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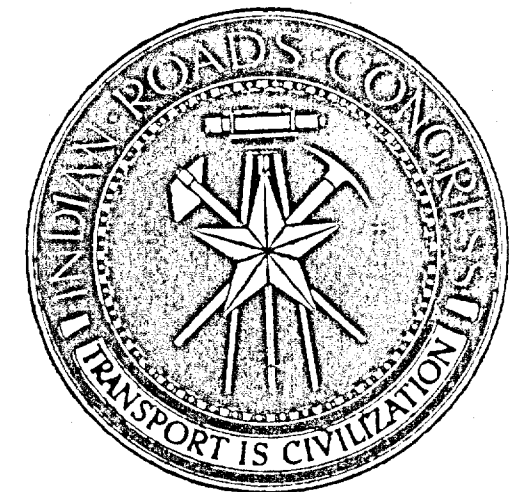
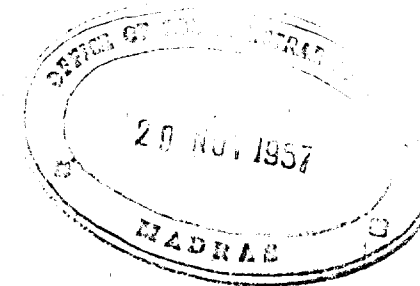
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TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

NOVEMBER 1957—No. 127

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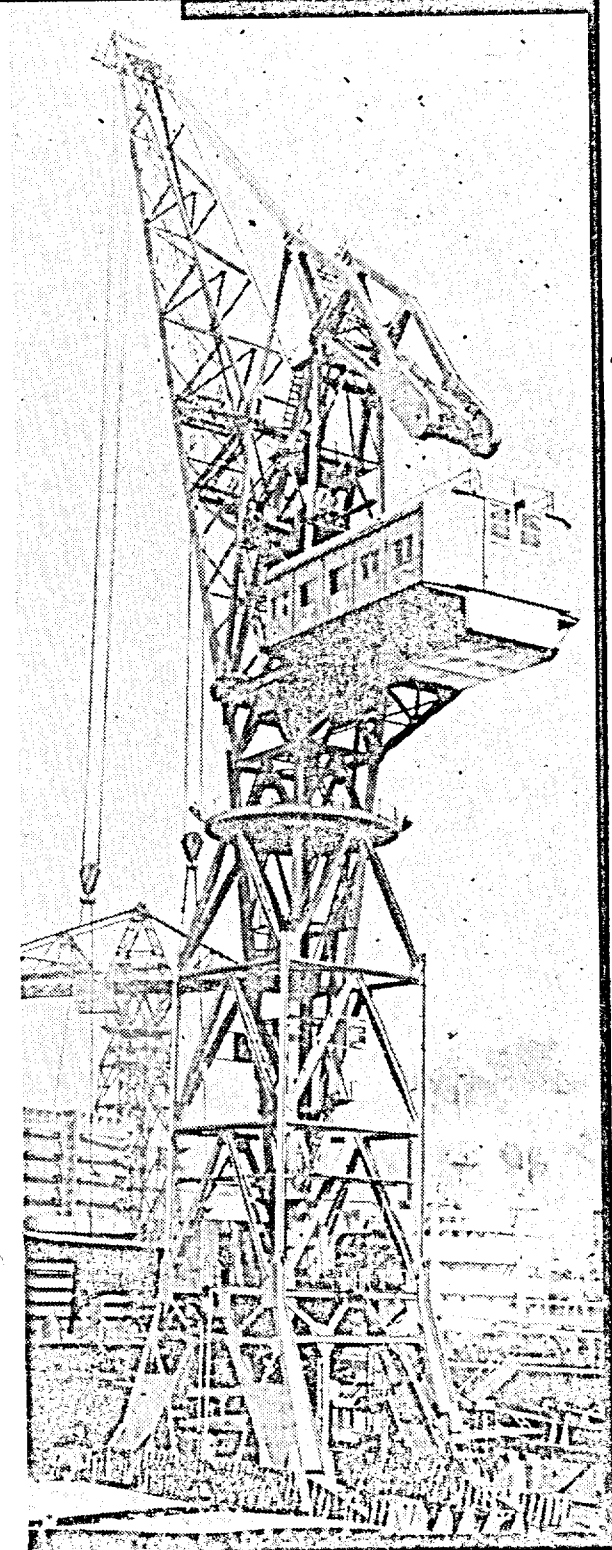
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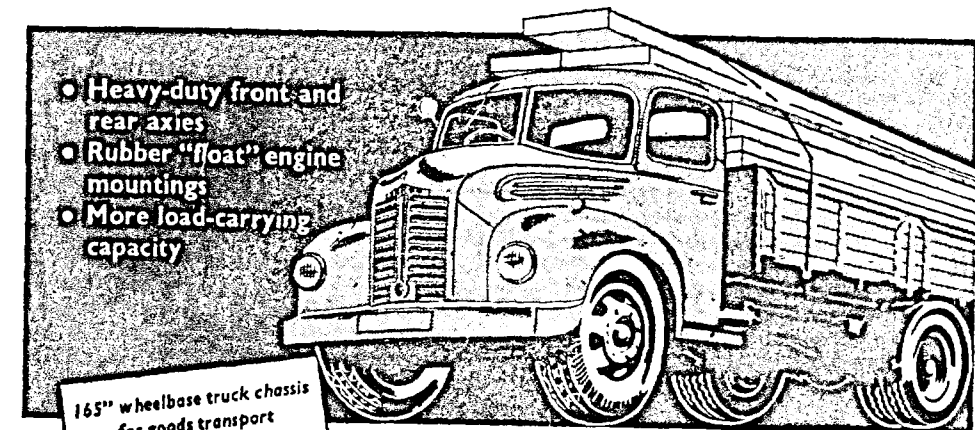
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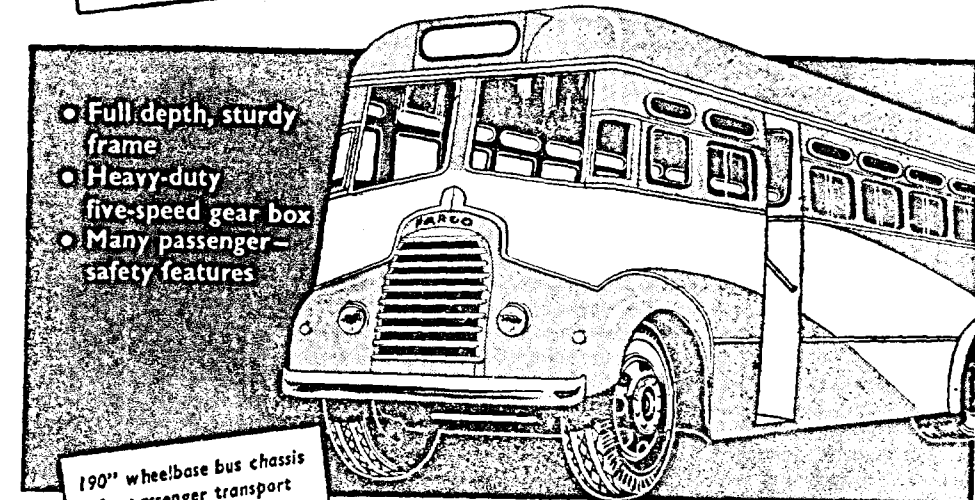
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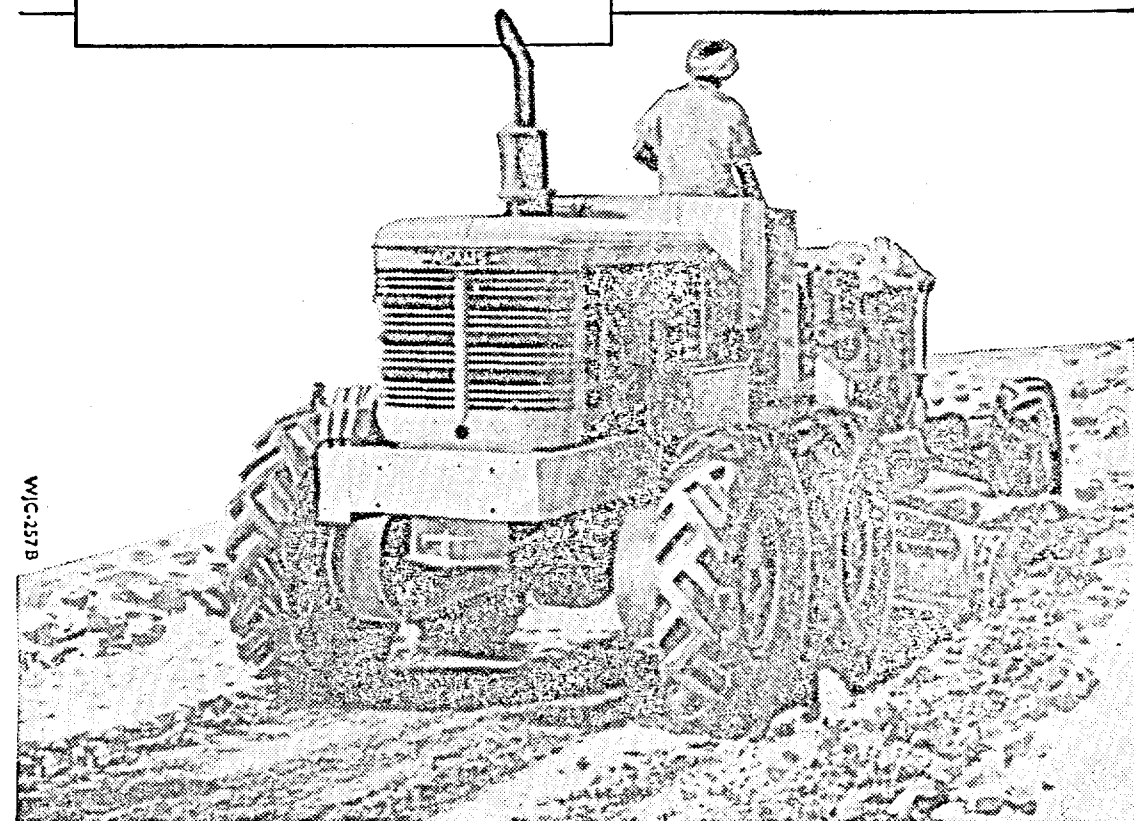
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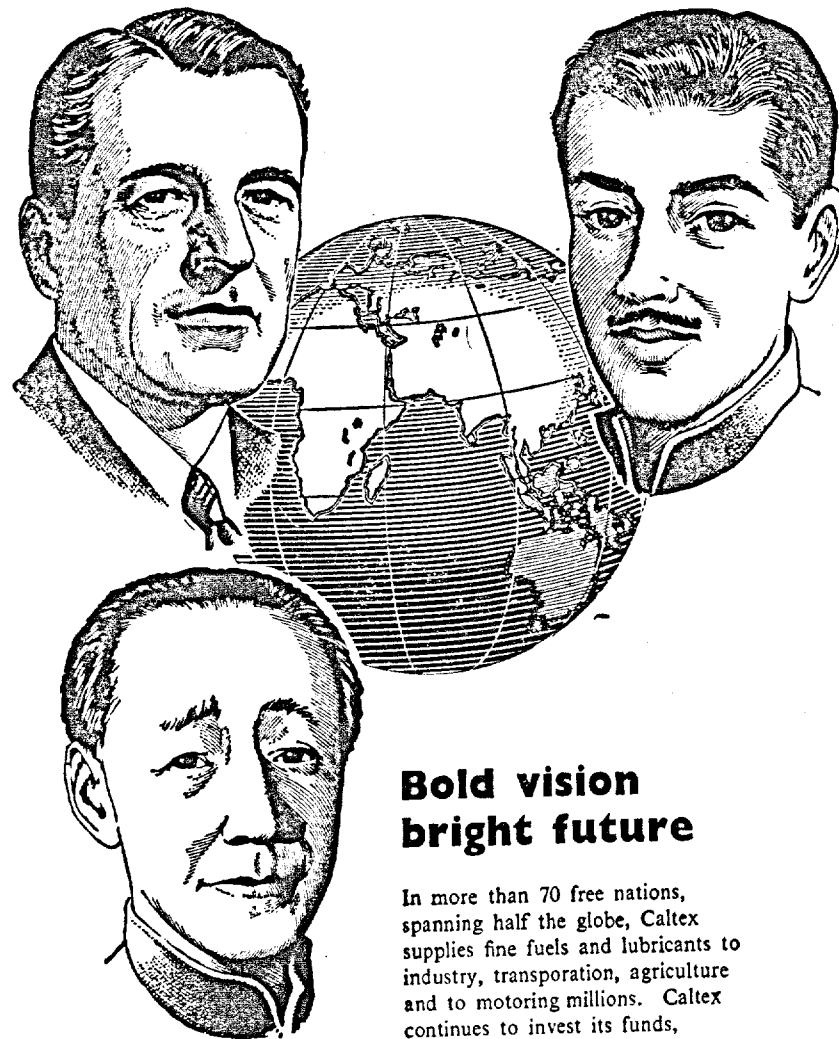
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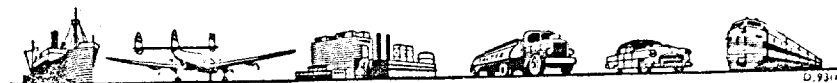
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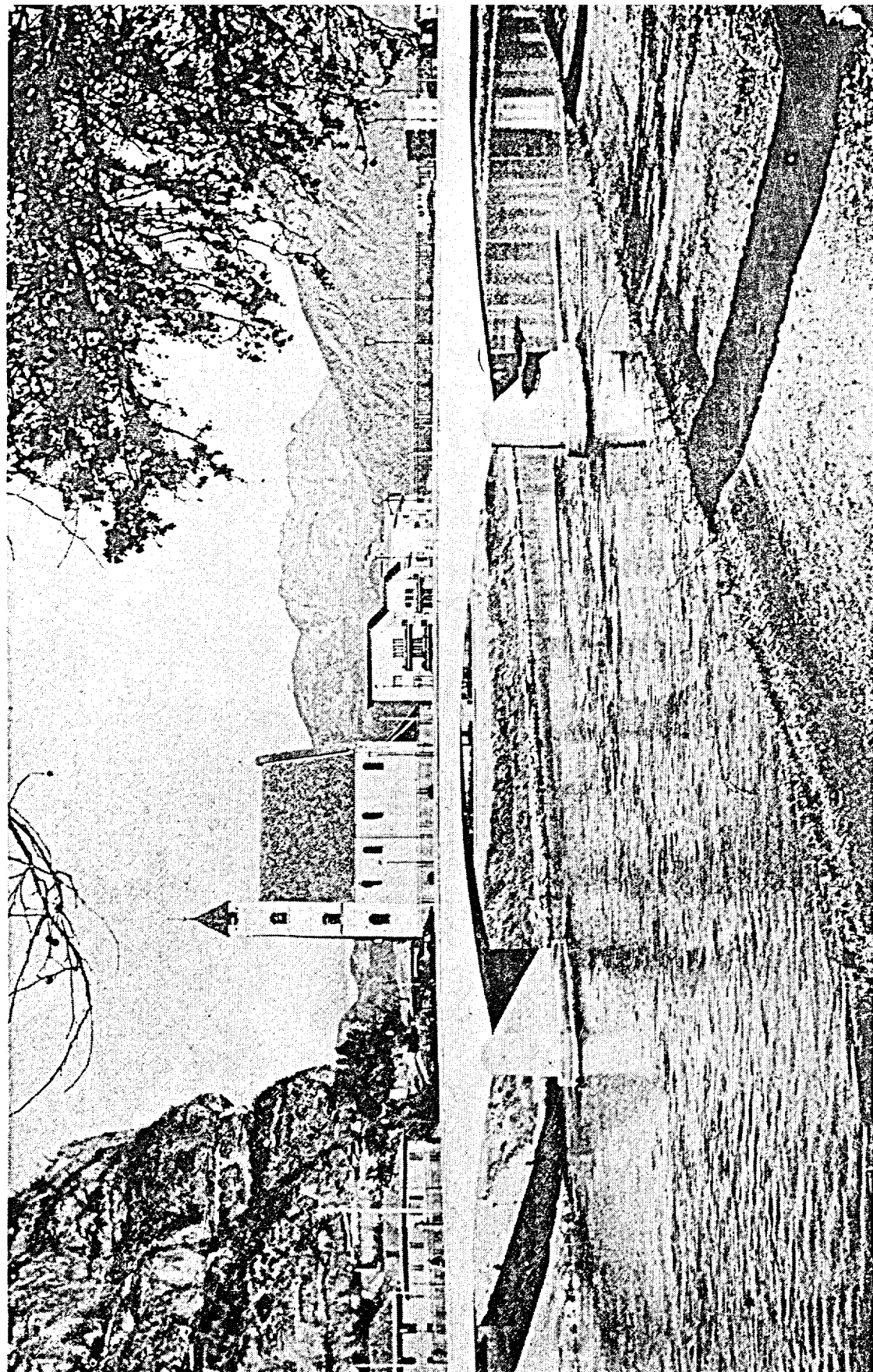
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NEW BRIDGE OVER THE ADIGE AT TRENTO, ITALY.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

NOVEMBER 1957

HILL ROADS

THERE is a vast area along the foothills of the Himalayas extending from Kashmir to Assam which is backward in road communications. The need to develop road communications in these areas has not only been recognised but actual construction work is in progress in several States bordering on the hilly region. This is a step in the right direction as cheap transport is a prerequisite for economic development of every area and in the quick development of the country it is desirable to ensure that no part lags behind in communication facilities.

