TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

SEPTEMBER 1955—No. 101

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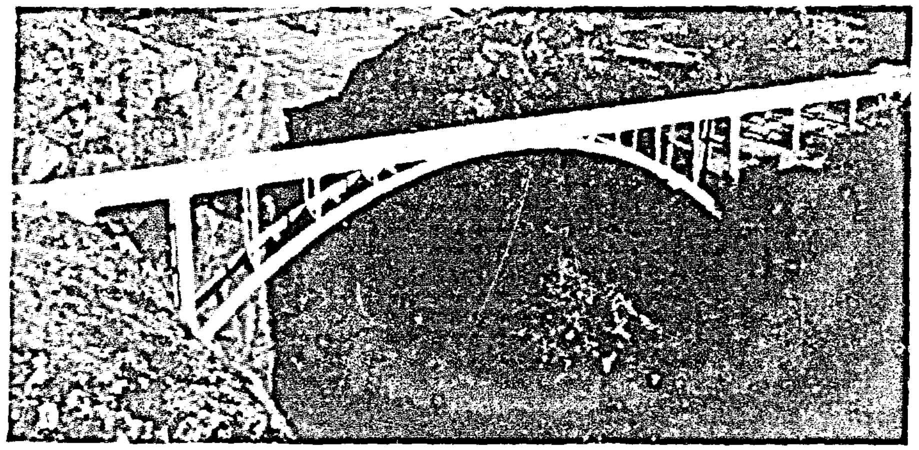


Bridge at Gueuroz, Switzerland.

A slender and graceful structure having two amazingly slender arch ribs of 323 ft span. The ribs are 2 ft wide and only 3 ft 7 in. deep at the crown and 6 ft 7 in. at springing. Such small depths were possible because of the deep parapet girders which serve to stiffen the arch ribs at the centre. Vertical posts of tee-section carry the deck.

(With acknowledgements to "Concrete and Constructional Engineering", June, 1955)

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

SEPTEMBER 1955 63

INADEQUATE HIGHWAY LAWS BLOCK PROGRESS

THERE is little doubt that inadequate and ill-advised law has been one of the chief bottlenecks impeding highway progress, Thomas H. MacDonald, U. S. Commissioner of Public Roads, pointed out in 1949 that:

> "The tempo of growth in highway service demands has been so rapid that legislation is lagging far behind both in range and in content. Highway officials, no matter how well qualified, may act only within the legal authority delegated by legislative action. The deficiency of first magnitude is legislative sanction to the state highway departments to organize to meet new duties, to use new methods, to extend their operations to new fields......"

More recently, Mr. MacDonald said of the highway engineer and official:

> "It is within their discretion to become the advocates of two essential concepts. The first of these is that our highways must have a completely integrated pattern for improvement and continuous maintenance, no matter how many systems or classes may be involved, and their future administration by the several units of government must be co-operative and not competitive. The second is that this important objective will require a complete overhauling and revision of highway laws in most of the states."

The first modern federal-aid act had been passed in 1916, one year earlier, providing for assistance to the states in the construction of rural post roads, and establishing a policy of co-operation between the federal government and the states in road improvement that in basic principle still remains largely unchanged. Based on this enactment, and a later ruling by the Department of Agriculture, each state was required to organize a highway department to qualify for federal-aid funds. This resulted, for the first time in many states, in the establishment of some measure of centralized control over highway affairs.

In general, however, the highway law of that era consisted of "an accumulation of uncorrelated statutes, frequently dating back to the time the state was founded."

This condition was due in part "to the emphasis placed in many states on local control of road administration, and in part to lack of policy and to political trafficking in such legislation. The purpose of practically all road legislation has been subordinated in one way or another to the idea of local self-government upon which our whole political system is based, and this has resulted in developing legislation of a restrictive and specific character not susceptible of statewide application, but designed to meet purely local conditions."

In a recent report on the highway statutes of Colorado, the Highway Research Board had this to say on the subject:

> "......There is ample evidence to conclude that highway legislation in some states has been deficient in providing basic principles and practices of modern management which progressive highway administration needs...... As is often the case with other legislation, highway legislation in many instances has been poorly conceived and inadequately considered and debated......While it is the administration of the law which really counts, the benefits of a properly drafted basic law are immeasurable, and such law is conducive to enterprising management."

Horse-and-buggy statutes which now handicap administration and block sound progress everywhere must be replaced by proper legislation capable of meeting the requirements of the motor age.

(From ' Better Laws are basic to Better Highway'—Dakota State Report, 1953.)

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

SETTLEMENT: Downward movement of the soil or of the structure which it supports due to shrinkage by consolidation or subsidence caused by the movement of the subsoil.

SLIP: Local soil movements produced by a mass of soil sliding over a slope.

CONCRETE ROAD BUILDING IN AUSTRALIA

APPROXIMATELY 1,100 miles of concrete road, or over 12,000,000 sq. yd.—taking an average width of 18 ft—are today in use in Australia. These are principally made of pre-mixed concrete, but rolled concrete has also been used and in Victoria considerable lengths of cement penetration road have been successfully carrying a large volume of traffic for many years. Some of the early roads of this last type, built over twenty years ago, are still in service today with many more years of useful life ahead.

Rolled concrete has been used mainly by the Victoria Country Roads Board and the Sydney City Council as an effective base for a bituminous topping. In the latter case it has practically supplanted the wooden block base.

The greatest concentration of concrete roads in Australia, carrying probably the greatest traffic density, is in the Sydney metropolitan area where the New South Wales Department of Main Roads uses mainly concrete in the construction of new and reconstructed main roads. In the same area the local authorities also use concrete predominantly for the building of the more important suburban streets.

These policies have been developed as a result of the very good service that concrete has given over many years, for several concrete roads laid in the early 1902s are still in excellent condition, carrying heavy traffic densities and with many more years of useful life ahead. In other cases early concrete roads still provide excellent base courses for a thin bituminous topping.

It is difficult, however, to generalize upon the service performance of concrete roads because so much depends upon the quality of the road laid in the first place. Generally where sound practices have been adopted it is the experience of Australian road building authorities that the service life of concrete roads, with low maintenance cost, is of a minimum period of thirty years and loan programmes for the purpose of concrete road building are related to that period.

There are some outstanding examples of long service life in heavy traffic density and among these is Parramatta Road at Homebush, near Sydney, which was constructed in 1920 and still has many more years of life before it need be re-surfaced.

The design of concrete pavements is largely empirical and is, for the most part, based on experience. More complex methods for the design of concrete slabs are confined in the main to airport and similar heavy duty paving. While overseas pavement practice has varied from time to time, the satisfactory results generally obtained from the methods used by the New South Wales Department of Main Roads and other authorities have encouraged their continuing use. The construction methods described in this article are those used by the New South Wales Department, but they are fairly typical of the practices in use throughout Australia today.

Most of the concrete pavements in Australia have been built in the major cities. Most of these, constructed by the Department of Main Roads in the Sydney area, have a depth of 7 in. thickened to 9 in. at the edges. Earlier examples were generally lightly reinforced with reinforcement placed in the bottom of the slab. More modern practice, however, has been to place the reinforcement in the top of the slab, both welded wire drawn fabric and mats of mild steel bars being used. Edge bars and corner reinforcing bars are also provided. In some lightly trafficked roads this thickness is reduced to $6\frac{1}{2}$ in. or 6 in.

Some recently constructed pavements, however, have been of the unreinforced constant thickness type, the depth of these being 8 in. In cases where expansion joints are omitted and contraction joints used a constant thickness of 8 in. is also adopted.

Concrete Mixes

A number of mixes are used, depending on the class of work being constructed. These are shown in Table 1.

Proportions are normally specified by volume and due allowance is made for bulking of the fine aggregate due to moisture.

Table 1

Mix	Design Strength lb per sq. in. at 28 days	Work
A 1 : 2 : 3	3,000	State highways.
B 1 : 2 : $3\frac{1}{2}$	2,670	Other pavements in metropolitan area.
C 1 : 2 : 4	2,500	Kerb and guttering in metropolitan area.
D 1 : $2\frac{1}{2}$: 5	2,000	Concrete base courses under bituminous macadam surface courses.

In many cases ready-mixed concrete is supplied under contract and the mixes shown in Table 2 are specified.

Table 2

	Cement lb	Aggregate (coarse and fine) lb
A	94	489
B	94	538
C	94	587
D	94	732

These mixes are the equivalent of those shown in Table 1.

Where it is desired to open the road for traffic at an early date, instead of after the normal period of 28 days, an additional $12\frac{1}{2}$ per cent of cement is used, the aim being to obtain in seven days the normal 28-day strength. Very little use is made of high early strength or rapid-hardening cement because of the greater shrinkage which is encountered.

Consistency

In general no more than $5\frac{1}{2}$ gallons of water per 94 lb bag of cement is added to the mix. Slumps of not more than 2 in. for hand finished and 1 in. for machine finished work are required.

Joints

On normal work transverse expansion joints are provided at 50 ft intervals. These are constructed with rigid metal bulkheads which extend the width and depth of the slab. When the bulkheads have been placed in position a strip of prepared joint filler is placed against the bulkheads on the side to be concreted so as to separate completely the concrete on each side of the joint. The concrete is then filled in and thoroughly spaded so as to form complete contact with the joint filler.

Concreting is then continued on the other side of the bulkhead and when a strip at least 3 ft long has been placed in position over the full width of the slab the bulkhead is carefully removed and the concrete compacted against the joint filler.

The joint filler used for transverse expansion joints consists of prepared strips of fibre or granulated cork matrix and bitumen containing approximately 20 per cent stabilizing material. Felt boards impregnated with bitumen are placed on either side of the prepared strips. The thickness of the joint filler is $\frac{3}{8}$ in. or at least 5/16 in. exclusive of the felt boards.

Some improvement in riding quality has been obtained by placing light steel channels over the top of the jointing material and screeding through over the top of the joints. The channel is placed in position after the bulkheads have been

removed. After the channel itself is removed the joint is finished off with edging tools.

For unreinforced slabs of constant thickness contraction joints of the weakened plane or ' dummy ' type are provided at intervals of 12 ft to 15 ft. These are formed by inserting a steel strip in the concrete to a depth of 2 in. after floating has been carried out. This strip, which tapers from $\frac{3}{8}$ in. to $\frac{1}{4}$ in., is removed before the initial set has taken place and the groove is finished with an edging tool. Where the work does not finish or butt against an old slab the last ten contraction joints are reinforced with $\frac{3}{4}$ in. tie bars spaced at 3 ft centres.

