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TRANSPORT
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JUNE-1951-NO-86

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MONTHLY REVIEW

JUNE 1954—No. 86

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INDIAN ROADS CONGRESS, NEW DELHI.

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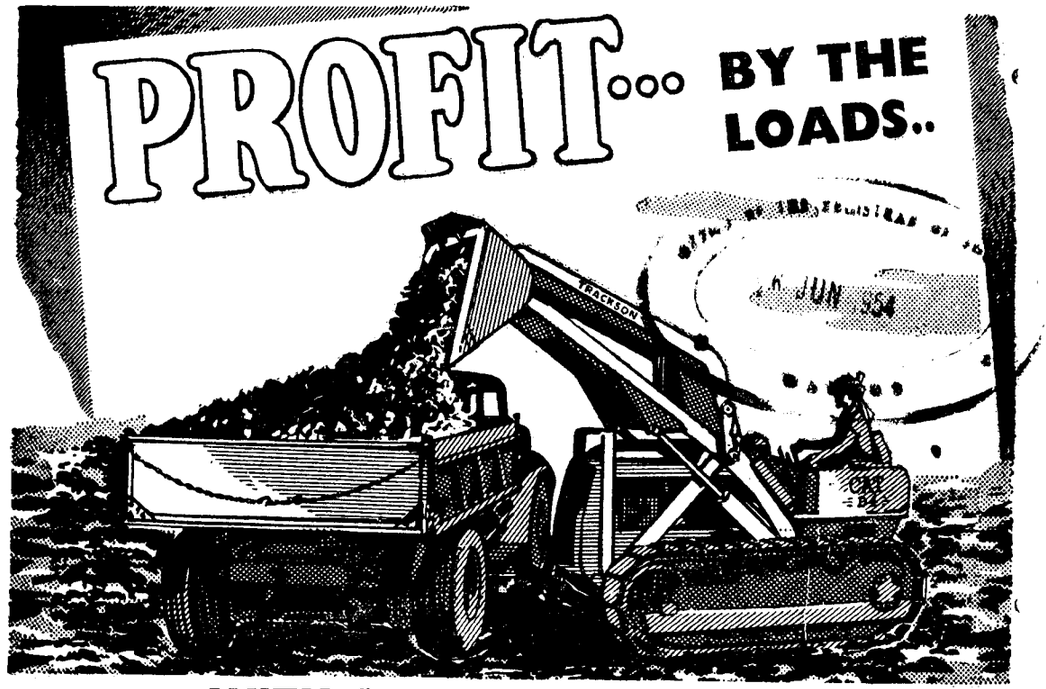

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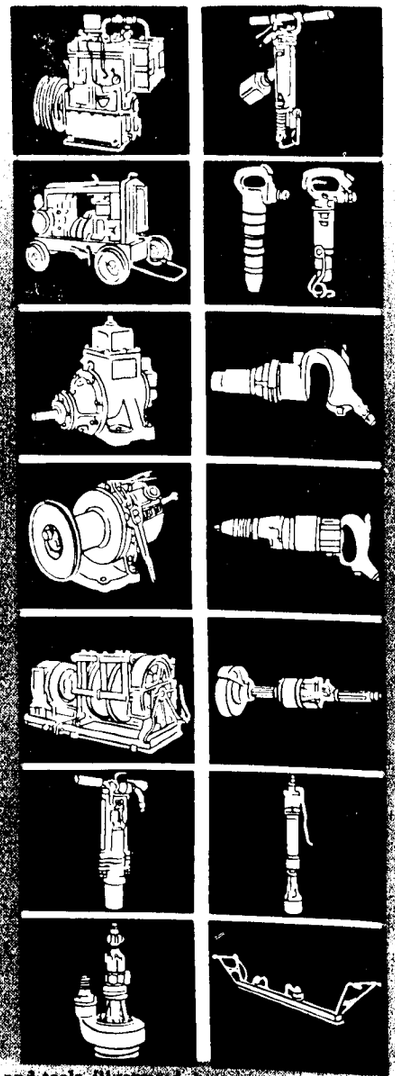

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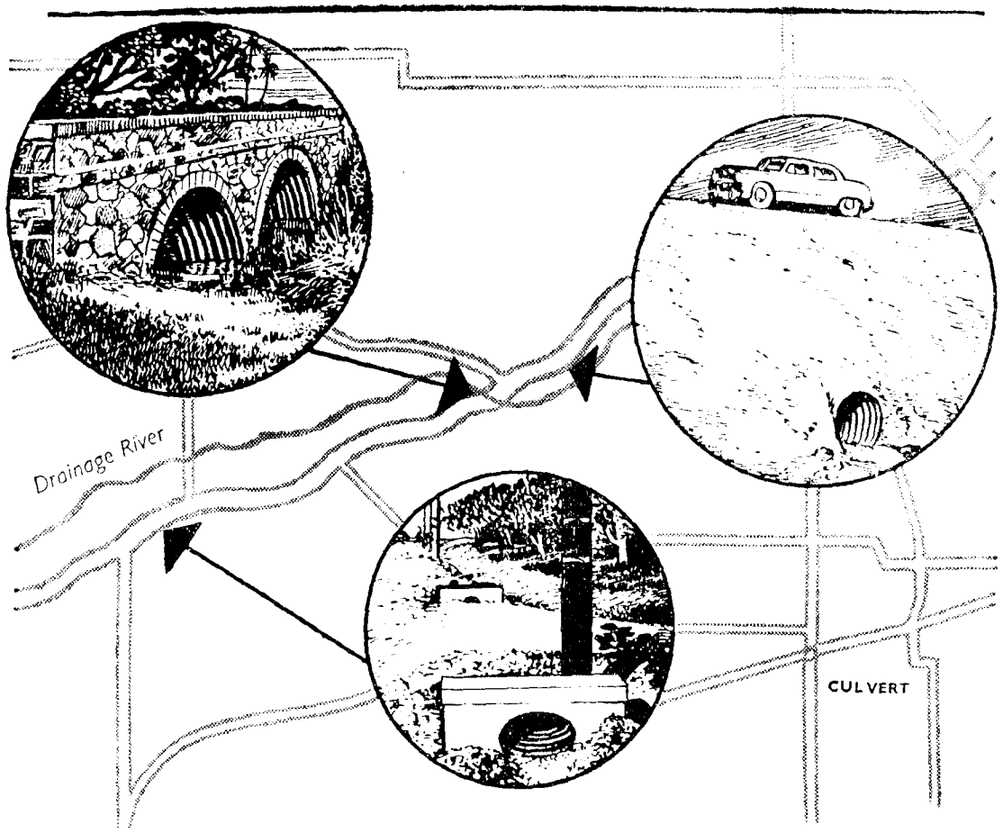

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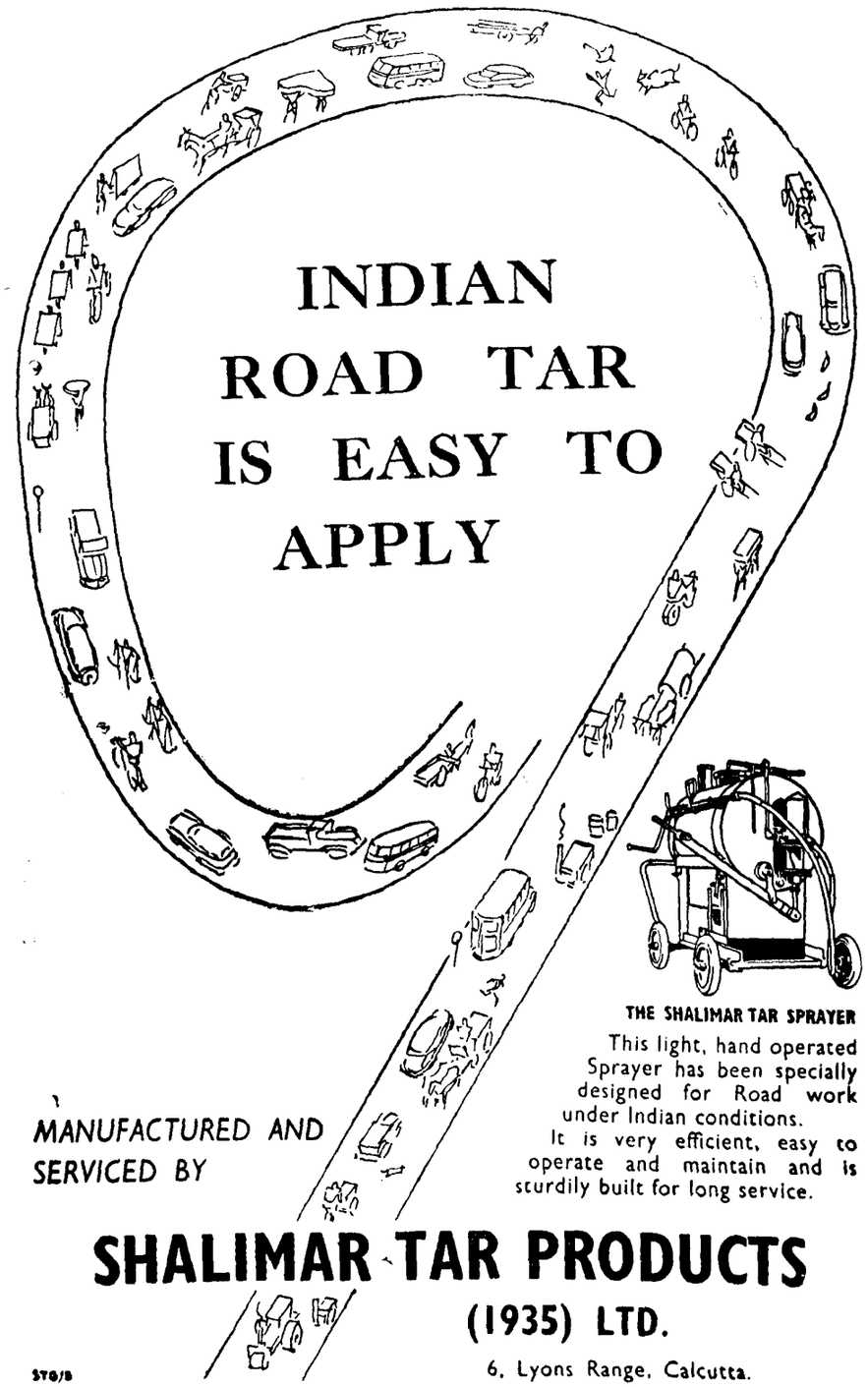

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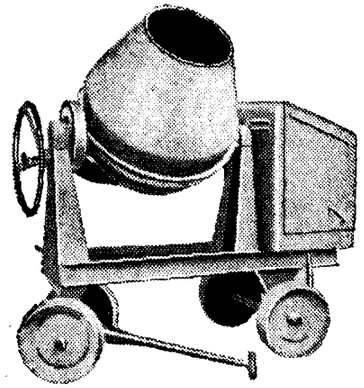

