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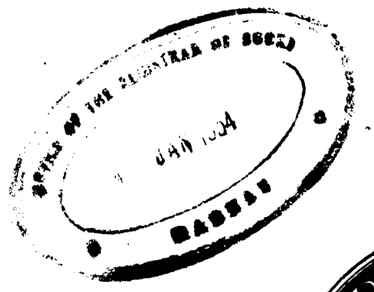
TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

DECEMBER 1953—No. 80



INDIAN ROADS CONGRESS, NEW DELHI.

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The Hon'ble Shri Lal Bahadur Shastri, Union Minister for Transport and Railways, addressing the Silver Jubilee Gathering of the I.R.T.D.A.

TRANSPORT-COMMUNICATIONS
MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

DECEMBER 1953

THE UNION MINISTER OF TRANSPORT ON ROAD DEVELOPMENT

THE Hon'ble Shri Lal Bahadur Shastri, the Union Minister for Railways and Transport, addressed the Indian Roads and Transport Development Association at its Silver Jubilee meeting on November the 21st, 1953. He dealt with various aspects of road development, motor vehicle taxation, and nationalization of road transport. During the course of his Address he said :—

"**Policy.** Our policy is to encourage the development of an integrated system of transport in which each of the different forms will play an appropriate and useful role in its own sphere of effective service whether it is railways, road transport or inland navigation. Government's plans are further based on a full recognition of the fact that the transportation facilities including in them railways, civil aviation, inland water transport and road transport, still lag behind the actual requirements for proper economic progress. There is less than one-fifth mile of road per sq. mile of area in India today, against 2 miles in the U. K. and one mile in the U. S A. On a population basis, India has only 6 furlongs of roads per thousand persons against 3.6 miles in the U. K. and 19 miles in the U. S. A. Large parts of our agricultural tracts are even now without adequate road facilities, which are so essential for the marketing of agricultural produce. You all know that historical and constitutional factors were largely responsible for this lack of development and Governments in India are quite conscious of the large leeway still to be made and the Community Projects do include the construction of rural roads as an important part of their programmes. I may say that I am personally very keen on the development of feeder roads connecting different villages to the main roads. A small amount of Rs 20 lakhs has been provided in the current year's budget for this purpose but I shall be glad to provide more if there is increased village road building on a voluntary basis.

"**The Road Plan.** The Nagpur Plan will, at the present level of prices, cost over Rs 745 crores. As the Minister in charge of roads, nothing will give me greater pleasure than to see this Plan executed, but unfortunately our resources in men, equipment and money will not permit of such development at the rapid pace visualised by the Nagpur planners. Unavoidable factors have forced us to limit the expenditure on roads in the Five-Year Plan to Rs 110.97 crores of which Rs 33.34 crores is to be spent in the Central sector and Rs 77.63 crores in the States sector. In addition, the Central Road Fund will provide approximately Rs 23 crores for expenditure in the States sector where I understand that an expenditure of over Rs 25 crores had been incurred by the States by the end of 1952–53. Of the expenditure in the Central sector, Rs 27 crores will be spent on national highways, that is, on the construction of about 1,000 miles of missing links and 60 new major bridges in addition to the improvement of about 4,000 miles of existing roads.

"I would like to share the views of your Chairman that the provision made

in the Plan for roads is not enough but I shall be unfair to the Planning Commission as well as to you if I do not point out the fact that the expenditure on the transport element alone during the period of the Five-Year Plan is likely to be as much as 29 per cent of the total cost of the Plan, a figure which was even criticised in some quarters as unduly high. With limited resources, the Government of India and the State Governments have undertaken huge schemes of development on all fronts and the process of balancing ends and resources naturally involves the pruning down of competing demands. As practical men, I have no doubt that, in this context, you will appreciate that the provision made in the Plan for roads cannot be regarded as inadequate.

"**Tolls.** In the matter of construction of roads the problem of negotiating rivers is a serious one and an expensive one at that. I have been thinking on the lines of people contributing their mite towards the construction of bridges in the form of a toll tax. I know this kind of tax is not generally popular and it is specially irksome to vehicular traffic but I really do not think they should grudge a small payment of this kind and their being stopped for a few minutes at the bridge. This inconvenience will be nothing compared to the trouble they have to go through now in trying to cross rivers through ferries and other means. I feel that the introduction of a small toll is bound to expedite the bridging of rivers. I might add that the toll might continue only for a prescribed period within which the money that has been spent could be recovered. I do want the practical implications of this matter to be considered fully in order to enable us to go ahead at a faster pace with our road development programmes.

"**Central Road Board.** I should like to say a word in passing on the suggestion regarding the creation of a Central Road Board. In recent years, we have built up in the Roads Wing of the Ministry of Transport an effective organization under a Senior Consulting Engineer, who has the status of a Joint Secretary, to administer the Central Road Fund and to supervise the execution of the road construction programmes. This Organization has been functioning well so far and the setting up of a Road Board might as well wait for the time being.

"**Motor Vehicle Taxation.** Taking the question of taxation first, there may be some justification for the view that the level of taxation in some part of the country is rather high and that it will be great advantage if the existing multiplicity of taxes could be rationalised and reduced to one or two specific taxes. I am not giving away a secret in stating that we in the Ministry of Transport agree substantially with a number of recommendations of the Motor Vehicle Taxation Enquiry Committee in regard to motor taxation. We have had several discussions on the subject with the State Governments who are primarily concerned and with the Ministries in the Central Government. We had again a special meeting with the representatives of the States who had recently raised their rates of taxes, in particular Madras and Bombay. But we cannot perhaps ignore the fact that the State Governments have their own problems. With their multifarious development programmes, it is not easy for them to forego part of their present revenues and they have, therefore, very naturally resisted any such move on our part but I must say to their credit that they have not turned down these proposals completely and that they basically agree with the soundness of the policy enunciated by the Motor Vehicles Taxation Enquiry Committee. I might tell you that the matter is still under our consideration and I trust you will agree that decisions on matters of this kind can be arrived at only within the framework of the Constitution and with the consent of the State Governments and this democratic process is necessarily slow.

"In the meantime, the general question of taxation in the country is under examination by the Taxation Enquiry Commission who are also expected to deal with the taxes on motor vehicles as part of their investigations. I am afraid the final decisions in regard to this matter may have to wait until the Taxation Enquiry Commission submit their recommendations but I can assure you

that the Government of India will view with considerable sympathy the position of the motor vehicle user in examining those recommendations.

"**Nationalisation.** I must point out that the Five-Year Plan envisages only a gradual expansion of nationalised passenger transport services in most of the States and that there is still considerable scope for private operators to run such services in large parts of the country. In the sphere of goods transport the State Governments have not so far made any noticeable inroads. In fact, in reply to recent enquiries from the Planning Commission, the State Governments have generally stated it as their policy that freight transport would largely be left to private operators."

—o—

THE LESSONS OF WAR AND PEACE ARE THE SAME

In Peace

"I have come to the conclusion that one thing to which we must give topmost priority is roads—roads of all kinds, not only very up-to-date bitumenized or cement roads, but roads of any kind, to open out vast areas of this country which are closed up to-day and which you cannot reach unless you walk or ride ..... I give roads first priority."

Jawaharal Nehru.

"Among the social services, I put communications first since I do not see how it is possible to effect any great improvement in health and education in the villages of India unless they can be reached surely and quickly at all times."

Lord Wavell.

In War

"The more experience I have had of both peace and war, the more I appreciate its general truth. After some years in high military command, I am inclined to put forward as a parallel dictum that "War is Transportation." Certainly it is the ruling factor in military operations, and no compaign has better illustrated this than that on the North-East frontier of India and in the north of Burma."

Lord Wavell

THE ROAD SYSTEM OF NORWAY

(Adapted from 'Bulletin No. 126 of International Association of Road Congresses and Report No. 77 by T. Backer to the International Association of Road Congresses'—Lisbon 1951).

History and Development

THE first road in Norway may be said to have been constructed in 1624. Since then road building was done more or less intensively so that in 1814 Norway had 11,000 kilometres (6,830 miles) of roads. These roads, however, were not constructed to the standards adopted in other European countries.

Modern road construction may be said to have been started in 1847. The following table shows the development of the road network from the year 1840:

Year	Main roads	County roads	Local roads	Total
	miles	miles	miles	miles
1840	3527		5968	9495
1900	6627		11128	17755
1920	8305		12848	21153
1925	8815		13352	22167
1930	9575		13671	23246
1935	8463	2563	13564	24590
1940	9126	3189	14189	26454
1945	9853	3256	14203	27312
1949	9886	3514	14084	27484

Classification

The public roads of Norway are divided into:

(1) Main roads (i.e. riksveger),

(2) County roads (i.e. fylesveger), and

(3) Parish roads (i.e. bygdeveger).

The construction of the main and county roads is mostly paid by the State. Districts interested in such roads contribute 5 to 30 per cent of the cost. The main roads are maintained by the State, the county roads by the respective counties, and the district roads by Parishes.

Finance

Under the provisions of the Road Act of 1912, as later amended, the cost of construction of new roads and re-construction of existing roads and bridges on the main and county roads is made from public funds with or without contributions from the rural districts. Since 1919 comparatively large grants have been voted on account of the Social Department for road works in order to provide relief for the unemployed. Earlier to 1942, contributions were made to roads which would replace local branch railways by the State Railways. But from 1942 subsidies are transferred to the road budget. In addition to this, the agricultural department contributes for the construction of roads to homesteads, to farm roads, and to forest roads.

Administration

The Director of Public Roads Administration (Vegdirektoeren) is the head of all public road construction and maintenance. He co-ordinates all technical and administrative matters concerning road construction and maintenance under public supervision.

There are 18 Chief Engineers (Vegsjefer) one for each county acting as administrator in the respective counties, with sufficient staff of technicians and clerks at his disposal. The Chief Engineer derives authority from the State, from the county, as well as from the Parish because he is in-charge not only of the principal roads but also of the local roads. In regard to

main roads they are subordinate to the Director of Public Roads Administration, and in regard to county roads they are subordinate to the chief of the county (Fylkesmannen) and the district road council (Fylkesvegstyret). Divisional Engineers (Avdelingsingeniorer) are in-charge of construction of newroads and bridges and maintenance and are subordinate to the Chief Engineer. The Divisional Engineers are assisted by Assistant Engineers and technical assistants.

Superintendents manage the work on the site and have 10 to 12 gangs of 4 to 7 labourers each in his charge.

Statistics

The number of motor vehicles registered on 31st December 1949 is as under:

Autobuses	5,024
Trucks	44,985
Passenger cars	62,658
Motorcycles	23,420
Special-build cars	2,013

Busline statistics, 1948:

Number of buslines	2,200
Driven vehicle/km	117.7 million
Passenger/km	1,214.7
tons/km	35.1

Ferries:

In 1948 there were 73 ferries connecting the public road network, 36 of them were in the main road network.

