

Transport communications

Monthly Review

Sep. 1953

No. 77

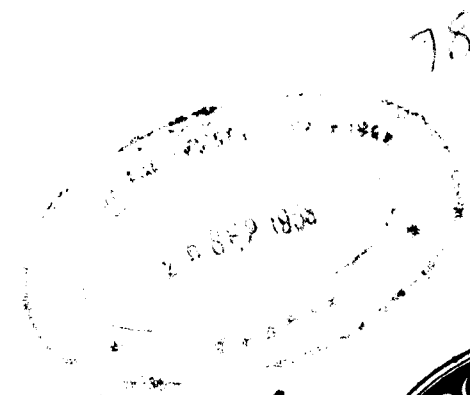
52
D41m2, N48
NS 3-77
99574

717

TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

SEPTEMBER 1953 — No. 77



INDIAN ROADS CONGRESS, NEW DELHI.

WACKER

Gasoline/Electric

High Speed Internal & External Vibrators

Vibration Tampers

INTERNAL HIGH FREQUENCY VIBRATORS - Compressing Concrete when building foundations, basic walls and reinforced concrete, construction of valley dikes, seaport quays, airport runways, etc.

EXTERNAL HIGH FREQUENCY VIBRATORS - Compression of ready made articles, construction of heavy and large sized concrete parts, road construction, forming of larger surfaces, in erection of Canal Walls, repairing concrete slopes of Canals, etc.

Other Applications - Agriculture and Chemical industry for emptying silos, bins and receptacles for screening various kinds of materials.

ELECTRO VIBRATION TAMPERS - Concrete and artificial stone industry in the manufacturing of concrete stones, hollow stone blocks, roof stones, window arches, steps for stairs, posts, planks, pipes and tubes for wells, etc.

Other Applications - In Foundries for Steel, cast iron and other metals, for compression of sand for Wet and Dry casting, for larger moulds and cores as well as for cleaning out Cupola furnaces and Bessemer Convertors.

Also used in stamping concrete pourings in road construction or surface laying.

REMEMBER

- Vibrators ensure intense compression
- increased strength
- less use of water
- saving in manpower - it takes one person to do the work of four
- saving in cement due to increased strength

ARMSTRONG SMITH LTD.

Gresham Assurance House,
Sir Phirozshah Mehta Road, Fort,
BOMBAY.

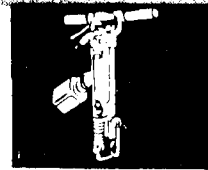
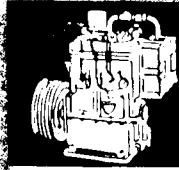
5/2, Garstin Place,
P. O. Box 787,
CALCUTTA.

36, Second Line Beach,
P. O. Box 79,
MADRAS.

Please mention this journal when replying to advertisements.

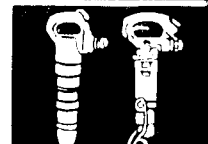
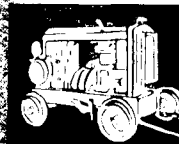
COMPRESSED AIR EQUIPMENT

STATIONARY COMPRESSORS
Two Stage. Displacements from 80 c. ft./min. to 638 c. ft./min.



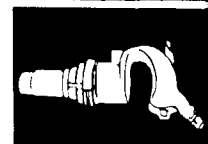
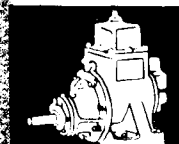
ROAD RIPPERS
Weights from 43 lbs. to 75 lbs.

PORTABLE COMPRESSORS
Two Stage. Displacements from 130 c. ft./min. to 360 c. ft./min.



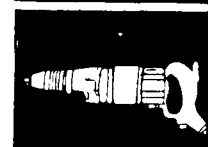
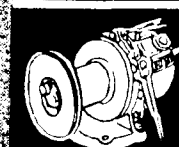
PICKS & SPADERS
Weights from 20 lbs. to 26½ lbs.

ROTOMOTORS
Vane type air-motors from 1½ b.h.p.



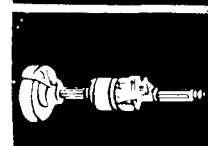
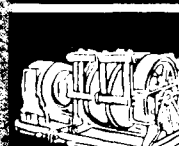
HAMMERS
Weights from 7½ lbs. to 13½ lbs.

AIRWINCHES
Lifting capacities from 1400 lbs. at 100 ft./min. to 3000 lbs. at 100 ft./min.



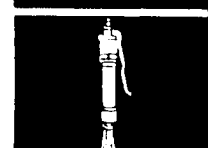
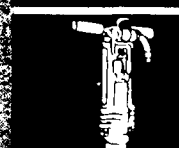
ROTODRILLS
Hand and screw-feed. Capacities to 3 ins.

SCRAPEHAULERS
Specially designed for scraper loading. Rope pulls from 2200 to 6600 lbs.



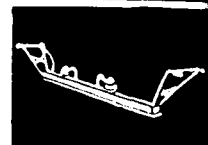
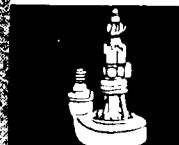
ROTOGRINDS
Radial and surface types. Taking 2" to 6" wheels.

HANDRILLS
Hand-held Rock Drills. Weights from 24 lbs. to 84 lbs.



RAMMERS
Weights from 9 lbs. to 40 lbs.

ROTOPUMPS
For water, oil or sludge. Will give 10 g.p.m. with 140 ft. head to 140 g.p.m. with 10 ft. head.



CONCRETE COMPACTORS
A new machine for Concrete Compaction.

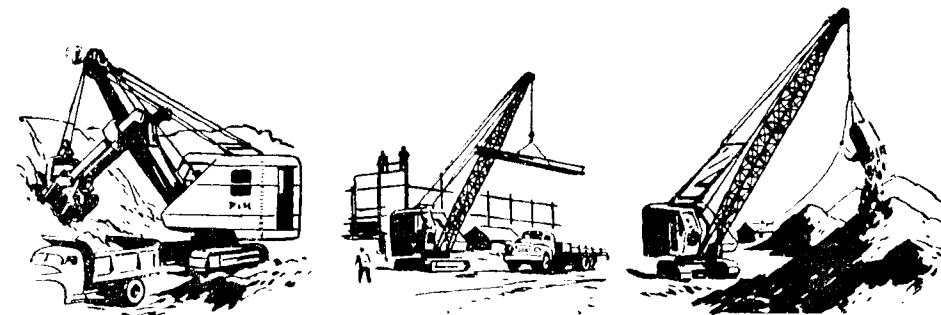
The machines and tools illustrated here are but a few of the products manufactured by Holman. There are also Drifters, Sinkers, Stoppers, Airlegs, Holbits and tungsten carbide tipped Drill Rods, all of which are world famous.

SOLE AGENT IN INDIA

BIRD & CO. LIMITED
CALCUTTA • DELHI • KANPUR

SELLING SUB-AGENTS:
KILICK NIXON & CO. LTD. BOMBAY. **BEST & CO. LTD.** MADRAS.

Please mention this journal when replying to advertisements.



ONE BASIC MACHINE FOR MANY JOBS



SOME OF MANY P&H ADDED VALUES

- Simplified front end attachments
- All-welded construction of rolled alloy steels
- True tractor-type crawlers
- Smooth hydraulic control

BETTER LIVING through BETTER ROADS

When one machine does the work of two, it is a good investment. But, when one machine can be used for six types of work, it becomes a better investment. P&H Power Shovels may be converted for service as (1) shovel, (2) dragline (3) crane, (4) clamshell, (5) trench hoe, (6) or pile driver. Easy conversion with front end attachment means less idle time... more profits with a P&H machine. Your P&H Distributor has complete information. See him.

HARNISCHFEGER OVERSEAS

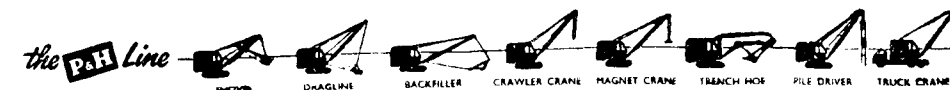
CORPORATION, MILWAUKEE 46, WIS., U.S.A.

Cable "Harnosco"

Established in 1884

AD-2461

P&H DISTRIBUTORS
PASHABHAI PATEL
AND COMPANY LIMITED
CONSTRUCTION HOUSE, BALLARD ESTATE, BOMBAY
ALSO AT DELHI AND CALCUTTA



Please mention this journal when replying to advertisements.

**PITTSBURGH
WELDED
STEEL WIRE
FABRIC**



for **BETTER
HIGHWAYS**

Highways laid in concrete have greater strength, rigidity and permanence, and Pittsburgh fabric provides the ideal reinforcement for continuous laying. Possessing a tensile strength of 60,000 lbs. per sq. inch far in excess of any medium, Pittsburgh fabric provides the greatest resistance to tear and wear for the modern highway - and can stand up to the heaviest traffic, from a fuel van to a giant bull-dozer.

Also suitable for:
Runways - Floors -
Walls - Roofs - Pavements - Culverts - Pipes -
Tunnels - Hangars.

Specify Pittsburgh
WELDED
STEEL WIRE FABRIC
FOR CONCRETE REINFORCEMENT

AVAILABLE IN VARIOUS
GAUGES AND SPACINGS
FROM READY STOCKS

Distributed by:
MANEKLAL & CO., NEPTUNE BUILDING, HORNEY ROAD
POST BOX 626, BOMBAY. 1.

Please mention this journal when replying to advertisements.



FERODO
BRAKE LININGS

**stop
everything!**

There's a correct
FERODO brake
and clutch lining
for every vehicle.
For technical
guidance and
advice, please
write to Ferodo
Limited's principal
vendors in India:

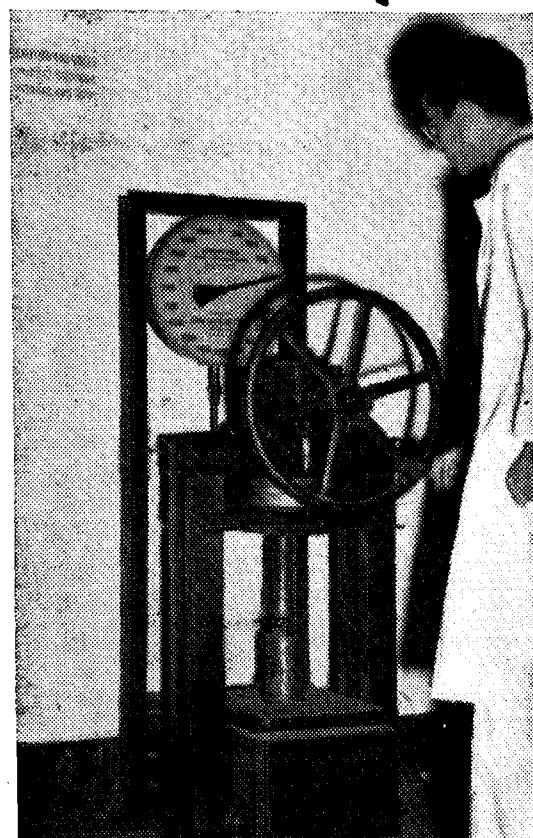
ASBESTOS, MAGNESIA & FRICTION MATERIALS, LTD.,
(Incorporated with Limited Liability in England)

13 Gunbow Street, Bombay

BRANCHES AT CALCUTTA AND MADRAS

Please mention this journal when replying to advertisements.

Make this your Laboratory!



A briquette of paving mix is tested on a Hubbard-Field Stability Testing Machine . . . to determine the shear strength of the compacted mix.



Penetration test determines the hardness of asphalt.

STANDARD-VACUUM
Marketers of Quality Asphalt Products



**Standard - Vacuum's
FREE technical
service can help you
build better roads!**

Fine equipment, expert technicians can help solve your roadmaking problems in the Standard-Vacuum test laboratories—maintained for your convenience. Please write or telephone for assistance or advice you may need — there is absolutely no cost or obligation.



TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

SEPTEMBER 1953—No. 77

TABLE OF CONTENTS

	Page
1. The Highway System of Greece	1
2. A Note on the Availability of Road Metal in North Bihar	4
3. An Inadequate Road System—What does it cost us?	5
4. Recommended Principles for the Design of Traffic Rotaries	9
5. Highway Access Control in the Netherlands	11
6. HERE AND THERE—	
(i) Regulation of Central Grants to States	13
(ii) Fire Resistance of Steel Columns Encased in Concrete	14
(iii) Recommendations of the Select Committee on Road Estimates in the U. K.	14
(iv) Traffic Capacity of London Streets	15
(v) 16-Mile Road Built by Voluntary Effort	16
(vi) Causes of Foundation Failures	17
(vii) The Inca Route	18
(viii) British Treasury Views on Road Maintenance	19
(ix) Bus or Car—which Gives Way?	19
(x) Responsibilities of an Engineer	20
(xi) India Needs More Roads	20
7. TECHNICAL INFORMATION—	
(i) Compaction of Soil—Questions & Answers	21
(ii) Concrete Pavements—Experience on Main Roads in New South Wales (Australia)	23
8. ABSTRACTS	25
9. SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS	26
10. Publications Added to the Roads Organization Library during July 1953.	28
11. BUDGETS AND ADMINISTRATION REPORTS	
(i) Punjab Civil Works Budget for the year 1953-54	29
(ii) Summary of the Punjab P. W. D. Administration Report for the Year 1950-51	30
12. List of Approved Works on National Highways	32
Also:—Definitions of Highway Engineering term—Words of Wisdom—A Compliment to Women Drivers—A Slight Misunderstanding—First Priority—God Forbid, No Please.	

Transport-Communications Monthly Review is published on the 25th of each month by the Indian Roads Congress, New Delhi.

This Review is sponsored by the Roads Organization, Ministry of Transport, but the Government of India accept no responsibility for any views or opinions expressed.

Subscriptions. Annual subscription including postage is Rs Fourteen. Single copy including postage is Rs one and annas four.

To Members of the Indian Roads Congress, Engineering personell below the rank of an S. D. O. and Engineering students a special

reduced subscription rate of Rs 8 per annum is offered. Students are required to apply through the Principal of their College.

Advertisements. Advertising rates are:

	Rs per insertion.
	Full Page Half Page
Inside front cover	100/-
Inside back cover	100/-
Outside back cover	120/-
Ordinary position	75/- 45/-

Detailed rate card can be had on application to the Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi-2,

Please mention this journal when replying to advertisements.

