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Transport-Communications

MONTHLY REVIEW

No. 65 September 1952

In this issue

Annual Subscription: Rs Fourteen Including Postage. PRICE RUPEE ONE;
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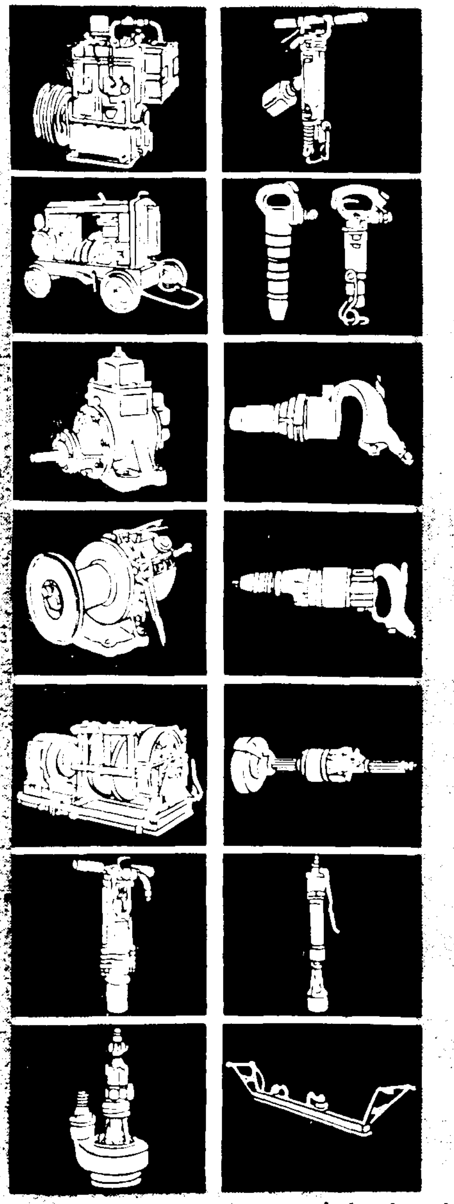

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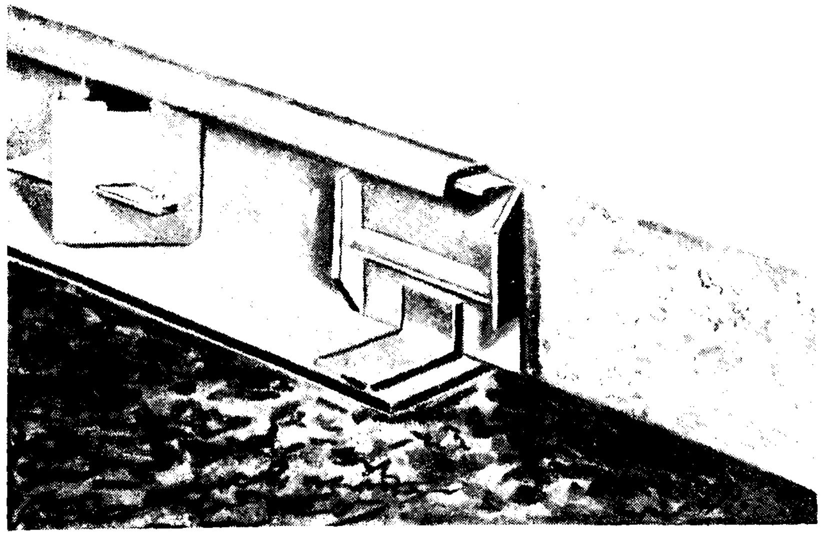

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MORE AND BETTER ROADS STRAIGHTAWAY *

A Plea for the issue of Road Bonds

OF all the handicaps this country suffers in the economic sphere, there is perhaps none that can compare with the lack of an adequate road system.

There is evidence to show that a metalled road "probably saves (in 1928) the cultivator two annas a mile on every trip his cart makes," and "if account were taken of the enormous mileage covered by cultivators' carts in moving crops to market, the financial saving to the country by a developed system of roads might perhaps be dimly guessed."

In India, few bullock carts can enjoy the luxury of operating on metalled roads because out of the 255,000 miles of roads in the country, 164,000 miles, or roughly two-thirds, are unmetalled. India owns 8 million bullock carts, and the loss in carting expenses to the country is assessed, on a very conservative estimate, at Rs 55 crores a year!

Even with the great preponderance of unmetalled roads, the length of our road system is most inadequate for the country's requirements. This paucity of roads is the root cause of most of our economic ills, because no production, whether in the agricultural or industrial field, can take place where men and materials cannot move freely from place to place.

Pilot Survey

A few years ago a pilot road survey of certain areas of Bombay State showed how road development would bring additional lands under the plough for growing more food, would encourage cultivation of money crops, including fruits and vegetables, and would effect considerable savings in transport costs, besides enabling numerous cottage and other industries to be started on a very profitable scale.

In the selected areas the financial benefits to the community were estimated at Rs 12 lakhs per year, whereas the necessary roads, including satisfactory maintenance for 20 years, would cost less than Rs 4½ lakhs per year, including 3½ per cent interest on a road loan redeemed in these 20 years. Thus, for every 100 rupees spent on roads, the return through increased earnings to the community would amount to Rs 277. This is independent of the inevitable rise in the revenues to Government and in the additional traffic with which roads would feed the railways.

A still greater asset would be the social advancement of the community through educational progress, provision of health services, personal enjoyment and the provision of the many other amenities of civilization, not capable of measurement in terms of money.

Colossal Waste

Another great wastage occasioned by our out-of-date and inadequate roads is represented by the higher costs of motor vehicle operation on existing roads. **The Bombay State Road Transport Corporation estimates that if roads in the State are modernised it would lower the operation costs of its buses by no less than Rs 2 crores annually.** This Corporation owns barely one per cent of the total number of motor vehicles in India, so that the total cost of bad roads to bus passengers and other motor vehicle users may well stagger our imagination.

* Abstracted from I. R. F. Bulletin No. 58

Minimum Road Needs

We have recently heard a great deal about the two Five Year Plans, the first one called the Post-War Reconstruction Plan and the second one known as the Five Year Plan of the Planning Commission. In neither of these have roads been given their rightful place as one of the most basic and fundamental needs of the country.

The minimum road needs of India in the matter of roads are embodied in the "Nagpur Plan" of December 1943, and involve the construction of 130,000 miles of new roads, besides the improvement of the existing 255,000 miles. The cost of this programme at the present level of prices will amount to Rs 750 crores.

It is clear that India's present revenues cannot provide Rs 750 crores for a road programme, even if it is spread over ten or fifteen years. It is true that motor transport itself is contributing to-day nearly Rs 40 crores annually, but a fairly big slice of this revenue, the Government say, is required for the country's general revenue and another big slice of between 12 and 15 crores is taken up by the maintenance of existing roads. Thus, if road development is restricted to current revenue resources, the Nagpur Road Plan has little chance of being completed in any foreseeable period of time.

The inability of securing an adequate road system from current revenues is not to be wondered at because, indeed, it is not the function of current revenues to pay for huge developing projects of this sort. **Nobody ever suggests that our irrigation projects or railway projects or power development projects should be restricted to the resources of current revenues**. In these cases it is always taken for granted that loan funds should be utilised for the purpose. How else could India have its comprehensive system of railway connections or the many dams and irrigation canals? Yet, when dealing with road plans, we have, unfortunately always restricted ourselves mostly to the limits set by the available current revenues.

Loans Justified

In building up a road system, no less than in constructing railway lines or irrigation projects, we are providing for the needs not only of the present taxpayers, but also of our posterity. It is, therefore, perfectly legitimate, and in fact essential, that the costs should be shared between the present and future taxpayers. The way to do this is to raise loans repayable over a period of 30 or 35 years, so that all those who use the roads during this period will contribute equally for the facilities provided, and by so doing make available the capital required.

If loan money is raised, substantial expenditure can be concentrated in a short period without putting an unbearable burden on the tax revenue of that period. Capital expenditure ensures that the country does not have to wait while works are constructed bit by bit from what is available each year from revenue.

Benefits

Conservative financial opinion has so far fought shy of loans for roads, presumably on the ground that the capital outlay would not yield direct and easily ascertainable returns, as railways would do. This argument, however, cannot stand a moment's scrutiny.

If roads encourage industrial and agricultural activity, as they assuredly would, does that not mean an increase in the purchasing power and taxable capacity of the people served by the roads?

Secondly, if improved roads reduce the heavy costs now incurred on road maintenance, is that not equivalent to a specific revenue receipt?

Thirdly, if new and better roads increase motor transport, thereby paying taxes on the additional amount of petrol consumed, is that not a specific source of income which can be set off against the capital costs?

Again, if better roads prolong the life of a vehicle are we not going to reduce import for assembling cars

in this country and thus save our dollar and sterling resources?

A cursory examination will show that the direct income to the exchequer from road development will thus be much greater than the return from capital spent on other investments, including railways and irrigation schemes.

To deal with the first of these points, regarding capital expenditure being justified for the construction of roads which would improve the economic productivity of the country, there was at least one financial authority in India, **Sir George Schuster** who firmly believed in this principle. Speaking of capital expenditure on roads, he told the Provincial Governments: "If by taking a long-sighted view it is possible, through a programme of road construction, to improve the revenue producing power of a province and the purchasing power of its people, then it might be desirable to launch a programme in times like the present............ If, after careful consideration, there seems to be a reasonable prospect that the development of roads will improve the purchasing power of the community.........the result would be that revenue would improve and the extra cost of meeting the service of the loans and maintaining the roads would flow back to the Provincial Governments. **I still believe myself that there must be examples in India where, in the present conditions, it would be justifiable to spend a certain amount of the capital that we can raise in the form of road development.**"

Here is an instance of a Finance Minister looking upon roads in their correct perspective—a perspective which India must adopt today if the root cause of our economic malaise is to be boldly and expeditiously tackled.

Capitalising Maintenance Cost

The second justification for a road loan with which the most orthodox financial opinion agrees, but which has, unfortunately, not been acted upon on any general scale, is that of investing money on improvement for the purpose of saving the large sums money wasted in annual maintenance. We have over 80,000 miles of roads of the waterbound macadam type, which involve large maintenance costs annually. If you spend Rs 10,000 or Rs 20,000 initially to modernise a road, and thereby save double that amount in maintenance costs during the next ten or fifteen years, it is a measure of economy which a poor country like India cannot afford to forego; indeed, it is the essence of prudent management of a country's finance that economies like this must be sought for and secured in the taxpayer's interests. But have any State in India had the foresight to capitalise future maintenance costs for securing such savings? The answer, for all practical purposes, must be in the negative.

Increase in Revenue

Coming to the third of the points cited above in justification of loans, namely the increased revenue that motor transport will yield if roads are developed, it is important to remember that every motor car on the road represents an annual revenue of between Rs 900 and Rs 1,500 to the public exchequer, while a truck pays over Rs. 500 annually and a passenger bus roughly Rs. 6,000. These taxes take the form of import duties on motor vehicles, excise duties on tyres, duties and sales taxes on petrol and vehicle, as also direct vehicle taxes. The total annual revenue today from the motor vehicle running on 1,81,000 miles of motorable roads is nearly Rs 40 crores. Under the Nagpur Plan the motorable mileage is to be increased to 290,000 miles — an increase of 61 per cent — so that the revenue from motor transport would increase at least by a similar percentage on account of the new roads, while the modernisation of the main arteries, which would attract additional traffic to them, could be depended upon to bring in a further addition of Rs 10 crores, thus giving us in all a sum of no less than Rs 75 crores annually. If no more than two-thirds of this revenue is set apart for servicing Road Bonds, we can have all the roads we need for our immediate requirements and we can pay for them in the next twenty years.

Saving on Foreign Exchange

We have to look forward to a large expansion in motor transport and still conserve our foreign exchange resources to the maximum extent possible. How can we do this? Firstly, we can prolong the life of the average vehicle so that the vehicle will be on the road for ten years instead of five or six; and secondly, we can ensure that vehicle requires fewer replacement parts. "One nationalised transport concern," told the Motor Vehicle Taxation Committee, "that, **with better roads, the vehicle strength could be reduced by one-third**." Again, a transport company operating on good roads spends $1\frac{1}{2}$ annas per mile of operation on repairs and replacements, while another company, operating on bad roads, has to spend 2 annas 5 pies. Surely the amount of foreign exchange that can be saved by providing better roads will run into crores of rupees.

