensely stimulating force ; it calls for the best efforts of able people, and gives full play to their initiative, enterprise, resourcefulness, and ingenuity. It lends interest and zest to the job, and gives rise to a proprietary spirit as distinct from a sense of ' just working there '. It makes people forget to watch the clock and concentrate their full energies on getting the job done.

Finally, responsibility is a most potent factor in developing able people to their full potentialities—as supervisors, executives, and staff assistants. Given real responsibility, even reasonably able men usually rise to the occasion, grow up to the job.

Where responsibility is closely held and highly centralised, there is normally a scarcity of employees qualified to take major responsibility when the need arises. Where responsibilities are clearly defined and properly delegated, however, there are usually many qualified candidates for promotion and advancement to fill these posts as they become vacant.

Thus responsibility is a major factor in attracting able men and in keeping them interested and satisfied in their assignments. Subordinate responsibility, in the American sense, is rarely accorded, accepted, or rewarded outside that country, and, in the result, many of these qualities must go a-begging. These concepts carry with them the notion of commensurate remuneration, and the American salary and administrative structure, broad-based and equalitarian, is fundamentally different from the European. The American organization presents many opportunities of earning high salaries and enjoying considerable independence and responsibility attractions which lead to the recruitment of individuals of higher personal qualifications.

[U. S. Highway Research Board.]

2. ROAD RESEARCH AND NATIONAL ECONOMY

IT is not the political organization of an industry—or a nation – which, primarily, makes it prosperous. It is the technical skill exercised in that industry and the value of the goods or service which it provides that is the more important factor. Improvement in the efficiency or productivity of an industry may far outweigh the disputed advantage to be gained from a change of ownership or administration A perusal of the recently published report " Road Research, 1951," is a forceful remainder of the possibilities inherent in such improvement, as they might be applied to road transport.

About 10 per cent of the community's expenditure on goods and services of all kinds was spent, directly or indirectly, on road transport, during the years 1949 and 1950 ; about 1,060 million pounds (Rs 1430 crores) were spent on road transport and travel in 1949 and about 1,220 million pounds (Rs 1,650 crores) in 1950-that is about three-quarters of the total expenditure in all forms of internal transport and travel. These figures are derived from a detailed study of expenditure during these two years which has been made at the Road Research Laboratory, and which is given in some detail in the report.

The significance of this knowledge and the use to which the Laboratory will apply it, may best be indicated by quoting from the Road Research Board's report : " We have kept constantly in mind the function of the road as a channel for

trade and for the flow of community life. The particular need, at the present time. is to make the road system play its full part in assisting the nation's drive for increased productivity.

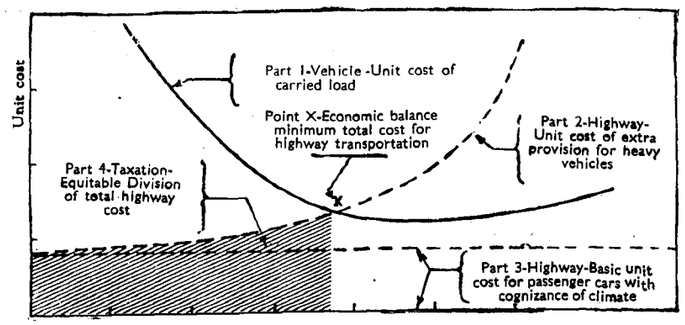
Any serious attempt to relate expenditure on roads to the economic return from the road system requires knowledge: knowledge of how to construct, maintain and improve them at the least cost, and knowledge of accidents, how to reduce their numbers and what it costs to do so. The aim of road research is to provide this knowledge so that the effect of measures to increase efficiency can be properly judged."

(Extracted from ' The Engineer '—December 26, 1952).

3. THE ECONOMIC AND ENGINEERING PROBLEM

THE western Association of State Highway Officials, U.S.A., sponsored a comprehensive field study of typical Western road design and construction. Rather than a search for information on destructive forces, the purpose of the investigation was to provide constructive data on the minimum cost for maximum service. The conclusions are expected to be helpful in determining equitable highway financing for the future.

The relationships between highway design and vehicle loads which form the study can best be expressed graphically. A graphic presentation of factors involved is given in the figure.



" The overall highway transport economic and engineering problem has four basic parts. The inter-relationship of these four parts has been interpreted graphically on the following assumptions :

Part 1 – The unit cost of carried loads : This is based on evidence that economies in commercial motor vehicle operations can be obtained by the use of vehicles with greater axle loads and gross weights than are now allowed. The law of diminishing returns will apply as some maximum limit, the magnitude of which has not yet been fully determined.

Part 2—Unit cost of extra highway provision: This is also based on evidence that pavement construction costs increase with provision for increased load supporting capacity in some relation not fully established.

" **Part 3**—Basic unit highway cost for passenger cars : There exists a basic cost necessary to provide highways for passenger cars with cognizance of the destructive effects of climatic conditions, a value which has not been firmly established for different types of highway.

Part 4—Taxation : It is possible to determine the highway cost responsibility of various classes of highway users as a basis for more equiatable taxation."

(Extracted from 'Western Construction'—January, 1953)

4. TANNATES AND CORROSION

Ancient Finds in Britain

INFORMATION obtained from examination of iron implements 2,000 years old may lead to a new method of protecting underground pipes from corrosion. Although the articles were buried in one of the most aggressive soils possible, they were found to be perfectly preserved. Tannates in the soil appeared to have completely prevented action by sulphate reducing bacteria. These bacteria are responsible for most cases of rapid corrosion in waterlogged clay soils.

The iron articles, ranging from hobnails to knives were found during excavations by the Inspectorate of Ancient Monuments, Ministry of Works, on a site at Hungate, York, in England. Normally, on a waterlogged site they would corrode in a very short time. Because of their excellent state of preservation, samples of the soil in which they had been buried were examined by the Chemical Research Laboratory, D. S. I. R. Sulphate reducing bacteria were found to be present but not active, though the soil would ordinarily have been highly aggressive towards iron. Scrappings from a Roman knife were examined chemically and it was found that there were traces of tannate in the little surface corrosion that existed.

