

Transport Communications

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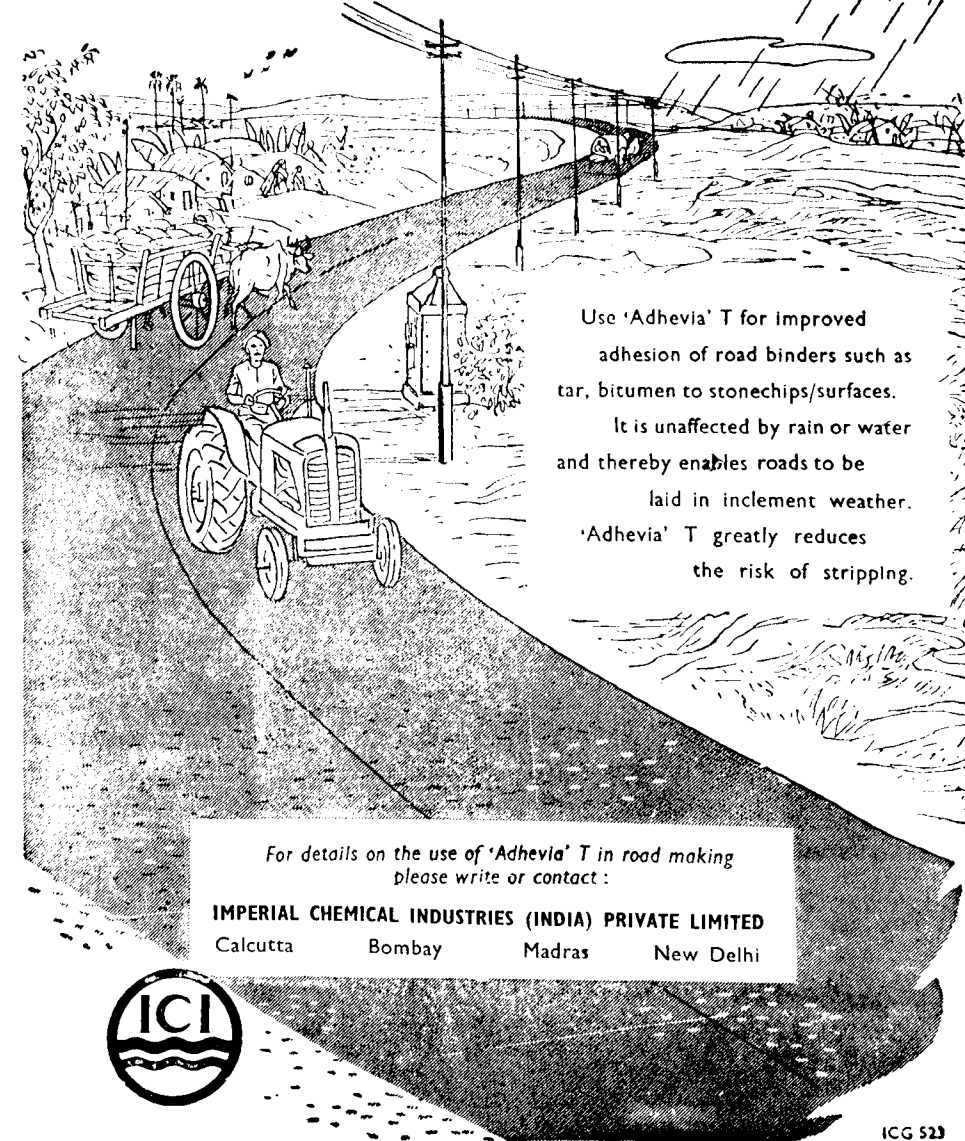
MONTHLY REVIEW