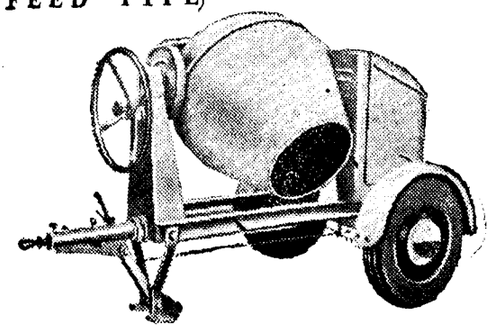

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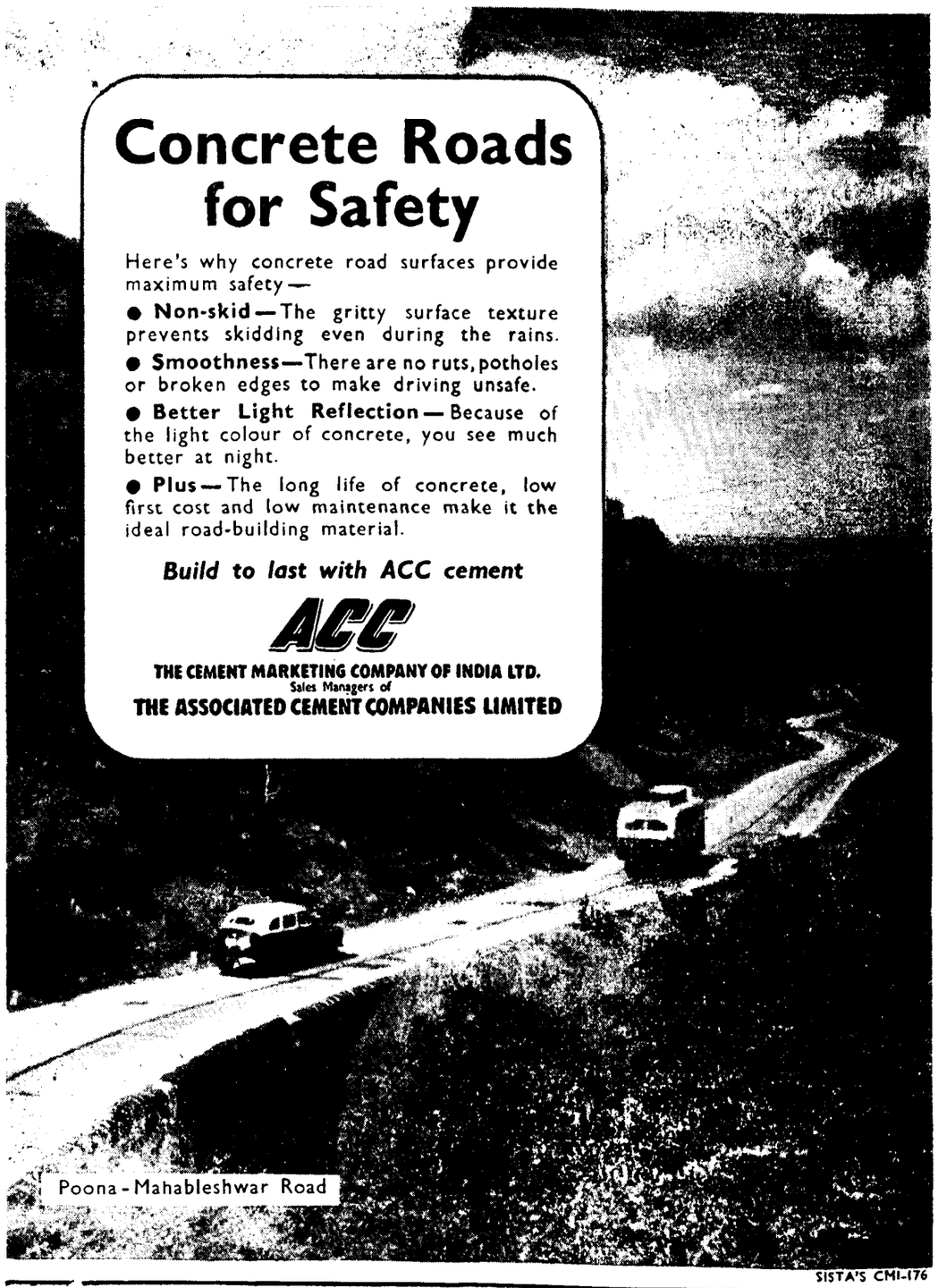

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MONTHLY REVIEW

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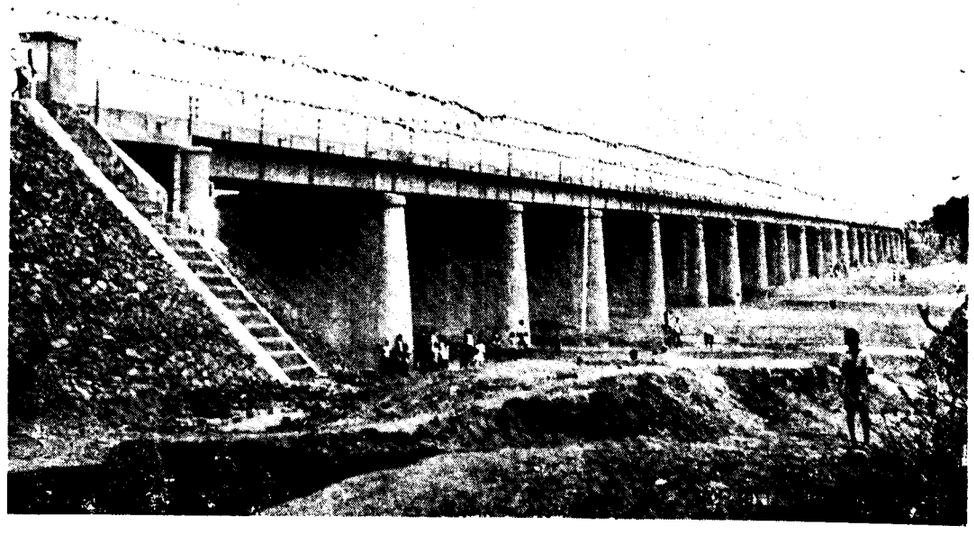
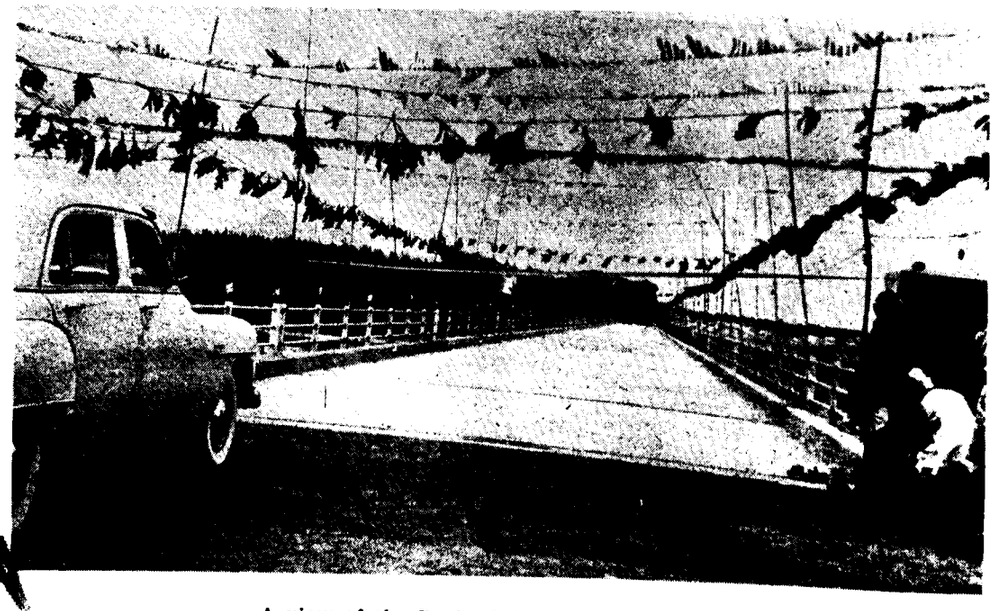


Champavati Bridge at 530/3-6 of National Highway No. 5.



A view of the Deck of Champavati Bridge.

TRANSPORT-COMMUNICATIONS
MONTHLY REVIEW

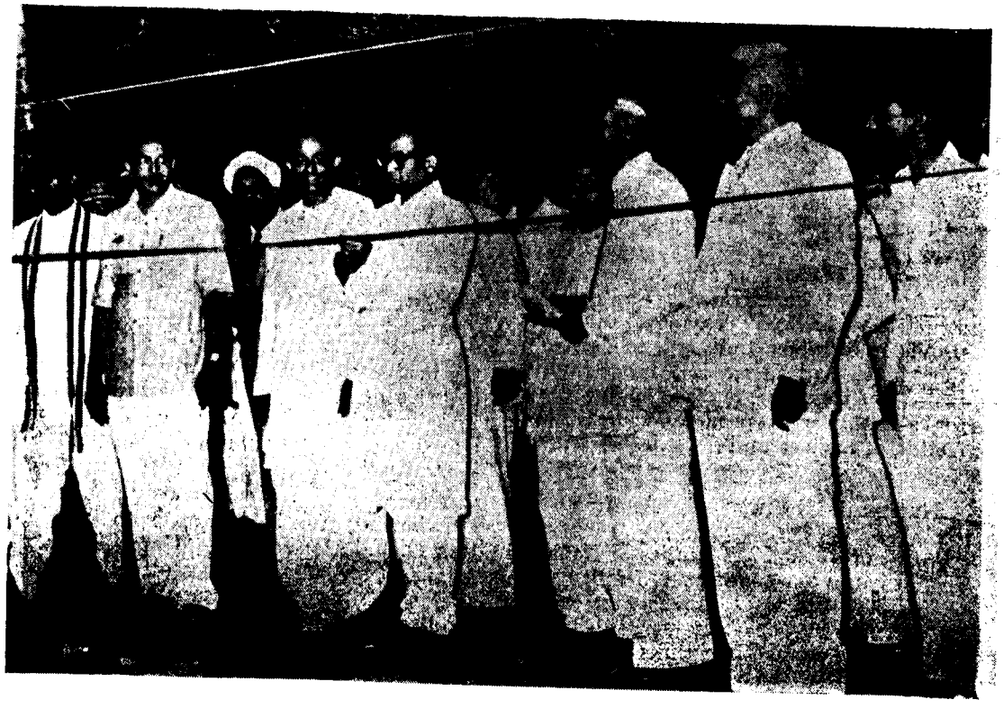
A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

JUNE 1954

THE CHAMPAVATI BRIDGE ON NATIONAL HIGHWAY No. 5 — OPENED

BRIDGE across the Champavati River at mile 530/3-6 of the National Highway No. 5 connecting Madras and Calcutta was opened to traffic by Shri O.V. Alagesan, the Union Deputy Minister for Transport and Railways on 30-5-54. The opening ceremony was presided over by Shri N. Sanjeeva Reddy, Deputy Chief Minister, Andhra.

The Champavati River has its source in Sringavarapukota and Ananthagiri Agency of the Visakhapatnam District of the Andhra State and crosses the Madras-Calcutta National Highway at mile 530/3-6 from Madras. This river is one of the thirteen major rivers that cross the National Highway No. 5. The bridge has been financed by the Centre. It consists



Shri O. V. Alagesan, the Union Deputy Minister for Transport and Railways opening the Champavati Bridge.

1

of 22 spans with a clear waterway of 945.5 ft. There are 6 units of reinforced concrete T-beam continuous over 3 spans, two simply supported units and two land spans.

Welcoming the guests, Shri J. M. Frederick, Chief Engineer (Highways), Andhra, said "The Andhra State covers an area of 63,530 sq. miles with a population of 20½ millions, and has a network of roads aggregating to 15,101 miles, in the 11 Districts of the State. Though the average density of population is only 322 per square mile, it ranges from 563 in a District like West Godavari to 170 in Kurnool District. Our road intensity is only 0.238 miles per square mile, whereas in Madras it is 0 397. In our State, the large areas of potential development, namely the Agency tracts and mountainous forests with their wealth of resources, are all thinly populated and insufficiently served by roads. It is obvious that the development of communications should invariably precede all developmental activities in other spheres. If the Agency tracts in the State are opened up by providing a suitable network of roads, connected to the main lines of communication, it will greatly help to tap fully the dormant resources of the State and increase the wealth of the State.

"Apart from this, the sense of isolation and neglect of people in the different parts of a State, caused by the physical barriers like rivers and mountainous tracts, has to be removed, and the construction of bridges across rivers and the provision of roads linking such parts of the State, will foster a sense of unity instead of isolation, and develop a desire for self-help and progress instead of a feeling of neglect and despair.

National Highways in Andhra

"Out of about 13,400 miles of National Highways in our country, 937 miles lie in the Andhra State. We feel that we are not adequately or fully served, in that there are no connecting links within our State between the National Highways along the East coast and the Western boundary of our State. The important place like Kurnool and the area lying between Kurnool and Guntur, have no easy outlet to the ports of Masulipatam, Kakinada and Vizag. Kurnool is the Capital, and at Guntur is located the High Court of the State. A National Highway of about 182 miles connecting the two places will not only connect the Calcutta-Madras road to the Banaras-Cape Comorin road, but will also open out the Nallamalai area, and give access to the projected Nandikonda Dam and Reservoir with its 300 ft wide canal in Guntur district, the Siddeswaram dam, and the famous Srisailam temple etc. in Kurnool district, and finally lead on to Thungabhadra dam and beyond. It may not cost the Government more than 40 to 50 lakhs of rupees to make this. It is hoped that the Government of India will take a long-range view of things and introduce this link in the National Highway system as a contribution to the newly formed State."

Shri N. Durrani, Superintending Engineer gave a history of the bridge and said: "This section of the road bears a traffic of about 1,500 tons a day. After throwing opening of the bridge the traffic is expected to increase even up to 2,000 tons. Taking the conservative figure of 1,500 tons only for 300 days in a year, the saving in the cost of transport will be about 2¼ lakhs per annum. This does not take into account the loss due to traffic hold-ups and long traffic detours due to floods when there was no bridge. Thus in about seven to eight years the entire cost of this bridge is paid off to the nation.

"As the waters of Champavati flow past the bridge into the vast oceans and as decades of time pass into eternity, this massive structure will continue to afford an easy means of transport to posterity."

Declaring the bridge open to traffic, Shri O. V. Alagesan, the Union Deputy Minister for Transport and Railways, said, "I believe the Champavati bridge is the first major bridge on a National Highway in Andhra State to be opened to traffic after the formation of the State and, therefore, the completion of this bridge has a special significance in the history of road development in Andhra.

Trunk Routes Improved

"The current Five-Year Plan envisages a total expenditure of about Rs 128 crores on the development of roads (i.e., on original works excluding maintenance) in India. Out of this amount, a sum of Rs 27 crores has been allocated for National Highways. As the main object of the National Highway scheme is to ensure continuous and well connected lines of communication along trunk routes in India, emphasis has been laid in the National Highway Plan on the construction of missing links and the bridging of unbridged rivers crossing the more important National Highways in the first instance.