Curing

Curing is normally carried out by spreading a layer of damp sand or loam over the surface. Membrane curing compounds have been tried but in general have been found to be uneconomical and it is doubtful if they are as effective as a layer of sand.

The low maintenance cost and long service life associated with concrete roads in Australia is generally recognized ; but their use in many areas in Australia has been inhibited to a very large extent by the necessity to build roads over wide, sparsely populated areas with the emphasis on minimum capital costs.

(From ' Concrete Quarterly 25'—April-June, 1955.)

ECONOMIC LIFE DEPENDS ON GOOD ROADS

Rail and river transport nearly always begins and ends with a road service, on which it depends. It is, therefore, true to say that all economic life depends on good roads.

Resolution of International Chamber of Commerce, Vienna—1953.

THE FAILURE OF THE OLD CAUSEWAY AND THE CONSTRUCTION OF A NEW HIGH LEVEL BRIDGE ACROSS SUNAR RIVER

By

Shri B. G. Naik

THE River Sunar crosses Rajgarh-Jhabua Road in Madhya Bharat (Major District Road) in mile 17 about eleven miles east of Jhabua. A causeway of 17 vents (10 ft spans each) of an average height of about 6 ft above normal river bed was constructed in the year 1938. The foundations of the causeway were taken to 8 ft below the bed level and founded in boulders and moorum.

The superstructure consisted of R. C. slabs 14 in. thick freely supported, 6 in. sand cushion, 6 in. lime concrete and 6 in. cement concrete wearing coat. The total obstruction to flow was thus 2 ft 8 in. (see Page 9).

During the monsoon of 1943 the foundations of pier No. 13 and 16 and the right abutment were undermined on the upstream side, resulting in their sinking. The R. C. slabs over these vents were also badly cracked.

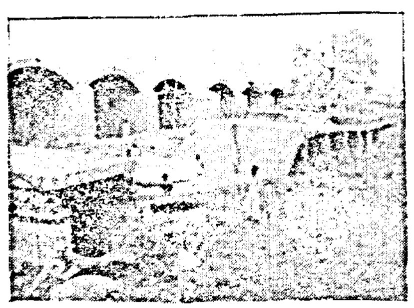


Photo 1. The damaged causeway with new Bridge under construction in the background.

The extracts below from the inspection report on the failure bring out the possible causes of the failure.

"(1) Insufficiency of Foundations.

With a hill stream of probable normal velocity of 8 ft per sec. and induced velocity of 15 ft per sec. in the vents after construction, considerable scour should have been anticipated. During the maximum flood, 5 ft of water flowed over the bridge and the depth of scour below H. F. L., as estimated from the scour holes now existing, must have been at least 22 feet. The M. E. S. Hand book recommends a depth of foundations equal to 1 and 1/3 × 22 ft. or 29 ft below the H. F. L. The bottom of the foundations of the causeway was 21 ft below H. F. L. and should have been taken another 8 ft below the present foundation level.

"(2) The scouring may have been cumulative.

It was observed in some other bridge on this road that very little attention has been paid in the past to maintenance. Scour caused in the previous monsoon still remained unattended to. In one case, a tree in front of a vent had been obstructing the flow and causing damage. It is possible that had there been better maintenance on the road and the scouring after each monsoon had been attended to in time, the present failure might have been avoided.

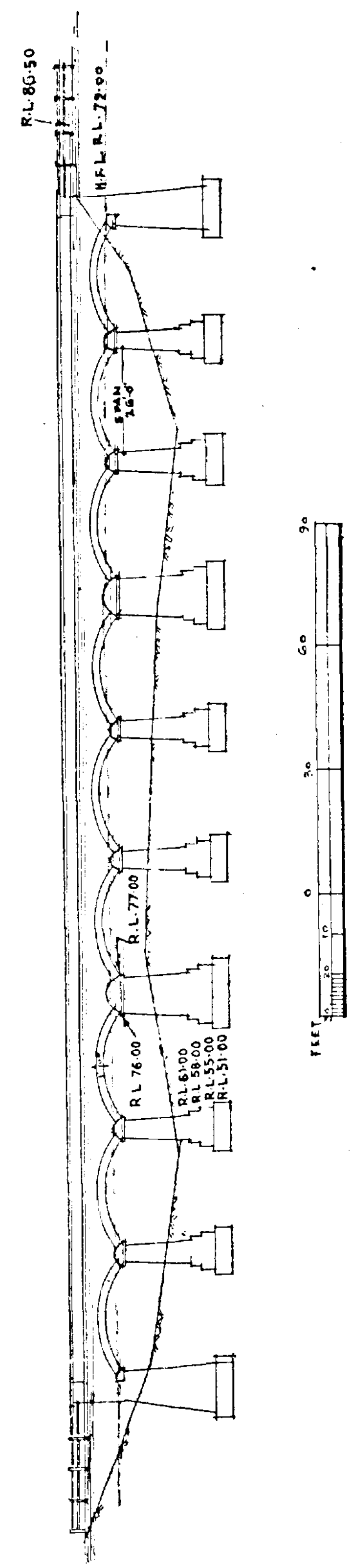
"(3) Wrong Layout

As the river is on a slight curve at the bridge site, more vents should have been provided on the Rajgarh side. It is estimated that another 30 ft of waterway is required."

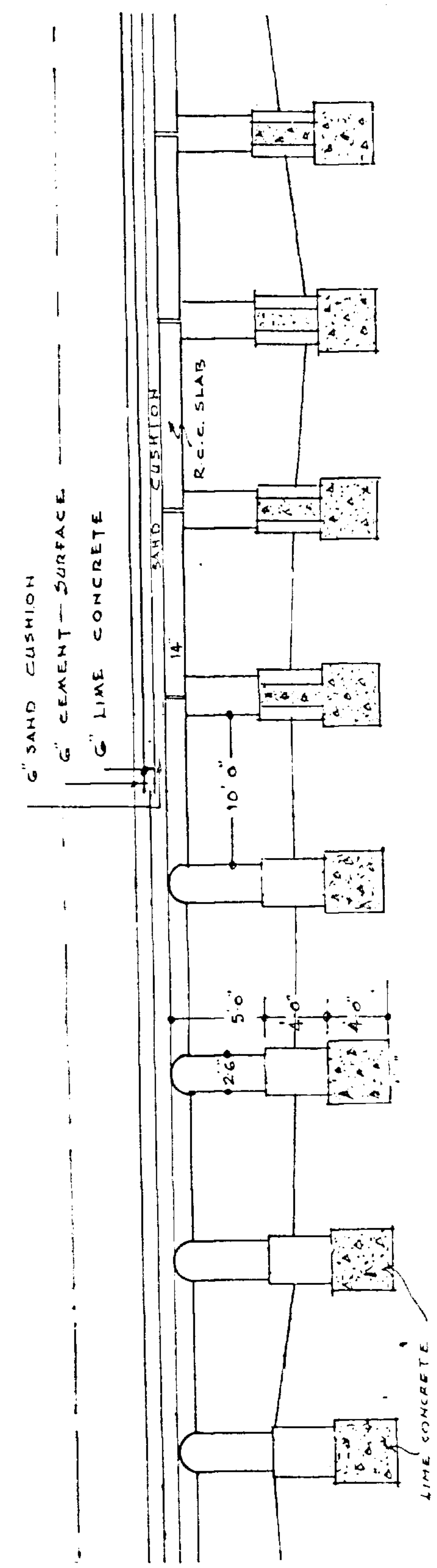
New High Level Bridge

It was proposed to rebuild the damaged piers and to protect foundation from scour by constructing curtain walls and providing concrete flooring.

But on the 14th July 1944, there was a heavy rainfall of 5 in. and 70 cents resulting in further damage to the causeway. The openings were blocked by floating trees, resulting in the settlement of piers and damage to the entire length of the causeway. The idea of repairing the causeway, therefore, was abandoned and it was decided to construct a high



Longitudinal Section of the High Level Bridge



Longitudinal Section of the Causeway

level bridge. The new high level bridge was opened to traffic on the 15th August, 1953.

Main Features of the New Bridge

The catchment area of the river above the site is 45 sq. miles. The anticipated maximum discharge under the bridge for this catchment is about 26,000 cusecs. The mean velocity of unobstructed stream was of 9.5 ft per sec. The anticipated velocity under the bridge is 11.5 ft per second. The waterway provided below the springing level is 2,600 sq. ft.

The new bridge is sited 60 ft downstream of the damaged causeway and is founded on the hard rock available at an average depth of 15 ft below the river bed level. 1 : 3 : 6 cement concrete mix was used for foundation.

The substructure consists of piers and abutment with open foundations. As good quality lime was not available near about, the work was done entirely in cement. The facing of piers is C. R. masonry of black trap stone in 1 : 6 cement mortar with hearting of 1 : 3 : 6 plum cement concrete. The batter in piers is 1 in 12.

The new bridge has nine spans of 26 ft segmental arches with a rise span ratio of 1 : 5. The length between faces of abutments is 277 ft (see page 9).

The arches are of precast cement concrete blocks designed for I. R. C. Standard class A (1947) loading. The thickness of

:Photo 2. **Arches under construction**

the arch ring is 1 ft 10 inches. In the beginning, 2 ft long cement concrete blocks (1 : 2 : 4 mix), 9 in. wide at the intrados and 9.9 in. at the extrados, each weighing 3.6 cwt. were cast. The handling of these blocks was difficult and resulted in breaking of edges. The length of blocks, therefore, was reduced to 1 ft 3 inches.

The width of the carriageway is 22 ft with water-bound macadam surface The parapets on either side are of coursed-rubble masonry.

The work was commenced on 14-4-51 and completed on 15-8-1953.

Costs

Particulars of Costs are given below:

Cost per running foot Rs 774/-.

Cost per sq. ft of carriageway Rs 36/-.

Cost per sq. ft of entire elevation Rs 21/-.

Cost per cu. ft of the bridge Rs -/13/-.