The reasons for the lagging behind of the hilly areas in the matter of road development are not far to seek. Road construction in the hills is both difficult and costly. Agriculture and industry are generally scarce in the hills at present, although roads provide a powerful incentive for agricultural and industrial development. Population is dispersed widely in scattered villages not uncommonly separated from each other by difficult physical barriers. In the past, political divisions into small units also hampered development of road communications on a broader basis. With spread of education and change in political and social outlook of the people roads have now come increasingly to be looked upon as the principal means of economic and cultural development of the hilly areas to bring them at par with the rest of the country.

The saying that to conquer nature one must obey her could never be more true than in the case of hill road construction. Topography of the country governs the profile of roads in a hilly region. Whereas roads going along the rivers have their alignments more or less determined by the course of the rivers, those going across the river valleys present serious problems of steep rises and falls. In between the two extremes there are of course cases where road alignments go over a ridge between two valleys or through rolling country winding on the hill slopes of the different ranges of ascending or descending altitudes. A careful study of the physical features of the country will be rewarded by rich dividends and so let the outlook in hill road development be: "to conquer the hills one must obey them."

Hill road planning has to be carried out within the limitations imposed by topography. In this connection the need for the classification of roads according to their importance and functions cannot be overemphasised as this constitutes the basis for planning of a network of roads on a scientific basis and for laying down specifications and priorities in the execution of the construction programme.

The old existing roads in the hills evolved mostly from footpaths or mule tracks connecting two villages, in utter disregard of engineering standards. The gradients were as steep as 1 in 7 or more and they followed a tortuous alignment with sharp hairpin bends at short intervals. They are, therefore, altogether inadequate for present day requirements. Today, roads in the hills are meant to cater for motor transport and adoption of proper engineering standards becomes essential. The problem of road construction and transport operation have to be viewed together over a long-term period. Without this attitude, hill road construction will not prove a practical success as a national undertaking.

The most important features in hill road design are: (i) grades and (ii) curves. Grades are related to tractive power, safe speed, petrol consumption, and wear and tear of vehicles. Steeply graded roads, even though they may be easier and cheaper to construct in the first instance, will prove hazardous and uneconomical in the long run. They impose severe strain on the tractive capacity of vehicles. Studies carried out in other countries have shown that petrol consumption increases by 11 per cent up to 3 per cent grade and by 111 per cent up to 6 per cent grade. In case of tyre wear, the increase is 15 per cent for grades of 3 to 5 per cent and 50 per cent for grades of 5 to 7 per cent. Similar figures for other grades have also been assessed. Taking all factors into consideration, grades steeper than 1 in 20 (5 per cent), except for short distances in unavoidable cases, are not recommended by the Indian Roads Congress. Grades become a permanent feature of a hill road alignment and any shortcomings in respect of them become impossible of rectification later on without abandoning the road altogether.

As regards curves, hairpin bends are an undesirable feature of a hill road alignment and should be avoided wherever possible. The other curves should also be possible of easy manoeuvrability. Reverse curves should be smooth and easily negotiable. The Indian Roads Congress recommends a Ruling Radius of 150 ft and an Absolute Radius of 100 ft for hilly country for a road of first rate importance. It may, however, be possible to do with a lesser radius in the beginning as gradual improvement in the case of curves is not ruled out at a later stage. It is admitted that a hill road evolves gradually and, although to start with the natural face of the hill has to be hugged, many improvements can be effected later on with a view to straighten or otherwise improve the road alignment as much as possible and provide adequate visibility wherever necessary.

Survey of hill roads is a difficult problem on account of the rugged nature of the terrain, limitations imposed by climatic conditions and altitudes, etc. Shortage of competent technical personnel, particularly in pioneering works, is not uncommon. These difficulties have, however, to be gradually overcome and proper engineering surveys of the road alignment made. Proper surveys of bridge crossings have also to be carried out in order to determine the correct type of bridge design to be adopted. Hill roads at higher altitudes have also some special problems which require careful thought and planning.

As regards methods of construction, from experience gained so far, stage construction seems to be best suited for hill road construction. This method consists of cutting and improving the road in stages, viz., (i) cutting a 4 to 6 ft trail for alignment and survey purposes and use by pack animals, (ii) widening to 9 to 10 ft jeepable road, (iii) widening to 12 to 18 ft motorable road, and so on. Adoption of proper grades suitable for eventual construction is, however, a prerequisite to be considered at the very first stage. This method of construction enables a check to be exercised on the road alignment and improvements to be carried out from stage to stage to rectify and preserve the road before the final stage is reached. It also conforms to the accepted idea that development of a road should proceed in unison with the actual use made of it.

And, finally, a word about the association of people's effort with hill road construction. Experience shows that the enthusiasm of the hillman can be best harnessed in the initial stages. The villager is keenly interested in the construction of the road only up to the time the first jeep or lorry passes over it. Once this is done, he thinks the task is accomplished and he is not inclined to put in the same serious effort as in the beginning. Further, unlike the initial stages, the road work at later stages becomes of a more specialised nature as proper formation widths, grades, curves, retaining walls, cross drainage works, etc., have to be provided. At this stage, suitable technical methods of execution and maintenance may have to be devised to ensure utilisation of funds to the best and most economical advantage.

Development of roads in hilly areas deserves encouragement and generous financial provision. The length of road required to join two places is longer in a hilly area than that in plains. Similarly, the average cost of construction is more, and roads form the only means of communication in such areas. The question of allocation of a proportionately bigger share of road development funds for hilly areas as compared to the plains, therefore, calls for consideration.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

SPANDREL: The space extending from the top of a masonry arch to the top of the carriageway.

SPANDREL WALL: A wall built upon the extrados of an arch up to the top level of the carriageway.

THE TRANSPORT SITUATION IN ASIA

By
M. S. AHMAD

Chief, Division of Transport, U. N. Economic Commission for Asia
And the Far East, Bangkok

A general idea of the current development of inland transportation facilities in Asia can be had from the following table which compares the lengths of railway, highway networks and motor vehicles in relation to population :

Country	Population per Km of railways	Population per Km of highways	Motor vehicles per thousand inhabitants	Number of motor vehicles per Km of road
Afghanistan	...	3,600	...	...
Burma	5,613	451	1.3	1.8
Ceylon	5,283	706	8.6	7.5
China: Taiwan	9,767	631	1.4	0.66
Mainland	21,327	2,766	...	...
France	485	57	109.0	10.0
India	6,610	930	0.8	1.0
Indonesia	16,147	19,212	1.8	3.0
Japan	4,433	630	9.1	5.6
Malaya	...	679	17.2	1.2
Pakistan	6,700	8,231	0.8	1.9
Philippines	21,730	820	5.3	4.5
Thailand	5,385	3,180	2.3	6.1
U. S. A.	236	31	351.0	8.0
U. K.	598	169	106.0	4.0

The figures, as may be noted, reveal a rather meagre development in respect of railways, highways and number of motor vehicles in relation to population, as compared with some of the more advanced countries of Europe and North America.

All countries of the region have highways and with the exception of Afghanistan and Laos, all countries of the region have railways; and some of them have natural inland waterways suitable for navigation. Aside from Japan, China,

Taiwan, India and Pakistan, the countries are not well developed either in respect to length of railways and highways or techniques. In many countries primitive animal-drawn carts and country boats still play a major role in the transportation systems.

The reasons are not far to seek. Lack of funds and personnel, supply difficulties in regard to materials and equipment, have retarded rehabilitation and extension in many countries, while, in some, unsettled conditions have prevented full utilization of available facilities and held up rehabilitation and development. Although modernization programmes are being undertaken in many countries, lack of trained personnel, inadequate financial resources and supply difficulties will have to be solved, before a more rapid rate of development can be achieved.

Another notable feature of the transport situation in Asia is the phenomenal increase, in the post-war years, in the demand for transportation. There are two important reasons for this, namely, (1) the serious damage and deterioration of transport equipment during the war period, and the slow rate of rehabilitation and extension despite vigorous efforts and (2) the demands created by the economic development plans that are being implemented in most countries of the region. Besides this, additional demands for transportation due to the natural growth of population have also imposed an extra burden.

It is therefore against this background of under-developed facilities and rapidly increasing demands that the transport situation of Asia will have to be considered. To sum up, the main problems facing the countries of Asia in regard to transportation development are:—

- (i) Coordinated development of cheap transportation facilities adequately to meet current and future demands ;
- (ii) Provision of adequate funds to finance development projects ;
- (iii) Introduction of modern techniques with modifications to suit local conditions, for efficient utilisation of equipment ;

- (iv) Adequate training programmes for ensuring sufficient number of skilled technical personnel to man key positions.

Turning now to the efforts governments are making for augmenting and improving transportation facilities, it is seen that in practically all the countries of the region, plans for development of transportation facilities have been adopted or are under consideration. On an average, about one-fourth of the planned public expenditure has been allocated to the development of transport and communications in the countries of Asia with the exception of Hong Kong, Laos, Malaya and British Borneo and Thailand. A major share of the planned investment is assigned to railways and roads. Despite this large-scale investment in the development of transportation facilities, taking the region as a whole, transport needs arising from increased production and from the implementation of development plans have not been fully met.

The development plans of various countries, besides making provision for funds, have also taken into consideration the need for introducing modern techniques and every effort is being made to establish adequate training programme to turn out sufficient number of trained personnel.

Rail Transport

With the exception of Afghanistan and Laos, railways form the principal means of inland transportation and move the largest volume of traffic.

Most of the early railway development, aside from that of Japan, has been financed from foreign capital. As railway construction was largely undertaken by the colonial powers in a large part of the region, networks were provided to aid in the shipment of primary export products such as minerals, plantation crops, etc.

Another feature of railway networks is the variety of gauges in Ceylon, India and Pakistan, in addition to the meter gauge or narrow gauge lines. The standard gauge is of 5 ft 6 in., while other gauges, particularly 3 ft 6 in. or one meter, are also in use.

International rail connections exist between India and Pakistan, Thailand and Malaya, Thailand and Cambodia, Mainland China and Northern Viet-Nam.

The railway development planning in most countries of the region lays emphasis on rehabilitation of existing facilities and their extension. A principal objective of railway development in some countries like Mainland China which, under the first 5-year plan, was reported to have completed by the end of 1956, 4,104 km of new railways, has been to open up the more remote and sparsely populated parts of the country for developing and facilitating access to neighbouring countries. New lines built in India during the first 5-year plan amounted to 610 km and an additional 730 km were being constructed. However, in the second 5-year plan, owing to the limitation of available funds, new construction is mainly confined to those required for operational purposes or to serve new industrial projects. Rehabilitation work has also proceeded apace in many other countries. In Burma, re-laying of 157 km of track was completed last year and five new industrial lines were laid in Southern Korea. In Indonesia, the State Railways which have their own draft 5-year plan, were investing over 50 billion Rupias for rehabilitation purposes including improvement of 2,000 km of railway track and the purchase of diesel locomotives. The railway development programme of Pakistan is mainly one of rehabilitation while in the Philippines a major extension of the main line to the Cagayan Valley is on the point of being implemented.

There was a general improvement, though perhaps inadequate, in utilization of existing capacities, and important additions to locomotives and rolling stock took place in Ceylon, Mainland China, Hong Kong, India, Japan, Southern Korea, Malaya and Southern Viet-Nam.

Many governments have been for some time orientating railway freight policies to promote economic objectives. Special freight rebates have been offered to encourage long distance movements of food grains from surplus to deficit areas and a more recent development in India has been the use of differential railway

freight rates to promote development. In 1956, a freight pool was established in India for steel and pig iron to reduce regional inequalities in development. In Pakistan, special reduced rates have been introduced with a view to facilitating the movement of basic commodities and to ensure adequate returns to the railway.

Highway Transportation

Highway development has continued to make good progress in a number of countries and in a number of cases foreign aid has played an important role. In Thailand, in the first 4-year programme (1952-55) 1.4 billion Baht were set aside for construction and rehabilitation of 2,000 km of highways; of this sum about 800 million Baht have already been utilized. Recently, the highway development programme was revised involving an additional expenditure of about 3 billion Baht for improvement and construction works, totalling 3,700 km to bring the country's total of all-weather roads to about 11,000 km. Foreign aid, both technical and financial, is playing an important part in this project. Highway development projects have also made considerable progress in some of the landlocked countries. For example, Nepal under the 5-year plan proposes the construction of 1,445 km of roads. Both Afghanistan and Laos, which depend upon highways as a major means of transportation, are devoting considerable sums of money and are expected to improve their communication systems in the near future.

Among other notable national highway development projects in recent years has been the construction of Prome-Taungup highway across Arakan Yomas in Burma, and the investment of 3 million Pesos in the construction of 4,500 km of federal roads in 1956 and 1957 in the Philippines. In China: Taiwan, a beginning has been made recently in the building of the East-West highway across the island with United States' aid, and in the second 5-year plan of the Government of India it is proposed to construct about 19,000 miles of new national highway and surfaced roads. Similarly, under the 5-year plan of the Government of Pakistan, 2,800 km of new construction is envisaged and improvements are expected to be

effected to nearly 3,200 km of roads. Although international highway links are rather few, in Asia there is a growing awareness on the part of the governments of the need for connecting the countries of the region by land communications. It is understood that recently Mainland China has negotiated with the Government of Burma for re-opening the Burma Road which was in use during the second world war. The possibility of road construction between East Pakistan and Burma is also included in the 5-year plan of the Government of Pakistan. The Governments of Thailand and Burma are also, it is understood, actively examining the possibility of constructing a southern road connecting the two countries.

Inland Waterways

Unlike railways and highways, inland waterways are confined to certain areas in the region where they are naturally endowed. Inland navigation by river or other natural means is important only in the Yangtse River Valley in Mainland China, North-eastern India, East Pakistan, Burma, Thailand, Cambodia, Laos, Viet-Nam and Indonesia. In recent years, governments have become increasingly aware of the importance of inland waterway transportation and the vital role it can play. A notable increase in the volume of inland waterway traffic has taken place in some countries. However, government services dealing with inland waterway transport and river and canal conservancy have on the whole remained comparatively inadequate with insufficient budgets and limited trained staff. High fuel prices, delays in obtaining import licences for essential spare parts and

complicated frontier formalities have tended adversely to affect the development of inland waterway transportation. Consequently, it has not always been possible to take full advantage of the technical improvements which have been effected at considerable expense.

The main objectives of improvement and development in inland waterway transportation have been the introduction of modern technological method for efficient working and the augmentation of fleets to increase carrying capacities. Among the more important technical improvements in recent years has been the introduction of push-towing on the inland waterways of Burma and the allocation of Rs 3 million for capital expenditure on a pilot project in India for the use of shallow draught craft and ferries, inland ports and canal conservancy. In Pakistan, under the 5-year plan, 83 million Rupees have been set aside for development of navigation and active planning is being pursued in Southern Viet-Nam for the construction of a large number of modern steel barges and substantial progress has been recorded in dredging operation.

A convention on the Measurement and Registration of Vessels employed in Inland Navigation was signed in Bangkok in June 1956 by Cambodia, China, Taiwan, Indonesia, Laos, Thailand and Southern Viet-Nam, which is expected to facilitate international waterway traffic and to shorten the turn-round time for vessels thereby increasing the carrying capacities and would also form a basis for compiling comparable inland waterway transport statistics needed for development planning.

MODERN ART

"I suppose this horrible thing is what you call modern art," said a woman in an art shop to a dealer.

"No, madam," he replied. "You're looking in the mirror"

FOURTH INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING

Professor Terzaghi Outlines the Secrets of Engineering Success

THE Fourth Conference of the International Society of Soil Mechanics and Foundation Engineering was opened in London last week by Sir Arthur Whitaker, K.C.B., M. Eng., President of the Institution of Civil Engineers.

Sir Arthur welcomed the twelve hundred delegates from 41 countries and said that he understood from Dr. Glanville, the Chairman of the Organizing Committee that a very full programme including the discussion of 176 papers had been arranged. Sir Arthur then introduced Professor Karl Terzaghi, President of the Executive Committee and Conference and declared the conference open.

Professor Terzaghi in his address gave a most interesting summary of the history of soil mechanics based on his own experience and summed up by saying that whilst an expert on soil mechanics must have a fundamental scientific background, soil mechanics was an art in the widest sense of the word and that the expert must live with soils and not base his conclusions solely on boreholes and test results.

