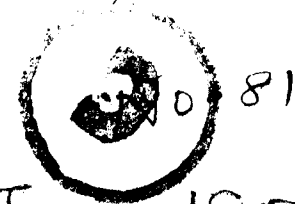


69

Transport Communications

Monthly Review



Jan 1954

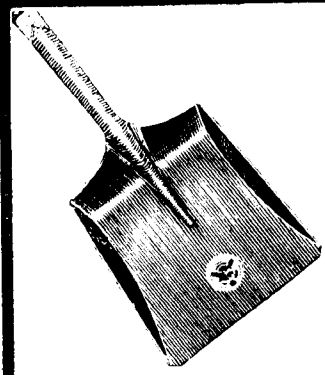
JL
D41m2, N48
N54.81
99528

FOR EVERY ROAD-MAKING JOB



Agrico implements are helping to build better roads and lay safer surfaces. Because Agrico implements are made from special quality steel and individually tested for superior strength, they are being employed more and more by leading engineers and contractors.

AGRICO
the right tool for the right job!

 SQUARE-NOSED SHOVEL Made from high-carbon steel to I.S.I. specifications. Fitted with seasoned wooden handles.	 PICK-AXES Available in two patterns. Extremely sturdy and long lasting. CROWBAR In standard length of 5'-5" and sections from 7'-8" to 11". Made from high-carbon steel.	 BALLAST-BREAKING HAMMER Available in 1 lb. weight. Breaks the heart of any stone - really strong and durable.
---	---	--



TATA AGRICO IMPLEMENTS

THE TATA IRON AND STEEL COMPANY LIMITED

Head Sales Office : 23-B, Netaji Subhas Road, Calcutta-1

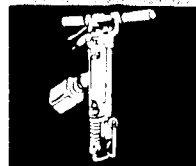
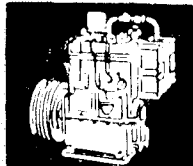
Branches at : BOMBAY, MADRAS, NAGPUR, AHMEDABAD, SECUNDERABAD, KANPUR, JULLUNDER CANTT. & VIZIANAGRAM CANTT.

AG 3871

Please mention this journal when replying to advertisements.

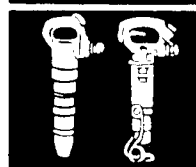
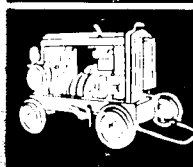
COMPRESSED AIR EQUIPMENT

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



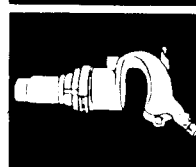
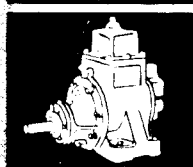
ROAD RIPPERS
Weights from 43 lbs. to 75 lbs.

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



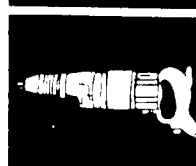
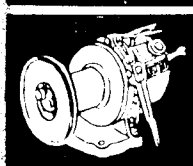
PICKS & SPADERS
Weights from 20 lbs. to 26½ lbs.

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



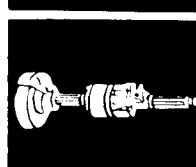
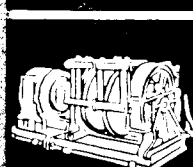
HAMMERS
Weights from 7½ lbs. to 13½ lbs.

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



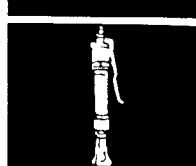
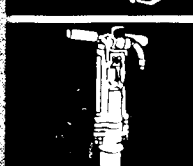
ROTODRILLS
Hand and screw-feed. Capacities to 3 ins.

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



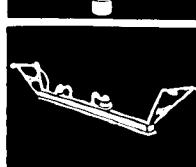
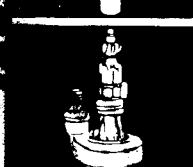
ROTOGRINDS
Radial and surface types. Taking 2" to 6" wheels.

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



RAMMERS
Weights from 9 lbs. to 40 lbs.

CONCRETE COMPACTORS
A new machine for Concrete Compaction.



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, Bolbits and tungsten carbide tipped Drill Rods, all of which are world famous.

BIRD & CO., LIMITED
CALCUTTA . DELHI . KANPUR

KILLICK NIXON & CO. LTD. BOMBAY. **BEST & CO. LTD.** MADRAS.

Please mention this journal when replying to advertisements.

the 'COMET' 90



for Passenger Transport

Made in 2 wheel bases for passenger vehicles, Leyland's latest, the 'COMET' 90, is an answer to the growing demand for reliable, heavy duty buses needed to augment the country's existing fleets. The 'COMET' 90 passenger buses require less fuel and lubricating oil, last longer and reduce maintenance costs.

Leyland DIVISION

ASHOK MOTORS LIMITED

Progressive Manufacturers

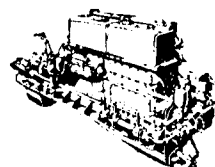
ENNORE, MADRAS

Please mention this journal when replying to advertisements.

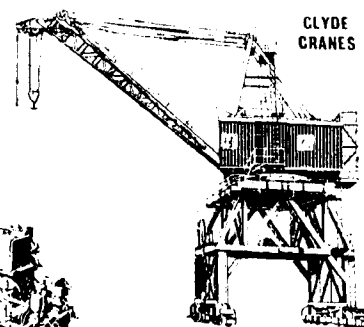
MECHANICAL EQUIPMENT For Indian Industry



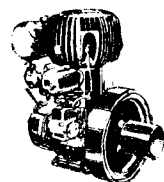
RUSTON
DIESEL LOCOMOS



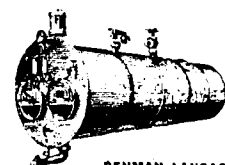
RUSTON MARINE
OIL ENGINES



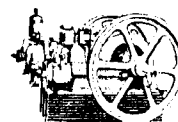
CLYDE
CRANES



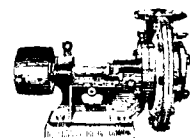
WOLSELEY
KEROSENE ENGINES



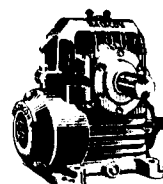
PENMAN LANCASHIRE
STEAM BOILERS



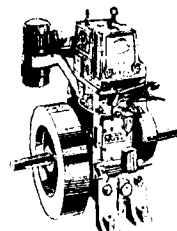
RUSTON HORIZONTAL
OIL ENGINES



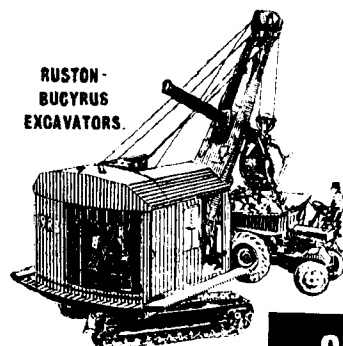
RUSTON
CENTRIFUGAL PUMPS



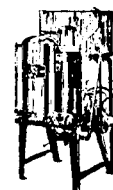
DAVID BROWN GEARS



RUSTON VERTICAL
OIL ENGINES



RUSTON-
BUCYRUS
EXCAVATORS.



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-18-57

TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

JANUARY 1954—No. 81

TABLE OF CONTENTS

GENERAL	Page
Role of the Federal Government in Highway Development in the U. S. A.	... 1
History of the Theory of Columns	... 5
Road Transport in Europe	... 8
Systematic Accident Investigation	... 10
Road Transport in the Union of South Africa	... 12
TECHNICAL	
Progress in Soil Mechanics, Structural Theory, and Structural Steelwork	... 14
The Operation of Angledozer and Bulldozers	... 17
A Note on Leaching and Afflorescence	... 20
HERE AND THERE	
1. Standardization	... 22
2. Damage to a New Road	... 22
3. Glass-Mixed Concrete	... 23
4. Correct Care and Handling of Wire Ropes	... 23
5. Acid Resistant Concrete	... 23
6. Roadside Plantings Reduce Traffic Noise	... 24
7. Prestressed Concrete Road	... 24
8. Diesel Engine Assembled in India	... 25
9. The Open Road	... 25
CURRENT LITERATURE	
Abstracts	... 26
Book Review	... 26
Selected Recent Literature in Engineering Journals	... 27
Publications Added to the Roads Wing Library During November 1953	... 32
BUDGETS AND ADMINISTRATION REPORTS	
(i) Govt. of Madhya Bharat Civil Works Budget 1953-54	... 34
(ii) Govt. of Saurashtra Civil Works Budget 1953-54	... 35
Approved Works on National Highways.	... 37

ALSO: Definitions of Highway Engineering Terms—Words of Wisdom—Period of Courtship.

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 personnel 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 per insertion

	Full Page	Half Page
Inside front cover	Rs 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.

V

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

JANUARY 1954

69 THE ROLE OF THE FEDERAL GOVERNMENT IN HIGHWAY DEVELOPMENT IN THE U.S.A.

*(Extracted from "Highway Construction—Federal-State Relations—Chamber of
Commerce of the U. S. A., Washington)*

THE integrated, efficient highway system in the United States today is due in great measure to the guidance and direction made possible through the Bureau of Public Roads.

Federal aid for highways is solely for construction and right-of-way acquisition and cannot be used for maintenance or administrative expenses of the state. Furthermore, it must normally be matched by state funds on a 50-50 basis. This matching basis is endorsed by the Chamber of Commerce of the U. S. as well as by the American Association of State Highway Officials.

An exception has been made for states with large areas of public lands. In these states the federal share is increased by a percentage equal to one-half the percentage of public lands the state contains. This permits the construction of interstate routes by states which otherwise might not be able to afford them.

Highway Departments in the States

In 1916 there were a few state highway departments, but many of them were without adequate power. Federal-aid legislation of 1921 requires that any state desiring to take advantage of federal aid should establish and maintain a state highway department, commission, board or official, suitably equipped and organized to discharge

the duties required by federal legislation. Within a very short time after passage of the 1921 Federal-Aid Road Act, highway departments had been established in all states, fully empowered and qualified to construct, maintain and administer state highways.

The Bureau of Public Roads, representing the federal government, exercises no positive control over any highway department or actions of the state. Rather the Bureau of Public Roads cooperates with the states in the planning and construction of highway facilities.

The states have the initiative in all projects. They select the system upon which federal funds are expended, determine the projects for construction, and decide upon standards of design and types of construction. The Bureau of Public Roads has the power to grant or withhold approval of a state's plans and proposals. In the case of an adverse decision, the state always has the right to discuss the case or to use state funds without federal aid.

Federal Highway Legislation

The federal government's responsibility for extending financial highway aid to the state began with the first Federal-Aid Road Act of 1916. This Act also created the Bureau of Public Roads, which has administered federal highway funds and directed federal highway policies ever since.

Twenty-three companion Acts have been passed since the original Federal-Aid Road Act. Although the primary purpose of most of them was to provide specific authorization of federal aid funds, several included basic changes and additions to the concept of federal aid for highways. Following are the highlights of these Acts and the year in which they were passed.

1921—All states were required to match federal-aid allotments by 50 per cent of the construction cost of any approved project, and to designate a system of primary and secondary highways not to exceed 7 per cent of the total highway mileage of the state. Up to 60 per cent of the federal highway contribution could then be expended on the primary system.

1932—Federal government was authorized to loan money to the states for use in matching federal-aid highway funds.

1934—Permission was granted by Congress for use of 1½ per cent of regular federal-aid funds for surveys, plans and engineering investigations. Future federal-aid funds were to be withheld from states making further diversion of motor vehicle revenues for non-highway purposes. For the first time specific allocations were made for the secondary or feeder roads.

1940-41—Permission was given the federal government to finance the entire engineering and three-fourths of construction cost of national defence projects, with the states providing the remaining 25 per cent. And at the same time the government paid the entire cost of engineering and construction on strategic military access highways.

1944—First allotments of federal-aid were made to urban areas with 5,000 or more population. The formula was established for apportioning federal aid for secondary roads, and provision was

made for a National System of Interstate Highways, not to exceed 40,000 miles. In 1943 federal aid was authorized for acquisition of right-of-way

1950—Authorization was granted for states and local subdivisions to use federal funds to retire bonds issued for construction of toll-free federal aid primary routes. Expenditures, up to 75,000 dollars, for safety were authorized from administrative funds for the Bureau of Public Roads.

1952—For the first time a specific allocation was made for the interstate system.

Federal-Aid Primary System

The bulk of federal-aid funds today are spent on the system of principal interstate and interstate roads selected by the states under the Federal-aid Act of 1921. This system comprises the most important rural roads in the nation.

There were three steps in selection of this Federal-Aid Primary System. First, individual state highway departments selected within their states the essential sections of such a system. Then highway departments of adjacent states were asked to connect their systems. Finally, the War Department was called upon for routes of strategic importance to national defence and the states were asked to include these routes among the roads selected. Thus the Primary System as finally determined met both national transportation requirements and the needs of national defence.

Following World War II, Congress recognized that certain highways were vital to the country as a whole and should receive first consideration in post-war reconstruction. These roads, selected by joint action of the states and the federal government, were labelled the National System of Interstate Highways. They comprise a little over one per cent of the rural roads in the United States but carry at least 20 per cent of the rural traffic.

The Interstate Highway System links principal metropolitan areas, cities and industrial centres, and connects with

important routes in Canada and Mexico. Such a system, obviously essential to national defence, is also vital to the peacetime economy of the country. The Federal-Aid Primary System, of which the interstate system is a part, forms the backbone of the most advanced and efficient highway transportation facility in the world. A recent survey by the American Association of State Highway Officials finds that 64 per cent of these roads are inadequate for today's needs.

Funds for federal-aid projects are apportioned one-third each in proportion to the state's area, rural population, and rural delivery and star route road mileage, except for urban projects which are based on population of places over 5,000.

Federal-Aid Secondary System

Congress has also authorized federal funds for secondary or feeder roads. The movement of farm produce to the primary routes and thence to the cities is an essential step in the nation's transportation network.