"The Plan for National Highways contemplates taking up the construction of 1,250 miles of missing links, 75 large bridges and the improvement of 6,000 miles of existing roads. The targets to be completed during the period of the Plan are 640 miles of missing links, 40 large bridges (besides many small bridges) and the improvement of 2,500 miles of existing roads. I am glad to say that the progress made so far is, on the whole, satisfactory, the expenditure during the three years of the Plan period being approximately Rs 12 crores.

More Bridges

"Out of the major bridges included in the National Highway Plan, as many as thirteen are in Andhra State and these are estimated to cost over Rs 3 crores, including the Champavati bridge. The construction of the bridge over the river Pennar near Nellore is now in an advanced stage and is likely to be completed soon. I hope the construction of the Gautami-Godavari bridge, which has already been approved, will be taken up shortly. As you all know, the Krishna bridge near Vijayawada will be constructed as part of the regulator project and I believe work has already been started on this project. I have also been informed that steps have been taken for fixing the site of the bridge to be built across the Vasishta Godavari. With the completion of the bridges over the Pennar, the Krishna, the Gautami and Vasishta Godavari, and the Champavati, uninterrupted road communication will be established from Madras in the south up to Cuttack in the north. I am glad to know that the stretch of this important National Highway is now being black-topped up to Vijayawada from Madras.

"If I may say so, Andhra is the youngest State in the Indian Union. There are still large areas in the State requiring development in the interior and for this purpose road communications are essential, since it is by the provision of adequate road communications alone to the remote corners of the State that we can best ensure the fruits of our increasing economic prosperity to reach every individual in the State, no matter where he or she lives.

Development of Roads other than National Highways

"Apart from their direct interest in the development of the National Highway system the Government of India are also interested in the development of other roads, as it is necessary that there should be a balanced development of all classes of roads. They have recently decided to give grants amounting to Rs 20 crores for the development of roads other than National Highways in States which will be of inter-State importance or will assist in the economic development of backward areas in States. Half of this grant of Rs 20 crores will be provided during the current and the next financial year and the remainder will be provided during the second Five Year period. Programmes submitted by various States for undertaking the construction of roads with this financial assistance were approved by the Government of India recently. The share of Andhra State is Rs one crore and I hope the construction of roads included in this programme will be taken up and pushed through as quickly as possible."

"To tax and to please, no more than to love and be wise, is not given to men."— Edmund Burke.

HIGHWAY ADMINISTRATION AND FINANCE IN CANADA

ALL roads in Canada except those in the Territories, National Parks, and Indian Reservations, which are the responsibility of the Federal Government, are under the jurisdiction of the Provincial and Municipal Authorities.

The Municipality in Canada is a group of towns with a central town as its principal Headquarters and is similar to the District Local Boards in India. There is a Road Authority for each Municipality and it works in close co-operation with the Provincial Municipal Highway Branch of Provincial Highway Department, which usually subsidises the road expenditure for both maintenance and new construction. The Municipal Road Officials work under the direction of the Provincial Highway Municipal Branch, though they work in accordance with the Municipal Constitution.

Each Province has a Highway Act of its own. The Department of Highways is responsible for the construction and maintenance and enforcement of regulations in respect of all highways.

The Minister responsible for the Department is assisted by a Deputy Minister who is generally a senior Highway Engineer and acts as an Adviser in matters of policy and construction and by an Assistant Deputy Minister who is an Executive Officer. Under their direction various branches and divisions carry on the work of the Department. The Department is divided into a number of special branches as shown in the accompanying chart. The construction and maintenance of roads entrusted to the Highway Department is carried on by the Engineering Department while in the case of other roads, execution of work is done by the municipal Road Officers, under the direction of Road Branch.

Two separate branches, one for Construction and the other for Maintenance, are maintained at the top for giving directions and the Divisional Engineer of each Division carries out the work of both maintenance and construction according to the instructions of the respective Chief Engineers for Maintenance and New Construction. This arrangement stimulates specialisation in each branch and results in efficient working and speedy turnout.

As regards the Municipal Roads, both construction and maintenance are done by the Municipal Road Officer. But in all details they are helped by the Municipal Road Branch of the Highway Department, with high level technical advice, which small individual bodies cannot afford to have normally.

The Municipal Road Branch of the Highway Department maintains a close contact with the Local Bodies and their Road Officials through the District Municipal Engineer. The Auditors of the Highway Department give timely assistance in matters pertaining to Statutory requirements and accounting practice. Moreover, this Branch operates rental service which places heavy equipment at the disposal of Local Road Authorities, thereby enabling them to avoid large expenditure on machinery for which their need is very acute but temporary.

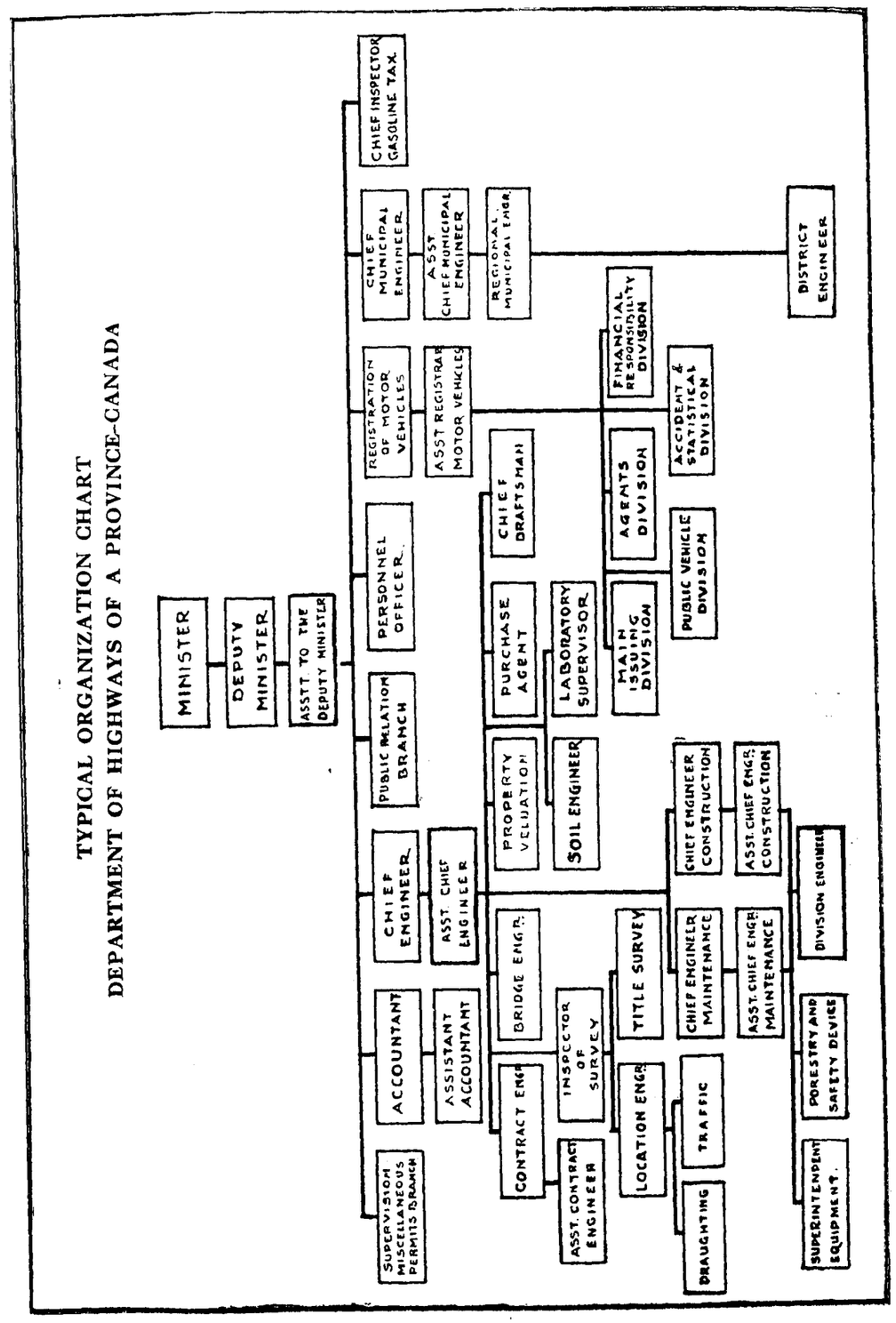
Surveying, designing and estimating for roads and bridges is done at the Central Office by separate branches with expert staff in consultation with the Divisional Engineers. Selecting contractors, purchasing materials, supplying and maintaining equipment, and controlling pool equipment, are also entrusted to specialised branches. Divisional Engineers are responsible to both Maintenance and Construction Chief Engineers.

Finance

The main source of revenue for the Provincial Highway Authority is gasoline tax, registration fees and other miscellaneous taxes pertaining to the automobile traffic.

(*Continued on page 8*)

TYPICAL ORGANIZATION CHART
DEPARTMENT OF HIGHWAYS OF A PROVINCE-CANADA



INDIVIDUAL AND ORGANISED RESEARCH

(Extracted from 'Contractors Record' 31—3—1954).

MORE and more public money is being voted for reasearch into those aspects of science which are of immediate political concern or of particular interest to commercial undertakings. Also the redistribution of wealth and consequent reduction in the number of wealthy leisured persons has reduced the possibility of individual researches being carried out other than the few that cost practically no money.

But if the advancements of science is to rely on sponsored organisation and paid scientists with instructions to investigate specific problems, progress will take a new turn which will not necessarily be for the good. For the history of the development of thought and, in particular, of the natural sciences, records the fact that most outstanding discoveries were made, not by mediocrites but by exceptional men who were prepared to devote the whole of their time and energy to the discovery of truth. **It has been said that genius is the ability to take infinite pains. Great discoveries are the work of genius.**

The part that can be played by official or sponsored research departments is by no means small. Where a sufficient amount of money has been made available and a specific problem set, some answer must be obtained in course of time. But herein lies a danger. Whereas the seeker after truth was his own critic and was prepared to accept the position if the ultimate results of years of patient labour was merely negative, the paid scientist has to produce results that will impress a lay critic and inspire him to approving further financial outlay. This brings about the striving after departmental credit with the inevitable sequel the premature publication of interim reports and of findings that cannot be proved and will sometimes not bear inspection.

Research consists not only of the collection of data, but also of its interpretation and its expression in some usable form. It is here again that research departments often fail to do what is required of them. They are usually experts in applying scientific method to determining facts, but, having found facts, they do not seem to know how to interpret them or to appreciate their significance to the practical man.

The drawbacks of organised research can very probably be overcome if the work of research departments is supplemented by working parties formed by professional institutions and similar bodies and by continued private investigation. Working parties should be formed mainly of known experts in the fields concerned who, in papers and publications, have shown that they have the necessary knowledge and the keen interest required. But too many working parties are made up from those individuals who delight in attending committees, the figureheads of departments and one or two pure scientists. The man who knows the work and could be of most use is left out.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

APEX OF A CURVE: The point of intersection of two straights connected by the curve.

APEX DISTANCE OF A CURVE: The shortest distance from the apex to the curve.

EVOLUTION OF REINFORCED CONCRETE

(Extracted from 'Engineering' February 12, 1954).

THE development of civilisation has been greatly influenced by the material at man's disposal and by the availability of the tools for working these materials, first wood, then stone, followed by bronze and iron, and so on to the materials of the modern work. In 1854, a new engineering age was born, that of ferro-concrete.

From early times, the Romans had used bronze and iron rods to reinforce the roof of the Frigidarium of the Baths of Caracalla. Some 1,500 years later Sir Christopher Wren had chains embedded in the concrete of the dome of St. Paul's Cathedral to resist the lateral thrusts. In this way a new technique was created, so permitting the further development of architectural structures. By the addition of reinforcement in the vertical plane, further developments became possible, and thus, in the eighteenth century, the great church of Ste. Geneveive, which became the Pantheon, was constructed in Paris.

Smeaton, however, discovered that varying percentages of clayey matters are mixed with limestone rocks and influence the behaviour of the calcined lime, and in 1791, in his "Narrative of the Building of the Eddystone Lighthouse," Smeaton described the experiments he had made from 1756 onwards, and it is these investigations which no doubt paved the way for the improvements in limes and cements.

There is a record of a patent granted in 1791 to James Parker to employ "a certain material never before made use of "for" burning bricks and tiles and calcining chalk, earth, stone and limestone," and a further patent was granted in 1796 covering an invention of "a certain cement or trass to be used in aquatic and other buildings and stucco work." Further quick-setting cements, developed on the Continent, were those of Pouilly in 1829, and Vassy in 1831, and in 1818 Vicat published his "Recherches Experimentales sur les Chaux de Construction, les Betons et les Mortiers Ordinaires."

In 1822, James Frost specified "a new cement or artificial stone," and he took out a further patent in 1893. Very shortly afterwards, in 1825, Frost estabilished cement works at Swanscombe and became the first maker of artificial cement produced adjacent to London. Prior to this date, however, one finds a patent specification dated October 21, 1824, in which Mr. Joseph Aspdin, a Leeds bricklayer, under the title "An Improvement in the Modes of Producing an Artificial Stone," describes a material to be called Portland Cement. In France, during the nineteenth century, two French scientists, Vicat and Le Chatelier, developed the technical possibilities of the new material and thus at the middle of the nineteenth century all the conditions necessary for the birth of ferro-concrete existed. In 1852, Coignet, a French engineer and contractor, constructed some terrace work at St. Denis, consisting of iron joists surrounded by concrete, and used a similar method in the construction of apartment buildings, and at the same time the Germans were making strides in the use of the new material under the title "Monierbau."