During the decade which followed the First International Conference, said Professor Terzaghi in the course of his remarks, strenuous efforts were made to solve the problems in earthwork engineering by mathematical methods similar to those which are used in structural engineering, and particularly in bridge design.

However, nature has placed very narrow limits to the kind of problems which can be solved in this manner. The solution of many of the problems in our field by mathematical means is impracticable on account of the inevitable gaps in our knowledge of the vital physical characteristics of the materials underlying our sites of construction.

The determination or the estimation of the factor of safety on slopes on natural soil is a very convincing example. If the soil located beneath a slope is homogeneous, the problem of computing the factor of safety can be mathematically performed; but in my life time I have met only two or three instances in which a slope was located on a homogeneous material. In most cases the slopes which give us trouble are located on soil deposits with a very intricate pattern of stratification, and as a consequence we cannot compute the factor of safety. Similar conditions are encountered in every other branch of earthwork engineering, and that fact led us gradually but inevitably to the boundary between science and art.

The methods of subsoil exploration which have been developed during the last decades have eliminated the most harmful and detrimental uncertainties involved in the design of foundations on the basis of precedent. Therefore, we are justified in predicting that the percentage of failures in the line of foundation design will dwindle, in spite of the fact that the knowledge of the subsoil conditions is very seldom complete.

Thinking with Your Hips

This conclusion leads us to the last, but very important, topic of this address--the question of how we can pass on our recently acquired knowledge and insight to the next generation of engineers. The answer to that question depends on the prerequisites for successfully practising an art. To practise an art successfully, one must acquire, to use a term coined by Theodore Roosevelt, the capacity of thinking with your hips and not with your head. In other words, you must acquire the capacity to arrive at a correct conclusion without the intermediate step of logical reasoning.

That process is illustrated by the following trivial example. When I was a youngster still engaged in a great variety of engineering activities, I had to design and supervise the construction of an intricate reinforced concrete edifice in St. Petersburg, in Russia. There were an extraordinary number of members with different dimensions and different loads in that structure; and the computations of the reinforcement and the dimensions were made by a whole crowd of ambitious but rather unreliable college graduates. The time which was set for completing the building was so short that it was out of the question that I should check on every one of the computations which came out of the designer's office. Therefore I adopted the following procedure. I always waited until the forms were placed and the steel was installed, and then I walked over that maze of timber and steel, looked at different members, and made a guess as to which ones were too weak or which ones were over-dimensioned, and invariably, or almost invariably, the guess was correct. I checked those members in the office, corrected the dimensions, and then I changed the layout in the field and all that was done merely on visual inspection.

There was no logical reasoning involved for the simple reason that I had already acquired in the field of reinforced concrete the capacity of thinking with the hips without the intermediate activity of the head. However, in order to arrive at that state and to get that instinct for what is right and what is wrong, it is necessary to practise that particular branch of our engineering sciences continuously. In order to accelerate that process, I never used any ready-made formulas; I always, whenever I needed a formula, derived it, and derived it over and over again until the whole thing became part of my system and became an unconscious activity. There are no shortcuts in the field of engineering.

Later on, when I concentrated on earthwork engineering, I underwent a similar development. In the early stage I used extensively theoretical procedures, some of which including the theory of consolidation, I had to invent myself; but during the last decades I solved almost

all my practical problems without any elaborate computations. However, in the realm of earthwork engineering, the materials subject to investigation are far more complex than reinforced concrete. Hence, in order to acquire competence in that field, one must live with the soil and observe its performance in the field in order to become gradually acquainted with the manifold aspects of the subsoil which are not disclosed by boring and by testing.

Forecast and Results

Last, but not least, one should never miss any opportunity to find out by direct observation the difference between the forecast and the results of our computations or guesses.

The student works with his head, and goes as far in that stage as logical reasoning can take him. After he embarks on his professional career, the useful portion of what he has learned becomes part of his sub-conscious, it becomes automatic, whereas the rest is forgotten. And only after he has passed through that long stage of assimilating and supplementing his knowledge by the results of direct observation can he dare, with a prospect of success, to tackle those difficult problems in earthwork engineering which cannot be solved by computation and other analytical methods.

Therefore, the secret of professional education is this: first persistent emphasis on every bit of what is worthy, in our realm of knowledge of being absorbed and digested and, secondly, equally persistent emphasis on the inevitable certainties which are associated with the use of analytical methods in connection with our problems in earthwork engineering.

Examining the array of knowledge which has filtered into my system and become an essential part of it, I find that on every pound of theory of structures and of soil mechanics comes one ounce of geology, but that one ounce of geology is just as important and essential as the yeast in the process of fermentation. But, at the same time, this one ounce which is so important for us represents only a minute fraction of the vast

amount of knowledge which has been accumulated in the files of the sciences of the earth.

Technician or Engineer

After a student has absorbed the theory of structure, has absorbed soil mechanics and studied geology, and after he has passed his final examination, then his real development starts, and the outcome of that development depends not only on the quality of the teacher but to a large extent on innate qualifications and environment. Many among those students who have passed their final examinations with flying colours never rise above the level of technicians, because they never learn the art of walking without the crutches of step for step logical reasoning. That condition cannot be eliminated by any system of education, because you

cannot possibly by any means make out of a man who was born to be an accountant a competent engineer. Those are two things which are incompatible. However, the same individual can be turned into a first-class technician, depending on the quality of the training which he has received, and this is important, because we need first-class technicians.

Those few among the students who are born under a luckier star gradually rise from the ranks of the technicians to that of competent engineers because they are, as a result of inborn qualities, capable of learning and thinking both with their heads and with their hips. The capacity for reaching that state has nothing to do with training.

(From "Highways and Bridges and Engineering Works," August 21, 1957.)

"I would say that the real problem today is not that of linking up a separate field of study called classical culture with modern culture, including scientific thought, but that of introducing the historical approach into all studies. In this way the role of the classics in the development of human thought and feeling becomes clear, but in addition science is seen not merely as a static collection of facts and principles, but as a developing adventure of thought. In other words, both the Humanities and the Sciences could come to be regarded as part of a comprehensive humanism. The history of man is the progressive realization of new possibilities, and this applies both to literature and the arts and to science."

—Julian Huxley

Wife: "What do you mean by coming home half drunk?"

Husband: "It's not my fault—I ran out of money."

CLIFTON BRIDGE AT NOTTINGHAM

Two Systems of Prestressing on New Bridge

CLIFTON Bridge will alleviate traffic congestion, and will also provide direct access from the city to a new housing estate at the village of Clifton. The bridge will eventually form part of a dual-carriageway trunk road planned for the area; the present construction, however, was authorised by the City Council to fill immediate needs regardless of the road programme.

Designed with an overall width of 46 ft 3 in., the bridge will comprise a 22 ft carriageway, a 9 ft cycle track, and a 6 ft footpath. When the trunk road programme is undertaken a duplicate bridge will be built immediately adjacent to provide a continuous dual-carriageway link with the trunk roads. The angle of skew to the river is 24 degrees, and the location is approximately 1½ miles upstream from Trent Bridge. Approach roads are carried on earth embankments at a maximum height of 30 ft.

The main bridge consists of a single 275 ft span over the normal bed of the river—the longest prestressed concrete span in the country—with a 125 ft span on either side. Viaducts were found to be necessary for flood relief on both banks of the river. On the city side (to the north) the embankment is broken at about 1,000 ft from the river by three 40 ft span viaducts. On the Clifton (south) side three 90 ft span viaducts will carry the road over the low-lying land and over the existing Clifton lane to connect with the approach road and embankment. The total continuous length of bridge, excluding the northern viaducts, will be almost 800 ft; design was according to Ministry of Transport standards for abnormal loading. The Magnel-Blaton system of prestressing is being used for both the main bridge and the southern viaducts; the northern viaducts are being prestressed by the Lee-McCall system.

The design of the main bridge is that of two balanced cantilevers, consisting of an

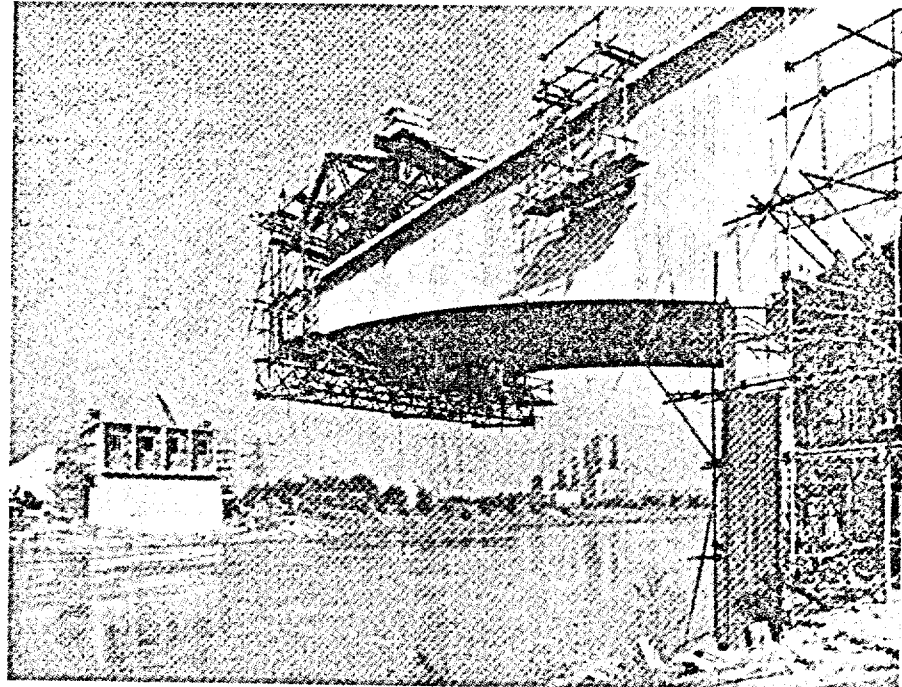
87 ft 6 in. long cantilever and a 125 ft "tailing down" or end span, with a suspended central span 100 ft long connecting the two cantilevers. In situ construction is used for the end spans and cantilevers; the central span will be built of precast beams.

The bridge is supported at the north end by a cellular retaining-wall type abutment with wing walls of counterfort construction surrounding the end of the embankment. At the south end a cellular abutment provides a junction support for the end span and for the first span of the viaduct. A flexible prestressed concrete column housed within the cellular portion of each abutment supports the end of the end span. Two solid piers, also of reinforced concrete, support the balanced cantilevers at the river banks 125 ft from the abutment. The piers are based on concrete piles and were constructed within a steel piling cofferdam. A prestressed concrete capping beam surmounts the piers; there is a concrete hinge between this beam and the bridge beams.

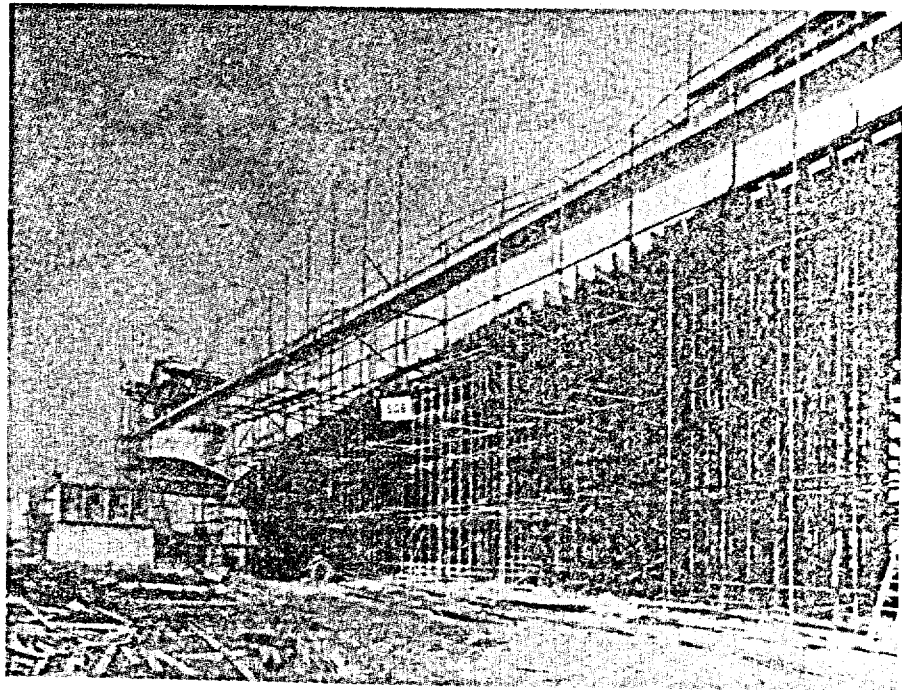
Cellular Cantilevers

The balanced cantilevers are both of cellular construction with 12 in. thick connecting webs and diaphragms. The longitudinal webs are approximately 10 ft apart; the transverse diaphragms are at 25 ft intervals in the end span and at around 21 ft intervals in the cantilevers. The top slab forms the 10 in. thick deck of the bridge; the bottom slab varies in thickness from 14 in. at the pier to 6 in. at the ends of the span. Heavy services pass through the diaphragms and under the precast beams of the centre span; lighter services are accommodated under the precast concrete slabs of the footpath and under the precast verge between cycle path and carriageway.

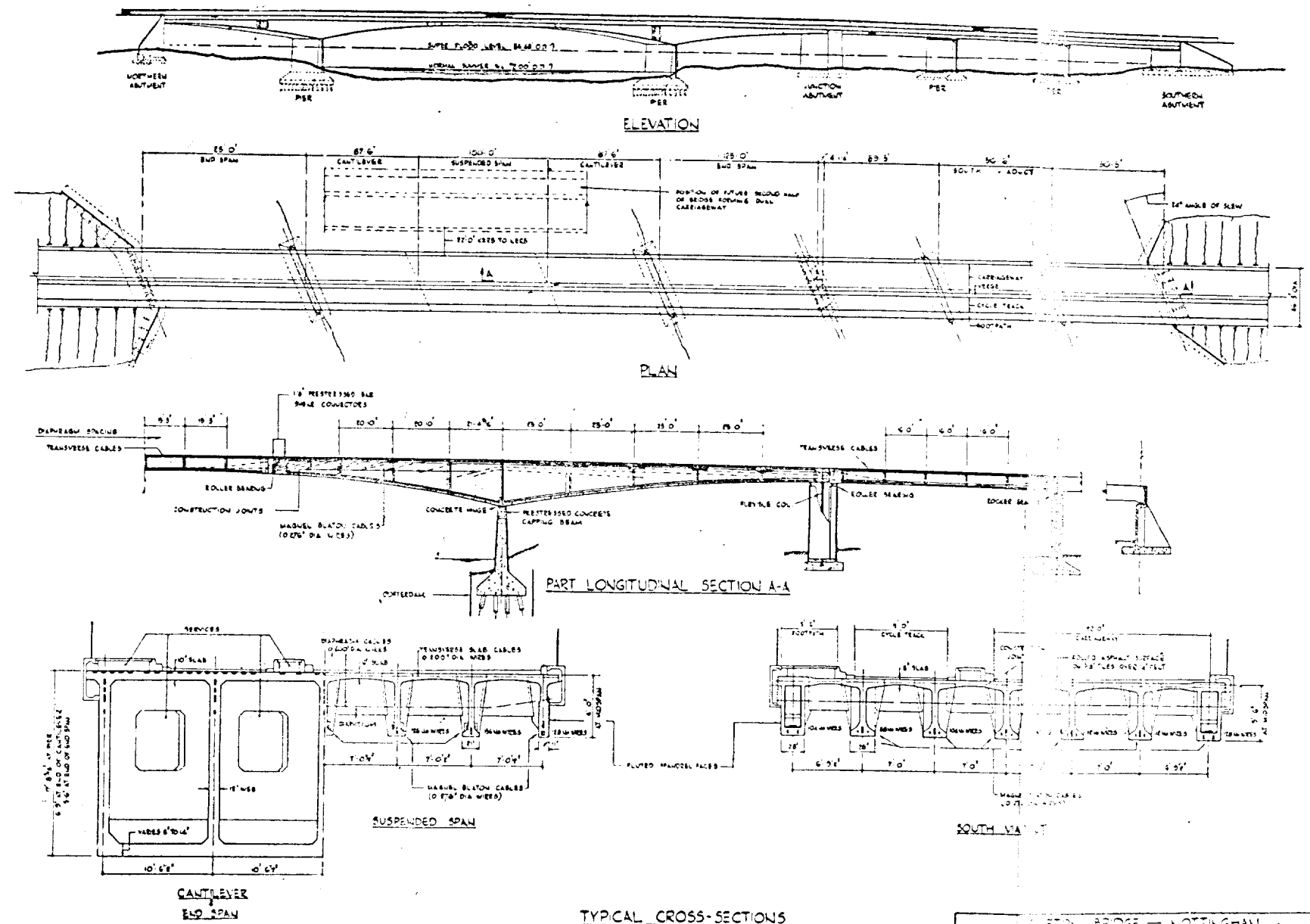
Construction of the end spans is on falsework in the normal manner. After



Taken only a short time ago, this photograph shows the fluted finish of the concrete which, being of a very high quality, is most attractive.