Surfaced Roads

	Main roads percent	Country roads per cent	Local roads per cent	Total per cent
Stone sets pavement ...	0.57	0.27	0.00	0.24
Concrete pavement	0.52	0.19	0.02	0.22
Bitumenous pavement ...	7.85	3.11	0.67	3.57
Total ...	8.94	3.57	0.69	4.03

Expenditure on construction and maintenance (1949-50)

(Rs lakhs)

(a) Maintenance expenditure:		
Main Roads	...	361
County Roads and Parish Roads	...	240
Total	...	601
(b) Construction expenditure:		
Construction of principal roads	...	303
Construction of local roads	...	200
Total	...	503

Standards

On account of weak financial position, main road construction prior to 1847 had a width of 4 metres and often only 2.5 metres. With the increase in motor vehicle traffic in about the year 1920, the width of the carriageway was found insufficient and had to be increased. Table I (Page 6) shows the standards now current.

Job Management

The Bureau of Public Roads, Norway carries road construction works with its own directly employed labour and supervisory staff. On account of the small annual financial allotments, the wide spread character of the road system work by contract does not meet the needs of the situation.

On account of the special topographical and climatic conditions with small road jobs scattered over large areas and small annual allotments, mechanization of road construction has made little progress. Manual labour is generally cheaper.

Maintenance Operations

Gravel aggregate surfaces form 90 per cent of the total length of roads. These roads are maintained by dragging and blading. In the earlier days dragging by horses was usual but now-a-days truck mounted blade graders are used.

Class of road	Traffic density vehicles per day(1) and night	Carriage-way(2) width in feet	Design speed mile/hour	Sight distance feet	Horizontal curves R min(1) feet	Vertical Curves: High Point at Peak R min. feet	Vertical Curves: Low Point at sag R min. feet	The steepest grade Ft per 1000 ft	Axle loading capacity tons	Vertical clearance over the traffic lane Ft	Vertical clearance over the traffic lane In.
Several lane divided roads	Greater than										
Class I	3,000	42.5	56 (40)	490 (295)	1640 (650)	6560 (3280)	3280	50 (65)	10	14	9
Double Lane roads		23									
Class II	600–3000	21	47 (31)	490 (260)	980 (500)	5250 (2620)	3280 (1640)			14	9
Class II	80– 600	20 / 18	37 (25)	360 (200)	650 (330)	3280 (1310)	1970 (980)	65 (80)	10	14	9(2)
Single lane road											
Class III	20– 80	11′6″	28 (19)	260 (130)	490 (160)	1970 (980)	984	80 (100)	10	14	9(3)
Class III	0– 20	9′0″	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	

Figures in ( ) refers to expensive construction terrain or unusual localities.

(1) Refers to the annual average day-and-night volumes.

(2) Vertical clearance may be reduced to 13.12 ft when bypass road is available.

(3) Design according to requirements of local conditions.

To bind the surface gravel aggregate and abate the dust nuisance, calcium chloride is applied early in spring and a second application is done in the summer. Sometimes sulphite waste liquor is also used.

For small patch repairs, removing of grass from shoulders, maintenance of drainage, etc., road gangs are employed.

Usually naturally occurring gravel is used. Large stones are screened and crushed to suitable sizes and then mixed with finer material in suitable proportions.

As a rule, quarries and equipment used in them are owned and operated by the Public Roads Administration.

Maintenance during the winter mainly consists of removal of snow. Snow fences either for snow accumulation or for deflection of snow are usually erected. For normal heavy snow removal work it has been found that a short wheel-based truck of 95 to 200 horse-power engine is most efficient. Light type of ploughs driving at relatively high speeds are mounted on these trucks.

The minimum requirement for a permanent surfacing is taken to be an average traffic of 200 vehicles per 24 hours.

Under heavy traffic the maintenance of gravel aggregate surfaces becomes difficult; they develop corrugations and become dusty.

Roads crossing agricultural district are usually fenced. In order to save in erection and maintenance of fences over long distances, cattle guards, i.e., grating construction in the road which prevents the passage of cattle, is resorted to.

Junctions

There is prohibition against erection of buildings at road junctions within an area bounded by straight lines between points in the central line of the road at a distance of 40 metres (125 ft) from their intersections.

Bridges

Bridges on all public roads have to be designed for a maximum axle loading of 10 tons under total truck loading of 16 to 20 tons, this loading having been adopted in 1943. At present only about 15 per cent of the 6,500 bridges on the main and county roads are designed according to the above loading.

LOSSES ON TRAFFIC STAGNATION

The London County Council has estimated, for the purposes of its Development plan, that in the Central area of London alone, on a conservative basis, the annual loss to the community from avoidable traffic delays is at least seven million pounds annually, in addition, the high cost to the community of road accidents due to obsolete layout and absence of adequate parking facilities must also be taken into account.

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"We want men to have convictions, based on sound thinking, and to be willing to stand up for them."

— James C. Leder.

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THE PLACE OF A MODERN ROAD SYSTEM IN THE NATIONAL ECONOMY

(Extracted from 'The Second Rees Jeffrays Triennial Lecture,' by C. T. Brunner, in association with James Drake.)

Roads are a National Asset

The development of the last fifty years have led to a great enlargement of the part played by roads in the national economy, so that today they are one of the most vital factors in the organization of our highly complex civilization, but public opinion and government action have lagged behind in their recognition of this.

Although roads today are regarded primarily as a track for mechanically-propelled and animal-drawn vehicles, this is not by any means their only value to the community. Bicycles and pedestrians benefit from a clean, and usually paved and illuminated, right-of-way and access to property. Roads also form convenient and accessible throughways for telephones and telegraphs, and for electricity, gas, water, and sewage mains. They offer a more flexible and less vulnerable means of transporting troops, military vehicles, and supplies than do railways, and are, therefore, of great strategic value. They act as feeders to all other forms of transport, enabling passengers and goods to be moved to and from docks, railway stations and airfields. In sparsely-populated rural districts, they increase the mobility of labour and bring town amenities within reach of country folk.

Value of Road Transport to Trade and Industry

Even when the railways had a virtual monopoly of inland transport, road transport was the chief means of taking goods to and from the railway stations and depots. Today, with most of the short-haul goods traffic carried by road, and with industry extending into areas remote from railway centres, adequate road transport has become absolutely essential to trade and industry.

Factors in the post-war growth of commercial road transport have been partly economic, partly a greater emphasis on speed of delivery, which has been stimulated by shortages, and partly fear of theft or damage on the railways. Probably the biggest consideration has been a growing desire by manufacturers and traders to keep the transportation of their goods under their own control.

Flexibility of road transport. Road transport is of particular value to industry because of its flexibility. It can be speedily adapted to take account of geographical changes in sources of supply, in centres of production, and in the destination of goods. Shortages of raw materials and components for industry have meant that they have had to be transported from wherever they were available, often at short notice and in small amounts from several scattered places. Shipping space has also been in short supply, so that it has had to be taken by exporters where and when it could be obtained, with the result that goods, originally destined for shipment from one port, often have had to be diverted elsewhere at short notice.

It is not only in the movement of goods that road transport assists industry. The establishment of light industries in new districts would have been practically impossible without road transport to bring workers to and from the factories. Buses and coaches are the most efficient, and in many cases the only, form of transport

which can be used for the daily movement of large numbers of people from places widely scattered round the new industrial centres. In this way road transport has enabled industry to take advantage of hitherto untapped sources of labour, and generally has contributed to the mobility of all available resources.

Road transport and industrial productivity

The flexibility of road transport will assist in the continual adjustments necessary to make industry more efficient, and its capacity to achieve a more rapid local expansion than other forms of transport will enable it to undertake a large share in the movement of the greater volume of goods entailed by increased production. This is really the inherent advantage of road transport over other forms of transport, in that it does not require any special track or terminals, and so can be brought into full use right away. It would be a waste of the country's resources if this asset were denied to the community.

Expenditure on Road Transport

Inspite of the importance of Road transport there has been no attempt to relate expenditure on roads to the yield from motor taxation. This situation is not confined to the United Kingdom, but the divorce of road expenditure from motor taxation has reached more alarming proportions in this country than elsewhere.

In 1950, the Belgian Exchequer derived approximately £43 millions (Rs 573 lakhs) from motor taxation ; of this sum one-third was allocated to the roads. Comparable figures for the United Kingdom during 1951–52 were £240 (Rs 300 crores) millions in motor taxation (excluding purchase tax on vehicles), of which only £30 (Rs 38 crores) millions or one-eighth was allocated to roads.

A table showing expenditure per head of the population, published at the end of 1951 by the Association of Automobile and Allied Industries of Italy, gives an idea of how far India is lagging behind many other countries in the matter of road development and maintenance :

Country		Road expenditure per head of population
		Rs
U.S.A.	...	135
Portugal	...	59
Sweden	...	35
Norway	...	34
Belgium	...	25
Britain	...	19
Italy	...	8
Turkey	...	5
INDIA	...	annas 15

Expenditure on road passenger transport

It has been estimated that expenditure on passenger movements by road accounted for over half of the amount spent in Great Britain on road transport in 1950.

Also the amount spent on public road passenger travel was more than double that spent on rail travel in the same year.

This gives an indication of the extent to which road passenger transport has become a part of the life of the people. It has enabled even the more remote rural areas to emerge from their comparative isolation, which had been left practically undisturbed by the railways.

Urban populations too, have become increasingly dependent on road passenger transport. The continued growth of towns has caused people's homes to be located farther and farther away from their place of work, and road transport has undertaken the bulk of the daily movement of passengers involved. Every attempt to relieve overcrowding by the creation of dormitory areas has caused great transport problems, with unbalanced loading and wasteful traffic peaks, which have tended to raise both operating costs and the level of fares.

Transport costs in the price of consumer goods

Transport costs form an appreciable part of the total cost to the consumer of

almost all goods. Scarcely any commodity goes through the manufacturing process from raw material to the consumer without incurring several items of transport cost. Thus, even a simple manufactured article, such as a steel saucepan, has been transported a great deal before it finally reaches the kitchen stove. The coal and ore have to be carried from the mines to the steel works and the sheet metal from the steel works to the kitchen utensil factory. Transport is again required from factory to wholesaler's warehouse and finally from there to the retailer. A similar process often takes place with, foodstuffs, since many foods go through some form of 'manufacturing'. For foods, such as vegetables, which are transported more or less straight from field to market, and frequently thence direct to the shop, transport costs are an even greater element in the price. In general, the simpler the manufacturing processes in producing an article, the greater is the relative importance of transport in its cost.