MARCH 1958—No. 131



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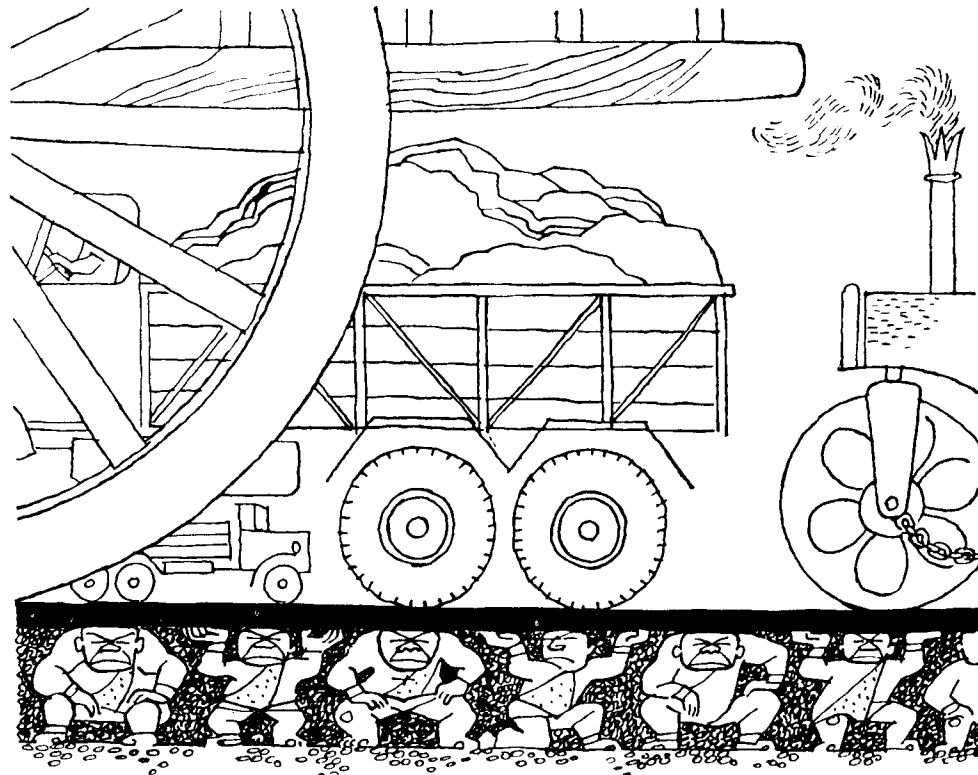
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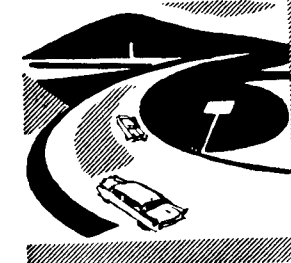
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THE STORSTROM BRIDGE BETWEEN ZEALAND AND THE ISLAND OF
FALSTER IN DENMARK

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

MARCH 1958

BRIDGING INDIA'S RIVERS

UNDER the above heading a series of 39 articles on completed bridges has been published so far in the columns of this Review. Although these articles do not profess to be an exhaustive collection of all the data on the finished works, yet it will be seen that they cover a sufficiently wide ground all over the country so as to be able to present a varied selection which will be of interest to engineers. Bridging problems in India are so vast and varied that each case requires individual attention. Nevertheless, a study of completed structures can be a source of information and instruction both to bridge designers and bridge builders. With the kind co-operation of members, it is proposed to continue the series of articles so that it may serve as a supplement to the more detailed information regarding certain selected bridges available in the Journal of the Indian Roads Congress (60 Papers published so far.)

It is not difficult to realise that the highway system of a country cannot be brought fully into commission unless bridges are provided over rivers which the highways have to cross. Crossing the rivers by boats and ferries is not only cumbersome and dilatory but also adds to the cost of transport, in addition to involving risk to human life. Bridges are, therefore, vital links in the communication system of a country. No wonder then that construction of major bridges has been given a high priority in the Second Five-Year Plan, in the course of which 116 major bridges are proposed to be constructed in the Central Sector; in addition there are others in the State sector of the Plan.

Construction of bridges is both a difficult and a costly item as compared to the construction of roads, and that is why building bridges over big rivers did not make much headway in India in the past, though individual instances of big bridges are not lacking. There is also another factor to be reckoned with and that is the diversity of bridging problems in a country with varying geographical features consisting of the mighty Himalayan ranges and the Indo-Gangetic plains in the north, the Vindhya range in the middle and the Deccan Plateau and the coastal strips in the south. These conditions principally determine the courses of the main waterways which the highways have to cross at various stages of the flow of rivers from their origin to their destination. Sometimes the same river is crossed several times, e.g., the Ganges is crossed eight times by road/rail bridges in Uttar Pradesh alone. But each time the problem is completely different. The fluctuations in the discharge of rivers at different times of the year and the phenomenon of river meandering in the deltaic plains further complicate the bridging problems.