Scaffolding is left in position until centre span has been completed so that the subsequent load will be distributed throughout the entire structure.



THE BRIDGE — NOTTINGHAM ASSEMBLY AND GENERAL ARRANGEMENT DETAILS	
R.M. FORD & SONS CIVIL ENGINEERS AND SURVEYORS NOTTINGHAM	F. TREMBERS MORGAN AND PARTNERS CONSULTING ENGINEERS LONDON

their completion the cantilevers will be constructed by cantilevering out in short 10 ft sections using a moving scaffold suspended from the previously completed section. The prestressing has been so designed that as each section of cantilever is completed a sufficient number of cables will be available for anchoring at that point to provide adequate strength in the completed structure for construction of the next stage. This procedure will continue until the cantilever is complete. Prestressing will be applied through wires in both the deck slab and in the webs of the cells; where necessary the wires of the deck slab are designed to curve into the webs for anchoring.

The 100 ft suspended span consists of seven T-beams, 6 ft 9 in. deep at their ends and 6 ft deep at their mid-point, that will be precast on the site and partially prestressed after casting. The centre beams will have 21 in. wide bottom flanges; the two outer beams will have a bottom flange 11 in. wide with a correspondingly thicker web portion. The beams are to be supported at 7 ft $\frac{1}{2}$ in. centres at the ends of the cantilevers on roller bearings at one end and on rockers at the other; 1 $\frac{1}{8}$ in. diameter prestressed bar shear connectors will be installed in the concrete at these points. After erection the spaces between the top flanges of the beams will be filled with in situ concrete to form a haunched monolithic deck slab having a minimum thickness of 6 in. and, at the same time, in situ diaphragms will be cast between the beams. After this concrete has matured, transverse and further longitudinal prestress will be applied.

The transverse stress will be applied through straight 0.2 in. wire cables in the deck slab and through curved 0.2 in. wire-cables in the diaphragms. The longitudinal stress will be applied to the beams by curved cables, the number of wires being dependant upon the working load of each beam.

The Viaducts

Each of the three 40 ft span north viaducts will consist of 162 ft 6 in. deep precast I-beams post-tensioned before

erection by the Lee-McCall system. With the beams in position precast planks will be laid over the spaces between the top flanges to provide a permanent form-work for the deck slab. Stiffeners between the beams will also be precast; transverse stress will be applied through these stiffeners when the deck concreting has been completed. The reinforced concrete sub-structure consists of two counterfort retaining-wall type abutments and two "hinged" wall type piers.

Each of the three 90 ft span south viaducts will consist of seven beams 5 ft 6 in. deep. The five centre beams will be I-beams, but to maintain a plane spandrel the two outer beams have been designed as box beams. The centre beams will be on 7 ft centres; the outer beams on 6 ft 9 $\frac{1}{2}$ in. centres. Prestressing, by the Magnel-Blaton system, is through 0.276 in. diameter wires.

The centre span of the south viaduct has been constructed by placing the concrete for the beams and deck in situ. Beams for the other two spans will be precast and prestressed on this completed span before launching into position. The spaces between the top flanges will be filled with in situ concrete to form a monolithic deck slab; stiffeners will also be cast in situ. Transverse prestress will be applied to the deck and stiffeners after the concrete has matured. The beam-stiffener system has been designed as a grillage, the sub-structure consists of solid fixed piers and a counterfort retaining-wall type abutment with wing walls at the earth embankment.

The main bridge and south viaducts will be architecturally integrated in elevation by means of a precast longitudinal fascia and a plane spandrel. The fascia, which will fit over the top flange of the outer beams, has an exposed white aggregate and is cast with "Snow-crete"; its purpose is to provide a pleasing contrast with the vertical fluted finish to be formed on the spandrel faces of the bridge and viaducts. The finish of all other concrete surfaces is plain.

(From "Contractors Record And Municipal Engineering", June 5, 1957.)

THE EFFECT OF FILLERS ON SOME BASIC PROPERTIES OF ASPHALT

By

V. VENKATASUBRAMANIAN*

Introduction

THE binding material in an asphalt pavement should form a strongly adhering skin round the particles of mineral aggregates binding them together. However, at the time of mixing the aggregates and the asphalt, the asphalt should have a very low viscosity so that it can easily flow and thoroughly coat the surface of the aggregates, and once the coated aggregates are spread and rolled, sufficient cohesion has to be developed to prevent displacement or early disintegration. These two properties are to some extent contrary to each other. The flow properties governing the ease with which the heated asphalt will flow into the voids of the aggregates in the case of 'grout' construction, or coat the aggregates thoroughly in the case of pre-mix bituminous concrete construction, are indicated by the ductility, penetration, and viscosity characteristics of the asphalt used in the mix. Also, while a high penetration binder aids greatly in wetting the aggregates, low penetration is an important deterrent to film stripping. The highway engineer has to ensure a proper balance of these two conflicting tendencies so that the resulting mix may be thin and durable. Usually mineral fillers are added to the mix to obtain the balance. These fillers give body to the matrix so that it will not flow readily, and increase its softening point.

Definitions

Generally in relation to bituminous mixtures, the term 'coarse and fine' aggregates refers to the material which is above No. 200 mesh sieve (7.4 microns), and the material passing the No. 200 mesh sieve is referred to as filler. The A.S.T.M. defines filler as an inert mineral

matter which is fine enough to pass a No. 200 mesh sieve. In fact the only test prescribed for the mineral filler by A.S.T.M. or A.A.S.H.O. is the screen analysis test.

Requirements of a good Filler

A filler judged merely by the proportion passing the No. 200 mesh sieve will not be completely adequate since it has been shown that the shape of the particles and also their gradation have a bearing on the efficiency of the fillers. The filler should in general be hydrophobic in nature, chemically inert so as to be incapable of reaction with the bituminous binder, must be physically active and show vigorous surface adhesion to the binding material. The incorporation of finely divided fillers to bituminous mixtures tends to prevent cracks in the pavement, and improves the weather resisting properties by protecting it from the disintegrating action of sunlight. The filler should be also able to mix thoroughly with the bitumen so that the resulting mixture is a homogeneous one.

Common fillers

The common materials used as fillers in the bituminous mixtures are ordinary portland cement, lime-stone dust, slaked lime powder, coal dust, etc. Portland cement is the most general in use. Sometimes it is possible to get better results by the use of a mixture of two fillers than by the use of either component alone in the same quantity.

Mix design factors

Different fillers act differently with any given type of asphalt; as such every asphalt-filler combination must be studied individually to assess its suitability.

lity. The filler also should be used in suitable proportions. The amount of filler in bituminous concrete varies generally from about 5 to 10 per cent, and for sheet asphalt pavements upto 20 per cent by weight. The amount of filler to be used in a given mix is limited by practical considerations, since mixtures which contain excessive amount of fillers are likely to be gummy, and therefore difficult to work with and will require excessive amounts of bituminous material. Also, excessive amounts of filler may lead to cracking in cold weather. The tendency in recent years is to use increasing amounts of filler accompanied by a decrease in the bitumen content.

Though the filler to be incorporated in the mix is to be chemically inert, the effect of the fillers on the physical characteristics of asphalts may be significant. The softening point, hardness, and tensile strength increase while the susceptibility-index and the ductility decrease in proportion to the quantity of filler added. When the percentage of filler is sufficient to destroy the fluidity of the mixture, as in the case of surface course of sheet asphalt pavements, where the filler content may exceed 80 per cent by weight, the physical properties of the mixture depend largely upon the pressure to which the mass has been subjected. The greater the compression, the greater will be the hardness, tensile strength, and density. Macleod has shown that a mineral filler should not be added to densely graded bituminous paving mixtures unless tests indicate that the addition will serve some useful purpose. Some writers believe that the filler acts in combination with the binder and not as an independent constituent of the mineral aggregate. The binder material is believed to combine with the filler forming a filler-bitumen mixture which fills the voids of the aggregates and binds them. Modern trend is to increase the amount of filler by increasing the finer fractions in the sand grading.

Apart from the void filling capacity of the filler, its supplementary functions are not clearly understood. It may be that a sort of chemical effect, not yet clearly understood, is produced by the filler. Hubbard says that the filler besides

carrying asphalt film by adsorption greatly increases the bond of adhesion. Most of the available specifications for fillers speak very little of their requirements except their grain size. A.S.T.M. specifies that a mineral filler should be of the following composition: 65 per cent passing No. 200 mesh sieve (0.074 mm.) 95 per cent passing No. 80 mesh sieve (0.177 mm.) and 100 per cent passing No. 30 mesh sieve (0.590 mm.). This requirement of a filler is rather incomplete since it is well known that the fineness of the filler has a direct influence on its stabilising power.

The specific gravity of the filler should be low. A lower specific gravity will mean a greater volume for a given weight and hence greater effectiveness since one of the essential functions of the filler is to fill in the voids of the aggregates. Also, the shape and size distribution of the particles of the filler material affect its behaviour in the bituminous mixtures, the effectiveness increasing with increasing fineness. An appreciable percentage of the filler material must pass through No. 500 mesh sieve, and some No. 800 mesh sieve.

There appears to be no simple established relationship between penetration, softening point, and ductility of the asphalt; each of these properties must be studied individually along with the stability of the design mix, if proper conclusions are to be arrived at regarding the asphalt-filler mixture. The penetration, ductility, etc., of the original asphalt decrease appreciably on the addition of fillers so that the original characteristics of the asphalt cannot be considered as a guide to the penetration, ductility, etc., of the filler-bitumen mixture though, broadly speaking, an asphalt having a higher penetration or ductility characteristics may yield a filler-bitumen mixture of higher penetration or ductility characteristics.

Experimental studies

To facilitate understanding of the behaviour of filler-bitumen mixtures in the field in a qualitative way, a series of laboratory tests were made on Mexphalte 80/100, using (1) cement, (2) lime-stone dust, and (3) coal dust as fillers. Only the

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fractions passing the No. 200 mesh sieve were used as fillers.

The cement used was normal portland cement. Though a popular filler material in this country, it is viewed with suspicion in Germany on account of its reaction with water. Lime-stone dust was obtained by pulverising lime-stone aggregates supplied by Associated Cement Companies from one of their quarries near Vijayawada. Coal dust was obtained locally. The asphalt used in the tests was supplied by Messrs Burmah Shell & Company. The specifications for the mexphalte 80/100 as given by the manufacturers are as follows:—

Penetration (25 degrees centigrade) 80—100.

Solubility in carbon di-sulphide—over 99 per cent.

Specific gravity—1.01 to 1.05.

Softening point in degrees centigrade—47-54.

Working temperature—350 to 375 degrees Fahrenheit.

Since mexphalte 80—100 is one of the most widely used bituminous binders, it was taken up for investigation. In all the tests the filler concentration was expressed as percentage by weight of bitumen. The penetration and softening point tests were done as per A. S. T. M. standards. The tests, however, were conducted at 30 degrees centigrade as the standard temperatures could not be maintained. The results are graphically represented in Figs. 1 and 2. It is interesting to note that the effect of cement and lime-stone dust are similar while the coal dust as a filler produces a more rapid change in the penetration and softening point values. It may be that by the addition of coal dust, the asphaltene content of the bitumen itself is increased by increasing the micelle content and reducing the resin content. In other words, the character of the bitumen with coal-dust as filler may tend towards that of blown bitumen with its high asphaltene content and a high softening point.

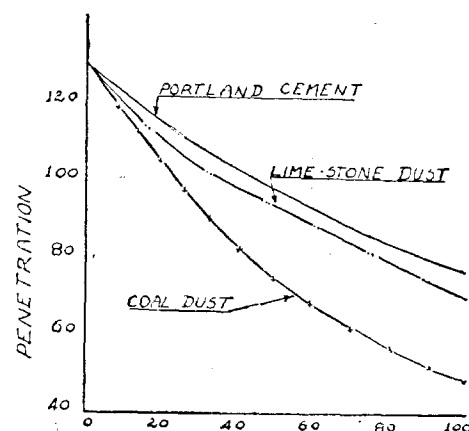


Fig. 1.

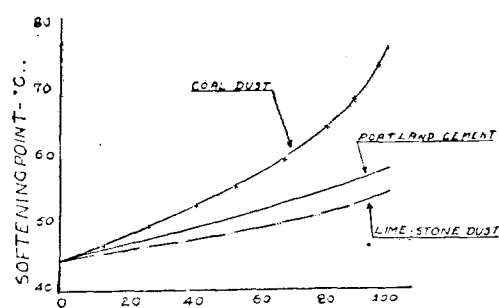


Fig. 2.

It is hoped to present the effect of fillers on ductility and adhesion of the bitumen and the stability and weathering properties of the bituminous mixtures in a subsequent article.

References

1. Asphalts and allied substances, Herbert Abraham; D. Van Nostrand Company Inc., New York.
2. American Highway Practice, L. I. Hewes; John Wiley & Sons, New York.
3. Proceedings of the Highway Research Board, U.S.A., 1956.
4. American Society for Testing Materials Standards—1952 and 1954.
5. Effect of fillers on bitumen and bituminous mixtures, K. R. Srinivasan, M.Tech. Thesis (unpublished), September 1956.

RIDING QUALITY OF ROADS AND RUNWAYS

by

J. M. FISHER, M.I.C.E.

THE term 'riding quality' is, in its general sense, one which is applied to the surfaces of roads, runways and other paved areas on which wheeled vehicles travel as a measure of the interaction which takes place between the road surface and the occupants of the vehicle. The extent to which one appreciates irregularities on a road surface is clearly a function, not only of their number and size, but of the springing characteristics of the vehicle in which one is travelling. All road users, and particularly those who are familiar with the 'dirt' roads in under-developed parts of the world are aware that certain classes of vehicle with 'soft' springing give a more comfortable ride over rough roads than do others.

It is the purpose of this article to consider riding quality, not as the personal assessment of the standard of comfort experienced when riding over a surface, but as the measurement of the irregularities on the surface. As the road programme proceeds it will focus attention on the question of riding quality of roads in the same way as the development of aircraft having high landing speeds and high tyre pressures is leading to the need for ever-increasing emphasis on the riding quality of runways. The two cases, although closely akin to one another, differ in the important respect that the wheel base of a road vehicle is generally very much less than that of an aircraft and irregularities which might affect the one have no very serious reaction on the other.

Assessing Surface Irregularity

A great deal of thought has been given to the means by which the surface irregularity of a road or runway can be measured and what is perhaps more important to contractors, clearly defined in a speci-

fication for the work. To this end various devices such as the multi-wheel profilometer and the bump integrator have been developed as the result of the Road Research Laboratory's work to establish suitable methods of measuring riding surface quality and both are frequently used in this country. The bump integrator, in view of its comparative simplicity, is coming to be widely accepted as a standard device for measuring surface irregularity.

The multi-wheel profilometer consists of a freely mounted recording wheel located at the centre of a 16-wheel articulated system covering an area of 22 ft by 4 ft. Vertical movements of the recording wheel in relation to the mean level of the area covered are recorded on a chart which forms a continuous profile of the road surface. In addition, the vertical movements of the wheel are classified according to their magnitude. In operation, the profilometer is towed at a slow walking pace over the length of the surface to be tested.

The irregularity index 'q' of the surface tested is the sum of the irregularities per mile in each of the amplitude ranges multiplied by the average irregularity within that range and is always quoted as inches per mile, whether the length tested is one mile or any other length.

The use of this machine allows a detailed analysis to be made of the positions and magnitudes of all irregularities and, therefore, provides an invaluable record for the engineer particularly when details of the construction techniques employed are known.