The soil on the site was peaty and contained many leather cuttings. Several mediaeval shoes were also found and a number of knives which may have been used in the working of leather. It is believed that in the middle ages a cordwainers' hall stood nearby and that the area was the centre of a leather industry. This was the obvious source of the tanning in the ground at Hungate.

Cultures were made of sulphate reducing bacteria and inoculated with soil from the site. Their activity ceased if more than 5 per cent was added. This result suggested that extracts from the leather were at least partly responsible. Other experiments using solutions made from the leather itself confirmed this.

Latter work has shown that tannic acid in greater concentration than 0.01 per cent stops the action of sulphate reducing bacteria. The discovery may result in a method of protecting water and gas pipes, for example, from corrosion.

(Extracted from 'The British Constructional Engineer'— February-March, 1953)

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5. CONTROL OF ROADSIDE ADVERTISEMENTS IN AUSTRALIA

IN the interests of amenity and safety, the rural main roads of New South Wales, Australia, have been kept clear of advertising signs for many years past by Councils and the Department of Main Roads in the exercise of their powers under the Local Government and Main Roads Act.

Advertising on main roads at business premises and on awnings where agreed to by the Council concerned, is generally not restricted by the Department, provided the sign relates to the business carried on within the premises, except that flashing and/or moving signs are prohibited. These are regarded as being distracting to drivers of vehicles. Ths following minor limitations also apply:

(1) Signs are not to extend beyond the kerb-line and are to be at least 8 ft 6 in. above the footway.

(2) They are to be attached to the building or awning and not on separate posts on the footway.

Where farm produce and meals are offered in rural areas, both stalls and signs are required to be off the roadway, but where stalls are obscured by roadside trees a limited number of neatly constructed signs may be placed on the roadway.

No objection is raised to the temporary erection of banners across main roads, provided they relate to objects of public character, are at least 18 feet above the roadway, and have the approval of the Council of the area.

The Department of Main Roads, New South Wales, is vested with authority under the Main Roads Act also to control any signs or hoardings adjacent to main roads which are considered prejudicial to the safety of the travelling public. In dealing with signs adjacent to main roads, the Department regards them as being prejudicial to the safety of the travelling public if they come within any of the following categories:

(i) Signs which obscure traffic warning signs or obscure definite road hazards which would otherwise be apparent to the driver of a vehicle.

(ii) Flashing signs which by their varying intensity from light to dark, or changing of colours, adversely affect the driver's vision and definition of the road pavement or objects on it.

(iii) Still signs illuminated or floodlit in such a manner that the intensity of light is such as seriously to impair the driver's vision and definition of the road pavement or objects on it.

(Extracted from 'Main Roads'—March 1953).

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6. APPLIED SCIENCE AND ROAD CONSTRUCTION

THERE is a popular and persistent fallacy that "anyone can make a road." Going right back into the dimmest periods of history it is true, of course, that primitive man trod out a track by the simple process of following the same route day after day. It is even said that buffaloes, in their various migrations, trod out regular tracks in uninhabited regions of North America and these tracks were so well located that railways followed their alignment thousands of years later.

That may well be the case, but if the history of road making is traced through the subsequent ages, it will transpire that, except during one or two brief enlightened periods, the roads have never fully satisfied the legitimate needs of traffic. The Roman roads were doubtless sufficient for the requirements of the invading legions and in the early nineteenth century the efforts of Telford and McAdam* enabled the mail coaches to run on the principal routes at quite respectable speeds, but in the intervening period, if travellers' tales are to be believed, the roads were atrociously bad and were often impassable in winter. Those two great roadmakers, like the Romans, used scientific methods of construction, and even if Telford and McAdam could not agree as to the merits of rigid and flexible foundations, they both agreed on the importance of good drainage, and the rigid versus flexible controversy has never been satisfactorily settled, right up to the present day.

Coming to our own times, it is plain that road design and development have failed to keep pace with ever-increasing traffic volumes, speeds and loadings, and the need for applied science in road construction is all the more urgent. Some of the problems in modern road building can only be solved by studying and applying the basic principles of physics and chemistry; others by applying the principles of dynamics established by Sir Issac Newton; and—since roads are inseparable from bridges—the road engineer of the present day requires a full knowledge of newly developed methods of construction and of the mathematics which they involve.

(Extracted from 'Highways and Bridges'—March 4, 1953).

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* Life sketch of McAdam appears at page 12 of this issue.

7. THE STRENGTH OF CONCRETE AT THE TIME OF LOADING

AMONGST building materials in general use concrete is possibly the only one that continues to gain strength over a long period. Materials such as steel and timber maintain their strengths if protected from the weather, but their strength is more likely to be decreased than increased by the passage of time. For many years the quality of concrete has been judged by its crushing strength at the age of 28 days, a period probably based upon the time required for the concrete to gain sufficient strength before props or other falsework could safely be removed.

In many structures, particularly those with a high ratio of superimposed load to dead load, the full design load is not applied for a considerable time after the concrete work is completed, and they may not be fully loaded until three months or more after concreting. In these circumstances a saving of cement could be made if the design were based on the strength of the concrete at, say, 90 days, rather than at 28days.

The increase in strength between 28 days and 90 days for a mixture with a water-cement ratio of 0.6 has been found at the Building Research Station, U.K., to be from 4,700 lb per sq. inch to 6,200 lb per sq. inch, while a similar mixture with a water-cement ratio of 0.45 and a strength at 28 days of 6,800 lb per sq. inch had at 90 days a strength of 8,400 lb per sq. inch. These increases are considerable, and give an indication of the extra strength of concrete at later ages.

As concrete still gains strength after 90 days, the practice of basing the design upon the strength at 28 days must often result in the use of richer mixtures than are necessary. A reduction in strength of 10 per cent may allow a saving of about 10 per cent of cement, and the shuttering and props could still be struck in less than a month. For example, if the dead load plus the construction load does not exceed about 80 to 85 per cent of the total load for which the structure is designed, the structure will still be adequate to carry these loads with the same factor of safety as eventually will apply to the total load. The practice of basing designs on the strength of concrete at 28 days seems wasteful in cases where the concrete will not receive its design load until its strength is considerably greater.

A similar cement content would in some cases affect the durability of the concrete because a higher water-cement ratio might be necessary with consequent lower resistance to frost and increased shrinkage. But the effect of frost need not be considered in the case of interior work, and compaction by vibration permits the thorough consolidation of stiff concrete mixtures. The bond between the steel and concrete in leaner mixtures would ber educed, but this would not be serious.