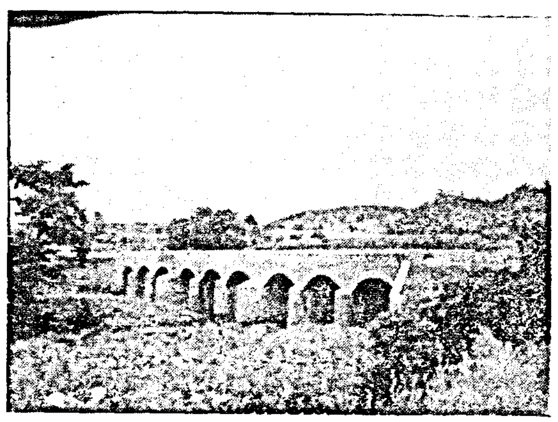


Photo 3

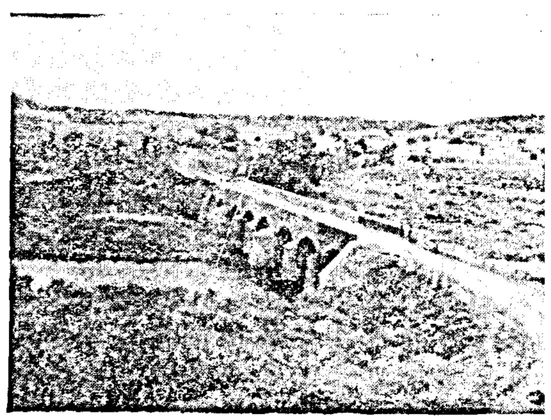


Photo 4

The Completed Bridge.

ORIGIN OF SOIL MECHANICS

An engineering problem cannot be satisfactorily solved unless the computation is based on a sound knowledge of the mechanical properties of the materials involved, and problems in earthwork engineering are no exceptions. Theories of earth pressure and bearing capacity have existed for more than a century, but their influence on engineering practice was almost nil. The reason is obvious—they were based on the assumption that the earth is either an ideally plastic or a perfectly elastic material and as a consequence they could account only for very few of the phenomena encountered in actual construction. Furthermore, practically all the difficulties encountered in earthwork and foundation engineering are due to the mechanical interaction between the solid soil particles and the water contained in or percolating through the voids of the soils. None of the theories which originated before the end of the nineteenth century made any provision for this interaction.

Several investigators with broad vision, such as A. Collin), started to adapt the theories to the results of field observations and laboratory tests, but they did not succeed in establishing schools of thought and procedure and their attempts were not followed up. However, some three decades ago, when the systematic investigation of the physical properties of soils became the concern of a large group of professional engineers and theories were modified in accordance with the findings, the contradictions between theory and reality disappeared, and theoretical methods for the solution of earthwork problems began to receive the attention which they deserve.

EARTH PRESSURE ON LATERAL SUPPORTS

Fundamental Principles: Theoretical principles for the computation of the earth pressure on lateral supports were clearly formulated by C. A. Coulomb almost two centuries ago, and since then such theories have been a favourite topic for scientists and theoretically minded engineers alike. Therefore, the history of these theories is an exceptionally instructive example of the radical changes produced by the impact of soil mechanics on earthwork engineering.

Coulomb's theory is based on the simplifying assumptions that earth is incompressible, that its deformations prior to failure are negligible, and that it fails by shear along plane surfaces of sliding. It was also assumed that the shearing resistance of the earth per unit of area of the surface of sliding is equal to

$$s = c + p \tan \phi \ldots\ldots\ldots\ldots \quad (1)$$

in which c is the cohesion; p, the unit pressure on the surface of sliding and ϕ, the angle of internal friction. For a cohesionless material such as dry, clean sand $c = o$ and

$$s = p \tan \phi \ldots\ldots\ldots\ldots \quad (2)$$

Coulomb's theory was published in 1776 (6) in the Memoires of the French Academy of Sciences at once attracted great attention, and has never ceased to preoccupy the minds of theoretically inclined engineers. Within the following century almost every theoretical aspect of the earth-pressure problem was investigated by analytical or by graphical methods on the basis of Eq. 1 or 2, and the bulk of earth-pressure literature steadily increased. However, the benefits derived by practising engineers from these developments were almost nil as testified by the following passage in the classical paper (7a) on "The Actual Lateral Pressure of Earthwork," by Sir Benjamin Baker, Hon. M. ASCE, published in 1881.

"A knowledge, however imperfect, of The Actual Lateral Pressure of Earthwork, as distinguished from what may be termed the "text-book" pressures which, with hardly an exception known to the Author, are based upon calculations that disregard the most vital elements existent in fact, is of the utmost importance to the engineer and contractor....... The vast divergence between fact and theory has perhaps impressed itself with peculiar force upon the Author,......because he has had the advantage of the experience gained in constructing about 9 miles of retaining walls, and......the still more valuable experience of 34 miles of deep-timbered trenches for retaining walls, sewers, covered ways and other structures.

The status of earth-pressure theories in engineering practice did not materially change, and the discrepancies between theory and reality did not decrease until a few decades ago, when the mechanical properties of soils became subject to systematic investigation. At that stage it soon became evident why Baker and his contemporaries failed to derive any tangible benefits from the extensive literature concerning the theoretical aspects of lateral earth pressure. Their failure was due to the fact that the computations were based on the assumption that the value ϕ in Eqs. 1 and 2 for any kind of soil is equal to the angle of repose of the soil.

In the English-speaking world the most influential proponent of the angle-of-repose concept was W. J. M. Rankine. The origin of the concept is not reliably known. Since Coulomb derived an equation for the critical height of vertical slopes on cohesive earth his name cannot be associated with it. Collin realized as early as 1846 that the maximum inclination of a slope on cohesive soil decreases with increasing height of the slope. In 1883, George Howard Darwin demonstrated by small-scale earth-pressure tests that the angle of internal friction of a sand can be very much greater than the angle of repose of the same sand.

Nevertheless, none of these discoveries received more than casual attention and Rankine's authority continued to prevail. A possible explanation for it was given by a discusser of a paper by A. W. Skempton in 1946. This discusser, J. Wilton, pointed out "......that the long survival of Rankine's methods may have been due to their suitability as material for examination questions."

The fate of the Collin and the Darwin publications illustrates the fact, to be observed in all branches of pure and applied science, that a newly discovered phenomenon or relationship does not receive the attention it deserves unless and until it can be fitted into a coherent system which is useful and convincing enough to be accepted by the majority of those who are interested in the subject.

Soil mechanics represents such a system. As a consequence as soon as it became established it started to act as a catalyst. Discoveries and rediscoveries followed each other in rapid succession. As a matter of fact it was not realised until afterward how many of the vital phenomena and relationships had already been recognized, decades or even centuries earlier, but these discoveries failed to make any impression on contemporary engineers and, as a consequence, were forgotten.

As a result of soil mechanics research the fictitious angle-of-repose concept was replaced by the results of systematic experimental investigations concerning the relation between normal pressure and shearing resistance for soils. Starting about 1920 the investigations led first to the conclusion that p in Eqs. 1 and 2 must be replaced by $p - p_u$, in which p is the total unit pressure on the surface of sliding and p_u is the pore-water pressure (1). Therefore Eq. 1 was replaced by

$$s = c + (p - p_u) \tan \phi \text{.........(3)}$$

Next it was found that the value p_u in Eq. 3 for saturated soils depends not only on the loading conditions but also on the rate at which the shearing stress is increased.

This important discovery led to the distinction between "slow" and "quick" shear values. Finally it was realized that the cohesion c of saturated clays is a function of the water content w of the soil. This fact is expressed by the equation:

$$s = f \quad (w) + (p - p_u) \quad \tan \quad \phi_t \text{......(4)}$$

in which ϕ is the true angle of internal friction.

On the basis of these findings the angle of repose concept has been discarded, and the limits of validity of Coulomb's Eq. 1 are now known to every competent soils engineer. Since the relationship between cohesion and water content, symbolized by f (w) in Eq. 4, can be very complex, earth-pressure and stability computations are based on the results of shear or triaxial tests performed under conditions of loading and drainage equivalent to those which are anticipated under field conditions. The results of such tests can usually be represented without serious error by an equation with the form of Eq. 2. However, for any given soil, the values of c and ϕ in the empirical equation can have very different values, depending on the test conditions. Hence, in contrast to c and ϕ in the classical Coulomb equation, the values c and ϕ in the equation representing the results of tests on cohesive soils are parameters without well-defined physical meaning.

Design of Retaining Walls—As long as angle ϕ in Eq. 1 was believed equal to the angle of repose of the backfill material, inexperienced retaining-wall designers proceeded under the illusion that the results of their computations were reliable where experienced engineers like Baker found that they could not be trusted and made decisions on the basis of their knowledge of precedents. There was no intermediate course. However, as soon as the fallacy involved in the angle-of-repose concept was generally recognized and the complexity of the relationship between c and p, Eq. 1, became known, the attitude of the engineering profession toward the problem of designing retaining walls underwent a radical change. It became obvious that the shearing resistance of a cohesive backfill cannot even be estimated in advance of construction unless a thorough borrow-pit survey has been carried out. Also the project must provide for placing and compacting the backfill in accordance with rigid specifications. On routine jobs none of these conditions is satisfied. Hence for the routine design of retaining walls simple semi-empirical rules have been developed which are based partly on Coulomb's theory and partly on what are now known to be lower limiting values for c and ϕ in Eq. 1 for the principal types of backfill materials. However, if a project calls for the design of an expensive retaining wall with a great height, soil mechanics provides the engineer with all the information required for preparing a safe and economical design, regardless of how unusual the design conditions may be. Since type and importance of the uncertainties in the evaluation of the basic data are known, they can be compensated by an adequate factor of safety and an appropriate selection of the backfill material.

(From "Transactions, American Society of Civil Engineers, Volume CT, 1953, by Dr. Karl Terzaghi, pages 669 to 672".)

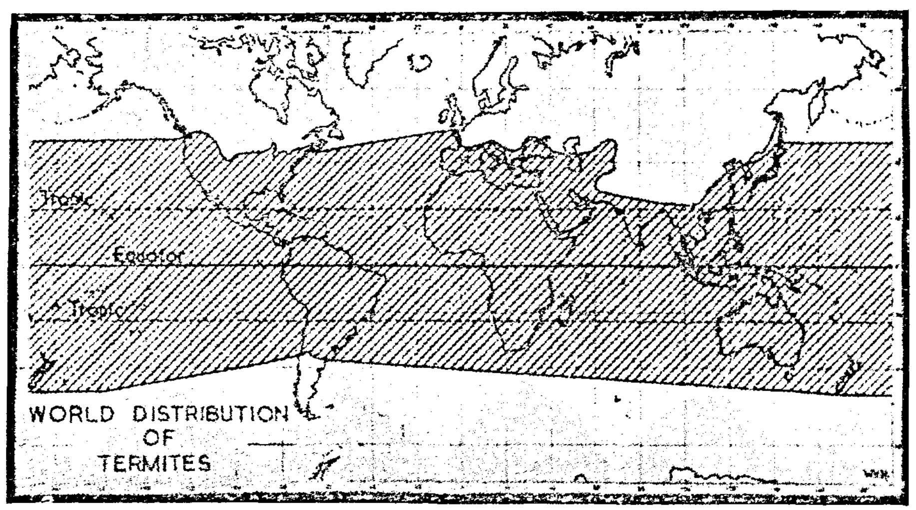
PLANNING

Planning means not only a decision whether a work is required or not but also a comparison of the need for the work with that of all others and the selection of the one most needed.