Reduction of road transport costs can therefore reduce, or check the rise in, the cost of living.

In March, 1951, the British Federation of Wholesale Confectioners stated that, for their range of commodities, expenses incurred in running motor vehicles amounted to 12 per cent of the total cost of distribution. Some idea of the importance of road transport to another food supply can be gained from the calculation by the National Dairymen's Association that the additional 9d. (annas 8) per gallon, imposed on the fuel duty in the 1950 Budget, alone raised the cost of milk production by about ½d. (½ anna) per gallon. Also the operating costs of road vehicles in the building industry, account for some 13½ per cent of total building costs.

Roads as industrial equipment

Roads are an intrinsic part of the nation's industrial equipment. Together with the vehicles which use them, they form huge conveyor-belts which take materials from stage to stage in the long manufacturing process from raw material to the consumer. This fact is recognized in the United States. In America the highway user and industrialist are firmly convinced that the country's road system is an extension of the production lines of industry and an essential part of its economic structure.

Capital Investment and roads

For these reasons roads should be taken into consideration when planning the nation's capital investment. We cannot afford to neglect an asset of such importance to industry and to the economy as a whole. The capital investment programme should be balanced between the different claims on it and adequate money should be made available for roads. Over-investment in roads at the expense of other forms of industrial equipment would, of course, be ill-advised, but the effect of tipping the balance in the other direction, by investing too little in roads, will hamper industrial efficiency. **The most modern plant and machinery in the world cannot compensate industry for an antiquated system of transport and communications.**

It is completely wrong to regard investment in road improvement and construction as economically unproductive and merely an addition to the amenities of life, which must wait its turn until industrial capital requirements have all been met **Investment in roads is essential to a proper balance of the country's economy.**

Road maintenance

In considering the improvements needed in the national road system, it is necessary to think not only in terms of the construction of new roads and motorways, essential though they are. There should also be adequate provision for the maintenance of existing roads. It is the same question of striking a balance and progressing uniformly in different spheres. Just as the national investment programme should be balanced, so that road improvement keeps pace with other industrial progress, so also the funds allocated to roads should be correctly proportioned between new construction and the maintenance of the various types of existing roads.

Defective roads add to the cost of transport

Defective roads may add materially to the cost of transport in the following ways:

Waste of time as a result of lower vehicle speeds and delays.

High fuel consumption.

Heavy wear on tyres.

Avoidable accidents, which are reflected in the cost of insurance.

Greater wear and tear on vehicles, resulting in increased cost of vehicle repairs and maintenance.

The point made is that inadequate roads can cause a serious inflation of the operating costs of mechanically propelled vehicles.

An economic approach to the assessment of requirements

A lightly trafficked route, of course, does not warrant a road of such a high standard as a heavily trafficked route. An economic approach is essential to the assessment of what is required, both of individual roads and of the road system as a whole. The aim should be to reduce to a minimum the total expenditure on road transport. Thus, a particular project for improving the roads should be judged primarily on the saving it would effect in vehicle-operating costs and is justifiable if its total cost is less than the total saving in vehicle-operating costs which would result from it.

Economy in vehicle-operating costs

The economies in operating costs, which might be reasonably expected to result from a minimum programme of road modernization, would be under the following heads:

1. Saving in time
2. Saving in fuel
3. Saving in tyres
4. Saving in maintenance expenditure
5. Reduction in cost of accidents.

Accidents

A reduction in the number of road accidents is one of the most profitable means of reducing waste that can be expected from better roads. The continued loss of life and personal injury is a most serious reflection on the adequacy of the present road system. In economic terms, the high rate of road accidents causes a heavy loss to the community, but in terms of human misery, its consequences are so tragic that even this great financial loss seems wholly inadequate as a measure of this grave problem, which has been left unanswered far too long.

The effect of road improvements on accidents is simply to produce conditions which are less dangerous—they cannot eliminate accidents. Less dangerous conditions can be defined as those giving rise to fewer accidents for a given volume of traffic, and it follows that the accident rate can be used to measure the safety of any road or intersection. Records of such accident rates enable the value of improvement schemes to be measured and forecasts to be made of the reduction in accidents to be expected by altering the road layout.

Accident rates, based on the volume of vehicular traffic, are considerably lower on rural roads than on roads in built-up areas. The reason for this is that on a rural road there is less opportunity for collisions with cyclists and pedestrians, while fewer collisions with turning vehicles occur because there are not so many intersections. The corollary to this is self-evident; if the road system is developed with a view to separating motor vehicles so far as possible from pedestrians and cyclists, there will be fewer accidents. Equally, if means are provided for facilitating the avoidance of collisions between vehicles at intersections, the number of accidents will likewise be greatly reduced.

Scope for building safety into the roads

Efforts should be concentrated on improving road design and lay-out in preference to imposing a multiplicity of restrictions on road-users. Safety should be built into the roads.

A recent investigation in Lancashire of 'before and after' accidents at six places

where improvements have been carried out, has shown that the number of accidents has fallen from 58 to 22 per annum.

Reductions in the accident rate, following improvements in highway operation and design, have also been reported from Connecticut, where the accident toll was compared before and after the adoption of alterations recommended by traffic engineers at particularly dangerous places. Proper lighting is also an important means of reducing accidents.

The secret of accident prevention is to lessen friction by means first of segregating motor traffic from other traffics including pedestrians, and secondly of segregating vehicles moving on the road, in different directions or at different speeds.

Safer conditions away from densely populated areas can be obtained either by passes or by roads taken over or under the general street level.

NUMBER OF MOTOR VEHICLES

	Per 1,000 sq. miles	Per 100,000 population
Ceylon	*1,500*	*500*
Malaya	*850*	*780*
Phillippines	*650*	*386*
India	*260*	*82*

We wish all our
Readers, Contributors, and Advertisers
A Happy and Prosperous
New Year.

INTERNATIONAL ASSOCIATION OF ROAD CONGRESSES

THE Tenth Session of the International Association of Road Congresses will be held at Istanbul, Turkey, in September 1955. The Ninth Session of the Association was held at Lisbon in September 1952.

The Congress will be held in two Sections, the first Section dealing with the construction and maintenance of roads will consider the following questions:

FIRST QUESTION

Surfacing of Roads & Runways

A. Concrete Roads and Runways

In particular: new methods of construction, increase in size of slabs, joints, dowels, prestressed concrete, air-entrained and plasticised concrete.

B. Surfacings made with plastic binders

In particular: new methods of construction; sealing preparations; standardization of stripping tests.

C. Questions common to various surfacings

(1) Non-skid properties: Measuring of these properties and their standardization - Determination of limiting coefficients.

(2) Frost and Icing: How these conditions occur—Remedies, palliatives—Protection.

(3) Modernisation of mechanical equipment and its use in construction and maintenance.

SECOND QUESTION

Soils

A. Bearing Capacity: Bearing capacity of the subgrade and carriageway foundations in relation to soil composition and water content. Improvement and standardization of tests.

B. Stabilization of Soils

In particular: Improvement of soils used. Prevention of erosion-Drainage-Laterite soils – Expansive soils.

THIRD QUESTION

Low-Cost Roads

A. Lightly trafficked roads in rural areas

Construction - Maintenance - Possible limitations of load and user - Mechanized equipment for construction and maintenance - Gradual improvement of standards.

B. Roads in under-developed areas

In particular: Road characteristics; cross section, profile, road and carriageway widths – Headroom below bridges, width and bearing capacity of bridges; Drainage, waterflow from catchment areas, standardization of small culverts and bridges – Statistical results.

The second Section dealing with Traffic on Roads, Administration and Finance will deal with two questions noted below:

FOURTH QUESTION

The road in relation to traffic

A. Traffic-Circulation

In particular: Censuses, traffic surveys (types and number of vehicles, distance and routes travelled) –

Estimating increases in traffic – Attraction of traffic to new routes.

B. **Road characteristics in relation to traffic**

In particular: Layout – Carriageway capacity – Lane capacity – Distribution on the carriageway – Segregation of streams – Designs of junctions and intersections.

C. **Road equipment** (outside built-up areas)

(1) Traffic control devices (use of carriageway markings, signs, control of, and provision for parking, waiting and stopping).

(2) Ancillary services – Installation for use of road users.

D. **Accidents, Road safety**

In particular: Accident statistics and investigation – How, from these studies conclusions can be drawn as to methods of design, construction and traffic regulation so as to avoid repetition of accidents and lessen their gravity.

FIFTH QUESTION

Allocation of Funds and Economic justification of roadworks

A. **Methods of Financing Works**

In particular: Allocation of special taxes – Tolls – Application to International routes.

B. **Economic justification of road works (Rentability generally)**

In particular: Statistical survey Modernization and Improvement; their final influences on maintenance charges and vehicle operation costs; Economies resulting from reduction in accidents.

The Sixth Question viz,. - Urban Roads and Traffic in Cities, with particular reference to car parks and parking layout and equipment of road intersections – traffic control signals – waterproofing and drainage of carriageways – Tramways in built up areas—will be considered by the Joint Session of the Sections I & II.

[Persons interested in submitting Papers to the Congress may contact the Chief Engineer of their State—*Editor.*]

WORDS OF WISDOM

Joy in one's work is the consummate tool, without which the work will always be done slowly, clumsily, and done without its finest perfectness.

— *Phillips Brooks.*

PRINCIPLES OF GRANTS–IN–AID*

(Contributed)

1. Working in Layers now Obsolete

IN modern society, the idea that each 'layer' of government should be able to raise the revenues necessary for the discharge of all its functions has been found to be unworkable.

In all advanced countries the higher authorities have tended to collect an increasingly greater share of the total revenue and the subordinate authorities have found themselves in the position of having to administer more functions than they can finance from their tax resources. A glance at the budgetary trends of a few leading countries conclusively indicates this tendency.

The growing disparity between the needs and the means of local authorities has been removed by developing a system of grants-in-aid from the National Exchequer to the local authorities.

2. Advantages of Grants-in-aid

Sydney Webb has called grants-in-aid "a characteristically English device which in his opinion is the pivot on which the administrative machinery really works".

Besides bridging the gap between the fiscal resources and governmental responsibility of local bodies, grants-in-aid have also other important functions to perform. They can be utilised for securing uniform national standards in social services and for levelling up abnormally poor and needy local communities. Further, the grants enable the National Government to carry out a national policy without duplicating or competing with similar services rendered locally.

3. Functions of the System

The Departmental Committee on Local Taxation of England in their Report (1914) specified three distinct functions of the grants-in-aid. According to the Committee grants-in-aid are the method by which the nation (a) contributes its own share towards the cost of semi-national services; (b) remedies inequalities in the incidence of local taxation; and (c) effectively supervises the administration of semi-national services.