A further effect of basing designs on strengths at later ages would be that there would be less demand for cement with exceptionally high early strength; these cements are made at a few works only, and insistence on their use may result in considerable delay in delivery. If engineers decide the strength required at various stages during construction, rather than base all designs upon the strength at one month whether or not the concrete will be fully loaded at this period, it may lead to as much economy in cement as many of the suggestions made in the "Economy Memoranda"* recently issued by the Ministry of Works.

(Extracted from 'Concrete and Constructional Engineering'—November, 1952).

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* *No. 1 "Cement for Housing & Small Building". No. 2 "Cement for Engineering and large Buildings". H.M.S. Office, U.K. Price 3d.*

8. ROAD SWEEPING MAGNET

CONSERVATION of tyres is a matter of utmost importance for every motor transport operator because tyre consumption is one of the major items of running costs, and generally works out to about 10 per cent of the total cost of operation.

India being mainly an agricultural country where bullocks are used for working on the farms, bullock-cart traffic on roads is very heavy. Consequently, thousands of motor vehicle tyres are damaged due to bullock shoe cuts; damages are also caused due to the presence of nails, spikes and other neglected scrap metal on the road.

Encouraged by the saving in tyres consequent on picking by hand of bullock shoes during the war period, a certain transport operator in South India had installed a road sweeping magnet.

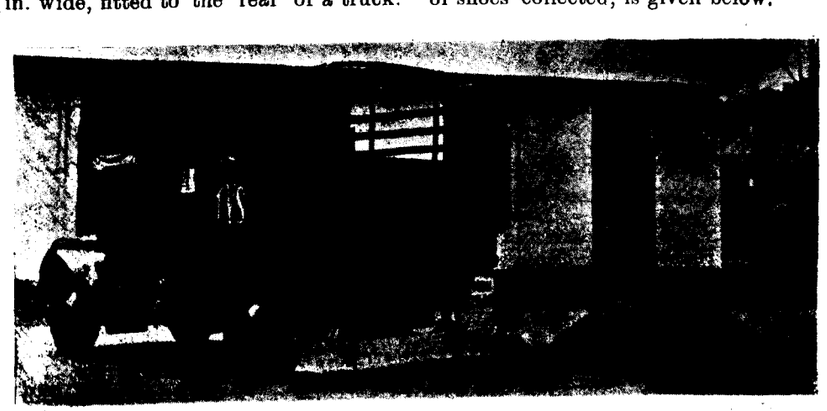
The road sweeping magnet is an electromagnet weighing 3,000 lb, 6 ft long and 18 in. wide, fitted to the rear of a truck. The road clearance is 4½ inches. An electro-generator, 2½ kilowatt and 120 volts, is used to magnetise the electric magnet. During operation the vehicle runs at 5 m.p.h., sweeping nearly 6 ft of the road. For wider roads the magnet performs more than one trip.

Ten weeks of operation with this magnet have resulted in a collection of 5,300 lb (about 2½ lakh pieces) of bullock shoes and other dangerous iron pieces.

It is claimed that the road sweeping magnet has, by elimination of bullock shoes on the road, reduced the average casualty of tyres from 20 to 2 a month.

The cost of operation of the magnet works out to Rs 1/6/- a mile, inclusive of fuel, lubrication, maintenance, driver's wages, and depreciation.

A photograph showing the road sweeping magnet fitted to a truck, along with a heap of shoes collected, is given below.



[Photo by Courtesy of the Southern Roadways, Madurai.

Truck with Road sweeping Magnet and Collection of Bullock shoes.

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9. TEMPERATURE AND CONCRETE BEAMS

A comparison of the behaviour of the beams tested at normal temperature showed that there was a considerable increase in the load required to cause failure in both the reinforced-concrete and the prestressed-concrete beams at minus 40° C. and that the load causing first cracking was much nearer to the ultimate load.

(From 'Highway Research Abstracts' February, 1953.)

ESTIMATE OF EXPENDITURE ON ROAD TRANSPORT IN GREAT BRITAIN

(Paper read before the Royal Statistical Society in January 1952 by E. Rudd)

(Contributed)

FROM the very interesting and instructive Paper referred to above the following facts emerge:

(1) About three quarters of the nation's expenditure on inland transport in 1949 and 1950 was on road transport.

(2) Road Transport absorbed about 10 per cent of the nation's resources against 3½ per cent absorbed by the Railways (12.5 per cent in 1951).

(3) The expenditure on road transport and on the unkeep of roads compared as follows:

Expenditure	1949	1950	1951*
	(£ millions)		
On transport	1,060	1,220	1,400
On roads	80	90	–
On accidents estimated	40	50	146
Total	1,180	1,360	–

(4) Transport and the distributive trades together account, roundly, for a quarter of the national effort.

(5) The breakdown of expenditure on transport of goods by roads is somewhat as shown in the table below.

Items	1949	1950
	Percentages	
1. Licences	4.5	4.1
2. Drivers' wages	34.2	31.7
3. Garages**	3.0	2.8
4. Insurance of vehicles	3.2	3.0
5. Fuel	13.9	17.7
6. Lubricants	1.3	1.3
7. Tyres	4.9	5.6
8. Maintenance	15.0	14.5
9. Depreciation	9.4	9.7
10. Interest on capital invested in vehicles	1.1	1.1
11. Administration and other expenses including profit	9.6	8.4

Items	U. K.	Prof. Madhava		
		12‡ companies	Official	Non-Official
Fuel charcoal or petrol	17.7		38.1	43.9
Lubricants	1.3	33.4 (12)	1.2	1.9
Tyres and Tubes	5.6		18.2	10.9
Repairs and Maintenance	14.5	21.5 (10)	16.0	5.4
Salaries and wages	31.7	17.7 (10)	6.8	6.5
Direction & Development	††	5.3 (12)	3.8	8.3
Taxes and Insurance	7.1	6.5 (11)	3 3	9.5
Depreciation & Interest	10.8	6.7 (12)	12.6	13.6
Profits	11.2†	11.7 (12)	–	–

* 1951 figures are taken from the Second Rees Jeffreys triennial lecture, 1952, at the Royal Society for the Prevention of Accidents.