Fortunately, by now, a large amount of hydraulic and geological data regarding rivers and their courses is available, thanks to the pioneering work of several eminent engineers in this field. Codification of knowledge derived from prolonged research, model experimentation and field experience is a notable contribution to the science and practice of bridge engineering in India and has served to provide broad guiding principles in formulating bridge projects. A study of some of the existing bridges, both rail and road, which are fortunately not few in number, is a further aid in this direction,

Most of the road bridges built in the past were either masonry or girder bridges and the spans were limited. The Grand Trunk Road is an instance in point. On this road, there are nearly 70 bridges of over 50 ft span in Punjab (India) State alone. They were built nearly a century ago but many of them are standing soundly till today and are monuments both to the skill and foresight of the older generation of engineers and the inherent strength of local materials employed. They were mostly designed for a 10 to 12 ton road roller. After World War II and the consequent post-war development, heavier vehicles began to ply on the roads and the need for revising the design loading for new bridges was keenly felt. The I.R.C. revised standard specification for highway bridges thus came into existence. With the steady increase in road transport in recent years and in view of the future development and industrialization of the country, it is seen that the measure was taken none too soon. The strengthening or reconditioning of old bridges to suit modern conditions is also a problem for careful study and ingenious reinforcement and replacement wherever possible.

With the advent of reinforced concrete it has become possible to build longer and stronger bridges. Various types of such bridges have been built in recent years. The types cover T-beam, arch, balanced cantilever, bow-string girder, rigid frame, etc., built to suit various spans and other requirements. The choice of type depends on various factors and a careful study of local conditions is required. For example, balanced cantilever is particularly suited where foundation conditions are not unyielding; the rigid frame requires solid foundation material but provides economy in continuity and becomes both lighter and pleasing in appearance. The use of the aesthetically pleasing arch is again recommended under suitable foundation conditions, while the bow-string girder, may be costly and like other through-type structures, although providing greater water clearance, may leave something to be desired as a smooth connecting link which is becoming increasingly necessary with fast moving traffic. Broadly speaking, the modern trend seems to be towards continuous spans as this is justified both from the point of view of simplified construction and economy in materials.

From reinforced concrete to prestressed concrete is not a small advance. Use of prestressed concrete as a method of bridge construction has introduced further possibilities of soundness and economy. The record of bridges of this type already built in India is quite impressive and the knowledge and experience thus gained will pave the way for adopting the technique on a wider scale on some of the big bridging projects yet to be undertaken in the near future. Generally speaking, prestressed concrete can be used with advantage for longer spans, thus effecting considerable economy in foundations and piers. There are, however, some difficulties in getting high tensile steel and other special equipment which are necessary for this type of work. Availability of these will make further progress easy.

Bridge construction is a specialized job and before the execution of any project can be undertaken, detailed surveys and collection of data are necessary, based on which economical designs can be prepared. On the execution side, there are questions of special plant and equipment and trained personnel. All this is a time consuming process, but once fully mobilized demands large scale and continuous activity. As pointed out by Shri Bisht in the course of his Presidential Address at the 22nd Session of the Indian Roads Congress, an increasing tempo of bridging activity calls for careful planning and specialization in our highway departments. Adequate finance has also to be assured. In specific instances where this is not forthcoming, recourse may have to be made to expedients like the one launched by the U. P. of levying tolls on big bridges for a specified period. The results of the U. P. experiment will be watched with interest.

Bridges are moulded permanently into the highway landscape of a region and thus become an integral part of it. Aesthetics of bridge design is, therefore, an important aspect which requires careful consideration. We have all felt the experience when the site of a bridge is pleasing to the eye and satisfying to the senses in the midst of the drab monotony of a long journey. To achieve this object, the design adopted for a bridge has to blend with the surroundings in the matter of proportions, masses and lines. The consideration of materials employed in respect of their texture, colour and treatment has also a significant part to play. Let our bridges be monuments worth seeing and admiring.