THE PREVENTION OF TERMITE DAMAGE TO BUILDINGS

TERMITES are social insects, which is to say that they never occur singly or in pairs. Whenever a termite is encountered there must be a colony not far away, unless of course one is dealing with a winged termite flying in search of a mate. The actual number of termites forming a colony can vary from 50 or 100, in the case of a dry-wood termite, to several millions if it is one of the large mound-building species of tropical Africa and south-west Asia. Killing termites is only of value when the colony as a whole is engaged, while protection is not a matter of turning aside a frontal attack, as with locusts, but of resistance to the long drawn out probing of sappers in a siege. Termite communities consist of a pair of reproductives, the so-called king and queen, or if these have been lost their place is taken by a number of less efficient supplementary reproductives, and a large number of workers and soldiers. All the work of the community is carried out by a special caste of worker termites except in the dry-wood species who use the nymphs who will later become flying adults. Guarding the colony is the work of a second sterile caste known as soldiers, the varied design of whose jaws gives us the most easily recognisable characters for identification. The food of termites is solely plant material of a woody nature-timber, grass stems, the droppings of herbivorous animals, paper, cellulose acetate fabrics and similar things. In their search for food, termites may gnaw through thin layers of soft material such as lead or various plastics, but such occurrences are local and infrequent. Tales of termites eating their way through steel and glass should be met with the modicum of incredulity.

It is essential to bear in mind that there are two groups of termites whose habits differ in ways that have an important bearing on methods of prevention and control. There are the " subterranean termites " and the " dry-wood termites. " The subterranean termites are the commonest, the most varied in behaviour and the most destructive. Most of them build their nests below the ground or in moulds of various distinctive shapes on the ground, while a few make nests of clay and chewed



WORLD DISTRIBUTION OF TERMITES

wood on the trunks and lower branches of trees with connections to the ground by means of narrow covered ways. Subterranean termites can be kept out of buildings by the use of mechanical barriers, though they will exploit to the full any way of getting round such precautions as may be offered by added stairways, supports for creepers and similar additions to the original plan. Dry-wood termites live, without any connection whatever with the ground, inside dry timber on which they feed as they bore their way along, after the manner of timber beetles. They digest wood by the aid of special protozoa which inhabit their gut and they have no need of moisture. When dry-wood termites swarm, they fly straight into the roofs of buildings and start new colonies inside the timbers there, or descend to the furniture if it has not been impregnated with suitable chemicals.

Termite-Proof Buildings

The design and construction of termite-proof buildings is a problem which has to be dealt with in the light of local conditions, both of materials and the kind of termite involved. The following suggestions are offered on general principles. It is perhaps in the field of low-cost housing that ingenuity of design for the prevention of termite damage offers the quickest dividends. An effective barrier over foundations and floors will add considerably to the life of such dwellings, and by removing the threat of damage to their personal effects add greatly to the comfort and material prosperity of the occupiers. It is on a monument in the South American republic of Colombia that prayers are inscribed for Divine protection against lightning, earthquakes, sudden death and termites.

Site Clearance

Site clearance is a necessary preliminary to building in all areas where there are subterranean termites, and especially in dry countries where shortage of food soon drives termites to seek out constructional woodwork. It is worth while doing it with particular care before erecting temporary buildings which may not have structural barriers incorporated in their design. The building plot should have all dead wood and old tree stumps dug up and removed for at least 20 ft beyond the foundations. On no account shonld stumps and waste timber be buried within the foundations of a building. Then a careful examination of the site should be made for termite mounds and for those holes on the surface which indicate a termite nest below ground. If there are signs of living termites the nests must be destroyed with an arsonic and sulphur smoke machine, or by introducing a suitable fumigant such as petrol, carbon bisulphide of DD. If the design of the building does not include a continuous concrete slab across the foundations to form a barrier against any upward movement of termites from the soil, then it is advisable to poison the surface layer of the soil within the limits of the foundations. This is done, after filling and consolidation, by watering the surface carefully with a 5 per cent solution of pentachlorophenol in fuel oil, or of sodium pentachlorophenol in water at a similar strength. The solution in oil is to be preferred where leaching is likely with a high water table. It takes a minimum of four gallons of solution to 100 sq. ft of soil surface to produce an adequate layer of poisoned soil.

Barriers

It comes as a surprise to some people that, in their search for timber, termites are able to penetrate concrete. Actually the insect has no power to do more than gnaw a way through a thin rendering or coat of whitewash, but it has infinite patience in seeking weak spots in a concrete mass through which it may eventually work its way. Such weaknesses are more commonly found when concrete for foundations has been mixed on dirt. But the use of inferior sand or aggregate, the use of inadequate proportions of matrix to aggregate, and just plain bad workmanship will all lead to cracks and hollows which may be hidden from view by a coating of cement. Reinforcement should be considered as a safeguard against cracking as a result of foundation movements, either as a result of shrinkage and swelling of clay soils or because termites had been excavating their nests in the subsoil. The reinforcement of concrete floors should also be considered as a measure to prevent cracking and the ùsbsequent entry of termites from the soil below.

The value of metal "ant guards" is a topic on which opinion is divided. They are widely recommended in America, and a recent publication from the French Building Research Centre advocates their use. The writer has observed their effectiveness in a number of buildings in East Africa. On the other hand, the 1950 report published by the South African National Building Research Institute could not be more negative regarding their suitability for conditions there. No doubt it is a matter of circumstances, for in a locality where termites commonly build mounds within the confines of the foundations and these mounds grow to a height which allows the termites to come into contact with suspended wooden floors, then ant guards along the foundations will not, in themselves, be effective. Where termite invasion is effected through the walls, or by covered ways constructed on the surface of the walls, the use of metal strips of projecting concrete slab is indicated.

One point about the use of barriers—they must be used on all interior foundations or footings of partition walls. This may seem to be rather obvious, but it is frequently found that infestation starts through a gap in the barrier in an inner wall.

Timber Impregnation

In areas where dry-wood termites exist, no amount of isolation from the ground will keep a building free from attack, and structural timbers need to be made termite proof. It is also a valuable second line of defence against damage by subterranean termites, in case cracks do develop in the system of barriers incorporated in the building of foundations and floors.

Large-scale timber impregnation is a highly technical matter involving a knowledge of the absorptive potential of the particular timber being used, the penetrative power of the preservative and its suitability for keeping away termites, in addition to general economics. The ultimate objective is an unbroken skin of termite resistant wood on each piece of timber, that is thick enough to withstand weathering or ageing, and mechanical injury. This introduces an element of doubt in the value of brushing techniques except for the patching up of the protective skin after joint cutting or repair work. For rough outside work, mineral creosotes are still among the best termite proofing agents. Their disadvantages are well-known.

It must be borne in mind when considering new chemicals for termite work that wood usually needs to be made safe from rotting and decay at the same time. For example, while impregnation with D.D.T. makes timber proof against termite attack it does not help at all to keep away fungi should the timber become damp. In practice it would need to be formulated with a fungicide. On the other hand, the compound pentachlorophenol was developed as a rot proofing agent befor its value against termites was discovered. However, the most important practical point about wood impregnation, whatever chemical is decided upon, is to ensure that penetration is adequate to provide "defence in depth" and not merely a superficial appearance of protection.

Resistant Timbers

It is open to doubt if any one timber will remain immune to all varieties of termites after 20 or 30 years. This is not intended to cast aspersions on any particular timber, but to draw attention to the fact that resistance in one country may not follow in another, if the termites to which the wood is exposed have different habits. Hardwoods like teak, mahagony and iroko are highly resistant to all subterranean termites, but after a time it would appear that some, at least, of the dry-wood species can make headway in them. Trade names for timbers can be misleading, as in the case of "bonteak", an oriental timber which is not related to teak either botanically or in termite resistance. Nevertheless a great deal of trouble may be avoided if it is possible to employ the heart wood of local timbers, which experience has shown to be reasonably resistant, for constructional work in buildings. In their absence, impregnated timber is advisable anywhere between 40° north and south latitudes, and from sealevel to 7,000 ft.

(From "The British Constructional Engineer, June, 1955.")

HERE AND THERE

1. ECONOMIC BENEFITS OF CONTROLLED ACCESS AND ROADSIDE

A LOGICAL question is: "What are the benefits of controlled access and why is it needed?"

Control of access preserves the capacity and public investment in the highway, provides safer and faster transportation, stabilizes and enhances the value of abutting and other property, and makes possible more economical motor vehicle transportation.

First, in suburban areas, lack of access control can cut traffic capacity 50 per cent and in urban areas, 70 per cent. Therefore, we can lose a considerable part of the public investment in highways without protection of highway capacity through access control and adequate right-of-way widths.

Second, greater accident experience on road sections with road-side commercial activities when compared with sections without roadside activities.

Third, a study of land market values and average traffic speeds in Texas disclosed that

(a) The per cent gain in market values in the land area immediately adjacent to the Freeway was more than 24 times as great as in the areas farther away from the Freeway. The per cent gain in market values in the area close to the Freeway but not right next to it was more than 15 times as great as the areas only indirectly accessible to the Freeway.

(b) Average speeds on the streets adjacent to the Freeway are from 15 to 18 miles per hour as against 37 miles per hour average on the controlled access highway.

Fourth, a study by Ralph A. Moyer of the University of California discloses that

The following savings per mile are attributable to access control features of a highway: gasoline, $1\frac{1}{2}$ cents for peak-hour conditions and only one-third or one-half as large during off-peak hours; tyre and brake costs by avoiding frequent starting and stopping, $1\frac{1}{4}$ cents; time savings $1\frac{1}{2}$ cents; accident costs, $1\frac{1}{2}$ cents. Professor Moyer estimates a total savings of about 4 cents per mile to the highway user by operating on highways where there is full control of access.

(From 'American Highways'—April, 1955.)

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2. PAKISTAN HIGHWAYS

MODERNISATION PROPOSED WITH U. S. AID

PAKISTAN has planned to modernise her highways with the help of U. S. economic aid.