American Example

While America is cited as an example to the world of how phenomenal prosperity can be achieved by expanding roads and road transport, we should not ignore that the road boom period in America—1904-1921—would not have added 700,000 miles of roads to the communications system of that country but for recourse to Road Bonds. Early Bond issues by resulting in the growth of motor traffic, soon brought ought the revenue potential of the highway user taxes, and the practice of issuing State Highway Bonds gathers momentum. While initially all bonds were financed by general revenues, motor taxation receipts gradually stepped in to relieve the general taxpayer and, because of capital expenditure having initially provided the much needed road system, the road user taxes increased to such an extent as to meet all expenses subsequently needed by the Road Authorities. By 1940 the United States had repaid the bulk of its highway debt, but even in that year the outstanding highway indebtedness was equivalent to nearly Rs 2,000 crores.

Better Roads Straightaway

Why should India fight shy of capital expenditure on roads? Prudent planning, economic and financial, requires that the Nagpur road Plan should be implemented within the next five or six years. Let us demand the issue of Road Bonds so that we may "have better roads straight away."

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TOO MUCH OF A GOOD THING

On January 1, 1852, the postage stamp made its appearance. Also, in the larger cities letter boxes were placed. Mail delivery was increased, in some cities to eight or ten times per day. These sudden improvements did not please everybody.

The "Economist" of 1858 wrote, "To receive mail so many times a day does not give us any rest and it prevents us from attending to our daily affairs."

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BRIDGING INDIA'S RIVERS 54

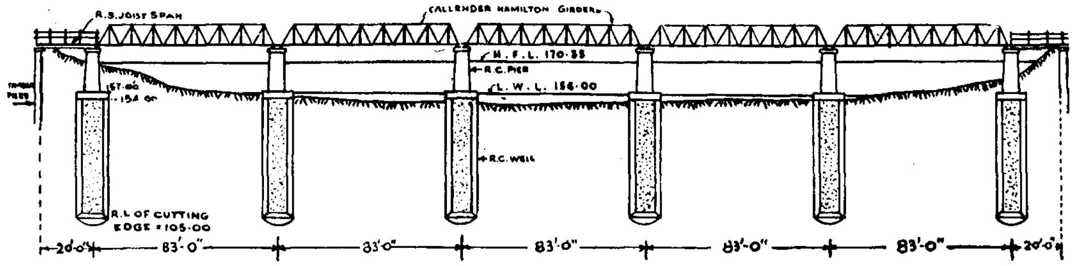
THE KALJANI, THE GADADHAR AND THE RAIDAK BRIDGES

As a result of the partition of India in 1947 communications between Assam and the rest of the Indian Union were severed. No means of communication—railway, road or navigable river—was available which did not, at one point or other, pass through Pakistan. To overcome this handicap and to connect Assam with the rest of India, the Government of India undertook the Assam Rail Link project and the construction of the Assam Access Road. Work on these projects started before the end of 1947.

same manner on the three rivers. It is, therefore, proposed to deal with all the three bridges in this article.

The rivers Kaljani, Gadadhar and Raidak are perennial streams and in dry weather carry about 6 ft of water flowing at a velocity of about 2 ft per second.

During floods the water level rises by about 14 ft and the velocity to about 6 ft per second, accompanied by appreciable scour. The Kaljani and the Gadadhar



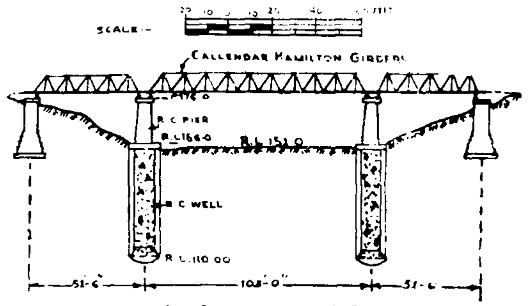
also carry brushwood. Piers consisting of timber piles, which it would not be possible to drive more than 25 ft into the river bed or brace properly, were not considered advisable. Screwcrete piles, too, were considered but equipment to drive these piles was not easily available. It was, therefore, decided to go ahead with the construction of permanent masonry substructures with Callendar-Hamilton trusses as superstructure, as a temporary arrangement pending the construction of permanent superstructures when traffic developed. The piers have been built for 2-lane bridges but the temporary Callendar-Hamilton superstructures provide only one-lane accommodation.

The Cooch Behar and Assam sections of the Assam Access Road project involved the construction or re-construction of several minor bridges and culverts, the strengthening some bridges, and the setting up efficient ferry arrangements on the Kaljani, the Gadadhar, and the Raidak rivers as a temporary expedient.

The alignment of the Cooch Behar section of the Highway was finalized in 1949 when investigation of sites for permanent bridges over these rivers was undertaken.

The three rivers rise from the same series of hills in Bhutan and flow through similar country. The catchment consisting of forest hills, tea gardens, and cultivated plains, is also similar in all the three cases. The foundation problems were identical and were solved in the

At the bridge sites the rivers are out of their boulder stages and their courses are very tortuous and unstable. The



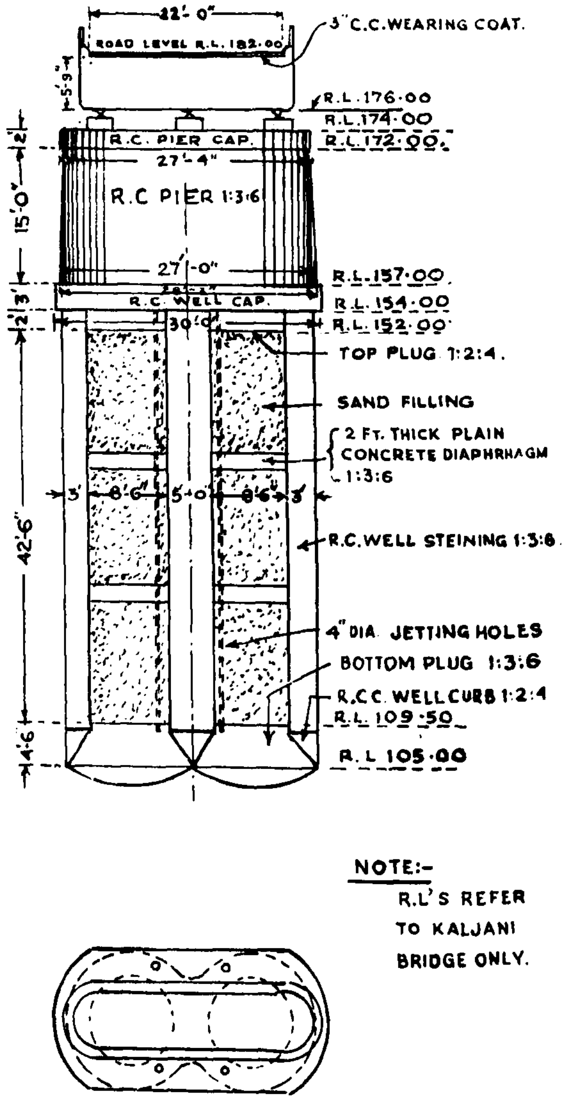
bridges were sited at as straight reaches as could be found in the circumstances and provision was made for training works.

The Gadadhar Bridge—Completed.

The substratum was found to be silt and sand, with some shingle at 30 ft or more below the bed level. The foundations consist of twin (figure-of-8) wells of lightly reinforced 1 : 3 : 6 cement concrete steining

Gadadhar Bridge East Abutment—showing scour against the toe wall of bank.

on heavily reinforced concrete well curbs, with mild steel cutting edges. The cutting edges consist of 9 in. $\times \frac{3}{4}$ in. mild steel plates welded to 3 in. $\times$ 3 in. $\times \frac{1}{2}$ in. mild steel angles. The well caps consist of 3 ft thick doubly reinforced concrete slabs.



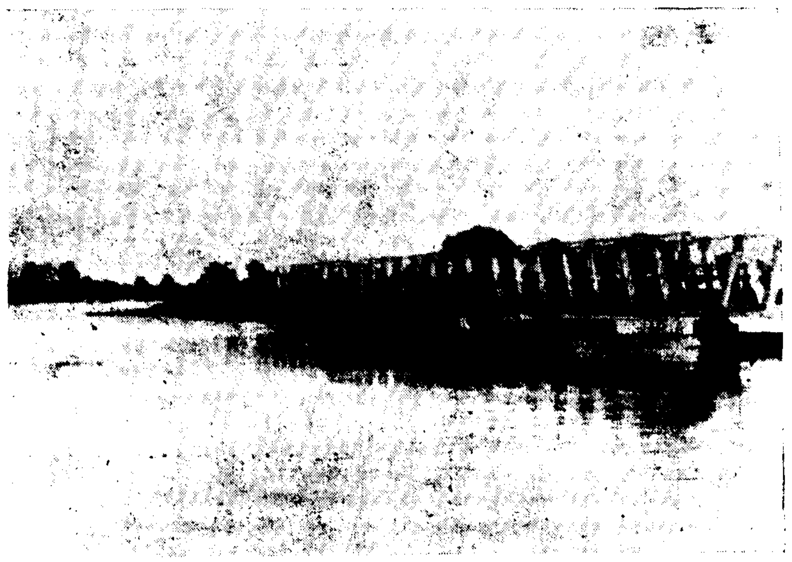
The piers are of lightly reinforced mass concrete (1 : 3 : 6) with semi-circular noses. The top dimensions of the piers, exclusive of the semi-circular ends, are 21 ft $\times$ 6 ft. The pier caps are reinforced concrete slabs, 2 ft thick on 83 ft spans and $2\frac{1}{2}$ ft thick on the 103 ft span.

The foundations and piers are designed for a reinforced concrete balanced-canti-

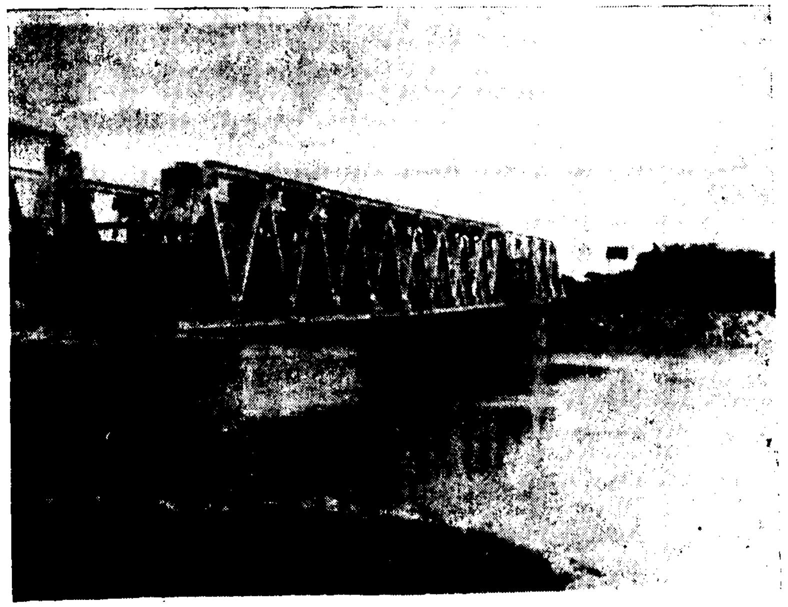
All photos by courtesy of Shri R. P. Chanda, Ex. Engr., Cooch Behar (W. B.)

lever and suspended-span type of bridge carrying 2-lanes of I.R.C. Class A or a single lane of I.R.C. Class AA loading.

The span lengths were dictated by considerations of the material immediately available for the superstructure. This happened, for the most part, to be 80 ft span Callendar-Hamilton trusses. The piers were, therefore, spaced 83 ft apart centre to centre. The Kaljani and the Raidak bridges were to have five spans of 83 ft each and two shore spans of 41 ft 6 inches. The Gadadhar bridge was designed for a central span of 103 ft and two side spans of 51 ft 6 inches.



Raidak Bridge—Showing a record flood (on 12-13 July 1952)



Gadadhar Bridge—under a high flood just falling down. Bank slopes, pitched with stone boulders, stood well under floods.