Federal aid secondary funds are allocated on the basis of one-third each for area, rural population, and rural delivery and star routes road mileage. Federal-aid funds are used on secondary roads selected by the states with the cooperation of local officials, subject to approval by the Federal Government.

Under existing law, federal funds available for construction on secondary routes eventually could be applied to about 650,000 miles. This is one-half of the total mileage now being used as mail routes according to the U.S. Bureau of Public Roads.

Federal Aid for Urban Areas

Streets and highways in towns and cities, carrying one-half of the nation's total motor vehicle traffic, have become the bottlenecks in the road network with congestion and delays exacting heavy economic waste.

Due chiefly to the cost of land needed for rights-of-way, urban improvements which are most urgently needed also are relatively more expensive than improvements on the rural highways. In some

instances, rights-of-way acquisition costs far exceed construction.

In 1944, federal-aid funds were, for the first time, provided specifically for urban construction. Later legislation has continued to authorize funds for the same purpose, allocated on the basis of urban population.

Planning surveys show that highway traffic is predominantly a short haul movement of goods and people, with the city as the origin or destination of most of the traffic on the routes entering it. Solving city traffic congestion by modernizing arteries inside the city is now becoming one of the generally accepted solutions to this problem.

The aim of federal-aid urban funds is the provision of free-flowing arterial routes in our cities. The states retain the primary responsibility for the administration of the programme. The planning and undertaking of a major street improvement is best done with close cooperation between all interested parts of government. Here federal aid has made possible coordination of planning and construction activities. The addition of funds for urban highways in recent years has shown the flexibility of the federal aid system and its ability to meet the changing needs of the nation's highway traffic.

Since World War II, the federal-aid programme in urban areas has been steadily accelerated. Approximately 600 miles of arterial expressway construction has been completed.

Highway Research and Planning

Highway development for the nation is no overnight job. The only guidance the highway official has to determine administrative and design policies is yesterday's experience and the collection and analysis of factual data. The cooperative effort afforded by federal aid has enabled states to draw not only on their own experience but that of other states as well. This applies particularly to research in materials, equipment, construction and maintenance procedures. The coordinating efforts of the Highway Research Board and the American

Association of State Highway Officials have been materially advanced by the support of the Bureau of Public Roads.

State-wide highway planning surveys, stimulated by federal aid, have been extremely valuable and productive of information necessary to the development of new policies and long-range highway planning. The information can be used to develop national as well as state and local needs, an important consideration in highways for defence.

Uniformity of Standards

The federal-aid Acts have required that the Bureau of Public Roads approve the design for highway projects submitted under the broad concept that they "will adequately meet the existing and probable future traffic needs and conditions thereon." Through the cooperation of the states and Bureau of Public Roads, standards have been set up that are reasonably uniform between states.

Nationally, standards have developed that are adequate for traffic yet are consistent with the particular circumstances of each state. Collective experience has enabled the states to establish the best standards of design and construction that are economically feasible. The result has been a system of highways that do not vary appreciably as state lines are crossed and that can be travelled with approximately the same degree of safety.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

- ROAD SIDE : The portions of the road land not reserved for traffic.
- LOCATION : (a) The act of selecting and defining in the field or on a plan the route of a proposed highway or the site of a work.
- (b) The actual route or site so determined.

Uniformity of Traffic Laws and Control

Through cooperation between the American Association of State Highway Officials and the Bureau of Public Roads the important main routes of the United States are identified by shield-shaped markers bearing the initials "U. S." the name of the state and a route number. Without this and similar helps, interstate, inter-regional and national transportation could become hopelessly confused. Location, form, and character of informational, regulatory, and warning signs, curb and pavement and other markings and traffic signals placed on any highway or street or federal aid syetem must be approved by the states and the Bureau of Public Roads.

Traffic Safety

Much necessary work in the interests of traffic safety has been done under executive order first, and later by congressional authorization. The Bureau of Public Roads had administered the successive President's Highway Safety Conferences.

These undertakings have made an important contribution to the continuing efforts to reduce slaughter on the highway. Attention has been centered on the need for action at state and local levels. The Action Programme now generally approved as a sound approach to the accident problem, has been strongly supported.

HISTORY OF THE THEORY OF COLUMNS

(Extracted from 'The Structural Engineer'—May 1938)

Leonardo da Vinci (1452-1519)

THE earliest record of experimental study of the strength of columns is perhaps that contained in the note books of Leonardo da Vinci written about four and a half centuries ago. This remarkable Italian is well-known as one of the greatest painters and sculptors in the annals of art, but he was also a scientist and inventor whose theories and discoveries were centuries ahead of his time.

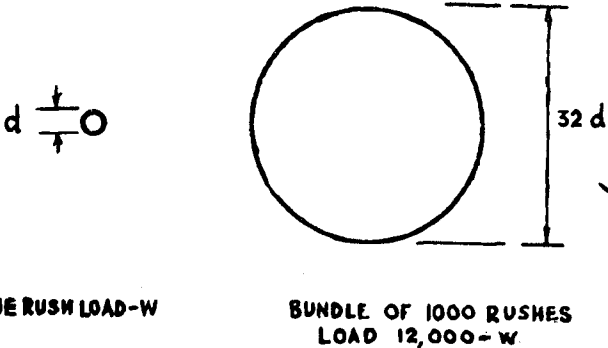
From the age of 30 he practised as a consulting engineer and architect in Milan at which city the manuscripts of his note books have been preserved in a huge miscellany known as *Codex Atlanticus*. These manuscripts have been deciphered with great difficulty for the four following reasons:

- (a) He wrote from right to left.
- (b) His writing was reversed in such a way as would result from looking at a normal script in a mirror.
- (c) He used an elaborate system of abbreviations, and
- (d) No punctuations.

In his manuscripts he gives the method of finding reactions for a beam with a concentrated load at any point — some of his calculations are incorrect but the errors are due to faulty arithmetic rather than to faulty principles.

His structures of the loading of struts are the first scientific attempt of their kind. He says: "Many little supports held together (in a bundle) are capable of bearing a greater load than if they are

separated from each other. Of 1,000 such rushes of the same thickness and length which are separated from one another, each one will bend if you stick it upright and load it with a common weight. And if you bind them together with cords so that they touch each other they will be able to carry a weight such that each single rush is in the position of supporting 12 times more weight than formerly. The increase of carrying capacity is entirely dependent upon the firmness of the binding and if loosely connected the total load becomes merely the sum of the loads each can carry separately."



This experimental result observed by Leonardo will be found to agree with the results obtained by modern strut formulae or graphs such as those given by Moncrieff.

Leonhard Euler (1707-1783)

Euler, the son of a Calvinistic Pastor, was a Swiss Mathematician who studied at Basle University under John Bernouilli. In 1733 he succeeded Daniel Bernouilli in the chair of mathematics at St. Petersburg and in 1741 was invited by Frederick the Great to Berlin as professor of mathematics.

His first important contribution to the theory of columns was a Paper in French to the Academy of Berlin in 1750, in which he deals with the least force which will suffice to produce curvature in a column. This was the origin of Euler's well-known formula and it also formed the subject of a further Paper in 1780 which he presented in Latin to the Academy of St. Petersburg to which city he had returned in 1766.

It is interesting to note that Euler made the error of assuming that the neutral axis lay at the extreme fibre on the concave side of the deflected strut.

Eaton Hodgkinson (1789-1861)

The experimental researches of Eaton Hodgkinson in the early half of the 19th century were of great importance in determining the formulae for the practical strength of beams and columns.

Hodgkinson was born at Great Budworth, near Manchester, in 1789, and in spite of adverse circumstances in his early days he rose to be a Fellow of the Royal Society of London, a Professor of Mechanical Engineering at University College, London and Consulting Engineer to Robert Stephenson on the design of the Menai and Conway Tubular Bridges.

In 1840 he presented to the Royal Society his Paper on "Experimental Researches on the Strength of Pillars of Cast Iron and Other Materials." The investigation which he there described was undertaken in order "to supply the deficiencies of Euler's theory of the strength of pillars if it should appear capable of being rendered practically useful, and if not to endeavour to adapt the experiments so as to lead to useful result."

In this Paper Hodgkinson gave the important relationship between the strengths of fixed-ended and round-ended pillars. He said that "a long uniform cast iron pillar with its ends firmly fixed has the same power to resist breaking as a pillar of the same diameter and half the length with the ends rounded or turned so that the force would pass through the axis." He introduced the term "flat-

ended" for such fixation as he employed in his tests.

Perhaps the most interesting point in Hodgkinson's Paper of 1840 is that he there gives a formula which is of the same type as the well-known Rankine formula and which would appear to be the source from which the latter is derived. Hodgkinson does not usually receive credit for this.

These experimental researches were carried out at the expense of Sir William Fairbairn, the famous Scottish engineer who shares with Robert Stephenson the credit of building the tubular bridges at Conway and Menai Straits and who was also one of the founders of the British Association.

The Crumlin Viaduct in South Wales is a remarkable example of wrought iron pin jointed lattice girder spans supported on towers composed of hollow cast iron columns. The great height of these towers, of which the largest is about 190 feet from base to cap, indicates the confidence of the designer, Mr. T. W. Kennard, in the state of knowledge of the behaviour of columns as long ago as 1853.

This structure was built between the time of Eaton Hodgkinson's first experiments and the time of publication of Rankine's Column formula.

W. J. M. Rankine (1820-1872)

Perhaps no name is better known to engineers than that of Professor Rankine.

We have Rankine's Column Formula, Rankine's Theory of Earth Pressure and Rankine's Formula for combined Bending and Torsion which figure in all text books on structural mechanics.

Important as these are to us it is said that "Rankine's most important contributions to science are in the dynamical theory of heat, in the theory of the steam engine, in that of waves in liquids especially in sea waves and on the resistance and rolling of ships."

In an obituary notice of Rankine in the Proceedings of the Royal Society it is stated - "There is probably no scienti-

fic writer to be compared with him in the three aspects of the extent covered by his treatises, their scientific accuracy and exhaustiveness, and their immediate adaptation to the use of practical men who may be utterly unable to follow the reasoning by which he arrived at his formulae."

Rankine was Professor of Civil Engineering and Mechanics in the University of Glasgow from 1855 to 1872.

His Column Formula is given in the first edition of his "Manual of Applied Mechanics" in 1858 where the numerical values for the constants are attributed to Gordon, who determined them from Hodgkinson's experiments.

Fidler's Column Formula

In 1886 Professor Fidler published a Paper dealing with the practical strength of columns, in which he derived a formula to fit the results of experiments by Hodgkinson (1840) and Christie of Pencoyd, Pennsylvania (1884).

The basis of his theory was that the physical axis of the column may deviate from the geometrical axis owing to variation of the modulus of elasticity although the column is originally straight and axially loaded.

He says that "experiment has shown that test pieces even when cut from different parts of the same bar will sometimes exhibit considerable differences in the modulus of elasticity; and it may be shown that the deflection of the column will follow a similar law if the modulus is somewhat greater on one side than on the other, as it would if there were an initial curvature of the axis."

He assumed the extreme values of E to

apply to the metal on either side of the cross section of the column and derived an expression for the deflection and maximum stress due to direct compression and bending.

J. M. Moncrieff (1865-1931)

One of the most exhaustive studies of column behaviour was that made by Moncrieff and published in the "Transactions of the American Society of Civil Engineers" in 1901. He built up practical formulae for safe loads on columns of iron, of steel, and of timber based upon the study of the published results of no less than 1,789 tests of columns by various experiments commencing with Hodgkinson's Tests of 1840.

Like Professor Fidler, Moncrieff pointed out that the "physical axis" of a practical column i.e., the axis passing through the centre of resistance of every section of the column—will not be coincident with the geometrical axis. In the case of built up columns it will be disturbed by cold straightening and riveting whilst in the case of timber and cast metal columns lack of homogeneous structure will have a similar effect. In the Moncrieff Formulae an equivalent and unintentional eccentricity of loading is assumed to allow for these practical defects, a suitable value having been determined from the tests he examined.

Mr. Moncrieff was, of course, President of the Institution of Structural Engineers for the Sessions 1928-29, and 1929-30.

Straight-line Formulae have been extensively used in the design of columns for skyscrapers in America.

Possibly one of the earliest examples was for the Fisher Building of 18 storeys in Chicago in 1896.

WORDS OF WISDOM

"Spare moments are the gold dust of time, for of all the portions of our life, the spare minutes are the most fruitful in good or evil."

—Anon.

ROAD TRANSPORT IN EUROPE

SOME IMPRESSIONS*

(Extracted from 'State Transport Review' November 1953)

IN man's conquest of distance which is the most outstanding achievement of this century, aviation must be granted the first place for the most spectacular results; but when it comes to constructive and massive development and expansion the credit must go to Road Transport. Even in advanced countries with efficient network of railways and airways, road transport has gradually equalled if not outstripped in importance and volume both these modes of transport.

Road Trains Compete with Railways

Passenger services are extremely well developed and are run by big companies using modern type of heavy diesel vehicles. Goods transport is also run by reasonably big units and they operate heavy diesel vehicles often with trailers. This is the most outstanding feature of goods transport seen in my tour where heavy loads are carried over long distances even between places connected by efficient railway service by means of two or even three trailers attached to a rigid 4-wheel unit. The carrying capacity of a vehicle with trailer is over 20 tons.

Italy has gone ahead with the development of road trains which consist of one tractor with 6 or 7 trailers and these run on ordinary roads even through hilly countries. The operating cost of such trailer type vehicles makes it possible for them to offer rates competitive with railways.

Oldest Nationalised Transport

Switzerland has the oldest nationalised transport undertaking. All public transport and majority of public transport is run by Government as a part and parcel of the Postal Department. Meeting the demands of tourists has been developed as a fine art. Another interesting feature is operation of composite vehicle on some routes

—these vehicles carry passengers, goods, mails, parcels, etc.

The British Transport Commission

The most outstanding event in the development of road transport is the establishment of the British Transport Commission. This is a vast organisation which controls the entire inland transport of the nation through five executives (1) Railway Executive, (2) London Transport Executive, (3) Road Haulage Executive, (4) Docks and Inland Water Ways Executive, and (5) Hotels Executive.