** Rents and rates of garages only.

‡The number of companies on whose returns each percentage is based is shown in brackets.

††Shown together with 'garages' under 'profits'.

† Including Administration charges and garages rents and rates.

Unfortunately no authoritative figures are available for Indian conditions. Prof. Madhava, in his essay[1] on road transport economics, quoted some figures obtained from various sources. But the figures related to an earlier period when conditions were different. The table shows the comparison of the U. K. figures with the results arrived at by Prof. Madhava.

The one peculiarity which immediately catches the eye is that fuel, lubricants, and tyres and tubes cost proportionately much more in India than in the U. K., while the reverse is true of salaries and wages. It is unlikely that the very great discrepancy can be attributable either to the unreliability of the Indian figures or the fact that the Indian and the U. K. figures relate to different periods. It can only be concluded in the absence of any more satisfactory explanation that there are significant differences in the conditions of operation of motor transport in the U. K. and in India. The comparison, however, forcibly emphasises the need for research to obtain deeper insight into the conditions under which motor vehicle transport is operating in India.

[*A copy of the original Paper has been added to the library of the Consulting Engineer to the Govt. of India (Roads) and can be borrowed by members of the I.R.C. and others interested.—Ed.*)

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DEFINITIONS OF HIGHWAY ENGINEERING TERMS

ROAD: A way over which both vehicles and other types of traffic may lawfully pass.

It includes the whole area up to the defined boundary and all structures and appurtenances to the road.

CARRIAGEWAY: That portion of the roadway designed and constructed for vehicular traffic.

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An official was inspecting a newly completed portion of a highway. He grumbled at everything. The crown was not high enough, the shoulder was too steep. The ditches not deep enough, and so on.

The foreman bore it all patiently. Then he straightened up to his full height and looking the inspector in the eye, he asked, "How is she for length?"

[1] Published in the Journal of the Indian Roads Congress, Vol. XI–1.

ROADS IN PARLIAMENT

1. National Highways in Travancore Cochin

REPLYING to **Shri Achuthan** in the House of the People the Deputy Minister for Railways and Transport, **Shri O. V. Alagesan**, said that about 244 miles of existing roads in Travancore-Cochin came under the present provisional National Highway System. About 10 miles are expected to be improved by the end of 1952—53 and about 40 miles in 1953—54. There would be no change in the mileage of National Highways at the end of the 5-year plan period.

The bridges at Alwaye and Edacochin (Aroor) would be completed by 1955-56.

2. Roads Submerged by the Tilaiya reservoir in Bihar

In reply to **Shri N.P. Sinha**, the Deputy Minister for Railways and Transport said that the length of the old road submerged during the last monsoon was $1\frac{1}{8}$ miles. The length of new road constructed at a cost of Rs 20 lakhs, including two major bridges, was $4\frac{3}{4}$ miles. A small bridge on the old road over a tributary of the main river Barakar was submerged.

3. Motorable and Jeepable Roads built by the Japanese and Allied forces during World War II in Manipur

Answering a starred question by **Shri Reishang Keishing**, the Deputy Minister for Railways and Transport said that no roads were constructed by the Japanese forces, but $98\frac{1}{2}$ miles of motorable roads and $315\frac{1}{2}$ miles of jeepable roads were constructed by the Allied forces. Of this mileage, $225\frac{1}{2}$ miles are maintained by Government through their Public Works Department and $188\frac{1}{2}$ miles through district administrations as bridle paths. The cost of maintenance per mile varied from Rs 250 to Rs 2,250.

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(*Continued from page 4*)

roads for which money has been provided in a comparable way have been financially successful in other parts of the world, notably in the United States of America, and have been the means of providing many fine new roads and bridges in that country.

Decentralisation of Initiative

Decentralisation of initiative and decision is one of the fundamental principles of the administration of modern large-scale private enterprise. Is it so certain that the same principle ought not to apply in the case of Government, with its ever-growing interest in every facet of our economic life ?

—o—

FREE LOVE

" Do you believe in free love. ? "
" Have I ever sent you a bill ? "

TECHNICAL INFORMATION

(i) LATERITE AS A ROADMAKING MATERIAL

VERY often an engineer is called upon to construct roads which traverse areas which are poor in high quality aggregate and he is very often forced to use whatever material is readily available for the purpose. Laterite is one such material.

Origin

Some laterites are thought to have been transported from their place of origin by wind or other action, but most of those with which the roadmaker is likely to be concerned are more likely to have been formed in situ, and it is thought that they have originated from the alteration and breakdown of the rocks over which they occur, arising from the chemical action of warm surface waters, rich in carbon-dioxide and certain bacteria, which filter down through the solid rocks after the torrential rains which occur in warm regions after a long dry period ; these waters are chemically active, and decompose the rocks into which they pass.

In the dry season which follows, an upward suction of moisture towards the surface of the ground takes place, and this process is known by geologists as " leaching "; the resulting product is the laterites so typical of tropical and semi-tropical areas of the globe. They can be formed from the alteration of many different types of solid rocks such as quartzites, sandstones, gneisses, schists, granites, dolerites and basalts ; the latter class of rocks is especially prone to lateritisation ; many of the Deccan traps of the plains of India have undergone this change.

The theory just expounded seems a likely explanation of the origin of laterites, since these are almost never found in temperate regions.

Nature

Laterite is a yellowish to reddish-brown material consisting partly of spongy open-textured pebbles which vary in colour from a rusty red to liver colour, or almost black, set in a matrix of silty clay, the texture and grading of this peculiar rough " gravel " being variable not only from place to place, but also within the same pit in many cases. The spongy coarse pebbles possess the structure known to geologists as " vesicular " when applied to rocks such as lava flows. Chemically, a laterite is rich in alumina, and a particular variety of it known as bauxite is worked extensively all over the world as a source of aluminium, these together with silica and iron oxides make up the bulk of the rock.

The chief difficulties in the use of this material for roadmaking lie in the fact that not only are their constituent pebbles extremely friable, but that they are so variable in composition. This means that continual watch has to be kept in the field on these variations, for if this is not done, differences in physical properties cause corresponding differences in the performance of the road under traffic.