The total expenditure to be incurred under the programme is estimated at Rs 10 million.

Aid offered by the U. S. so far has amounted to 640,000 dollars.

The programme comprises survey, research and training and is divided into two separate projects for West and East Pakistan.

The West Pakistan project consists mainly of research work. Its first part has been planned for completion by April, 1957. It will be based on a wellequipped research laboratory located at Lahore.

The East Pakistan project, which would continue over a period of four years, has been mainly designed to elevate and flood-proof the existing roads, now impassable for about six months of the year owing to deep water conditions. This would facilitate the year-round flow of consumer goods to internal markets and export of materials to Chittagong port.

(From 'Times of India,'—16-8-55.)

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3. PROFESSOR G. MAGNEL

IT is with deep regret that we report the death of G. Magnel, the inventor of the Magnel-Blaton System of Prestressing.

The system, which was primarily conceived for post tensioning, comprised a rectangular cable made up of a number of high-tension wires in layers each of four wires, and the 'sandwich' end anchorages. The wires, either 0.200 in. or 0·276 in. in diameter, were made to retain their positions throughout the length of the cable by the use of "grills," the number and spacing of the grills being determined by the curvature of the cable. In this way the wires could be accurately tensioned without the frictional losses that had detracted from some other systems of prestressing. The regular spacing between the wires also permitted full grouting to be accomplished after tensioning of the cable had been completed.

The anchorages consisted of the distribution plate used to transfer the cable load to the end of the beam and the sandwich plates and wedges used for holding the stressed wires. Each layer of four wires was laid in pairs in slots of the plates and they were stressed in pairs; after stressing, a wedge was driven between the two wires and this was sufficient to hold the wires when the jacking force was released. Although, as already mentioned, the cables were originally intended for grouting in post-tensioned beams they have also been successfully used externally to the beam section.

Gustave Paul Robert Magnel was born on September 19, 1889, at Esschen in the province of Antwerp and received his technical training at the University of Ghent between 1907 and 1912. In 1913 he came to London as an assistant engineer, and later as Chief Engineer, for D. G. Somerville and Company of London, with whom he was engaged on the design and construction of several warehouses. In 1919 he was appointed Assistant Professor at his own University of Ghent and in 1927 he became Professor responsible for structures and, particularly, reinforced concrete.

Apart from his teaching duties at the University, Magnel built up an extensive consulting practice. As early as 1921 he had been responsible for some iron-ore silos at Ougree-Marihaye, Liege, which were the largest then constructed. Later works included industrial buildings for the Societe Belge de l' Azole, Liege, the Walnut Lane Bridge in Philadelphia, and, later, many of the prestressed-concrete structures erected in Belgium. At the time of his death he was designing the 2,082-ft high television tower that is proposed for the Brussels World Fair in 1958.

He was a director of the Pre-Compressed Concrete Engineering Company of Montreal, Canada, and of Stressed Concrete Designs, Limited, London; he was a member of the Institution of Civil Engineers, to which he had been elected in December, 1950, and of the Institution of Structural Engineers. In 1950 he was awarded the Frank P. Brown medal of the Franklin Institute of Philadelphia for his contributions to the study and practice of prestressed concrete.

(From 'Engineering' -July 15, 1955.)

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4. SYMPOSIUM ON CORRELATION BETWEEN CALCULATED AND OBSERVED STRESSES AND DISPLACEMENTS IN STRUCTURES

A CONFERENCE will be held in London in September 1955 on "The correlation between calculated and observed stresses and displacements in structures."

A list of the Papers is given below :

- "Some factors in the field testing of structures," by F. G. Thomas.
- "Site strain measurements: some philosophical aspects," by A. Goldstein.
- "Techniques for field measurements of deformation and earth pressure," by W. H. Ward.
- "Testing of prestressed steelwork," by R. A. Sefton Jenkins.
- "Loading tests on bridges," by F. G. Thomas.
- "Stress, measurements in the steel frame of the new Government Offices, Whitewall Gardens," by R. H. Wood and R. J. Mainstone.
- "Some experiments on Clifton Suspension Bridge," by A. R. Flint.
- "The behaviour of saw tooth portal frames," by Professor J. F. Baker.
- "Tests to destruction on a Vierendeel girder," by Professor F. B. Bull.
- "Full-scale loading tests on a welded plate-girder floor system," by B.E.S. Ranger.
- "The design of a raw-sugar silo," by E. T. Moss.
- "Telephone Manager's Office, Kilburn," by H. C. Adams, S. C. C. Bate, and F. Walley.
- "Site strain measurements : examples of prestressed concrete structures," by A. Goldstein.
- "Loading tests on the floor systems of a reinforced concrete building," by A. J. Ockleston.
- "Load tests on a small prestressed-concrete highway bridge," by P. B. Morice.
- "The deflexion of reinforced concrete portal frames with sloping rafters," by W. C. Andrews.
- "Test of a precast prestressed shell roof," by J. J. Lewkowicz.
- "Settlement studies on structures in England," by L. F. Cooling and R. E. Bibson.
- "A survey of comparisons between calculated and observed settlements of structures on clay," by D. H. MacDonald and Professor A. W. Skempton.
- "Some comparisons between measured and calculated earth pressures," by W. H. Ward.

(From 'Chartered Civil Engineer'–Bulletin of the Institution of Civil Engineers, July 1955.)

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5. LOSS OF PRESTRESS WITH TIME

IN THE REPORT of the Building Research Board for the year 1954 it is stated that measurements of strain in the prestressed concrete main beams of an office building at Kilburn have continued in order to observe the magnitude of the losses of prestress in the steel. There has been an appreciable increase in this loss during the year due to creep and shrinkage of the concrete. After $2\frac{1}{2}$ years this loss has now increased to about 12 per cent, and is only slightly less than the ultimate loss assumed in the design. The report continues : "Analysis of the behaviour of this structure and of tests in the laboratory shows that the total loss of stress in the steel due to elastic shortening of the concrete on stressing, to creep and shrinkage of the concrete, and to relaxation of the steel may amount to 20 per cent for post-tensioned steel and possibly to 25 per cent or more for pre-tensioned steel. These losses are greater than the usual allowance of 15 per cent made in design. Such under-estimates of the losses increase the risk of cracking, but would be expected to have little influence on the ultimate strength of a structure."

(From 'Concrete & Constructional Engineering-July, 55'.)

6. RE-VIBRATING BOOSTS CONCRETE QUALITY

RE-VIBRATING concrete just before it reaches its initial set can produce many benefits. It makes concrete stronger, denser, more uniform. Although revibration is effective in ordinary concrete, it performs even better when the set is retarded.

Here's a sample: Tower spandrel beams on the New York Thruway's Tappan Zee Bridge were poured in four 3-ft lifts. To prevent cracking in the bottom surface as concrete is placed in higher lifts, the entire mass was kept fluid with a retarder. The full depth was then revibrated.

By assuring adequate time for revibration, the retarded concrete yielded a substantial gain both in uniformity and in 28-day compressive strength.

(From 'McGraw Hill Digest' -July, 1955.)

7. CODE OF PRACTICE FOR USE IN STRUCTURAL STEEL IN BUILDINGS

THE Indian Standards Institution has circulated for comments to interested parties in the country a Draft Indian Standard Code of Practice for Use of Structural Steel in General Building Construction. This draft contains recommendations for good practice in the design of steel buildings, providing for efficient, economic and modern methods of design and fabrication. The code gives guidance on the loadings to be considered and the stresses which are permissible for steel produced in India to Indian Standard Specifications. The provisions on design and fabrication, if properly applied, will ensure that modern and economical practices are being followed in the construction industry.

The Sectional Committee responsible for this draft had on its committees various steel producers, designers and fabricators from important private and government organizations.

8. ROAD PLANNING IS A PROBLEM IN DYNAMICS

IN a Paper on the Planning of Roads, read before the Royal Society of Arts, London, Mr. Vallis said that stripped of all the complications which envelop and disguise it, the core of road planning emerges as a straightforward problem in dynamics.

It is not to be supposed from that remark that the process as a whole bears any resemblance to an exact science. Technical problems abound, but human and administrative problems enter into it too; indeed, they are usually the more numerous and intractable.

Yet, although pure mathematics and pure science are rarely the direct concern of the engineer engaged in road planning, all his work is ultimately founded on them. It is difficult to imagine any object more static than a road, and at first glance the assertion that it is fundamentally a dynamical problem may appear something of a paradox. But the engineer's object is to build a road which will carry vehicles safely at any speed up to a predetermined maximum known as the design speed. Those vehicles are masses which have finite though continually varying velocities and directions. The Laws of Motion which were put into formal shape by Newton in his **Principa** bind them as securely as they bind the theoretical particles of the mathematician's textbook. There is no escape.

It is true that on the road the moving masses are machines controlled by fallible human brains and muscles which too often ignore the natural laws and attempt to defy them; the engineer can take no such risks. No matter what difficulties lie or are placed in his way, his road must provide a path which not only looks safe but is safe, in the sense that a vehicle can travel along it at any speed up to the design speed without its driver's being lured into any attempt to defy the natural laws. Translated into practical terms, this means that his road must conform to certain fairly rigid requirements, among which standards of horizontal and vertical curvature, and of gradient, are of prime importance.

To plan a future road effectively means spending money now......If, however, a fairly long view is not taken, those who come after us will find themselves in difficulties as great as, and perhaps greater than, those which we are encountering. The question is, therefore, what sacrifices are we under an obligation to make for the benefit of our successors, to enable them to build a road which we can clearly see they will need?

Mechanical advances are making ever higher speeds possible, and the desirability or otherwise of planning roads to take advantage of them needs some examination. The attainment of high speed by other forms of transport—air, sea, and rail—is not condemned. On the contrary, it is applauded as are efforts to attain still higher speeds. On roads alone is speed condemned. The reason, of course, is the shockingly high number of accidents, many of which are, rightly or wrongly, attributed to speed. This should not blind us to the desirability of attaining high speeds on long road journeys, if they can be attained with safety. It is of the greatest importance to remember that the overwhelming majority of accidents occur on roads which are totally unfitted for present-day traffic; roads which have only a single carriageway for traffic in both directions, and which are used by pedestrians and pedal cyclists as well as by heavy and fast moving vehicles. These roads are in no way comparable with the dual-carriageway motor roads which are now contemplated, and roads of this modern type, whose design is founded upon all the accumulated technical knowledge and skill which are now available, can justifiably be planned for speeds considerably higher than those to which we are accustomed today.