THE HIGHWAY SYSTEM OF GREECE

(Extracted from 'Permanent International Association of Road Congress')

Bulletin No. 132)

IN Greece, as in other countries, the rate of road construction was markedly accelerated by the advent of the automobile as a means of transport. The new era of road construction in Greece commenced in 1927, and by 1932, the greater part of the old road system, covering some 9,000 kms (5,600 miles) had been thoroughly reconstructed and, in addition, 2,000 kms (1,200 miles) of new roads had been opened to traffic. This period of 5 years may be regarded as the most active period of road-construction in the pre-war years. The roads were designed to meet the requirements of motor vehicles, and allowance was made for considerable future increase in traffic. Where some departure from the original plans had to be made, this was due to the poor geographical and morphological structure of the country.

The economic crisis in 1932 brought about a temporary interruption of road construction. But in 1936 progress was resumed, only to be halted, in its turn, by the convulsions of war in 1940, and the occupation and the guerilla warfare which followed. The period of 1940-1948 was a painful experience. Every form of road work, even such urgent work as was required to maintain the roads in a reasonable state of repair, ceased over the whole of the road system. Furthermore, the existing engineering structures, particularly bridges and retaining walls, had been blown up, so that in 1948 there were 1,348 bridges, with a total length of about 18,000 metres, destroyed and a road network of 17,000 kms (10,500 miles) almost entirely ruined.

The year 1948 constitutes a starting point for the Greek highway system. It was, in fact, in that year that a new period began, the period of reconstruction, during which American aid played a leading part. To-day, most of the trunk roads have been restored to their pre-war condition, or even improved, since reconstruction

has been carried out so as to provide greater permanence; a large number of secondary roads have been improved from the point of view of traffic-carrying capacity; and 3,000 kms (1,900 miles) of new roads, though admittedly of somewhat primitive construction, have been opened to traffic. The total length of the road system now in use has thus reached 20,000 kms (12,400 miles).

Present Classification of the Road Network

Under the legislative enactments now in force, the roads in Greece are classified as follows:

- Main roads;
- Secondary roads;
- Local roads;
- Rural roads.

The main roads are those which link the county towns of the Prefectures (Greece is divided into 50 Prefectures) and these county towns to the sea ports. Roads leading to important scenic points or to archaeological sites, where there are ancient monuments of artistic or historical importance, are also regarded as main roads. Some of these main roads have been included in the international highway system in accordance with the agreement signed at Geneva on 16th September, 1950.

The secondary roads connect the centres of smaller administrative units, i.e., the provinces.

In addition to the above-mentioned classification of roadways, a more rational system, based on the analysis of a detailed survey, has been worked out and is at present under discussion. Approval of the proposed classification would enable a decimal system of numbering roads to be introduced.

Administration

The Highways Department, a branch of the Ministry of Public Works, is at the head of the organization dealing with road-construction work. Constructional work in connection with bridges, and with aerodromes for civil aviation, also comes within the province of this Department.

The Highways Department is divided into seven Directorates. Each Directorate is divided into various sections. Under the Directorate of Planning, a Materials Laboratory has been established. Its function is the application of scientific methods to the selection of materials, research into their optimum composition, and the control of the quality and strength of road works.

Statistical Information

The length of the highway system at present open to traffic reaches a total of 19,909 kms (12,300 miles) as compared with a length of 41,500 kms (25,700 miles) which is required to connect all the centres of population in the country.

These roads are classified as follows :

Class of road	Length of road in miles		
	Open to traffic	Planned or not yet completed	Total
Main roads ...	7,217	3,130	10,347
Secondary roads	2,390	4,980	7,370
Local roads ...	2,750	5,280	8,030
Total ...	12,357	13,390	25,747

During the year 1950-51 approximately 155 thousand million drachmas (Rs 14,72,50,000) were spent on the reconstruction and the maintenance of roads and on the rebuilding of bridges.

Twenty thousand million drachmas (Rs 1,90,00,000) of this sum were spent

by local authorities on work which came within their province.

Source of Funds

The Government is responsible for the construction and repair of the main roads and the necessary funds are included in the annual budget. Work on secondary and local roads is financed by the local authorities, but as their financial resources are usually limited the Government assists them by granting additional funds.

In Greece, the total number of motor vehicles on the roads, excluding those owned by the Government, is 32,227, comprising 4,778 motor-buses, 10,163 private cars, and 18,336 goods vehicles. Petrol consumption amounts to 200,000 tons (448,00,000 gallons). State revenue is provided by various duties, taxes, etc..

Road Surfacing and Methods of Repair

The 19,969 kms (12,400 miles) of the road system which are open to traffic are classified, from the point of view of quality of surfacing, as follows :

(a) Surfacing of cold-process asphalt having a thickness of 2.5 to 5 cms (1 to 2 in.) ...	Miles 1,433
(b) Sprayed surface ...	360
(c) Macadam and surfacings compacted by traffic ...	8,422
(d) Sundry temporary Surfacing ...	2,186
Total ...	12,401

A special Directorate of the Ministry of Public Works is responsible for the maintenance of the highway system. Maintenance work consists of the prompt repair of damage to the bituminous surfacing whenever it occurs, and of the improvement of macadam surfacings, or of surfacings compacted by traffic, by covering them with a layer of bitumen. The task of the above-mentioned Directorate is rendered particularly arduous at the present time owing to the roads having been left without any repair, even of the most rudimentary character, for a period of eight years, owing to the war.

Traffic Density

Systematic censuses have, however, been carried out since the beginning of the fiscal year 1952-53, and a map showing traffic density is expected to be published very shortly which will be used as a basis for future planning. Goods traffic on the highway system has been estimated at approximately 600,000,000 ton-kilometers. The greatly increased use of the roads is shown by petrol consumption, which has risen from 64,000 tons in pre-war years to 200,000 tons per annum at the present time.

Future Prospects

A four-year plan for road improvement has been drawn up which provides for the renovation of a further 1,500 kms (930 miles) of main traffic arteries, the renovation of a similar length of the secondary road network, and the opening to traffic of 1,200 kms (745 miles) of new roads, so that towards the end of the fiscal year 1955-56 the total length of the highway system will reach 21,200 kms (13,165 miles), as compared with the 41,500 kms (25,770 miles) which are required to meet the country's needs.

In addition to the road work now in hand, which has been described above, the question of international highways constitutes a current problem. According to the convention signed at Geneva on 16th September 1950 by the various European countries, the international highways in Greece cover a total length of 2,450 kms (1,520 miles) and include the road running from the Yugoslav frontier to Salonica, and thence to Athens and Constantinople, which has been classed as a motorway. The cost of construction has been estimated at 80,000,000 U. S. dollars. Such expenditure is beyond the financial resources of the Greek budget. Fortunately, it has been recognised, at various Congresses held at Geneva, that mutual aid is justified and advisable where road construction of general interest to the European community as a whole is concerned. Plans and surveys are now being made in order to demonstrate the value to the European community of the development of relations with our country by improving the means of communication. It will also be shown that funds devoted to this purpose are likely to prove productive.

78

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

STREET : A road within a town or other centre of habitation which has become partly, or wholly, defined by buildings established along one or both frontages.

LANE : A narrow way or passage between hedges, walls, or buildings, over which a right of way exists.

A NOTE ON THE AVAILABILITY OF ROAD METAL IN NORTH BIHAR

(Condensed from a Note by Shri A. Acharya, Geological Survey of India)

Introduction

THE whole of North Bihar is a thick deposit of alluvium. There is no visible sign of any rock-outcrop except in the beds of some of the rivers and nalas flowing, in their upper reaches, through the crystalline and other hard rock terrain. Because of the lack of good road stone the construction of metalled roads at reasonable cost has become a tough problem. For the more important roads, road metal is brought from some districts in South Bihar but the transport charges considerably push up the project costs. Investigation was, therefore, undertaken to explore the deposits of shingle and boulders in the beds of Pindai nala near Bhikhna Thori and Gawnaha, and of the streams and nalas near Gobardhana during April 1952.

Deposits Near Bhikhna Thori

The Pindai nala flows past Bhikhna Thori and contains large deposits of shingle and boulders. These deposits have been examined for about five miles on either side of Bhikhna Thori and it is observed that they are extensive and quite thick, i.e., about six feet on the average. The shingle and boulders are made of hard, strong quartzites derived from the erosion of the Siwalik conglomerates cropping out in the Someswar hill ranges. More than 80 per cent of these deposits range from 3 to 5 in. in size, though boulders of more than 6 in. in size also occur.

Dry attrition, abrasion, and compression tests, according to B. S. 812-1943, were conducted at the Alipore Government Test House on the 1-in. samples of shingle collected near Bhikhna Thori. Results are given below :

Test results show that the quartzite shingle and boulder deposits of the Pindai nala near Bhikhna Thori are quite suitable for use as road metal. Railway communication between Bhikhna Thori and Narkatiaganj remains cut off for about six months in the year.

Deposits near Gawnaha

The shingle and the boulder deposits of the Pindai nala near Gawnaha had the same physical properties as those of the deposits near Bhikhna Thori and were equally extensive and thick. The deposits are suitable for use as road metal. The railway communication up to Gawnaha is open throughout the year.

Deposits near Gobardhana

The deposits of shingle and boulders in the beds of Shingha and Dhunghi nalas near Gobardhana are composed mainly of soft calcareous sandstones, shales and schistose rocks which cannot stand up to tests applied to road metal. Only 30-35 per cent of the deposits are of quartzites derived from the erosion of Siwalik conglomerates. Even these are not as tough and hard as those occurring near Bhikhna Thori and Gawnaha. The compression and abrasion tests of the samples from the quartzite shingle and boulder deposits, however, gave satisfactory results.

The deposits near Gobardhana are, therefore, considered inferior to those near Bhikhna Thori and Gawnaha. Besides transport from Gobardhana to Ramnagar, the railhead, would add to the costs.

TEST RESULTS

Quarry	Attrition test dry		Compression test lbs per sq. inch.	Abrasion test coefficient of hardness.	Specific gravity
	Percentage loss of weight after 1000 revolutions.	French coefficient of wear			
Bhikhna Thori Quarry	1.8	22.2	18,551	17.2	2.68
Gobardhana Quarry	2.6	15.4	17,330	16.1	2.64

AN INADEQUATE ROAD SYSTEM
WHAT DOES IT COST US?

[Adapted from 'Road International'—Spring 1953.]

The cost to the community of an inadequate road system or the value of a good one goes far beyond mere convenience in use. In this article, Colonel Richards discusses the nature and effect of some of the elements of unnecessary cost imposed on industry and the community in general by unsatisfactory road conditions.

IT is not uncommonly supposed by that large section of the community in which resides the greatest political inertia in relation to road improvement—those who do not own or operate a road vehicle—that the benefits of an improved highway system would accrue to what is known as the transport industry, and would thereby be restricted to one section of the community; or that its principal objects would be to pander to an irresponsible lust for speed, which might be curbed by other means; or to minister to the comfort of that wealthy section of the community (if such there be today) which can afford to own and drive motor car—and who ought to be prepared to put up with a certain amount of discomfort.

Nothing could be farther from the truth. The purpose of a modern highway system is to reduce operating costs, by saving the fuel consumption and wear and tear on vehicles caused by uneconomic gradients and alignment and by constant braking and acceleration; to save time and increase the certainty of operation of road transport (for the value of the equipment and manpower involved is enormous), and to reduce the misery and cost of accidents. The British Road Federation has estimated that the actual savings in the operating costs of vehicles using the roads of the expressway, motorway, or American Turnpike type are in the nature of (i) Fuel—40 per cent, (ii) Tyre wear—30 per cent, (iii) Running time—50 per cent, in total aggregating a reduction of at least 30 per cent in vehicle operating costs. In regard to the saving of time, the value of even

small speed increases, merely as an inverse measure of time taken, on the journeys made, and equipment used, by the London public road transport service alone has been estimated at £ 2,000,000 per annum for an increase in journey speed of one mile an hour, and this does not take into account the value of the time of, or the convenience to, that part of the travelling public for whom bus and coach transportation represents the most efficient (and sometimes the only) means of conveyance to work.

BAD ROAD DESIGN—ITS ADVERSE EFFECT ON INDUSTRIAL ECONOMY

It is urgently necessary to consider the economic cost of an inadequate road system at present levels and its restrictive effect upon the expansion of our industrial and social life in the future. It is an unfortunate fact that the effects of inefficient highway transportation, most of them arising from the deficiencies of the highway system, are for the major part indirect and unseen. Almost everyone can appreciate the monetary effect of increases in public service vehicle fares due to increases in taxation. The private motorist can readily grasp the increased sums that he is called upon to pay for his travel from the same cause. But the major effects—which are those of unnecessary transportation costs—pass unobserved, since they only occur as elements of the cost of other articles; their criteria are seldom known and their importance even more rarely grasped.

They lie in the following causes :

- (i) Unnecessary distance, increasing proportionately the cost of travel and transportation, in all its elements.
- (ii) Unsatisfactory road surfaces, causing excessive wear and tear on the vehicle, and particularly on its tyres.
- (iii) Excessive or unnecessary gradients, directly increasing the cost on the gradients themselves, and sometimes over other parts of the route as well.
- (iv) Unnecessary rise and fall, even where the gradients are moderate.
- (v) Unsatisfactory horizontal alignment, sharp curves and bends, causing a reduction in speed and additional tyre wear through sharp angles of turning.
- (vi) Unnecessary halts and delays, including all interruptions to free travel such as congestion, junctions, and wide variations in speed.

And, in particular, one item whose cost in terms of money is large but for which money is not the only standard of cost—accidents.

Collectively, the effect of these impediments to the efficient use of highway transportation in industry is very considerable, and imposes a heavy and unnecessary burden upon industry and the national economic effort. Its effect upon the nation's private purse is equally large. That the losses imposed upon highway transportation by an inadequate road system may be very much more than slight may be seen from the following consideration of the "unnecessary cost" components already enumerated.