It was towards the end of the nineteenth century that Francois Hennebique, in France, made a series of developments beginning with the use of stirrups to reinforce beams against shear, and earned recognition, with Coignet's son Edmund, as the "Pioneers of the modern evolution in the art of building." Edmund Coignet, for example, on March 1, 1889, presented at a meeting held at the Societe des Ingenieurs Civils de France, the first communication dealing with the new material, and during 1896-1900 Louis Considere published the results of his experiments and investigations into the use of ferro-concrete, and in particular his invention relating to hooped concrete.

In 1896, Mr. L. G. Mouchel commenced the development in Britain of the Mouchel Hennebique system of ferro-concrete, the first structures erected entirely in this material being the flour mill and granary at Swansea, followed by an oil mill building at Liverpool, and a river retaining wall at Southampton. The first ferro-concrete jetty in the United Kingdom was built at Woolston, near Southampton, in 1899. Ferro concrete bridges were built in Hampshire in 1900 and in Lancashire in 1902.

The earliest record of a bridge built in this material is, however, a small foot-bridge of 15 meters span constructed in France in 1897. This was followed by a bridge at Perpignan, and in 1902 by a bowstring bridge in Paris. In 1898 a bridge of some 43-m. span was constructed over the Steyr in Austria, and at Chatelleraut in France between 1898 and 1900 there was built the largest ferro-concrete bridge of that time, which had three arches, the centre arch having a span of 172 ft, and a rise of 17 ft, 6 in., say, 10 per cent of the span. In those days the adoption of ferro-concrete for such a bridge was considered somewhat daring.

In Germany the Monier patents were first granted in 1884, and the well-known engineer, Emperger, published a report detailing the uses of ferro-concrete in the Great Exhibition of 1900 in Austria.

Acceptance by public authorities. It must be stated that in the early dates public authorities were not enthusiastic in supporting the development of the new system of construction. The more important the authorities, the more rigid were their rules and regulations, and accordingly the first structures were for private concerns rather than public authorities. Thanks, however, to the progress made in France and elsewhere, the new material was used more and more by public authorities in this country.

On October 20, 1906, a French Ministerial circular was published which regulated the adoption of ferro-concrete in France, while in 1907 a report by a Joint Committee constituted by the Royal Institute of British Architects was published in Great Britain. The chairman of this Joint Committee was Sir Henry Tanner, F.R.I.B.A., President of the Concrete Institute which was found in 1908 and is now known as the Institution of Structural Engineers. The vice-chairman was Professor W. C. Unwin, President of the Institution of Civil Engineers. A second report by the same committee was issued in 1911 and was followed by the regulations of the London County Council published in 1915. While these regulations applied to the design of structures to be built within the County area, many of the other large Corporations of Great Britain, not having any by-laws applicable to ferro-concrete work, adopted the regulations of the London County Council.

With the publication of these rules or Codes of Practice, the use of ferro-concrete developed very quickly, and large numbers of bridges, buildings, factories, workshops, warehouse buildings, reservoirs, jetties, wharves, tanks, granaries, garages, barrages and cooling towers were built.

(Continued from page 4)

The petrol tax is collected at the rate of 10 to 20 cents per gallon by the Provincial Highway Authority and about 90 per cent of the expenditure incurred by the Provincial Government is derived from the gasoline and the Motor Vehicle Operational Taxes and the balance is provided for from the Central Revenue and Central Road Fund. Municipalities also levy taxes for the use of roads within jurisdiction.

(Adapted from 'Report on Highway Engineering Technique adopted in Canada' by L. W. Kale and H. J. Yadhav.)

CONTROLLING THE USE OF ACCESS

CONTROLLING the use of access from abutting property to a highway, by purchase, eminent domain or police power, is an important part of any comprehensive control programme. Control of "use" involves restricting the **kind** or **purpose** of use that can be made of an approach to a highway. It provides a desirable flexibility in access control and oftentimes makes possible a less expensive but entirely adequate alternative to complete restriction of access. Since the number of vehicular movements at an approach to a highway has a direct relationship to the kind of use that is made of the approach, controlling the kind of use effectively controls the frequency of use and thereby limits the incident of exposure to possible accident, minimises safety hazards, and promotes the movement of highway traffic by eliminating a primary cause of reduced speed zones.

In 1947 the Oregon State Highway Commission commenced what has since developed into a comprehensive and well planned programme for controlling the use of access. So far as the writer knows, Oregon is the only State thus far to pursue such a programme. Where land is acquired for right of way by deed or eminent domain proceedings, Oregon controls access by either prohibiting it entirely or by limiting it to approaches at prescribed locations, of specified widths, and for particular purposes, such as (1) private residential use, (2) farm purposes, (3) forest product purposes, (4) existing (described) activity, (5) future (described) activity, and (6) farm crossings of the highway.

The use of access may be restricted by eminent domain to the same extent as by agreement and purchase if there is sufficient statutory authority. Oregon's action is based upon a general statute which authorizes the Highway Commission to acquire "any and all right of access" without expressly authorizing control of the use of access.

The extent to which control of use of access may be effected by exercise of police power, without the necessity of paying compensation therefor, is, as yet, poorly defined. Court cases illustrate the inherent problem, with elusive answer, of drawing a line between reasonable regulation under police power and "taking" under eminent domain. A review of cases involving varying degrees of direct and indirect interference with access discloses that, in general, police power can regulate the use of **future** access, but eminent domain is required to effect the quantity, location or use of **existing** access. Police power will validate a properly drawn statute authorizing partial or total restriction of access, including use thereof, to future highways, and, based on analogy to zoning authority, police might suffice to prohibit an increased degree of use of existing access to existing highways.

To be sustained by the courts as a reasonable exercise of police power, any statute regulation the use of access should clearly set forth its purpose and the intention of the legislature to delegate such authority, and should prescribe standards of reasonableness to govern its application. In court tests of such statutes, the inapplicability to police power of the doctrine of *stare decisis* should be emphasized, for what was an unreasonable regulation yesterday may be entirely reasonable and proper today under changed conditions, needs and concepts.

(Extracted from 'Highway Research Abstracts No. 11'—December, 1953)

THE INDIAN ROADS CONGRESS SPECIFICATION FOR ¾ in. THICK BITUMINOUS CARPET

[For adoption when improvised hand mixing drums are used for premixing]

I. MATERIALS

1.1. **Binder:** The binder shall be **bitumen** of a suitable grade.

1.2. **Stone Chippings:** The chippings shall consist of angular fragments of clean, hard, tough, durable rock, of uniform quality throughout. They should be free of elongated or thin pieces, soft or disintegrated stone, vegetable or other deleterious matter.

1.3. **Sand:** The sand shall consist of clean, hard, durable, uncoated, coarse dry particles, and shall be free from, injurious amounts of dust, soft or flaky particles, or organic matter, or other deleterious substances.

II. QUANTITIES OF MATERIALS REQUIRED PER 100 sq. ft. OF ROAD SURFACE

	Cu. ft. per 100 sq. ft.
2.1. **Aggregates:**	
(i) **For Carpet:**	
Stone chipping – ½ in. (passing ¾ in. mesh, retained on ⅜ in.)	6
⅜ in. down (passing ½ in. mesh retained on ¼ in.)	3
	9
(ii) **For Flushing:** Coarse sand	½
2.2. **Binder**	Lbs per 100 sq. ft.
(i) **For Tack Coat:**	
(a) on a water-bound macadam surface	15–20
(b) on an existing black-topped surface	12–15
(ii) **For Premixing:**	
For ½ in. stone chippings (as described above) 6 cu. ft. at 3½ lb	21
For ⅜ in. stone chippings (as described above) 3 cu. ft. at 4 lb	12
Total	33

III. CONSTRUCTION

3.1. **Preparation of Base:** Before the carpet is applied to the existing base, the road must be absolutely free from dust or caked mud. Where the existing base is pot-holed or rutted, these irregularities must be filled in with premixed chippings and well rammed, about a week before the carpet is laid.

The surface should be cleaned by:

(a) Removing caked earth and other foreign matter with wire brushes.

(b) Sweeping with brooms.

(c) Finally dusting with old sacks.

3 2. **Tack Coat:** The binder should be heated to an appropriate temperature and applied to the base (water-bound macadam surface or already black-topped surface) at the rate specified above.

For application of the tack coat it is best to use a sprayer, but if none is available, pouring cans may be used. The binder should then be brushed out evenly.

The tack coat should be applied *just* ahead of the spreading of the premix.

3.3. **Preparation of Premix:** Place one cu. ft. of ½ in. chippings and half a cu.ft. of 3/8 in. chippings into the mixer and thoroughly mix dry.

Add 5.5 lbs of the binder heated to a temperature suitable for the grade of bitumen used and mix until the chippings are thoroughly coated with the binder.

Empty the premix on to stretchers or wheel barrows and carry to site.

The quantities of chippings and binder per batch as given here may be proportionately increased if it is possible to handle them properly in one operation.

3.4. **Spreading of Premix:** Immediately after applying the tack coat, spread the premix with rakes to the desired thickness and to the correct camber, and check by template. Or, distribute evenly by means of a Track Spreader.

3.5. **Rolling:** As soon as sufficient length (about 50 rft) of premix has been laid, commence rolling with a power roller of medium weight (8–10 tons). Rolling should commence at the edges and progress towards the centre.

When the roller has passed once over the whole area, any high spots or depressions which become apparent should be corrected by removing or adding premix. When this has been done, roll to compaction. Avoid excessive rolling as this serves no useful purpose but may spoil the carpet.

Damp the roller wheels to prevent the Premix from adhering and picking up.

3.6. **Flushing Sand:** Over the compacted surface spread coarse sand or hard stone dust at the rate of half a cu.ft. per 100 sq.ft. and lightly roll it.

3.7. **Opening to Traffic:** Traffic may be allowed on the road 24 hours after completion of rolling.

IV. SEAL COAT (When Specified)

4.1. A seal coat should be applied as soon as found necessary but not later than one year after laying the carpet. The binder heated to the required temperature should be applied to the cleaned surface and blinded with grit. The quantities of grit and binder to be used are:

Materials for seal coat	Quantities per 100 sq. ft. of road surface
Stone chippings–¼ in. (passing ⅜ in. mesh but retained on 1/10 in.)	3 cu. ft.
Binder	20 lbs

WHERE CAUSE FOLLOWS EFFECT

The teacher had been taking his pupils in a subject which he very much loved.

"Now, you see, cause must always necessarily come **before** *effect. Is that quite clear?"*

"No," came from one youngster,, "not always."

"Then, my boy, perhaps you will be good enough to give me an example if you can."

"Yes, sir. A man pushing a wheel-barrow."

MAKING CONCRETE

(Extracted from 'The British Constructional Engineer' Nov.-Dec., 1952)
(Concluded from p. 26 of the May '54 issue)

The "Bulking" of the Fine Aggregate or sand.

WHEN the quantities to be used in a mix are specified by volume, these quantities refer to the dry material. The volume occupied by a quantity of coarse aggregate or gravel is about the same whether it is dry or wet, but fine aggregate or sand occupies a much larger volume when it is damp than when it is dry. This increase in volume is called "bulking." A small amount of water present in a sand can produce a large amount of bulking; for example, as little as one part of water in 20 of sand by weight can increase the volume of sand by one-third. Sand as delivered from the pit is usual by damp and, unless allowance is made for "bulking," measurement by volume can lead to a concrete with too little sand and hence lower in working qualities, while the volume of the finished concrete made from each bag of cement will be less than it should be.

The actual amount of "bulking" that takes place depends both on the grading and on the water content of the sand; since these may change from day to day bulking may also change. A method of levelling-out changes in bulking in different deliveries is to store the aggregate in flat-topped stock piles. This helps to even out the moisture content in the pile, but the bottom one foot should be reserved for drainage purposes and not used, fresh material being deposited on it. The degree of bulking can readily be determined on the site; a suitable method is as follows.

A parallel sided container is partly filled with the damp sand, levelled off but not pressed down, and its depth measured. Water is then added and the sand is well stirred and then allowed to settle. The volume occupied by the sand after settling is roughly equal to that occupied by the same weight of sand and dry. The new depth of sand is measured. The method may be illustrated as follows:

Let D the depth of the sand when damp and D_1 the depth after setting under water; then the percentage bulking $= \frac{D - D_1}{D_1} \times 100$ and this additional percentage of sand should be added to the mix to give the required proportions.

The easiest way to allow for this increase in volume is to increase the depth of the gauge box by $\frac{D - D_1}{D_1}$ using some kind of removable strapping. For example if $D = 12$ in. and $D_1 = 9$ in. the bulking is $\frac{12 - 9}{9} \times 100 = 33\frac{1}{3}$ per cent or one-third. For each cu. ft. of wet sand an extra one-third of a cu. ft. of sand should be added. This can be readily done by increasing the depth of the gauge box by one-third of its original depth, i.e., 4 in.