The Road Research Laboratory's bump integrator gives an overall assessment of the bumpiness of the length of pavement

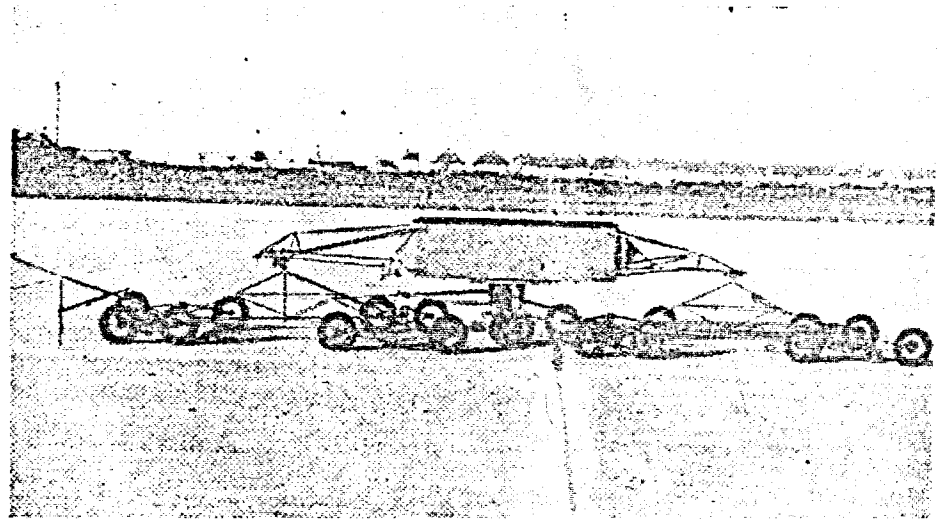
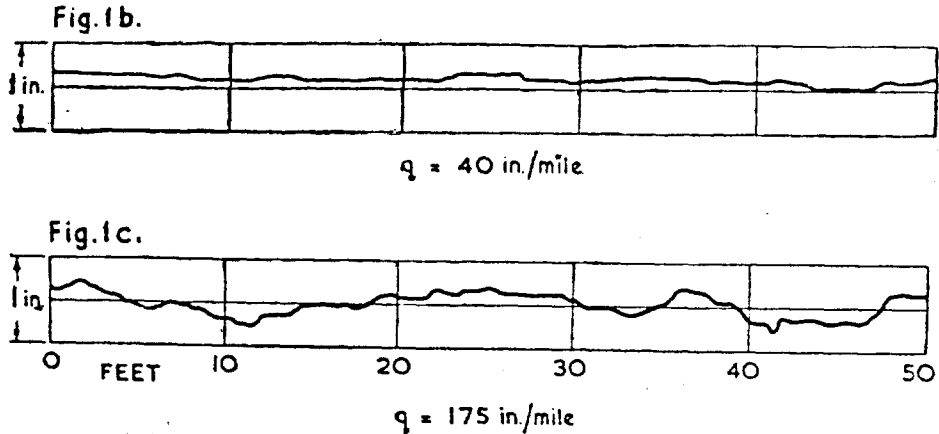


Fig. 1a. The Road Research Laboratory's multi-wheeled profilometer



$$\frac{\text{VERTICAL SCALE}}{\text{HORIZONTAL SCALE}} = 60:1$$

Figs. 1b and 1c. Traces typical of the profiles recorded of what would be a road of good riding quality (Fig. 1b) and what would be a road of poor riding quality (Fig. 1c). The vertical scale of the irregularities is a natural one, i.e., their actual size, but the horizontal scale is 1 in. to 5 ft. The vertical distortion is, therefore, 60 to 1.

under test but, unlike the profilometer, gives no pictorial record of the irregularities in a surface. It consists of a single wheel trailer drawn at a standard speed of 20 miles per hour. The wheel is mounted on two single leaf springs and its 6.00 lb tyre is loaded to a standard weight by the chassis. The upward movements of the wheel in relation to the chassis are

integrated and recorded in inches on an electrically-operated counter. The distance travelled is recorded by the number of revolutions of the wheel. The irregularity index, denoted by 'r' is similarly expressed in inches per mile.

The relationship between the results recorded by the two machines is deter-

mined simply by testing a rough surface having differing standards of riding quality, with the two machines.

Specifying Riding quality

At the present time there is only one multi-wheel profilometer in existence—that operated by the Road Research Laboratory—and no more than three or four bump integrators operated by the Road Research Laboratory and local authorities. It is, therefore, impracticable at the present stage to specify riding quality in terms of the results recorded on these instruments. However, it is found that there is a reasonably close relationship between the values of the irregularity indexes given by the profilometer and the bump integrator, and the magnitude of the depression under a 10-ft straight edge.

Broadly, a 'q' value of 40 in. per mile is equivalent to a departure of no more than 1/8 in. from a 10-ft straight edge laid along the line of the road at any point, while a 'q' value of 90 in. per mile is equivalent to a departure of 1/4 in. It is common practice in this country to specify that the departure from a 10-ft straight edge shall not exceed 1/8 or 3/16 in. at any point and that the reduced level at any point on the surface should not depart by more than 0.01 of a ft from

the levels shown on the drawings. This latter requirement is one which can be more readily complied with in concrete than the bituminous surfaces.

Significance of Index

It may be possible eventually to specify the riding quality of roads and runways in terms of the 'q' value to be complied with and to link the payment made for their construction to this figure.

Since the sensation of comfort or discomfort felt by the occupants of vehicles when driving over roads is clearly related to the unevenness of the surface some broad classification can be made, though it is possible, of course, that the sensations registered may be influenced to some extent by the performance of the vehicle. In the particular case of a road with no irregularities whatsoever, a ride in a vehicle whose tyres were not truly round and whose springing was hard would result in sensations which could not arise from the surface itself. There may well be a lower limit of irregularity below which no reduction will have any effect on the sensations but this limit does not appear to have been achieved so far.

Table 1 gives an assessment of the relationship between the values of the irregularity index 'q' and a physical description of the riding quality.

Table 1

Irregularity index 'q'	Description of riding quality
Up to 40 in./mile.....	Very good—only very slight in well sprung car with good tyres.
40 to 75 do	Good—slight, but appreciable disturbance can be felt.
75 to 130 do	Irregularities quite noticeable.
130 to 200 do	Would result in some discomfort.
Over 200 do	Bad riding quality.

It is generally considered that the riding quality of the best bituminous surfaced roads laid with mechanical finishers

on bases which themselves have a good riding quality has reached a stage where further reductions in the irregularity

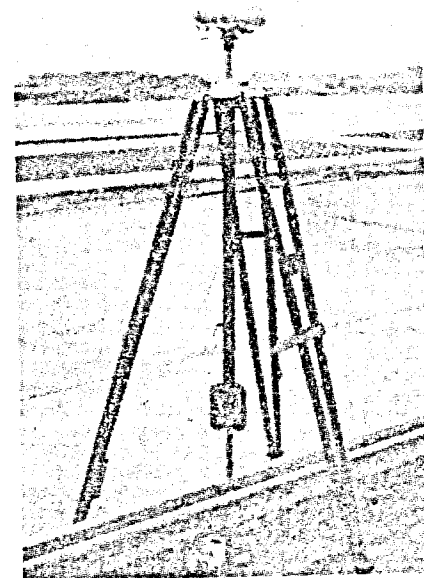
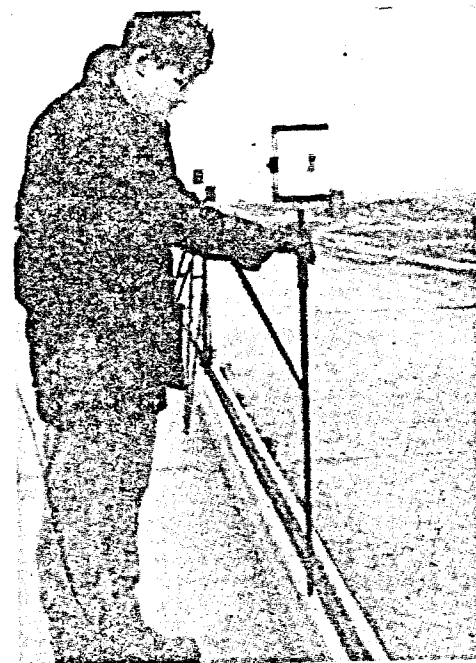


Fig. 2. The accuracy of setting forms for concrete roads is facilitated by the use of this optical levelling device instead of the conventional boning rods.

index would possibly not be appreciated. The same cannot be said, however, of hand-laid surfacings, whose riding quality often leaves much to be desired. With modern machine-laid surfacings the irregularity index 'q' is often in the region of 30 in. to 50 in. per mile shortly after laying, but this figure may tend to increase with use, particularly if the road surfaces are subjected to high temperatures for considerable lengths of time, and when high temperatures are accompanied by high intensities of loading.

On the other hand, concrete roads have often been considered to have a rather poor or bad riding quality, machine finished work generally being inferior in quality to good hand-laid work. Much of the discomfort experienced when travelling over concrete roads has been associated with joints, whose construction presented less of a problem in alternate bay hand finished work than in continuous machine laid work.

Concrete roads have the great advantage, that provided they are built to

give a low irregularity index, their good riding quality will continue for a great number of years. Some concrete roads laid in this country 30 years ago still have good riding qualities. Apart from the question of settlement of slabs due to changes in the stability of the base—a problem whose incidence is made much more remote by proper application of design principles and compaction techniques—there seems to be no reason why a first class concrete road should not remain in first class condition, for a great number of years with only very little maintenance.

Riding Quality of Concrete Roads

Many concrete roads, hand laid by the alternate bay method, have shown riding qualities superior to those laid by machine. But since the former method could not now be tolerated on any major scheme, much effort has been devoted to finding the reasons for the lower standard of machine finished work; and, having found the reasons, to take the necessary

steps to correct their short-comings. The fact that on recently constructed works—mostly airfields—a standard of riding quality on concrete surfaces has been achieved which probably surpasses, in some respects, that attainable on bituminous surfacings, is testimony to the diligence with which this problem has been pursued.

Among the many problems which have had to be elucidated in the quest for better riding quality of concrete roads are those of accuracy of the forms between which the concrete is laid, the accuracy of form setting and of their stability under the loads imposed during the spreading and finishing processes, the uniformity of the concrete used, the uniformity in spread density of the concrete and of depth of spreading, performance of compacting and finishing machines and of joint construction. Each of these factors makes some contribution to the quality of the finished surface and only by proper attention to every detail is it possible to ensure that the surface will prove satisfactory. It is, however, probable that the greatest single contribution to the physical appreciation of good riding quality is the improvement which has taken place in joint construction.

Since the profile of the finished surface is largely controlled by the level of the smoothing beam on the finisher as it moves forward and that this level is governed by the forms, it is clear that the accuracy of the forms and of their setting has considerable influence on the quality of the finished work. The high degree of evenness of profiles on many of the concrete roads on the Continent is attributable in no small measure to the accuracy of the formwork. In this country forms which are accurate to 1/16 in. in 10 ft can be obtained and manufacturers are paying a great deal of attention to supplying forms to such a rigid specification. No less important than the accuracy of the forms themselves is the accuracy of setting and this is greatly facilitated by the device shown in Fig. 2, which is used in lieu of the conventional boning rods. By using this device forms can be set to an accuracy of 1/16 in. over a distance of 200 ft. which is a far higher degree of accuracy than has previously been attainable.

It has been established from observation and experiment that provision at the working place of concrete which is of uniform proportions and consistency and which is spread to uniform density and to the correct depth over the whole area is essential if surfaces of low irregularity index are to be achieved with the minimum of labour. The development and use of plant which enables these requirements to be met makes notable contributions to this end.

Bad riding quality of concrete roads has, in the past, been largely associated, justifiably or otherwise, with the quality of the joints. Because of this there has been a move towards the elimination of joints to the greatest extent possible. This is, no doubt, a very creditable move but perhaps one which leads to increased costs because heavy reinforcement is required to control cracking in long slabs. The modern technique of sawing joints in the hardened concrete results in a profile on which the presence of joints cannot be detected, and hence there is perhaps not the same need for long jointless slabs and heavy reinforcement. Expansion joints to accommodate temperature movements in the slabs and contraction joints to control the shrinkage, which takes place as the concrete hardens, can be cut in the concrete with diamond or carborundum saws and in certain classes of aggregate, at low cost. A technique introduced into this country from America some two years ago for smoothing the finished concrete by drawing straight-edges across its surface immediately after the passage of the finishing machine has also made a big contribution to the attainment of good riding qualities but it is interesting to note that on roads in Denmark, where the riding qualities are probably as good as any in the world, there has been no resort to the use of this device.

Standards attained

Some indication of the extent to which improved techniques in the construction of concrete roads and runways have resulted in improvements in the riding qualities of work carried out by John Laing recently is shown in Table II.

Table II

Location	Average 'q' value over whole of work	Lowest 'q' value over short length	Lowest 'q' value over long length	Remarks.
Lines (runway) ...	79	43	50	Unreinforced joints at 20-ft intervals.
Oxton By-pass Extension (road) ...	59	30	45	Reinforced joints at 97—112-ft intervals.
Norfolk (runway) ...	39	29	35	Reinforced. Joints at 120-ft intervals.

The results quoted for the runway in Norfolk are the best ever recorded for work carried out in this country and compare very favourably with those recorded in any other country. There is no doubt that the attainment of such smooth profiles over long lengths with no irregularities associated with joints has done much to re-establish the confidence which many engineers hold in concrete for roads and runways. The fact that these figures will be maintained for several decades without any need for periodical re-shaping and re-surfacing, as is necessary on bituminous roads, makes concrete roads economically attractive although perhaps rather more expensive in the initial cost.

It should be mentioned that the attainment of a good riding quality on roads and

runways is brought about by paying attention to detail at every stage of construction, and by giving the operatives every facility for turning out a first-class job. These high quality surfaces are not achieved at the expense of rate of production, not of increases in man-power employed. In our experience, keeping operatives informed of the standards they have produced on each successive job encourages the will to do something better and develops a sense of pride in achievement, a quality the absence of which many people now deplore.

Figs. 1 (a), (b), (c) and Table I are reproduced by courtesy of the Director, Road Research Laboratory.

(From "The Surveyor and Municipal and County Engineer", July 6, 1957).

A man lives in a fictitious world unless he can compare ultimate results with design assumptions, however sound his theoretical knowledge.

—Karl Terzaghi

(The Fourth International Conference on Soil Mechanics and Foundation Engineering).

REDUCING BITUMEN STRIPPING FROM AGGREGATE

Successful N.S.W. Tests with Tar and Creosote

THE use of tar and creosote to reduce stripping of bitumen from aggregate is described in the official journal "Main Roads" of the Department of Main Roads, New South Wales, Australia.

As a result of the laboratory and field tests it is concluded that the tar used provides a satisfactory and economical material for promoting adhesion under the conditions obtaining on main roads in New South Wales, provided the spraying viscosity is adjusted to suit road temperatures and conditions. Experiments on routine work elsewhere indicate that tar is ineffective if the viscosity of the sprayed binder is too high for satisfactory initial adhesion to the aggregate; further investigation work is needed to determine the most suitable way of adjusting the viscosity for low temperature conditions. In the meantime the Department of Main Roads is not using the tar method when pavement temperatures are below 85 deg. F.

The question of viscosity under high road temperatures is also being investigated. This is related to the viscosity of the tar flux at ordinary atmospheric temperatures, because it is naturally more convenient and economical if the tar is sufficiently fluid to be added to the bitumen without preliminary heating. The tar originally used by the Department of Main Roads had a viscosity of about 1.0 stokes at 50 deg. C. and while this material could be poured cold from drums it could not be pumped readily from road tankers with the equipment available to the field spraying organisations.

In order to assist distribution by bulk transport, a more fluid tar was tried, with a viscosity of about 0.5 stokes at 50 deg. C. This material could be handled satis-

factorily but, at a concentration of 8 to 10 per cent necessary to obtain adequate anti-stripping properties, it tended to over-flux the bitumen to the stage that aggregate could be plucked out by fast moving traffic in hot weather. Experience to date suggests that under such conditions the most suitable grade of material is one with a viscosity of 1.25 to 2.0 stokes at 50 deg. C.

The effect of the tar on the life of the bitumen is not yet known, but natural weathering tests commenced in 1954 indicate that while some tars may adversely affect bitumen, the tar at present in use seems to be having no ill effect on the bitumen. This tar is distilled from a mixture of coal gas tar and a carburetted water gas tar derived from petroleum gas oil. A tentative specification for the material is as follows:—

- (i) Definition—The tar shall consist of a distilled vertical retort tar with the addition of water gas tar in an amount not exceeding 25 per cent.
- (ii) Properties—
 - (a) Viscosity, stokes at 50 deg. C.—1.25 to 2.0.
 - (b) Specific gravity 25 deg. C./25 deg. C.—min. 1.03.
 - (c) Matter insoluble in carbon bisulphide per cent wt.—max. 5.
 - (d) Water content per cent wt.—max. 0.5.
 - (e) Distillation test per cent wt.—to 230 deg. C.—max. 5 to 300 deg. C.—max. 30.
 - (f) Softening point of residue from distillation (Ring and Ball) deg. C.—max. 50.

- (g) Sieve test—There shall be no residue when passed through No. 14 B. S. sieve.

The usual procedure in fluxing with this tar is to pump the required amount into the sprayer, then add the hot bitumen so that the resultant temperature does not exceed 310 deg. F. and circulate for at least twenty minutes before spraying. As tar of this viscosity is effective as a binder, the calculated rate of application for the binder should include the tar present in the bitumen.

Precoating with Creosote

Although the tar described has the advantage of being a flux and part binder as well as an anti-stripping agent, there is still some doubt concerning its effectiveness at low temperatures and until this matter has been more closely investigated it is preferred, when pavement temperatures are below 85 deg. F.; to use aggregate precoated with creosote. This practice developed from laboratory tests carried out in 1954 to compare the relative merits of antistripping agents added to the binder and creosote pre-sprayed on the aggregate. Results appeared to favour the creosote; in fact, almost any creosoted aggregate developed a satisfactory resistance to stripping as judged by the plate test.