The most outstanding feature of the B. T. C. as well as the Executives is that it consists of boards mostly of full-time members who are responsible for specific executives or authorities. All these men are experts in their respective fields and parliamentarians are conspicuous by their absence and generally these are small compact business like bodies.

A Vast Organisation

The total fleet owned by the Transport Commission under the British Road Haulage Executive is about 40,000 vehicles with additional 3,000 spare trailers and 2,000 departmental vehicles. As if to remind us of the good old times, the Road Haulage Executive still operates 658 horse-drawn carriages. The rolling stock of the London Transport consists of 8,900 buses, majority of which are double deckers and 1,800 trolley buses.

The Provincial and Scottish companies operating road passenger transport own about 15,000 buses.

The total fleet of Road Haulage is 80,000 and that of London Transport 10,000. The table below gives a comparison of the conditions with those in India.

	Provincial Scottish Companies U. K.	Bombay State Transport
No. of vehicles...	15,000	2,000
Staff ...	60,000	9,000
Total mileage operated ...	550 million miles	60 million miles
Gross takings ...	Rs 6,20 million	Rs 72 million
Earnings per bus mile	Rs 1.13	Rs 1.31
Cost per bus mile	Rs 1.05 (19d.)	Rs 1.15
Fare per mile ...	1.2 to 1.5	0.75

Roads Make a Difference

It will be seen that the mileage obtained in the U. K. per vehicle is considerably high and also the seating capacity is more. This is made possible by excellent roads. However, with these advantages, the earning per bus mile and the gross earning are obviously in favour of the Indian company and that when it is operating at half the fare. But all the same it has to be admitted that the cost here is high. *This obviously is due to the fact that the vehicles and spare parts are very expensive and due to bad roads the consumption of spare parts is much higher.*

Less on Maintenance

While analysing the cost which is 19 d. in the U.K., I noticed that the bulk i.e., 14 d. was on account of direct operation and only 4 d. on maintenance and depreciation. In this country we find that we have got to make much higher provision for maintenance and depreciation and this again is obviously due to bad roads and dearth of skilled personnel.

Another outstanding achievement of the Commission was the policy of regarding road and railway services as two sections of a single service for purposes of day-to-day operation or of the planning of future services including applications to the licencing authority for new or altered road services. One result which has been particularly evident has been the ability of the Commission to provide adequate road service where unremunerative railway passenger services are withdrawn

from branch lines. Upto 1952 as much as 1,546 route miles of railway lines were approved for closing down. Each case was considered by area transport users consultative committee and unremunerative railway lines were closed where satisfactory alternative services were available.

Towards Complete Integration

My impression was that gradually the importance of road transport has had to be accepted even by railway authorities and now the job is to co-ordinate the two services into one completely integrated system. In contrast to this realisation, in this country demands seem to be pouring in for opening more and more branch railway lines even when they are estimated not to be economical. The demand is only on the ground of convenience to the public. I would like to mention here that every mile of railway line costs over Rs 2 lakhs whereas a first class cement concrete road can be built at less than Rs 1 lakh per mile. I feel that instead of incurring capital expenditure on railway lines on such routes, from point of view of the overall economy of the country it will be better to build wide cement concrete roads which will make it possible for road transport operator to utilise big diesel vehicles with trailers or articulated vehicles, thus enabling him to provide service at cheap rates almost comparable to the railway charges. This will minimise considerable capital expenditure and provide more elastic transport which is required in the interior areas.

Specialized & Large Scale

Road Transport has established itself as a highly specialised industry which has to be integrated with other forms of transport. In this, goods transport is actually more important than passenger transport. Road transport in the present day perspective cannot be run efficiently by a small operator. A small operator cannot provide the increasing demands made by the user of the industry. The only two feasible alternatives are either to encourage formation of large operating units with certain safeguards and guarantees or the State taking over the entire system. Side by side, other ancillary activities would have to be developed with active encourage-

(Continued on page 13)

* By D. D. Sathe, M.A., J.P., I.C.S., President, Indian Institute of Road Transport.

SYSTEMATIC ACCIDENT INVESTIGATION

(Extracted from 'British Road Federation's Monthly Bulletin, No. 200,' October 1, 1953)

ACCIDENTS are inherent in all forms of transportation and it is unlikely that they will ever be eliminated completely. The objective must therefore be to reduce the accident rate to a minimum. This has been very nearly accomplished in some forms of transport but in the case of road traffic there is a long way to go before it can be claimed that accidents have been reduced to the lowest possible figure.

If accidents could be prevented or reduced substantially there would be great financial saving to the country and more important still a great saving in human life and individual pain, loss and distress.

Road transport like any other form of transport by rail, sea or air, is mainly an engineering problem. Yet road accidents are investigated only by local police officers, whose main responsibility is to ascertain whether or not a breach of the law has occurred.

In his report, the police officer is expected to say whether an accident was due in any way to road conditions. Not being a highway engineer he normally confines his remarks to points upon which he feels competent to express an opinion, such as that the road was slippery due to ice or grease, or that the accident occurred at a blind corner. He is unlikely to suggest for instance, that the surface was insufficiently nonskid, for various technical reasons, or that there was an insufficient length of level waiting space on a steep side road approach, and whether it was possible to rectify it and what it was likely to cost. It is even more unlikely that he would report that an optical illusion due to an unfortunate combination of vertical and horizontal alignment was the basic cause of the accident.

It is probable that road conditions, in a broad sense of the term, enter into a much larger proportion of the accidents than is generally supposed.

A new approach is needed. This must be by a factual examination of accidents which should cover a technical appreciation of the conditions of both road and vehicle. This appreciation, which involves the movement of vehicles and the structure and characteristics of the road, including all its ancillary equipment, can only be made by a properly qualified engineer.

Accidents to rail, sea and air transport are the subjects of investigation by engineering experts and as a result the safety of these forms of transport has continually increased and must now be nearly a maximum. Road accidents are not so investigated.

It is axiomatic that the first step towards preventing a disease is to find the cause. Effective steps towards preventing or reducing traffic accidents can only be taken if the causes which produce them are clearly known and carefully studied. Up to the moment, the investigation of traffic accidents has been carried out by persons who, though able to assess many of the more immediate and obvious causes of a particular accident, are not competent to give an opinion on road and vehicle conditions which most likely enter into the cause, and still less to see how the prevention of a particular accident might be dependent upon a broad plan for accident prevention as a whole. Before the problem of accidents can be tackled with chance of success it is necessary to have much information not now available, and the collection of this information must be in the hands of those who are best qualified and competent to recognise relevant facts and classify them.

An accident investigation engineer shall inspect the site of every serious accident, the cause of which was not self-evident from the police report, in company where possible with the police officer making the original report. A copy of the report of each such accident on trunk

roads would be sent with his own opinion of the cause to the divisional road engineer.

The accident investigation engineer would prepare each month, for submission to the divisional road engineer, a list of accidents which had occurred on each road, stating for each accident whether his investigations had shown one or more of the following factors to have contributed to the cause:

- (1) Vertical or horizontal alignment of road.
- (2) Insufficient width of carriageway.
- (3) Incorrect crossfall of carriageway (i.e., lack of superelevation or excessive camber).
- (4) Lack of or incorrect lane markings.
- (5) Lack of definition of edge of carriageway.
- (6) Ribbon development or uncontrolled access, (e.g., waiting vehicles, vehicles emerging from private accesses).
- (7) Lack of parking or lay-by space.
- (8) Defective road junction layout.
- (9) Defective or insufficient warning, direction or mandatory signs or traffic control signals.
- (10) Insufficient or badly designed or sited street lighting.
- (11) Lit or unlit advertisements and signs confusing to drivers.
- (12) Insufficient or inadequate facilities for pedestrians crossing the carriageway.
- (13) Surface conditions of carriageway.
- (14) Mechanical defect in vehicle.
- (15) Defective lighting on vehicle.
- (16) Physical disability of driver.
- (17) Physical failure of driver.
- (18) Error of judgment by driver or pedestrian.
- (19) Other causes.

In the case of factors 1-13 being present, he would give the approximate cost of

remedying the road defect and state whether a major improvement would be involved or whether the work could be carried out as a minor improvement or under maintenance.

These reports should be analysed to find out:

- (a) general trends and inferences to be drawn from causes of accidents;
- (b) lengths of roads and junctions on which road conditions are the main cause of accidents;
- (c) prevalent failures of road signs, signals, lighting and vehicle mechanism and equipment.

There should be set up at the headquarters of the Ministry of Transport a road accident inspectorate under the chief engineer. This would include engineers with experience in holding public inquiries and considerable experience of highway and traffic matters generally. They would be responsible for holding the necessary public inquiries and, under the chief engineer, for the general direction of the campaign to ascertain from the systematic investigation of individual accidents the main causes of accidents, and the preparation of:

- (a) Recommendations for the mechanical improvement of vehicles and their equipment.
- (b) Recommendations for improvement of road signs, signals, equipment and standards, street lighting and the illumination of road signs.
- (c) A national priority list of road improvements indicated by the results of accident investigation to be of first importance in the interests of safety.
- (d) Additions or amendments to the Highway Code.
- (e) Matters calling for new legislation in the interests of safety.
- (f) Any other recommendations which they consider would reduce the accident rate on highways.

ROAD TRANSPORT IN THE UNION OF SOUTH AFRICA

THE construction and maintenance of roads in the Union of South Africa is undertaken by local, provincial and central government authorities. Prior to 1935 municipal councils were responsible for roads within their respective municipal boundaries, whilst provincial councils, and divisional councils in the Cape Province, were responsible for other public highways. The results of this decentralization were lack of uniformity and considerable variations in standards from province to province. In 1935 a **National Road Board** was established together with a **National Roads Fund**, revenue for the latter being derived from a special allocation of three pence per gallon from the customs duty on petrol imported together with moneys specially appropriated by Parliament. The construction and maintenance of roads, however, was still carried out by the provincial authorities, money being advanced by the National Road Board for the construction of trunk roads according to a co-ordinated plan drawn up by the Board.

In 1948, the powers, functions and duties of the National Road Board were transferred to a newly created National Transport Commission, which also took over the powers and functions of the Central Road Transportation Board which had been set up in 1930 under the Motor Carrier Transportation Act. To-day, the Union possesses a network of first-class national roads, with good secondary roads maintained by provincial and local authorities. In many cases, however, bridges have been inadequate to handle the larger vehicles which in recent years have been found necessary to cope with loads too bulky or heavy for rail transport.

The most important feature, however, of the Union's road motor transportation system is the control exercised by the

local transportation boards set up under the Transportation Carrier Act of 1930. As a result of pressure brought to bear by the Railway Administration and the large municipalities, whose urban tramway undertakings were experiencing competition from newly introduced motor omnibus services, this Act was passed by the Union Parliament, and has been amended from time to time. It must be remembered that during the decade following the First World War, road motor transportation developed rapidly and railway monopolies in all countries were challenged by this more flexible means of transport. Restrictive legislation was passed in many countries, and the Union was not slow to adopt similar measures. As a result, road motor transportation in the Union has not developed as it would have done in the absence of restrictive legislation. Leaders of commerce and industry, together with leading economists, have regularly and consistently condemned the restriction of private road transport, but so far without avail. Considerable dissatisfaction has been expressed during recent years at the delays experienced in railing goods from the ports, where large quantities of imports accumulate owing to the shortage of rolling-stock and running staff. With existing equipment, the railways experience great difficulty in handling the ever-growing volume of traffic, much of which could with advantage be allowed to travel by road.

Nevertheless, the private motor car, being subject to no such restrictions as those imposed upon commercial vehicles has become an important factor in the social and economic life of the Union. In 1952, over half a million motor cars were registered, or one to every five Europeans. The aggregate mileage covered by these private vehicles must be in the neighbourhood of 1,560 million miles per annum, compared with 84 million train miles run

by the railways and 60 million vehicle miles run by urban trams, trolley buses and motor omnibuses. This is probably one of the reasons for the fact that municipal passenger transport undertakings have been run at a considerable loss for many years, though it is significant that the privately owned and operated services in Cape Town and Port Elizabeth are run at a profit with Transportation Board control of fares, routes and schedules in operation. It may be noted here that the motor omnibus and trackless tram have replaced the electric tramway except on certain routes in Johannesburg.

transport in the movement of large tonnages over long distances. But for the movement of goods with a high value-to-weight ratio and for passenger transport, the motor vehicle performs a very necessary function. Its success, however, depends largely upon the existence of good roads and low-priced fuel. The Union at present possesses some 4,500 miles of two-way road surfaced with tar or its equivalent, about 35,000 miles with crushed stone or gravel surface, and about 50,000 miles with earth surface.

It is certain that road transport can never successfully compete with rail

(Extracted from 'Transport and Communications Review,' April-June 1953.)

(Continued from page 9)

ment of the State. Thus, while organising goods transport, new efficient agencies would have to be set up to facilitate transport of agricultural products from the producing centre to the marketing centre and this would naturally include reasonable warehouse facilities, co-operative or other credit arrangements to the producer as well as to the wholesale purchaser, adequate control to ensure quick movement etc. Among other activities, greatest emphasis will have to be laid on ancillary industries making components for vehicles which are acceptable to the user are manufactured in this country on a planned basis and with due regard to the ancillary industries referred to earlier.

Organise in A Big Way

In the light of my recent experience abroad I would like to see top-most

priority being given to development of road transport in this country. The prerequisite for this is of course roads. Execution of road schemes has to be done with far-sightedness. In order to bring our road system to reasonable modern conditions we will have to adopt unorthodox methods. Simultaneously, road transport must be organised in a big way by companies or State undertakings who can deliver the goods. Only such organisations can give modern facilities to the user. In order to encourage development of road transport, all obstacles must be eliminated. The principles of the taxation system must be such as to encourage more vehicles coming on to the roads. On the Governmental side telephone and radio communications along the highways must be improved and the question of technical training in the automobile line must be handled more effectively.

PROGRESS IN SOIL MECHANICS, STRUCTURAL THEORY AND STRUCTURAL STEELWORK

(Extracted from 'Highways and Bridges', October, 1953).