Mixing and Placing

Concrete should always be thoroughly mixed whether this be done by hand or by machine. Very little concrete today is mixed by hand and with most types of mixers in use a mixing time of two minutes is recommended. After mixing it is much better to discharge the complete contents of the drum into a truck or skip than to wheel-barrow, since if the mix is discharged a bit at a time into a number of wheelbarrows there is an increased risk of segregation. The concrete should be transported to its final position, whether by truck, wheelbarrow, chute or pipe, with the minimum delay.

After placing the concrete should be thoroughly compacted by robbing, tamping or vibrating to remove all the air pockets or voids and to make a dense homogeneous mass. Failure to do this can have serious effects on the finished concrete. Figure 2 shows the very rapid fall in strength as the percentage of air voids increases. Only 5 per cent of air voids can reduce the strength by as much as 30 per cent.

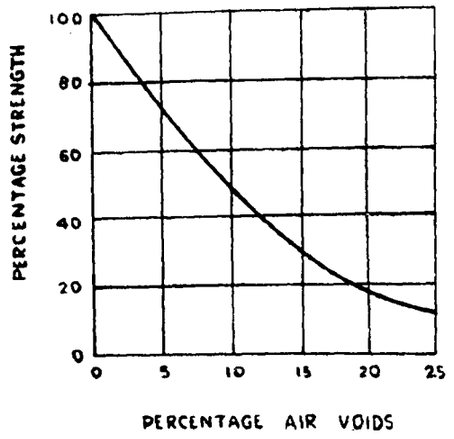


Fig. 2. Effect of air voids on the strength of concrete.

Badly compacted concrete is also likely to contain unsightly patches of honey combine or porous concrete which in turn may lead to the corrosion of any reinforcement used and to spalling of the faces.

If a concrete of high quality is to be made, good compaction is essential. This may often mean extra work during placing, but on no account should more water be added in order to reduce the work of compacting.

Curing

After compacting, concrete needs time to develop its full strength. It is particularly important not to let the concrete dry out rapidly at early stages as this leads to surface crazing and shrinkage cracking. Fresh concrete should be protected from drying winds or sunshine and when strength and resistance to wear are important it should be kept damp, if possible for a week or more, by covering with water, wet sacks, matting, or waterproof paper or some other suitable material.

WORTH REMEMBERING

It has been said that the higher men climb the longer their working day. Any young man with a streak of idleness in him may better make up his mind at the beginning that mediocrity will be his lot. Without immense sustained effort he will not climb high, and even though fortune or chance were to lift him high, he would not stay there. For to keep at the top is harder almost than to get there.

—I. Rigg. Director, Taylor Woodrow Ltd.

CARDINAL PRINCIPLES OF ROAD DESIGN

The underlying soil must eventually carry all wheel loads; the volume and character of traffic determine the type of surfacing; the underlying soil together with the repetition of maximum axle loads determines the nature of foundation design; climate exerts an influence over all phases of highway design.

PROTECTION OF SUBGRADES AND GRANULAR BASES BY SURFACE DRESSING

(Extracted from Road Note No. 17—1953, Department of Scientific and Industrial Research U. K.)

INTRODUCTION

IT is generally accepted by road engineers that the prepared formation of a new road should be protected from the action of weather during the period prior to the construction of the pavement. Failure to provide this protection can lead to a seriously weakened formation if wet weather is experienced during the work. The engineer has to choose either replacing the softened soil with satisfactory material or of risking an early failure of the road.

Not only can the strength of soil be reduced by the action of water, but the drying of exposed clay formations can also have serious effects on the roads built on them, since the dry soil will become wetter after the pavement has been constructed and the resulting increase in volume may cause defects to develop in the road surface due to differential movements.

A simple and effective method of protecting a soil formation or base from the action of weather is to apply a surface dressing. This surface dressing can have several advantages. As it establishes a control over the moisture conditions in the subgrade it enables methods of pavement design to be used with greater confidence than would otherwise be possible. This will generally lead to more economical designs. The 'in-situ' California Bearing Ratio test can also be used to estimate the thickness of pavement required instead of the more costly procedure of obtaining or preparing samples of the soil for testing in the laboratory. Surface-dressing the formation also has the advantage that, with soils which have sufficient strength to carry traffic loads without serious deformation, the protected formation can be used to carry construction traffic for many months. Lastly, if the soil formation are prepared and protected before the winter (rainy) months, road construction work can continue during the bad weather where otherwise work would have to be stopped owing to the softening of the subgrade.

The purpose of this note is to describe the method of protecting soil formations and bases by surface dressing and to recommend details of the treatment to be employed in different circumstances. Although experience with the technique is limited, the note is put forward with the object of assisting the engineer on the basis of present knowledge.

TYPES OF SOIL FORMATION AND BASE SUITABLE FOR TREATMENT

Soils so far treated satisfactorily include sandy clays, heavy clays, marls and gravel-sand-clays (hoggins). The results of these investigations suggest, therefore, that most soils are likely to be protected successfully by surface dressing.

A surface dressing does not significantly increase the bearing capacity of a subgrade; a surface-dressed formation can therefore be used successfully to carry traffic only where the prepared soil formation is of sufficient strength to carry traffic loads without serious deformation. This is usually the case with well-compacted gravels-sand-clays, sands, and clays or marls which have a moisture content at least one or two per cent lower than the plastic limit of the soil.

Where the bearing capacity of a soil is low it may be possible to bring it into a condition in which it will carry traffic, by spreading a 3-in. layer of compacted granular material such as clinker, quarry waste, etc., on top of the formation as soon as it is exposed, and applying a

surface dressing to the surface of the granular material. If the granular material is not cohesive, a prime coat may be necessary before applying the surface dressing.

Where a surface-dressed formation is to be used to carry construction traffic particular attention should be paid to the drainage of surface water. Otherwise the combination of ponded surface water and traffic is likely to cause very rapid failure of the surface dressing and the underlying formation. A double surface dressing is also considered essential in all such cases.

PREPARATION AND DRAINAGE OF SURFACE OF FORMATION

The surface of the formation should be reasonably smooth and free from ruts and other depressions, and all loose material should be removed. The soil should be well compacted, and it is usually desirable to roll saturated clays with a few passes of a light ($2\frac{1}{2}$-ton) smooth-wheeled roller to improve their shape. To facilitate the removal of surface water, the formation should be cambered or have a slight crossfall. If the formation level is below that of the verges, provision must be made for the removal of the surface water which will collect near the edges of the formation. If no drainage system for subsoil or surface water is present, temporary ditches on either side of the road with grips at intervals of about 10 ft will usually be sufficient for the purpose.

RECOMMENDATIONS FOR THE SURFACE DRESSING

Number of Dressings Required

If the formation is to be protected from the effects of weather for periods of less than one month and if it will not be subjected to traffic, adequate protection can be provided by surface dressings in which the binder is spread at a rate of at least one gallon per four sq. yd. (28 lbs. per 100 sq. ft.) This can be obtained in a single application with hot binder, but a double surface dressing may be required if bitumen emulsion is used.

Where protection for a long period is required, the rate of spread of binder should be 3 sq. yd. per gallon (36 lbs. per 100 sq. ft.) or heavier. This will normally necessitate a double surface dressing with all binders. Regular inspections should be made and rapid repairs should be carried out if the binder film is ruptured by traffic or any other cause.

Prime Coats

A prime coat is not considered to be essential; it will serve a useful purpose only on soils where the surface has no cohesion when the dressing is applied. On such soils the additional penetration obtained by a prime coat may prevent the surface dressing scaling off the surface under traffic. Suitable binders for prime coats are low-viscosity tars (5-10 s at 30° C) or light cut-back bitumens (M. C. 0 or M. C. 1 grade American grades). The rate of spread will depend on the nature and state of the surface being primed, but, in general, it will be within 3-5 sq. yd. per gallon. (22 to 36 lbs. per 100 sq. ft.) It is not necessary to apply any blinding material to a prime coat.

Binders-Type and Viscosity

Tar binders should for general use have a viscosity* in accordance with the following table, depending on the time of the year during which the work is carried out.

Period of year	E. V. T. (°C.)	Viscosity at 30° C. (S. T. V.s)
November, December, January, February, March	25–29	22–30
April, May, September, October	29–33	43–60
June, July, August	33–35	84–120

Bitumen binders should be cutback bitumens having a viscosity within the range 20-60s at 40 deg. C. (Standard Tar Viscometer).

* Applies to conditions in U. K.

Emulsions should be rapid-breaking, containing at least 62 per cent of bitumen by weight. It is normally not possible to apply emulsions at rates heavier than 3 sq. yd. per gallon, corresponding to a rate of application of bitumen of about 5 sq. yd. per gallon. Two successive dressings are usually required with bitumen emulsion to provide adequate water-proofing.

Aggregates - Type, Size and Grading

The principal function of the aggregate in the surface dressing of soil is to prevent the binder film being picked up by traffic. The mechanical properties of the aggregate are not important, and any local aggregate should be suitable.

The best results will be obtained from clean, single-sized chippings which are free from dust and conform to the requirements of B. S. 63. The rates of spread for the different sizes of aggregate are :

Nominal size of chippings (in.)	Rate of application	
	sq. yd. per ton	cu. ft. per 100 sq. ft.
¾	70–80	3 to 3.5
½	90–100	2 to 2.5
⅜	100–120	1.75 to 2.25
¼	140–170	1.25 to 1.75

Generally, ½-in. chippings will be found most suitable for a single dressing, and 3/8-in. chippings followed by ½-in. or 3/8-in. chippings for a double dressing.

It is possible that fine material such as sand or quarry fines would be satisfactory when applied as a blanket layer at least an inch in thickness, but this is a matter where further experience is required.

Rates of Spread of Binder in Relation to Size of Stone

The rate of spread is not as important as in the case of normal surface dressing, but it is important to ensure that a continuous film is obtained. The rates of spread should, in general, be within the limits given in the following table for a single dressing :

Nominal size of chippings (in.)	Rate of spread. Tar or bitumen measured at 100 deg. F.		Rate of spread of Emulsion*	lbs. per 100 sq. ft.
	sq. yd. per gallon	lbs. per 100 sq. ft.	sq. yds. per gallon	
¾	2½–3	37 to 45	—	—
½	3 —4	28 to 37	3–4	28 to 37
⅜	4 –5	22 to 37	3½–4½	25 to 32
¼	4½–6	18 to 25	4–5	22 to 37

When 3/8-in. or ¼-in. chippings are used, with the rates of spread recommended in the table, a double surface dressing is necessary to insure impermeability. When a double dressing is used, then the rate of spread of binder in the first dressing should be as given in the above table and in the second dressing a lighter application of binder should be used, the area covered per gallon being increased by about half a square yard.

When a single dressing is to be blinded with a layer of quarry fines or sand, then the rate of spread of binder should be 3–4 sq. yd. per gallon.

METHODS OF APPLICATION

Binder

Owing to the nature of the work, i.e., the requirement that the soil formation shall be covered as soon after exposure as practicable, it is probable that only small areas of surface dressing can be done at any one time. This will mean that on most sites the use of bulk binder distributors will be both impracticable and uneconomic, and hand-spraying will be the most appropriate method of application. The evenness of the distribution of binder in this work is not as important as it is in normal surface dressing, and the seal will be effective so long as a continuous film of binder is ensured over the treated surface. Suitable equipment for application of the binder would be as follows :

One Binder heater, 100–250 gal. capacity fitted with hand or power-driven pump and spray lance and suitable tackle for handling barrels.

If emulsions are used, the standard hand-operated emulsion equipment is most suitable.

Chippings

When the binder is hand-sprayed, it is probably also most economical to apply the chippings by hand. This can most conveniently be done from either a 3–5 ton lorry or from barrows loaded from small stock-piles at convenient points on the site. When chipping, it is important to ensure that the binder is well blinded, so that lorries do not pick up any binder on their wheels.

Rolling

The dressing should be rolled after the chippings have been applied. A 2½-ton roller will normally be sufficient for this purpose.

* Rates of spread in this column refer to the emulsion itself. The resulting rate of spread of binder after coagulation will of course be lighter.

HINTS FOR THOSE WHO DICTATE

Dictators are requested to speak most indistinctly when dictating, as it assists the typist considerably.

Please smoke while dictating - this aids pronunciation. A nice juicy pipe is particularly welcome.

Hours for dictation : lunch-time, tea-time, and any time between 5-30 and 8-30 p.m. In the evening you are particularly requested to ask for work to be done urgently, and then proceed on your homeward journey. We have no homes.

Also, when dictating, please charge up and down the room ; we can understand what you say much more distinctly, especially when you jingle your keys and odd coppers.

Please lower your voice to a whisper when dictating names of people and places, and in no circumstances spell them to us. We are sure to hit upon the right way of spelling them. We of course know everybody and every place.

When we don't hear a word and ask you to repeat it, shout at the top of your voice. Or else refuse to repeat it at all. We have second sight.

Never say "please" or "thank you." It is a dreadful waste of breath.