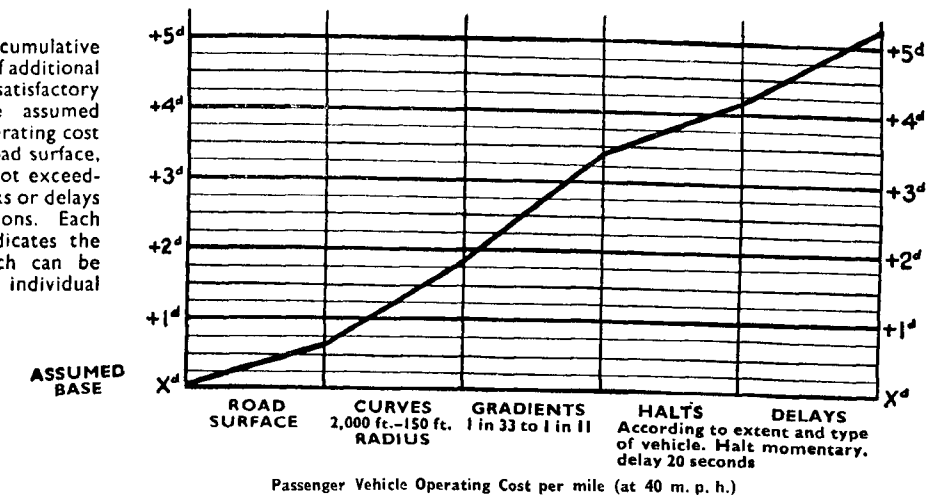
Circuitous Routing. The effects of circuitous routing, or unnecessary distance, involve both a cost-element and a time-element. The cost-element is dependent upon the extra length of the journey over the type of road being used. The time-element is similarly dependent upon the type of road, in so far as it affects the rate of travel. Certainty in operation is also an important factor as it affects other

elements of industrial cost. Where highway conditions are good only the time-element, at minimum rates of travel, is involved. Where they are bad, some or all of the further cost-elements will be involved and the cost of transportation, industrial and personal, will be greater than the necessary minimum.

Bad Surfaces. Rough or loose road surfaces impose additional mechanical wear and tear on the vehicle by road shock, increase rolling resistances and consequently the fuel-distance ratio, and materially increase tyre wear. It has been estimated, by American sources, that the cost of vehicle repair for passenger cars on rural roads may be increased by 50 per cent for loose or bad surfaces, as compared with those in good condition, and by as much as 100 per cent on surfaces in very poor condition. Tyre tread wear on poorly surfaced roads at a constant running speed of, say, 30 m.p.h., may be more than twice that on good road surfaces, i.e., the life of a set of tyres may be reduced from thirty to fifteen thousand miles.

Bad Geometrics. With inconstant speed operation, accelerating, braking and stopping, such as is often necessary on roads of poor alignment, width and surface, the relative wear may be greater by a further 20 per cent. The effects of bad alignment, sharp curvature and gradient on these roads in producing excessive tyre wear is as great apart from the factor of inconstant speed in operation. Unsatisfactory horizontal alignment, involving questions of width, curvature, visibility, junctions, halts and delays, congestion and checks in free running, causes increased in operating cost and is a prolific source of accidents. The cost of wear on tyres due to curvature alone is a function of the speed, sharpness of curve and the amount of superelevation, or banking, applied. The rate of tyre wear has been found to be two to three times that of operation at the same speed on straight sections of road. In addition to tyre wear, fuel consumption is also increased by up to 15 per cent for vehicle operation on curves, the combined, weighted, costs giving a net increase of 24 per cent on curves where the excess centrifugal thrust is 0.15.

This chart indicates the cumulative effect of the elements of additional costs incurred by unsatisfactory road conditions. The assumed base cost infers the operating cost per mile given good road surface, flat curves, gradients not exceeding 1 in 33 and no checks or delays due to road conditions. Each horizontal division indicates the variable increase which can be occasioned by each individual cause



Excessive Gradients and Infructuous Rise and Fall

Excessive or unnecessary gradients increase vehicle operating costs in a number of ways. Their effect is always greatest on laden industrial vehicles. Considering unnecessary rise and fall, apart from steepness of gradient, it has been estimated that the unnecessary fuel consumption for industrial vehicles of 10,000 lb gross weight would be 1/10 gallon per mile for a gradient as flat as 1 in 30 rising to 4/10 gallon per mile for a vehicle of 70,000 lb gross weight. On such a relatively slight gradient all except the heaviest industrial vehicles could operate in their highest gear. When the steepness of the gradient increases this becomes no longer possible and the vehicle has to change successively into lower gear until the point is reached at which an alteration in the rear axle reduction ratio may be necessary.

On tangent two-lane highways in good condition the operating costs of passenger cars are increased by 2 per cent, as compared with level-surface running, for an increase in gradient to 3 per cent (1 in 33), by 6 per cent for an increase to 7 per cent (1 in 14), and by 12½ per cent for an increase to 9 per cent (1 in 11) at a constant-speed operation of 40 m.p.h. For a change in gear, necessitated by weight or an interruption in free running, the increases are very much greater.

The increase in fuel consumption due to unnecessary rise and fall has already

been mentioned. The increase due to steepness of gradient is even greater, rising, for a high-powered passenger car running at 40 m.p.h., with constant speed operation, from 18 miles per gallon on a level surface in good condition to 12 miles per gallon on a gradient of 1 in 9.

CHECKS IN TRAVEL PUSH UP TRANSPORT COSTS

The total value of halts and delays involves operating costs and tyre wear, in addition to time lost in standing, braking and accelerating.

Stop-and-go tests, carried out in the United States, from limited speeds (one stop every 500 feet from a speed of 15 m.p.h.), simulating moderate congestion, showed a rate of tyre wear from seven to ten times that of constant speed travel. The increase in tyre wear from continuous but interrupted travel varies from zero up to these amounts according to speed and frequency. The average rate of wear for a representative distribution of running speeds, such as would be encountered on a normal highway, in attempting to maintain a speed of, say, 40 m.p.h., was 20 per cent greater than for constant speed operation.

Estimates for the value of time are always difficult to make, and to justify. It has, however, been approximately assessed, in American investigations, that the generally accepted rates are 75 cents (Rs 4/-) an hour, or 1½ cents (1½ anna) a mile for average passenger cars, goods

vehicles being proportionately higher in relation to their weight and pay load.

Excluding standing time, American estimates of the cost of braking to a standstill and accelerating again for a passenger car range from 1/12 of a cent (one pie) at an approach speed of 10 m.p.h. to 1.7 cents (1.5 annas) at an approach speed of 60 m.p.h. To this must be added the cost of the standing delay, at the rate already given. It is interesting to note that on this basis each stop at a junction, or traffic light, or in congested traffic, involving a standing delay of only one minute, will cost approximately 2 d. (1.5 annas) per passenger vehicle and possibly 6 d. (4.5 annas) for an industrial goods vehicle. In constant running operation, subjected to checks and interruptions, imposes similar additional costs.

Economic Advantages of Good Roads

From this recital, based upon measured tests, of the value of the unnecessary elements of cost involved in highway transportation over inadequate roads, it should be more than apparent that the economic difference between satisfactory and unsatisfactory conditions is very large.

In addition, the cost to the community of the differences in accident rates between the two standards of highway, good and bad, is equally large. To attempt to place a value upon human life or injury is not easy. Of its personal, human value, no one could be in doubt.

The part that industrial road transport plays in the general transportation services of a country, and its effect upon

our standard of living and ability as a nation to survive, is seldom sufficiently appreciated. Few of the commodities used or consumed in our daily life derived their value of cost from their scarcity; it arises from the processes or operations which are applied to them, and of these road transport is not the least and, apart from labour, is by far the most common. It has been estimated, for example, that the operating costs of the road vehicles used in the building industry represent 13½ per cent of the total building costs. Equally, the applications and repercussions of the cost of inefficient road transportation in other aspects of the general life of the community are widespread and significant. In the Memorandum on road policy prepared by the British Road Federation and submitted to the Minister of Transport it was stated that "the demand for maximum productivity and lowest possible costs, necessary to enable us to compete as effectively as possible in world markets, is dependent upon maximum efficiency in all phases and stages of production. No matter how capable the works and how efficient the machines, factories, mines and farms, productivity must fall short of what is possible when one vital part of twentieth century production—road transport—is forced to operate at much less than peak efficiency by reason of the out-of-date and inadequate roads which form by far the greater part of the road system."

Highway transportation—rapid, cheap, flexible, and efficient—is the mode of the twentieth century. Nothing can take its place; nothing can compensate for any deficiency in its conditions of operation. Nothing can relieve industry of its share of the burdens imposed upon it.

It is a good example of living in a "fool's paradise" to substitute costly maintenance for needed capital improvements.

—Thomas H. MacDonald.

RECOMMENDED PRINCIPLES FOR THE DESIGN OF TRAFFIC ROTARIES

(Contributed)

IN India traffic rotaries are found suitable where the turning traffic is about 50 per cent of the total traffic on the intersecting roads or where cross traffic is 30 per cent or more of the total.

Design Speed

The recommended design speeds round rotaries are 25 and 20 m. p. h., corresponding to the design-speeds of 50 and 40 m.p.h., on the straight for the radiating roads. The design of the rotary is governed by the requirements of the radiating road which is of the highest class in the group.

The Central Island

The geometric shape of the central island should be either a circle or composed of a series of circular curves of large radii. Corners should be avoided. To eliminate

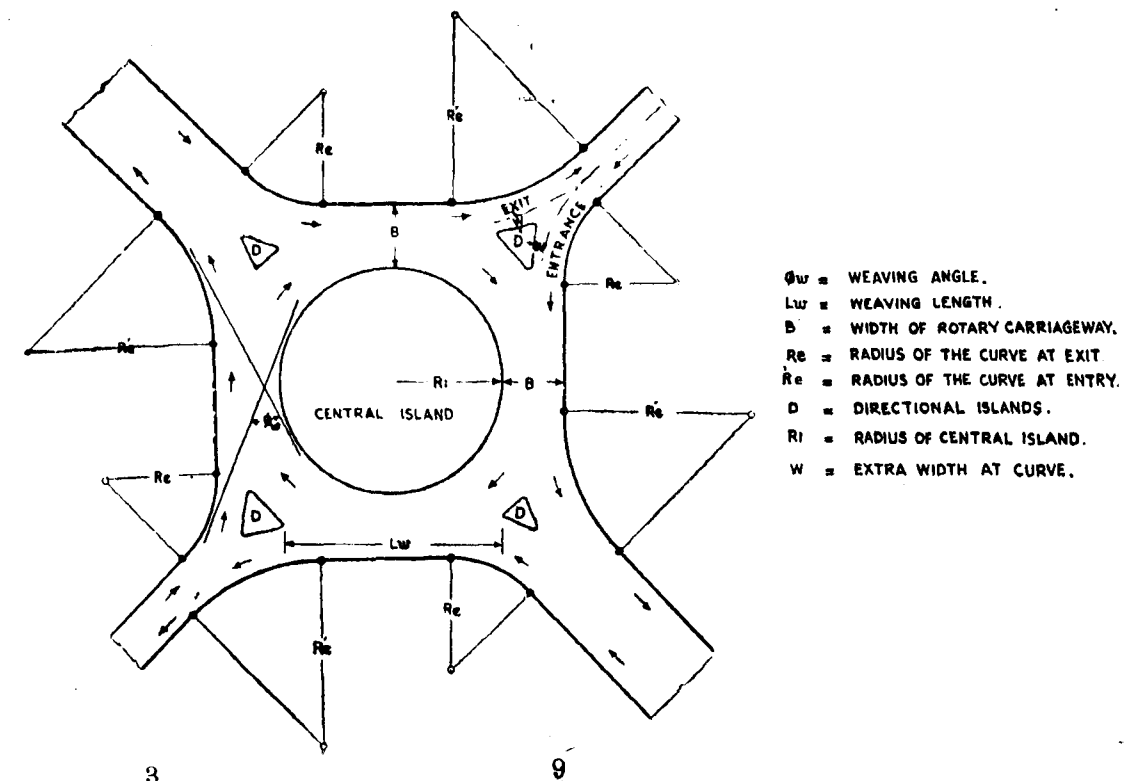
reverse curvature in the path of the vehicles between the entrance and exit of the adjacent radial road, the outer kerbs should not be concentric with the central island as far as possible.

While calculating the required radius or radii of the island, superelevation is ignored as it is generally not possible to provide effective superelevation. The recommended minimum Radius (R_i) for the central island is 60 ft for the design speed of 20 m. p. h., and 100 ft for 25 m. p. h.

Footpaths should not be provided on the periphery of the central island.

Weaving Angle (ϕ_w)

The weaving angle (see Figure) should not be less than 15 nor more than 40 degrees.



Weaving Length (LW)

Recommended minimum and maximum weaving lengths are:

Design speed (m.p.h.)	20	25
Minimum weaving length (ft)	100	150
Maximum weaving length (ft)	200	300

Width of Rotary Carriageway (B)

The width of the rotary carriageway at all the narrow points should be constant and not less than $\frac{1}{4}$ th of the total of the widths of all radiating roads, subject to a minimum of 32 ft and a maximum of 42 feet.

Entrance and Exit Curves

The radius at entry (*Re*) should nowhere be less than the minimum radius of the central island. To facilitate easy flow of traffic the exit radius (*Re*) should be larger than the radius of entry. The minimum exit radius of 100 ft for the design-speed of 20 m. p. h. and 150 ft for 25 m. p. h. are recommended.

To channelise the traffic properly, entrances and exits should be funnel shaped. The minimum extra width provided at the centre of the curves—

$$W = \frac{200}{R} + \sqrt{R}$$

where *V* = Design-speed (m.p.h.)
R = Radius (ft)

Directional Islands

Directional islands should be such as would channelise all traffic and suitably reduce the speed of the traffic approaching the rotary. In all directions the carriageway should be sloping away from them. They may or may not be symmetrical about the centre line of the radial road.

Straight sided triangular islands designed to give wider entries are to be preferred to those whose sides are concentric with the kerbs at the junction. The kerbs of the channelising islands should be 4 in. to 6 in. high. Raised directional islands may be omitted in less trafficked rotaries but should be provided when traffic grows.

Cross Slope

It is generally not possible to provide effective super-elevation. The cross slope, however, should not be less than the normal camber of the road nor exceed 1/15.

As most vehicles (except those turning to the left) have to cross the crown-line, cross-slope adjacent to the crown line should not be steeper than 1/20; and the algebraic difference of the cross slopes on each side of the crown line should lie in the range 0.05 to 0.09, depending on the weaving distance being long or short.

Sight Distances

The sight distance should not be less than 160 ft for the design speed of 25 m. p. h. and 120 ft for 20 m. p. h.