The first field trials were done on Main Road No. 184 near Windsor, using as cover aggregate a damp, hydrophilic river gravel precoated with creosote at one-half to two gallons per cubic yard of stone. The work was satisfactory and indicated that further research was warranted; in the meantime, the process was extended to other areas with generally good results.

A rate of application of three-quarters to one and one-half gallons per cubic yard has been used on the more recent works depending on the nature of the aggregate. The creosote is sprayed on the aggregate in stock-piles immediately in front of the loader. A conventional stirrup pump adjusted to a finer spray without atomising has been found satisfactory for this purpose, but other methods could be used depending on the type of loading and spreading equipment.

The creosote should be sprayed in such a way that the operator does not come in contact with the fumes. (As a precautionary measure exposed parts of the body may be covered with a suitable barrier cream. If the eyes are affected they should be flushed with clean water, then a few drops of glycerine applied, followed by further flushing with fresh water.)

The creosote on the surface of the stone has a strong fluxing effect on the bitumen with which it comes in contact; indications are that this local fluxing effect will permit a reduction of about 6 per cent in the general fluxing agent (usually a light petroleum flux oil). In hot weather the creosote can cause local over-fluxing to the extent that the aggregate may be dislodged by fast traffic before the binder has set up sufficiently. Consequently, until further data are available, the department of Main Roads practice is to use creosote precoating only when road temperatures are below 85 deg. F.; otherwise the tar additive is safer.

The creosote used to date is that covered by Australian Standard Specification K. 55: "Creosote oil for the preservation of timber." A study is being made of other types of tar oils to determine whether satisfactory results can be obtained with oils which are more easily handled than creosote. Creosote added to the binder is not so effective as the tar, the soft pitch fraction of which seems to be the active constituent in promoting adhesion.

Although investigations are not yet complete, it is already clear that the field results confirm the laboratory tests in demonstrating the value of creosote in promoting initial adhesion of aggregate and in resisting subsequent stripping from hydrophilic action.

Conclusions

Although experimental work is still continuing the following observations seem warranted at this stage:—

- (i) In laboratory and field tests of various methods for minimising

(Continued on page 34)

HERE AND THERE

1. PLAIN WORDS

● FOR some, leaving college is like going to prison. After three, perhaps four, years of liberal freedom, all garlanded with sweetness and light, the graduate must gather his personality together and ram it into a routine for which he has been ill prepared. Listening to quartets in the small hours, bright gossip over a leisurely mid-morning coffee, rowing once a day, breakfast at Grantchester after dancing all night, perhaps a few well-chosen lectures, and then, suddenly, a harsh new world of nine-till-five reality, with at best a game of football on Saturday afternoons. If the graduate has the misfortune to be an engineer beginning an apprenticeship, he may even find that he is expected to clock on—at 7-30, when most undergraduates are still in bed. Education is supposed to be a preparation for life—sometimes a life, unfortunately, that few of us can lead.

To carp at the bounty of a liberal education is to appear ungrateful, but its place in life to-day is clearly due for re-examination. Currently, the two most publicised educational requirements are for more and better engineers, and for a broader and more liberalised engineering education. Can the two be reconciled? Is a compromise possible? Attention has been drawn to the success of Russian polytechnics, but where a few lectures on Marxism are the only rival claims to a student's interest, his discipline is unlikely to be undermined. And whereas in

Cambridge "Das Betreten's not verboten," in Kiev it is probably compulsory. There, the step from college to industry may be an easy one.

At least one company in Britain have recognised the traumatic adjustment the graduate is required to make, and thoughtfully included in their apprenticeship brochure inviting references to the full civic life, complete with Halle orchestra and an attractive countryside, available to their employees. But for the others, nostalgic contact with the sparkling intellectual life of college can only be kept up through the New Statesman and Nation or the "posh (Sunday) papers."

Recently the Sunday Times published pictures of young men and women who were in residence at Oxford some ten years ago and have since become successful. Not one was a technologist. Most were engaged in the tertiary activity of entertaining us. Entertainment does, in fact, seem the sole livelihood able to satisfy the delicate appetites created by high-class British education: the only satisfactory alternative is to become a piping goat herd on some sunny Aegean island. It is really not surprising that so many of our talented young men say in effect: "T'he'll with engineering, I'm going to be a poet."

(From "Engineering", June 28, 1957)

2. CAR PARKING STANDARDS

● THE Town Planning Committee of the London County Council reports that following discussions with the Government departments concerned and the City Corporation on the question of the standards of car parking accommodation which might be applied in the considera-

tion of planning applications and upon consideration of the advice of a working party set up by the Minister of Housing and Local Government in 1953, the committee are reviewing the standards to be applied to all types of development and have so far considered the standards for

(i) offices and showrooms, (ii) industrial buildings and (iii) residential flats.

The standards so far adopted are as follows:—

Offices and Showrooms: For all new development and when a change of use of a building or part of a building is proposed, the developer should be required to provide one car space per 2,500 sq. ft. of gross floor space.

Industrial Buildings :

- (i) With factory and Office space combined, under 2,500 sq. ft. gross floor space. 2 car spaces.
- (ii) With factory and office space combined, between 2,500 sq.ft. and 5,000 sq.ft. gross floor space. 3 car spaces.
- (iii) With combined or separate office space, over 5,000 sq. ft. gross floor space. 2 car spaces basically, plus 1 space for every 2,500 sq. ft. of offices, plus 1 space for every 5,000 sq. ft. of factory area.

For the purposes of calculating the parking accommodation required, the floor space occupied by substantial fixed plant and equipment of a permanent nature will be excluded from the gross floor space; loading and unloading facilities will be dealt with separately. It is proposed to review these standards in three years' time in the light of experience gained.

3. THE BIRMINGHAM-PRESTON MOTORWAY

● THE Minister of Transport and Civil Aviation has announced the proposed line of the 97-mile long Birmingham-Preston Motorway. Forming part of the four year programme announced in February, 1955, the road will link the

Residential Flats. (i) One car space to every two lettable units where development takes place within the 200 persons per acre residential density zone; but, wherever possible, developers should be encouraged to regard this standard as a minimum and provide a greater amount of space for parking purposes, particularly in the areas of greatest congestion; (ii) One car space to every four lettable units where development takes place in the remainder of the county outside the 200 persons per acre residential zone.

General. In formulating these standards the Committee realised that, in some cases, the particular circumstances of a site or the nature of the building may make it impracticable to insist on the provision of the full amount of car-parking accommodation and will deal with all such cases on their merits with the object of securing as much parking space as is reasonable in the circumstances.

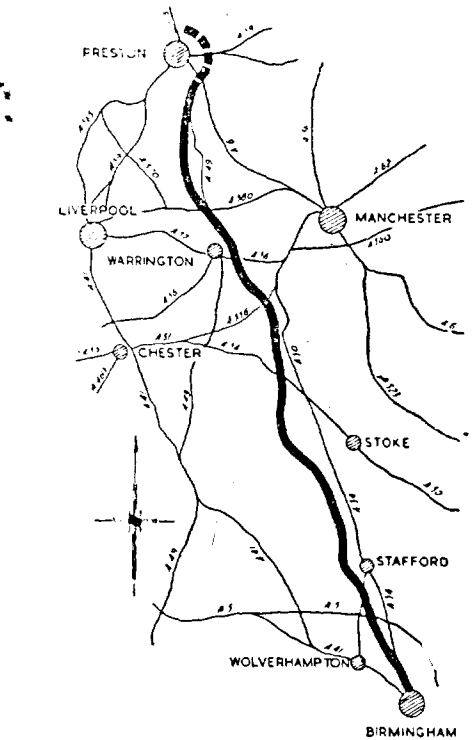
For building of other kinds there has been little experience on which to base standards of car-parking provision but the following table is used as a guide:—

Type of Building	Provincial Standard
Hotels	... One car space for five bed-rooms.
Large shops and Stores	... One car space for 2,500 sq. ft. wherever practicable.
Cinemas	... One car space for 60 seats.
Theatres and concert halls	... One car space for 15 seats.

(From "Roads and Road Construction", August, 1957).

industrial areas, of Lancashire with Birmingham and, by way of the southern part of the London-Yorkshire Motorway, with the south of England.

The new road will run from a point on A. 41, the Birmingham-Wolverhampton



road in West Bromwich, Staffordshire, in a general northerly direction, passing to the west of Cannock, Stafford, Newcastle-under-Lyne and Stoke-on-Trent; through Cheshire, passing to the east of Sandbach and west of Knutsford, to cross the Manchester Ship Canal approximately one mile east of Warrington; then

through Lancashire to the west of Wigan to join the southern end of the Preston by-pass, now under construction, near Bamber Bridge.

The motorway will be for the exclusive use of motor traffic. It will be built to the same modern standards as the London-Yorkshire motorway and is designed to relieve traffic congestion in the industrial areas of the Midlands and Lancashire, by providing for a safe uninterrupted flow of fast-moving traffic in the areas through which it will pass.

The motorway will pass under or over roads intersecting its line of route and, except for the roundabout junctions at each end, access to it will be limited to a number of intermediate junctions where traffic will enter or leave the motorway on the near side of the traffic stream. As the road will pass through a heavily industrialised area, the placing of such connections will be more frequent than on the London-Yorkshire motorway.

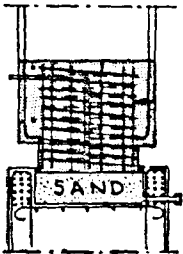
There will be a tunnel to carry the road under the waters of the Tame Valley Canal in Staffordshire, and eight bridges carrying it over other navigable waters. In addition there will be many public road bridges, railway bridges, and bridges for public paths, private and agricultural accesses across the proposed new road.

(From "Roads and Road Construction" May, 1957.)

4. ADJUSTING THE LEVEL OF FOUNDATIONS

● A method of adjusting the level of the foundations of a building which may be subjected to variable settlement has been devised by the French engineer M. Albert Caquot and is being used in Le Havre in the "Porte Ocean", a building of fourteen stories, where a variable settlement of 2½ in. is expected. The accompanying crosssection through a column and foundation illustrates the method. The lower part of the column is reduced in size so that it may pass through a ring-beam anchored to the foundation. This ring-beam contains a

bed of sand laid on top of the foundation, on which the precast base of the column is placed. Extending from the top of the precast base are reinforcement bars placed so as to lap with the longitudinal reinforcement of the remainder of the column to be cast in place. A tube passes through the ring-beam to the bed



of sand and is sealed by a removable cap at its outer end. When it is necessary to alter the level of the base of the column the cap is removed and an auger is inserted into the sand so that by rotating the auger some of the sand is removed and the base of the column slides down within the ring-beam. Another tube passes through the precast base to the sand so

that it is possible to inject cement-grout under pressure to raise a column or to stabilize the sand at any desired level. The foregoing is abstracted from a recent number of the Belgian journal "La Technique des Travaux".

(From "Concrete and Constructional Engineering", Vol. LII, No. 7, July 1957.)

5. ROUNDABOUTS IN URBAN AREAS

THE London County Council is being criticised in certain quarters for constructing roundabouts at important junctions instead of flyovers.

While being strongly in favour of advanced highway design whenever it is economically feasible and definitely advantageous, we remain unconvinced that the construction of elaborate fly-over junctions, here and there, would prove the infallible solution to the traffic problems which the popular press would have us believe.

To be effective, highway design must have continuity in speed and capacity standards over a reasonably long distance and it is useless to provide a high standard at isolated points while the intervening connecting links remain totally inadequate.

When a bridge is rebuilt for structural reasons opportunity is sometimes taken to widen the carriageway if the old width is obviously too little and such widenings are sometimes carried out on an ample lines with a view to providing for future traffic requirements. But unless the approach roads have sufficient capacity the effectiveness of the bridge widening is negligible and may even result in worse jams if, say, three lanes of traffic on the bridge have to converge to two on the approaches.

A representative of one of the motoring organisations has complained that

drivers are confused at roundabouts because there is no specific ruling as to priority when entering the weaving area. This may be true and we agree that driving technique at roundabouts should be standardised by some such regulation. Difficulties at roundabouts are often caused by unintelligent motorists and on at least three occasions in recent times we have seen drivers attempt to go round in the wrong direction. A complete impasse can result, also, from the refusal of a thruster to give way until an equally obstinate thruster blocks his progress and simultaneously that of everyone else.

It must be remembered, however, that a certain amount of weaving would occur at the ends of the slip roads to a fly-over or underpass, and if these slip roads had to be fitted into a confined space, as they would in heavily built-up surroundings, this weaving could be quite as difficult and probably more dangerous than that on a well-designed roundabout.

In any case there is little point in embarking on extremely expensive flyovers at isolated points separated by completely obsolete and inadequate streets when the only real solution to London's traffic problems will ultimately prove to be drastic new construction on the lines of a master plan.

(From "Highways and Bridges and Engineering Works," June 1957.)

6. TRAFFIC CONTROL BY TELEVISION

THE television installation for traffic control in the Market Square at Durham is to be made permanent.

At present a policeman stationed in the Market Square is required to control traffic which he cannot see. The object of the new installation is to give him a clear picture of the traffic on two of the approaches to the Square.

Traffic entering by the Square by the Framwell-gate and Elvet Bridges can only pass in one direction at a time. The constable controlling the traffic lights on the bridges from his police box in the Square, cannot see the number of vehicles waiting and must also estimate the time needed to clear each line of

traffic between the Square and the bridges.

The television cameras which are now to be installed at each bridge will transmit a picture of the actual traffic conditions to a screen in the control box and will help the constable to reduce delays to traffic to a minimum. He will also see the kind of traffic waiting and make allowance for heavy, slow-moving vehicles. In addition, the television will enable him to see whether vehicles parked nearby are interfering with the flow of traffic. This new method of traffic control was tried out successfully in Durham in August 1956.

(From "The Surveyor & Municipal & County Engineer," July 1957.)

7. NEW ZEALAND'S PORTABLE BRIDGE

A portable bridge, designed by an Auckland engineer specially for New Zealand conditions, will be given a trial at Silverstream, near Wellington, by the New Zealand National Roads Board. The bridge may prove the solution to construction problems in the replacement of single-span bridges, particularly in back country areas. Prefabricated from extruded aluminium alloy sections, the

bridge will replace a narrow concrete bridge just north of the Silverstream Hospital. The bridge has a span of 30 ft and it is 24 ft wide. It weighs a little more than three tons and will be transported bodily to the site where the abutments have been prepared by the Ministry of Works.

(From "Highways and Bridges and Engineering Works," July 3, 1957.)

8. ROAD LESSONS FROM THE CONTINENT

RECENTLY returned from a visit to France and Belgium to inspect modern road developments there, the party of Conservative and Socialist M. P. s who went over as guests of the Roads Campaign Council, were this week loud in their praises of Continental progress in that direction. Mr. Stephen McAdden said both the countries visited had shown much more vigour and resolution than we in pressing forward with new roads and thought that a roads commission, free from political interference, was essential in this country. Mr. Ernest Davies stressed that the coming of the European

free trade area would place us at a disadvantage in that our transport costs would be higher than on the continent. Even when we did build new roads, we did not always get our money's worth—the new West London exit to the Great West Road was "a disgrace with its traffic lights and roundabouts (Mr. Davies might have specifically mentioned the failure to build the flyover at Hammersmith) and was out-of-date before it was completed. Mr. G.R. Strauss added that road construction showed a greater return on capital investment than any other industry, but loans were, he

thought, the most expensive way to build new roads. On the other hand, Belgian experience has been that this form of finance works well and ensures continuity of effort, because authorities know well in advance what money will be available. Visits such as that just arranged by the Roads Campaign Council obviously stimu-

late wider interest both in Parliament and in the country. Provided the resulting comment and criticism is well-informed nothing but good can result from a sustained attack on our laggard Treasury.

(From "Modern Transport", June 1, 1957.)

9. WHY DO BUILDINGS ON CLAY FOUNDATIONS SETTLE?

SOME light is being shed on one of the causes of building settlement by research being conducted by the Division of Building Research of the National Research Council of Canada. Begun in 1954, the investigation seeks an explanation of damage caused by differential movement to houses built on clay soils.

An area three blocks by twelve in Ottawa was chosen for study. The houses, for the most part, were 2½ story, 60 to 80 year old brick structures resting on heavy stone foundations. Almost every structure had suffered differential settlement ranging from 1 to 15 in. The soil consisted of a deep Leda clay deposit topped with 6 ft of fine sand.

An extensive shallow boring program revealed that the moisture content of soils was always lowest at points at maximum settlement. Surveys showed that in almost every instance, settlements were greatest

in that part of the structure nearest trees and streets.

The results have shown that ground movements are dependant upon climatic conditions and aggravated by the presence of trees. Settlements start in the spring when leaves appear and the water table starts to drop. Peak settlement is reached when the water table is at its lowest in late summer. Autumn rains raise the ground water table with a consequent raising of the ground surface.

A laboratory testing program has been started to study the shrinking and swelling properties of the Leda clays in the Ottawa region. Results of this study to date indicate the differential movement is not completely reversible when severe moisture content changes occur.