When we stagger out with a pile of files in our arms, please don't trouble to get up and open the door. With practice we ought to be able to open it with our teeth, or perhaps crawl under it.

Why be difficult, when with a little more effort you can be impossible?

THE TYPISTS.

ROAD TESTS ON CONTROLLED TRUCK AXLE LOADINGS

(Extracted from 'Civil Engineering and Public Works Review Vol. 49, No. 571, January, 1954'.)

THE final report on the **Road Test One-MD** covering the effect of controlled truck axle loadings on concrete pavements, has been published by the 'Highway Research Board, Washington, U. S. A.' A summary of the major findings of this report are given below.

Cracking of Pavement Slabs Related to Cases of Loading. Of the five distinct cases of loading applied in the stress studies (Table below), only two were associated with the cracking that developed in traffic testing the pavement sections. These were: (1) corner loading, which was responsible for transverse cracking that occurred in the vicinity of transverse joints, and (2) special loading, which was responsible for longitudinal cracking that appeared in Section 4.

CASES OF LOADING APPLIED IN THE STRESS STUDY

Type loading	Position of Vehicle wheels and location of critical strain.
Interior.	Wheel load in interior area of slab some distance from any edge. Critical strain directly under load and parallel to longitudinal axis of pavement.
Free-edge.	Wheel load at logitudinal free edge of slab at considerable distance from any corner. Critical strain directly under or immediately adjacent to load and parallel to longitudinal free edge.
Corner.	Outside wheel load of vehicle at or in immediate vicinity of outside joint corner. Critical strain along and parallel to longitudinal free edge of slab in the vicinity of joint corner.
Transverse joint-edge.	Wheel load at transverse joint edge some distance from any corner. Critical strain directly under load and parallel to transverse joint edge.
Special.	Outside wheel load of vehicle at or in immediate vicinity of outside joint corner. Critical strain between outside and inside wheel loads at 5 ft 2 in. from free edge and at right angles to longitudinal axis of pavement. (Distance 5 ft 2 in. selected because general line of longitudinal cracking developed under test traffic in Section 4 was approximately that distance from free edge of pavement).

Load, Stress and Deflection. The magnitudes of pavement stress and deflection increased with the magnitude of the applied load for both single and tandem-axle loading.

Stresses in Loaded Slabs on Granular Soil. The measured stresses for all cases of loading investigated for slabs on the granular non-pomping subgrade soil were below generally accepted design limits (50 per cent of the modulus of rupture of the concrete) for all four of the rear end loads used in traffic tresting and for even heavier loads, applied only after traffic testing for purposes of stress measurement. In the area where these tests were made, the granular material was a deep natural formation.

Stresses in Loaded Slabs on Nonpumped Fine-Grained Soil. Stresses measured in slabs on fine-grained pumping soil prior to the development of pumping were, for the critical corner case of loading approximately 12 per cent

higher than those measured in the slabs on the granular soil but were still below generally acccepted design limits (50 per cent of the modulus of rupture) for all four of the rear-end loads used in traffic testing.

Stresses in Loaded Slabs on Pumped Fine-Grained Soil. Pumping and the accompanying loss of subgrade support caused large increases in the stresses for the corner case of loading in all four test sections and for the special case of loading in Section 4, where the 44,800 lb tandem axle truck operated.

Cracking was not observed under the test loads applied only for the measurement of stresses although the stresses for the corner case of loading approached in some instances, the point where cracking might be expected. That stresses of greater magnitudes for the corner case of loading resulted under application of all four of the rear-end loads used in traffic testing, is indicated by the cracking that occurred in all lanes of the test pavement.

Stress Variation at Pumping Joints. The maximum stresses observed varied considerably from joint to joint, depending on the pattern and degree of pumping.

Deflection of Loaded Slabs on Granular Soil. The measured deflections for the two cases of loading investigated for slabs on the granular nonpumping subgrade soil were small for all four of the loads used in traffic testing and for even heavier loads, applied only for purposes of deflection measurement. For the maximum rear-end loads used in traffic testing, the deflections for the corner loading (creepspeed values) averaged approximately 0.025 in. whilet hose for the free-edge loading averaged approximately 0.014 in.

Deflections of Loaded Slabs on Nonpumped Fine-Grained Soil. Corner deflection measured for slabs on the Fine-grained soil prior to the development of pumping averaged approximately 65 per cent greater than those measured for slabs on the granular soil.

Deflections of Loaded Slabs on Pumped Fine-Grained Soil. After pumping had developed, the maximum deflections increased considerably. In some instances, the corner deflection approached 0.2 in. before cracking occurred.

Explanation of Failure of Slabs on Fine-Grained Soil. The failure of the slabs on the fine grained soil is explained by the fact that deflections of these slabs under all of the test loads were sufficient to cause pumping when the other requisites for pumping were present. As pumping developed, the deflections increased (more rapidly under the heavier than the lighter loads) with correspondingly more rapid increase of stress to a magnitude sufficient to cause rupture of the slab.

Stress - Deflection Relationships Between 18,000 and 22,400 lb Single-Axle Loads. For the Fine-grained soil, prior to the development of pumping, the 22,400 lb single-axle loads caused 12 per cent higher stress in the vicinity of the slab corner than the 18,000 lb single-axle loads; however, it caused 12 and 24 per cent higher deflection, respectively, at the corner and free-edge of the slab. The greater deflections for the heavier load caused a more rapid development of pumping and the resulting build-up of stress reached the breaking point of the concrete in substantially shorter time.

Stress - Deflection Relationships Between 18,000 lb Single and 32,000 lb Tandem-Axle Loads. For the fine-grained soil, prior to the development of pumping, the 18,000 lb single-axle load and the 32,000 lb. tandem-axle load each caused essentially the same stress in the slab in the vicinity of the slab corner. The deflections caused by the tandem-axle load, however, were slightly greater at the corner (3 per cent) and much greater at the free-edge (61 per cent) than those caused by the single-axle load; hence the more rapid development of pumping and earlier build-up of stress to the rupture point in the section on which the tandem-axle trucks operated.

Stress-Deflection Relationships Between 44,800 lb Tandem and Other Axle Loads. For the fine-grained soil, prior to the development of pumping, the 44,800 lb tandem-axle load caused 12 per cent higher stress in the vicinity of the slab corner than the 22,400 lb single-axle

load and 22 per cent higher stress than the 32,000 lb tandem-axle load. The deflections caused by the 44,800 lb tandem were 60 and 70 per cent greater at the corner and free-edge respectively, than those caused by the 22,400 lb single and, similarly, 16 and 33 per cent greater than those caused by the 32,000 lb tandem. These greater deflections caused a correspondingly greater and more rapid development of pumping and build-up of stress, which coupled with the greater stress producing effect of the heavier of the tandem trucks, accounts for the particularly severe damage in the section on which the 44,800 lb tandem-axle truck operated.

Effect of Tandem-Axle on Pumping. From the very extensive studies of deflection data and from the many pumping observations, it was found that tandem axles spaced 50 to 55 in. apart did not act as two single-axles. The pumping action of the two-axle and three-axle vehicles was the same in character, the lighter front axle causing a small ejection, the heavier single rear axle a larger ejection, and the heavier tandem rear axles a single ejection somewhat larger than that caused by the single rear axle.

Effect of Speed. The magnitude of induced stress and pavement deflection decreased progressively with increase of vehicle speed for slabs supported on both the granular and fine-grained soil subgrades. The percentage reduction with speed was different for the various cases of loading and varied to some degree with the condition of support. With the exception of the corner case of loading for pumping slabs, the stress and deflection resulting at vehicle speeds of 40 m.p.h. averaged approximately 20 per cent less than the magnitudes recorded at creep speed. For pumping slabs, the stresses for the corner case of loading averaged approximately the same for both vehicle speeds.

Effect of Lateral Placement. The magnitude of stress and deflection at the outside edge of the pavement was progressively reduced by increase of distance of the wheels from the edge. With the wheels at 30 in. from the edge, the magnitudes of edge stress and deflections were approximately 50 per cent of the magnitudes recorded with the wheels 6 in. from the edge.

Condition of Load-Transfer Devices. The load-transfer devices were properly installed in good condition prior to the application of the controlled test traffic, but such traffic caused funnelling or progressive loss of the effective bearing of the concrete around the dowels of the badly pumping joints where slab deflection was large.

Influence of Temperature Warping on Stresses and Deflections Caused by Loads. The stresses and deflections caused by loads acting at the corners and edges of a pavement slab were influenced to a marked degree by temperature warping of the slab. For the corner loading, the stresses and deflections for a severe downward-warped condition were observed to be only approximately one-third of those for the critical upward-warped condition. For the free-edge loading, the effect of temperature warping, although appreciable, was not as pronounced as for the case of the corner loading.

Effect of Faulting. Faulting (simulated ¾ in. step-off) caused a reduction in both stress and deflection in the vicinity of the end of the heaving or depressed slab at vehicle speeds of both creep and 40 m.p.h.

CITY BRIDGE DEPARTMENT

Hellow, is this the City Bridge Department?
"Yes, what can we do for you?"
"How many points do you get for a small slam?"

HERE AND THERE

1. DANISH-SWEDISH ROAD LINK TUNNEL-CUM-BRIDGE SCHEME

A group of Danish and Swedish contractors have submitted plans to their Governments for building a bridge and tunnel link between the two countries. It would join them via the Oresund, narrow stretch of sea separating the two States.

The scheme would cost about £ 30,000,000 (Rs. 45 crores) but, argue its supporters, it would be well worth the money by bringing into even closer contact two nations which already have much in common with each other.

Both Governments concerned have approved in principle of the need for such a connection between their people.

The idea is to build a bridge just over three miles long to join Malmo, Sweden, with Salt Isle, two-thirds of the way across the Oresund. From the island a tunnel would be driven one and a half miles to the Danish shore. The proposed bridge would be 150 feet high in parts.

Contractors behind the proposition, backed by banks in the two countries concerned, are prepared to find half the cost of the project in return for the right to charge tolls over the bridge-tunnel link for 60 years. At the end of that period, it would be handed over to joint ownership by the Swedish and Danish Governments. Tolls would then be abolished.

The Governments are asked to find the other half of the initial cost.

It is estimated that the project would take two years to plan in detail and five years to build.

Sponsors of the move estimate that 2,000,000 cars, 1,000,000 motor-cycles, several hundred thousand lorries and 2,000,000 bus passengers would use the link every year.

A more ambitious variation of the scheme envisages the laying down of railway lines in addition to providing for road traffic.

(Extracted from "The Hindu" dated 10-5-54.)

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2. GERMANS REVIEW APPRAISAL OF U. S. TRAFFIC

FIVE German traffic specialists who recently completed a five week study in the United States have made the following observations:

(1) Free-flowing traffic is maintained regardless of the type of motor vehicles involved; (2) Heavy and light traffic move together satisfactorily; (3) driver efficiency contributes to free-flowing traffic; (4) extensive development of automobile traffic is a primary factor in the rise in the standard of living in the United States during the past 20 years; (5) nearly all tax revenue derived from motor vehicles is used for highway construction; (6) borrowing has facilitated financing of improvements for rapid relief of traffic problems; (7) development of traffic engineering has contributed to rational and efficient highway expansion.

(From 'State Transport Review' —May 1954).

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3. CARS AND TRUCKS COMPARED WITH INCOME PER HEAD

	Income per Head (equiv. U. S.)	Cars per 1,000 population	Trucks per 1,000 population
U. S. A.	1,857	279	59
Canada	1,228	161	54
Sweden	1,062	51	14
Switzerland	967	39	9
Australia	911	126	65
New Zealand	907	149	55
U. K.	758	50	20
Belgium	700	41	18
Norway	698	24	20
France	691	38	22
W. Germany	483	21	11
Netherlands	465	16	9
Argentina	298	12	7
Brazil	231	5	4
Portugal	186	9	4
Turkey	170	0.6	0.7
Thailand	67	0.6	0.3
India	53	0.5	0.3

Figures refer to 1952, or in the case of a few countries to 1951 or 1950.

(Extracted from 'British Road Federation' April, 1st, '54)

4. SETTLEMENT CHECK PLATFORMS FOR ROADWAY EMBANKMENTS

IN order to check an embankment settlement on one of their major highway construction schemes, the Californian State P.W.D. Division of Highways have installed a number of settlement platforms at various levels within the embankment and its foundations.

The platform consists of an inverted siphon of copper tubing with one end installed in the embankment or underlying foundation at the point chosen to determine settlement and the other end positioned outside the limits of construction at about the same elevation where recordings may be taken. Recordings are taken by filling the inverted siphon with water and noting the elevation of the water. An overflow into pervious material is provided when installing the settlement platform in the embankment.

(Extracted from 'Highways & Bridges' —April 29, 1954).

5 PRESTRESSED RUNWAY

FLAT jacks, Mr. Guyon says, provide a cheap way of prestressing without any tensioning steel when external abutments are available for the jacks to act against. These devices also will be used for longitudinal prestressing of a runway to be constructed this year at Maison Blanche, Algiers Airport. Cables, however, will apply the transverse prestress.