Not only do laterites disintegrate during extraction, but also during sieving, consolidation and the subsequent action of traffic. Against all this must be set the fact that they are known to harden to some extent after extraction, though this hardening takes some months to complete. The hardening is thought to be due to further oxidation of the high iron content of the material, the dehydration of the free oxides of aluminium and iron as the material dries out, and the precipitation of these oxides as cementing material.

Physical Properties of Roadmaking Laterites

These can be considered under four headings as follows :

(a) Nature of concretions (pebbles)
(b) Grading

(c) Atterberg constants of soil mortar

(d) Load-bearing properties.

Nature of Concretions

These have been mentioned above; their strength can be measured either by means of the aggregate crushing test or by some form of tup test. As an alternative to the aggregate crushing test, the engineer may prefer to use the Deval Rattler test or the Los Angeles test; of these tests, only the tup test can be carried out either in a pit or on the job; the others all need a properly equipped testing laboratory. If the tup test is used, it is suggested that not too heavy a falling weight, say 20 lb, in weight, be used in place of the heavier weight used for higher quality aggregates.

Grading

The grading of a laterite can be determined by ordinary mechanical analysis. The grading curves of such a material usually show a marked deficiency in the sand fraction, and this is one of the reasons why the substance is not usually an ideal one for roadmaking purposes. In any case, it should be remembered that as stated above, the constituent fragment of many laterites are so friable that a mechanical analysis has little meaning when applied to such a material. Grading curves can, however, be used in a comparative way, if this disintegration is taken into account.

Atterburg Constants

The liquid limit and plasticity index of the soil mortar of laterite can be found just as in the case of any other soil, and the figures thus obtained are of great value in assessing the probable roadmaking qualities of local materials.

Load-bearing Properties

The wellknown California Bearing Ratio test can be used for the evaluation of the probable load-bearing properties of a laterite. It is suggested that in view of the probability of road in tropical areas being liable to become inundated in the rainy seasons, the C. B. R. test should be carried out on a soaked specimen.

The Modified Proctor density test can, if necessary, be done on a laterite, but is not recommended in view of the known liability of the material to disintegrate under impact.

Compaction of Laterites in the Field

It has been found that pit-run laterites are best compacted in the field by means of a sheepsfoot roller, followed by a pneumatic-tyred roller; if hardened lateritic crust material is being used, a flat-wheel roller gives the best results. It is suggested that a trial strip be laid containing sections with varying proportions of water in order to find the best moisture content at which the material can be compacted; due allowance should be made for evaporation of water during the process of consolidation.

Suggested Specification Requirements for Laterite Gravels

It is suggested that the soil mortar should have a liquid limit of between 25 and 30, a plasticity index of 10 and 15, and a soaked C. B. R. value of between 30 and 40 for the material as a whole.

Conclusion

It will be seen from the foregoing that laterite gravels are variable in character, that some are better than others, and that accurate field evaluation of their physical properties is necessary if the best results are to be obtained. The methods outlined above are, of course, only comparative, but are none the less valuable on this account. It is also necessary to point out that the best results will be achieved if the gravel surface after laying is protected from undue traffic abrasion and, above all, from unnecessary changes in soil moisture content by a light surface dressing of tar or bitumen with a thin layer of chippings above it. This will also lessen the usual tendency of laterite gravels to corrugate in dry weather.

(Extracted from 'Contractor's Record & Public Works Engineer'—March 1951).

(ii) ROAD GRADIENTS IN NEW SOUTH WALES, AUSTRALIA

STEEP grades on roads have always attracted public interest in New South Wales, Australia. In early days the outlook regarding grades was mainly influenced by the hill climbing capacity of the early cars, and by safety when going downhill. As the motor vehicle has developed increased power and better performance, views regarding desirable grades have been changing.

During more recent years as the use of commercial vehicles has expanded, the needs of the heavy commercial vehicle have tended more and more to determine the desirable form of design for rural arterial roads, in respect not only of grades, but also in respect of width and pavement strength.

The commercial vehicle is underpowered as compared with an average car, because its power-weight ratio is lower than that of a car. For this reason, commercial vehicles are considerably slowed down when climbing steep grades, sometimes to little more than walking pace. The extent to which this occurs varies with such factors as the speed at which the grade is approached, the steepness and length of the grade, the weight of the load carried, and the performance characteristics of the vehicle itself.

The slowing down of heavy vehicles climbing long grades on two-lane roads either reduces the speed of following vehicles, or results in overtaking, which manoeuvre on a steep grade involves risk unless there is ample visibility between vehicles travelling in opposite directions. The impatience of drivers of light vehicles blocked by heavy vehicles in this way sometimes leads to this risk being taken, with occasionally unfortunate results.

Where it is economically impracticable to build a new road without steep grades, or where old steep roads cannot be rebuilt, an alternative means of improvement of two-lane roads which may sometimes be possible is to widen the roadway along the steep portion to a width sufficient for three lanes of traffic. In this way space is provided to permit slow-movingl orries proceeding uphill to move over to the left and thus enable faster moving vehicles to overtake them in greater safety. This solution is finding application in the United States of America. Unfortunately some of the steepest existing grades on arterial roads in this State are situated on ground having a steep side-slope, often liable to landslips. In such circumstances, the widening of the roadway to provide a third traffic lane is likely to be impracticable.

If a commercial vehicle approaches a steep grade at fair speed, its momentum will carry it up the grade a certain distance without marked speed reduction. On short steep grades, therefore, the need to provide a third traffic lane does not arise.

On longer lengths of steep grades, speed of heavy trucks falls off rapidly and the vehicle eventually reaches a "crawl" speed on which it continues in low gear until the grade eases off. The approximate average sustained speed of fully loaded double-decker omnibuses in climbing grades are as follows:

Grade per cent.	Speed in m.p.h.	Gear.
Lev	31.7	Top
	1.7	,,
	28.3	,,
	26.3	3rd
	18.7	,,
	15.7	,,
	13.	,,
	11.8	2nd
	11.	,,
	10.3	,,
10	10.3	,,

(Extracted from 'Main Roads'—September, 1952).

ABSTRACTS

625.746*—TRAFFIC REGULATION DEVICES.

"Traffic Aids on the Sydney Harbour Bridge" (Main Roads, June 1952, pages 97–100).