The main features of the bridges are tabulated below :

	Kaljani & Raidak Bridges	Gadadhar Bridge
1. Spans	5×83 ft 2×41½ ft	1×103 ft 2×51½ ft
2. Length between abutments 6	492 (as actually built 455 ft)	200 ft
3. Length of well shaft	52 ft	46 ft
4. Height of pier shaft	15 ft	17½ ft
5. Catchment area	114 sq. miles. Kaljani 433 sq. miles Raidak 1200 sq. miles.	
6. Maximum bearing pressure on foundation soil	6 tons per sq. ft	6 tons per sq. ft
7. Minimum clearance above H.F.L. at centre of span	8 ft	8 ft
8. Maximum velocity of currents to be allowed for in design	10 ft per second	10 ft per second

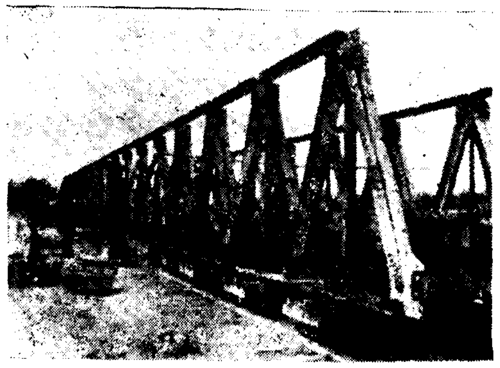
COSTS

The cost of the bridges per running foot, as constructed at present with Callendar-Hamilton superstructures was about Rs 2,000/- for the Gadadhar and the Raidak bridges and Rs 2,130/- for the Kaljani bridge. These unit costs do not include the cost of training works.

Well sinking on these bridges has been the most costly item. It cost Rs 1,100/- per running foot of the well shaft from the cutting edge to the top of the well cap, even where the well cap was actually above the ground.

No Snags

There have been no snags in the construction work. Except for some minor tilts and shifts in the Kaljani foundation wells, the work has proceeded smoothly. The design of the permanent superstructure on that bridge will be suitably modified to allow for the effects of these displacements of the foundations.



The Raidak Bridge—Callender-Hamilton truss assembled on the bank before launching.

A safety platform on the Kaljani Bridge.

Raidak Bridge during construction.

One serious development has taken place on the Kaljani bridge. This bridge was sited normal to the current but in the last two rainy seasons the river is said to have shifted its course and the bridge has now a skew of 40 degrees. Attempts are being made to train the river into its original course.

As sufficient Callendar-Hamilton truss material could not be obtained for the four 41½-ft shore spans on the Kaljani and the Raidak bridges, these spans were reduced to 20 feet. The abutment piers were made of timber piles instead of cement concrete and bridged with R.S joists.

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WORDS OF WISDOM

"SEEK NOT TO LEARN, BUT TO THINK ; SEEK NOT TO ACCEPT, BUT TO QUESTION AND SOLVE."

President—California University.

—o—

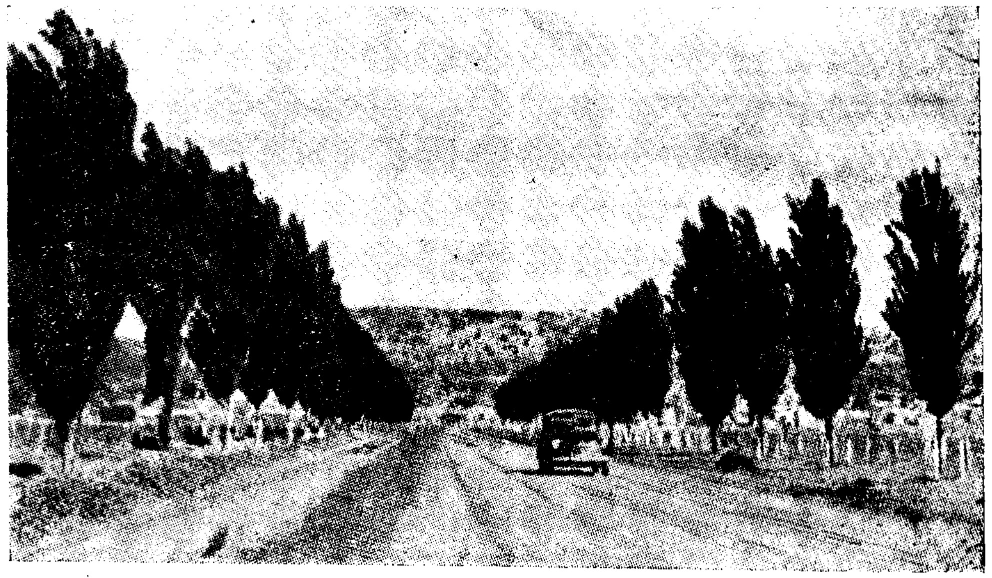
SCIENCE (?) WITHOUT DISCIPLINE

The great physicist Max Planck, discoverer of the quantum equation, gave up the study of economics in despair, because he could not understand the discipline of a science where assumptions and arguments could be changing so constantly.

—o—

ROADSIDE TREE PLANTING

[Tree planting along roads forms a part of almost every road construction estimate in this country. While most of our roads have good and shady avenues, the road engineer is not always successful in his efforts to beautify our highways by growing trees along them. An account of tree planting activities in Australia extending over 16 years from 1934 to 1950 has been published by the Department of Main Roads, New South Wales, in their publication " MAIN ROADS " (December 1950). Extracts from that article entitled " Successes and Failures in Roadside Tree Planting" are given here for the guidance of our engineers.]



Avenue of Lombardy Poplars approaching Coolah.

IN 1934 the Department of Main Roads, New South Wales, instituted a policy of planting trees on her highways. Planting took place mainly during the years prior to the war No planting was done during the war years. Since the war efforts have been concentrated mainly on the care of trees already planted and replacement of dead trees in past plantings. Successes and failures of the efforts have been analysed in the above-mentioned article to obtain information to guide future activities.

Climate

Climatic conditions in New South Wales are extremely diverse. Parts of the State could be classed as sub-tropical, with mild winters, summer rains, and high humidity. Elsewhere snow may fall in winter, and some areas are subject to bleak winter winds. In the western half

of the State the rainfall is scanty and irregular and summer temperatures are high. The northern half of the state receives most of its rain in summer and the southern half in winter.

With such a large variety of climatic conditions, tree types suitable for one district were often found to be quite unsuitable for another district.

Difficulties Anticipated

Difficulties associated with the successful growth of roadside trees in exposed positions, and often with little moisture, were fully anticipated, and it was decided, therefore, to utilise hardy varieties of trees, judged most likely to be successful. Lists of trees were drawn up considered appropriate to various climatic conditions, and advice was obtained on methods of planting and care of trees.

Failures have not been extensive. The principal failures were due to planting in over-exposed positions and to irregular rainfall and drought. Elsewhere such failures as have occurred have generally been isolated, being due to local causes such as insufficient depth of soil, climate too hot or too cold for a particular type of tree, rainfall irregular, insufficient ground moisture, insufficient shelter, frost action, lack of watering in the intitial stages, failure to maintain tree guards, waterlogging, and so on. Failures in some cases would have been avoided if trees more suitable to local conditions had been selected.

Unfavourable Conditions for Tree-planting on Roadsides

Roadsides where tree-planting is warranted are almost invariably less favourable to tree growth than sites in parks and gardens in towns where there is more shelter and moisture. Further, towns are frequently close to streams, and built on alluvial soil having permanent moisture at depth. On nearby higher ground, there may be only a relatively shallow soil cover over rock. For these reasons all trees which will grow successfully in a town are not necessarily suitable for planting along roads, even in the same neighbourhood.

Among the unfavourable circumstances that may affect roadside tree-growth are the following :—

1. **Lack of Moisture**—Roads are necessarily constructed in such a way as to drain away the water that falls as rain. Artificial watering of trees is out of the question on account of cost, except for the first few years while the young trees are being established. It has been very noticeable in a number of cases where avenues have been planted by the Department that excellent results have been obtained where the trees are on an alluvial flat, but where the road rises over higher ground the trees are inferior and losses more frequent.

   Excellent tree growth can often be secured on roads in irrigation areas, although the country otherwise would be unfavourable to trees.

   There are parts of the State where climatic conditions would appear to be ideal for deciduous trees—natives of cold climate countries overseas. However, unless rainfall conditions are favourable, success may not be achieved. This became particularly apparent during the war years when shortage of labour for watering, and the onset of a period of drought, resulted in substantial losses of young trees.

2. **Lack of Shelter from Wind**—This is a most important factor in some areas subject to cold winter winds of considerable force. The planting of trees in groups, surrounded by quicker growing " nurse " trees or shrubs to provide shelter, may permit tree growth in such circumstances.

3. **Absence of Top-soil**—On roadsides there is sometimes little or no top-soil. This has occurred mainly as a result of surface erosion due to travelling stock. Stock eat grass and young tree growth, and the feet of the animals disturb the soil surface. Wind and rain remove the surface soil. Both past destruction of mature trees on roadsides and

the operations involved in constructing and maintaining the road, may also have contributed to loss of surface soil.

4. **High Water-table**—Where the ground water level is close to the natural surface, most tree varieties will not grow. Drainage of areas of this type for purposes of tree planting is usually out of the question, and any planting must be confined to the few varieties of trees which thrive under these conditions, such as swamp oakes (Casuarina Glauca) and willows.

5. **Adverse Soil Conditions**—Apart from insufficiency or excess of moisture, soil conditions may be adverse to tree growth in other respects. For example, depth of soil from natural surface to rock may be insufficient to support tree growth. This situation may often arise in granite country. With soft rocks. if a sufficient shattering of the rock is effected before a young tree is planted, its roots will usually develop satisfactorily and ultimately find their way into the joint planes in the rock.

Then again, some trees appear to be naturally shallow rooted and grow well in shallow soils overlying a clay subsoil. Others are deep rooted, and grow naturally on deep alluvial soils, where, no doubt, their roots reach down to underlying moisture.

Nature of soil is also of significance. Some native trees grow best in sandy soil, others in clay. However, generally it is the presence or absence of moisture which has greater influence in determining success or failure rather than soil type.

Other Adverse Factors

Trees planted on roadsides are liable to damage from grass fires, stock, and vehicles.

Destructiveness by persons has not been extensive, and has been more than offset by the interest and care for trees generally displayed by nearby residents.

The presence of overhead wires is adverse to tree planting, and planting, under or near wires has generally been avoided, on account of the cost of pruning which would be involved later, but in a few cases low growing trees have been planted under wires.

Desirable Procedure in New Roadside Tree Planting

Experiences of past planting indicates that in any further planting undertaken, the following procedure should be carefully followed:—

1. Make a list of trees known to be climatically suitable for the district, and which have preferably already been proved suitable for roadside planting.
2. Examine the site closely, especially in respect of moisture conditions, depth and type of soil, and extent of exposure to winds.
3. Select from the list, the type of tree to be planted, taking full account of the conditions at the site in making the selection.
4. Provide tree-guards or fencing and prepare the ground thoroughly. Provide stakes.
5. Plant at the correct time. This is autumn* for most varieties, but spring for young trees subject to frost damage.
6. Include an item in the annual Maintenance Programme to cover Care and Maintenance of Trees.
7. Set up a proper organisation to ensure care and maintenance. This should cover cultivation around the young trees, including removal of weeds and grass, especially in dry weather, frequent watering in dry weather for the first few years, repair of tree-guards or fencing, and fire protection. In addition, the tree itself may require spraying or other attention to cope with insect infestation or fungus growth, and pruning to ensure strong straight growth, or to deal with damage by wind or frost.

* In India, the summer rains.........Ed.

8. Ideally, specially trained personnel should be available to undertake the planting and care of roadside trees. However, most maintenance organisations may not have enough tree work to call for a specialist. The best procedure is to select employees who display a special interest in trees, and to guide and assist them to become proficient in the work. Advice on tree care and pruning can often be obtained from either parks or forestry officials.

Avenue Planting Versus Group Planting

Careful attention to detail as described above can result in the satisfactory growth of roadside trees in most locations. However, tree-planting does not just consist of planting the hardiest tree and making it grow successfully, but rather it is an aspect of landscape architecture. Its success is judged not alone by healthy tree growth, but also by the general landscape effect created.

The Australian rural landscape is essentially unorganised, and experience shows that the planting of avenues of trees in country areas should generally be confined to the approaches to towns, or to large bridges or other man-made features. Elsewhere, avenues seem to lack significance, and long avenues tend to become monotonous. Where travel speeds are high, regularly spaced trees may become irritating to the eye. On the other hand, the monotony may induce drowsiness, as is always liable to occur on any road which lacks some degree of variety.

Not only will **group planting** be found more satisfying than avenue planting, but it is also cheaper to carry out and to maintain.