Grades

Traffic rotaries may be constructed on sloping ground, only where this is unavoidable, but the maximum grade should not exceed 1 in 30 for any road in the vicinity of the rotary.

Landscape Development

A rotary provides ample scope for effective landscape development. Such development is, however, left to individual judgment, as circumstances of each case are different.

Signs

Vehicles approaching rotaries at night should be forewarned of the existence of the rotary. Red reflectors should be fixed on the kerbs of the central island, facing each approach road, and also on the tail-ends of the directional islands.

HIGHWAY ACCESS CONTROL IN THE NETHERLANDS

(Extracted from Circular No. 88, Highway Research Correlation Service of the Highway Research Board, U.S.A.)

IN the early days every property owner whose land abutted on a main road had access to the highway. However, in 1937, a law was passed which had for its objective the limitation of access to State roads, or, as stated in the preamble of the Act, "to lay down regulations to check, in the interest of road traffic, ribbon development along roads under authority of the State or named in the State highway plan." This Act, the title to which might be translated as "Traffic Act Restricting Ribbon Development," became law on May 31, 1937, and has been quite firmly enforced.

This law does three significant things. First, it prohibits the erection of buildings within a certain distance of State highways, second it prohibits alteration of the purpose of an existing access on State roads, and third, it prohibits access to highways constructed on new locations. The law applies not only to roads on the existing State system, but also can be applied, by decree of the official charged with carrying out the provisions of the Act, the Minister of Public Works, to roads under an authority other than the State, and to planned State roads, if these roads are included in the so-called State highway plan.

Erection of Buildings

The law prohibits the erection, rebuilding or alteration of any building within five meters (16.4 feet) of the border of the road, including shoulders, road ditches, etc. Road borders for roads included in the State plan, but not yet built are designated by the Minister. However, these prohibitions do not apply in the event of construction of a building was started and a permit therefore obtained within certain time periods prior to enactment of the law. The Minister may also grant other exemptions at his discretion.

Apart from the above the law prohibits the erection, reconstruction or alteration of any building within a distance from the centre line of the surfaced part of the main traffic lanes of any road especially designated by the Minister.

There is also a provision prohibiting the erection of objects which obstruct the view at the intersection of two roads or on curves. These prohibited objects are to be designated by the Minister, but do not include buildings. In the case of vegetations if objections are made, the Minister must consult with the Forest Board before making a decision.

Control of Access

No one has access to State roads or to roads which are in the State plan unless a permit for such access was issued or in effect prior to enactment of the law, or if such access existed prior to 1925 and continued uninterrupted after that time. In other words, any one who can prove that a civil right of access existed before initiation of this act may retain such right as an exemption to the provisions thereof. Such access rights remain in force only for the purpose existing at the time of passage of the act or the granting of the permit. Under this provision, if a landowner has a single access to a State highway and desires to subdivide his land or if he wants to erect a building on his land, he must make application to the Minister for permission to construct additional entrances to the highway or to use the existing access as an access to the new building. And in most cases he will be refused such permission. This was not as true in the early days of the Act as it is at the present time. The intent here appears to be to freeze the character of the land abutting on State highways. This plan is not meeting with much opposition from the people concerned.

Enforcement of the Act

Provision is made for enforcement of the Act and for penalties to be imposed in case of violations. State or municipal police and officials of the Corps of State Engineers are charged with enforcement of the provisions of the Act and may remove or cause removal of encroachments or restore the access to its former condition, but usually only after notice has been given to the offender.

Compensation

Compensation for damages is provided for insofar as landowners suffer "unevenly and severely." The amount of such compensation is arrived at by means of an appraisal made by landowners residing in the vicinity who are appointed by the court. No compensation is deemed necessary if the property owner has access "of equal magnitude" to a parallel road, unless the construction of the road results in separating a landowner's property into two isolated portions in which case he is either allowed access from the two portions or full compensation for the damage incurred. However, if the Minister refuses to grant an exemption or withdraws an

existing exemption, thereby making the exercise of a civil right of access wholly or partly impossible, full compensation may be claimed by the landowner. Access rights which have existed over a long period of time are seldom withdrawn, and if they are, compensation is quite liberal.

Provisions of the Act do not apply within existing "built-up" areas. Such built-up areas are designated by the Minister of Public Works, with the advice of the Provincial Government. However, the designation need not be revised when the built-up areas expand.

During the operation of this Act, no amendments have been made, indicating that its provisions were well thought out before its enactment, and that it is generally acceptable to those affected.

The main purpose of the law is on the one hand to make possible a network of expressways which the Government had planned for future construction on the State system, and on the other hand to protect the existing roads against excessive encroachment of new buildings, thus preserving the capital invested in them.

WORDS OF WISDOM

Seeing clearly what is wrong, often is the necessary antecedent to seeing clearly what is right. But pride in ability to spot the wrong can easily breed smugness. We can too easily be self-satisfied with flaw-picking as an accomplishment in itself. Yet flaw picking alone never helped anybody enough to bring much gratification to the picker - or the picked. The beginnings of satisfaction start when some good outcome is conceived.

"Wise men are always in doubt; only idiots are sure of their case."

"Are you sure of that?"

"Yes, absolutely."

HERE AND THERE**1. REGULATION OF CENTRAL GRANTS TO STATES**

THERE are special statutory provisions in the U. S. A. which have made grants-in-aid conditional upon compliance with certain federal standards. This is the finding of Mr. O. K. Ghose, until recently a Deputy Secretary in the Ministry of Finance, who last year visited the U. S. A. and Canada under a U. N. Economic Development fellowship.

Mr. Ghose says: "Both in Canada and the U. S. A. each aid programme is secured by law, laying down conditions, ceilings, or annual rates of expenditure, etc. There is basic federal legislation authorising appropriations on a continuing basis. Funds are apportioned among the States in accordance with the criteria specified in the basic legislation. A federal agency is given supervisory powers over the aided programme, including the power to issue rules and regulations and to audit expenditure.

Certain corresponding State legislation is enacted. State plans for the operation of aided programmes are approved by the federal supervisory agency. Federal grants are matched by State and or local funds. Federal grants are subject to withdrawal if the specified standards and conditions are not met.

The Suggestions

He has made the following recommendations in the Indian context:

- (i) There should be a suitable Central executive authority in charge of all general Government grants and loans, as a co-ordinating agency. The Planning Division of the Economic Affairs Department now fulfils this function to some extent, but it is too small and inadequately staffed to exercise any effective control over Central disbursements.

- (ii) Central expenditure by way of loans/grants to States should be

covered by Federal/State legislation programme, each programme indicating broad details and, among other things, ceiling sums, rates of expenditure, etc.

- (iii) Such expenditure should be further governed by rules and regulations conceived for each particular programme and be then incurred by the appropriate officers without day-to-day financial control by an outside agency.
- (iv) There should be, a concurrent pre-audit of expenditure incurred before actual payment. Pre-audit, however, would not question the propriety of any particular order except when the general rule or order in question is being framed. For this purpose, general rules should have the approval of the audit authorities.
- (v) Once ceilings, etc., have been laid down, authorizations should be issued by the Central executive authority on the model of Canadian crown companies in anticipation, where necessary, of annual Parliamentary appropriations, if such annual appropriations are held to be inevitable.

Desirable Link

These recommendations would seem to constitute a desirable executive link between the plans of the Planning Commission, their budgetary correlation, and the proper and effective expenditure of the properly designated sums fixed for specific programmes, without any undue procedural delay. The recommendations are in the light of U. S. practice regarding federal aid.

There is a public administration clearing house in the U. S. A. called the Council of State Governments. It is a joint

governmental agency, established and supported by the States for service to the States. It acts as a medium to improve legislative, administrative, and judicial practices in the U. S. A. and secures full co-operation among the States in solving

inter-State problems, both regional and national. It also helps in facilitating and improving Federal State relations.

(Extracted from 'Hindustan Times'—
June 27, 1953)

2. FIRE RESISTANCE OF STEEL COLUMNS ENCASED IN CONCRETE

THE results of tests to determine the fire resistance of steel columns encased in concrete made with a silicious aggregate are given in Building Materials and Structures Report No. 124 of the National Bureau of Standards of the U. S. A. Four 6-in. by 6 in. columns of H-section were tested, with a concrete cover to the flanges of 2 in., the concrete being filled solidly into the re-entrant angles. The aggregates used were river gravel and crushed quartz.

The load of 36½ tons imposed on the columns during the test was equal to the allowable load for the size of column and effective length as calculated by the formula of the American Institute of Steel Construction. The load was applied before starting the fire test and was maintained until rapid yielding of the column occurred. One column with gravel aggregate concrete was loaded to 73½ tons until the temperature of the steel was 833 deg. F., when the load was reduced to 36½ tons.

The fire-endurance limits of the columns with river gravel aggregate was somewhat greater than those with quartz aggregate. For the former yielding occurred at 3 hours 34 minutes and 3 hours 32 minutes and for the latter at 3 hours 10 minutes and 2 hours 50 minutes. The average temperatures in the steel of the first two columns were 1,346 deg. F. and 1,337 deg. F. respectively and for the second two columns 1,157 deg. F. and 1,148 deg. F. The maximum temperature recorded in all columns was about 1,400 deg. F. Spalling of the concrete did not occur, as had been reported in previous tests with silicious aggregates, and the cracking was not sufficient to expose the shaft before the critical temperature of the steel was attained. The results indicate that concrete made with silicious aggregate provides an acceptable material for the protection of structural steel against fire.

(Concrete and constructional Engineering,
June 1953)

3. RECOMMENDATIONS OF THE SELECT COMMITTEE ON ROAD
ESTIMATES IN THE U. K.

THE recommendations of the Select Committee of the House of Commons (U. K.) appointed to consider road estimates are summarised as follows:

(i) The Ministry of Transport and the Treasury should re-examine the procedure at present used in the framing of estimates for expenditure on roads, and seek to devise some method which, while causing the minimum of inconvenience to highway authorities, would furnish the Ministry with a more precise picture of the condition and the needs of the roads for which the taxpayer and the ratepayer is asked to provide.

(ii) The Ministry of Transport, in conjunction with the highway authorities, should work out, as a matter of urgency, a formula which would permit highway authorities to acquire and to use small pieces of land (up to a specified limit) which they require for the more efficient execution of schemes of maintenance or minor improvements.

(iii) The Ministry of Transport and the Department of Scientific and Industrial Research should consult together with a view to improving the means by which knowledge of the results achieved by the

Road Research Laboratory is disseminated.

(iv) Immediate consideration should be given by the Ministry of Transport and by the Treasury, in conjunction with the Department of Scientific and Industrial Research, to the expansion of the work of the Road Research Laboratory, the necessary cost being met by a corresponding reduction in the Treasury contribution to the Road Fund.

(v) The grant to the Royal Society for the Prevention of Accidents should be continued, but the Ministry of Transport should, as soon as possible, arrange a meeting of the Society with the Pedestrians

Association and the Cycling Touring Club, with a view to arranging for the full participation of these two bodies in the work of the Society.

(vi) The Ministry of Transport should consult with highway authorities and other organizations concerned with road safety, in order to bring about the greatest practicable uniformity and consistency in the application of traffic signals, crossings and all other such devices, without involving highway authorities in constant reference to the Ministry of Transport on matters of detail.

(Extracted from 'British Road Federation
Monthly Bulletin'—June 1st, 1953).

4. TRAFFIC CAPACITY OF LONDON STREETS

INVESTIGATIONS have been carried out during the past few years into matters relating to the traffic capacity of roads in Central London. The main conclusions, which can only be regarded as applying to the conditions studied, are as follows:

(1) On streets narrower than about 30 ft the speed of traffic decreases as the flow (defined as the number of vehicles passing a point per hour) increases, although on wider streets where there are no intersections this effect does not occur until the flow reaches a certain level. Using the relation between speed and flow, capacity can be defined as "the flow which produces the minimum acceptable journey speed."

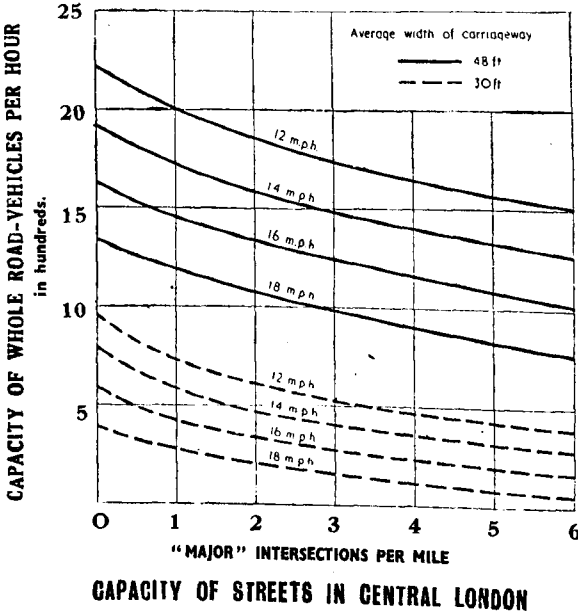
(2) Taking this speed as 15 m. p. h., the capacities of major routes in Central London with the present type of traffic and the degree of parking along them are as follows:

Carriageway width (ft)	Capacity (v. p. h.)*	Capacity per 10-ft width (v. p. h. *)
25	480	190
30	700	230
40	1,200	300
50	1,700	340

* Vehicles per hour.

(3) The capacity of an intersection controlled by traffic lights and carrying typical London traffic is about 1,000 vehicles per hour of "green" time per 10 ft width available for traffic in any direction through the intersection. (The capacity of an intersection controlled by traffic lights is dependent on the timing of the cycle and on the maximum flow which can pass during the "green" time.)

(4) The effect of intersections on the capacity of a street is considerable. The



CAPACITY OF STREETS IN CENTRAL LONDON

figure shows the capacity of streets with carriageway 30 and 48 ft wide having various numbers of "major" intersections per mile along them, a "major" intersection being one where important traffic routes cross.

(5) The average effect of changes in concentration of waiting vehicles in the range 10 to 50 per mile is a loss of 4 per cent of capacity for each 10 waiting vehicles per mile. The effect of the first few vehicles is proportionately greater. A single waiting vehicle within 50 ft of an intersection can reduce the capacity of the affected approach road by 20 to 35 per cent.

(6) The capacity of streets and intersections is reduced by about 1 per cent for each 1 per cent of the traffic which

consists of medium or heavy commercial vehicles or buses.