BRIDGING INDIA'S RIVERS

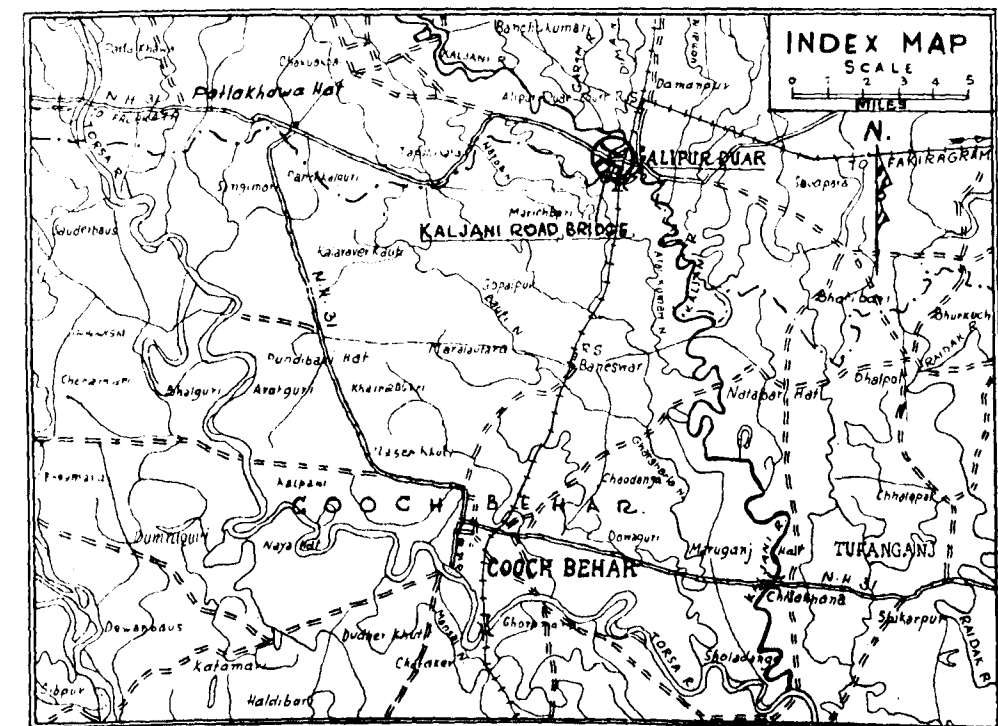
KALJANI BRIDGE AT ALIPUR DUAR

(BY COURTESY OF WORKS & BUILDINGS DEPTT., WEST BENGAL)

Kaljani River

THE RIVER KALJANI originates in the Bhutan Hills within a few miles from the West Bengal boundary. Many streams, big and small, have mingled their waters to build up this river. Chief amongst them are the ALAIKURI and the DIMA. Rising from the Bhutan Hills, the two streams flow southwards, carrying down the water of various other tributaries, and meet near the town of Alipur Duar to form what is known as the KALJANI.

and narrow stream, calm and tame. With the onset of rains, however, the scene is completely changed and in a rather dramatic fashion. With the first showers in the upper reaches, the tributaries start pouring into the main stream their discharges, heavily loaded with boulders and uprooted timber, and the KALJANI presently swells into a mighty river, a giant mass of swirling water surging forward with terrible fury, tearing at the banks, flooding the countryside, and sweeping off all obstacles on her way.



The behaviour-pattern of the KALJANI shows all the general characteristics of a typical North-Bengal river. During summer the greater portion of the river-bed gets dried up, the flow dwindles and the KALJANI meanders along, a small

Location

As will be seen from the index map, the river KALJANI while flowing from North to South cuts across three lines of communication of vital importance, viz., (1)

the Falakata-Patlakhowa-Alipur Duar Road, (2) Dinhata-Cooch Behar-Alipur Duar Section of the Northern Railway, and (3) the National Highway No. 31 leading to Assam. The Railways built their bridge long ago; the bridge over the National Highway No. 31 has also been completed about three years back. But the gap in the Patlakhowa-Alipur Duar Road, the life line for the town and the surrounding areas on the left bank of the river, remained unbridged so long. For people in these areas life continued, as in the past, in a state of virtual isolation with regard to road communication, especially during the monsoons.

After several attempts the project was seriously taken up for consideration after Independence. The influx, in consequence of the Partition, of a large number of displaced persons in the town of Alipur Duar created a state of acute congestion and the atmosphere steadily grew unhealthy. Extension of the town on to the other side of the river where suitable land was available could relieve this congestion. The need for a bridge was felt all the more keenly by all concerned. The matter was taken up in right earnest and finally the project for construction of the KALJANI BRIDGE was approved by the Central Government in April 1952, at a cost of Rs 16.10 lakhs including the cost of approaches. The work was commenced on 30-12-53 and was practically completed by the end of June 1956, in spite of the fact that progress was considerably held up due to the abnormal and untimely floods that came in the intervening years of 1954 and 1955.