Where **avenue planting** has been undertaken, the effect has been spoiled in some cases by replacing dead trees by trees of another variety. While the mixing of tree types can be successful under special circumstances, the ordinary avenue requires to be uniform in type if it is to convey a true dignity and formality of appearance. There are many examples where street trees are of mixed type, with the result that the trees add little to the appearance of their surroundings.

Experience with avenue planting indicates also that the eucalyptus is generally unsuitable on account of its unsymmetrical habit of growth, and because its form is so much associated with the natural landscape.

The alternative to avenue planting is group planting. On roads one chain wide, when space has been set aside for overhead telephone and electricity wires, there is generally no space left for free-growing trees, unless low growing species are available and suitable. Even in the case of roads one and a half chains wide, there is only just sufficient space for avenue planting after allowance has been made for overhead wires. If group planting is desired, the only way to achieve it in such circumstances is to take advantage of any local widenings of the road reserve, e.g., as sometimes occurs at bends. Where roads are two chains wide or more, there is no difficulty in group planting.

Group planting provides an opportunity to introduce contrast and variety by the use of exotic or other trees not native to the district, and not similar to the background trees. Groups should not be planted in regular rows, but to a scheme which will take into account the growing habits of the trees. For example, smaller growing trees might be placed on the fringes of the group, creating ultimately a pyramidal effect, the smaller trees also in this way protecting the taller trees.

Group planting has the advantage that it is flexible, and the tree types can be selected to suit the exact conditions at each site. Further, group planting may be undertaken on as small a scale as desired, and yet give pleasing results. In fencing areas for group planting, the needs of travelling stock must not be overlooked.

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SPECIAL ARTICLE NO. 8.

STANDARDS FOR SIGHT DISTANCES FOR HIGHWAYS.

[Adapted from Paper No. I.R.C. 149.]

Introduction

The safe and efficient operation of fast moving motor vehicles depends, among other things, on the distance along the road at which obstructions become visible to the driver. When traffic was confined to slow moving animal-drawn vehicles visibility was not an important matter. With the increase in the number of motor vehicles and improvements in motor-vehicle design and consequent increase in their speed of travel, it is vitally necessary in the interests of safety that the road be open to the view of the driver for a **sufficient distance** to enable him to control his speed to avoid striking an obstruction. Also it is necessary that the road should be open to the view of the driver for a sufficient distance to enable him to overtake vehicles without hazard.

When an adequate length of the road is not open to the view of car drivers there is a tendency for them to reduce speed so that vehicles begin to "bunch" together with the result that the capacity of the road to deal with traffic is reduced. The Specifications and Standards Committee of the Indian Roads Congress have laid down standards for sight distances suitable for Indian conditions.*

Terminology

(a) **Sight distance**—The distance along the road surface at which a driver has visibility of objects, stationary or moving, at a specified height above a carriageway.

(b) **Stopping distance**—The distance travelled by a vehicle from the time a danger is comprehended by the driver to the actual stop i.e., the distance travelled during the time occupied (1) in seeing the obstruction, and applying the brakes and (2) during deceleration.

(c) **Overtaking of vehicles**—The act by which a vehicle travelling at speed overtakes another vehicle moving in the same direction.

(d) **Minimum sight distance**—The minimum distance along the road open to the view of the driver of a vehicle. It should be the distance within which a vehicle travelling at the design speed can be stopped.

(e) **Minimum overtaking sight distance**—The necessary minimum distance open to the view of the driver of a vehicle intending to overtake another travelling below the design speed so as not to obstruct traffic in the opposite direction.

The standards for **sight distances** should satisfy the following two main conditions—

(a) The driver of a vehicle, travelling at the design speed should have a long enough view ahead to enable him, on sighting an object on the road, so to control his vehicle as to avoid striking the object, and

(b) The driver should be enabled to overtake slower vehicles without causing an obstruction or hazard to other traffic.

The minimum sight distance necessary depends on the mechanical perfection of the vehicle, the frictional force that can be brought into play to bring the vehicle to a stop, and the driver characteristics such as "perception-time" and "brake-reaction-time." Factual data on the above aspects under Indian conditions are lacking. So, basing their recommendations on the available literature of other countries, the Specifications and Standards Committee have laid down standards which they consider will be suitable for Indian conditions.

*Journal of the Indian Roads Congress Vol, XV-I, Aug., 1950.

Stopping distance — The distance within which a motor vehicle can be stopped depends on

(a) the time in which a driver can comprehend a danger on the road and apply the brakes,

(b) the efficiency of the brakes of the motor vehicle,

(c) the grip of the tyre on the road surface called the frictional resistance.

Perception and brake-reaction time—The time that a driver takes to comprehend the danger depends on the strength of vision of the driver, the angle subtended by the object at the eye, colour contrasts, the shape of the object, alertness of the driver, and atmospheric visibility. At high speeds, perception time is generally less than at lower speeds owing to the fact that the average driver is generally more alert.

After comprehending the danger the driver applies his brakes. The time interval between the perception of danger and commencement of the action of applying brakes is called **brake-reaction-time.** Laboratory tests indicate that when the driver is all set and ready to act, it takes a little over 0.4 of a second to move his foot from the accelerator to the brake pedal after the appearance of a red light. In actual traffic conditions the reaction time is far in excess of this laboratory result, since the driver is not usually all set to react, and he does not know the type of action he has to make, as he may instead of applying the brake have to step on the accelerator or turn the steering wheel to avoid the obstruction. The age of the driver also influences the reaction. Improvement in vehicle design and efficiency of modern braking systems tend to decrease the brake reaction time.

In America the perception time has been found to vary from 2 seconds for a speed of 30 MPH to one second for 70 MPH. Experiments conducted under laboratory conditions show that the average brake reaction time is 0.64 of a second. Further experiments have also shown that the brake reaction time may vary from 5 to 7 times that obtained under laboratory conditions. American Road Engineers assume that the perception and brake reaction time varies from 3 seconds at speeds upto 30 MPH to 2 seconds at 70 MPH. Bearing in mind diverse factors that influence the perception and brake-reaction time and that no accurate value could be assigned to apply to the divergent road, vehicle, and driver conditions the Specifications and Standards Committee have adopted a perception and brake-reaction time of 3 seconds for 30 MPH. The alertness of the driver increases with speed and the perception and brake reaction times recommended for various speeds are given in the Table below.

Table I.

Perception and Brake-reaction time

Speed in MPH	Upto 30	40	50
Perception and Brake-reaction time.	3.0	2.75	2.5

Brake efficiency and Braking distance. Modern vehicle design incorporates very efficient brakes which if maintained in efficient condition and thrust hard can prevent the wheels from turning. Such locking is apt to carry the vehicle forward, the tyres rubbing along the road surface. A braking force exceeding the total frictional resistance between the tyre and the road surface produces a skid. Therefore, the safe effective braking factor is the efficiency of the brakes or the frictional resistance between the tyre and the road surface whichever is less.

Frictional Resistance between the tyre and the road. The coefficient of friction between the tyre and the road depends on

(a) The type and condition of the road surface.

(Continued on page 22)

CONCRETE DURABILITY

[Extracted from ' Journal of the American Concrete Institute, Part 2 ' December, 1948.]

DISCUSSING a Paper entitled " Concrete Durability: Twenty-five Years of Progress " by R. B. Young, Mr. M. Hirschithal writes :—

" It is discouraging to find that since our more scientific approach to the art of concrete making, which dates back just about 25 years to the time of Abrams' cement-water ratio pronouncement, and greater study and knowledge of the constitution of portland cement and its reactions, we have been confronted with greater difficulties than before in our attempts to produce durable concrete. It is to be hoped that the fortuitous discovery of the effect of very slight additions of certain grinding aids in cement manufacture on concrete making, resulting in air-entraining cement (and concrete) with its increase in durability of the concrete will not have a similar aftermath in the next 25 years.

In the writer's opinion the two fundamental causes of concrete failures are concerned with the materials and with the process of manufacture respectively, and they are both the result of the attitude or viewpoint taken by the engineering profession at large (with but few exceptions) toward the subject of concrete manufacture, viz., that while it is considered necessary to employ a steel or iron worker in steel construction, a carpenter in timber a bricklayer or mason in brick construction, any kind of labour at all is considered suitable for concrete construction.

Selection of Materials

The same type of mental attitude applies to the selection of materials entering into concrete making. Too wide a latitude is permitted in the specification of materials —cement, sand, and aggregate, because of this attitude, all stemming from the fixed idea that concrete must be a " cheap " material of construction, resulting in a frequent selection of a source of material close at hand that may not meet the requirement of a first-class finished product.

In timber construction, for instance, if a certain grade of lumber is required, it is not unusual to specify that it be obtained from a source as much as 3,000 miles away, to cite the use of Oregon pine for use on the Atlantic seaboard. In the case of steel construction, products of a Pittsburgh or Birmingham mill will be shipped to the Pacific coast for use there.

On the other hand, when a concrete project is planned, the question of material " locally available " immediately enters into the selection. In the case of concrete, " commercial availability " will most often govern the specifications which are written so as not to result in undue hardship to the producer or constructor. Even in the manufacture of cement, the " available " clinker must be used or else the cost of cement is saddled with the additional cost of transportation and resort is had to " sweetening " the available clinker.

The writer appreciates the fact, that, with stringent specifications governing all the ingredients entering into concrete making and with the employment of labour trained to be skilled in the " manufacture " of concrete, the cost of the resulting product would be considerably increased and the strength of its competi-

tion with other materials of construction possibly reduced for the time being, but if it should result in a more durable and more uniform, reliable product, it certainly would pay in the long run by its saving in the cost of maintenance, which has now become so great.

A fact that militates against concrete as a material of construction is the lack of consistent uniformity in successive batches obtained from the mixer in the same structure, resulting in a spot vulnerable to attack by weathering, where a subnormal batch has been poured. Wide variations in tests of field specimens give evidence of this lack. This may be due to the tolerances we allow in grading, percentages of deleterious substances permitted, manner of mixing, placing, and curing.

Dangerous Cure-alls

One of the evils that may also share in the responsibility for poor concrete is the tendency to view any new discovery in concrete-making as a cure-all to the exclusion of other principles and precautions in the production of good concrete. When the cement-water ratio theory was promulgated and put into practice, most contractors and others concluded that once you fix this ratio nothing else matters —grading, character of material, etc. The danger is now present in the discovery of the efficacy of air-entraining agents in cement or concrete ; the writer was very much perturbed to read of tests in the use of air-entraining cement that indicated that unacceptable fine aggregate used with this cement met durability tests to the same extent as sound fine aggregate, although that same (unacceptable) sand failed when used with normal cement. This example carried further would soon put air-entrainment in the cure-all category with dire results.

The writer does not feel at all certain that air-entraining agents benefit the concrete because they entrain air so much as because these admixtures in the minute amounts used possess certain other properties and air-entrainment is only incidental. At any rate it is to be hoped that in going " overboard " on air-entraining agents, the other important principles of concrete making are not thrown overboard.

Most Common neglect

One of the principles most often neglected is that of the necessity of proper curing. Very frequently, particularly at the last operation of a " job " or structure, no curing is given the concrete, even of the perfunctory type of spraying the surface once or twice a day even in temperatures of 100 F. and over. This, coupled with loose or deficient inspection, is the most common neglect in concrete work.

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MORE WORDS OF WISDOM

Roads to open up the hidden tracts of India must come first. The one thing to which we must give topmost priority is roads—roads of all kinds...............

Pandit Nehru

—o—

HERE AND THERE

1. GOOD VEHICLES ON BAD ROADS

THE main difficulty which the State Transport organization was facing said Shri Vadilal* was the condition of roads in the State of Bombay. Bombay's roads were not only not good as they ought to be, they were not even as good as they were in several other States.

"I need not elaborate the obvious fact," he said "that these bad roads take a heavy toll of the comfortable and therefore costly buses that are placed at the service of the public. Nobody who has made even a superficial study of Bombay's roads would try to minimise the extent to which the cost and efficiency of the transport service are affected by them notwithstanding strenuous efforts on the part of the undertaking to give the best possible service."

[*State Transport Review*, *Bombay, Oct, 1951*]

[*This is what we have always been stressing—that the road and the vehicle are parts of the same system, that it is not possible to get good service from the best vehicles without a good road, and that* **roads come first**........*Ed.*]

2. NEW FINANCING TECHNIQUE AIDS PUBLIC PROJECTS

A new financing technique has been used by Tennessee cities that have reached their bonded debt limits. The method has been employed with good results to finance construction of schools, fire houses, city halls, and similar projects.