(From 'Highways and Bridges'—May 18, 1955.)

9. RADIO-ACTIVE COBALT USED IN TESTING BUILDINGS

THE workers of the Concrete Building Institute of the Building College in Brno, Czechoslovakia, headed by Mojmir Ciganek, have been highly successful in using radio-active isotopes for testing the strength of the ferro-concrete constructions.

They used radio-active cobalt in photographing the dislocation of steel in reinforced concrete constructions, such as in beams and stanchions and for finding out the inherent conditions of pre-fabricated materials.

By this means they have achieved very exact and detailed pictures of these conditions which previously had to be obtained in a much more difficult way and without the same degree of precision resulting.

When working on this new method, the workers of the Institute were helped by metallurgic workers in the Brno factories which have been using radio-active isotopes for testing the quality of weldings.

10. STABILIZATION WORK IN BLACK COTTON SOIL BAPATLA - PEDDANANDIPADU ROAD 10/0 TO 18/2

THIS was the first stabilized soil work to be taken up in a typical black cotton soil area subjected to prolonged waterlogging in the sides for a major part of the year.

The stabilized soil foundation consisted of a blanket course of 22 ft × 3 in. and a base course of sand-gravel mix (2 : 1) 20 in. × 5 in. The wearing course was of water-bound macadam 12 ft × 3 in. with two sides berm (3 ft × 3 in.) of gravel-sand mix (1 : 1) protected with grass edges 2 ft wide on either ends.

The method of processing of stabilized soil consisted of manual operations of mixing and spreading and compacting with tyre rolling with a grader and power rolling with a three-wheel steam roller. The cost per mile using stabilized soil base was Rs 29,000 and compared very favourably with that of the conventional method of using stone soling, viz., Rs 38,000.

For the period from March 1951-52 about 3 miles of the above work was completed.

The uneven settlement and other foundation difficulties often noticed in black cotton soil areas are conspicuously absent in the stabilized reaches and the surface is standing extremely well.

(From the "Administration Report of the Highways Department, Madras, 1951-52.")

11. THROUGH ROUTES IN URBAN AREAS

A BASIC CAUSE of much of the traffic muddle on state and Federal urban routes is conflict between through-traffic and access-traffic. The three fundamental purposes of the street system is expected to serve are

1. To provide access to abutting property.

2. To permit circulation within a given area.

3. To facilitate movement from one area to another and through the city.

When a street predominantly serves one of these basic purposes, certain distinct characteristics are observable in the traffic accommodated.

For example, where the primary function is to serve abutting property, people and goods are constantly seeking access to residences, stores, warehouses and other buildings. Parking for vehicles at rest is a vital consideration. Frequent stops and turning movements are made to reach access points. Traffic as a rule moves slowly.

On streets where the chief function is circulation within an area, the need for stops and turns to reach homes, places of business, etc. is appreciably less; parking requirements are relatively fewer, and the speed of movement is markedly stepped up.

On streets principally devoted to through-traffic from one area to another or through the city, there are few stops and turns for local access; there is little desire to park; and speed of movement and trip time become of paramount importance.

Now it must be clear that no street can serve all three purposes equally well at the same time. There can be no real operating efficiency when traffic with all these varying characteristics is thrown together to compete for the limited street space available. The result can only be interference and confusion.

The most modern traffic engineering measures will not avail much so long as we persist in the impossible position of trying to make a business or shopping street serve the purpose of a through-street.

The first requisite, then, in choosing streets for a through route is to give careful attention to existing service and traffic characteristics. The streets selected should

Continued on page 24

CURRENT LITERATURE

ABSTRACTS

PLASTIC ANALYSIS AND DESIGN OF MILD STEEL VIERENDEEL GIRDERS by A. W. Hendry—The Structural Engineer, July 1955.

THIS Paper discusses the application of the simple plastic theory to the design of mild steel Vierendeel girders. Three modes of failure are described and equations are derived for calculating the collapse load of a girder in each of these modes. Experimental results are quoted in confirmation and the application of the analysis to the design of parallel and inclined chord girders is illustrated by calculations for the design of a five panel bridge girder.

—*Author's Summary.*

"THE PERFORMANCE DURING THE FIRST FIVE YEARS OF THE EXPERIMENTAL CONCRETE ROAD AT OXTON, NOTTINGHAM"* BY J. A. LOE, PROCEEDINCS OF THE INSTITUTION OF CIVIL ENGINEERS, U. K., Part II, Volume 4, Number 1, February, 1955.

The Paper gives an account of the structural performance of the experimental concrete road at Oxton, Nottinghamshire, during the first 5 years after being opened to traffic in February 1948; it also includes information on the horizontal movements occurring at some of the joints during this period.

The experimental road at Oxton is planned to form one of a series of experimental roads designed to determine the most economical thickness of concrete construction on various types of soil. It has not yet been possible to proceed with the construction of the other roads and it is important to emphasize that the interim conclusions drawn from the performance of the Oxton road may apply only to roads on soils similar to the gravelly-sand occurring at Oxton.

The Oxton experiment includes slabs of 4-to-8-inch thickness laid directly on the subgrade, slabs of 3-to-6-inch thickness laid on bases 2 and 4 inches thick, and slabs of 3-to-5-inch thickness laid on 6-inch bases; the bases in all cases consist of sand stabilized with 7 per cent by weight of cement. A length of 180 feet of each thickness of construction was laid, half being reinforced with 7 lb. per square yard of oblong-mesh reinforcement and half being of plain concrete. Expansion joints were placed at 90-foot intervals, with intermediate contraction joints 30 feet apart in the reinforced concrete and 15 feet apart in the plain concrete. All the transverse joints include dowel-bars at the longitudinal joint has no dowel or tie-bars.

The experimental road, which forms part of one carriageway of a dual-carriageway road, carries about 700 vehicles per day in winter and about 850 vehicles per day in summer; about 35 per cent of these vehicles consist of heavy lorries.

The Paper includes a number of interim conclusions and observations on the performance of the road after use by traffic for 5 years. *(Author's Summary).*

(Continued from page 22)

already be functioning largely as through-facilities, or they should be capable of conversion to this type of use. Then the resources of traffic engineering can be applied to provide a maximum of swift, safe, unimpeded movement. Curb-parking should be abolished, turning movements controlled, and other steps taken to increase capacity and eliminate delays.

Since most of our larger cities have an ample number of arterial streets, certain ones can be adapted without too much difficulty to through-service exclusively. However, many of the small cities have only one or two main streets, and these are often overrun by hordes of vehicles funneled in by state and national trunk lines. These streets are badly needed to serve local access uses. All that these small communities gain from the through-vehicles is traffic paralysis, since they are not business-bringers, but are merely intent on getting through town as quickly as possible. As experience has shown, the only lasting solution in this situation is to build a bypass around the town to carry the state and Federal route traffic.

(From 'Traffic Engineering', June, 1955.)

FLATTERY

"*You sure have a way with the girls. What's your secret?*"

"*Flattery, man, just a little flattery. Last night my girl and I were out walking. She got a fly in her eye and I said, "No wonder, I don't see how a fly could miss such big eyes.*"

(*two days later*) : "*Your secret's the bunk. My girl got a fly in her mouth.*"

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

IV. SOIL ENGINEERING AND DRAINAGE

1. **Sand Drain Applications by the Port of New York Authority**; JOHN M. KYLE and MARTIN S. KAPP, *Separate No. 456, Proceedings of American Society of Civil Engineers*, June 1954.

2. **Foundation Problems of the Elutna Project**; WILLIAM R. JUDD-*Separate No. 444, Proceedings of American Society of Civil Engineers*, June, 1954.

3. **Difficult Pile Foundation in Shifting Ground Layers**; *Der Bauengineur*, June 1954, pp. 231-232 (in German).

4. **Bearing Capacity of Soils and its Determination with VSS-Testing Apparatus**; ROB RUCKLI, *Strasse und Verkehr*, July 54, pp. 267-268 (in German).

5. **General Introduction to the New VSS-Standard on Soil Testing**; *Strasse und Verkehr*, July 54, pp. 268-274 (in German).

6. **Tests of Sub-base Soil and Foundation Materials of Roads**; D. BONNARD-*Strasse und Verkehr*, July 54, pp. 271-274 (in German).

7. **The VSS-Testing Apparatus**; G. AMBERG, *Strasse und Verkehr*, July 54, pp. 275-276 (in German).

8. **The CBR-Method**; L. BENDEL, *Strasse und Verkehr*, July 54, pp. 276-278 (in German).

9. **The Application of Plate Bearing Tests in the Practice** F. GERMANN-*Strasse und Verkehr*, July 54, pp. 278-282 (in German).

10. **Are You Getting Good Compaction-Washington has a New Method for Measuring in Place Density of Highway Soils**; HERBERT W. HUMPHRES, *Western Construction*, June 54, pp. 84-86 & 96.

11. **The History and Construction of the Foundations of the Asia Insurance Building, Singapore**; WILLIAM JOSEPH ROBERT NOWSON, *Paper No. 5975-Proceedings of the Institution of Civil Engineers, Part I, General Volume 3*, July 54, No. 4-pp. 407-456.

12. **Expressway Crosses New Haven Larbor Front on Hydraulic Fill**; ERNEST T. PERKINS-*Civil Engineering*, July 54, pp. 37-41.

13. **Vertical Sand Drains for Stabilization of Muck-Peat Soils**; J. C. CARPENTER and EDWARD S. BARBER *Separate No. 351, Proceedings of American Society of Civil Engineers*, November 1953.

14. **The Design of Road Foundations**; D. J. MACLEAN, *The Surveyor*, August 14, 54, pp. 697-700.

15. **Modern Procedures for Underground Investigations**; GEORGE F. SOWERS-*Separate No. 435, Proceedings of American Society of Civil Engineers*, May 54.

16. **Flexibility as a Factor in Design of Stabilised Soil Bases**; H. E. BROOKE-BRADLEY-*Roads and Road Construction*, August 54, pp. 252-254.

17. **Drainage and Gumbo Soil Problems for this Country**; A. F. COUSINS, *Better Roads*, August, 1954, pp. 19 & 20.

18. **Structural Properties of Soil in Place**; *Highways and Bridges and Engineering Works*, August 18, p. 3.

19. **Piling Works at Southmead Housing Estate, Wandsworth**; A. J. C. HALDON-*Highways and Bridges and Engineering Works*, September 15, 54, p. 11.