THE following extracts from the Presidential address of Lt.-Colonel R. F. Galbraith, the President of the Institution of Structural Engineers (U. K.) for 1953-54 concern site investigations and soil mechanics, foundation works, structural theory and structural steelwork.

SITE INVESTIGATIONS AND SOIL MECHANICS

The development in site investigation and the theory and practice of soil mechanics during the last few years has enabled structural engineer to depart from the rather empirical rules that defined the safe bearing pressure for various types of soils and to predict with much greater certainty the probable sub-soil conditions.

About fifteen years ago the maximum concession made to site investigation was the excavation of a single trial hole somewhere on the proposed site and if possible where no load bearing member would be needed. To-day, site investigation commences with a study of the geology of the district and an examination of the bore hole results record at South Kensington by the Geological Survey. This preliminary work enables the engineer to decide the number and position of trial pits or bore holes. Trial pits tend to become expensive if carried to a depth greater than 10 to 15 feet, but in stiff ground where no timbering is required they permit a visual examination of the various strata. Shallow bore holes can be made in light soil by a post hole auger, whilst bore holes of medium depth are readily made by a shell and auger boring rig, or other type of rig. In the case of deep boring through rock diamond bits are used to obtain cores, driven by machines capable of drilling to a depth of 1,000 ft. Whatever type of

drilling is used careful records are kept of each strata showing depth, soil type, water level, etc.

Samples are taken at various depths and are either disturbed, i.e., taken from the bore hole and packed into airtight containers or undisturbed when care is taken to preserve the natural structure of the soil. Special sampling tools are used to obtain undisturbed samples. When boring has been completed the various engineering properties of the samples are tested in the laboratory.

The information obtained from the borings and from laboratory tests of the mechanical properties of the soils enable the engineer to solve his foundation problems in a rational way.

In addition to borings and laboratory tests it is sometimes desirable or necessary to make actual bearing tests on the site.

The results obtained by these bearing tests need careful interpretation as they only reflect the character of the soil located within a depth of less than twice the width of the test plate, and unless the soil is uniform to a considerable depth, which is most unlikely, the results will be misleading. It is necessary to select an allowable soil pressure not only from the results of such tests, but also from the character of the soil profile and from the size of the foundation itself.

FOUNDATION WORK

Geophysical methods to determine the depth of bedrock have been developed to assist the engineer. A geophysical survey can quickly give a general picture of the bedrock surface under the whole site enabling the subsequent drilling programme

to be planned economically. In dealing with river sites where drilling is more difficult and costly than on dry land, several rock profiles can be obtained across the river by geophysical methods at the cost of a single bore hole the **Seismic Refractory method** and the **Electrical Resistivity method** are those generally used in these cases. The results obtained by the seismic method are accurate within 10 per cent.

The modern method of dealing with excavation in waterlogged soil is to lower the ground water level all over the site by pumping from a number of points or wells simultaneously. Filters are used to prevent sand being pumped out of gravel. Three systems are in general use—the **Shallow Well System** where a number of bored filter wells are connected to a ring suction main connected to the pumping equipment, the **Well Point System** uses a number of small tubes with a short filter portion jetted into position and connected by a ring main to the pumping unit. With shallow wells or the well point system the maximum lowering of the water table will be about 15 ft below the axis of the pump, but of course multi-stage pumping can be used when greater depths are required than can be reached by a single stage.

The **Deep Well System** has a number of large diameter bored filter wells each equipped with its own submersible pump lowered into the filter well. Deep wells are only limited by the depth of boring and the location of water bearing strata.

In 1951 after several years of careful study of earth pressure problems the Civil Engineering Code of Practice Joint Committee convened by the Institution of Structural Engineers under the Chairmanship of Mr. F. E. Wentworth Shields issued "Civil Engineering Code of Practice No. 2—Earth Retaining Structures." Formulae and tables are included for various types of soils which may be regarded as the latest opinion on the subject and enables engineers to calculate the probable earth pressure under certain conditions, but engineers must also reserve the right to depart from the results obtained from any particular theory and base the design on the results of experience.

The older forms of timbering to the vertical sides of open excavations or trenches have been somewhat modified since 1939 by the extreme shortage of timber. Steel joist walings and concrete poling boards with timber rakers have been successfully used. Inter-locking steel sheet pilings have proved invaluable in some cases of heavily waterlogged sites. The steel piling is often withdrawn after the permanent construction has been built. In many cases the use of any support has been avoided by battering the sides of the excavation to a suitable angle to avoid slip.

The methods used for permanent construction to resist earth pressure have not varied very much in the past decade or so. The reinforced concrete retaining wall is probably the most common solution to the problem of building work.

The **Geotechnical processes** which are now in use in suitable cases whereby the properties of the soil can be changed either permanently or temporarily must be mentioned. The most useful processes for building work are the **Freezing processes** used for excavation in fine grain soils below ground water level, and the **injection processes** which includes cement grouting, clay grouting and chemical consolidation. The **Chemical Consolidation method** has proved most successful and most varied in application. The materials which are suitable for this treatment are deposits of sand or gravel, both above and below ground water level, and containing up to approximately 5 per cent of impurities. Very fine sands, say of effective grain size less than 0.1 millimetres are too fine for injection. Clays, silts and peats are also unsuitable, and other processes such as freezing, explosive consolidation etc., should be used.

STRUCTURAL THEORY

Castigliano published his now famous treatise on the principle of least work in 1879, but little regard was paid to this until 1909 when an English translation by Mr. Ewart S. Andrews, one of our Past Presidents, was published. Professor Hardy Cross published his moment distribution method in 1929. Since then

an ever-increasing stream of theories, methods and analogies have been put forward by various authors, many of whom indulge in a considerable amount of mathematical gymnastics to avoid the fundamental fact that the calculations for a redundant structure, apart from the very simple cases, must of reality be a complicated business. However, a careful analysis backed by sound engineering judgment and experience may well repay the engineer by producing an economic design.

In 1944 Professor J. F. Baker and his team of experts at The Engineering Laboratory of the University of Cambridge developed what is now known as the "Plastic Theory." This is an outstanding contribution to modern thought.

The results obtained by this theory are illustrated in a striking manner in the case of the 60 ft standard storage shed designed for the War Department by Professor Baker and his team at Cambridge in 1951. The original War Department design uses 4.54 pounds of steel per square foot of floor area, whilst the Cambridge design requires only 3.1 pounds per square foot, i.e., a saving of 34 per cent. The table of comparative weights and sizes is worthy of study by all engineers.

Professor A. L. L. Baker has put forward a plastic theory of design for ordinary reinforced concrete and prestressed concrete and for shell roofs. Considerable experimental work in support of the theory has been carried out, and further work is proceeding at Imperial College, University of London.

There has been an increasing use of plastic models to study the deformations of statically indeterminate structures such as portal frames. The equipment used can be very simple—a drawing board, pins; a model of the structure being examined and a scale are sufficient, but

more elaborate equipment such as Professor Begg's deformeter can be used. In either case the results obtained by the use of such methods are comparable to the results obtained by more rigorous analysis.

STRUCTURAL STEELWORK

High tensile steel B. S. S. 548 has been used with economy in a number of buildings carrying heavy floor loads. The initial extra cost of approximately 10 per cent, of the structural steelwork is offset by a saving of perhaps 30 per cent in the weight due to the increased working stresses permissible. The use of a high tensile rolled section may avoid the use of a compound section with a consequent saving in cost. In addition high tensile steel will generally result in increased headroom and smaller concrete casings.

The cast of welded steelwork has been one of rapid development. Since the first report on welded steel structures was issued by the Institution of Structural Engineers in 1935 there has been continual research by several important organisations, and considerable improvement both in the technique of welding and in the manufacture of electrodes. Perhaps one of the most outstanding applications of welding has been the Bailey Bridge designed by Mr. D. Bailey, now Sir Donald.

The Freeman Bridge over the Rhine and the Festival of Britain Bridge over the Thames are but two examples of the many uses. Bailey Bridging has been put to both in war and in peace.

If the principles of prestressing are correct for concrete there seems no reason why they should not achieve an economy in steel when applied to structural steelwork. The first published use of prestressed steel was by professor Magnel in 1950. Mr. R. A. Sefton Jenkins has now designed a 60 ft span lattice girder for the Harlow Development Corporation which has a prestressed bottom core.

THE OPERATION OF ANGLED OZERS AND BULLDOZERS

(Extracted from 'Contractors Record & Public Works Engineer' - September 1953)

DOZING plant is capable of performing various earthmoving operations.

Stripping and Short Haul Excavation

The stripping of soil and short haul excavation is efficiently carried out by dozers, the length of one-way haul not exceeding 200 ft. In operating the plant the aim should be to handle each load on the blade once only. It has been found that bulldozing the earth into heaps, where it was then loaded by a mechanical excavator fitted with shovel equipment into transport for disposal, proved highly satisfactory both from the progress and the unit cost points of view.

Hillside Excavation

In carrying out excavation by a dozer along the sloping face of a hillside, as in excavation for a new road, the cut may be started by working straight downhill in short passes at right angles to the road until an area is excavated large enough for the tractor to run on. Excavation can then be commenced along the line of the roadway. In carrying out this excavation the cut should be made, if possible, commencing at the top working downhill with the cut as this contributes to large output. The first excavation pass should be started at the upper level of the slope, a turning pass being made as the machine travels forward to push the excavated material over the side of the slope. It is good practice in carrying out work of this kind to slope the excavation in somewhat towards the hillside, as this makes for maximum output. If the final excavation is to be performed by tractor and scraper units, care should be taken to ensure that a sufficient width

of benching is taken out by the dozer to accommodate the scraper unit, with its rear wheels running on firm excavated ground.

Bulk Filling

In carrying out excavation and bulk filling on short haul, such as in excavating roads on undulating ground, dozers not only carry out the work efficiently, but they also assist in consolidating the fill as they travel over it. In placing the fill, care should be taken to commence filling from the centre outwards, the material being deposited in layers of reasonable depth. Subsequent layers will then be consolidated as the filling is deposited, thus tending to consolidate the whole.

When filling is deposited by vehicles, dozers are particularly useful in spreading and levelling the material over the area to be filled. Angledozer travelling over the area level and consolidate the whole drifting high spots into low areas as required. In pushing material to fill over a face, the material should not be pushed further than is necessary. The fill at the face is best kept ramped up, so that the machine has a down grade to travel on in running backwards. In adopting this practice it has been found that the machine is less likely to bog down under soft conditions.

Trimming and Finishing

Although the dozer is not a finishing tool in the strict sense of the term, it is capable of trimming and finishing to reasonably close limits.

Side slopes in cutting, if not too steep, may be finished with the dozer working parallel to the top. In doing this the ground

trimmed in each pass falls downwards, and is dealt with in the next pass and so on until the bottom of the cutting is reached.

In the case of steep cuts or slopes to banks the usual practice is to work up the slope, starting at the bottom, travelling either at right angles or diagonally up the slope. The finishing pass is best given by dropping the blade and travelling in reverse.

Backfilling

In carrying out backfilling maximum output is obtained if the dozer is travelled as often as possible on the same line, as the material windrowed at the sides then tends to drop in front of the blade, where it is then picked up in the load.

Angledozerers are particularly suitable for backfilling shallow trenches, as they drift the material towards and into the trench as the machine moves forward. In using bulldozers for this work the machine should commence diagonally to the trench, turning into it at right angles at the end of the pass.

Spreading and Levelling

Dozers are excellent tools to apply in spreading and levelling where materials are deposited in heaps. The machine with its blade lowered travelling to and fro pushes the material into place, spreading, levelling and compacting it as it goes. They are, therefore, commonly applied in spreading road foundation materials, such as clinker and hardcore. The machine should travel ahead in a straight line, the material being drifted along under the cutting edge of the blade to the requisite level.

Stockpiling

Bulldozers are used to a large extent in stockpiling materials, such as tidying up large heaps of gravel, pushing aggregates up to concrete mixing plant, excavating and stockpiling earth for loading to transport by mechanical shovel, etc., etc.

For handling materials such as concrete aggregates, sand, etc., a "U" type blade

is best suited for this purpose, as they minimise spill from the blade and permit of greater loads being moved per cycle.

Push Loading Tractor and Scraper Units

Rubber-tyred tractor and scraper units only load the scraper to approximately 50 per cent of its capacity, and it is the normal practice to push load scrapers of all sizes in order to ensure full loads.

In push loading the bulldozer should always push the scraper in a straight-forward line under full power with a view to speed of operation in making the cut. Getting the tractor and scraper unit and the bulldozer out of line results in excessive loading time and small loads.

It is the usual practice for the push-loading dozer to operate along with more than one scraper unit. Good positioning on the part of the bulldozer operator, therefore, eliminates loss of time in push loading the scraper units it serves, thereby contributing to large production. Increased production is also obtained by continuing to push the scraper after it has been loaded. In doing this the tractor and scraper plant is helped on its way, enabling the operator to change gear, get up speed and move quickly away with the load.

The number of wheeled tractor and scraper units served by a bulldozer is obtained thus :

Number of tractor and scraper units served per bulldozer =
$$\frac{(\text{Time taken in loading}) + (\text{Time of haul})}{(\text{Time taken in loading})}$$

Thus, if the time taken in push loading is three minutes and the time of haul four minutes, the number of units served by the bulldozer is then given by :

Number of units served =
$$\frac{3+4}{3} = 2 \frac{1}{3}$$

Therefore, for economical working two tractor and scraper units would be operated along with one bulldozer.

The Output of the Plant

The output of dozer plant is influenced by the following factors :

- (1) The number of loads pushed by the dozer per hour.
- (2) The cubic yards of solid material held on the blade per load.

The time per load is made up of the "fixed time" and the "travelling time" per cycle. The fixed time consists of the constant time involved in each cycle, the travelling time being, of course, variable depending on the length of push. In considering output, however, it should be noted that the fixed time is also variable, depending on the nature of the operation performed.

For example, in the case of stripping or short haul excavation the fixed time is the time taken in making two gear changes, i.e., forward and reverse, but in backfilling there is a gear change, then a swing in direction, and then a further gear change, all of which involves more time.