The technique, called the "lease-purchase" method, works this way:

A town or county government draws up specifications for the public works facility it wants to build. The specifications are turned over to a private company with suitable financial backing. The company constructs the building, then, leases it back to the local unit of government for an annual or monthly rental fee.

The rental is determined by the cost of servicing the debt incurred in construction of the building. At the end of the stipulated lease period—when the construction cost has been liquidated—title to the building is turned over the government unit without further payments.

"**Carefree lease**"—A variation of this technique is the "carefree lease," whereby the company is freed from the maintenance, repairs, taxes and insurance costs of the new facility so that the amount received in rents is net to the company.

The Tennessee State Planning Commission cites as an example Whiteville, North Carolina, which wanted to build a city hall.

A non-profit corporation was created to construct the building and the city leased it from the corporation. A local savings and loan association put up the money. The city pays 371 dollars a month rent, and subleases space to other agencies for 470 dollars a month. In 10 years, the city will own the building.

[*Extracted from 'Engineering News Record' Feb. 21, 1952*]

* Shri Vadilal Lallubhai, Chairman of the Bombay State Road Transport Corporation in a speech on 18-9-51.

3. FRENCH ROAD PROJECTS

IT is proposed that work on the express motor road tunnel through Mont Blanc shall begin in the Spring of 1952. The 13 kilometre (8 miles) long tunnel, which is to cost some £ 7,143,000, will be 8 metres wide and some $4\frac{1}{2}$ metres high, with four traffic lanes. The tunnel, which will take some three years to complete, will be three times longer than the Mersey Tunnel, England, at present one of the longest existing highway tunnels. The transit time for motor vehicles will average fifteen minutes. The toll proposed for motor vehicles is some 10/6d. The creation of a special road fund, by the Government, may be expected to facilitate the financing of the project.

(*From "I. R. F. World Highway Report"—March 1952*).

4. THE BEST METHOD OF CURING CONCRETE PAVEMENTS

AFTER 2 years' experience in the use of wet earth for curing concrete pavements, the Kansas State Highway Commission is convinced that no other type now available serves the purpose as well, according to R. L. Peyton. Damp burlap is used for the first 24 hours, and then the earth goes on. It is kept moist for 10 days and removed after 20 days.

(*From 'Better Roads'—February, 1952.*)

5. ENGINEERING TRAINING

AT a meeting of the Junior Institution of Engineers which was held in London on Friday evening last, Air Commodore F. R. Banks, C.B., M.I.Mech. E., F.R.Ae.S., was installed as president for the year 1951-52. His presidential address, which was delivered after the installation ceremony, was entitled "Enterprise in Engineering," and in the course of it Air Commodore Banks made several observations on the subject of engineering education and training.

To-day, he said, an engineering degree from one of the universities was considered essential, but he considered that a university degree was only the start. It was, in fact, very similar to the granting of "wings" to a pilot; a degree qualified the man to obtain experience in his profession.

Air Commodore Banks then spoke of the case of the man with inherent engineering ability who was unable to pass examinations, saying he did not think that kind of man was sufficiently considered or catered for to-day, especially in view of the fact that there was always a shortage of good men. In his young days, Air Commodore Banks recalled, and particularly in the earlier days of those somewhat older, it was more important to have served a practical engineering apprenticeship of at least five years than to have academic qualifications.

The greater technical knowledge of today, however, compared with that of forty years ago, was such that a much higher standard of education was necessary in order to meet modern requirements. Air Commodore Banks therefore suggested that it should be the responsibility of industry, the universities, and the technical colleges to get together and try and hammer out an engineering curriculum which had as its basis a good mixture of practical engineering and technical or theoretical instruction. Thus, the man who was unable to pass the academic requirements for a B.Sc. degree could take a simpler and more practical test and obtain a certificate qualifying him to enter a firm to start an engineering career. With equal opportunity, if he grasped it, and continued theoretical training, there was no reason why such a man should not do as well as his more academic brother.

(*Extracted from 'The Engineer' - Dec. 21, 1951*)

6. HUMAN TOLERANCE TO DECELERATION*

A brief summary of the experimental results of 166 aircraft runs is given. The results have been confined to relatively few well chosen experiments because of the inherent danger to subjects, the excessive wear and tear to the machinery, the great difficulties in obtaining good instrumentation recordings, and the relatively high operating cost per run. Economy of effort has been achieved by combining the stepwise exploration of the range of human tolerance simultaneously with the development of adequate restraints and safeguards. Additional information is given in motion pictures which were shown at an exhibit at the meeting where this paper was presented.

Some idea of the tremendous kinetic energy attained by a human body at aircraft velocities may be obtained from seeing the high-speed movies of a 185-lb dummy. It breaks two 1000-lb straps, catapults from the sled seat at 150 m.p.h., plunges through a windshield of one-inch thick pine plank, and hurtles in a straight line for 710 ft farther before coming to rest.

(Highway Research Abstracts, June, 1951)

7. WHAT MAKES GOOD ENGINEERS?

A contributor to the **North Carolina Engineer**, for January 1952, lists out the ten most important traits of character which go to make a good engineer:—

1. Faith in truth and enthusiasm for it;
2. Habit of detecting the main issue ;
3. Habit of following through and completing a job;
4. Ability to recommend, to argue a point ably, and to know when to stop;
5. A professional consciousness;
6. Habit of putting the best possible interpretation on behaviour of one's associates ;
7. Consistency in policy;
8. Ability to write good letters ;
9. Cost consciousness ;
10. Management consciousness.

8. DEFINITIONS

A **Psychologist** is a person who tells you what you know already in language you can't understand.

A **Statistician** is a person who draws a mathematically precise line from an unwarranted assumption to a foregone conclusion.

A **Consulting Engineer** is a person who tells you how to do a job that you knew how to do before he was born, and he gets paid better than you for his inanities.

A **Highway Economist** is a person who writes this sort of thing—

"To obtain optimum intercommunity mobility (it is also true of intra-community mobility)-the factors of vertical alignment and surfacing being the same—in the inter-connections of two points, whether peripheral or central with respect to either community (or to a single community), location without curvature is to be sought, thus obviating circuitous travel except to an unavoidable degree, and so achieving the maximum facility of intercommunication, measured in terms of the economies of time and operating costs, and convenience and safety of travel."

This is the way the highway economist says "A straight line is the shortest distance between two points"—or more shortly "Make your highways as straight as possible."

An **Economist**, pure and simple, is a person who writes something like this—

"Reflation is an alternative to inflation. When the Central Banks are in the strategic position of manipulating credit, it is quite possible—see the action of the Danzig Knonbank in 1934—by employing sundry well-known technique such as the inversion of the rediscount rate and the hazardous but conclusive open-market operations, to bring about an upward movement in values which reacts unfavourably on speculative activities, tends to thaw frozen assets in the commodity exchanges, implements stock movements, attracts gold from abroad, revivifies the climate of opinion, and so arrests the vicious spiral."

[The Editor assures the reader that the last recorded quotation was NOT taken from any well-known weekly dealing in the subject of economics but from a book called "The Tyranny of Words" by a Mr. Chase who said that there was not "an atom of meaning in the entire statement—not one scintilla of sense." He knew because he had concocted the passage himself—Ed.]

*J. P. Stapp. WPAFB ; Journal of Aviation Medicine, February 1951 (22-1 Bi-Monthly); pp. 42-45, 85. Technical Data Digest, Vol. 16, No. 5, May 1951. Highway Research Abstracts, June 1951,

9. GEOPHYSICAL METHODS OF SUBSURFACE EXPLORATION IN HIGHWAY CONSTRUCTION

(R. Woodward Moore, Highway Engineer, Public Roads, Washington, 1950 August)

Geophysical methods of subsurface exploration have been employed in various fields of engineering for more than 20 years. Since 1933 the Bureau of Public Roads has been studying the application of these methods to highway work, and has found that earth resistivity and refraction seismic tests are well adapted to road construction problems. The Bureau has designed and built portable equipment for both types of test, which were described in Public Roads in 1935.

Subsequent work carried on during the past 15 years in 21 States, has established both methods as useful, rapid, and economical means of obtaining preliminary information on the depth and nature of subsurface formations. In this article are presented a review of the theory and method of operation of the two types of equipment, and the results of a number of actual field surveys made with them.

It will be evident from these data that, while both geophysical exploration methods are useful, the earth resistivity test is more universally applicable to a variety of highway construction problems than the refraction seismic test. Detailed subsurface surveys can best be made by initial use of the resistivity equipment, followed by check tests with the seismic test where needed. Detailed subsurface surveys can best be made by initial use of the resistivity equipment, followed by check tests with the seismic apparatus where needed. Since the fundamental principles of the two methods differ widely, concordant data from both may be accepted with considerable assurance. (ORIG)

[From the 'Transport Documentation' of the Netherlands Transport Institute.]

10. AIR-GRAVEL CONCRETE.

A light-weight concrete, suitable for the construction of monolithic walls and other elements of small structures, has recently been developed by the National Bureau of Standards, U.S.A.

The concrete is prepared in conventional mixing equipment in the normal way, except that an industrial aerating agent or a detergent is added to the mix to cause it to foam by entraining finely divided air cells in the cement paste. The entrained air acts as a lubricant and produces workable mixtures having relatively low water-cement ratios. Two types of air-foam stabilizers were used: neutralized resin, and sodium lauryl sulphate-type detergent (agent X).

Air contents as high as 45 per cent were found possible in concretes containing no sand, while about 30 per cent could be attained with mixtures containing both sand and gravel. The air content is, however, limited critically by the minimum compressive strength requirement of 500 lb. per sq. in. One per cent increase in air content is generally accompanied by a decrease of about 100 lb per sq. in. in compressive strength. The lowest cement content permitting the attainment of the required strength in an "air-gravel" concrete was about 3½ bags of cement per cu. yd. of concrete. The air-gravel concretes offer appreciable advantages in reduced density and thermal conductivity but these are gained only at the cost of strength. The use of light-weight aggregate blended with dense aggregates in relatively high air-cement concretes has, therefore, been suggested as a means of obtaining worthwhile reduction in density and thermal conductivity while maintaining low order drying shrinkages. [*J. Franklin Inst.*, 252 (1951), 429.]

SIGHT DISTANCES

(Continued from page 15)

(b) The presence of moisture, mud, or similar soft skins covering the pavement.

(c) The condition of the tread and air pressure of the tyres.

In American Practice the friction factors are assumed to vary from 0.62 at 30 MPH to 0.5 at 70 MPH and with a factor of safety of 1.25 to allow for the many variations in vehicle design, surface condition and drivers, the safe working coefficient of friction is assumed as 0.5 at 30 MPH to 0.4 at 70 MPH. In Australia a coefficient of friction of 0.4 is assumed for a speed of 30 MPH for urban conditions. The test prescribed in the Indian Motor Vehicle Rules for testing brakes assumes that the coefficient of friction lies between 0.3 and 0.4. Considering all the above factors a friction coefficient of 0.4 has been assumed in the calculations.

(To be continued.)

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PROTECTIVE DRIVING

Stay in your own lane on hills and curves and observe the markings on the highway. That's **protective driving,** *and it means you'll help avoid a collision with oncoming cars by watching for the danger spots and observing the highway markings that are placed there for your protection.*

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THE RISE AND FALL OF ROADS, RAILWAYS AND CANALS IN GREAT BRITAIN

(Extracted from 'Highways and Bridges,' - March 29, 1950.)

WITH the passage of the Transport Act, which came into force on January 1, 1948, a new era relating to all forms of transport came into being. On that date the railways and the canals owned by the railway companies, as well as those canals placed under Government control during the war years 1939-45, passed into public ownership—some 2,000 miles of canal being affected.

Road transport, also, is now being steadily engulfed. One by one, its operating companies are being swallowed by the British Transport Commission appointed under the Act, the object of which is alleged to be that through public ownership and by the concentration of all forms of transport in the hands of the Government, the national economy will benefit.

Nationalization Leads to Loss

At the present time, the majority of private and municipally owned road enterprises are making reasonable profits, but the railways, since nationalisation, have lost annually large sums of money, which at present have to be made good by the taxpayers. It is possible, or even probable, as the acquisition of the private and municipal road enterprises proceeds, that their profits may be used by the Government to restore the solvency of the railways, until in turn—as in all other nationalised industries to date—they, too, are turned into a loss by increased costs and administrative expenses, so necessitating increased charges, if any profit at all is to be made.