(From "Engineering News Record," April 18, 1957).

(Continued from page 28)

stripping of aggregate due to hydrophilic action, the Department of Main Roads has obtained superior results with (a) creosote precoating of aggregate, (b) a tar added to the bitumen.

- (ii) Either process can be safely employed in the field provided due allowance is made for pavement temperatures, spraying viscosities, volume and speed of traffic, etc., obtaining on any particular work.

- (iii) While creosote has some advantage in counteracting the effect of dust on aggregate, it is important that aggregate be as free from dust as practicable.

- (iv) The use of these materials does not remove the need for normal care, if successful bitumen surfacing work is to be done.

(From "Highways and Bridges and Engineering Works," August 21, 1957).

CURRENT LITERATURE

ABSTRACTS

PHOTOGRAMMETRY AND AERIAL SURVEYS. Bulletin 157 Highway Research Board, Washington, D. C.

THIS publication contains seven papers on the use of aerial surveys and photogrammetry in highway location and design, presented at the 36th Annual Meeting, as follows:

"Introduction to Photogrammetry and Aerial Surveys," by William T. Pryor.

"Equipment, Methods and Standards of Accuracy Applicable to Aerial Surveys," by Robert D. Miles.

"Relationships in Contour Interval, Scales, and Instrument Usage," by William T. Pryor.

"Applications of Photogrammetry to the Location and Design of Freeways in California," by L. L. Funk.

"Planning Aerial Photography and Film Processing for Mapping work," by John H. Wickham, Jr.

"The Engineer's approach to Electronic Computing Methods," by Joel D. Aron.

"Coordination of Plotting Instruments and Computers in Cross-Sectioning and Calculation of quantities," by E. S. Preston.

The Bulletin concludes with some seven pages of general discussion of the several papers.

AN APPRECIATION OF THE WORK CARRIED OUT ON FATIGUE IN PRESTRESSED CONCRETE STRUCTURES. R. E. Rowe—Magazine of Concrete Research, Vol. 9, No. 25 March 1957.

A review of the work carried out on fatigue in prestressed concrete is

made in this report and observations by the various investigators are included.

All the tests show the excellent fatigue resistance of prestressed concrete in the design range of loading. From the review it is apparent that for loadings outside the design range, i.e. after cracking has occurred, the governing factor affecting the fatigue strength of prestressed concrete is the fatigue strength of the high-tensile steel used for stressing. Figures obtained for the fatigue strength of high-tensile wires show that for most types in present use a mean value of 60-65 per cent of the ultimate strength should be taken. No comparable figures for the fatigue strength of high-tensile alloy bars are available.

Suggestions are put forward for future research on fatigue in prestressed concrete and the need is emphasized for fundamental research into the behaviour of both high-tensile wires and high-tensile alloy steel bars under fatigue conditions.

THE USE OF FLY ASH IN SOIL STABILIZATION. W. Wright, and P. N. Ray—Magazine of Concrete Research, Vol. 9, No. 25, March 1957.

AN increasing quantity of flyash is being produced by the power stations of this country. Experiments using three different soils are described which suggest that flyash can replace some of the cement normally used for soil stabilization.

TRAFFIC SPEED AND VOLUME MEASUREMENTS—Highway Research Board, Washington, D. C.—Bulletin 156.

THE three papers contained in this bulletin were presented at the 35th

Annual Meeting of the Highway Research Board.

The first, by C. A. Rothrock and L.E. Keefe, gives the results of a special study, financed by the Yale Bureau of Highway Traffic, in which careful and precise measurements were obtained during an 8-hour period of the progress of all vehicles in a lane of traffic through a test section subject to congestion.

The second paper, by W. J. Mortimer, describes a "Moving Vehicle Method of Estimating Traffic Volumes and Speeds," as used by Cook County, Illinois, in traffic studies.

"Speed and Travel Time Measurement in Urban Areas" is discussed in the third paper, which is a committee report comparing the merits of the several methods for determining travel time and/or speed on urban highway facilities.

HIGHWAY MAINTENANCE STUDIES—Highway Research Board, Washington, D.C., Bulletin 155.

THIS bulletin contains two papers presented at the 35th Annual Meeting of the Highway Research Board, January 17-20, 1956.

The first paper, "Report of the Committee on Maintenance Costs," was presented by H.A. Radzikoski of the Bureau of Public Roads. The trends in maintenance costs are described and two methods of estimating maintenance costs are proposed.

The second paper, "Maintenance Study of County Roads in Minnesota," was presented by E.S. Ward, County Highway Engineer of Kandiyohi County, Minne-

sota. It was a report of a committee appointed by the Executive Committee of the County Highway Engineers Association of Minnesota. Counties in Minnesota have been using a uniform accounting system for about ten years. It was decided that, although this was a good system, individual interpretations of cost items were creating individual systems in many counties. The procedure for a new study was developed to cover cost accounting and the extent of maintenance service provided.

SOME PHASES OF ROAD RESEARCH IN AUSTRALIA by A.H. Gawith and T.M. Coulter. *The Journal of the Institution of Engineers, Australia*, Vol. 29, No. 1-2, Jan.—Feb. 1957.

THE purpose of this paper is to review the progress of research work in Australia, and to record some details of the work that has been done during the last thirty years. It has been prepared under the direction of the Conference of State Road Authorities of Australia, an association of the road authorities of the six States and the Commonwealth Department of Works, which meets regularly to consider road problems of common interest.

The paper describes work carried out by the road authorities individually and also investigations conducted conjointly by members of the Conference. It is divided into the following parts:

1. History of the establishment of road research organizations and facilities in Australia.
2. Some details of work done.
3. Suggested likely future trends in research.

VALOUR AND DISCRETION

"What's the difference between valour and discretion?" asked the teacher.

And the lad replied, "Coming out of barber's shop without paying is valour, and discretion is not going back to the same shop."

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

SOIL ENGINEERING AND DRAINAGE

1. **Rapid Measurement of the Moisture in Sands**; J. DAUBE, *La Technique Routiere*, No. 2, July 1956, pp. 47-50 (in French).
2. **Soils and Rocks in Road Construction in New South Wales**; *Main Roads-Vol. XXI*, No. 4, June 1956, pp. 112-116, part I.
3. **Modern Developments based on Engineering Properties of Soils**; S. RAJARAMAN, *Journal of the Institution of Engineers (India)*, Vol. 37, No. 2, Part I, October 1956, pp. 71-83.
4. **The Design of Machinery Foundations with Special Reference to the Vibration Problem**; B. N. VENKATA RAO, *Journal of the Institution of Engineers (India)*, Vol. 37, No. 3, Part 2, November 1956, pp. 217-240.
5. **Steel Bin Walls Bolster Seaside Highway**; *Roads and Streets*, May, 1956, pp. 65-67.
6. **Soils and Rocks in Road Construction in New South Wales**; Part II Soils, Description and Typical Test Figures for common Types, *Main Roads, Vol. XXII*, No. 1, September 1956, pp. 9-16.
7. **Earth Movement Affecting L. T. E. Railway in Deep Cutting East of Vxbridge**; JOHN DOUGLAS WATSON, *The Proceedings of the Institution of Civil Engineers, Part II*, Vol. 5, No. 3, October 1956, pp. 302-331, Railway Paper No. 61.
8. **The Investigations, Design and Construction of Payalebar Airport, Singapore**; JOHN JEFFERIS BRYAN, *Proceedings of the Institution of Civil Engineers, Part II*, Vol. 5, No. 3, October 1956, pp. 379-417, Airport Paper No. 30.
9. **Limiting the Effects of Dewatering Soil, Concrete and Constructional Engineering**, Vol. 4, No. 8, August 1956, pp. 473-474.
10. **The Dynamic Pressures on Turbine Foundations**; JOSEF GEIGER, *Beton und Stahlbetonbau*, Vol. 51, No. 4, April 1956, pp. 86-88 (in German).
11. **Determination of Earth Pressure under a Circular Plate in Simple Cases**; DR. EBERHARD LUSSEK, *Die Bautechnik*, Vol. 33, No. 3, March 1956, pp. 100-101 (in German).
12. **The Skin Friction of Pile Foundations**; YOSHISHIKA NISHIDA, *Die Bautechnik*, Vol. 33, No. 10, October 1956, pp. 337-340 (in German).
13. **Foundation Design Based on Bearing Capacity of and Settlement Analysis of Soil**; H. S. BHATIA AND N. AMANULLAH, *Journal of the Institution of Engineers (India)*, Vol. 37, No. 5, Part I, January 1957, pp. 429-440.
14. **Results of Research on Frost Susceptibility in Soils**; PIERRE LA ROCHELLE, *Roads and Engineering Construction*, October 1956, pp. 189-200.
15. **The Allowable Settlements of Buildings**; A. W. SKEMPTON AND D. H. MACDONALD, *Proceedings of the Institution of Civil Engineers, Part III*, Vol. 5, December 1956, No. 3, pp. 727-784.
16. **Use of Vibration for the Deep Compaction of Granular Soil**; FREDRICK L. CARSEL, *Civil Engineering*, Vol. 51, No. 599, May 1956, pp. 532-536.
17. **Practical Use of Electro-Osmosis to Lower Water Table**; *Highways and Bridges and Engineering Works*, Vol. XXIV, No. 1173, January 16, 1957, pp. 11-21.

18. **American Practice in the design of Major Highways, Highway Drainage (Contd);** E. N. W. RICHARD, *Vol. 35, No. 410*, February 1957, pp. 41-47, *Vol. 35, No. 411*, March 1957, pp. 70-74.
19. **The Influence of the Soil Physical Characteristics of Cohesive Soils through the Grain Size Fraction <0.002 mm. and Water Absorption;** DR. R. NEWMANN, *Der Bauingenieur, Vol. 32, No. 1*, January 1957, pp. 6-17 (in German).
20. **Soil Investigations for Goschen Alp Earthen Dam;** J. TELLER, *Schweizerische Bauzeitung, Vol. 75, No. 2*, January 12, 1957, pp. 18-23 (in German).
21. **Complete Dewatering Water Saturated Soils through Electrosmosis;** PROF. A. BELLURGI, *Die Bautechnik, Vol. 34, No. 1*, January 1957, pp. 1-3 (in German).
22. **Divided Block Foundations with Intermediate Elastic Layer, Subject to Vibrations;** DR. KARL POLZ, *Die Bautechnik, Vol. 34, No. 1*, January 1957, pp. 20-28 (in German).
23. **A Review of the Design of Earth Pressure Cells;** K. H. PEATTIE AND R. W. SPARROW, *Civil Engineering, Vol. 50, No. 590*, August 1955, pp. 872-874.
24. **Sand Flum for Soil Mechanics Research;** P. W. ROWE, *Civil Engineering, Vol. 50, No. 590*, August 1955, pp. 879-900.
25. **A Note on Covard's Soil Mechanics Theories;** H. R. REYNOLDS, *Civil Engineering, Vol. 50, No. 590*, August 1955, pp. 883-884.
26. **A Direct Method for the Location of Slip Planes;** J. M. WATERS AND D. L. BARTLELL, *Civil Engineering, Vol. 51, No. 603*, September 1956, pp. 983-985.
27. **Microscopic Dust-Sampling Methods can Affect Size Estimations;** A. J. GRUISE, *Engineering, Vol. 183, No. 4750*, March 22, 1957, pp. 365-368.
28. **The Stability of Embankments and Its Circular Rupture According to the Theory of M. Caquot-Calculation and Tables for Application;** R. GUILLOL, *Revue Generale Des Routes Et Des Rerodrigues Vol. 27, No. 303*, April 1957, pp. 87-91 (in French).
29. **Building Today—For the Airport of Tomorrow;** *Engineering News Record, Vol. 158, No. 18*, May 2, 1957, pp. 30-34.

The misfortunes hardest to bear are those which never happen.

JAMES RUSSELL LOWELL

PUBLICATIONS ADDED TO THE ROADS WING LIBRARY DURING MARCH TO JUNE, 1957.

1. **Stahlbau Ein Handbuch Fur Studium Und Praxis in 3 banden. Band I,** by Grundlagen (Published by the Stahlbau-Verlags GmbH Wm Dawson and Sons Ltd. Germany Keln 1956.)
2. **Der Bruckenbau Herausgegeben 2. Band Massivbrucken** by Josef Fritsche and Ernest Melan (Wen Frauz Deuticke 1948).
3. **The Steel Skelton Vol. 2: Plastic Behaviour and Design** by J. F. Baker and J. Heyman Published by the Cambridge University Press London.
4. **List of Surface - active Agents for use in Surface Dressing (Research Note No. RN/2551-July 1955)** published by the Deptt. of Scientific and Industrial Research, Road Research Laboratory, London.
5. **Results of Test on a "Knapping-Motion Jam Granulator"** by A.R.C. Boatman, (Deptt. of Scientific and Industrial Research, Road Research Laboratory, London).
6. **Street Lighting and Accidents (A study of some New Installations in the London Area)** by A. C. Tanner and others (Department of S.I.R., Road Research Laboratory, London).
7. **Direction Indicators** by R. L. Morse and others (Department of Scientific and Industrial Research, Road Research Laboratory, London).
8. **List of Equipment for a concrete-testing Laboratory** by J. M. Gregory (Deptt. of Scientific and Industrial Research, Road Research Laboratory, London).
9. **Bearing Capacity of Roads-C.B.R. test No. 25593/CT** by J. M. Gregory (published by the Deptt. of Scientific and Industrial Research, Road Research Laboratory, London).
10. **Soil-Cement Roads — Scope and Application** by M. J. Obeach (Department of Scientific and Industrial Research, Road Research Laboratory, London).
11. **Encyclopaedia Britannica (A to Anney) Vols. 1 to 24** (Published by the Encyclopedia Britannica, Ltd., London).
12. **Report by the Railway Board on Indian Railways for 1955-56, Vols. 1 and 2** (published by the Manager of Publication, Delhi.)
13. **The Design and Construction of Engineering Foundation (Spon's Civil Engineering Series)** E. and F.N. Spon Ltd., 22, Hersrieth Street, London W.C. 2, by F.D.C. Henry.
14. **Steel Construction (Fifth Edition)** American Institute of Steel Construction, New York N.Y.
15. **Engineering Analysis** by Stephen H. Crandall (McGraw-Hill Book Co.,) 330, West 42nd Street, New-York 36, N.Y.
16. **Madras Highways Manual (Vol. III)** (Superintendent Government Press, Madras).
17. **Report by the Railway Board on Indian Railways for 1955-56, Vol. No. II Statistics.**

BUDGETS AND ADMINISTRATION REPORTS

Government of Mysore Budget for the year 1957-58

The following extracts relating to Civil Works have been taken from the Government of Mysore civil works budget for the year 1957-58.

Revenue (Civil Works)

Heads	In lakhs of rupees	
	Budget Estimates 1956-57 (Last five months)	Budget Estimates 1957-58
Rents	1.07	3.64
Ferry Receipts	0.22	0.89
Receipts from Workshops	0.16	...
Recoveries of expenditure	3.90	6.00
Transfer from Central Road Fund	48.40	38.24
Transfer from State Road Fund	2.33	1.83
Grant from Government of India for Construction and Development of State Roads of Economic or Inter State Importance	26.84	31.10
Miscellaneous	2.55	11.82
Deduct—Refunds	-0.04	-0.12
Total	85.43	93.40

Expenditure (Civil Works)

Buildings

Original Works	28.66	62.91
Repair	11.20	19.20

Communications

Original Works	13.88	124.73
Repair	80.33	150.45
Establishment	14.80	42.14
Tools and Plant	8.82	17.95
Grants-in-aid	5.16	14.95
Suspense	6.37	10.65
Development Schemes	71.74	...
Add Recoveries	160.78	403.64
Total	401.74	846.62

Capital Account of Civil Works outside the Revenue Account

Heads	In lakhs of rupees	
	Budget Estimates 1956-57 (Last Five months)	Budget Estimates 1957-58
Original Works		
Buildings	90.59	125.56
Communications	0.24	129.25
Miscellaneous	...	15.22
Establishment	7.58	21.06
Tools and Plant	4.30	25.72
Development Works	86.58	...
Add—Recoveries	18.75	16.00
Total	298.04	332.81
Revenue from Roads		
Receipts under the Indian Motor Vehicles Act	2.16	4.48
Receipts under the State Motor Vehicles Taxation Act	62.29	148.50
Other receipts	0.20	0.57
Deduct—Refunds	-0.51	-0.71
Total	64.14	152.84

(A brief review of the budget)

THE revenue and expenditure on revenue account of the Government of Mysore for 1957-58 are estimated at Rs 5,092.52 lakhs and Rs 6,028.51 lakhs respectively, with an anticipated deficit of Rs 935.99 lakhs.

The expenditure on civil works for the year 1957-58 is estimated at Rs 846.62

lakhs which is 16 per cent of the total revenue of the State.