The technique was worked out on an experimental 80 × 50 ft taxiway at Orly Airfield, near Paris, late last year. Some ways of avoiding shrinkage cracks in the concrete—principally by applying a temporary longitudinal prestress—resulted from experience gained with the first pair of 16 × 325 ft strips built at Orly.

Another significant application of flat jacks was for the longitudinal prestressing of a cylindrical aqueduct, about 24 ft in diameter, for the Bassin d'Essai de Carenes in Toulouse, France. Constructed of 150 ft long precast units, the huge pipe was compressed by expanding flat jacks inserted in temporary gaps between the ends of the units, with terminal units acting as abutments. Circumferential prestress was applied with cables.

(Extracted from 'Engineering News Record' —March 4, 1954).

6. CEMENT CONCRETE PAVEMENT EDGE PROTECTION

TWO-LANE concrete pavements carrying heavy or fast traffic, especially if not more than 20 feet wide, are likely to suffer from edge wear and spalling if the edges are not specially protected by some means more durable than an earth shoulder. Further, wearing away of shoulder material adjacent to a concrete pavement causes water to collect alongside the slab, and contributes to wet subgrades, and thus to pumping at joints and warping of slabs due to swell of underlying soil, or displacement for other reasons.

To provide against these features, it is the practice on main roads in rural areas to construct an edge strip 15 inches wide adjacent to each edge of a concrete pavement. The edge strips comprise usually a surface course of premixed bituminous macadam over a base course of sand stone ballast.

Stabilisation of shoulders with cement has been tried and found satisfactory for a short period. Eventually the shoulders wear down, and it is then more difficult to keep the top of the shoulder stable and at correct level to protect the edge of the slab. Bitumen surfacing of stabilised shoulders has also been carried out, but the need to spray in narrow widths and protect the slab from being covered with bitumen during spraying operation makes the work expensive. Nothing better than a strip of bituminous macadam along the edge of the slab has so far been found to protect the edge of the slab and reduce the cost of shoulder maintenance.

(Extracted from "Main Roads, December, 1951.").

7. FULLY TRANSITIONAL VERSUS COMBINED CIRCULAR ARC AND TRANSITION CURVE

SOME think that the whole curve, within certain well-defined limits of centrifugal ratio, should be transitional, others that the combination of a true arc and transition is better. There is little doubt that the latter is to be preferred; for the greater proportion of the curvature is easier for driving because the relation of the steering wheel to the vehicle can remain constant on circular curves. Also the superelevation does not change as on a transition curve.

(Extracted from the 'Surveyor' 27th March 1954.)

8. FINANCING OF ROADS

LONG-RANGE, comprehensive plans mean nothing unless financing can be secured to carry out these plans. One of the great tasks in the U. S. A. is to safeguard road funds to assure that they will be used for highway purposes. Diversion of highway-user taxes and other road income to non-highway purposes has been severe in some of the States. To prevent this diversion, nearly half of the forty-eight States' have passed anti-diversion amendments to their State constitutions, safeguarding highway funds by earmarking them for highway administration, maintenance and construction.

It has been the experience that the heads of government agencies are changed and administrative policies are changed, highway funds may be diverted unless there are legal restrictions preventing diversion.

(Adapted from 'Roads & Engineering Construction,' November 1952).

CORRESPONDENCE

STABILISED SOIL IN ROAD CONSTRUCTION IN MADRAS STATE

To The Editor,
Transport-Communications
Monthly Review.

Dated 7-4-54.

Dear Sir,

I have read the article "Stabilized Soil in Road Construction in Madras State" in February 1954 issue of Transport-Communications Monthly Review. I have a few queries on the subject.

In Moorum Sand mix construction it is said that the materials were dry mixed, a measured quantity of water was added and allowed to soak overnight, and then the materials were mixed wet and compacted at the optimum moisture content. The material was left wet overnight, how then was the moisture control effected? Did not the moisture content fall below the optimum overnight?

In the above construction, was any section laid without leaving the water to soak overnight? How did the dry densities of such soils compare with the soils left to soak?

In Soil cement construction, it is said that "cement was added on to the pulverised soil or soil moisture as recommended by the laboratory and the wet mixing and compaction were completed within six hours of the addition of cement". Initial hydration of cement results within half an hour to an hour. If roller was put on the surface after the period, was there no loss of strength in the materials.

Yours faithfully,

7-4-1954

Dated 22-4-54.

I am glad to furnish you with the following particulars:

Paras 2 and 3.

In all cases where the mixing operations are undertaken manually or say without the use of specialized equipments as pulvimixers or single pass mixers, overnight soaking serves two important purposes.

1. Dry clods of the binder soil (Moorum and Sandy clay) absorb moisture and attain a soft and loose condition susceptible to easy pulverization during the wet mixing operations.

2. Overnight soaking facilitates a more uniform mixing at lesser cost and expenditure of time.

In other words a soil mix that is allowed to soak overnight in water can be mixed more uniformly, and easily in a shorter time than the same material to which water was added just prior to mixing.

In the case of machine mixing, however because of the tremendous power in operation, overnight soaking for pulverization or mixing is not necessary.

Overnight soaking is not to be mistaken as a method for effecting rigid control on the moisture content of the soil during the construction operations. If the day was cloudy, humid and cool, the construction and evaporation losses may be negligible. If the day was hot and dry, this loss may be as much as 2 to 3 per cent. In all cases the extra quantity of water required to bring the mix to its optimum is always added, before compaction is commenced.

In the initial stages of the stabilization work by manual method in Madras, sections were laid without soaking the materials overnight. This presented certain difficulties in pulverising the binder soil and effecting uniform mix and an improvement over this was seen in soaking the materials overnight. In both cases the density values obtained by similar methods of compaction were the same, provided the materials were pulverized and mixed to the same degree of uniformity.

Re. Para 4.

From a theoretical and research point of view, it is known that increase in

(*Continued on page 26*)

CURRENT LITERATURE

ABSTRACTS

U. D. C. 624.131.47. SOIL SURVEY PROCEDURE - Road Research Technical Paper No. 15 (Second Edition), Road Research Laboratory, Harmondsworth, England - published by Her Majesty's Stationery Office, London; Price 1 sh. 9 d. net.

A soil survey forms an essential part of the preliminary engineering survey for a road, and its primary object is to provide the engineer with information concerning soil and ground water conditions that will be encountered during the construction of the road. A soil survey comprises:

1. The exploration of soil conditions over the site by boring or other means and the preparation of sections indicating the soil profiles and ground-water levels.

2. The examination and testing of samples taken from the site in order to classify them and deduce the probable behaviour of the soils.

The booklet deals with the various steps of the soil survey under the heads:

1. Equipment and Personnel;
2. Soil Survey Procedure;
3. Ground Water Investigation;
4. Soil Classification; and
5. Presentation of Information.

Under the heading Equipment and Personnel, a full list of equipment necessary for a large-scale survey is given. Notes on hand augers, mechanical augers, containers for samples, and the minimum weights of the samples necessary for the various tests are given.

When speed is more important than the accuracy of information about the types of soil, geophysical methods can be used to determine the approximate depths of strata or the water table. Two such methods, "Seismic Method" and "Resistivity Method" are described. The seismic method is generally used where information concerning soils at considerable depth is required, while the resistivity method can be used for shallow depths. The information obtained by these methods should be supplemented by that obtained from trial borings.

The section on Soil Survey Procedures deals with the subject under heads, site Reconnaissance, determination of the soil Profile, and collection of samples and location of water table.

The system of soil classification recommended is described in detail.

Details of the manner of presentation of the information collected in the field such as soil profile, plans, typical sections, table of test results on soil, are given and illustrated.

A list of references is given.

THE FUNCTION OF THE [illegible]PA[illegible]TORY IN ENGINEER[illegible]ON-STRUCTION by G. H. Nol[illegible] Separate No. 400 of [illegible]erica[illegible]ciety of Civil Engineers—Feb[illegible]

The function of the laboratory in Engineering Construction can be divided into two broad categories, first, design and Development, and second, Control and Inspection. In the translation of ideas of the designer to realities in the field the laboratory plays the role of an incubator for many ideas because they must be tested before use.

The data on which the Engineer bases his design, whether it is a building, highway or a bridge, involve the following three laboratory procedures:

1. A knowledge of the physical and chemical properties of the materials such as steel.
2. A knowledge of the structural properties of combined materials such as compressive, tensile and bond strength of concrete etc.
3. Evaluation of existing conditions such as the bearing value of soils etc.

Through the selective use of quality materials and by setting up proper laboratory controls, a more economical and better structure can be built.

The Paper elaborates on the above aspects.

D411.2, N48
N54-86

GLOSSARY OF HIGHWAY ENGINEERING TERMS—British Standard 892-1954, British Standard Institution, 2 Park Street, London, W. 1. Price 10 shillings Net.

The glossary now published is the first revision of the B. S. 892 published in 1940. Definitions of over 700 terms are given under the following sections :

1. Highway types
2. Preliminary operations
3. Construction
4. Materials
5. Plant and Tools
6. Traffic.

An alphabetical index is included.

BOOK REVIEW

TOWN AND COUNTRY PLANNING by A. J. Brown and H. M. Sherrard, published by the Melbourne University Press, Carlton, N. 3, Victoria, Australia.

Town and country planning is the direction of the development and use of land to serve the economical and social welfare of the community in respect of convenience, health and amenities. Planning a town involves the preparation of a design for arrangements of various parts such as residential areas, industry, shopping centres, parks, etc. Country planning involves the determination of the best use of rural land to yield the greatest economic and social advantage.

This volume is intended to serve as a general introduction to the subject and relates the practice in countries, notably in Great Britain and the United States of America, to Australian conditions. It is written mainly for three classes of readers, viz., the general public, administrative officials who have to deal with town and country planning, and students in the universities and technical colleges.

After introducing the subject in Chapter II, the book gives a historical background. Chapters III to XIII deal with the various components of planning such as zoning, housing, parks and playgrounds, public utility services, aesthetics of town and country planning and roads and road traffic. Of special interest to Road Engineers are the Chapters IV and V which deal with roads and road traffic. Chapter IV deals with arterial road system under the following heads :

1) Planning and Arterial Road System
2) Forecasting Future Traffic
3) Traffic Capacity of Roads
4) Location of Arterial Roads
5) Ribbon Development, etc.

Chapter V deals with road junctions, control, and parking. The section relating to road junctions is dealt in some detail under the heads channelising, design of round-about junctions, visibility, grade separation, comparison of types of junctions, etc.

Chapters XIV to XIX demonstrate the application of the principles enunciated in the earlier chapters.

Chapters XX and XXI deal with legislative, administrative, and financial machinery necessary to implement the planning proposals.

The book is well got up and contains more than 100 figures and 120 photographs.

(Continued from page 24)

the duration of mixing time affects the strength and durability characteristics of the soil-cement adversely. But from a practical point of view, a period longer than 1 hour is necessary and a duration of 6 hours for processing has been found to be a maximum permissible interval that does not show detrimental influences on the stability characteristics of the soil-cement. The design tests for soil cement make an allowance in the quantity of cement added in the soil-cement mixture towards any such loss in stability due to limitations in the construction operations. While a maximum duration of 6 hours has been specified in the article, the average processing time for the actual work described was about 3 hours only.

I hope the replies I have furnished are sufficiently detailed. I shall be glad to answer you of any further queries you may have. I shall be thankful if you would please let me have of a list of the publications, if any, of your institution on Soil Engineering. —THE AUTHOR.

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BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF AJMER BUDGET FOR 1954-55

	(In lakhs of rupees)		
	Accounts 1952-53	Revised Estimate 1953-54	Budget Estimate 1954-55
Total Revenue	213.53	180.05	225.87
Total Expenditure met from Revenue	210.98	177.53	225.87
Surplus	2.55	2.52	...
CIVIL WORKS—REVENUE			
Receipts from C.R.F.	...	0.42	0.48
Rents	...	0.15	0.12
Total	0·12*	0.57	0.60
CIVIL WORKS—EXPENDITURE			
Original Works			
Buildings	1.04	1.86	2.18
Communications	1.23	3.64	4.08
Repairs			
Buildings	0.01	2.30	2.30
Communications	2.74	3.00	3.00
Charges on Road Development met from Subventions from Central Roads Fund	...	0.42	0.48
Establishment Charges	0.31	1.62	1.74
Tools & Plant	0.02	0.16	0.18
Development Schemes Local Development Works...		0.15	0.15
Total	5.35	13.15	14.11
RECEIPTS FROM ROADS			
Receipts under the Indian Motor Vehicles Act.	0.43	1.10	1.75
COMUMNITY DEVELOPMENT PROJECTS			
Communications	...	0.63	0.50

* only total available.

GOVERNMENT OF AJMER BUDGET FOR 1954-55

(A brief note on Civil Works)

TOTAL revenue and expenditure of the State for the year 1954-55 are both estimated at Rs 225.87 lakhs while the revised Estimates for 1953-54 and Accounts for 1952-53 indicate surpluses of about Rs 2½ lakhs.

The budgeted expenditure on Civil Works for 1954-55 works out to 6.2 per cent of the total State revenue for the year as against 7.3 per cent for 1953-54 (Revised Estimates) and 2.5 per cent for 1952-1953 (Accounts).