It is interesting to note how history has a way of repeating itself. Before the advent of railways, England possessed a magnificent system of waterways formed by its rivers and canals. Between the years 1760 and 1840—a period of 80 years—some 3,000 miles of canals of varying widths were constructed and operated. The year 1838, however, in which the London-Birmingham railway was opened, saw the beginning of the decline of the canal system, much of the traffic of which was gradually captured by the railways by methods described later.

In turn, with the advent of the petrol- and oil-driven engines, road transport has become, since 1920, a serious menace to the prosperity of the railways by capturing from them in steadily increasing amounts a great deal of their goods and passenger traffic.

Opposition to Inventions

As in the canal phase, and in fact with all new inventions, there was considerable opposition to the construction of railways, naturally by the canal companies, and later by owners of the once famous mail coaches operating on the main roads of England, whose business was completely ruined. Earlier, the anti-canal interests had urged that canals would ruin others engaged in land transport, such as the carriers by pack-horse and wagon, reduce the number of draught animals, put large areas of land out of cultivation, and ruin the coasting trade.

Actually the canal did none of these things because of the great increase in trade and industry fostered by them, and the coasting trade greatly increased. The decline of the canals was partly due to the avarice of some of the canal owners, who, having themselves become infested with the railway mania which engulfed the whole country about the year 1845, thought that by selling their property to the railway companies they would receive a greater return on their capital if it were invested in railways. The latter, on their part, were only too eager to buy up the canals in order to reduce or extinguish a rival competitor.

As would be expected of human nature, the railway companies, in spite of their statutory obligations to maintain these canals in a navigable condition, quite often deliberately sabotaged them.

The railways did, however, introduce elsewhere the element of competition with those canals remaining in the hands of their original owners, who had been guilty, as in all monopolies, of charging exorbitant rates, until the arrival of the railways enforced a reduction. Unfortunately the Government of that day—doubtless shareholders of the railways—were wilfully blind to the essential part played by canals in any system of national communications and so failed to afford them the protection they needed in which to flourish.

The popular notion at the present time with regard to canals is that transport by inland water navigation is obsolete, arising probably from public observation of the many which are in a neglected condition, overgrown with weeds, partially silted-up or completely derelict.*** ***

Canal Utility

There are fortunately, however, still many canals in as good a condition today as when they were built 150 or more years ago, notably those in the Birmingham area, which is the centre of the canal system. Many are monuments of engineering skill—created by such masters as Brindley, Telford, Rennie, Jessop, and Whitworth—with their immense cuttings and embankments, many tunnels and magnificent aqueducts.

Canal transport is particularly suited to the carriage of bulk merchandise, for example coal, which can be stockpiled at canal depôts and delivered thence by lorry in large or small quantities as required by factories or householders.*** ***

Alluding again to railways, probably the strongest argument for their nationalisation is that the public interest, and not profits, should be paramount, though there seems little likelihood of the latter, but rather immense losses, on their present showing, the prospect to date being a deficit of some 50 million pounds on three years' working. A case for higher freight charges on both railways and canals has already been submitted to the Transport Tribunal which, if approved, will be to the further detriment of trade and commerce and necessitate increased costs of both goods and services to the public.

Shackling Road Transport

In course of time the inventiveness of mankind has been the means of turning the tables on the railways. Whereas the stage coaches on the roads, and many of the canals, were put completely out of business by the advent of the railways, road transport in its turn has now captured much of the goods and passenger traffic of the railways.

More fortunate than the coach and canal owners, the railway companies were able to deploy and use their considerable Parliamentary influence, in attempts to secure the shackling of road transport and, unfortunately for the public, were to a large extent successful.

The country has an obvious need of all its available means of transport. The tendency towards the exclusion or unreasonable restriction of some in order to bolster up others is entirely wrong and detrimental to the trading interests of the country, where cheap and efficient transport is the life blood of the arteries of trade and commerce.*** ***

Deliberate Obstruction

The Government of the day claims to act solely in the public interest by the nationalisation of all means of transport. Is it doing so by seizing all the large, highly efficient and profitable road transport concerns handling goods and passenger services, by repressing and over-regulating others, and by its procrastination, parsimony and discouragement in the construction of new motorways and the maintenance and improvement of existing highways?*** ***

Whilst co-ordination of all forms of transport is ideal in theory, the elimination of all competition by nationalisation of road, rail and canal services will remove any brake whatsoever on the tendency already exhibited towards an increase in the charges for the transport of goods on both railways and canals. It is a practical certainty, too, that the wide difference between motor coach and railway passenger fares on nationalised road transport will ultimately be removed, for the twofold purpose of making good the losses on the railways and to neutralise the attraction of the lower fares of road travel. The ultimate step will doubtless be the reduction, or even elimination, of those road services which compete successfully with the railways.*** ***

Such a course may appear to be sound economics, but it has been proved over and over again—as in the case of canals versus railways, 100 years ago—that **whenever and wherever competition is eliminated and replaced by a monopoly, services become indifferent and dictatorial and costs inevitably rise.*****

It may, perhaps, be argued with some reason that the road system of England (apart from private streets) was constructed by labour or funds contributed by the public in the form of taxes, for the benefit of mankind, in absolute contrast to the canals and railways which were constructed primarily as profit-making speculations.*** ***

The railways own their tracks and appurtenant buildings, as well as the engines and rolling stock using them. This fact might be considered as a parallel reason for nationalisation of road transport, in order that the roads and the transport using them should together also belong to the nation. The two cases, however, are not strictly parallel, as whilst roads have been developed over a period of some 2,000 years for the public convenience, railways were superimposed over the road system during the past 100 years, and for private profit.

Elimination of Competition

Once the Road Haulage Executive, on behalf of the Government, has become possessed of all the major road transport concerns, there will be no check whatever in the form of competition, at present provided by their independence, hampered though they are by undue restriction and control.

There are plenty of warnings in past history as to what happens when one form of transport gets a stranglehold on another. Ample evidence is available to prove that the railways deliberately strangled the canals, regardless of the public interest, because they were dangerous competitors. Will the nationalised railways—through the Government—treat differently such a dangerous rival as road transport? Will the Government build new motorways and carry out badly needed improvements to the existing highway system for the development of a dangerous rival, or will it shackle and restrain it to an even greater extent than has been done during the past three decades?

An example in this respect is the absurd schedule of speeds forced on road coach operators. A permissible maximum speed of 30 m. p. h. over a distance of, say, 400 miles (London to Edinburgh) is simply ridiculous for the modern highly efficient machine, fitted with power-operated brakes. In America, road coaches travel at speeds of 60 m. p. h. on suitable roads without danger to the public. If it is argued that there are no roads in England suitable for such speeds, then it is time they were provided by the construction of motorways.*** ***

Road Transport is Efficient

It says much for the operators of motor transport that, in spite of their handicaps, they have furnished to the public a means of travel which is attractive, cheap and efficient. The public response to the facilities offered is sufficient answer to the question as to whether there was need of them.*** ***

Except for factories possessing their own railway sidings or canal wharves, road transport has one inestimable advantage, amongst others, over both railways and canals; viz., door to door collection and delivery of goods. In the majority of cases, however, the assistance of road transport has to be utilised to initiate and complete the carriage of goods and passengers.

The transhipment of goods from one form of transport to another involves both delay and expense. The railways have, however, for some years been sufficiently progressive to see and partially ameliorate this disadvantage of transhipment by introducing a method of small bulk deliveries by means of sealed containers which are lifted bodily from the railway trucks, placed upon road vehicles and so delivered at their ultimate destination, such as factories or shops. Even with these aids, the 100 per cent complete convenience of door to door collection and delivery made possible by road transport can be equalled neither by railways nor canals.

Air Transport

Nothing has been written above about air transport because it is doubtful whether air transport will ever become a serious competitor to railways, canals or roads as regards the carriage of goods in the British Isles.

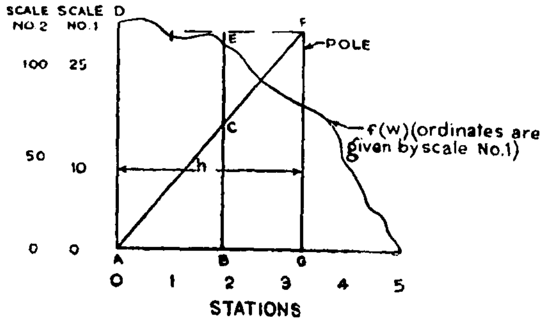
For passengers requiring speed it has some attractions, but even in such cases the use of road or rail services is necessary for the completion of the journey from the airport.

GRAPHICAL INTEGRATION

(Continued from page 29)

are used. If the loading curve is subject to rapid changes, shorter increments should be used to attain the same degree of accuracy that would be obtained on smoother curves.

Proof of the Method:



Area of curve from D to E = FG x AB

From similar triangles,

$$\frac{FG}{BC} = \frac{AG}{AB}. \quad \therefore FG = \frac{AG \times BC}{AB}$$

Area of curve $f(w)$ from A to B

$$\frac{AB \times AG \times BC}{AB} = AG \times BC$$

But, AG $\frac{\text{Scale }^2}{\text{Scale }^1}$

Therefore, ordinate C represents the area under the curve from D to E, etc.

ROAD CURVES IN PRACTICE

PRACTICE IN BUILT-UP AREAS

[Extracted from "Roads and Road Construction" June, 1952.]

ON the Bevendean estate, on which only very moderate vehicle speeds will be attained, the simplest form of curvature was adopted, both horizontally and vertically, with one exception in which a wholly transitional lemniscate curve, having a minimum radius of 90 feet, was adopted in order to effect a change of direction of some 160 degrees. The maximum superelvation on this curve was 12 inches on a width of 20 feet, and was applied by pivoting the carriageway cross-section about its centre, the inner edge falling a maximum of 6 inches below the level on the centre line, and the outer edge rising 6 inches above it, the superelevation diminishing uniformly to that of the normal cross-section at both extremities.

All other horizontal curves are simple arcs, whose radius varies from 120 feet to 700 feet on the centre line. Their superelevation varies from 6 inches to 16 inches in 20 feet, the same method of pivoting about the centre line being adopted, and the longitudinal gradient of the centre line remaining unaltered. As there are no transition curves, the superelevation is carried backwards or forwards on the tangent beyond the beginning and end of the curve for a distance of some 100—150 ft, the rate of gain of superelevation longitudinally being 4 inches in 50 feet. The maximum crossfall given on any simple curve is 16 inches in 20 feet.

Vertical curves are inserted at all changes of gradient, and are designed to fit the existing ground surface as closely as practicable in order to avoid the necessity of excessive provision of flights of steps or ramps to the houses adjoining. The form of curve adopted approximates that of the simple parabola, a railway curve being applied to a distorted longitudinal section and the elevations scaled off. Although theoretically the resultant curve is, strictly speaking, an ellipse, for the low vehicles speeds prevalent on this housing estate it will suffice. The appearance of the vertical curves on the site, however, leaves nothing to be desired.

—o—

LONELY

"Is Jim a confirmed bachelor?"

"He is now. He sent his picture to a Lonely Hearts Club and they sent it back with a note saying: 'We're not that lonely.'"

—o—

TECHNICAL INFORMATION.

1. BRIDGES IN SPILL ZONES OF BIG STREAMS OR RIVERS

[*A note issued by the Consulting Engineer to the Government of India (Roads), Ministry of Transport.*]

SOMETIMES cases of construction of bridges in spill zones of big streams or rivers arise. As far as possible, these structures should be avoided and the bridges on the main streams and rivers made big enough to carry the entire discharge. Where this is not possible and some structures are necessary in view of local conditions great care should be exercised in the design of these structures as the discharges become indeterminate and it might happen that discharges actually passing through them may later be found to materially exceed those for which they were designed. In view of this difficulty, the following precautions should be taken:—

1. Where rock foundations are available at a reasonable depth, the structures must be invariably founded in rock.

2. Where rock foundations are not available at a reasonable depth, the bridges must be provided with solid masonry floors (with the ring level about 1 to 2 ft below the low bed level of the streams) and necessary curtain walls upstream and downstream and aprons, where necessary.

There is a probality of these structures functioning under fairly high afflux conditions. Efforts should be made to calculate the afflux and design the structures as falls for the actual difference of levels so as to prevent damage by scour.

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2. GRAPHICAL INTEGRATION

By W. L. VAUGHAN

(Extracted from 'Aero Digest'—July, 1951)

A very useful, accurate, time-saving method for reducing the laborious work involved in computing shears, moments, and deflections of beams subjected to non-uniform loading from basic loading data is known as "Graphical Integration."