20. **Construction of New Quays at Tunis Port-Problems Posed by Construction of Quays in Silt Terrains of Indefinite Depth**; M. FRANCOIS BEAN and M. BERNARD PETIGNY, *Annales des Ponts et Chaussees*-July-August 54, pp. 413-464 (in French).

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BUDGETS AND ADMINISTRATION REPORTS

BHOPAL STATE BUDGET FOR 1955-56

The following extracts relating to Civil Works have been taken from the Bhopal State Budget for 1955-56

	(In lakhs of rupees)		
	Actuals 1953-54	Revised Estimates 1954-55	Budget Estimates 1955-56
REVENUE			
Rents		1.23	1.40
Ferry Receipts		—	—
Receipts from Workshop		0.07	0.07
Transfer from Central Road Fund		4.40	3.64
Miscellaneous		0.79	0.51
Deduct-Refunds		0.03	—
Total	5.63*	6.46	5.62
EXPENDITURE			
Buildings			
Original Works	8.06	10.00	10.00
Repairs	4.70	3.50	3.50
Communications (Other than National Highways)			
Original Works	5.02	4.40	3.64
Repairs	13.93	9.50	9.50
Establishment	2.96	4.70	9.14
Tools & Plant	0.90	0.35	1.00
Development Schemes			
Buildings	—	1.90	0.24
Communications	—	4.39	9.19
Tools & Plant	—	4.00	2.00
Suspense	21.10	4.50	6.00
Lump-cut & Recoveries	−14.27	-3.75	-14.47
Total	42.40	43.49	39.74

* Details not available.

Capital Expenditure on Civil Works outside the Revenue Account

	(In lakhs of rupees)		
	Actuals 1953-54	Revised Estimates 1954-55	Budget Estimates 1955-56
Buildings			
Original Works	—	11.94	18.60
Communications (other than National Highways)			
Original Works	—	6.86	—
Total	—	18.80	18.60

REVENUE FROM ROADS

Receipts under the State Motor Vehicles Taxation Act	—	3.00	3.00
Total	—	3.00	3.00

GOVERNMENT OF BHOPAL BUDGET FOR THE YEAR 1955-56

(A brief review with reference to Civil Works)

THE budget estimates for 1955-56 place the revenue at Rs 347.22 lakhs and expenditure on revenue account at Rs 354.41 lakhs, anticipating a deficit of about Rs 7.19 lakhs. The revised estimates of revenue and the expenditure met from revenue for the year 1954-55 amount to Rs 304.30 lakhs and Rs 317.07 lakhs respectively which indicate a larger deficit viz., Rs 12.77 lakhs. The actual revenue for 1953-54 amounted to Rs 234.73 lakhs as against an expenditure of Rs 237.72 lakhs resulting in a deficit of Rs 2.99 lakhs.

The expenditure on Civil Works including Development Expenditure met from the revenue is estimated at Rs 39.74 lakhs for the year 1955-56 which works out to 11.4% of the anticipated total State revenue. The corresponding ratio for 1954-55 (revised estimates) and 1953-54 (actuals) were 14.3% and 18.1% respectively.

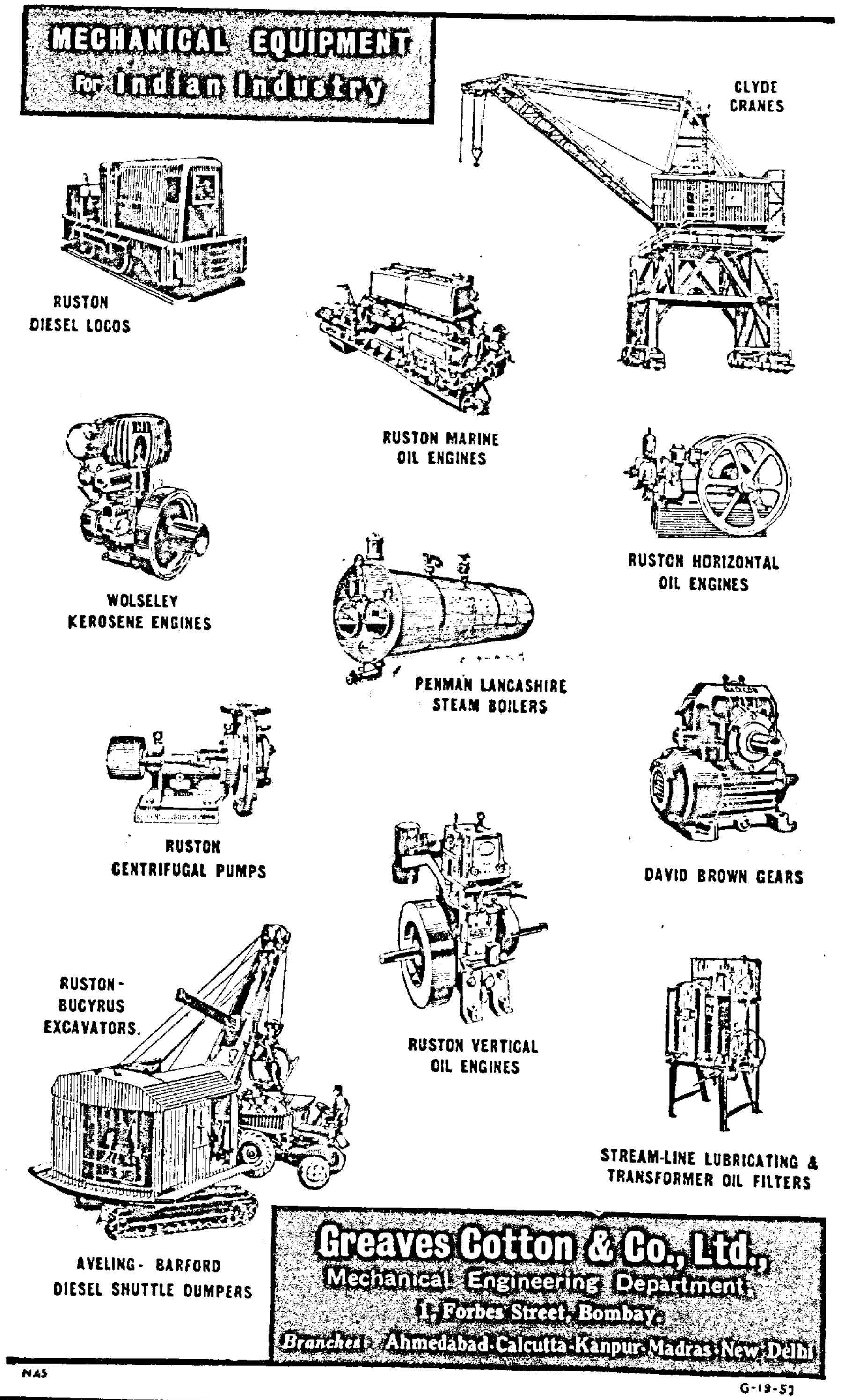
The expenditure on Communications alone (Original Works and Repairs only) is placed at Rs 22.33 lakhs for 1955-56 as against Rs 18.29 lakhs for 1954-55 (Revised Estimates) and Rs 18.95 lakhs for 1953-54 (Actuals). In terms of total State revenue, the expenditure works out to 6.4% for 1955-56 while it formed 6.0% in 1954-55 and 8.1% in 1953-54.

Capital expenditure on Civil Works outside the revenue account is estimated at Rs 18.60 lakhs for 1955-56 which is earmarked exclusively for "Buildings." The revised estimates for 1954-55 indicate an outlay of Rs 18.80 lakhs of which the share of 'Communications' is Rs 6.86 lakhs. No capital expenditure was incurred on account of Civil Works in 1953-54.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
		ANDHRA	
1.	1318 AH 7	Widening culverts in mile 0/6 to 60/0 of the Kurnool-Gooty road, N. H. No. 7.	3.47
2.	1319 AH 7	Improving ghat portion M. 37/4-7 of the Kurnool-Gooty road, N. H. No. 7.	0.13
		HYDERABAD	
3.	1321 HD 9	Reconstruction of the damaged arch culvert No. 291 in mile 78/6 of Hyderabad-Sholapur Road-N. H. No. 9-in Bidar District.	0.51
		HIMACHAL PRADESH	
4.		Two works each costing less than 2 lakhs.	1.41
5.	1343 HP 22	Widening of 6 ft track to full width from Luri to Rampur (miles 73/0 to 78/0) part of Hindustan-Tibet Road, N. H. No. 22.	4.01
		TRAVANCORE-COCHIN	
6.	1324 TC 47	Easing the curve in M. 21/5-6 of Trivandrum-Quilon road, N. H. No. 47.	0.97
7.	1339 TC 47	Improvements to M. 2/5 to 5/2 of Quilon-Aleppey Section of N. H. No. 47.	3.55
8.	1345 TC 47	Construction of a bridge across the right arm of Perinjor river on N. H. No. 47.	15.49
		MADHYA PRADESH	
9.	1325 CP 6	Black topping miles 132 to 145 of Nagpur-Raipur section of N. H. No. 6.	2.42
		PUNJAB	
10.		Three works each costing less than 2 lakhs.	4.81
11.	1331 PB 2	Widening of Delhi-Faridabad section of N. H. No. 2 (miles 11/5 to 19/3) to four lane width.	8.49
		RAJASTHAN	
12.	1327 RJ 8	Providing 1 in. thick premix carpet in miles 12-23, 26-30, & 33-35 of Jaipur-Ajmer road, N. H. No. 8.	3.46