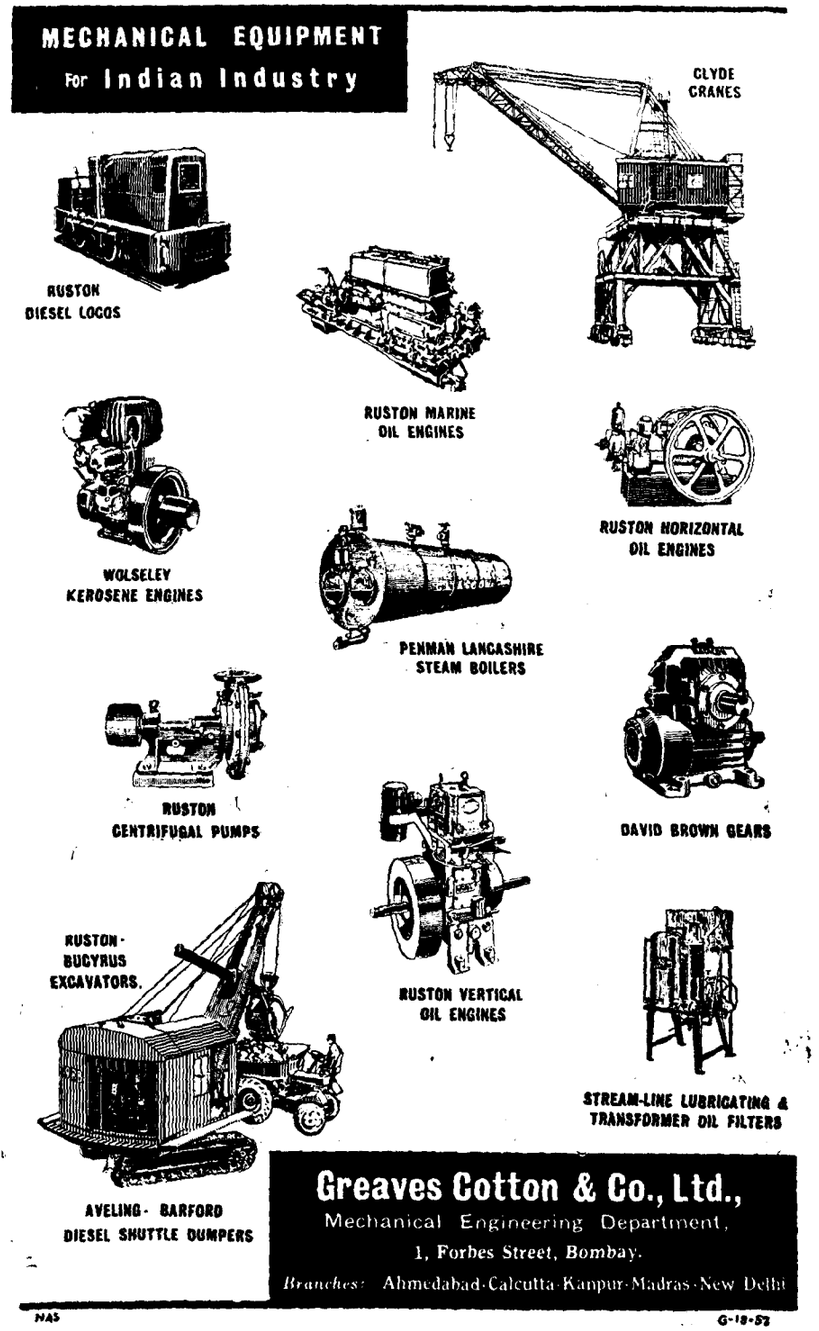
2 The expenditure on communications along (Original Works & Repairs only) forms 3.3 per cent of the total State Revenue for the year 1954-55 while for 1953-54 (Revised Estimates) and 1952-53 (Accounts) the corresponding ratios work out to 3.9 per cent and 1.9 per cent respectively.

3. The provision for communications in the Community Development Project in the State amounts to Rs 0.5 lakhs in the current year as against Rs 0.63 lakhs in the previous year. These are monthly charges on account of establishment and equipment.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
		ASSAM	
1.	A 883 AS 39	Surveying the slipped area in miles 48-72 of Barpather-Dimapur road, N. H. No. 39	0.11
		BIHAR	
2.	A 882 BR 21	Additional survey work for construction of N.H. No. 31 from Narainpur to Karhagola under Purnea Division.	0.14
3.	B 882 BR 31	Additional survey work for construction of National Highway No. 31 from Mokamehghat bridge site to Narainpur under Sharasa Division.	0.08
		BOMBAY	
4.	890 BM 8	Providing cross drainage works in miles 0/0 to 16/2-440 of the Bariavi-Vasad Section of the Bombay-Ahmedabad Road, N. H. No. 8	2.20
		MADHYA PRADESH	
5.	896 CP 7	Electrification of Rest House No. II at Katni on N. H. No. 7 in the Jabalpur District.	0.02
		PUNJAB	
6.	881 PB 22	Improvements to Kalka-Simla Road N. H. No. 22, mile 88, 87 and part of miles 86 and 83.	0.83
7.	886 PB 1	Construction of Bridges over gaps in furlongs 1 and 3 of miles 130 of G. T. Road (N. H. No. 1)	1.65
8.	887 PB 1	Construction of a bridge over gap in mile 127/2-of G. T. Road (N. H. No. 1)	2.02
9.	888 PB 1	Construction of a bridge over gap in mile 140/7 of G. T. Road (N. H. No. 1)	0.74
10.	889 PB 1	Construction of a bridge over gap in mile 145/1-2 of G. T. Road (N. H. No. 1)	0.93
11.	891 PB 22	Improvements to Kalka-Simla Cart Road (N. H. No. 22) in mile 75/3.	0.31

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
12.	892 PB 22	Improvements to Kalka-Simla Cart Road (N. H. No. 22) in mile 86/7.	0.27
13.	893 PB 22	Improvements to Kalka Simla Cart Road (N. H. No. 22) in mile 45/5-6.	0 19
14.	894 PB 22	Improvements to Kalka-Simla Cart Road (N. H. No. 22) in mile 73/5.	0.21
15.	898 PB 1	Widening of Bayen Bridge in mile 242/6 of G. T. Road (N. H. No. 1)	0.24
		UTTAR PRADESH	
16.	879 UP 28	Painting Miles 23–40 of Lucknow-Gorakhpur road (N. H. No. 28)	9.07
17.	880 UP 28	Painting Miles 54–60 of Lucknow-Gorakhpur road (N. H. No. 28)	7.57
18.	884 UP 2	Widening miles 111/0-120/0 in Agra Distt. (local miles 756-765) Delhi-Agra Section of N. H. No. 2	5.14
19.	885 UP 2	Widening miles 60/0-111/0 in Mathura Distt. (local miles 766-817) Delhi-Agra Section of N. H. No. 2	17.71
		WEST BENGAL	
20.	895 BG 6	Construction of a bridge over the Damodar at Bagnan on N.H. No. 6 and approaches thereto.	12.29
21.	897 BG 34	Construction of a temporary salpile bridge over the river Pagla in the 16th mile of the English Bazar-Khejuriaghat section of N. H. No. 34.	1.01



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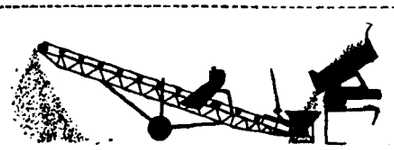

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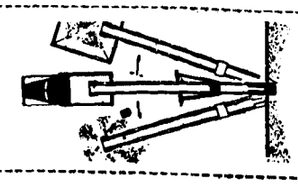

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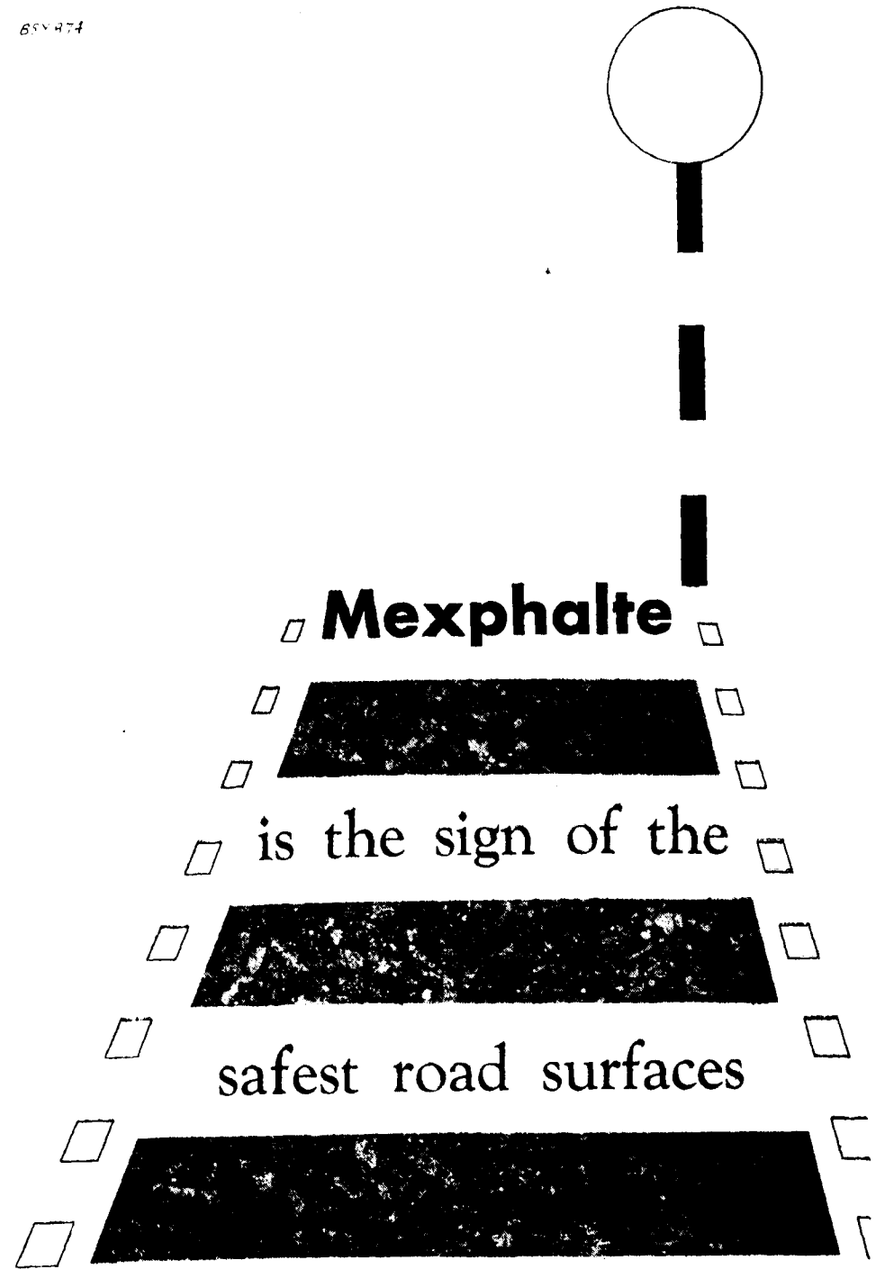

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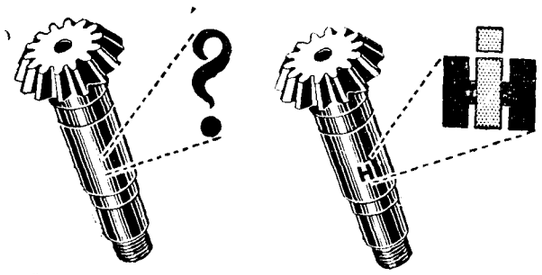

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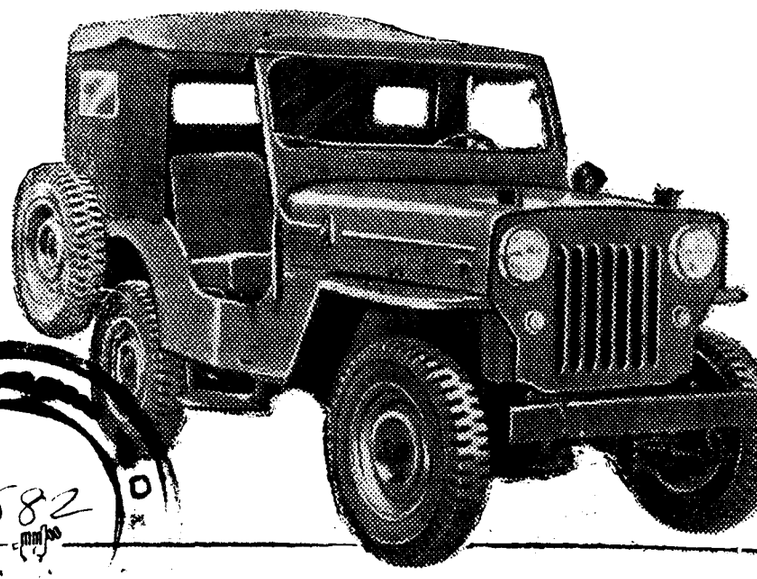

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