This describes how, during peak traffic of 5,600 vehicles per hour, the six traffic lanes on the bridge with 57 ft 6 in. roadway are used to allow orderly traffic flow free from traffic interference by "traffic line-stripes" by unidirectional increase in the number of traffic lanes during peak periods, and by the use of movable rubber traffic markers.

Reflector studs are used to mark the lines during nights. Experiments are reported to be in progress to make the traffic markers more visible during nights.

The layout of the junction of various approach roads to the South of the bridge are given.

625.81—LOW COST ROADS.

"Specifications for Road Gravels and Sand-clays". (Main Roads, June 1952, pages 101—109).

The article discusses the use and properties of gravels and sand-clays in pavement construction. Standard for material for soil-aggregate sub-base, base, and surface courses with reference to typical mixtures of materials available in New South Wales are discussed. Grading curves and tables are given. While the A. A. S. H. O. does not prescribe any grading restriction for size below No. 200 sieve size, it was found necessary that the grading should be extended down to a much smaller grain size.

625.736—PREPARATION OF ROAD BED.

Preparation of Gravel Pavements for Bitumen Surfacing:

H. C. Macready, Divisional Engineer, Department of Main Roads (Main Roads, December. 1952, pages 35–40).

This article gives details of field methods used for obtaining a good bitumen-surfaced pavement out of gravel surfacing. Details of preliminary operations to correct the alignment, profile and surface irregularities, depending on type of gravel, time of year, rainfall, plant available and other factors, are given. The processes of grading, watering, compaction, and maintenance grading are described.

624.22—STEEL BRIDGES.

The protection of Steel Structures in Salt Atmosphere :— H. C. Bright (Main Roads–December, 1952, pages, 53–59).

Experiments were conducted by cleaning and painting all the faces of plates by various processes and exposing them to atmospheric action by suspending them, so that one face was exposed to sunlight and the other shaded. The conclusions are that the surface preparation of steel by sand blasting is the best, scraping and wire brushing next best and flame cleaning and wire brushing is the least effective; Redlead is a better rust-inhibiting primer than zinc chromate for imperfectly cleaned steel, and Tung-oil phenolic paint vehicle provides a more waterproof paint than an alkyd vehicle. For exposure in salt atmosphere zinc paints failed but aluminium was extraordinarily good on grit-blasted surfaces.

625.8.072 : 620.60—TESTING AGGREGATES.

Stripping of Bitumen from Aggregates (Main Roads, March 1952, pages 90-95.)

The method adopted in New South Wales to test a large number of aggregates by subjecting them to "Immersion-Compression Test" is described. The procedure followed for the tests was slightly different from the test procedure prescribed by the U. S. Bureau of Public Roads.

An appendix of the test procedure adopted is given.

* Indicates Classification of the subject according to the Universal Decimal Classification System.

625.746.5—ROADS SPECIAL WORKS. TRAFFIC REGULATIONS.

"Traffic Paint Development in California" E. D. BOTS (HIGHWAY RESEARCH BOARD BULLETIN 57, 1952. pages 1-8).

Based on Laboratory experiments, large-scale experimental trials of five different kinds of white line marking paints were carried out. The formulations tried were (1) the D. B. B. chinawood oil; (2) Alkyd; (3) Dispersion resin; (4) Chinawood oil-pentalyn varnish-chlorinated rubber; (5) modified phenolic resin-castor oil-chlorinated rubber. All of these were tried with reflectorisation beads.

Type (4) gave the best results under all conditions of traffic (30,000 vehicles per day) and weather (alternate wet and dry).

Experiments are in progress to perfect this material. Another formulation which promises good results is "Pliolite" with a mixture of chlorinated paraffins for use in cross walks in unbeaded lines.

(*Continued from page 7*)

National and Provincial Highways and ten feet in other cases.

(ii) The standard suggested is the minimum. Higher standards are to be adopted where necessary. In curves, the building line on the inner side shall be at an increased distance from centre, to secure adequate sight distance.

(iii) In open areas in the case of markets, factories, and other industrial establishments, (existing or potential), the overall widths between building lines shall as far as practicable, be those indicated in column 5 (overall widths of control lines).

(iv) In the case of built up areas, width of road land will not necessarily be uniform. Hence width of strip beyond road boundary is given in col. 8.

Taking the above recommendations as a model various States have framed standards to suit their local conditions.

EXPERIENCES OF AN ENGINEER

A young aspiring student engineer once asked me to advise him what courses he should take in college to become a city engineer and then how he could become one. My advice to him was – take all the psychology, political science, law, economics and public speaking offered, and then if he has any time left he should take some mathematics, science and possibly a course or two in engineering. Above all, I advised him, to be on the alert politically as to probable condidates for Mayor and pick out a possible winner and if the candidate has a daughter, by all means marry her.

- Wallace W. Sanders, Chief Engineer, Department of Public Works, City of Louisville.

BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF BOMBAY CIVIL WORKS BUDGET 1953–1954

The following extracts relating to Civil Works have been taken from the Government of Bombay Budget for the year 1953-54

	(In lakhs of rupees)		
	Actuals 1951–52	Revised Estimate 1952–53	Budget Estimate 1953–54
I. Revenue (Civil Works)			
1. Rents	13.09	15.00	14.00
2. Ferry receipts	1.01	.91	1.00
3. Tolls on roads	.01	...	.01
4. Receipts from self-supporting workshops	.60	.50	.50
5. Recoveries of expenditure	3.25	1.09	1.00
6. Miscellaneous	16.11	63.01	16.80
7. Transfer from Central Road Development A/C.	26.63	76.51	135.24
8. Transfer from the Special Development Fund	.56	...	...
9. Deduct - Refunds	2.61	– 0.25	– 0.20
Net Total	58.64	156.77	168.35
II. Expenditure (Civil Works)			
1. Original Works	130.30	262.17	387.81
2. Repairs	112.26	120.10	133.94
3. Establishment	30.23	13.31	–22.12
4. Tools & Plant	30.90	9.68	10.09
5. Grants-in-Aid	19.32	18.67	16.55
6. Suspense	–20.83	–10.00	0.16
7. Charges in England	– 1.93	– 1.52	– 1.88
Total	300.25	412.41	524.55
III. Expenditure (Communications)			
(a) **Original Works**			
1. Ordinary	34.57	90.00	68.52
2. Central Road Fund	26.23	76.51	135.24
3. National Highways	23.20	48.02	114.05
4. Road Works financed from State Sugarcane cess fund	–	6.19	6.31
Total—Original Works	84.00	220.72	324.12