(7) The capacity of uninterrupted streets 30 to 33 ft wide is reduced by 5 per cent for each 1,000 pedestrians crossing per hour per mile.

(8) The capacity of intersections is reduced by $\frac{1}{2}$ to 1 per cent for each 1 per cent of the traffic which turns right.

It must be emphasized that these results are only known to apply to the type of road conditions found in Central London, i.e., a high proportion of buses, taxis and commercial vehicles, as well as private cars, few cyclists, limited parking and large numbers of pedestrians.

(Extracted from the Report of the Director of Road Research, U.K.—Road Research, 1951).

5. 16-MILE ROAD BUILT BY VOLUNTARY EFFORT.

HERE is a magnificent example of what can be achieved by self-help and co-operative effort. The 16-mile long Hathni-Budha Road in the Buldana District of Madhya Pradesh has been constructed by the local villagers with labour, land, and some money contributed by themselves. The urgent need for this link to serve the 17,000 people living in the nine villages en route having been strongly felt, the community as a whole, under the inspiration of the Deputy Commissioner, decided upon taking up the work on their own.

Organization

This is how they went about it. Road committees were formed in each village, comprising about 25 of the leading men and village officials. The members of each of the committees then selected the office-bearers, who, in turn, elected a Central Working Committee which was to decide on the general policy and programme of work and to co-ordinate the activities of the several committees. The entire work was next planned in detail with the active support of the officials in such a way as to ensure smooth implementation and maximum efficiency.

Contributions

Convinced of the benefits which would accrue to them when the project is completed, the villagers voluntarily parted with land required for the road. The total cost of the lands thus donated by the cultivators was of the order of Rs 25,000. The records officers were on the spot and did the necessary surveys and the "operation road" started straightway.

Every adult in the village was asked to provide 3 or 4 days voluntary labour either by actually working in the field or by contributing wages in lieu thereof.

Even school children with their teachers joined in the performance of the easier jobs. Cattle and carts belonging to the villagers were mobilised for collection of earth and boulders, for working ploughs, digging trenches, and drawing rollers on the road. A subscription was raised in addition from every cultivator—of a fraction of land revenue paid by him.

"Road days" were celebrated at intervals for sport and joy when all the work was suspended and every one took a hand wholtime in the "operation road". In this and other ways enthusiasm and fer-

your for this community job were infused and sustained.

Results

The construction of the whole road, involving Rs 30,000 on earthwork and Rs 45,000 on boulders and moorum collection, has been accomplished within the brief time of 65 days—much sooner than any contract agency would have tackled it. Such are the possibilities if popular will and support are harnessed to a scheme and there is unity of purpose and no factions in the villages.

Government Help

Government has not been slow in appreciating this spirit and has offered a grant of Rs 9,000 for the work.

That the road to prosperity lies through self help is the lesson that the entire area has come to learn.

He who cuts his own wood warms himself twice.—Ed.

(Condensed from 'The Hindustan Times' dated 5-7-1953.)

6. CAUSES OF FOUNDATION FAILURES

A Foundation failure reveals itself by producing defects in the surface of the road; e.g., cracks, disintegration and settlement. It may thus be impossible solely by visual inspection to distinguish between surface defects that have resulted from the failure of the foundation and those in which only the surfacing is involved. Settlement and severe forms of disintegration can usually be regarded as clear indications of a foundation failure but the causes of cracks and minor surface blemishes are sometimes difficult to identify without recourse to a detailed study of the properties of the materials comprising the pavement and the subgrade.

The deformation of the base materials and soil beneath a road can arise from a number of causes:

(1) **A Low Modulus of Deformation.** Stresses set-up in the subgrade and base by a wheel load will be accompanied by corresponding strains, the magnitudes of which are functions of the modulus of elasticity of the materials concerned. If the modulus is low, excessive deflections may result. The use of the term "modulus of elasticity" is not strictly correct, since soil rarely behaves as a truly elastic material, a permanent deformation usually resulting from the application of a load. For this reason the term "modulus of deformation" is sometimes preferred.

(2) **Insufficient Strength.** If the stresses set up in the subgrade or base are sufficiently great, plastic deformation or shear failure will occur, resulting in permanent

settlement which will increase with repetition of load. Low strength of soils usually results from a high moisture content, and to a lesser extent from a low dry density.

(3) **Poor Compaction.** Repetition of load or traffic vibrations may result in an increase in the state of compaction of the subgrade and base materials, which will be accompanied by a non-recoverable settlement.

(4) **Settlement due to Consolidation in the Subgrade or in the Soil Strata Beneath.** When a saturated compressible soil is loaded, its volume is reduced as water is squeezed out from the soil. Thus, if layers of compressible soil exist below the road structure, settlement can result from traffic loads, from the weight of the road structure and from over-burden loads due to any fill. Owing to the non-uniformity of soil strata, these settlements are rarely uniform and can cause failure of the road pavement.

Settlement of a saturated soil due to consolidation differs from that resulting from compaction, in that the soil contains at all times a negligible volume of air voids, and compaction by mechanical plant does not usually increase its dry density.

(5) **Volume Changes.** Peat and cohesive soils above their shrinkage limit will shrink or swell if a decrease or increase in moisture content occurs. When the subgrade is composed of these types of soil, changes in moisture content will result in upward or downward movements of the

road surface. In practice, these movements are not usually uniform owing to the lack of uniformity both of soil type and of changes in the moisture content.

In summer the soil in the verges and under the edges of roads tends to become drier than that under the crown, and with clay subgrades the edges of the road settle more than the centre. These movements are not usually sufficiently large to cause failure of the road structure but in periods of prolonged drought sufficient shrinkage can occur to cause the formation of longitudinal cracks in road surfaces. Vegetation, by the local removal of moisture, can also cause surface irregularity.

(6) **Removal of Soil from the Subgrade by Seepage Water or by other Agencies.** Water seeping through permeable soils may carry away some of the fine material in suspension. This is often termed "internal erosion"; it can seriously impair the support to the road structure. Water flowing to subsoil drains may similarly impair the support at the edge of the pavement, and so cause failure of the structure. Rabbits and other burrowing animals have also been known to undermine roads built on embankments.

(Extracted from 'Road Research Technical Paper No. 21, Road Research Laboratory, U. K.)

7. THE INCA ROUTE

THE expedition in search of the lost and forgotten great stone highways of the Incas has finished its first survey of the towering Lake Titicaca basin.

Highest Lake

Living through the freezing nights and searing days around the rim of the highest navigable lake in the world has taken its effect both on the machines and members of the expedition.

Most of us—the six men and one woman forming the expedition—have had the soroche, the mountain sickness that occurs about 13,000 feet high, mostly from reduction of oxygen.

Yet, despite the disabling of our jeep and the disabling of the director and his wife for some days, we have made progress found the general route of the ancient roads and have enlarged greatly our knowledge of the Inca Empire that Spain destroyed 400 years ago.

The expedition's best discoveries were the auxiliary roads that lead off from the royal roads of the Incas towards the Upper Amazon, where the Incas took their gold.

These discoveries have extended our knowledge of the Incas and given us insight into their engineering techniques, for these roads, since they are off the usual commercial runs, have been well preserved; everything is intact including the

way markers called "topos" put up by the Incas, in a forgotten century, to mark the way.

The bridges are still there and the rest houses so complete that the Inca could come back and drink from the same stone table used at the height of the empire.

Lake Titicaca, 130 miles long by some forty miles wide and about two and a half miles above sea level, has supported in its basin some of the oldest cultures of South America.

Early inhabitants found its fertile shores and adjacent valleys a promising land.

Ruined Cities

At the southern end of the lake are the ruins of Tiahuanacu, built no one knows precisely when and a puzzle to the archaeologists; all we know is that it greatly influences by its design most Peruvian cultures.

Long after came the Aymara speaking people, who spread about the whole of the 5,500 square-mile Lake Titicaca. They, in turn, were defeated by the Incas, who quickly would put the stamp of their culture on the land.

With the Collas, as they were called (for they blocked the Inca southern expansion), the Incas moved in during the late fourteenth century, quickly extended their

famous stone roads into Bolivia, and continued down into northern Argentina and central Chile.

The Inca roads became the civilising agency of the Andes. We know generally where the Inca roads run.

Used By Spaniards

At the northern tip of the lake at the place called Ayaviri, the Inca Great Road splits. One route went to the east, the other to the west of Lake Titicaca.

We traced the road out of Ayaviri; but to find it complete, one would have to build a subway. For the Spaniards utilised these fifteen-foot-wide stone highways, and at times resurfaced them.

In recent years a modern highway has been put upon them.

So, many of the Inca highways lie under the modern roads, just as in Italy, France and England the old Roman Roads lie under the new.

But the towns mentioned by the early Spanish still are here and we can follow the road through their description.

The Inca built tampos or way stations every eight or ten miles and, between these, small rest houses, for a stretch of 2,000 miles.

Each way station was maintained by a community of Indians whose duties were to grow the crops, keep up a certain section of the road by repairs, and feed the soldiers or authorised travellers on the royal road of the Incas.

(Extracted from the *Times of India*, dated 11-7-53)

8. BRITISH TREASURY VIEWS ON ROAD MAINTENANCE

"PHYSICALLY roads are piece of the Industrial Equipment of the country which must be maintained and so the State, as the owner of these roads, are no more free than an industrialist is, not to maintain his plant. If we do not

maintain the roads certain very unpleasant consequences follow. We actually waste money."

(Extracted from 'British Road Federation,' *Monthly Bulletin*, June 1st, 1953).

9. BUS OR CAR—WHICH GIVES WAY?

WHAT says the law when two vehicles meet on a narrow bridge, and neither will give way to the other?

In North Wales a bus and a car met on Bangor-on-Dee bridge and could not pass. Neither of the drivers would reverse, and the traffic was held up for an hour until the police arrived and caused the car to be removed to relieve the obstruction.

Both drivers were subsequently summoned at Wrexham Bromfield for causing obstruction, but as both summonses were dismissed the question remains unanswered.

The bridge was 70 yards long and 10 ft wide, and the car driver's case was that he started to cross the bridge before the bus. When he was more than half-way over he met the bus which he expected to reverse and give him an opportunity to proceed. No law obliged a smaller vehicle to give way to a larger one.

The case for the driver of the bus was that the obstruction was unavoidable, as it would have been against public safety to reverse the bus on such a narrow bridge.

(Extracted from 'Motor Transport'—January 17, 1953.)

10. RESPONSIBILITIES OF AN ENGINEER

THOSE of my readers who have insufficiently reflected on the conditions in which technicians carry out their activities or who are ignorant of them will perhaps be astonished at the importance which I attach to the moral side of technique. May I assure them that if, among the certitudes which I have acquired during a half-century of construction and research there is one which is abundantly certain, it is that virtues of character—courage, probity, respect and love for the task accepted—are infinitely more necessary to the engineer than those of intelligence, which is never more than a tool in the hands of a moral being.

If the employment of prestressing entails technical consequences of some weight, the decision to use prestressing is foreign to consideration of pure technique. It is nothing other than taking

up a position relative to the external world by a technician who decides to accept, the better to dominate that world, an increase of responsibility and effort. Taking such a stand constitutes an element in a problem infinitely more vast and purely moral, whose solution affects the development of human society itself. It is the problem of the balance between our needs and the means of satisfying them. There is a choice between two types of solution; man can limit his effort and restrict himself to what nature offers almost directly, or he may endeavour to extract from nature the maximum of advantage and material satisfaction at the cost of a more and more perfect understanding of and a more and more complete submission to its laws.

(E. Freyssinet in his foreword to Y. Guyon's book "Prestressed Concrete")

11. INDIA NEEDS MORE ROADS

"CONSTRUCTION of roads on a more extensive scale is necessary. The plan provides for only 600 miles of National Highways and about 3000 miles in the States in the course of the 5-year period. As is well known, the present road facilities especially in the interior, are awfully inadequate and great difficulty is experienced in moving agricultural produce. The construction of a considerably larger mileage of pucca

roads would not only be advantageous to agriculture but would also benefit the economy as a whole by making the traffic of goods easier and cheaper. These facilities are of great importance in any scheme of national development."

(From the presidential address of Shri Shanti Prasad Jain at the 26th Annual Session of the Federation of Indian Chamber of Commerce & Industry held in March 1953.)

A COMPLIMENT TO WOMEN DRIVERS!

After the wife had been at the wheel for some time, the husband said, "Darling will you let me drive so that I can relax for a while?"

TECHNICAL INFORMATION

1. COMPACTION OF SOIL*

(Contributed)

8. Is there a definite relation between dry density and moisture content?

For a given amount of compaction the dry density increases with increase in the moisture content up to the optimum moisture and then decreases. The dry density of soils having their particle sizes extending over a wide range without excess or deficiency of any particular size, increases

The curve has a steep rise for moisture contents lesser than the optimum. For moisture contents greater than the optimum the curve approaches the curve, known as zero air void curve, relating dry density of the soil having no entrapped air with moisture.

This relationship is different for different soils (See question 9).

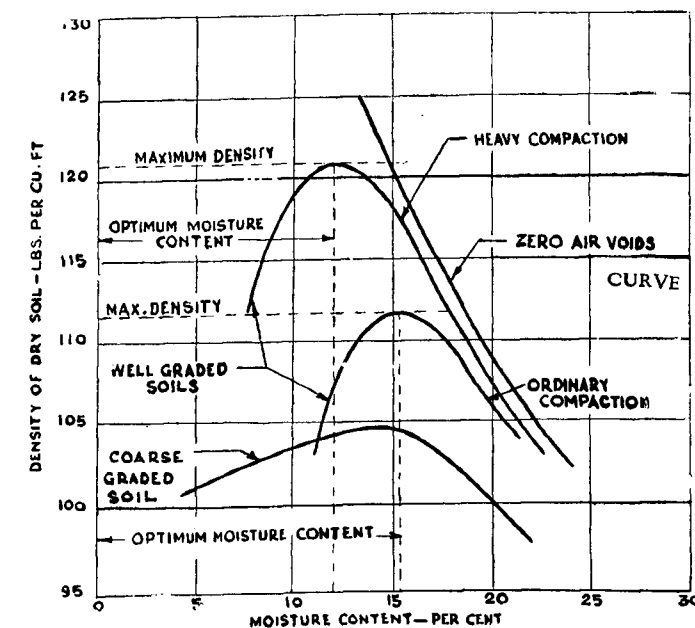


Fig 1. Moisture Dry Density Relationship.

more than that of closely graded soils by the application of the same amount of compaction. Closely graded soils are those having an excess of some particle sizes and a deficiency of others. Typical dry density moisture relationship curves are shown in Fig. 1. It is seen that there are two moisture contents at which a given dry density can be attained one below and the other above the optimum moisture.