4. The Problems

There are two problems to be solved in any grants structure: (a) the total amount to be distributed; and (b) the basis on which this amount should be distributed between the different recipient authorities. The answer to the first depends mainly on the distribution of the functions between the different public authorities as laid down by the Constitution.

5. Various Systems of Distribution

The financial administration of grants in various countries has, in the course of years, revealed the following possible criteria according to which grants can be distributed between various bodies.

(i) Principle of Derivation

According to this method, the Central Government distributes the amount of the grant between the different bodies in proportion to amounts of taxes collected in those localities. Such a system of revenue division hardly deserves the name of a grant. This system only enables a more convenient basis for tax collection and no national objective can be advanced. This system would appropriately obtain in a Customs Union where the member States join together for convenience without any consciousness of national integrity. Another demerit of this method is that in the case of indirect taxes, it is difficult to allocate correctly the revenue collected to the different localities.

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* An earlier article on this subject appeared in this Journal for December 1948.

It is when the revenue is allocated out of the 'common pool' on some modification of the strict derivation principle that we enter the realm of grants.

(ii) Promotional Grants

Grants may also be allocated to local bodies for specific purposes. The amount of grant may be fixed in proportion to the contribution of the local authority; this basis is known in America as 'matching dollar for dollar'. A serious disadvantage of this method is that only well-off authorities can take advantage of such grants and consequently it accentuates different local authorities. An argument in favour of this system is that it tends to "help those who help themselves". But this overlooks the essential fact that the local authorities who cannot 'earn' larger grants because their own contributions are small, may not have the capacity to help themselves.

While this method also puts a premium on extravagance it tends to distort local budgets by encouraging growth in certain directions at the expense of others.

But, nevertheless, this method has done much to promote capital investment in the development of even advanced countries.

(iii) Equalization Grants

This system of grants purports to equalise opportunities by distributing central funds according to the needs of the local authorities. The principle was supported by the Minority of the Royal Commission on Local Taxation in England (1901) who suggested the allocation of grants according to 'necessity' and 'ability'. The actual difficulty lies in carrying out the 'needs' test in practice. Regional figures of per capita income (if they are available) may form a basis for distinguishing between regional needs. The distribution of grants on the basis of population or area is a partial application of this principle.

6. The Requisites of a Good System

The proportion in which the different methods explained above should be combined will depend upon local circumstances and the historical background in each country; perhaps it does not seem practicable to suddenly disrupt any existing system of distribution.

It will be useful to quote here from a *White Paper issued by the British Government in 1929 when the Local Government Act (1929) was passed in Britain. In the terms of the White Paper a proper system of grants-in-aid should

(a) recognise that a fair contribution should be made from the Exchequer towards the cost of local services;

(b) ensure that local authorities have complete financial interest in their financial administration;

(c) be adapted in its working to the needs of the local areas;

(d) permit the greatest administrative initiative;

(e) provide for sufficient general control and advice from the Central Department to ensure a reasonable standard of performance.

7. Objections to the System of Grants-in-aid

We may finally consider an objection that is sometimes advanced against a system of grants-in-aid. Grants, it is alleged, are an insidious device by means of which the Central Government may seek to destroy the local autonomy. In reply to this argument it may be stated that far from undermining the position of local authorities, grants-in-aid from higher authorities enable the local bodies to administer essential social services popularly demanded of them. The Central aid to subordinate units "can be made a valuable device for preserving local self-government while at the same time raising service standards and effectively utilising the most desirable tax sources".

8. Application to Roads

In this connection, the system of giving grants-in-aid for road purposes in this country will naturally be called to the

(Continued on page 22)

(Vide para 16, White Paper on Local Government Act, 1929)

DESIGN OF KERB ALIGNMENT AT STREET CORNERS

(Extracted from 'Roads and Road Construction'—March 1953).

Factors Affecting Design. The principal factors to be considered in designing the rounding of a kerb at a corner are as follows:—

(i) The shape of the curve should permit a vehicle of normal size to turn left within the path prescribed by traffic regulations, and without encroachment upon the lanes provided for opposing traffic.

(ii) Sight distance at any point should be adequate for a driver approaching the intersection to see other traffic approaching so that he may control his vehicle and avoid collision.

(iii) The passage of pedestrians across the road should be as short as possible and approximately at right angles to the general line of traffic flow.

It will be seen that there could be some conflict between requirements for motor vehicles and for pedestrians; the design described herein to a large degree meets the needs both of vehicles and of pedestrians.

Vehicles Adopted for Design Purposes. The turning requirements of motor vehicles at intersetions depend on: (1) The characteristics of the vehicle making the turn, i.e., its wheel base, overall dimensions, and minimum turning radius; (2) the actions of the vehicle operator in making the turn; and (3) the turning speed of the vehicle.

From considerations of vehicle characteristics, two "design vehicles" were selected as representative of the main vehicle groups, viz.:— a commercial vehicle having a wheel base of 17 ft 6 in. overall length 27 ft 6 in., width 8 ft and minimum turning radius 40 ft, and a passenger vehicle of 12 ft wheel base, overall length 19 ft, width 6 ft and minimum turning radius 28 ft. The commercial design vehicle has characteristics of those of double-decker omnibuses in use in New South Wales. (Australia)

Turning Requirements of Vehicles. For a normal 90 degrees turn at a street intersection, the time occupied in turning the steering wheel from straight to full-lock is about 6 second and the average turning speed of the vehicle is about 5 miles per hour. For a passenger car, the corresponding time appears to be about 2.8 seconds at a speed of 10 miles per hour.

The rear wheels should track inside the front wheels by a radial distance which can be found geometrically, and is expressed by the formula $R - \sqrt{R^2 - L^2}$, where R = radius of turn in feet at the outer front wheel and L = wheel base of the vehicle in feet.

A curve of approximately lemniscate shape is followed in practice.

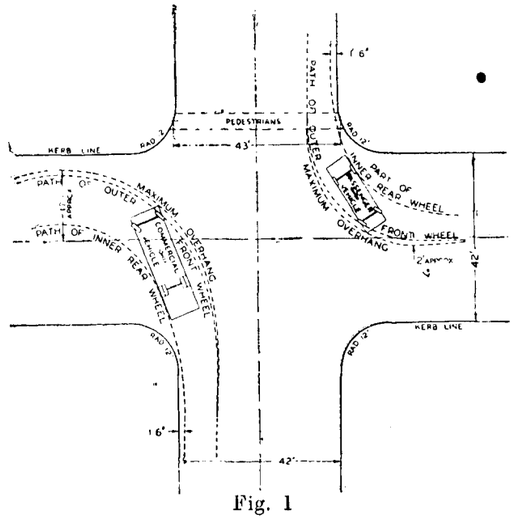

Fig. 1

The Left-hand Turn at Intersections.

At the intersection of two four-lane carriagways there are four forms of left turning movement to be considered, viz., a turn from the kerbside lane of one street either to the kerbside or to the second lane from the kerb in the intersecting street, and a turn from the second lane from the kerb in one street either to the kerbside lane or to the second lane in the side street.

A left turn from the second lane from the kerb should not be used to fix the shape of turnout curve for the following reasons:

(a) When turning left out of a "through" road it is desirable that a driver should use the kerbside lane for his deceleration manoeuvre and ultimately make his turn from that lane so as to leave the second lane from the kerb free for other traffic.

(b) On many bus routes, stopping places are located near an intersection where the bus turns left so that the left turn is commenced from the kerbside lane.

(c) The New South Wales traffic regulations require that a vehicle turning left from one street to another should keep as near as practicable to the left boundary of the carriageway.

Adoption of the kerbside lane for the commencement of a left turn leaves two alternatives to consider, i.e., whether provision should be made for a vehicle to turn into the kerbside lane or the second lane from the kerb in the side street.

Commercial vehicles are able to turn left from kerbside lane to kerbside lane when provided with a simple curve of 50 ft radius, or, alternatively, a three-centred compound curve of approximately 120 ft, 40 ft and 120 ft radii, as shown in Fig. 2. Either of these layouts provide adequately for the commercial vehicle, but they have two important disadvantages as follows:

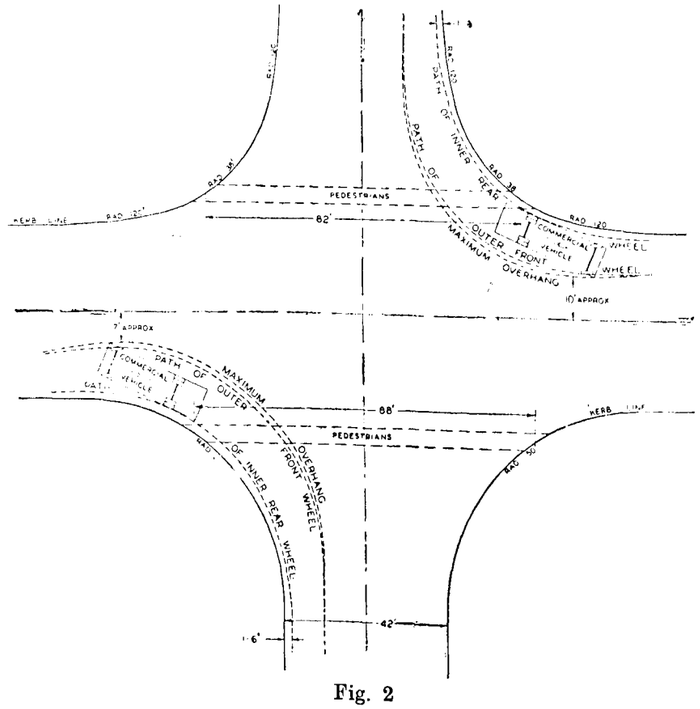

Fig. 2

(a) Pedestrians are required to traverse a distance of 82 ft in one case and 88 ft in the other in crossing a carriageway whose normal width is 42 ft, and

(b) small wheel base vehicles might be encouraged to turn with little or no reduction in travelling speed from the regulation maximum of 30 miles per hour in built-up areas. This could readily be achieved on a radius of about 100 ft from the second lane in one street to the second lane in the other street, and would create a serious hazard for pedestrians stepping from the kerb to cross the road. It has proved in practice to be a hazard also to the vehicle, particularly where the crossfall of the intersecting street is adverse to the direction of turning.

From consideration of pedestrian safety, therefore, it would appear that a design for the curving of footway edges at street corners should not provide for all vehicles to turn left from kerbside to kerbside lane.