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
13.	1328 RJ 8	Providing 1 in. thick premixed carpet in miles. 7-24 and 35 (excluding mile 21) of Jaipur.Delhi road, N. H. No. 8.	3.39
14.	1334 RJ 8	Construction of culverts on Kherwara-Bichiwara section of N. H. No. 8 (miles. 0-15).	1.93
		MADRAS	
15.	1320 MD 46	Widening the existing improved surface in M. 70/0 to 78/0 and 87/2 to 100/0 in North Arcot Division, N. H. No. 46.	2.70
16.		Two works each costing less than 2 lakhs.	3.60
17.	1342 MD 7	Construction of a bridge across the Arjuna river at M. 339/4 of N. H. No. 7.	4.08
		ASSAM	
18.	1330 AS 37	Construction of a new bridge at Doom Dooma in mile 317 of Assam Trunk Road, N. H. No. 37.	8.87
		MADHYA BHARAT	
19.		Two works each costing less than 2 lakhs.	3.56
		BOMBAY	
20.		Two works each costing less than 2 lakhs	2.10
21.	1340 BM 8	Constructing a bridge across Nadri river on Raigadh-Ratanpur section of Bombay-Ahmedabad-Delhi Road N. H. No. 8.	2.76
		UTTAR PRADESH	
22.	1341 UP 26	Construction of a bridge over the Betwa at Jhararghat in mile 25 of Jhansi-Saugor road, N. H. No. 26.	23.43
		BIHAR	
23.	1344 BR 28 A	Improvement to the Chapwa-Sagauli-Raxaul-Nepal border road-section of N. H. No. 28A, mile 1/6 to mile 12/3.	9.73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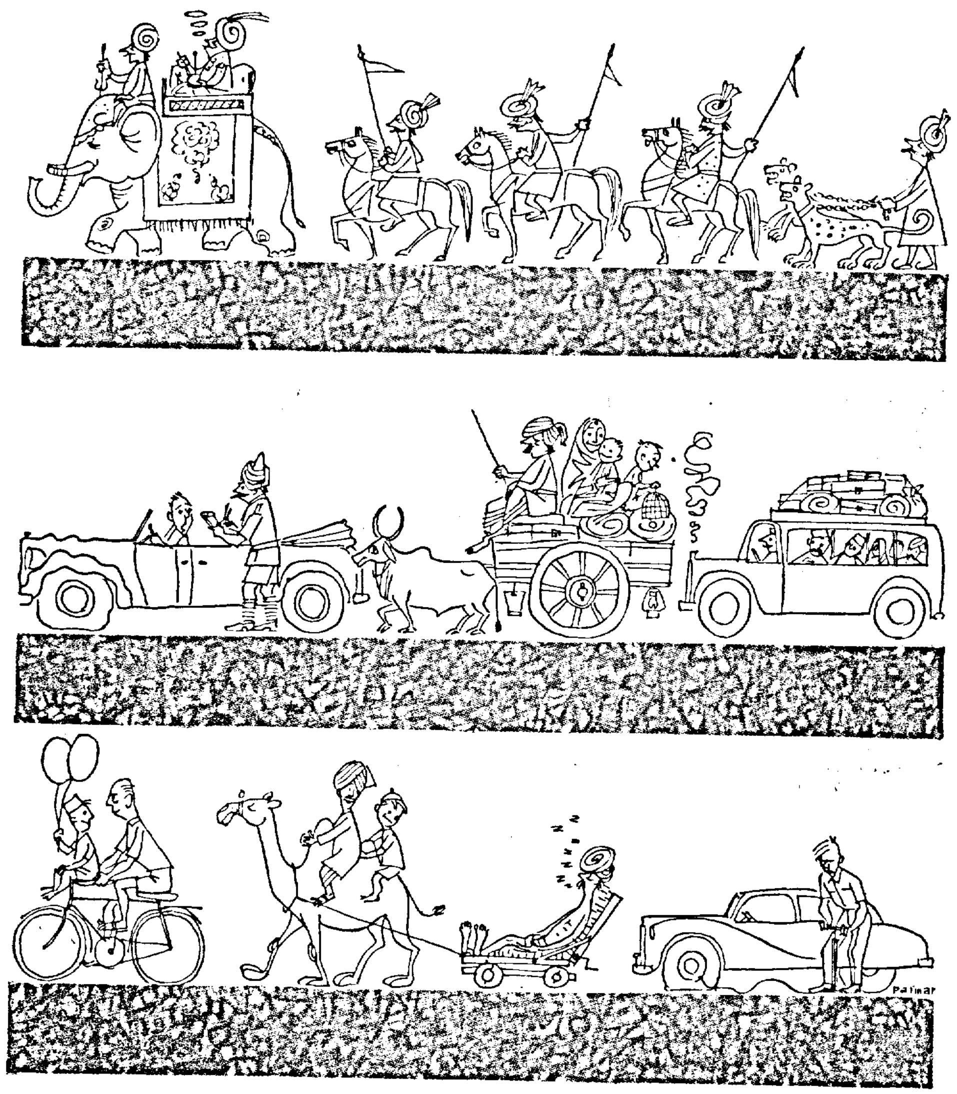
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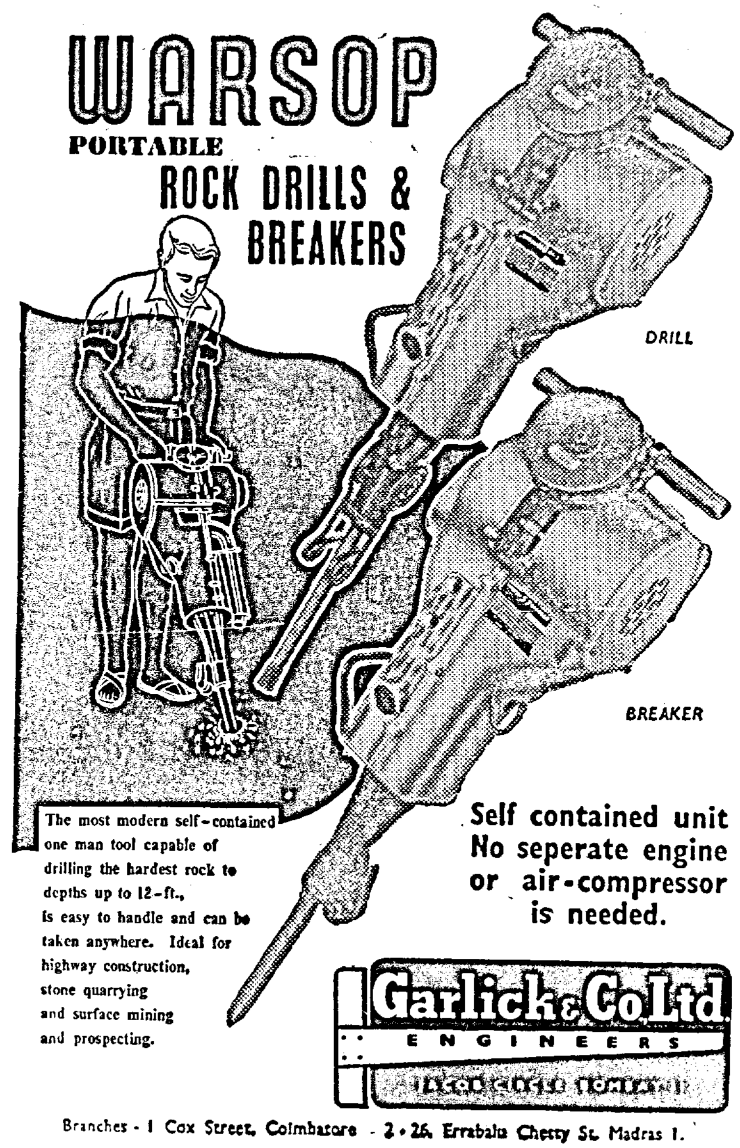
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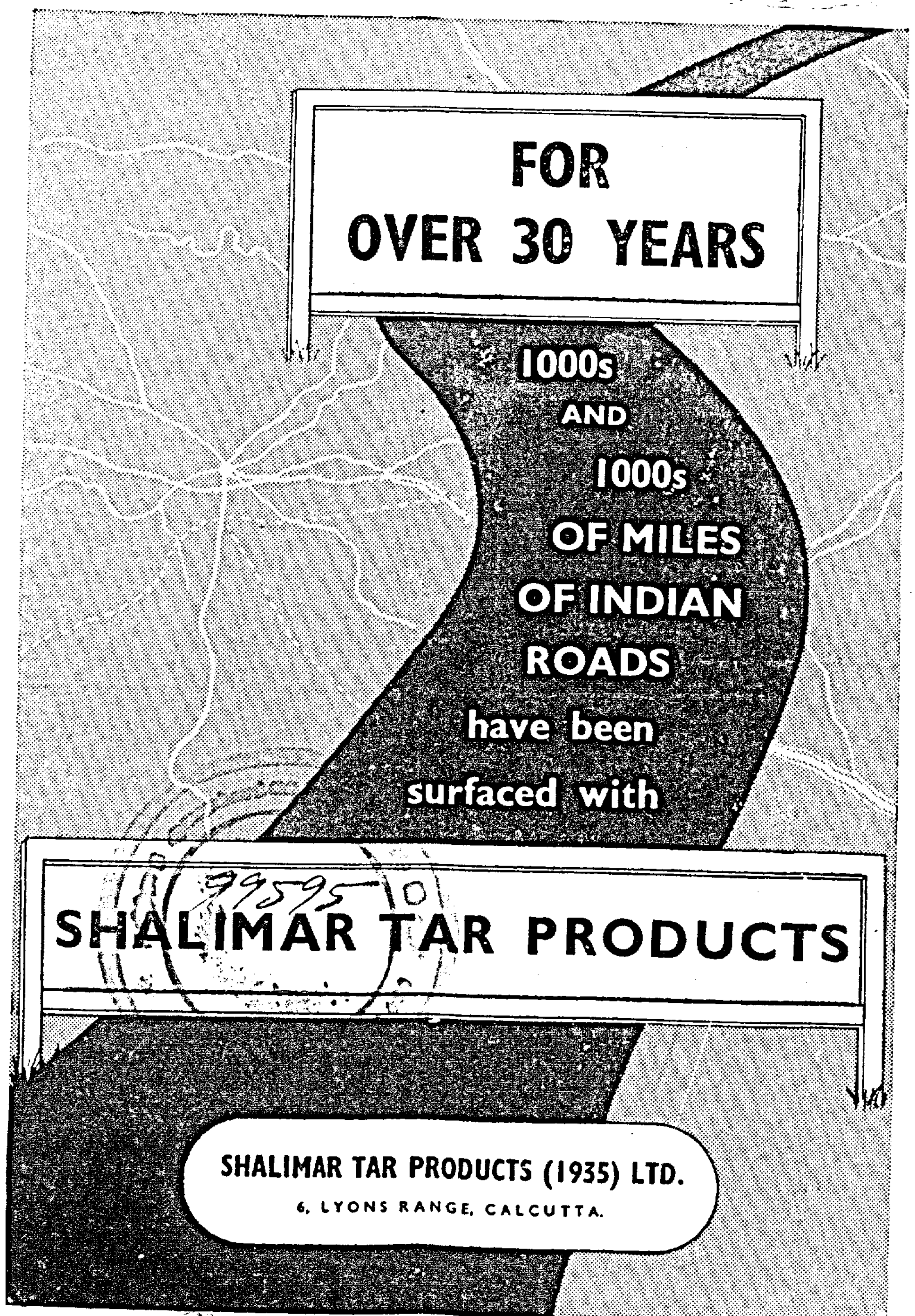
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