Another factor which must be taken into account in considering output is the volumetric change of the material after it has been excavated. Solid ground, bulks considerably after it has been excavated, this bulking varying with the nature of the ground.

Output

Table 1
Table showing the Normal Output of Angledozerers

Tractor drawbar horse power.	Nature of ground and output in units of 1000 cu. ft. per hour					
	Vegetable soil.	Loamy soil	Sand	Clay	Gravel	Chalk
40 to 50	1.6	1.5	2.0	0.8	1.7	0.7
60 to 70	2.0	1.9	2.5	1.0	2.1	0.8
80 to 90	2.6	2.4	3.2	1.3	2.8	1.1
130 to 140	3.0	2.8	3.8	1.5	3.2	1.3

Table 2
Table showing the Normal Output of Bulldozers

Tractor drawbar horse power.	Length of one-way haul in feet and output in units of 1000 cu. ft. per hour.			
	50 ft.	100 ft.	150 ft.	200 ft.
40 to 50	1.3	0.8	0.6	0.4
60 to 70	1.6	1.0	0.8	0.5
80 to 90	2.4	1.7	1.1	0.9
130 to 140	3.0	1.9	1.4	1.0

Note.—The outputs shown in this table refer to sand. For the output in grounds other than sand use the multipliers shown in Table 3.

Table 3
Table of Multipliers for Use with Table 2 in order to Compute the Output of Bulldozers in Ground other than Sand.

Nature of Ground.	Plant output multiplier.
Sand	... 1.00
Vegetable soil	... 0.80
Loamy soil	... 0.75
Clay	... 0.40
Gravel	... 0.85
Chalk	... 0.33

Being related to normal outputs, the data shown in these tables may be used in computing the following :

- (1) The machine power required to carry out a specific amount of work in a given time.
- (2) Knowing the quantity of work which has to be done and the output of the plant per hour, the time required to carry out the work.
- (3) The unit cost of the work performed by the plant, knowing its working cost and its normal output per hour.

NOTE ON LEACHING AND EFFLORESCENCE

(Reproduced with the permission of the Indian
Standards Institution, Delhi)

1. INTRODUCTION

LEACHING is the washing out or removal of soluble salts especially the anhydrous salts in cement, by percolation of water. Efflorescence is the deposition of these soluble salts as hydrated crystals or other compounds on the finished surfaces of masonry and concrete forming unsightly deposits. Thus leaching and efflorescence are inter-related, the former being the cause and the latter the effect.

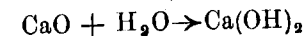
Efflorescence and leaching have harmful effects and are factors to be avoided. While efflorescence causes unsightly deposits on the finished surfaces causing awkward and unpleasant appearance, especially with unplastered surfaces, prolonged leaching action may become a potent cause of disintegration of the structure due to continual removal of lime.

According to Pearson, "Efflorescence is always objectionable in appearance and is generally a symptom of faulty condition, the neglect of which may frequently involve progressive and serious disintegration."

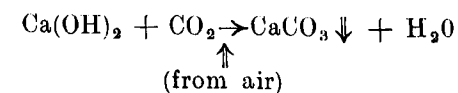
2. CAUSES OF LEACHING AND CHEMICAL CHANGES IN CEMENT DUE TO LEACHING

The soluble salts in the mortar or the masonry units are the potential causes of efflorescence. The source is not necessarily in the cement but the cement is very likely to be a factor.

Portland cement is a complex mixture of a number of anhydrous compounds, the more important of which are silicates, aluminates and aluminoferrates of calcium. Small amounts of oxides of calcium and magnesium are also present. On contact with water, the free lime is converted into hydrated lime.



This calcium hydroxide is somewhat soluble in water and in porous concrete, this is frequently precipitated in the form of calcium carbonate on the surface of the drying concrete as a white deposit causing unsightly blemishes



Thus the anhydrous compounds are hydrated and are also partly broken up into simple substances with the liberation of a further quantity of lime which first goes into solution and deposits as crystals. These simpler calcium silicates so formed are stable in the presence of a saturated solution of calcium hydroxide. But when the calcium hydroxide is removed due to leaching, the silicates are also broken down rapidly resulting in all the lime being removed leaving behind only hydrous silica, alumina and ferric oxide.

But the calcium carbonate formed on the surface due to the conversion of the calcium hydroxide into carbonate in the presence of carbon dioxide is insoluble in water and hence prevents further percolation of water resulting in the gradual decrease in leaching and removal of lime. This action of calcium carbonate is usually called the "Self Healing" action.

According to Kellam, this white deposit may also be due to soluble sodium salts. While the calcium carbonate formation aids in checking leaching by the self healing action, the sodium salt deposits keep the pores open and are hence more harmful. It is to be noted that this self healing action of calcium carbonate is not effective in the presence of carbon dioxide or sulphates in the water.

3. TEST FOR LEACHING

There is no standardized method of test for efflorescence but it has been suggested

that the general scheme of making small mortar slabs or cylinders with a standard sand free from soluble materials, placing them upright in a small quantity of distilled water and exposing them in a warm, dry room will usually indicate within 24 to 48 hours any appreciable amount of objectionable salts. The test is of course qualitative and needs some development but there should be no great difficulty in making it a simple and satisfactory test for the purpose.

4. REMEDIES

The general treatment should be to ensure in advance that readily soluble salts are not present in any of the elements that enter into a high grade masonry job. The following treatments are some of the methods adopted to prevent or reduce leaching and efflorescence:

Percolation through cracks in the mortar or concrete being the potential cause of leaching, the best and foremost precaution to be taken is to prevent by every possible means the access of water. Design and workmanship are the most important factors for this. Admixtures of water repellent materials to the cements and coating bricks with waterproof materials are generally recommended in situations where an excessive amount of efflorescence is noticed.

Permeability through the structure should be reduced by avoiding causes of cracking to the greatest possible extent. Cracks in concrete are usually formed due to difference of temperature between surface and body caused by the heat of hydration and due to expansive nature of certain types of aggregates.

The heat evolved in mass concrete should be dissipated by proper cooling arrangements and clay and alkali aggregates should be avoided in concrete.

Use of special cements are recommended in certain cases. Practically all the masonry cements contain or will develop after being mixed in mortar, calcium hydroxide which under practically adverse conditions may appear as an encrustation. Such adverse conditions may arise from lack of proper protection of the work under construction, faulty

flashing of drainage, permeable walls, inadequate protection against ground water, and even from driving storms.

Proper Grading. Pores in concrete promote leaching. Evans classifies pores as macroscopic and microscopic, the microscopic pores being subdivided into water concentration pores, border pores and structure pores due to improper grading. Proper care should be paid to control factors such as optimum proportion of water, grading of materials, thoroughness of mixing, etc.

Use of Pozzolanas. Reducing the amount of free lime in the body of the structure by limiting the same in the cement or by using pozzolanas is suggested as a means to prevent or reduce leaching. Free lime alone need not necessarily bring about leaching and efflorescence. The same cement when used at one particular place may lead to efflorescence whereas in many other places it may give a perfectly sound work.

According to Carl A. Menzel, the leaching of calcium hydroxide can be substantially reduced when the cement paste contains finely divided silica (O-No. 200) in the same or nearly the same amounts as required for optimum strength.

Curing in high pressure steam and carbon dioxide. It is believed that when cured in high pressure steam, the silica combines with most of the soluble calcium hydroxide to form a fairly insoluble compound which contributes to the permanent strength and denseness of the hardened cement paste. Thus, both the amount of soluble material available and its rate of leaching are substantially reduced.

Another effective method for dealing with calcium hydroxide was found by steaming the concrete in the presence of carbon dioxide gas. In this case, the carbon dioxide combines directly with the calcium hydroxide to form the relatively insoluble calcium carbonate. With effective carbonation the blemish or loss of colour value of brightly coloured mortar by efflorescence was completely eliminated in the few cases tried by Carl A. Menzel. This method can be applicable only in the case of precast units of concrete.

HERE AND THERE

1. STANDARDIZATION

THE term 'standard' means accurately defined processes, sizes, qualities, and tests of materials and equipment that have been generally agreed upon by makers, users, and the public, as proper and desirable for general use.

There are three principal types of standardization, viz., **fundamental**, **functional**, and **dimensional**.

Fundamental Standards. Such standards generally concern the subjects such as weights and measures, and activity in this field is, as can be understood readily, under the jurisdiction of national governments.

Functional Standards. These standards are designed to achieve fitness for purpose. They may deal with terms, symbols, and definitions; with quality, from the viewpoint of composition and performance; with methods of test to remove misunderstandings as to procedure for measuring and for analysis; with codes of practice or methods of use for the purpose of obtaining adequate results and safety in use.

Dimensional Standards. These are standards which, by achieving simplifica-

tion, unification, and interchangeability, eliminate duplication of effort and multiplicity of designs and methods, in the production of articles fundamentally similar.

What do Standards Accomplish?

Standards have four distinct values, as follows:

- They educate by setting forth quality goals for the guidance of producers and consumers alike.
- They simplify by limiting the number of sizes, the variety of processes, the amount of stock, and the associated paper work — thus reducing the overhead costs of manufacturing and selling.
- They conserve by cutting down the losses, wastage, and unnecessary tooling that accompany odd-lot manufacture, thus promoting large-scale production of standard design.
- They certify by serving as hall-marks of quality and value.

(Extracted from 'Mechanical Engineering' —August 1952)

2. DAMAGE TO A NEW ROAD

AN interesting case occurred recently in the District Court of Tanga (Tanganyika). The plaintiffs were the Societe Dumez and they claimed damages from Mr. V. Venglis for trespass on the New Korogive Road when it was under construction by the plaintiffs. The damage was done by the defendant's motor car driven by his son on the newly made but uncompleted road surface. Evidence was given on behalf of the plaintiffs that serious damage could be occasioned by using the newly laid surface

before it was ready for traffic. Although there was a conflict of evidence as to the adequacy of warning signs exhibited by the plaintiffs, the magistrate held that, in this case, the trespass was deliberate and he awarded the plaintiffs the sum of 400 s. as damages. The magistrate said that in assessing damages he had no basis of comparison on which to proceed and he had also borne in mind that this was the first case of its kind.

(Extracted from 'Civil Engineering and Public Works Engineer'—November 1953).

3. GLASS-MIXED CONCRETE

EXPERIMENTS, by the Armour Research Foundation in the United States, in the use of glass grains as a substitute for sand in concrete mixes, have been carried out at the Illinois Institute of Technology. So successful have they proved that the material is now to be developed for commercial use. The glass grains, which are hollow and therefore very light, are made in a specially designed furnace. Their strength to weight ratio has been found to be very high owing to their spherical shape, and as a result con-

crete mixes made with this substance—called "Kanamite"—are strong, but unusually light. It has further been found that the glass also improves the insulating properties of the concrete and because the glass spheres do not absorb water, mixes are less stody than normal. Even when only small quantities of water are used, the mixes can be pumped through ordinary hoses like liquids.

—(Extracted from 'Civil & Structural Engineers Review'—November 1953).

4. CORRECT CARE AND HANDLING OF WIRE ROPE

GREAT care should be taken in handling and installing wire rope. Otherwise it may become permanently damaged before it is put into service.

Kinks and Kinking. Careful handling will prevent kinks, which are almost impossible to remove and result in permanent damage to the rope. If a loop forms in slack rope, it should be thrown out at once, because a kink will develop if this loop is drawn tight. The strands are distorted and become permanently set in this position. Excess wear occurs and wires will fracture at this point. Even if the wires are not badly damaged, the rope is out of shape, which will mean excess wear on the displaced strands.

Unreeling and Uncoiling. There is always danger of kinking a wire rope if it is improperly unreeled or uncoiled. A reel should be mounted on facks or a turntable so it will revolve as the rope is pulled off. Sufficient tension should be applied to keep slack from accumulating, by means of a board acting as a brake

against the reel flange. Or, the end of the rope may be held by a workman and the reel rolled along the ground.

When transferring rope from one reel to another be sure the rope is taken from the top of the full reel and wound over the top of the empty reel, or from the bottom of one reel to the underside of the second reel. Reverse bends are thus avoided.

Inspection of Equipment. Before installation, the drums and sheaves on which the rope is to be used should be carefully examined. A new rope cannot be expected to give good service if the sheaves or drum are badly worn or damaged. If a sheave is cut out of round or has worn bearings, it will not run true and will damage the rope. Make sure that the grooves are smooth and of full diameter for the rope which is used on them. A sheave with a corrugated or pinching groove should be turned out or replaced by a proper one.

(Extracted from 'Roads and Streets, —October, 1953).

5. ACID-RESISTANT CONCRETE

IT is well known that, owing to the high proportion of free lime which it contains, concrete has a relatively low resistance to corrosion by acids. To overcome this weakness, the Ocrietfabriek N.V., of Baarn, Germany, have developed a system of treating concrete with a gas

containing fluorine which, it is claimed, greatly increases the resistance of concrete to corrosion by converting the free lime present into acid-resistant compounds. The international trade name given to concrete so treated is "Ocrated" concrete.

The treatment can be controlled by altering the gas pressure and the treatment time so that it is possible to vary the thickness of the treated layer of the concrete according to the degree of resistance required. In addition to improving resistance to acid corrosion, "Ocratone," it is claimed, increases the strength and compactness of concrete and raises its resistance to mechanical abrasion. The tests on the process have been carried out by the Dyckerhoff Portland Zementwerke A.G. Wiesbaden, Amonsburg.

The invention, it is claimed, opens up a number of opportunities in the concrete, artificial stone and asbestos cement industries. Examples are concrete pipes for

sewerage, which often face corrosion from both inside and without; artificial stone products, which in time tend to become coarse in texture owing to the corrosion of the cement; piles owing to the nature of their task, are usually employed in aggressive peat, marsh or clay soils; concrete tiles, both for increased resistance to acid atmospheres and for increased resistance to abrasion; and for drain pipes.

In addition, new possibilities are opened up in regard to light weight concretes, which, while retaining their low weight, can be given sufficient strength to make them useful for structural purposes.

(Extracted from the Indian Concrete Journal, October 1953).