In turning left from the kerbside lane to the second lane from the kerb, the commercial design vehicle would trace a path as indicated in Fig. 3. The portion of footway area shown hatched is that which would require to be removed in

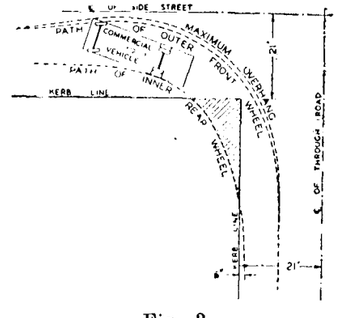

Fig. 3

order to permit such a turn. From an examination of this area it is apparent a symmetrical kerb layout is not essential if it is desired to design for minimum turning conditions. When making this turn, the transition of the inner rear wheel of the design vehicle approximates to a radius of 60 ft at the commencement of its path so that the provision of a 60-ft radius curve at the kerb should guide a commercial vehicle into a correct path when starting the turn. Once this is accomplished, the shape of the remainder of the kerb will have little effect on the vehicle's path, and an ease to the alignment of the intersecting street may be made in as short a length as possible.

On this basis a standard two-centred compound curve has been designed having radii of 60 ft and 15 ft as shown in Fig. 4, the 60-ft radius section being for the purpose of guiding commercial vehicles into the second lane from the kerb, while the 15 ft radius section accommodates the turning path of a passenger vehicle in a turn from kerbside lane to kerbside lane. With this layout the normal path of pedestrians across the intersection in the case of a carriageway normally 42 ft wide is 57 ft (The equivalent symmetrical layout would involve a radius of 35 ft with a corresponding crossing distance for pedestrians of 73 ft).

A two-centred compound curve has a further advantage over a symmetrical curve in that the area of road pavement required at an intersection is kept to a minimum. In comparing pavement areas on a normal four-way square intersection it was found that the area saved by adopting the two-centred layout was approximately 150 sq. yards in the case of the the three-centred curve of 120 ft, 40 ft and 120 ft radii, approximately 170 sq. yards for the simple 50 ft radius curve, and approximately 50 sq. yards for a curve of 35 ft radius.

In order to examine the 60-15 compound curve layout with regard to aesthetics, models were constructed so that the unsymmetrical layout could be viewed from all aspects. It was concluded that the lack of symmetry would not be detected by casual observation by the road user.

General Application of Compound Curve

The two-centred compound curve layout has now been adopted by the Department

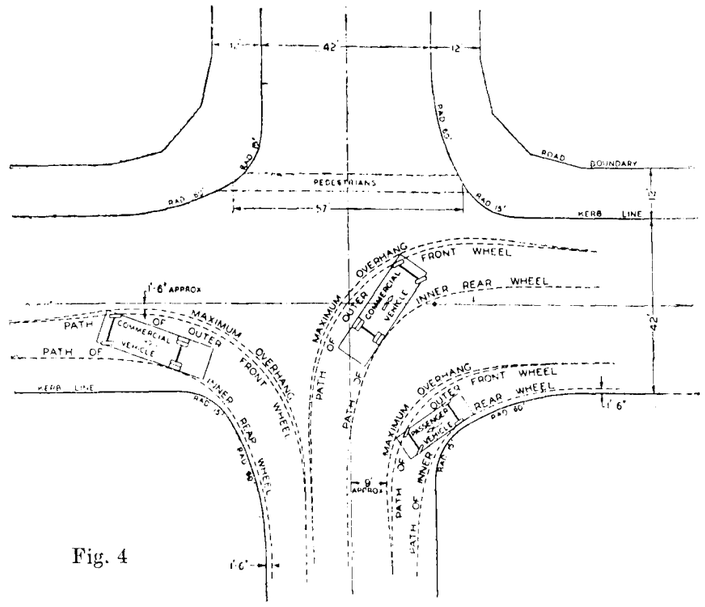

Fig. 4

of Main Roads (New South Wales, Australia) in built-up areas at the intersection of the following:

(a) two main roads,

(b) a main road and sub-arterial road, and

(c) a main road and a side street carrying bus traffic, or

a large percentage of lorry traffic.

Fig. 5 illustrates a geometric construction for the compound curve at a square intersection. The layout is suitable for angles of skew in the side streets of upto 30 degrees.

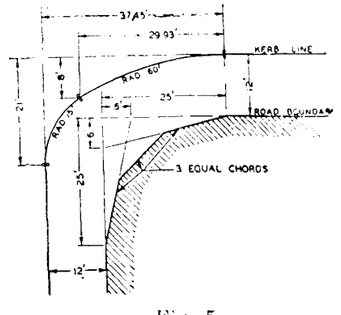

Fig. 5

For angles of skew greater than 30 degrees, it is desirable that the layout should, if practicable, be replanned to make the angle of intersection within 30 degrees of a right angle. If replanning is impracticable because of interference with buildings, etc., the intersection on the existing site should preferably be designed to incorporate traffic islands to channel turning movements, and to reduce unnecessary pavement areas which might induce vehicles to wander or make speedy and dangerous turns. Islands serve also as a refuge for pedestrians.

Turnouts to Residential Streets

In the determination of a suitable layout for corners at the intersection of a main road with a side street in residential or local shopping areas, the following factors have been considered :-

(a) The total turning movements of all vehicles are, in general, numerically low ;

(b) commercial vehicles form a small percentage of the total of all vehicles turning ;

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"A"

* The first number represents the issue number the second within bracket the page of that issue.

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(c) side street carriageway widths may be less than 42 ft; and

(d) land acquisitions for corner cut-offs should be kept to a minimum.

By the use of similar design methods to those outlined above, it has been found that where the width of the carriageway of the side street is 30 ft or greater, a true circular curve of 15 ft radius will permit the passenger design vehicle to turn left from the kerbside lane into the second

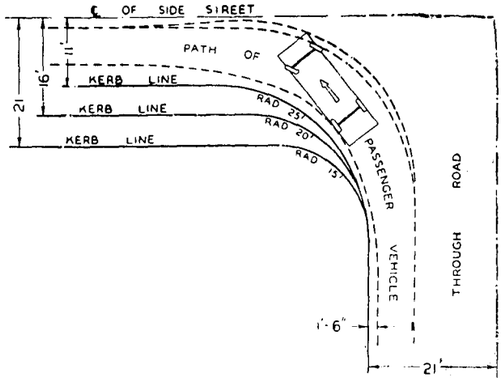
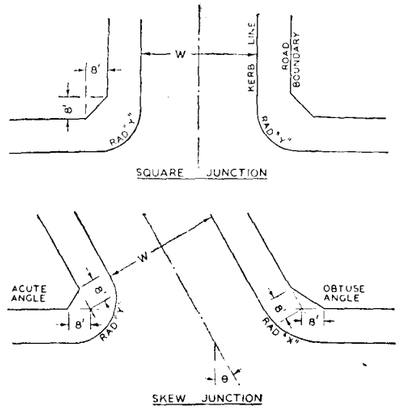


Fig. 6



RADIUS OF TURNOUT TO SIDE STREETS IN RESIDENTIAL & LOCAL SHOPPING AREAS

Angle of Skew θ	Width of Carriageway in Side Street 'W'	Kerb Radius Obtuse Angle Side 'X'	Kerb Radius Acute Angle Side 'Y'
0°-5°	30' AND OVER	15'	15'
	22' TO 29'	15'	20'
	LESS THAN 22'	15'	25'
6°-12°	32' AND OVER	15'	15'
	22' TO 31'	15'	20'
	LESS THAN 22'	15'	25'
13°-20°	34' AND OVER	20'	15'
	22' TO 33'	20'	20'
	LESS THAN 22'	20'	25'
21°-30°	34' AND OVER	25'	15'
	20' TO 33'	25'	20'

Fig. 7

lane from the kerb. For carriageway widths of less than 30 ft, however, or where the side street is not at right angles with the main road, the kerb radius requires modification, as shown in Fig. 6 and detailed in the table in Fig. 7, if the passenger design vehicle is to turn left without encroachment upon the lanes of opposing traffic in the side street.

Although the commercial design vehicle cannot turn left from the kerbside lane without crossing the side street centre line, it is possible for it to turn safely in a carriageway 42 ft wide from a position about 7 ft from the kerb, as shown in Fig. 8.

Figure 7 illustrates the standard layout which has been adopted by the Department of Main Roads, for the intersection of a main road with a side street in residential and local shopping areas.

Sight Distance

In order to provide for adequate sight distance at an intersection in a built-up

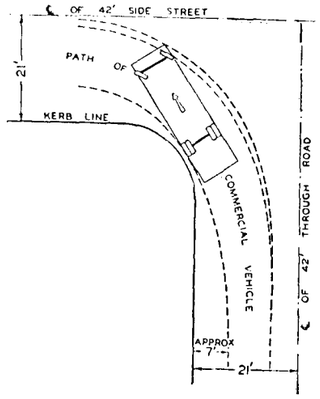


Fig. 8

area, it is usually necessary to allow some form of cut-off at the road boundary on all corners.

The length of sight distance to be provided should be determined by allowing for the stopping distance of a vehicle moving at the design speed of the road. In the case of a side road intersecting with a main or "through" road, however, it is considered reasonable to assume that some extra caution will be exercised by a driver in approaching the intersection along the side road, and a stopping distance calculated from two-thirds of the main road design speed is adopted. On this basis the method of determining the extent of cut-off required is illustrated in Fig. 9.

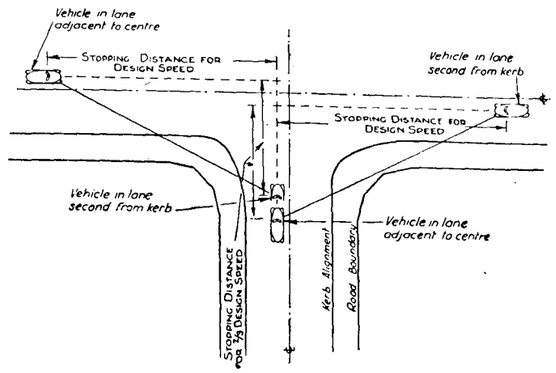


Fig. 9

Where a road is 66 ft wide and the footway width is 12 ft, the desirable minimum cut-off at a minor side road intersection is 8 ft measured from the corner along each boundary line. This cut-off is suitable for kerbline radius of from 15 to 20 ft.

In the case of a road where there is substantial turning commercial traffic, and the 60-15 compound curve is used, a three-chord cut-off is desirable in order to maintain a minimum footway width of 12 ft. For a square junction the three-chord cut-off is as shown in Fig. 5.

(Continued from page 16)

minds of road engineers. The Central Road Fund is a case in point. The Fund incorporates a machinery for giving effect to the sound principles of grants-in-aid distribution discussed above. While the main part of the fund, i.e., 80 per cent of the total receipts, is distributed in proportion to the petrol consumption in each State, the resources of the Reserve made up of the remaining 20 per cent are employed to "balance out" pointed cases of inequalities in distribution. For example, the sole basis of petrol consumption might deny an equitable grant to a State which precisely because of its underdevelopment of road transport needs considerable assistance for roads. In other words, the grant from the Reserve is based on the principle of equalisation as against the main part of the Fund which is distributed on the principle of derivation.