9. How does increase or decrease in the amount of compaction affect the dry density?

For the same soil, increased dry density is obtained with increase in the amount of compaction for any particular moisture content. The greater the amount of compaction the lesser is the optimum moisture content.

* Continued from page 24 of Transport-Communications Monthly Review, August 1953.

10. The dry density moisture relationship is different for different soils and varies with the amount of compaction. How then can we assess the relative suitability of different soils?

A test for compacting soils has been standardised. The procedure is as under. Soil is rammed in 3 equal layers into a 4 inches diameter cylinder of $\frac{3}{8}$ cubic foot capacity. The compacting effort is supplied by 25 blows of a standard hammer weighing 5½ lbs with a drop of 12 inches. For details interested readers may refer to "Standards for Testing Soils", Central Board of Irrigation publication No. 42.

Because the work done on the soils tested by the above standard procedure is the same in every case the maximum dry density obtained is a measure of the relative suitability of the soils tested.

11. How is the optimum moisture content found?

The dry densities at different moisture contents are found out by the standard method (see question 10) and a curve with moisture content along the x-axis and dry density along the y-axis is plotted. The peak point of this curve gives the maximum dry density obtainable under the standard compaction and the corresponding optimum moisture content.

12. The determination of the optimum moisture content involves laboratory investigations. Is there any practical method by which one can judge the optimum moisture in the field?

The optimum moisture for standard compaction is roughly 2 to 5 per cent less than the value termed plastic limit of the soil. The plastic limit is the lowest moisture content, expressed as a percentage of the dry soil, at which a soil can be rolled into threads $\frac{1}{8}$ in. dia. without breaking.

For fine grained soils the optimum moisture content is greater than that for coarse grained ones.

A rough guide can be obtained in the field by the following test.

Take a handful of the soil and press into a ball. When you are able to make a ball of the soil without the soil sticking to your palm with the lowest possible moisture the soil is at the optimum moisture.

13. Of what use are the laboratory determinations of optimum moisture and maximum dry density in the field?

Laboratory determinations help in selecting the best available soil for use in an embankment. The soil giving the greatest dry density with the standard compaction test is the best.

The laboratory determinations give only a guide to the moisture content which would produce the best results. Because the optimum moisture content depends not only on the nature of the soil but also on the method of compaction (see question 9), when different weights of rollers are used the optimum moisture is different. Hence no standard test can give results of general validity. On any one job, accurate value can be obtained only by making a field test with the compacting equipment to be used.

14. When a soil is compacted at optimum moisture will the density that is attained and the moisture content remain constant indefinitely?

There is no construction procedure which will assure non-fluctuating moisture content and density.

An increase in moisture causes loss of stability and swelling while decrease causes shrinkage.

However, there is one point at which the soil will offer greatest resistance to change. This point is attained by means of comparative effort in conjunction with moisture control about the optimum moisture.

(To be continued).

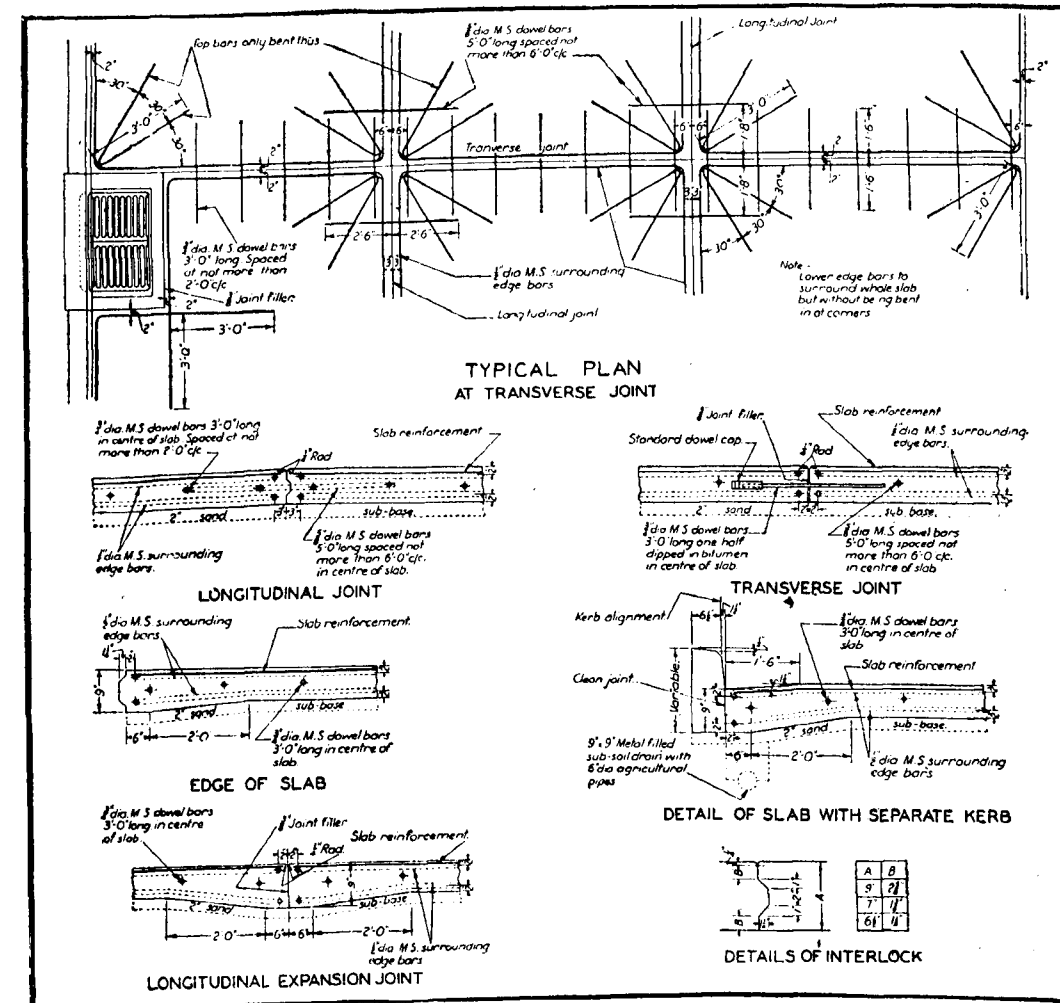
2. CONCRETE PAVEMENTS

Experience on Main Roads in New South Wales (Australia)

Early Concrete Roads

THE first concrete pavement in New South Wales was built in 1920. Subsequently a number of lengths of concrete pavements had been built on heavily trafficked roads. All these early pavements are in use although some have been covered by

been seven inches thick; some less heavily trafficked roads have been six inches or six and a half inches thick. All have been constructed with edges thickened to two or three inches more than the slab thickness, with the exception of one recent short length of uniform thickness slab. Those built in the Sydney district have usually



Details of Pavement Design.

a bituminous surface course. To some extent this resulted from wear by steel-tired vehicles which existed in large numbers during the early life of the pavements.

Design

The concrete pavements built by the Department of Main Roads have mainly

been lightly reinforced in earlier years, the reinforcement being placed usually in the lower part of the slab but latterly more often near the slab surface. Both welded draw-wire fabric and mats of mild steel bars have been used. It has been the practice also to provide edge bars and corner reinforcing bars. Transverse expansion

with mild steel dowels are at 50 ft intervals, and longitudinal deformed joints with steel tie-bars are placed usually at about 10 ft apart. While overseas concrete pavement practice has varied from time to time, the generally satisfactory results obtained with the Department's design have encouraged its continued use.

Details of the pavement design which has generally been used by the Department of Main Roads in the past are shown in Fig. (page 23).

Mix

The concrete mixture used has mainly been 1: 2: 3 parts of cement, sand and coarse aggregate on the more heavily trafficked roads, and 1: 2: 3½ on other roads. The coarse aggregate usually consists of 50 per cent commercial ¾-in. gauge stone, and 50 per cent commercial 1½-in. gauge stone.

Sub-base

Concrete pavements built by the Department of Main Roads in the Sydney district have almost invariably been placed over a sand sub-base not less than 2 in. thick. No sub-base was provided on some early concrete roads in rural areas.

Service mains

It has been the general practice before constructing concrete pavement to remove to the footways all water and gas service mains to which house service pipes are attached, to avoid subsequent cuts into pavements. As a result, pavements have been built across recently restored pipe trenches. Trenches are normally filled with sand, watered and rolled to obtain maximum consolidation. In earlier works, reinforcement was provided in the bottom of the slab where it crossed newly refilled trenches; latterly, it has been customary to provide reinforcement on the top of the slab to assist in preventing the opening of

surface cracks due to stresses set up by changes of temperature, etc., and on this account no special reinforcement has been provided over pipe trenches.

Pumping

The principal fault which has developed in the concrete pavements built by the Department of Main Roads has been pumping at transverse expansion joints. This feature has also been common on concrete pavements in overseas countries. At the present time two mudjacking gangs are usually employed dealing with about 112 miles of concrete road in the metropolitan area, partly six-lanes, partly four-lanes and partly two-lanes wide. Apart from this aspect, maintenance has not been extensive, with the exception of one road. The extensive maintenance on this road is believed to be owing partly to settlement of fairly high fills, partly to the lack of sufficient slab strength for the poor sub-grade—i. e., insufficient thickness of concrete and absence of a sub-base—aggravated by deterioration and failure of some dowelled transverse joints, and partly due to subgrade softening by ingress of water from groundwater, from sullage from adjacent houses, and through joints and cracks.

Cement concrete pavements on heavily trafficked main roads in New South Wales have given generally good service. Their use has been confined mainly to towns. In rural areas, when heavily trafficked main roads require strengthening, it is usually practicable to salvage the old pavement and use it as a base for new work. Where no such old pavement is available or suitable, and there is considerable weight of traffic to be carried, consideration is given to the relative economy of the various types of pavement available, including cement concrete.

(Extracted from the 'Main Roads' - June 1953).

ABSTRACTS

624.131. ANNUAL REPORT (1951) OF CONCRETE RESEARCH LABORATORY, CHEPAUK, MADRAS. The work done in the laboratory is presented in two sections: (1) Soil Mechanics and (2) Building Research.

In the section on Soil Mechanics, routine tests for ascertaining the bearing capacity of the soils for the foundation of the bridge across Bharatpuzha and Upputeru are presented.

Reports on research studies on the variation of cohesion and the angle of internal friction of black cotton soils from Madurai at different moisture contents and various degrees of compaction are included. The main conclusions of the study, which is still in progress are: (i) that the angle of internal friction is inversely proportional to the moisture content and (ii) that cohesion has an optimum value similar to the dry density but occurs at a moisture content below the moisture content for maximum dry density.

The section on Building Research deals with:

- (1) Use of sea sand in construction work.
- (2) Chemical studies of surkhi.

- (3) Strength of cement mortar with various admixtures.
- (4) Accelerated curing of concrete.
- (5) Various dimensions of the specimens on the strength of concrete.
- (6) Design of mix with reference to strength and workability.

625.712.65. SPECIAL PROCEDURE FOR PAVEMENT DESIGN by L. A. Palmer—Proceedings Vol. 79, Separate No. 195, American Society of Civil Engineers, June 1953.

In building airfield pavements to stand up to the heavy loads and thermal shock produced by the more modern types of aircraft, the Bureau of Yards and Docks, United States Department of the Navy, has established the testing procedure and the design criteria described in the Paper.

The Paper describes the requirements to be satisfied by the materials used, the types of tests to be performed, and the principles on which the construction methods of pavement are based. It brings out that materials of construction must fulfil special requirements to be used on runway ends and that the structural properties of the base course and the sub-base for the runway must conform to high standards.

A SLIGHT MISUNDERSTANDING

In gratitude to an American philanthropist who had given a large cheque towards the cost of restoring an old English church, the vicar sent him a gramophone recording of a service at which the congregation had rendered thanks for "the succour so providentially brought to us in time of need."

Back came an indignant cable from the United States: "Have stopped payment of my cheque. Find some other sucker."

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

I. ROADS IN GENERAL

1. **Large Agricultural Country Needs Good Roads**; G. L. ANDERSON, *Better Roads*, April 1953, pp. 19-20, 34, 36.
2. **Co-ordinating Traffic Planning and Urban Development**; D. M. GRAHM, *Traffic Quarterly*, April 1953, pp. 279-286.
3. **Road Research at Home and Abroad**, Dr. GLANVILLE's Paper at the Institution of Highway Engineers, *The Surveyor*, April 11, 1953, pp. 251-253.
4. **Highway Engineering in New Zealand**; Lt.-Col. P. R. KUMAR, *The Journal of the Institution of Military Engineers, India*, April 1953, p. 132.

II. FINANCE AND ORGANIZATION

5. **Management of Public Works - The Application of the Scientific Approach to Their Execution**; F. O. SIBLEY, *The Surveyor*, February 14, 1953, p. 119.
6. **Some Aspects of Building Contracts, Part II**; N. P. GREIG, *Indian Builder*, June 1953, pp. 8-10.

III. PLANNING, LAYOUT AND SURFACE CHARACTERISTICS

7. **The Design of Motorways, Highways and Bridges and Engineering Works**, May 6, 1953, pp. 1-3, 10.
8. **Spiral Tables for Highway Design**, H. GRISWEL, *Roads and Road Construction*, May 1953, pp. 122-125.
9. **Petrol Stations and Amenities, How the Problem is Being Tackled**, *The Surveyor*, April 4, 1953, p. 243.

IV. SOIL ENGINEERING AND DRAINAGE

10. **Soil Survey in Highway Engineering - American Development of Sub-surface Exploration by Rapid Methods, Earth Resistivity Testing**; Lt.-Col. E. W. W. RICHARDS, Part 4, *Roads and Road Construction*, May 1953, pp. 135-141.
11. **Mulching for Roadside Protection and Improvement** *Roads and Engineering Construction*, April, 1953, pp. 128, 166-171.