6. ROADSIDE PLANTINGS REDUCE TRAFFIC NOISE

NEW York State engineers, from personal observation, conclude that highway border plantings greatly reduce noise at adjacent residencies. AASHO has appointed a special committee to study effects of planting in reducing both noise and dust, but at this time no report has been made on actual tests.

Certain studies indicate that if the surface of barrier slopes is sound absorptive, such as grassy turf or dense vines,

the over-all noise reduction may amount to as much as 8 or 10 decibels.

Hedges and trees with dense foliage are effective.

Buffer plantings should average from 25 to 35 ft wide, according to some who have studied them. Planting design should be governed by the type of highway cross section, and the width of right-of-way.

(Extracted from 'Roads and Streets, October, 1953).

7. PRESTRESSED CONCRETE ROADS

THE merits of concrete pavements are well-known but the following additional advantages accrue when prestressing is used:

- (1) transverse cracks are eliminated;
- (2) Joint spacings can be considerably increased thereby affording a better riding surface and reducing the percolation of water to the subgrade; and
- (3) a reduction in slab thickness is possible.

A few prestressed concrete pavement and runway works have already been undertaken in foreign countries, the most notable among them being the runway at Orly airport in France. Several experimental stretches have also been constructed in Great Britain and should provide important data on the performance of prestressed pavements.

(Extracted from 'Indian Concrete Journal', October 15th, 1953.)

8. DIESEL ENGINES ASSEMBLED IN INDIA

THE wide applications and uses of diesel engines in modern road, rail and marine transport industries, has resulted in an ever-increasing demand. The PERKINS high-speed diesel engine, has for some time been assembled in the Madras workshops of Messrs. Simpson & Co. Ltd. Whilst only some few components are at present being produced in this country it is the company's aim that the engines should be produced entirely in India.

9. THE OPEN ROAD

WITH many a curve through the rolling hills
Where woodlands border its side,
And birds are singing the livelong day,
And waters cool in the shadows glide,
Down through the valley's pleasant land,
It leads away to the country wide.

There is ever a lure in the open road,
As I follow its winding way.

—Geo. D. Thompson

(Extracted from 'The Highway Magazine'—October 1953).

PERIOD OF COURTSHIP

"I WONDER how long girls should be courted."
"The same as short ones."

Enough Concrete was laid on airfields during the war to build a highway round the world.

CURRENT LITERATURE

ABSTRACTS

625.7. RESEARCH NEEDED IN GEOMETRIC HIGHWAY DESIGN—Special Report No. 12 of the Highway Research Board, Washington, D. C. (1953).

The Committee on Geometric Highway Design, which was formed in 1948, has had under consideration the research needed in that field for accumulation of data.

In order to make clear the exact meaning of Geometric Design, the following definition is given:

“Geometric highway design is a phase of highway design dealing with the visible dimensions of a roadway.

“It is dictated, within economic limitations, by the requirements of traffic and includes the design elements of horizontal and vertical alignment, sight distances, cross section components, lateral and vertical clearances, intersection treatment, control of access, etc.”

The report contains a brief statement of 26 research problems. Every one of the problems given is dealt with under the following heads:

- (1) General problem.
- (2) Specific Statement.
- (3) Factors involved.
- (4) Research and Data needed.
- (5) Selected References.

BOOK REVIEW

“STANVAC Magazine,” Vol. I No. 1, published by the Standard Vacuum Oil Company from Bombay will now be a regular feature for disseminating information about the oil industry in general and Standard Vacuum in particular. It is intended to narrate the Company's

history, explain its policies and practices, and speak of its hopes and aspirations.

The short article “Why Trombay” about the site of the new “Refinery” is informative.

The get up is attractive.

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

I. ROADS IN GENERAL

1. The Engineer as Administrator—*editorial—Engineering*; September 25, 1953, pp. 401-402.
2. America's experience on turnpike roads: LIEUT.-COL. E. W. W. RICHARDS, *Road Tar*, September 1953, pp. 19-23.
3. The work of the road research laboratory: *Roads and Road Construction*, October 1953, pp. 300-302.
4. Flow in Open Channels: R. SILVESTER, *The Journal of the Institution of Engineers, Australia*, September, 1953, pp. 155-162.
5. Engineering in Primary Production: A. B. DOYLE, *The Journal of the Institution of Engineers, Australia*, September 1953, pp. 163-174.
6. Gates and grids on main roads: *Main Roads*, September 1953, pp. 2-3.
7. The use of explosives in road work: *Main Roads*, September 1953, pp. 17-23.
8. Planning for the leisure of the Community: D. J. HALL, *The Journal of the Institution of Municipal Engineers*, October 1953, pp. 209-226.
9. Lowering of Liverpool—Leeds—Hull trunk road under Cooper Bridge: J. McINNES, *The Journal of the Institution of Municipal Engineers*, October 1953, pp. 241-248.
10. The transport needs of Agriculture: G. A. BAXTER, *The Journal of the Institute of Transport*, September 1953, pp. 209-215.
11. The road plan for Lancashire: *Highways and Bridges and Engineering Works*, October 21, 1953, p. 153.
12. The impact of statistics on Civil Engineering: PROF. HYMEN LEVY, *Proceedings of the Institution of Civil Engineers, London*, Part I, Vol. 2, November 1953, No. 6, pp. 681-695.

13. State, County, Road Engineers get Tips on How to cut Costs: J. ROLAND CARR, *Engineering News Record*, October 1, 1953, p. 23.
14. City and Railway Collaborate; Invent New-pavement Guard: *Engineering News Record*, October 1, 1953, p. 37.
15. Engineering means Swifter, Safer Traffic for Dayton: *Engineering News Record*, October 29, 1953, pp. 54-56.
16. Baytown Tunnel is opened to Traffic: *Engineering News Record*, September 24, 1953, p. 25.
17. How to Measure State Interest in Agricultural Roads: G. A. RIEDESEL, *Engineering News Record*, September 24, 1953, pp. 31-32.
18. High Speed Channels Spell Low-Cost Airfield Drainage: ENSIGN HOWARD JAWBY, *Engineering News Record*, November 5, 1953, pp. 41-44.

III. PLANNING, LAYOUT AND SURFACE CHARACTERISTICS

19. Rural Road Inventory: E. R. FOLE, *California Highways and Public Works*, July-August 1953, pp. 26-31 and 60.
20. The Economic Value of Road Improvement—American Ways of Assessment—Part 5—Layout: LIEUT.-COL. E. W. W. RICHARDS, *Roads and Road Construction*, October 1953, pp. 285-288.
21. The Design of Motorways: THOMAS EDWARD HUTTON, *The Proceedings of the Institution of Civil Engineers, London*, Part II, Vol. 2, October 1953, No. 3, pp. 711-754.

IV. SOIL ENGINEERING AND DRAINAGE

22. Solving Unusual Foundation and Steel-framing Problems: C. D. CARRUTHERS, *Roads and Engineering Construction*, August 1953, pp. 130-132 and 156-158.

23. **Construction of Compacted Earth-fill Dam in New Brunswick**; *Roads and Engineering Construction*, August 1953, pp. 122-125 and 139-144.

24. **Soil Samples Frozen**; *Engineering News Record*, September 10, 1953, p. 76.

V. SOIL STABILIZATION AND LOW-COST ROADS

25. **Soil Stabilization as Applied to the Construction of Airfield Pavements**; *Roads and Road Construction*, October 1953, pp. 303-304.

26. **Recent Progress in Soil-Cement for Road Construction**; D. J. MACLEAN, *The Engineer*, November 27, 1953, pp. 712-714.

27. **Soil-Cement and Concrete Roads**; *Engineering*, November 27, 1953, pp. 681-682 (Part I).

VI. ROAD STONE AND AGGREGATES

28. **Aggregates cooled on belts for Valtarna Dam in India**; E. A. BERTSCH and AMERICO SILVERA, *Engineering News Record*, September 3, 1953, pp. 37-38.

29. **Danger-Slippery When Wet**; C. E. LARSON, *Engineering News Record*, October 29, 1953, pp. 45-46.

30. **Lightweight Aggregates—Expanded Shale**; JOHN W. SHAVER, *Concrete*, October 1953, pp. 3-6 and 41.

31. **The percentage voids in Compacted Gravel as a Measure of its Angularity**; F. A. SHERGOLD, *Magazine of Concrete Research*, No. 13, August 1953, pp. 3-10.

VII. CONCRETE

32. **Factors Affecting the Riding Quality of Machine-laid Concrete Roads**; REGINALD HERBERT HENLEY KIRHAM, *Proceedings of the Institution of Civil Engineers, London, Part II*, Vol. 2, October 1953, pp. 656-709.

33. **Concrete Hardening Speeded up by 60 per cent**, *Engineering News Record*, November 5, 1953, p. 70.

34. **Glass Mixed Concrete**, *Civil & Structural Engineers' Review*, November 1953, p. 414.

35. **Lean-Mix Concrete**, *Civil & Structural Engineers' Review*, November 1953, pp. 437-438.

36. **The Economics of Concrete Roads**, *The Surveyor*, November 1953, pp. 832-833.

VIII. OTHER MATERIALS AND CONSTRUCTIONAL DETAILS

37. **Roof-Bolting—The dry ducter hand rib enables overhead drilling to be carried without dust or sludge depending on the mixer**, *The Overseas Engineer*, October 1953, pp. 106-107.

- 37(a) **Bridge Piling 105-ft Long**; R. W. FINKE, *Western Construction*, September 1953, pp. 72-73.

38. **Repairs to Roof Structure of the New Theatre, Northampton**; A. B. GRANT, *The Structural Engineer*, 1953, pp. 329-31.

39. **Special Features of the Affric Hydro-electric Scheme (Scotland)**, CYRIL MINCHIN ROBERTS, *Proceedings of the Institution of Civil Engineers, London, Part I, Vol. 2*, September 1953, No. 5, pp. 520-609.

40. **Wood Preservation**; NORMAN ARTHUR RICHARDSON, *Proceedings of the Institution of Civil Engineers, London, Part I, Vol. 2*, November 1953, No. 6, pp. 649-678.

41. **Hangar's Timber Trusses Set New Span Record**, *Engineering News Record*, September 3, 1953, pp. 31-32.

42. **On-Schedule at Niagra, ONTARIO**, *Hydro Construction, Engineering News Record*, September 10, 1953, pp. 33-38.

43. **Progressive Tunneling Works Without Use of Liner Plates**, *Engineering News Record*, September 10, 1953, pp. 55-59.

IX. MAINTENANCE

44. **The Improvements to Roads by Partial Use of "Viagraph-Tracing" Aid** (*L'amélioration des*

chaussées par emplois partiels à l'aide du "viagraph-traceur"); J. L. WENNAGEL, *Revue Generale des Routes et des Aerodromes*, November 1953, pp. 69-70 (in French).

X. BRIDGES AND OTHER STRUCTURES

45. **One-mile Long Bridge with 1447-ft Suspension Span, Over Halifax Harbour**; P. L. PRATLEY, *Roads and Engineering Construction*, August 1953, pp. 113-115, 155-156.

46. **Trends in the Design of Large Bridges**; W. SCHWEISHEIMER, *Roads & Engg. Construction*, August 1953, 154, 162-167.

47. **Arctic Engineering Know-how Gets Acid Test at Thule**; S. D. STURGIS, *Civil Engineering*, September 1953, pp. 31-35.

48. **Progress with Construction of Some Large Bridges, Main Roads**, September 1953, pp. 12-15.

49. **An Aluminium Alloy Bascule Bridge**, *The Engineer*, October 2, 1953, pp. 429-431.

50. **Crane Gantry Girders for Steelworks**; J. S. TERRINGTON and J. M. HAWKES, *The Structural Engineer*, Oct. 1953, pp. 268-285.

51. **The "Why" and "How" of the World's Foremost All-welded Steel Viaduct**, *Western Construction*, Sept. 1953, pp. 78-81.

52. **A Derivation of Maximum Stanchion Moments in Multi-Storey Frames by Means of Nomograms**; R. H. WOOD, *The Structural Engineer*, November 1953, pp. 316-328.

53. **Corrugated Concrete Shell Roofs**; JAMES HARDRESS de WARRENNE, *Proceedings of the Institution of Civil Engineers, London, Part III, Vol. 2*, August 1953, No. 2, pp. 154-196.

54. **The Application of Precast Concrete to the Construction of Acton Lane 'B' Power Station**; JOHN ANTHONY DETRINGTON, *Proceedings of Institution Civil Engineers, London, Part III, Vol. 2*, August 1953-No. 2, pp. 197-235, 340-42.

55. **Further Research in Reinforced Concrete and its Application to Ultimate Load Design**; PROF. ARTHUR LEMPRIERE LANOEY BAKER, *Proceedings of the Institution of Civil Engineers, London, Part III, Vol. 2*, August 1953, No. 2, pp. 269-310.

56. **The Trend of Development in the Design and Equipment of Underground Railways**; DOUGLAS HARLOW COOMBS and GEOFFREY JAMES WILSON, *Proceedings of the Inst. of Civil Engineers, London, Part II, Vol. 2*, Oct. 1953, No. 3, pp. 605-655.

57. **Wrap-around Cables Prestress Long Continuous-Girder Bridge**; FRITZ LEONHARDT and CURZON DOBELL, *Engineering News Record*, September 3, 1953, pp. 43-47.

58. **Staggered Piers Aid Erection**, *Engineering News Record*, September 10, 1953, p. 30.

59. **Concrete Caissons Towed to Bridge Site**, *Engineering News Record*, November 5, 1953, p. 22.

60. **Precast Rigid-frame Warehouse**, *Engineering News Record*, November 5, 1953, p. 31.

61. **Prestressed Span is Double-decked for Railway on Top, Coal Conveyor Below**, *Engg. News Roads*, Nov. 5, 1953, pp. 63 and 67.

62. **Factors Governing the Ultimate Bending Moments of Normal Reinforced and Prestressed Concrete Beams with Reference to a Proposed Plastic Theory**; STEPHEN REVESZ, *Magazine of Concrete Research No. 13*, August 1953, pp. 11-26.