THE OPERATION OF ANGLE-DOZERS AND BULLDOZERS

(Extracted from Contractors Record Public Works Engineer, September, 1953.)

DOZING plant properly applied and efficiently operated is capable of performing various operations relating to civil engineering work.

Angledozers and bulldozers are available with cable or hydraulic control fitted with blades which can be adjusted in relation to the ground, both in a vertical and horizontal plane.

The operations for which this type of plant is suited are :

1. Site clearing, removing scrub and undergrowth.
2. Tree felling.
3. Stripping soil and short haul excavation.
4. Excavation along sloping hillsides.
5. Bulk filling.
6. Trimming and finishing.
7. Back filling.
8. Spreading and levelling.
9. Stockpiling.
10. Push loading.

The Operation of the Plant

For efficient operation the two essentials are :—

(1) The operator must be thoroughly experienced in handling the plant and also be conversant with the mechanical adjustments possible in relation to the set of the blade, etc.

(2) The plant must be properly applied.

Some hints which contribute to the care of the plant and its efficient operation are as follows :

(1) In order to protect the crank case and other vital parts of the machine when travelling keep the blade just clear of the ground, thus permitting it to touch any low obstruction standing above normal ground level.

(2) In operating the plant adjust the blade to take a reasonable amount of cut without overloading or stalling the engine.

(3) In carrying out the excavation pass work downhill if at all possible, as this contributes to large production.

(4) In carrying out stripping or short haul excavation do not reverse or push the excavated material further than is necessary.

(5) In excavating, a full blade handles more easily than an empty or partially filled one.

(6) In light trimming always aim at having at least half a load on the blade.

(7) In final trimming and levelling the final pass is best made by dropping the blade on the ground and travelling in reverse.

(8) In operating the plant as a bulldozer alter the vertical tip of the blade to suit the nature of the ground, tipping the blade backwards, or forwards as the case may be. Correct positioning assists digging and the floating or rolling tendency of the material on the blade, thereby contributing to increased output.

(9) To assist in hillside excavation on sloping ground or in the penetration of hard ground alter the horizontal tilt of the blade so as to commence the cut with the low end of the blade.

(10) In travelling down steep gradients lower the blade so as to use it as a brake.

(11) In operating the plant keep the control wire bond tight, for if left too loose kinking and uneven running on the drum may result, causing damage to the bond.

(12) Use only the correct size of wire bonds on the machine as laid down by the manufacturer.

(13) If a machine becomes bogged down, do not frantically "rev" up the engine. With the engine at about half-throttle engage the flywheel clutch slowly keeping both steering clutches engaged. Do not attempt to wriggle the machine out using the clutches, as this only tends to bog it still further in. The aim should be to ease it out straight ahead; using the throttle in conjunction with the clutch to do so.

Site Clearance

Clearing Scrub and Undergrowth. In clearing scrub and undergrowth, including small trees and bushes, the blade should be lowered a few inches into the ground so as to just cut the roots as the machine travels forward. This operation is necessarily carried out in a low gear, first or second gear usually being employed. The object is to cut the roots cleanly. Now and again it may be found that the blade may glide over the roots without severing them, necessitating reversing and taking a deeper cut. Having cleared an area, the whole may then be pushed into a heap ready for disposal.

Felling Trees 3 in. to 9 in. in Diameter. Trees ranging from 3 in. to 9 in. in diameter may be felled by raising the blade high so as to get good leverage, the trees then being pushed over with the roots intact. Having felled the tree, the whole may then be bulldozed clear of the stump hole ready for disposal.

Felling Trees 9 in. to 18 in. Diameter. Trees coming within this range are best felled by forming a ramp of earth 4 ft to 5 ft up the trunk so as to get leverage. Lifting the blade as high as possible, the machine should then be run up this ramp until the blade makes contact with the trunk, the clutch then being actuated so as to produce a rocking motion which is imparted to the tree. This rocking motion should be commenced gently at first on half throttle, and then increased until the tree falls. To assist in this operation the roots on the ramp side may, if desired, be exposed and cut through prior to forming the ramp. Having felled the tree with the roots intact, it may then be pushed completely clear of the ground.

Felling Large Trees 18 in. Diameter or Over. Having assessed the probable line on which the tree will fall, a cut should be made on the opposite side of the tree to sever some of the larger roots. Having done this, two similar cuts should then be made on either side of the tree again on those sides away from the line of fall, the roots being cut as before. An earth ramp should then be formed up against the trunk, as in the case of trees 9 in. to 18 in. diameter, the plant then running up this ramp and pushing the tree over. As the tree falls, the dozer should be reversed quickly away from the tree so as to prevent damage to the machine from roots as the falling tree pulls them out of the ground. Having felled the tree, the hole may then be filled in and the whole dozed clear of the ground.

Output of Plant

Site Clearance

Item		Output per hour for tractor drawbar horse power of			
		40 to 50	60 to 70	80 to 90	130 to 140
Clearing scrub and undergrowth, small bushes, etc. units of 100 sq. ft.		75	95	135	175
Felling trees 3 to 9 in. dia.	No.	4.00	5.60	8.00	10.00
Felling trees 9 to 18 in. dia.	No.	...	2.10	3.20	4.00
Felling trees 18 to 30 in. dia.	No.	...	...	1.60	2.00

Note:—Attendant labour is also involved in clearing to heaps for burning or clearing away.

HERE AND THERE

1. HISTORY OF THE THEORY OF ELASTICITY

Robert Hooke

(1635—1702)

HOOKE'S Law of Elasticity is one of the basic principles of design of structures in which we employ materials which more or less follow this Law.

Robert Hooke was born at Freshwater, Isle of Wight, in 1635 and for the first seven years of his life was so weakly that it was doubtful whether he would grow to manhood. In spite of this early setback he lived to the age of 67 and became one of the most versatile contributors to the proceedings of the Royal Society in London. Educated at Christ Church, Oxford, he became Professor of Geometry in Gresham College at the age of 30.

He was a contemporary of Issac Newton and Christopher Wren and assisted in the rebuilding of London after the great fire of 1666.

In 1678 Robert Hooke published a treatise "*de Potentia Restitutiva*" and showed experiments to confirm his Theory of Springs and Springy Bodies. One of these experiments was made with a string of brass wire 37 feet long extended by weights hung on the lower and by which he made it evident that the wire extended proportionally to the weight so that if one weight extended it one length, two extended it two lengths and so on.

He showed the same principle to apply to a helical spring and to a watch spring and enunciated his Law of:

"*Ut tensiosic vis*";

i.e., the power of any spring is in the same proportion as the tension thereof.

He is said to have arrived at this Law about the year 1660 when studying the behaviour of springs for watches.

Hooke was also the first man in the world to suggest that fossils might be used to construct a chronology of the earth.

The Bernouillis

(18th century)

James, John and Daniel Bernouilli were members of an illustrious family of which no less than eight members contributed to the advancement of knowledge during the course of the 18th century.

James, as Professor of Mathematics in the University of Basle, studied the problem of the catenary curve of a suspended chain and determined the elastic curve of a cantilever loaded at the free end. The assumption that a cross section of a beam which is plane before bending remains plane after bending is attributed to James Bernouilli.

John was Professor of Mathematics at Basle when Euler was a student at that University.

Daniel Bernouilli in one of his early investigations gave a demonstration of the problem of the parallelogram of forces and his theorem relating to the flow of water was published in 1738.

The Bernouillis like Euler, their contemporary and colleague, studied the elasticity of beams and columns from a mathematical standpoint.

Thomas Young

(1773–1829)

Dr. Thomas Young, physician, physicist and student of Egyptain inscriptions wrote a book in 1807 entitled "A Course of Lectures on Natural Philosophy and the Mechanical Arts."

In this book, 130 years after the publication of Hooke's Law, we find the idea of a modulus of elasticity introduced for the first time and also the term resilience.

2. COUNTRIES DRIVING RIGHT

These countries drive right.

Argentine
Austria
Belgium
Belgian Congo
Bolivia
Brazil
Canada
Canary Islands
Chile
China
Colombia
Costa Rica
Cuba
Czechoslovakia
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
Eritrea
Finland
France
French Colonies
Germany
Gibraltar
Greece
Guatemala
Haiti
Holland
Honduras Republic
Hungary
Italy
Iraq
Israel
Jugoslavia
Lebanon
Luxembourg
Mexico
Netherland West Indies
Newfoundland
Nicaragua
Norway
Paraguay
Panama
Persia
Peru
Phillippines
Poland
Portugal
Saudi-Arabia
Spain
Switzerland
Syria
Transjordan
Tripolitania
Turkey
Uruguay
U. S. A.
U. S. S. R.
Venezuela

—Extracted from 'LIFE' Feb. 27, 1950.

3. THE ENGINEER AND RISKS

A solicitor once said that lawyers were not paid to take risks. The engineer must take risks. But there are different kinds of risks and they can more often be assessed. An engineer has been defined as a man who can do for six pence what any man can do for a shilling. This is a good definition, for it calls attention to the engineer's obsession with the question of cost. He must do his work in the most economical way, bearing in mind future maintenance and the cost of raising capital. To do this he must often take risks, for his art is so complex that he cannot have full knowledge of every factor. As future generations will know more, they will never know all.

He does not therefore take a risk through lack of care or sparing himself trouble. Unless he sometimes takes risks, his work must he unduly extravagant. He recognises the risk, weighs it carefully, and if possible calculates the extra cost of completely avoiding it and the cost that will occur should his venture fail. He is then in a position to know whether that risk should be taken or not. It is but seldom in such cases that he can ask the advice of his employers, for his explanation will be too technical for their comprehension. *The best he can do is to expect no praise if his gamble succeeds and to be ready with a reasoned answer if it fails.* It is sometimes suggested that an engineer is not justified in taking risks with the money of others. This is far from the truth, but the risks must be worth taking.

Telford never designed a structure of needless solidity at his employer's expense. He recognised that an engineer must take risks and that sooner or later a day may come when failure occurs; then his reputation must stand up to the criticism to which he will be exposed.

The engineer does not, however, take risks on estimates of cost, which are clearly for the guidance of his employers.

(Extracted from "The Municipal Engineer in Modern Life," 'The Journal of the Institution of Municipal Engineers'— August 1953.)

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4. "DRIVER—ANALYSIS"

CAN a Doctor predict safe drivers? Dr. Harold Brandaleone, Medical Director of the Third Avenue Transit (Bus) System in New York City claims that he can determine the ability of the prospective operators to drive safely.