	(In lakhs of rupees)		
	Actuals 1951–52	Revised Estimate 1952–53	Budget Estimate 1953–54
(b) **Repairs**			
1. Ordinary	–	–	41.74
2. National Highways	34.82	37.76	47.73
Total—Repairs	–	–	89.47
(c) Capital Expenditure Not charged to Revenue	10.54	14.00	20.45
IV. Receipts from Roads			
1. Receipts under Motor Vehicles Acts	146.45	187.54	215.17
2. Sales Tax on Motor Spirit	70.24	110.00	175.00
Total	216.69	297.54	390.17

A BRIEF REVIEW OF THE BOMBAY BUDGET

THE total revenue receipts of Bombay for 1953-54 are estimated at Rs 67,83.58 lakhs and revenue expenditure at Rs 67,76.09 lakhs with a consequent surplus of Rs 7.49 lakhs. The revised estimates for 1952-53 indicate a deficit of Rs 3,90.36 lakhs with the revenue receipts amounting to Rs 64,33.77 lakhs and revenue expenditure to Rs 68,24.13 lakhs.

Revenue expenditure on Civil Works for 1953-54 estimated at Rs 524.55 lakhs forms 7.7 per cent of total State revenue. The corresponding percentage figures for the two previous years 1952-53 and 1951-52 are 6.4 and 4.8 respectively.

Revenue expenditure on communications under Original Works excluding National Highways is estimated at Rs 210.07 lakhs in 1953-54 and forms 3.1% of the total revenue receipts of the state in the year. The corresponding percentage figures for 1952-53 and 1951-52 are 2.7 and 1.0 respectively.

WORDS OF WISDOM

Substitution of words for deeds may lead to a delusion of progress.

GIRLS AND NEWSPAPERS

Girls are like newspapers : They have forms ; they always have the last words ; back numbers are not in demand ; they have a great deal of influence ; they are well worth looking over ; you cannot believe everything they say ; they carry the news wherever they go ; they are much thinner than they used to be ; every man should have his own and not borrow his neighbour's.

BOOK REVIEW

"Basic Road Statistics of India—Third (1952) Supplement"

COMPILED by the Consulting Engineer) to the Government of India (Roads) and published by the Manager of Publications, Delhi, Imperial Octavo, pages 55; price Rs 3-10-0 (or 5 sh. 9d)

The Third (1952) Supplement to Basic Road Statistics brings up-to-date the statistical information contained in the previous volumes. It contains a few new items of statistical information such as imports of petroleum into India and the production of automobiles and of tyres and tubes. The main interest of the volume lies in the fact that it provides access to authoritative information which only official sources are in a position to furnish.

There is a considerable gap in the availability of statistics which has to be filled in the future and this can be done only by achieving a greater recognition of the value of statistical fact in administrative work. The frequently heard accusation ' the relevant statistics are not available ' can now be said with much less justification in respect of roads and road transport.

The Roads Organization have taken the initiative in collecting the information from various sources including non-official ones, and making it available to the public in a conveniently compiled form. We hope the continued publication of this useful information will, by demonstrating the value of the statistics contained therein in actual practical work, create a great appreciation of the importance of statistics among those who are in the best position to furnish them.

The book deserves to be on the desk of every person having anything to do with roads and road transport.

List of Approved Works on National Highways

S. No.	Job No.	Name of work	Estimated Cost Rs (Lakhs)	Remarks.
		MADRAS		
1.	713 MD 7	Formation of a diversion road from mile 16/2 to 19/1 of the Karur-Arvakurichi-Dindigul Road.	0.51	
2.	719 MD 5	Black-topping miles 120/0 to 169/2 in Nellore Division, length 45.8 miles.	8.67	
3.	720 MD 5	Black-topping miles 188/0 to 233/0 in Ongole Division, length 43 miles	7.44	
4.	721 MD 5	Black-topping miles 233/0 to 241/0 in Guntur Division, length 8 miles.	1.32	
5.	722 MD 5	Black-topping miles 443/0 to 464/0 and 495/2 to 499/6 and 15/4 to 16/4 of Vemulavalas cross road in Visakhapatnam Division, Length 25.8 miles.	5.14	

S. No.	Job No.	Name of work	Estimated Cost Rs (Lakhs)	Remarks.
		BOMBAY		
6.	711BM-8	Land acquisition for diversion of National Highway No. 8 outside Navsari town.	1.48	
7.	712BM-8	Construction of cross drainage works on the Pirojpur-Prantij section of the Bombay-Ahmedabad National Highway.	1.88	
8.	714BM-8	Providing cross drainages on Broach Wareria section of the Bombay-Ahmedabad National Highway.	0.68	
		WEST BENGAL		
9.	A-709BG-2	Survey of the section of N.H. No. 2 between Donkuri and Serampore required for the construction of a by-pass from Willingdon bridge to North of Serampore.	0.03	
10.	A-710BG-6	Preliminary survey of Kalora-Joypur Beel section for the construction of a by-pass of National Highway No. 6 between Willingdon bridge and Andul.	0.03	
11.	B-710BG-6	Survey of approaches to the Willingdon Bridge from Joypur Beel required for the construction of a by-pass of N. H. No. 6 between Willingdon Bridge and Andul.	0.01	
		ASSAM		
12.	715 AS 40	Reconstruction of bridge No. 50/2 on Gauhati-Shillong Road, N.H. No. 40 washed away by monsoonic rains of 1952.	1.62	
		SAURASHTRA		
13.	716--SR8-A	Land aquisition and earth work for the construction of the Saurashtra limit to Limbidi section of the Kandla-Ahmedabad National Highway No. 8-A in Saurashtra.	3.22	

Bombay Electric Supply and Tramways, Bombay, before nationalisation was paying in income-tax alone Rs 42 lakhs a year. To-day Corporation of Bombay owns it and there is no profit and so no income-tax.