V. SOIL STABILIZATION AND LOW-COST ROADS

12. **Texas Stabilizes Roads with Quicklime**—*Engineering News Record*, Feb. 5, 1953, pp. 38-41.
13. **Methods of Soil Stabilization—Their Application to the Construction of Airfield Pavements**—*The Surveyor*, April 4, 1953, pp. 235-237.
14. **Bituminised Soil as Construction Material for Kutcha Houses**; Dr. R. C. HOON, *Indian Builder*, June, 1953, pp. 3-7.

VI. ROAD STONE & AGGREGATES

15. **Gap-graded Aggregate**; J. D. O. KEFFE, *Concrete and Constructional Engineer*, May 1953, pp. 173-178.
16. **Aggregate Gradation Specifications for Bituminous Concrete**, J. B. DALHOUSE, *Roads and Engineering Construction*, April, 1953, pp. 129-131, 163-166.
17. **How Aggregate should be Prepared and Handled to Ensure Good Concrete**; R. F. BLANKS, *Roads and Engineering Construction*, April, 1953, pp. 142-156.

VII. CONCRETE

18. **Prestressed Concrete Roads, Summary of a Lecture** by Lt.-Col. W. P. ANDREWS at Liverpool, *The Journal of the Institution of Municipal Engineers*, May 1953.
19. **Quality Control of Concrete—Its Rational Basis and Economic Aspects**; N. M. PLUM, *Proceedings of the Institution of Civil Engineers*, Part I, Vol. 2, May 1953, pp. 311-336.
20. **Test Post-Tensioned Highway Slabs**, *Engineering News Record*, April 23, 1953, pp. 6-9.
21. **Labour Saving Way to Spread Concrete by Hand**, *Roads and Streets*, March 1953, p. 81.
22. **Fire Resistance of Prestressed Concrete—Results of Research Station Tests**, *The Surveyor*, March 7, 1953, pp. 86-88.
23. **Concrete Roads**; A. VITTORZ, *Bulletin Technique de la Suisse Romande*, May 16, 1953, pp. 179-183 (in French).

VIII. OTHER MATERIALS AND CONSTRUCTIONAL DETAILS

24. **Creep of High Tensile Steel Wire**; N. W. B. CLARKE and F. WALLEY — Correspondence — *Proceedings of the Institution of Civil Engineers*, Part I, Vol. 2, May 1953, pp. 359-365.
25. **Reinforcement Used at High Stresses in Concrete Bridges Abroad**; AKE HOLMBERG—*Engineering News-Record*, May 7, 1953, pp. 57-58.

IX. MAINTENANCE

26. **A Study of Road Maintenance Production, Connecticut**, *Better Roads*, April 1953—pp. 28, 31, 40.
27. **Highway Maintenance Problems Solved by Research**; J. WALTER—*Roads and Engineering Construction*, March 1953, pp. 142-144, 176-181.

X. BRIDGES AND OTHER STRUCTURES

28. **Group Loadings Applied to the Analysis of Frames**; F. I. F. MORRISON, *Proceedings of the American Society of Civil Engineers*, Separate No. 183, April, 1953.
29. **The Equivalent Rectangle in Prestressed Concrete Design**; J. J. PEEBLES, *Proceedings of the American Society of Civil Engineers*, Separate No. 187, April 1953.
30. **Bridge Foundations in Difficult Ground**; F. M. McNAUGHTON, *The Journal of the Institution of Municipal Engineers*, May 1953, pp. 505-517.
31. **Planning a New High Bridge in the Mountainous Rivers**; *Schweizerische Bauzeitung*, May 2, 1953, pp. 259-268.
32. **Design Data for Single Span Bridges in Prestressed Concrete**; A. W. HILL, Part (1), *The Surveyor*, April 4, 1953, pp. 231-232.
33. **Design Data.....do..... Part 2**, *The Surveyor*, May 2, 1953—pp. 295-297.
34. **New Prestressed—Concrete Bridge in North Devon—Replacement of Structure Destroyed by Floods: Use of Hollow Concrete Trough Units**, *The Surveyor*, April 4, 1953, p. 238.

XI. TRAFFIC AND ROAD USER CHARACTERISTICS

35. **Chesapeake Bay Highway Bridge and its Effect on Traffic**; G. N. LEWIS Jr. and N. C. HOPKINS, *Traffic Quarterly*, April 1953, pp. 163-178.
36. **Some World Traffic Problems**; R. O. SWAIN, J. PLUM and F. TWIN, *Traffic Quarterly*, April 1953, pp. 212-223.
37. **The Rate of Change in Transverse Placement - Open Discussion**, *Traffic Engineering*, April 1953, p. 238.

XII. TRAFFIC MARKINGS, SIGNS AND SIGNALS

38. **Traffic Regulation, Improvement of Intersections and Capacity:** M. JENNI, *Strasse and Verkehr* - May 1953, pp. 151-155 (in German).
39. **Automatic Traffic Count on the Swiss Highway Systems,** *Strasse and Verkehr*, May 1953, pp. 156-161 (in German).

XIII. VEHICLE AND STREET LIGHTING

40. **Public Roads Illuminated with Flourence Lamps:** C. RY. POCHON, *Bulletin Technique de la Suisse Romande*, May 16, 1953, pp. 115-121 (in French).

XIV. SAFETY AND ACCIDENTS

41. **Protecting Road Crews from Traffic,** *Better Roads*, April 1953, pp. 25-27, 44, 46.
42. **Illuminated Advertisements and Traffic Hazards:** W. LETTER, *Strasse and Verkehr*, May 1953, pp. 149-150 (in German).

XV. PLANT, MACHINERY AND APPARATUS

43. **Design of Low Frequency Fatigue Testing Machine:** C. V. JOGA RAO and L. S. SREENATHAN, *Journal of the Indian Institute of Science*, Bangalore, April 1953, pp. 87-92.
44. **A Mobile Engineering Laboratory:** C. W. NEWBERRY and R. C. JERRETT, *Engineering*, May 22, 1953, pp. 669-671.

PUBLICATIONS ADDED TO THE ROADS ORGANISATION LIBRARY DURING JULY 1953

The Manager of Publications, Delhi.

1. **Agricultural Wages in India - Vol. II - Appendices** issued by Ministry of Labour, Govt. of India.
2. **I. R. S. No. B-2-45.** For erection and rivetting of bridge girders issued by Min. of Rlys. (Rly. Board).
3. **I. R. S. No. B-5-53.** For Reinforced Concrete Pipes for use as Culverts issued by Min. of Rlys. (Rly. Board).
4. **Indian Railway Code for the Engineering Department** (Provisional Issue), Second Reprint. Issued by the Min. of Rlys. (Rly. Board).
5. **Indian Railways General Code, Vol. II - Appendices.** Issued by the Min. of Rlys. (Rly. Board).
6. **Soil - Cement Roads - Construction Handbook - containing Data**

Sheet "Use of Sand - Funnel Density Apparatus for Determination of Field Densities of Soils and Soil Mixtures in Place" (Reprint). (The Concrete Association of India, Queen's Road, Bombay).

7. **Stress Analysis of Concrete Pipe - Engineering Monographs No. 6,** by H. C. Olander. (U. S. Deptt. of the Interior, Bureau of Reclamation, Technical Editorial Office, Denver Federal Centre, Denver, Colorado).
8. **Fourth Vana Mahotsava, July 1953.** (Ministry of Food & Agriculture, Govt of India).
9. **Building New India.** (The Planning Commission, Govt. of India, New Delhi).
10. **Bison Information Book, Vol. II, 1952.** (Concrete Ltd., Stourton, Leeds, 10).

BUDGETS AND ADMINISTRATION REPORTS

PUNJAB CIVIL WORKS BUDGET FOR THE YEAR 1953-54

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

	(In lakhs of rupees)		
	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
I. Revenue (Civil Works)			
(i) Rents	8.34	7.32	7.39
(ii) Tolls on Roads	0.15	0.33	0.33
(iii) Recoveries of Expenditure	18.68	—	12.50
(iv) Transfer of Central Road Fund	23.34	22.95	9.10
(v) Miscellaneous	16.01	23.03	19.75
(vi) Deduct—Refunds	- 1.28	- 0.46	- 0.33
Total:	65.24	53.17	48.74
II. Expenditure (Civil Works)			
(i) Original Works	89.07	91.15	129.28
(ii) Repairs	68.29	66.89	62.90
(iii) Tools & Plant	0.73	1.08	1.54
(iv) Grants-in-Aid	4.08	5.49	5.85
(v) Suspense	- 22.61	- 9.77	4.00
(vi) Establishment	12.92	15.96	18.40
(vii) Deductions	- 13.02	- 23.59	- 1.70
Total:	139.46	147.21	220.27
III. Expenditure (Communications)			
(a) Original Works			
(i) Provincial	3.22	14.07	62.61
(ii) Financed from Central Road Fund	—	—	—
(iii) Punjab Govt.'s Ordinary Share	6.62	9.38	12.75
(iv) Government of India Reserve	36.14	13.57	8.85
	39.78	Not available	40.00
(b) Repairs			
Total:	85.76	—	124.21
IV. Revenue from Roads			
(1) Receipts under Motor Vehicles Acts	20.16	20.02	20.95
(2) Net Receipts under Punjab Motor Spirits (Taxations of Sales) Act, 1939	22.47	21.47	21.48
(3) Receipts under Punjab Passengers and Goods Taxation Act 1952	—	17.02	42.01
Total:	42.63	58.51	84.44

A BRIEF REVIEW OF THE PUNJAB BUDGET

(With special reference to Civil Works)

THE Punjab Budget for 1953-54 provides for total revenue receipts of Rs 19,73.91 lakhs and expenditure charged to revenue of Rs 20,04.72 lakhs with a consequent deficit of Rs 30.81 lakhs. The revised estimates for 1952-53 indicate a surplus of Rs 167.35 lakhs with the revenue receipts amounting to Rs 18,56.10 lakhs and expenditure to Rs 16,88.75 lakhs.

Revenue expenditure on Civil Works for 1953-54 estimated at Rs 220.27 lakhs is about 50 per cent higher than the corresponding expenditure under Revised Estimates 1952-53 (Rs 147.21 lakhs). It forms 11.2 per cent of total estimated

State revenue in 1953-54 (Rs 19,73.91 lakhs), the corresponding percentage figures for the two preceding years 1952-53 (Revised) and 1951-52 being 7.9 and 7.7 respectively.

The budgeted provision for communications under the Head 'Original Works' is Rs 84.21 lakhs in 1953-54, being more than double the corresponding provision under Revised Estimates 1952-53 (Rs 37.02 lakhs). The total estimates for communications under both original works and repairs amount to Rs 124.21 lakhs in 1953-54 and form 6.3 per cent of total State revenues in the year.

2. SUMMARY OF THE PUNJAB P. W. D.

ADMINISTRATION REPORT FOR THE YEAR 1950-51

Road Milage

The total length of roads in the Punjab at the end of the year under review was as follows:

	National Highways	Other Roads	Total
(1) Metalled and surface painted	778	1,505	2,283
(2) Concrete	2	-	2
(3) Water-bound un-surfaced and soil stabilised roads	2	79	81
(4) Unmetalled	19	830	849
	801	2,414	3,215

Road Expenditure

The total expenditure on maintenance of these roads during the year amounted to Rs 52.32 lakhs including Rs 17.74 lakhs on account of National Highways. The

corresponding expenditure in the previous year amounted to Rs 53.51 lakhs. Expenditure incurred on development of roads during the year under report amounted to Rs 50.89 lakhs which included Rs 17.41 lakhs spent on National Highways.

Road Works Executed

The activities of the Department on the improvement of roads were mainly connected with the widening of the different sections of the Grand Trunk Road from 12 ft to 22 ft metalled width and providing an alternative route to Kashmir from Jullundur to Pathankot, which would considerably shorten the distance between these two towns. The Department has also to discharge heavy responsibilities for maintaining to a military standard the roads near about the border which in the past were of little consequence.

Communications Board

The State Communications Board distributed during the year Rs 3.30 lakhs as

grants to the various District Boards for the development and maintenance of class II roads.

Establishment Charges

Total expenditure on execution of Civil Works (excluding Public Health Works) incurred during the year under report was Rs 157.55 lakhs and the expenditure on Civil Works establishment was Rs 17.05 lakhs. Thus the gross percentage expenditure on Civil Works establishment works out to 10.8 per cent, the corresponding percentage for Rehabilitation Works (Outside Civil Works) being 12.1. After allowing 25 per cent deduction for extra departmental activities the net percentage on establishment comes to only 9.3.

FIRST PRIORITY

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

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

first of all, communications,
secondly, schools,
and thirdly hospitals and dispensaries.

GOD FORBID, NO PLEASE

A newspaper manager was desirous of securing our advertisements. He wrote to us, with a view to impress upon us the promptness of their news service:

"We are sending you a copy of our paper dated....."

It features on the front page the sad news of the fire which burnt down 9 buses and the bus station causing big loss to the.....Company.

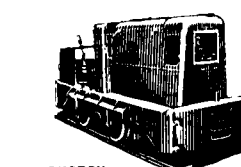
Our paper broke this news first to its readers in the early morning as the fire broke out.

We look forward to opportunities when we can be similarly serviceable to your establishment as well."