Dr. Brandaleone has worked out a classification system—the "transit profile"–which enables him to judge the safety standard of a driver. According to him, "there is a direct relationship between the mental, emotional and physical health of the operators and their proneness to accidents."

In World War II, U. S. Army Air Force had a system of classifying the candidates for pilot trainings. Dr. Harold Brandaleone's system is based on that. The "profile" covers the drivers' sight, hearing, emotional stability, physical stamina, and "motorability" grade.

Each driver is given a health rating on this basis. If the rating falls below a certain point, he cannot drive. Tests have shown that accident rate in the group with unsatisfactory rating was 50 per cent more than in the satisfactory group. Already in the Third Avenue Transit (Bus) System, accidents have been cut by 50 per cent by Dr. Brandaleone's pre-employment examination. He also suggests that veteran employees should be re-examined at regular intervals.

—From 'State Transport Review'— April 1953.

5. THE ENGINEERS' METHOD OF THINKING

A method of thinking is necessary if one's work as an engineer is to be creative, productive and practical. The engineers' method of thinking is an adaptation of the "Scientific method" of observation and analysis of facts on which a programme of action is based, to which has been added a purposeful practicality in which efficiency and cost consciousness have high priority. It demands also a logical mind, flexible enough to deal effectively with illogical people and illogical situations.

(Extracted from "Mechanical Engineering," August 1952).

6. STRENGTH OF HEMP OR COTTON ROPES AND STEEL CABLES

FOR cotton or hemp rope, square the diameter of the rope in inches and multiply the product by 200. Thus for a $\frac{1}{2}$ in. rope we have $\frac{1}{2} \times \frac{1}{2} \times 200$ or 50 lb, which is the safe strength.

For steel cable, square the diameter of the cable in inches and multiply by 12,000. Thus for a $\frac{1}{2}$ in. cable we have $\frac{1}{2} \times \frac{1}{2} \times 12{,}000$ or 3,000 lb, which is the safe strength.

From 'Roads and Streets,' January 1949.

CURRENT LITERATURE

ABSTRACTS

625.7. TRAFFIC-ACCIDENT STUDIES—Bulletin No. 74, Highway Research Board, 2101, Constitution Avenue, Washington, D.C.

The bulletin contains the following four Papers on Traffic Accident Studies:

(1) Traffic-Accident Trends.

(2) Relation between Number of Accidents and Traffic Volume at Divided-Highway Intersections.

(3) Interstate Highway—Accident Study, and

(4) Relation of Traffic Signals to Intersection Accidents.

Paper No. 1 gives the trends of traffic accidents in the U. S. A.

Paper No. 2 is a study of 1,811 accidents, a significant conclusion of which is that accident rate at intersections is much more sensitive to changes in the volume of traffic on the cross road than on the main highway.

Paper No. 3 is a study to find out how accident rates on main rural highways are affected by the design features of the road and represents information furnished by 15 States of the U. S. A. The data so collected was sorted out by means of punched cards. Details of the cards adopted are given.

Some of the conclusions are:

(1) Traffic volume has a strong effect on accident rate.

(2) Sharp curves have higher accident rates than flat curves while carrying the same amount of traffic.

(3) The accident rate at intersections is much influenced by the total traffic on the minor road. An increase in the percentage of the cross traffic from less than 10 to 15 per cent makes the intersection twice as hazardous.

(4) Three road intersections (T & Y junctions) are considerably safer than four-road crossings.

(5) Road features such as grade, frequency of curves, frequency of sight restrictions, and shoulder widths, appear to have no consistent effect on accident rates.

Paper No. 4 is a study by the Michigan State Highway Department of traffic signals operating on rural and suburban roads. The study has shown that the "stop go" signal is not a safety device. The investigations are being continued.

624.21. INVESTIGATION OF WIND FORCES ON HIGHWAY BRIDGES—Highway Research Board, Special Report 10, 2101, Constitution Avenue, Washington 25, D.C.

Existing specifications stipulating the wind forces for bridge design are generally based on tests on flat plates of various sizes and shapes. The requirements are ordinarily conservative. Therefore, a co-operative project in which the Bureau of Public Roads contributed the engineering and consulting services was set up to study the problem and the report is the result of the work of the Committee.

The models tested represented a 100-ft pony-truss span with 22-ft roadway to a 1 : 16 scale and two 250-ft through high trusses of light design with 24-ft and 36-ft roadway, respectively, to a 1 : 24 scale. There were also 1 : 24 scale models of deck plate girder bridges 9 ft deep, having two, four, and six girders and 28-ft, 34-ft, 48-ft, and 52-ft roadways, some with 5-ft cantilevered sidewalks.

Force and moment coefficients were determined at a wind velocity of 100 mph. after testing each model at velocities down to 25 mph.

On the basis of these tests the specified wind load of 50 lb per sq. ft on 1½ times the area of the bridge in elevation is adequate for the transverse forces on trusses without live load in a 100-mph. wind. A considerably lighter loading per sq. ft is indicated by the pony truss and deck girder models. In localities exposed to extreme winds, perhaps heavier loading should be used.

The ratio of maximum longitudinal to maximum transverse force was 0.60 and 0.50 for the through trusses with 36-ft and 24-ft roadway, respectively; 0.25 for the pony truss; and less for the deck girder spans. These indications tend to support the wind force of 50 per cent and 25 per cent of the lateral force for trusses and girders, respectively.

The tests showed that the wind forces generally increase with the increase in the width of bridge whether or not additional supporting members are used but no clear-cut nor consistent criterion for this increase is evident.

An upward angle of only 5 deg. materially increases most of the wind forces and upward angles of 5 deg. and 10 deg. revealed strong vertical forces and overturning moments not provided for in the specifications. Winds of this nature occurring in gusts or near bluffs or other features of the terrain may have contributed to the failure of some bridges in the past. The report suggests a criteria for these lifting and overturning forces.

The conclusions given in the report are as follows:

(1) The indicated tendency to overturning and uplift at the windward shoes within the same range of wind conditions can be approximated conservatively by the specified lateral wind force acting at the centre of gravity of the area in elevation supplemented by a lifting force of 20 lb per sq. ft of plan area assumed to act midway between the centre line and the windward truss (or deck edge in the case of cantilevered deck construction).

(2) The maximum downward reaction to the leeward shoes can be conservatively approximated by the overturning effect of the specified lateral force, plus a downward force of 20 lb per sq. ft of plan area acting at the leeward quarter point of the exposed area.

(3) These tests and the others cited showed the maximum wind loads on girder and pony-truss spans to be less than 70 per cent of the maximum on through truss spans. However, it would seem inadvisable to consider reducing the specified loading for girders and pony trusses until these indications are confirmed by more comprehensive tests, including tests on through girders, deck trusses, open-grid decks, etc.

(4) There are probably locations where the design should provide for wind velocities greater than 100 mph. If security against tornadoes is to be provided, considerably greater wind loads, particularly uplift, should be specified.

624.137.5 ANCHORED BULKHEADS by Prof. Karl Terzaghi, Separate No. 262, Volume 79–Proceedings of the American Society of Civil Engineers, September 1953.

Bulkheads are the retaining walls of the waterfront.

Since 1930, when the existing procedure for bulkhead design originated, knowledge of the earth materials and the mechanics of the earth pressure has increased. This Paper suggests revisions of the existing procedure based on experiments and observations.

Part I of the Paper deals with the fundamental assumptions made in the methods of bulkhead design now current. These are compared with the observational data published in the past few decades.

Part II deals with the evaluation of the forces acting on anchored bulkheads and with the safety requirements. The importance of the errors involved in estimating bending moments and soil reactions depend, to a large extent, on the type of soil involved in the design problem, on the degree of complexity of the structure of soil strata, on the degree of uniformity of the backfill material, and on the time

(Continued on page 35)

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38. **Proceedings 1951 Northwest Conference on Road Building at Seattle, February 14, 15, 16, 1951** (The Engineering Experiment Station, University of Washington,).

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(Continued from page 29)

and labour invested in the subsoil exploration. Therefore, it would be economically unjustified to select the allowable stresses and safety factors in the construction materials without taking into considertion the degree of reliability of the available data. The selection of these values requires experience and good judgement.

If the designer has only the results of a conventional subsoil exploration available, the problem must be solved on the basis of empirical values such as those contained in this Paper. In connection with the design of bulkheads, involving unusual features not treated in this Paper, the designer must improvise the procedure; and in doing so, it will be found advantageous to consult the results of the experimental investigations summarized in Part I.

BUDGETS AND ADMINISTRATION REPORTS

1. GOVERNMENT OF RAJASTHAN, CIVIL WORKS BUDGET 1953-54.

The following extracts pertaining to Civil Works have been taken from the Rajasthan Budget for the year 1953-54.

(In lakhs of Rs)

	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
I. Revenue (Civil Works)			
1. Rents	4.31	6.00	7.00
2. Ferry Receipts	0.10	0.10	0.10
3. Tolls on Roads	0.21	0.15	0.15
4. Recoveries of Expenditure	0.18	0.21	3.75
5. Transfer from Central Road Fund	0.97	27.93	57.35
6. Miscellaneous	3.00	2.65	12.75
7. Deduct - Refunds	...	- 0.04	- 0.10
Total	8.77	37.00	81.00
II. Expenditure (Civil Works)			
1. Original Works	11.99	15.11	10.06
2. Repairs	68.60	76.59	76.99
3. Suspense	- 5.43	2.08	2.00
4. Establishment	15.24	9.30	8.38
5. Tools and plant	3.04	1.15	1.68
6. Probable savings	...	- 0.23	...
7. Regrant of lapses	...	0.40	0.24
8. Establishments and tools & plant charges transferred to other heads of account	- 5.22	...	...
Total	88.22	104.40	99.35
III. Expenditure (Communications only)			
1. Original Works			
(a) Works financed from State Revenues	...	2.81	0.73
(b) Works financed by grants from Central Road Fund (ordinary allocations)	...	8.93	7.35
2. Repairs	45.65	56.00	56.00
Total	...	67.74	64.08
IV. Revenue from Roads			
1. Receipt under Motor Vehicles Act	24.76	30.15	35.00

RAJASTHAN has a balanced Budget for 1953-54 with both revenue receipts and expenditure charged to revenue amounting to Rs 19,44.00 lakhs. The revised estimates for 1952-53 indicate a surplus of Rs 35.65 lakhs with the revenue receipts amounting to Rs 17,50.00 lakhs and expenditure to Rs 17,14.35 lakhs.

The revenue expenditure on civil works for 1953-54 estimated at Rs 99.35 lakhs forms 5.1% of total revenue receipts of the State. The corresponding percentages for the two preceding years 1952-53 (Revised Estimates) and 1951-52 (Actuals) are 6.0 and 5.7 respectively.