– Motor Transport, March 1953

Books added to the Roads Organisation Library during March 1953

1. **Community Projects-A Draft Handbook.**

   (Community Projects Administration, Planning Commisson, Govt. of India). (Superintendent, Printing and Stationery, United Provinces, Allahabad, 1936).

2. **Note on Regime Diagrams for the Design of Canals and Distributaries**, U. P., P.W.D., Irrigation Branch Technical Paper No. 1 by G. Lacey (2 copies)

3. **Annual Administration Report of the Uttar Pradesh Town and Village Planning Department for the year 1951** (English version).

4. -do- -do- (Hindi version)

   Building Research Station, DSIR., Garston, Watford, Herts, U. K.

5. **Dutch Light-weight bricks (Holandske Lehcene Cihly-Kiln Kerisoliet** (Translated from the Czech by B. Butterworth), (Typed copy) - Liby. Communication No. 547, by M. Mache.

6. **Method of retarding the setting of Calcium Sulphate. Library Communication No. 442**, (Translated from the German by K. P. R. Ehrenberg) Typed copy, by F. Graf and W. Chorbacher.

7. **Sulpho aluminate, a positive factor in expanding cement** by P. P. Budnikov and Z. S. Kosuireva.

8. **Sound and Unsound expansion of cement containing blast furnace slag, due to calcium sulphate.**

   A contribution to the study of expanding cements (Abstract) by F. Gille.

9. **Manufacture and Properties of Concrete from Cement and Woodshavings** - (Translation No. 1605)- Translated by H. E. Kijlstra - Photocopy by Otto Graf.

   (Commonwealth of Australia, Commonwealth Scientific and Industrial Research Division of Forest Products, 314, Albert Street, East Melbourne, c. 2.)

10. **Ueber die Herstellung und ueber die Eigenschaften des Beton aus Zement und Holzspanen** (Photocopy of the original in German) by Otto Graf.

    (Bauverlag, GMBH, Wiesbaden, 1949).

11. **Finite Deformation of an Elastic Solid** by Francis D. Murnaghan (Chapman & Hall Ltd., London, 1951).

12. **The Determination of the Cement Content of Soil-Cement Mixtures-I.** A Laboratory Method contained in the "Journal of Applied Chemistry, Vol. I, Part 12, Dec. 1951."

    -do- II, Rapid Field Methods, by L. E. Clare and P. T. Sherwood.

    (The Society of Chemical Industry, 56, Victoria St., London, S.W.1.)

13. **Classification of Bitumens in Asphalt Technology by certain Rheological Properties- Parts I-IV,** by S. L. Neppe

    (Reprint from the Journal of the Institute of Petroleum, Vol. 38, 1952).

14. **Investigation of Wheel Load Stresses in Concrete Pavements-Proccedings No. 13.** by G. Bergstrom and Sven Linderholnn.

    (Swedish Cement and Concrete Research Institute at the Royal Institute of Technology, Stockholm.)

15. **Engineers Manual - Vol. 3, Part I, Statics of Structural principles and Bridge Strutctures** (New French edition) (Manuel de La Ingenieur) by Hutte. (Libraire Polytechnique Ch. Beranger, Paris, 15, Rue des Saints-Pares, 15-Liege 1, Quai W.-Churchill 1, 1952).

16. **Dry Rot in Wood - Forest Products Research Bulletin No. 1** (5th edition).

17. **The Design of Buildings - Steel Economy Bulletin No. 1.**

18. **Recommendations for tar surface dressings - Road Note No. 1** - (2nd edition), prepared by DSIR, Road Research Laboratory, U. K.

19. **Recommendations for Bituminous Surfacings for Roads carrying Tracked Vehicles - Road Note No. 13**, prepared by DSIR, Road Research Laboratory, U. K.

20. **Economy in Building Materials** - A Report by Sir Charles J. Mole and Others. (2 copies)

21. **Fourth Annual Report of the British Transport Commission for the year ended 31st December 1951.**

22. **Specification for Road and Bridge Works.**

23. **Memorandum on the Lighting of road Vehicles** - R.V. L. Memo. issued by the Ministry of Transport, U. K.

24. **New Cement Coating Laboratory Developed at Ga. Tech. Experiment Station** - Dixie Contractor, Vol. 26,

    No. 52, dated 18-6-52, page 39.

    (Dixie Contractor, 508, Luckie Street, N. W., Atlanta, Georgia.

25. **Hydraulic Binders, Properties, Choice and Conditions for Use** (LIANTS HYDRAULIQUES, PROPRIETES, CHOIX ET CONDITIONS D'EMPLOI) By Henri Lafuma.

    (DUBOD, 92, Rue Bonaparte, Paris-6, 1952)

    Pacific Builder and Engineer, Inc., Wall Street at Third Avenue, Seattle 1, Washington.

26. **How to Reduce the Cost of Minor Highway Drainage Structures** - "Pacific Builder and Engineer", Vol. 57, No. 8, August 1951, Pages 70-71, by R. E. Tarbet.

27. **"In Place" Soil Shearing Tests-** (An article) **with Vane Borer Prove Highly Successful** - "Pacific Builder and Engineer" Vol. 58, No. 5, May 1952, pages 66-7, by G. Bryce Bennett.

28. **The Mulberry Harbours** by Sir Bruce G. White, late Director of Ports & Inland Water Transport, War Office, U. K.

    (Reprint from "The Central" No. 94, December 1946, the Journal of the Old Centrallians).

29. **Basic Road Statistics of India, Third (1952) Supplement** - Compiled by the Consulting Engineer to the Govt. of India (Roads) (The Manager of Publications, Delhi). 2 copies.

30. **Annual Bulletin of Transport Statistics, 1950.** (Economic Commission for Europe, Transport Division, United Nations, Geneva,1951).

31. **Building and Civil Engineering Plant - Its Purchase, Application and Operation** by Spence Geddes. (Crosby Lockwood and Son Ltd., 39, Thurloe Street, London, S. W. 7, 1951).

32. **Streets Relieving of Welded Structures** - A reprint from "Welding", Vol. 17, No. 10, October 1949, by R. Weck.

    (British Welding Research Association, London.)

33. **The Fifth Year, 15th August 1952** (The Publications Division, Ministry of Information and Broadcasting, Govt. of India).