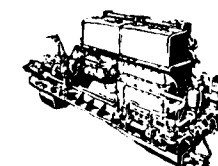
LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job. No.	Name of work	Amount (Rs lakhs)
BOMBAY			
1.	751 BM 8	Acquisition of land for widening the Mindhola Bridge to Kadodra Section of National Highway No. 8 in Bombay and diversions near Palsana, Baleswar and Chalthan villages.	1.45
2.	752 BM 8	Construction of the Boriavi-Vasad Section from mile 13/0 to 16/2-400 of the Bombay-Ahmedabad Road (National Highway No. 8).	4.79
3.	754 BM 8	Construction of the Prantij-Himmatnagar Section of the Bombay-Ahmedabad National Highway No. 8.	10.10
4.	755 BM 8	Construction of Himmatnagar-Gomdi subsection of the Himmatnagar-Raigadh Section of the Bombay-Ahmedabad National Highway No. 8.	3.67
5.	757 BM 8	Land acquisition for approach road to and for extension of the Lindiyad quarry on the Bombay-Ahmedabad National Highway No. 8.	0.38
6.	758 BM 4	Asphalting miles 180/0 to 245/1 of the Bombay-Poona-Bangalore N.H. No. 4 in Belgaum division.	11.86
7.	760 BM 8	Construction of a diversion in miles 136/4 to 138/7 (near Bagwada and Udwada villages) on the Bombay-Ahmedabad N.H. No. 8.	1.39
HIMACHAL PRADESH			
8.	753 HP 22	Construction of three 4-ft span culverts in miles 26/2, 28/1 and 34/2 on the H.T. Road (N. H. No. 22).	0.13
MADRAS			
9.	766 MD 5	Formation of a bypass road at Kovur between miles 111/0 and 112/4 of Madras-Calcutta road.	2.97
ORISSA			
10.	750 RS 42	Realignment of curves at 15th mile on Cuttack-Sambalpur Road-N.H. No. 42-VII Section.	0.38
PUNJAB			
11.	756 PB 1A	Construction of bridges and culverts on the bypass at Tanda.	2.15
12.	759 PB 22	Construction of a high level bridge over Ghaggar River in mile 22 of the Ambala-Kalka Road.	15.27

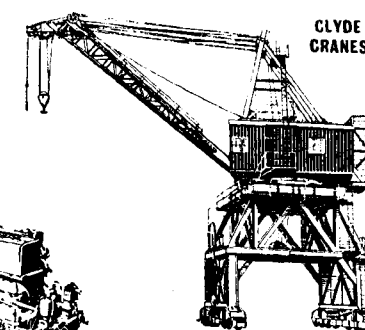
MECHANICAL EQUIPMENT For Indian Industry



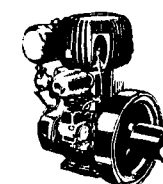
**RUSTON
DIESEL LOCOS**



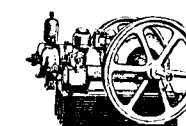
**RUSTON MARINE
OIL ENGINES**



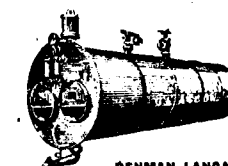
**CLYDE
CRANES**



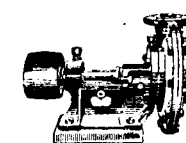
**WOLSELEY
KEROSENE ENGINES**



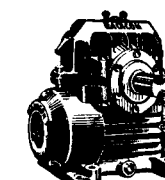
**RUSTON HORIZONTAL
OIL ENGINES**



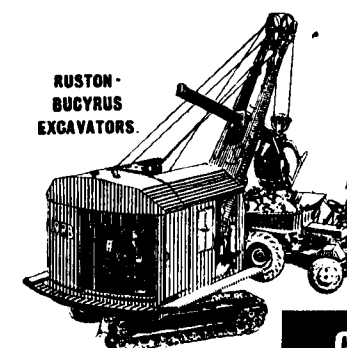
**PENMAN LANCASHIRE
STEAM BOILERS**



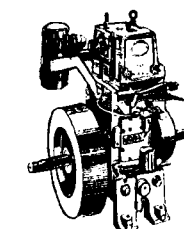
**RUSTON
CENTRIFUGAL PUMPS**



DAVID BROWN GEARS



**RUSTON-
BUCYRUS
EXCAVATORS**



**RUSTON VERTICAL
OIL ENGINES**



**STREAM-LINE LUBRICATING &
TRANSFORMER OIL FILTERS**

**AVELING-BARFORD
DIESEL SHUTTLE DUMPERS**

Greaves Cotton & Co., Ltd.,

Mechanical Engineering Department,

1, Forbes Street, Bombay.

Branches: Ahmedabad, Calcutta, Kanpur, Madras, New Delhi

NAS

G-19-53

Please mention this journal when replying to advertisements.

GANNON, DUNKERLEY & CO., (MADRAS) LTD.**CIVIL, SANITARY & CONSTRUCTIONAL ENGINEERS**

Specialists in Design and Construction of R. C. C. Structures, Bridges, Buildings, Water Supply and Drainage Schemes, Sanitary Installations etc. . . .

Sole Licensee in South India for the Italian 'R' System of Prestressed Concrete.



Registered Office: 14, BOAG ROAD, MADRAS-17.

Telephone: 88316 & 88549.

Telegrams: "VITOPUS", Madras.

MILLARS' MACHINERY

Concrete Mixers—Tilting and non-Tilting Types.

Asphalt Mixers—for Hot and Cold Mix.

Roller Pan Mixers—for Mortar.

Diaphragm Suction Pumps for effective lift up to 25 ft.

Self-Priming Pumps for handling Seepage at lowest possible cost.

Tower Hoists for speedy construction.

Wellpoint Pumping Equipment for dewatering—the only successful method of combating running sand.

TIMBER

HARDWOODS - SOFTWOODS - PLYWOODS

MILLAR'S TIMBER & TRADING CO., LTD.

(INCORPORATED IN ENGLAND)

VICTORIA HOUSE, VICTORIA ROAD, BOMBAY-27.

Telephone: 41077

Telegrams: JARRAH

Branches and Agents throughout the World.

Please mention this journal when replying to advertisements.

NOW all the **HOT PATCH** material
you want..any type..any quantity

where and when
you want it



for **ALL** maintenance
and small paving jobs

the **NEED**

In the face of ever heavier traffic loads, rising costs and lack of funds greatly limit new construction and place an ever greater burden on maintenance programmes in city, town and district. For this work even the best patch is none too good. Yet until the advent of the new Mixall, an efficient and economical means of producing all types of hot high quality patch material has not been available.

is **ANSWERED**

A small, highly portable unit, capable of on-the-spot production of even the highest types of hot mixes comparable to those produced in Barber-Greene's largest continuous hot mix plant—that is the Mixall. Its range of usefulness extends throughout the field of road maintenance into small paving and resurfacing jobs.

In the Mixall, Barber-Greene offers a unique and effective combination of an efficient rotary drum aggregate dryer with a proved B-G twin shaft heated pugmill mixer. It is rightly called the Mixall because of all the things it can do.

- ... Mix all quantities: from a single 300 lb. batch up to 5 tons per hour of hot mix—or up to 10 tons per hour of cold patch.
- ... Mix in all locations: towed to the job by truck loaded with aggregate... fed directly from truck or from stock pile or pit. Can work in a single traffic lane. No set-up time required.
- ... Mix in all weather: heated aggregate makes low atmospheric temperature mixing possible—allows quick repair to prevent major failures.
- ... Mix all types: of bituminous materials including stabilized mixes—as well as low slump Portland cement mixes.

Send for Details

Barber-Greene Overseas, Inc.

DISTRIBUTORS OF BARBER-GREENE PRODUCTS MANUFACTURED BY:

BARBER-GREENE COMPANY, Aurora, Illinois, U.S.A.
BARBER-GREENE OLDING COMPANY, LTD. England
BARBER-GREENE (CANADA), LTD., CANADA

Please send me the descriptive 8-page bulletin on the Mixall

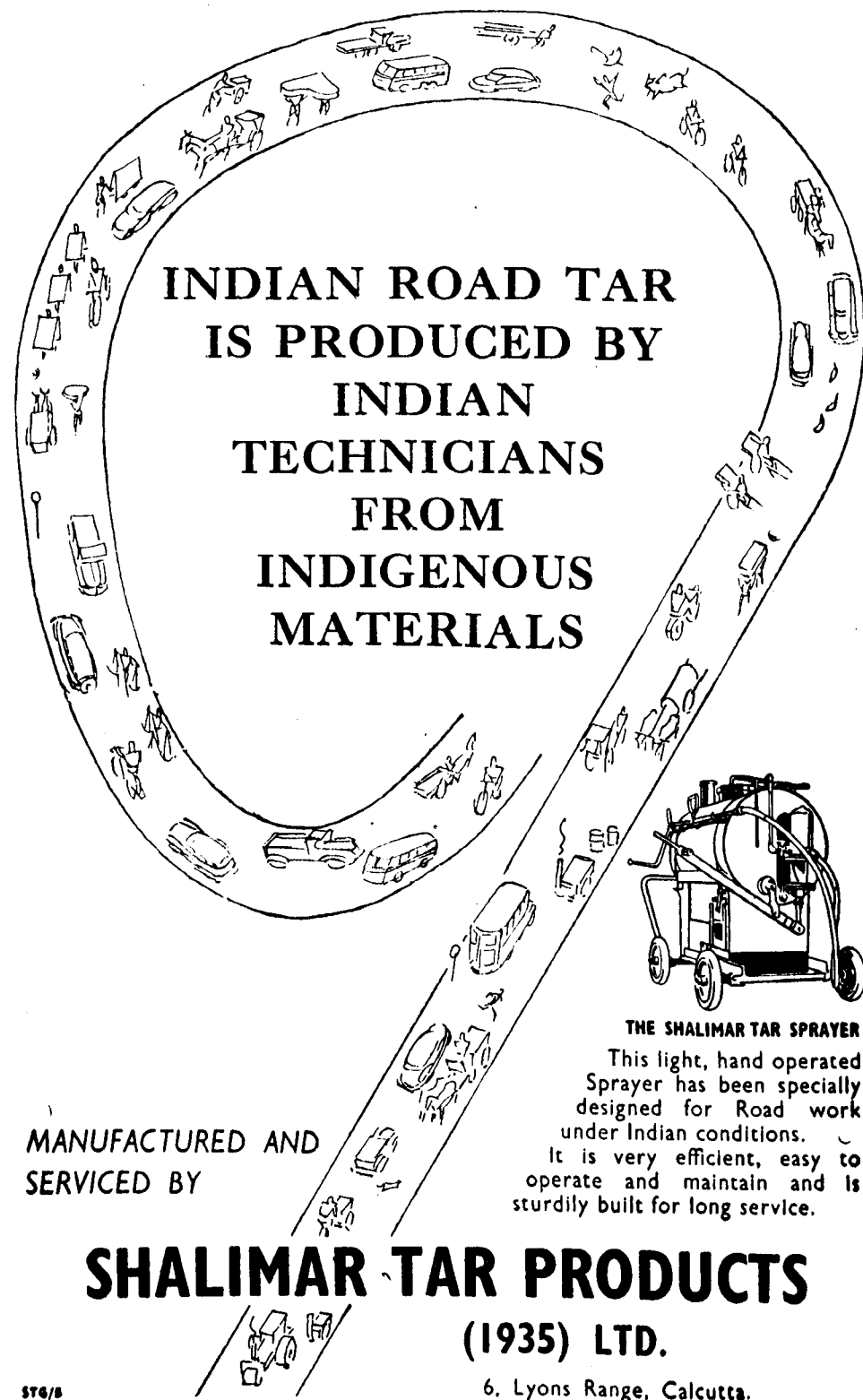
Name

Firm Name

Address

City State

Please mention this journal when replying to advertisements.



STG/B

Please mention this journal when replying to advertisements.

GENERAL MOTORS INDIA LIMITED

1953 MODELS

CHEVROLET and BEDFORD

PETROL AND DIESEL VEHICLES

ARE AGAIN AVAILABLE IN AMPLE SUPPLY

at lower prices



GMI assure the tens-of-thousands of GM vehicle owners—present and future—that **AMPLE SUPPLIES OF SPARE PARTS** will continue to be available in the future, as they have been during the past 25 years.



GENERAL MOTORS INDIA LIMITED

Fosbery Road, Sewree, Bombay

Serving India's transport needs for a quarter of a century

Please mention this journal when replying to advertisements.

BSY-650

IN NEW DELHI



Traffic Rotary at Council Chamber—1" Shell-macadam with Mexphalte 80/100 (fluxed with K) laid during October 1952. Subgrade is surface dressing on WBM.



Ferozeshah Road—Surface painting with Mexphalte 80/100 originally and repainted with Mexphalte 80/100 during 1945/46.

BURMAH-SHELL ... IN INDIA'S LIFE AND PART OF IT

“HOTFIX” ASPHALT
Chief Characteristic
UNIFORM
NON-SKID
DURABLE
ECONOMIC

For particulars, please write to—

Messrs. McLEOD & CO. LTD.,
3, NETAJI SUBHAS ROAD,
CALCUTTA.

A limited number of copies of the following publications are available for sale.

Publications.		Price inclusive of postage, etc.	
		Rs	A. P.
1.	Volume IX—Part 4—October 1945	3	0 0
2.	Volume IX—Bound—Madras 1945	10	0 0
3.	Volume X—Part 4—August 1946	3	0 0
4.	Volume XI—Part 4—May 1947	3	0 0
5.	Volume XI—Bound—1947	12	0 0
6.	Volume XII—Part 1—September 1947	3	0 0
7.	Volume XII—Part 2—January 1948	3	0 0
8.	Volume XII—Part 3—April 1948	3	0 0
9.	Volume XII—Part 4—March 1948	3	0 0
10.	Volume XII—Part 5—September 1948	3	0 0
11.	Volume XII—Bound—1947-48	12	0 0
12.	Volume XIII—Part 1—December 1948	3	0 0
13.	Volume XIII—Part 2—January 1949	3	0 0
14.	Volume XIII—Part 3—January 1949	3	0 0
15.	Volume XIII—Bound—1948-49	11	0 0
16.	Volume XIV—Part 1—September 1949	3	0 0
17.	Volume XIV—Part 2—December 1949	3	0 0
18.	Volume XIV—Part 3—December 1949	3	0 0
19.	Volume XIV—Part 4—July 1950	3	0 0
20.	Volume XIV—Bound—1949-50	8	0 0
21.	Volume XV—Part 1—August 1950	3	0 0
22.	Volume XV—Part 2—November 1950	3	0 0
23.	Volume XV—Part 3—January 1951	3	0 0
24.	Volume XV—Part 4—August 1951	3	0 0
25.	Volume XV—Bound—1950-51	9	0 0
26.	Volume XVI—Part 1—November 1951	3	0 0
27.	Volume XVI—Part 2—March 1952	3	0 0
28.	Volume XVI—Part 3—April 1952	3	0 0
29.	Volume XVI—Part 4—October 1952	3	0 0
30.	Volume XVII—Part 1—December 1952	3	0 0
31.	Volume XVII—Part 2—January 1953	3	0 0
32.	Volume XVII—Part 3—January 1953	3	0 0
33.	Road Research Bulletin No. 1	5	0 0
34.	I. R. C. Standard Specifications and Code of Practice for Road Bridges in India (1937)	1	8 0
35.	Proceedings of the Chief Engineers' Conference at Nagpur on the Post-war Road Development in India	2	8 0

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

தவணைத்தாள்.

ப, எண் :

[illegible]

S.F. 259A-6-1,00,000-30-1-84.