Although the principles involved in graphical integration are not new, few engineers realize that there is available a simple, expedient method. It involves use of only two triangles, and it is slide-rule accurate.

A limited application of the method in a somewhat different form from that presented here appears in volume one of the second edition, p. 249, **Airplane Structures**, by Alfred S. Niles and Joseph S. Newell.

Particularly applicable to the integration of loading curves to give shears, moments, and deflections of cantilever beams, the method may also be employed for a beam with more than one support.

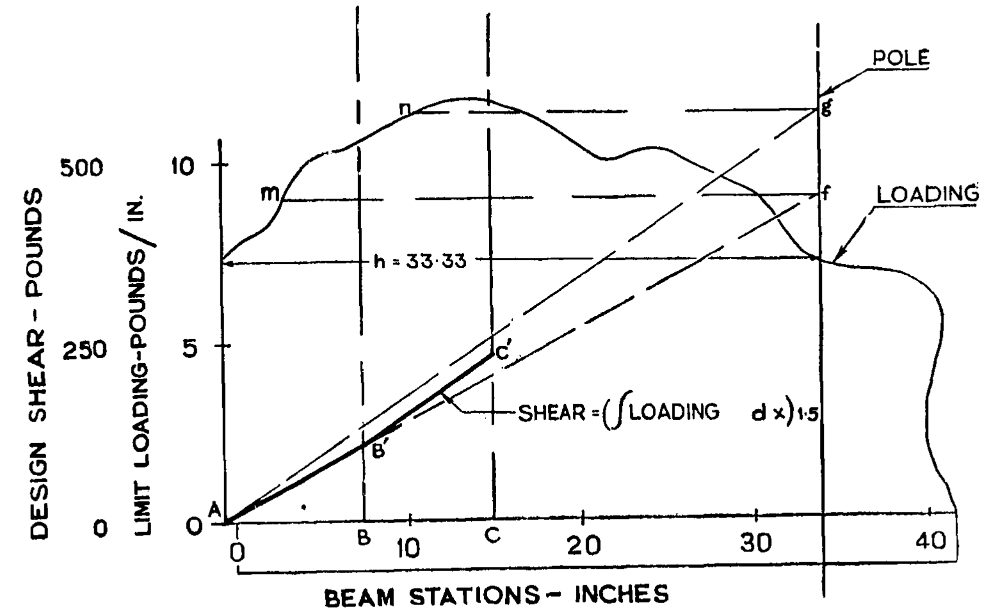
One advantage of the method is that multiplication of basic values by any

number of constants may be done automatically while integrating. For example, the design pressure coefficient and the multiplying factor 1.5 may be multiplied by a plot of C_L times the chord of a wing while integrating the curve along the semi span of the wing to give design shears on the wing.

An example is given to illustrate the procedure.

Given: A cantilever beam. A plot of the applied (limit) loading as shown.

Required: To draw a design shear curve (limit multiplied by 1.5).



Integration of the loading curve is done as follows;—

1. Estimate roughly the area under the loading curve. The purpose of this step is to select a convenient scale for the shear curve that is easy to read and that will not run off the paper. The estimated area under the loading curve is roughly 40 in. x 8 lb per in. or 320 lb. The design maximum shear would then be 1.5 x 350 lb or 480 lb.

2. Having selected a shear scale, divide any ordinate on the shear scale by any ordinate on the loading scale, i.e., 250 divided by 5 or 500 divided by 10. Divide this quotient by the multiplying factor 1.5. This gives a pole distance, $h = 33.33$ inches.

3. To draw a design shear curve from the origin at Station O to Station B, go to m the horizontal midpoint of Station O to Station B on the loading curve. Project this point on to the pole at F. Connect points F and the origin with a straight edge. Draw a straight line A'B'. This is the required shear curve between Station O and Station B.

4. Project the midpoint of the loading curve, n between Stations B and C to the pole at g. Connect the origin with point g with a straight edge. Slide the straight edge so that a line parallel to a line through points g and the origin can be connected to the shear curve at point B.' B', C' is the required shear curve from Stations B to C.

The remainder of the shear curve may be completed in the same manner.

In general, if small increments are taken, e.g., Station B to Station C is short, the shear curve will be done with a higher degree of accuracy than if larger increments

(Continued on page 26)

ADMINISTRATION REPORTS AND BUDGETS

(i) ORISSA PUBLIC WORKS DEPARTMENT ADMINISTRATION REPORT FOR THE YEAR 1949-50

THE Public Works Department was in charge of the State Highways and Major District Roads. The lower category roads in the old Provincial area were maintained by the Local Bodies and those in the late "Indian" States (now merged in Orissa) by the Revenue Department. There were 18,069 miles of roads in the State, of which 3,408 miles or about 19 per cent were metalled and the rest unmetalled. The total length of National Highways in the State, the financial responsibility for the improvement and maintenance of which rested on the Central Government was 829 miles.

A five year programme for development of major roads including those in the late "Indian" States areas had been drawn up to cover the whole of the State as uniformly as possible. The cost of improvement of roads and construction of bridges was estimated at Rs 262 lakhs. A similar 5-year programme for development of roads of lower category to link up rural and urban areas was in hand. The State Government met the expenditure on roads in their charge from the State Revenues including Post-war Development grant and in some cases roads were financed wholly or partly from the Central Road Fund.

An interesting feature of highway administration in the State was the 'Census of Traffic' on National and State Highways which was taken to ascertain the intensity of road traffic. This would enable the State Government to determine the standard to which the roads should be improved. It was intended to extend the 'Traffic Census' to other classes of roads in the State at a later period.

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(ii) RAJASTHAN PUBLIC WORKS BUDGET 1951-52

The following extracts pertaining to Civil Works Budget have been taken from the Rajasthan Budget for the year 1951-52.

		(Rs Lakhs.)	
		Resvied Estimate 1950-51	Budget Estimate 1951-52
I. Revenue (Civil Works).			
1. Rents		3.56	3.83
2. Ferry Receipts		.08	.03
3. Tolls on Roads		.12	.12
4. Miscellaneous		2.93	2.18
	Total	6.69	6.16
II. Expenditure (Civil Works).			
(a) From Revenue Account.			
1. Original Works		35.52	12.74
2. Repairs		57.69	77.81
3. Establishment		18.80	20.66
4. Tools and Plant		1.37	1.44
5. Suspense		3.26	1.35
6. Deduct lump sum cut		17.26	—
	Total	99.28	114.00
(b) From Capital Account. (outside Revenue A/c.)		54.00	60.00
III. Expenditure (Communications).			
(a) From Revenue Account.			
1. Original Works		18.03	6.27
2. Repairs		40.54	55.81
	Total	58.57	62.08
(b) From Capital Account. (outside Revenue A/c)		22.15	19.68
IV. Revenue from Roads.			
1. Ferry Receipts		.08	.03
2. Tolls on Roads		.12	.12
3. Receipts under Motor Vehicles Act		18.50	23.50
	Total	18.70	23.65

—o—

A BRIEF REVIEW OF THE RAJASTHAN BUDGET

(With special reference to Civil Works)

THE total revenue receipts of Rajasthan State for the year 1951-52 are estimated at Rs 16,05.17 lakhs and revenue expenditure at Rs 16,20.17 lakhs, with a consequent deficit of Rs 15 lakhs. The revised estimates for 1950-51 show a much bigger deficit of Rs 91.87 lakhs with the revenue receipts amounting to Rs 13,94.00 lakhs and expenditure to Rs 14,85.87 lakhs.

Revenue expenditure on Civil Works for 1951-52 estimated at Rs 114.00 lakhs form 7% of the total State expenditure in the year, the corresponding percentage for the previous year being nearly the same. Revenue expenditure on communications (original works and repairs) in 1951-52 is estimated at Rs 62.08 lakhs against Rs 58.57 lakhs provided in the previous year. In addition, Rs 19.68 lakhs have been provided for communications from the capital. account during the current year. The revenue expenditure on communications form about 4% of the total State expenditure in each of the two years 1951-52 and 1950-51.

List of Approved Works on National Highways

S. No.	Job No	Name of work	Estimated Cost Rs	Remarks
		BOMBAY		
1.	612 BM 8	Construction of north approach road to the bridge over Narbada river at Broach on the Bombay-Ahmedabad National Highway No. 8	1,37,900/-	
		ORISSA		
2.	614 RS 5	Surface painting to N. H. No. 5 from Khandgiri to 25th mile of Cuttack-Ganjam Road	80,600/-	
		PUNJAB		
3.	613 PB 1	Remodelling the approaches of Sirhind Canal Bridge in mile 177/7 of the Grand Trunk Road in Ludhiana District.	11,300/-	
		TRAVANCORE - COCHIN		
4.	610 TC 47	Surface dressing with pre-coated chips certain stretches of the Alleppey—Aroor and Quilon-Alleppey sections of N.H. No. 47 in Travancore-Cochin	3,33,600/-	
5.	611 TC 47	Survey for the construction of a bridge over the crossing at Aroor on N.H.No. 47	5,000/-	

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" Why ? "

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List of Books added to the Roads Organisation Library during July, 1952

1. **B. S. 1796 : 1952 Method for the Use of B. S. Fine-Mesh Test Sieves.** (British Standards Institution, 24, Victoria Street, London, S.W.1.)

McGraw-Hill Book Company, Inc. New York, 1951.

2. **Soil Mechanics, Foundations, and Earth Structures—An Introduction to the Theory and Practice of Design and Construction.** (1st Edition.) By Gregory P. Tschebotarioff.
3. **Engineering Graphics** by John T. Rule and E. F. Watts.
4. **The Agricultural Engineer, Summer 1952; containing an article on "Economical Use of Water for** Irrigation " By S. R. Vasudev. (The Agricultural-Engineering Society, Allahabad, Agricultural Institute, Allahabad).
5. **The Automatic Gauge Control Device** By S. R. Vasudev. (Reprints from the Irrigation and Power Journal, Vol. VIII, No. 4, October 1951).
6. **B. S. Code of Practice C. P. 123.101 (1951) Dense Concrete Walls.** (The Council for Codes of Practice for Buildings, Construction and Engineering Services, Lambeth Bridge House, London, S.E.I.).
7. **United Nations Statistical Year Book, 1951.** (Statistical Office of the United Nations Department of Economic Affairs, New York, 1951).
8. **Annual Report (Technical) 1949—Research Publication No. 15** by D. V Joglekar. (Central Water Power Irrigation and Navigation Commission, CWIN Research Station, Poona).
9. **Supplement to the Consolidated Great English-Indian Dictionary** by Dr. Raghu Vira. (The Secretary, The International Academy of Indian Culture, Nagpur).
10. **The River Hooghly—A Brochure** by N. M. Ayyar (Commissioners for the Port of Calcutta.)
11. **Engineering Aspects of the Transport Problem of London (with 5 charts)** By R. B. Hounsfield. (The Euston Press, London, N.W.I.).

The Division of Building Statistics and Structural Engineering, The Royal Institute of Technology, Stockholm, Sweden).

12. **Torsional and Lateral Buckling of Eccentrically Compressed I & T Columns—54 (1949). ACTA POLYTECHNICA Bulletin No. 2** by Henrick Nylander.
13. **Combined Bending and Torsion of Simply Supported Beams of Bisymmetrical Cross Section—55 (1949)—ACTA POLYTECHNICA Bulletin No. 3** By D. V. Patterson.
14. **Reinforced Concrete** by Oscar Faber. (E. & F. N. Spon, Ltd., 22, Henrietta Street, London, W. C. 2, 1952).
15. **The Construction of Earth Roads (ERDSTRASSENBAU)** By H. Lenssink and E. W. Goerner. (Erich Schmidt Verlag, Berlin).
16. **The Modern Road Engineering—Problems and Technic (Der neuzeitliche Strasenbau - Aufgaben und Technik)** By Dr Ing. Erwin Newmann (Springer-Verlag, Berlin, 1951).

His Majesty's Stationery Office, London, 1951.

17. **The Pedestrian Crossings (General) Regulations, 1951—Statutory Instruments No. 1192.**
18. **The Pedestrian Crossings (London) Regulations, 1951—No. 1193.**
19. **The Road and Rail Traffic Act (Exemption) Regulations, 1951—No. 1641.**
20. **The Motor Vehicles (Authorisation of Special Types) Order, 1951—No. 1642.**
21. **Tables for Continuous Beams (Tables Pour Poutres Continues)** By Otto E. Bollinger. (DUNOD, 92, Rue Bonaparte (VIe), Paris, 1950).
22. **Civil Engineering Reference Book** By E. H. Probst and J. Comrie. (Butterworths Scientific Publications, London, 1951).
23. **Final Report of the Public Works and Municipal Services Congress and Exhibition, 1950.** (The Public Works and Municipal Services Congress and Exhibition Council, 84, Eccleston Square, London, S.W.1.).