63. **Tests on End-anchored Unbonded Prestressed Concrete Beams Having Parabolic Steel Eccentricity, Subject to Uniformly Distributed Loading**; F. W. GIFFORD, *Magazine of Concrete Research No. 13*, August 1953, pp. 27-36.

64. **Reconstruction of the Brooklyn Bridge**, *The Engineer*, Nov. 27, 1953, pp. 686-689.

65. **Post Buckling Behaviour of Long Square Boxes Under Torsion**; B. H. FALCONER, *The Engineer*, Nov. 27, 1953, pp. 690-694.
66. **Relaxation Methods: A Retrospect**; SIR RICHARD SOUTHWELL, *The Engineer*, November 27, 1953, pp. 706-709.
- XII. TRAFFIC MARKINGS, SIGNS AND SIGNALS**
67. **Experimental Pedestrian Crossing Indicator**, *Roads and Road Construction*, October 1953, p. 304.
- XIII. VEHICLES AND STREET LIGHTING**
68. **New lights Success**; ROY MATTHEWS, *California Highways and Public Works*, July-August 1953, pp. 50-51.
69. **Co-operation in Public Lighting**; C. C. SMITH, *Roads and Road Construction*, October 1953, pp. 293-294.
70. **Public Lighting in Belgium**; ANDRE BOERBOOM, *Roads and Road Construction*, October 1953, pp. 295-298.
71. **Principles of Illumination of Highways with Heavy Traffic (Principes de l'éclairage routier conditionné par le trafic)**; J. B. de BOER, *Revue Generale des Routes et des Aerodromes*, November 1953, pp. 59-68 (in French).
- XV. PLANT, MACHINERY AND APPARATUS**
72. **Cement Handling, Bulk Transport and Storage for the Smaller Contract Results in Appreciable Economics**, *The Overseas Engineer*, October 1953, p. 89.
73. **Checking Road Surface Irregularities**; P. J. MADDICKS, *Roads and Road Construction*, October 1953, p. 284.
74. **Tracks or Rubber Tyres? How to Choose the Right Plant in the Job**; R. D. PAMMENT, *Roads and Road Construction*, October 1953, p. 289.
75. **Plumbing Provides Plumb for Tunnel Surveys**, *Western Construction*, September 1953, p. 88.
76. **Planning the Plant for Production of Stone-sand**; W. R. Easley and J. H. CHEVANS, *Western Construction*, August 1953, pp. 60-64, 122.
77. **The Handling of Cement**; DENNIS FRANK ORCHARD, *The Proceedings of the Institution of Civil Engineers, London, Part I, Vol. 2*, September 1953, No. 5, pp. 616-642.
78. **Road Deflection Under Load Measured by Portable Device**, *Engineering News Record*, October 1, 1953, p. 29.
79. **Building Panels Precast in Plastic Forms**, *Engineering News Record*, October 22, 1953, p. 33.
80. **Supports for Concrete Shuttering**, *Engineering News Record*, October 2, 1953, p. 447.
81. **The Design and Use of a Demountable Mechanical Strain Gauge for Concrete Structures**; P. B. MORICE, *Magazine of Concrete Research*, No. 13, August 1953, pp. 37-42.
- XVI. TAR AND BITUMEN (INCLUDING SURFACE DRESSING)**
82. **The Development and Practical Application of Dense Tar Surfacing**; E. W. HINCHLEY, *Road Tar*, September 1953, pp. 5-12.
83. **Problems in the mixing of Bituminous Material**; D. C. BROOME and A. E. HOWES, *Roads and Road Construction*, October 1953, pp. 278-284.
84. **Stabilized Shale Road Bases**; *Roads and Road Construction*, October, 1953, pp. 290-292.
85. **Bituminous Surfacing Work—Theory and Practice**; J. H. MOULD, *Main Roads*, September 1953, pp. 4-11.
86. **Some Special Applications of Bitumen Emulsions**; W. L. PEARD, *Highways and Bridges and Engineering Works*, September 1953, pp. 6-7 and 11.
87. **Teattle Tests Rubber-Asphalting Paving**; *Western Construction*, September 1953, pp. 61-62.

88. **Effect of Jet Aircraft on Paving—Problems now being overcome, Civil Engineers Told**; *Highways and Bridges and Engineering Works*, October 21, 1953, p. 4 and 9.
89. **Rheology of Bituminous Materials**; B. G. MENTEN, *Highways and Bridges and Engineering Works*, October 21, 1953, pp. 6-7.
90. **6,000 Miles of 30 ft wide surfacing now possible for year**; *Highways and Bridges and Engineering Works*, October 21, 1953, pp. 7-8.
91. **Asphalt and Soil-Cement Team for High-type Air Base Roads**; *Engineering News Record*, September 3, 1953, pp. 41-42.
92. **Wire Mesh Bituminous Pavement Tested**; *Engineering News Record*, November 5, 1953, pp. 53 and 57.
93. **Lower Cost Irrigation Canal Linings**; T. V. D. WOODFORD, *Engineering News Record*, November 5, 1953, pp. 35-40.
94. **The Ageing of Road Tars (Le vieillissement des goudrons routiers)**; M. MARCEL LEROUX, *Revue Generale des Routes et des Aerodromes*, November 1953, pp. 23-35 (in French).
95. **Modern Evolution of Researches on Tars for Roads (L'évolution moderne de la recherche sur le goudron pour routes)**; Dr. HEINZ-GERHARD FRANK, *Revue Generale des Routes et des Aerodromes*, November, 1953, p. 36 (in French).
96. **Recent Progress in the Use of Tars for Roads (Progres recent dans l'emploi du goudron pour routes)**; W. E. ANE, *Revue Generale des Routes et des Aerodromes*, November 1953, pp. 50-55 (in French).

**PUBLICATIONS ADDED TO THE ROADS WING LIBRARY
DURING NOVEMBER 1953.**

1. **A solvent Method for the Recovery of Tar Binder from Road Materials** (Reprinted from the Journal of Applied Chemistry, No. 2, 1952, pp. 192-198), by E. H. Green (Printed by Harrison & Sons, Ltd, London, Printers to His Late Majesty King George VI).
(Division of Highways, Department of Public Works, State of California, 1950)
2. **BITUMEN**, Vol. 14, No. 1, January, 1952, containing an article "The bearing capacity of existing roads laid on different types of base and subgrade".
(Bitumen, Hamburg 36-Dammtorstr 31).
3. **H. M. S. O. London, Floor Finishes for Industrial Buildings-National Building Studies Special Report No. 11**-by G. E. Bessey.
4. **A Survey of the Behaviour in Use of Asbestos-Cement Pressure Pipes-National Building special Report No. 15**, by F. E. Jones and J. P. Latham.
5. **Selected Bibliography of Technical Papers written by Engineers of the Bureau of Reclamation**.
(Technical Library, Denver, Colorado, January 30, 1948).
6. **Precasting Highway Bridges and Structures — Highway Research Board, Bulletin No. 39**-Presented at the 30th annual meeting by R. B. McMinn.
(Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, 25, D. C., 1951).
7. **The Railway Highway Grade Crossing Problem-Economic Principles** by A. Kenneth Beggs.
(Stanford Research Institute, Stanford, California).
8. **Right of Way Form Book** edited by Rudolf Hess.
9. **The Eastern Economist Ltd. 52**, Queensway, New Delhi.
10. **A Programme of National Education for India-Eastern Economist Pamphlets Series No 19**, by Humayun Kabir.
11. **Deficit Financing, Capital Formation and Price Behaviour in an under developed Economy-Eastern Economist Pamphlets Series No. 21**, by Dr. V. K. R. V. Rao
12. **Practical Design Handbook for Engineers** (new enlarged edition) by Dr. Alois Cibulka (Clarke & Courts, Houston, Texas).
13. **Highway Research Board, 2101, Constitution Avenue, Washington 25, D.C.**
Scour Around Bridges-Highway Research Board Report No. 13—B (Presented at the 30th annual meeting, 1951)
14. **Studies in Night Visibility-Highway Research Board Bulletin No. 43** (Presented at the 30th Annual Meeting, November, 1951).
15. **Pennsylvania Prestressed Concrete Bridge Members-an article contained in the Journal "Rock Products"**. Vol. 55, No. 5, May, 1952 by M. W. Loving (Maclean-Hunter Publishing Corporation, 309, West Jackson Boulevard, Chicago 6, Illinois).
16. **A study of the Practical Efficiency under static Loading of Riveted Joints connecting Plates-Bulletin Series No. 492** by M. W. Wilson, and others (University of Illinois, Urbana)
17. **The Story of the Sydney Harbour Bridge-A Brochure** (Department of

- Main Roads, New South Wales, Sydney, Australia, 1952).
18. **Deliberations of the International Society of Soil Mechanics held in Paris from July 7-9, 1952 and the supporting Power of Piles** (LA MECANIQUE DESSOLS ET LA FORCE PORTANTE DES PIEUX). (Institut Technique Du Batiment Et Des Travaux Publics, Paris).
19. **The Manager of Publications, Delhi.**
The Gazette of India Extraordinary Part II—Section I, date 14—9—53 containing the Andhra State Act, 1953-No. 30 of 1953 (2 copies).
20. **Report of the Committee on Training of Civil Air Pilots, 1953.**
21. **Census of India, 1951, Volume XIII-Travancore-Cochin—Part I—Subsidiary Tables—P. C. C. 65** (2 copies).
22. **-do-Part II — Tables — P. C. C. 67** (2 copies).
23. **Companion of the Constitution of India** (Indian Law Review, 51, Jhamapooker Lane, Calcutta, 9). (2 copies).
24. **Five Year Plan Progress Report for 1951-52 and 1952-53.** (Planning Commission, Government of India, May, 1953).
25. **The Mersey Tunnel Joint Committee, Municipal Buildings, Liverpool 2, England.**
The Mersey Tunnel.
26. **The Mersey Tunnel—The Story of an Undertaking.**
27. **The Story of the Mersey Tunnel, Officially named Queensway.**
28. **Bristol on the move—A Travel Survey** (British Transport Commission, London, 1953.)
29. **Highway Maintenance Manual** (Division of Highways, Bureau of Public Works, Department of Public Works and Communications, Republic of the Philippines).
30. **Report on the first Prestressed concrete Test Beam in the Philippines** (Co-operative Project of the U. S. Bureau of Public Roads—MSA Philippine, Bureau of Public Works, University of the Philippines, Atlantic, Gulf and Pacific company of Manila).
31. **The Indian Motor Vehicles Act** by B. N. Chaudhuri
(Law Book Co., Sardar Patel Marg, Post Box No. 4, Allahabad—I, 1952).
32. **Annual Report of the Hirakud Research Station 1952, Research Publication No. 4**-by Dr. R. C. Hoon (Central Water and Power Commission, New Delhi, 1953).

BUDGETS AND ADMINISTRATION REPORTS

1. GOVERNMENT OF MADHYA BHARAT CIVIL WORKS BUDGET
FOR THE YEAR 1953-54.

The following extracts relating to Civil Works have been taken from the Madhya Bharat Budget for the year 1953-54.

	(In lakhs of rupees)		
	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
I. Revenue (Civil Works)			
1. Rents	2.97	2.30	2.30
2. Ferry Receipts	0.40	0.50	0.45
3. Receipts from Workshops	0.13	0.15	0.15
4. Recoveries of over Payments	0.15	0.03	0.03
5. Miscellaneous	5.15	1.53	1.00
6. Collection of Payments for Services Rendered	0.01	0.02	0.02
7. Receipts from the Road Fund- Gwalior	1.60	...	...
8. Subventions from the Central Road Fund	7.79	14.00	14.58
Total	18.20	18.53	18.53
II. Expenditure (Civil Works)			
1. Original Works	48.19	60.97	51.52
2. Repairs	49.61	50.04	57.14
3. Development Schemes under Five- year Plan	...	20.00	64.30
4. Tools & Plant	1.34	0.50	1.00
5. Suspense	-0.79	1.00	1.00
6. Lapses	3.99	...	...
7. Deduct-Economy Cut etc.	...	...	-18.00
8. Deduct-Contribution from development and other Fund	-11.49	7.00	-3.00
9. Establishment	10.73	10.41	10.50
Total	101.58	135.92	164.46
III. Expenditure (Communications only)			
1. Original Works	23.53	31.40	19.58
2. Repairs	37.66	38.12	45.12
3. Development Schemes under Five Year Plan	...	n. a.	37.50
Total	...	...	102.20
IV. Receipts under Motor Vehicles Act.	12.45	15.00	17.00

n.a = not available

A BRIEF REVIEW OF THE MADHYA BHARAT BUDGET

(With special reference to Civil Works)

THE total revenue receipts of Madhya Bharat for 1953-54 are estimated at Rs 14,29.78 lakhs and revenue expenditure at Rs 14,49.26 lakhs with a consequent deficit of Rs 19.48 lakhs. The revised estimates for 1952-53 indicate a surplus of Rs 27.8 lakhs with the revenue receipts amounting to Rs 13,00.94 lakhs and revenue expenditure to Rs 12,73.14 lakhs.

Revenue expenditure on Civil Works for 1953-54 estimated at Rs 164.46 lakhs forms 11.5 per cent of total estimated revenue in the State during the year. The corresponding percentages for the two

preceding years 1952-53 (Revised Estimates) and 1951-52 (Budget Estimates) were 10.4 and 8.8 respectively.

Expenditure on communications (Original Works and Repairs) during 1953-54 is estimated at Rs 102.20 lakhs which includes Rs 37.50 lakhs provided under the five-year plan for Original Works Communications.

The expenditures under communications (Rs 102.20 lakhs) amounts to 7.1 per cent of the total revenue (Rs 14,29.78 lakhs).