The proportion of revenue expenditure on communications (original works and repairs only) to total revenue for 1953-54 (Budget Estimates) and the preceding year (Revised Estimates) are 3.3% and 3.9% respectively.

2. GOVERNMENT OF P.E.P.S.U. CIVIL WORKS BUDGET FOR 1953-54.

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

(In lakhs of rupees).

	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
I. Revenue (Civil Works)			
1. Rents	1.07	2.05	4.21
2. Recoveries of expenditure	0.24	9.14	2.54
3. Transfer from Central Road Fund	0.14	1.51	0.61
4. Miscellaneous	2.60	3.35	4.55
5. Deduct - Refunds	- 0.04	...	- 0.04
Total	4.01	16.50	11,87
II. Expenditure (Civil Works)			
1. Original Works	22.19	41.64	97.81
2. Repairs	25.51	24.00	27.79
3. Establishment	7.25	10.79	16.82
4. Tools and plant	0.27	1.13	1.01
5. Suspense	12.21	- 5.33	0.10
6. Deduct - Recoveries of expenditure incurred on account of other departments	...	...	- 29.64
Total	67.43	72.23	113,89

	(In lakhs of rupees).		
	Actuals 1951–52	Revised Estimates 1952–53	(Rs lakhs) Budget Estimates 1953–54
III. Expenditure (Communications only)			
1. Original Works*	3.69	18.00	34.60
2. Repairs	15.31	14.85	17.00
Total	19.00	32.85	51.60

*This includes expenditure financed from the Central Road Fund Grant for which the figures for the three years are as follows:—

	—	1.51	0.61

IV. Revenue from Roads			
1. Receipts under Indian Motor Vehicles Acts	4.58	5.00	4.50
2. Motor Spirit Sales Tax	3.61	3.50	3.50
Total	8.19	8.50	8.00

THE total revenue receipts of P.E.P.S.U. for the year 1953–54 are estimated at Rs 634.93 lakhs and revenue expenditure at Rs 703.54 lakhs with a consequent deficit of Rs 68.61 lakhs. The revised estimates for 1952–53 indicate a surplus of Rs 45.68 lakhs with the revenue receipts amounting to Rs 624.80 lakhs and expenditure to Rs 579.12 lakhs.

The revenue expenditure on civil works for 1953–54 estimated at Rs 113.89 lakhs forms 17.9 % of total revenue receipts of the State. The corresponding percentages for the two preceding years 1952–53 (Revised Estimates) and 1951–52 (Actuals) are 11.6 and 11.1 respectively.

The proportion of revenue expenditure on communications (original works and repairs) to total revenue for 1953–54 (Budget Estimates) and the two earlier years 1952–53 (Revised Estimates) and 1951–52 (Actuals) are 8.1%, 5.3% and 3.1%, respectively.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

DIVERSION: An alteration in the course of road, river, or stream, as a temporary expediency during construction, improvement, or repairs.

RECONNAISSANCE: A preliminary, and usually rapid, examination or survey of a region in reference to its natural features, or other local conditions to determine the location of a proposed highway or other work.

3. HYDERABAD BUDGET FOR 1953-54

The following extracts relating to Civil Works have been taken from the Government of Hyderabad Budget for the year 1953–54.

	(In lakhs of Rs)		
	Actuals 1951–52	Revised Estimates 1952–53	Budget Estimates 1953–54
I. Revenue (Civil Works)			
(i) Rents	8.12	7.85	7.79
(ii) Receipts from Workshops	...	1.77	1.99
(iii) Recoveries of Expenditure	0.03	0.04	0.04
(iv) Transfer from Central Road Fund	29.00	0.86	24.00
(v) Transfer from State Fund	...	12.43	12.91
(vi) Miscellaneous	3.75	0.38	0.40
Total	31.90	23.33	47.13
II. Expenditure (Civil Works)			
(i) Original Works	28.10	30.86	53.65
(ii) Repairs	86.60	87.90	94.00
(iii) Establishment	46.83	54.40	53.59
(iv) Tools & Plant	2.14	2.14	2.06
(v) Grants-in-Aid	...	2.57	...
(vi) Suspense	-14.25	...	...
(vii) March 1952 Supplement	2.47	...	...
Total	151.89	177.87	203.30
III. Expenditure (Communications)			
(i) Original Works	20.81	20.57	44.54
(ii) Repairs	67.41	67.37	71.37
Total	88.22	87.94	115.91
IV. Revenue from Roads			
(i) Receipts under Motor Vehicles Acts	12.92	13.72	15.42
(ii) Sales Tax on Petrol	n. a.	10.29	15.86
Total	...	24.01	31.28

A BRIEF REVIEW OF THE HYDERABAD BUDGET

(With special reference to Civil Works)

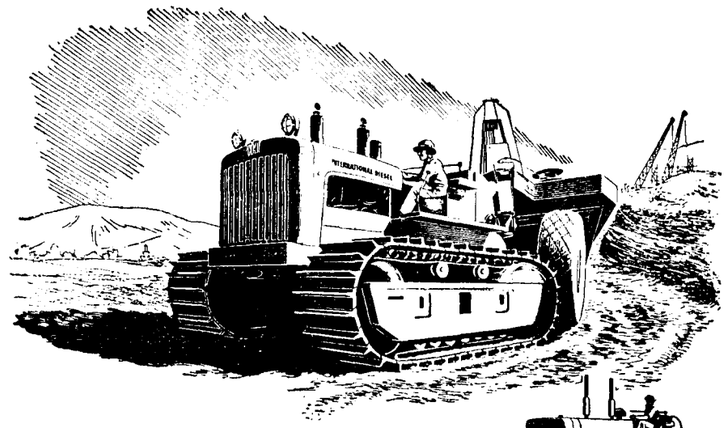
The total revenue receipts of Hyderabad for 1953–54 are estimated at Rs 28,01.73 lakhs and revenue expenditure at Rs 28,21.83 lakhs with a consequent deficit of Rs 20.10 lakhs. The revised estimates for 1952–53 indicate a surplus of Rs 1,08.91 lakhs with the revenue receipts amounting to Rs 27,91.06 lakhs and expenditure to Rs 26,82.15 lakhs.

Revenue expenditure on Civil Works for 1953–54 estimated at Rs 203.30 lakhs forms 7.2 per cent of total State revenue in that year. The corresponding percentages for the two preceding years 1952–53 (R. E.) and 1951–52 (Actuals) were 6.4 and 5.1 respectively.

Expenditure on Communications (Original Works and Repairs) during 1953–54 is estimated at Rs 115.91 lakhs and as a fraction of total revenue it amounts to 4.1 per cent. The corresponding percentages for the two previous years (1952–53 and 1951–52) are 3.2 and 3.0.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
		WEST BENGAL	
1.	799 BG 2	Reconstruction of two culverts Nos. 53/1 and 54/1 in miles 54 and 55 of G.T. Road	26
2.	800 BG 2	Land acquisition for National Highway No. 2 (old alignment)	3.55
3.	809 BG 34	Widening of the Barasat-Jaguli Section of National Highway No. 34 (16.2 miles)	13.11
		MADRAS	
4.	801 MD 5	Black topping miles 279.0 to 290/0 of Madras-Calcutta Read in Krishna Division—National Highway No. 5.	1.56
		PUNJAB	
5.	802 PB 8	Widening of miles 14 to 19 of Delhi-Alwar Road, National Highway No. 8 in Gurgaon District	0.71
6.	805 PB 22	Construction of a high level bridge over Jhajjar Nadi in mile 33 of Ambala-Kalka Road	2.59
7.	808 PB 22	Widening Road between Ambala and Dhulkot, National Highway No. 22.	0.74
		RAJASTHAN	
8.	803 RJ 8	Construction of a bridge over Achrol river in mile 21 of Jaipur-Alwar Section of National Highway No. 8.	2.80
		BOMBAY	
9.	804 BM 8	Construction of the Raigadh–Ratanpur Section of Bombay-Ahmedabad-Delhi Road, National Highway No. 8.	17.31
10.	814 BM 8	Providing cross drainage works on the Raigadh-Ratanpur Section of the Bombay-Ahmedabad-Delhi Road-N. H. No. 8.	3.28
		ORISSA	
11.	806 RS 5	Surface painting N. H. No. 5 (Cuttack-Berhampur Road) from miles 32 to 34, 42 to 68 and 71 to 72 and widening the metalled width from 42nd to 47th mile and 50th mile of Cuttack-Ganjam Road	3.96
12.	812 RS 8	Constructing link road between National Highway No. 42 and 6 near Sambalpur in Orissa	0.68
13.	815 RS 42	Construction of a bridge over Singlijore on N.H. No. 42 in Orissa	1.22
		MADHYA PRADESH	
14.	807 CP 6	Resectioning and black topping of Nagpur-Amravati Road, a section of N. H. No. 6 in Wardha District	3.51
		HIMACHAL PRADESH	
15.	810 HP 22	Construction of an explosive magazine at Gaura on the Hindustan Tibet Road	0.06



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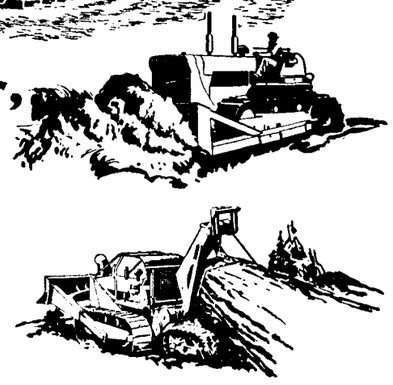

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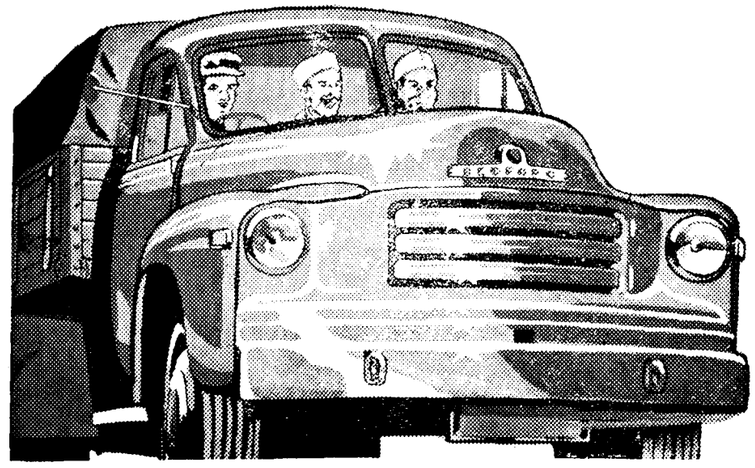

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