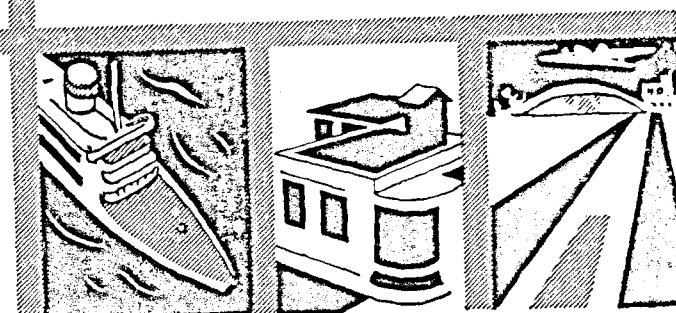
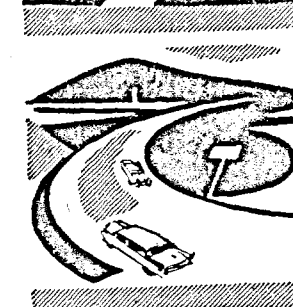
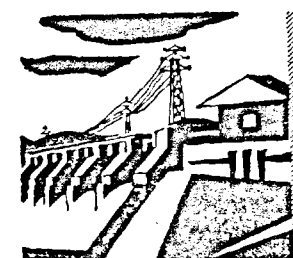
The expenditure on communications alone (original works and repairs only) works out to Rs 275.18 lakhs for 1957-58 which is 5.4 per cent of the total revenue.

The Capital outlay on civil works outside the revenue account is estimated at Rs 332.81 lakhs for 1957-58.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of Work	Amount Rs lakhs
ASSAM			
1.	1786 AS 37	Widening the National Highway No. 37 (Gauhati to Jorahat) miles 2 $\frac{1}{4}$ to 12 $\frac{3}{4}$ in Khasi Jaintia Hills.	2.78
2.	1790 AS 37	Improving and constructing a permanent road on National Highway No. 37 at Palashbari.	10.36
BIHAR			
3.	1792 BR 2	Extension of one span of 12 ft 9 in. in the bridge over the river Kao in the 4th Qr. of 344 mile G. T. Road National Highway No. 2.	0.13
4.	1793 BR 31	Construction of northern approach road to Mokameh bridge along National Highway No. 31.	14.36
BOMBAY			
5.	1787 BM 3	Improvements in miles 81, 82, 83 and 84 by providing 1 $\frac{1}{2}$ in. thick premix asphalt carpet on the cracked portion of Bombay-Agra Road, National Highway No. 3.	1.80
6.	1788 BM 3	Land Acquisition for the construction of bye-pass outside Ahmedabad town on National Highway No. 8.	8.00
DELHI			
7.	1784 DLH 10	Acquisition of land adjacent to the bulk storage depots of the various petrol companies along Rohtak Road at Shakurbasti.	0.36
JAMMU AND KASHMIR			
8.	1789 JK 1-A	Purchase of Carbon monoxide Detectors for Jawahar Tunnel Project at Banihal in Jammu and Kashmir State.	2.28
UTTAR PRADESH			
9.	1791 UP 2	Construction of an overbridge at Farrah Railway Station on Delhi-Agra Road, National Highway No. 2.	3.33
10.		Two works each costing less than 2 lakhs.	2.94
WEST BENGAL			
11.	1796 BG 6	Construction of culverts (upto 2 ft 0 in.) for sub-section from M. 2 F. 1 to M. 3 F. 5 of Joypur-Beel-Alampur Section of National Highway No. 6 in the Dist. Howrah.	0.59

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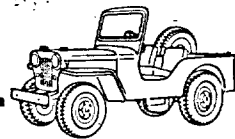
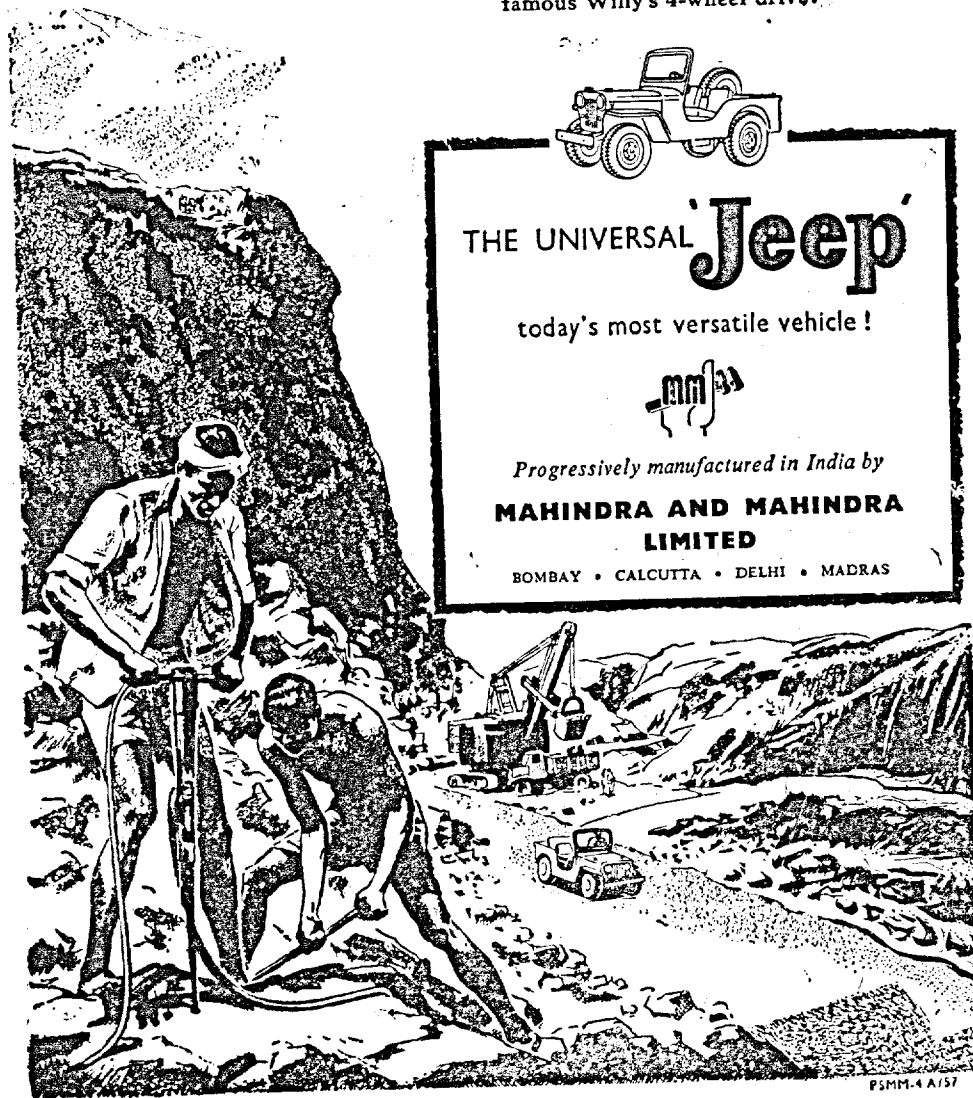
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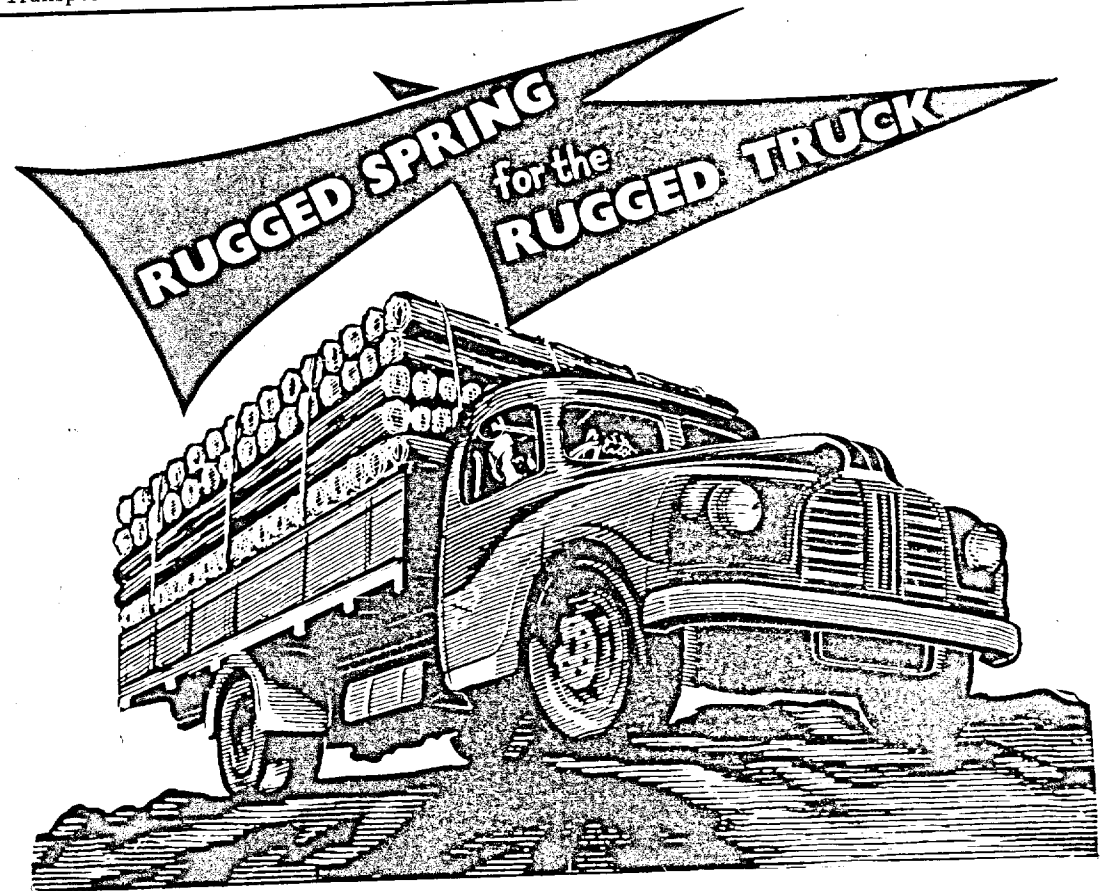
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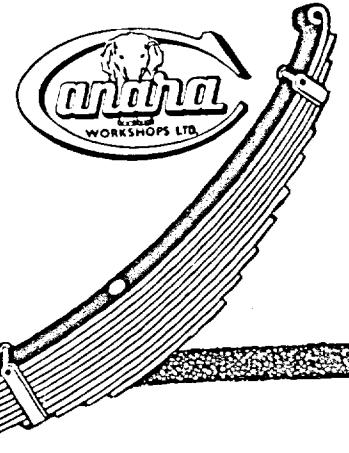
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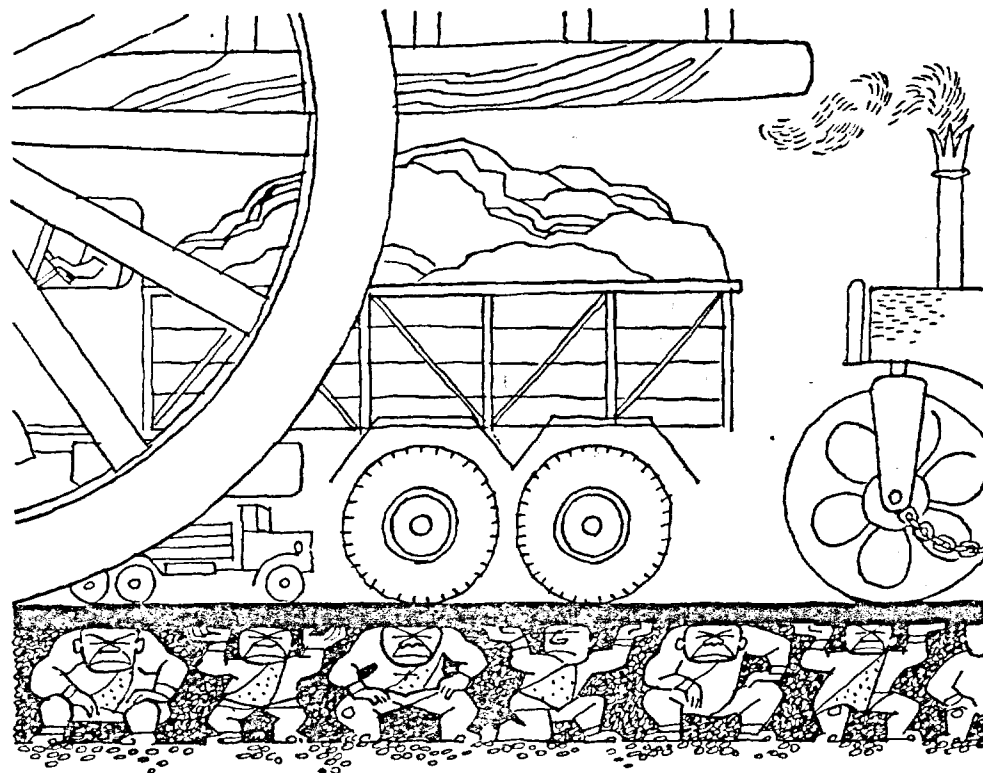
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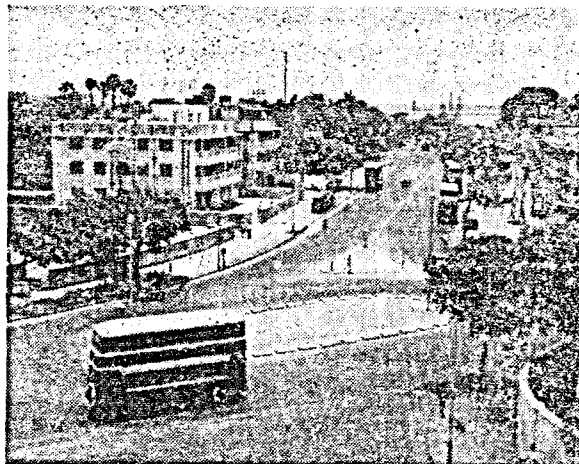
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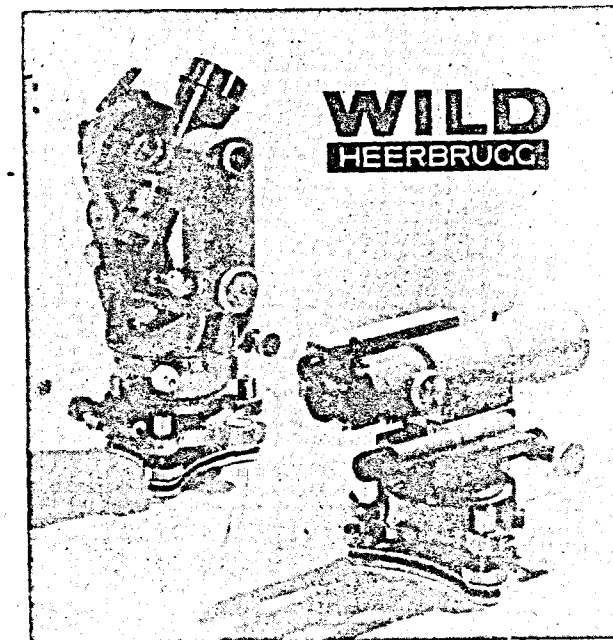
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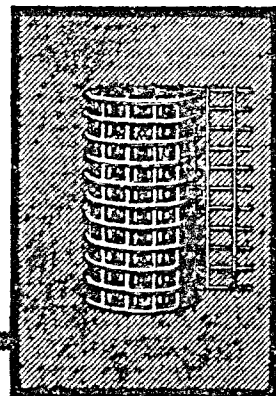
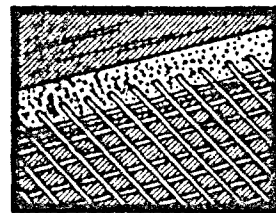
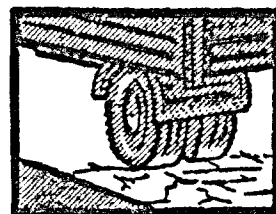
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Concrete roads have longer lives than other types of roads, but only if special care is taken with earth works, subgrades and bases while in construction.

Concrete roads crack under certain conditions. Initial shrinkage of setting, variation in temperature and moisture content, non-uniform subgrade support, traffic loads and chemical pressure are some of the causes.

When the roads are reinforced with **WELDED STEEL WIRE FABRIC**, the high distributive efficiency of the closely meshed wires reduce shrinkage cracks.

WELDED STEEL WIRE FABRIC for concrete reinforcement

The welded steel wire fabric holds even fractured slabs together. When cracks are formed welded steel wire fabric prevents disintegration and reduces the impact of heavy wheel loads. In short, this fabric presents a distributive network of reinforced steel which is essential for better concrete roads. In fact this reinforcement is more economical than additional thickness of concrete. Available in various gauges and spacings.

Distributed by:

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BUILD THE ROADS WELL... WITH STEEL WIRE FABRIC

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