2. GOVERNMENT OF SAURASHTRA CIVIL WORKS BUDGET 1953-54.

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

	(In lakhs of rupees)		
	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
I. Revenue (Civil Works)			
1. Rents	3.86	4.75	5.15
2. Tolls on Roads and receipts from workshops	0.01	...	...
3. Transfer from Central Road Fund	0.15	26.20	10.82
4. Miscellaneous	6.24	1.40	4.32
5. Rent of furniture	...	0.07	0.08
6. Recoveries of Expenditure	0.25	0.19	0.07
7. Deduct-Refunds	-0.05	-0.10	...
Total	10.46	32.51	20.44
II. Expenditure (Civil Works)			
1. Original Works	46.07	90.95	103.84
2. Repairs	26.03	30.40	29.50
3. Establishment	7.33	8.38	9.98
4. Tools & Plant	1.14	0.41	0.44
5. Grants-in-aid	1.68	...	3.20
6. Suspense	9.11	...	...
7. Deduct-Probable Savings	...	...	-0.10
Total	91.36	130.14	146.86

	(In lakhs of rupees)		
	Actuals 1951-52	Revised Estimates 1952-53	Budget Estimates 1953-54
III. Expenditure (Communications)			
1. Original Works	27.99	74.99	70.95
2. Repairs	16.51	19.00	18.00
Total	44.50	93.99	88.95

IV Revenue from Roads

1. Receipts under Motor Vehicles Act	14.03	14.13	14.11
2. Receipts on account of Motor Spirit Sales Tax	6.78	9.00	9.00
Total	20.81	23.13	23.11

A BRIEF REVIEW OF THE SAURASHTRA BUDGET

THE Saurashtra Budget for 1953-54 provides for total revenue receipts of Rs 941.77 lakhs and expenditure charged to revenue of Rs 995.45 lakhs leaving a deficit of Rs 53.68 lakhs. According to the revised estimates for 1952-53 revenue receipts amount to Rs 983.63 lakhs and revenue expenditure to Rs 1165.96 lakhs with a consequent deficit of Rs 182.33 lakhs.

The revenue expenditure on civil works for 1953-54 estimated at Rs 146.86 lakhs

forms 15.6 per cent of total revenue receipts of the State. The corresponding percentages for the two preceding years 1952-53 (R. E.) and 1951-52 (Actuals) are 13.2 and 12.2 respectively.

The proportion of revenue expenditure on communications (original works and repairs) to total revenue for 1953-54 (estimates) and the two earlier years are 9.4 per cent, 9.6 and 5.9 per cent respectively.

"Of all communications, road communication is the nearest to man. You have to go to a railway or a waterway or an airway, but the roadway comes to you."

O. V. Alagesan.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No	Name of work	Amount (Rs in lakhs)
BOMBAY			
1.	811 BM 8	Construction of a bridge (with approaches) across the Purna river on the diversion of the Bombay—Ahmedabad National Highway No. 8 outside Navsari town.	17.56
2.	813 BM 8	Construction of a bridge over Kim river near Moti Naroli on the Bombay Ahmedabad Road—National Highway No. 8 (excluding approaches).	5.45
3.	824 BM 6	Improving and widening miles 195/0 to 208/0 of the Dhulia—Edlabad—Nagpur Road. National Highway No. 6 (excluding the portion relating to Waghur bridge and its approaches).	6.04
RAJASTHAN			
4.	816 RJ 8	Construction of a metalled road from Bichwara to Ratanpur Section of National Highway No. 8.	4.38
ORISSA			
5.	817 RS 5	Black-topping National Highway No. 5, Puri to Ganjam District border to Ganjam Village (miles 660/0 to 679/4).	2.49
6.	822 RS 42	Construction of a bridge over the Balichaṭri Jore on National Highway No. 42.	0.88
7.	823 RS 43	Re-aligning the road from mile 14/4 to 14/7 of Itikivalasa Jeypore road of National Highway No. 43 in Orissa.	0.10
ASSAM			
8.	818 AS 37	Improving certain miles of A. T. Road—N. H. No. 37 between miles 39 and 61 in Nowgong Division (11½ miles).	4.51
MADRAS			
9.	819 MD 47	Black-topping miles 231/1 + 500 to 236/5 of N. H. No. 47 in Salem South Division.	2.21

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
DELHI			
10.	820 DLH 2	Constructing bridges and culverts on the portion of the bye-pass connecting N. H. No. 1 with N. H. No. 2 from Rajghat to the crossing of Power House Railway siding.	0.87
PUNJAB			
11.	821 PB 10	Widening miles 16 to 45 of Delhi—Hissar—Sulemanki Road (N. H. No. 10) in Rohtak District, Punjab.	9.00
12.	827 PB 1	Widening Budha Nallah bridge in mile 192/3 of G. T. Road (N. H. No. 1) in Ludhiana District.	0.33
TRAVANCORE—COCHIN			
13.	825 TC 47	Additional boring in connection with the construction of a bridge at Aroor Crossing at National Highway No. 47.	0.15
HIMACHAL PRADESH			
14.	826 HP 22	Purchase of special tools and plant for the construction of Hindustan—Tibet Road (N. H. No. 22) from Simla to Chini.	12.63

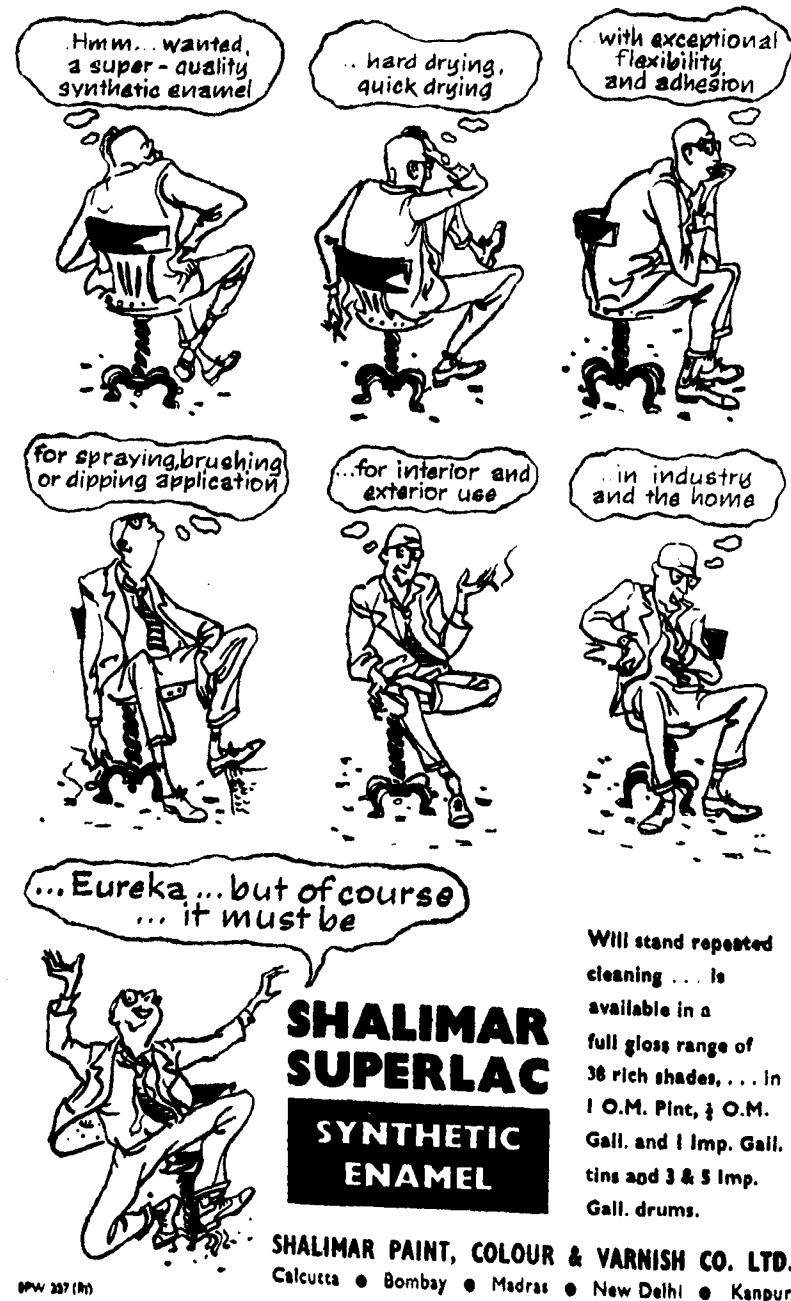


FERODO
BRAKE LININGS

**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



...Hm... wanted, a super-quality synthetic enamel

...hard drying, quick drying

...with exceptional flexibility and adhesion

...for spraying, brushing or dipping application

...for interior and exterior use

...in industry and the home

...Eureka... but of course ... it must be

SHALIMAR SUPERLAC
SYNTHETIC ENAMEL

Will stand repeated cleaning ... is available in a full gloss range of 36 rich shades, ... in 1 O.M. Pint, ½ O.M. Gall. and 1 Imp. Gall. tins and 3 & 5 Imp. Gall. drums.

SHALIMAR PAINT, COLOUR & VARNISH CO. LTD.
Calcutta • Bombay • Madras • New Delhi • Kanpur

OPW 237 (R)

Please mention this journal when replying to advertisements.

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.

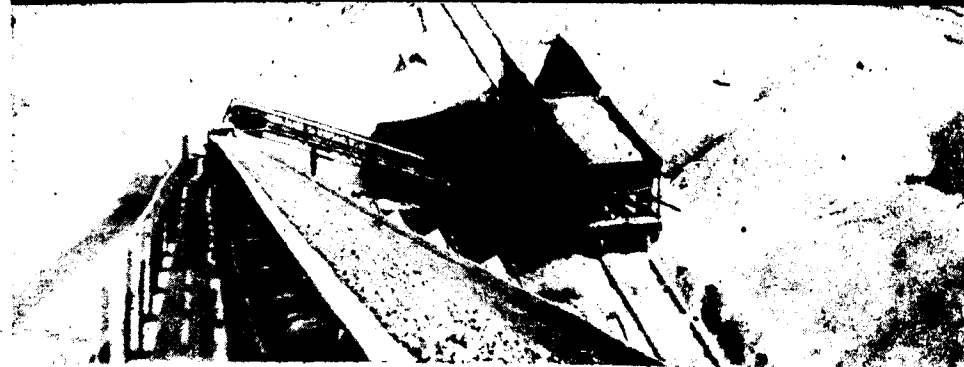
Telephone: 41077

Telegrams: JARRAH

Branches and Agents throughout the World.

Please mention this journal when replying to advertisements.

THE BARBER-GREENE *Redi-Fab* SERIES
MEETS THE NEED OF 2 OUT OF 3
PERMANENT CONVEYOR INSTALLATIONS



WHAT PACKAGED CONSTRUCTION MEANS TO YOU!

With the Redi-Fab Series:

- (1) You get a quotation quickly.
- (2) You get fastest delivery because Redi-Fab components are manufactured in advance—they are normally sold to you "off-the-shelf" by your B-G distributor or from factory stocks.
- (3) You completely eliminate special engineering costs.
- (4) You greatly reduce the time and cost of erection.
- (5) Your Redi-Fab Conveyor can be lengthened, shortened or otherwise altered to meet new conditions.

WIDE CHOICE OF

COMPONENTS AND ACCESSORIES

include feeders, belts and belt covers, cam rollers, packstops, A-frame, truss sections, channel frames, walkways, hoppers.

WRITE FOR *Redi-Fab* CATALOG

A copy of the Barber-Greene Redi-Fab Catalog will be sent promptly on request.

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 mention this journal when replying to advertisements.

PUBLICATIONS OF THE **INDIAN ROADS CONGRESS**

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

Publications.			Price inclusive of postage, etc	
			Rs	As. P
1.	Volume IX—Part 4—October 1945	...	3	0
2.	Volume IX—Bound—Madras 1945	...	10	0
3.	Volume X—Part 4—August 1946	...	3	0
4.	Volume XI—Part 4—May 1947	...	3	0
5.	Volume XI—Bound—(Parts 3 & 4) 1947	...	6	0
6.	Volume XII—Part 2—January 1948	...	3	0
7.	Volume XII—Part 3—April 1948	...	3	0
8.	Volume XII—Part 4—March 1948	...	3	0
9.	Volume XII—Part 5—September 1948	...	3	0
10.	Volume XII—Bound—1947-48	...	12	0
11.	Volume XIII—Part 1—December 1948	...	3	0
12.	Volume XIII—Part 2—January 1949	...	3	0
13.	Volume XIII—Part 3—January 1949	...	3	0
14.	Volume XIII—Bound—1948-49	...	11	0
15.	Volume XIV—Part 1—September 1949	...	3	0
16.	Volume XIV—Part 2—December 1949	...	3	0
17.	Volume XIV—Part 3—December 1949	...	3	0
18.	Volume XIV—Part 4—July 1950	...	3	0
19.	Volume XIV—Bound—1949-50	...	8	0
20.	Volume XV—Part 1—August 1950	...	3	0
21.	Volume XV—Part 2—November 1950	...	3	0
22.	Volume XV—Part 3—January 1951	...	3	0
23.	Volume XV—Part 4—August 1951	...	3	0
24.	Volume XV—Bound—1950-51	...	9	0
25.	Volume XVI—Part 2—March 1952	...	3	0
26.	Volume XVI—Part 3—April 1952	...	3	0
27.	Volume XVI—Part 4—October 1952	...	3	0
28.	Volume XVI—Bound—1951-52	...	8	0
29.	Volume XVII—Part 1—December 1952	...	3	0
30.	Volume XVII—Part 2—January 1953	...	3	0
31.	Volume XVII—Part 3—January 1953	...	3	0
32.	Volume XVII—Part 4—December 1953	...	3	0
33.	Volume XVIII—Part 1—December 1953	...	3	0
34.	Volume XVIII—Part 2—December 1953	...	3	0
35.	Volume XVIII—Part 3—January 1954	...	3	0
36.	Road Research Bulletin No. 1	...	5	0
37.	I. R. C. Standard Specifications and Code of Practice for Road Bridges in India (1937)	...	1	8
38.	Proceedings of the Chief Engineers' Conference at Nagpur on the Post-war Road Development in India	...	2	8

Copies can be had from the Secretary,

INDIAN ROADS CONGRESS,
JAMNAGAR HOUSE, SHAHJAHAN ROAD,
NEW DELHI-2.

தமிழ்நாடு ஆவணக்காப்பக நூலகம்,
எழும்பூர், சென்னை-600 008.

தவனினைத்தாள்.

தே. எண் :

ப. எண் :

[illegible]

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