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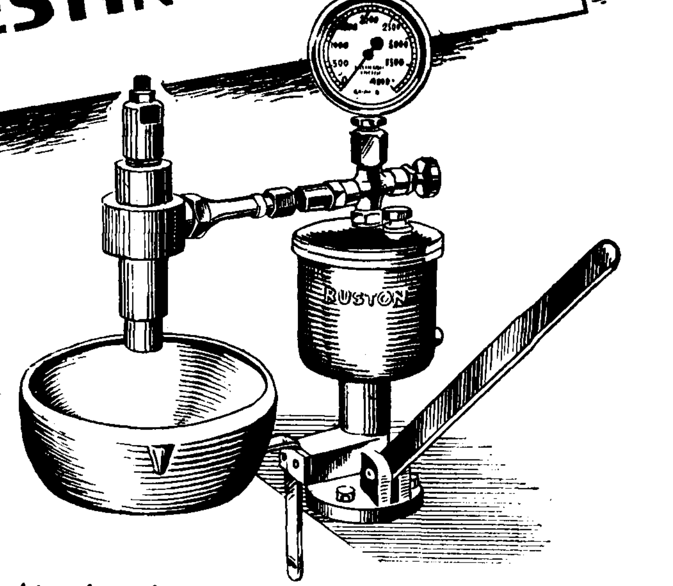

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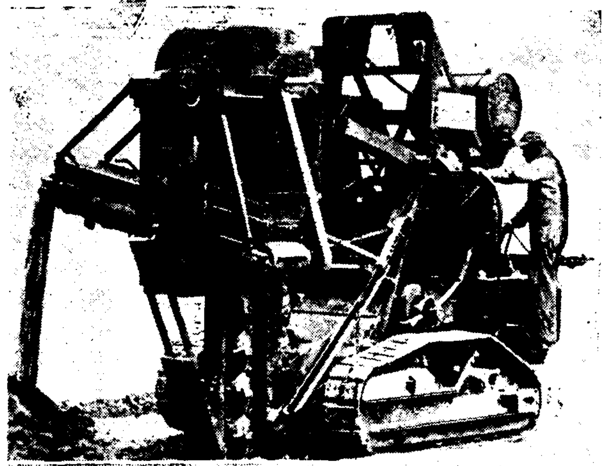

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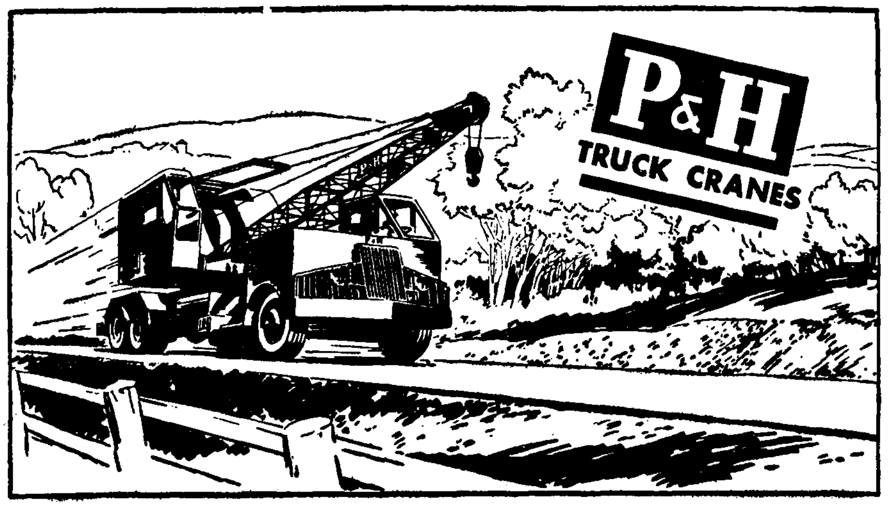

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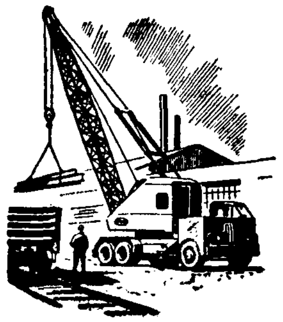

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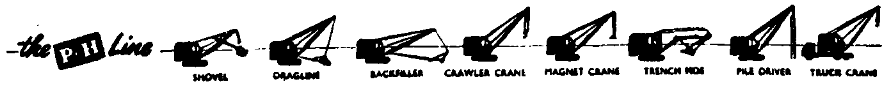

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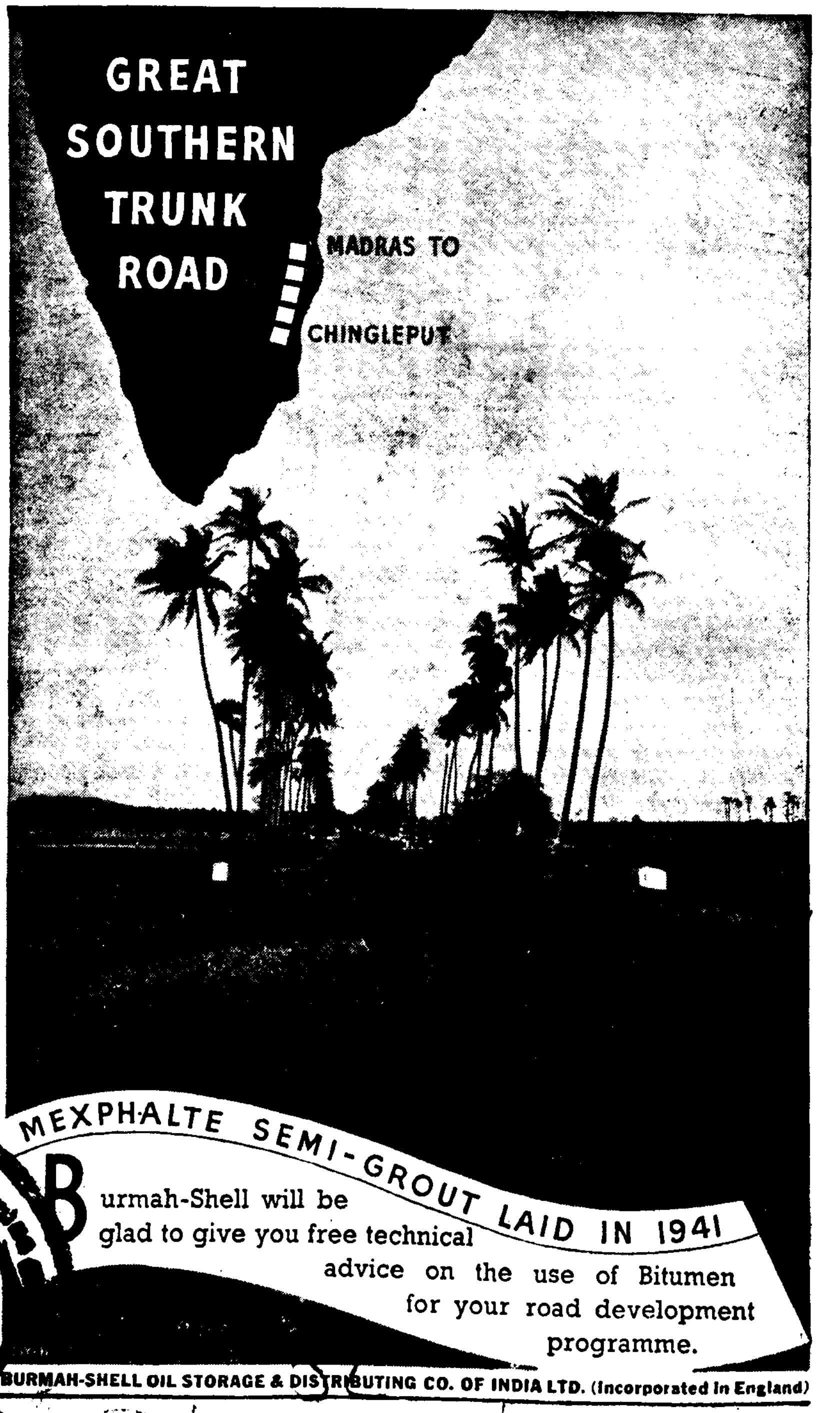
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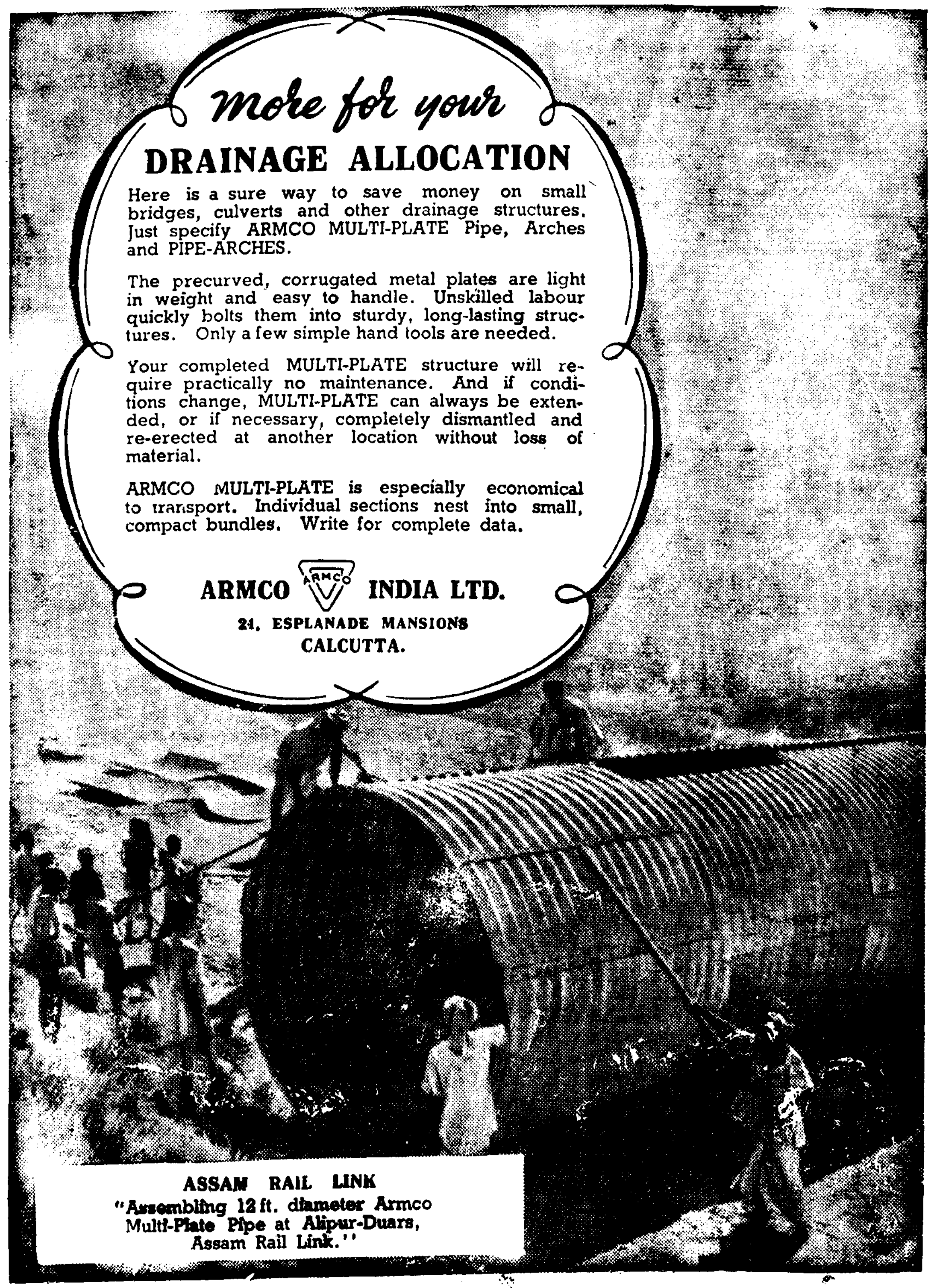
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Printed by K. S. Krishnan at The Progressive Printers, 17, Coral Merchant Street, Madras 1, & Edited and Published by J. M. Trehan, Hony. Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi-2—800.