Waterway

Though the river remains docile and carries only a small discharge during the major part of the year, sudden freshets and heavy floods occur frequently during the monsoons. Necessary provision has, therefore, been made for adequate flood discharge. The railway bridge on this river, within a mile downstream of this site and constructed about half a century ago, has a clear waterway of about 350 feet. The road bridge on National Highway No. 31, about 20 miles downstream along the river course, was constructed a few years ago with a clear waterway of 450 feet. The waterways of these two

bridges were good guides and after due consideration of other relevant factors, including the behaviour of the river at the two bridges, it was ultimately decided to have the new bridge designed with a clear waterway of about 400 feet.

Design

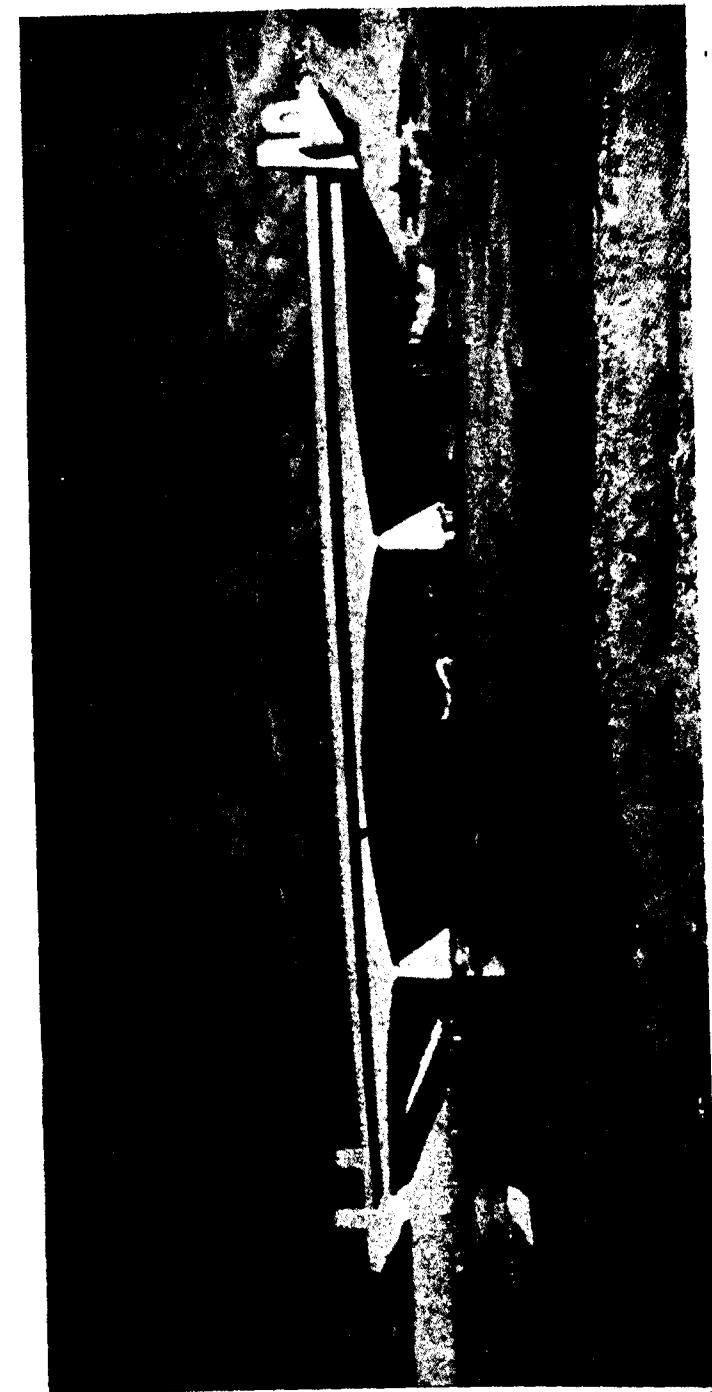
In the early forties, a tentative design had been prepared with 15 spans of R. C. Box culvert of 30 feet each. Subsequently, however, the river was found to carry a large volume of drift timber and in order to obviate the chances of entanglement of such drift timber with consequent hazards of blockage of openings, it was ultimately decided to redesign the bridge with large openings.

Two alternative schemes of R.C. long-span bridge one with 5 spans of T-beam and slab and the other with 3 spans of hollow-box girder were accordingly prepared. The latter was found to be cheaper on actual tender. Moreover, in addition to longer openings, the hollow-box girder with the soffit slab provided a smooth under-surface, thus minimising the chances of entanglement of drift timber. This design was, therefore, ultimately adopted for execution.

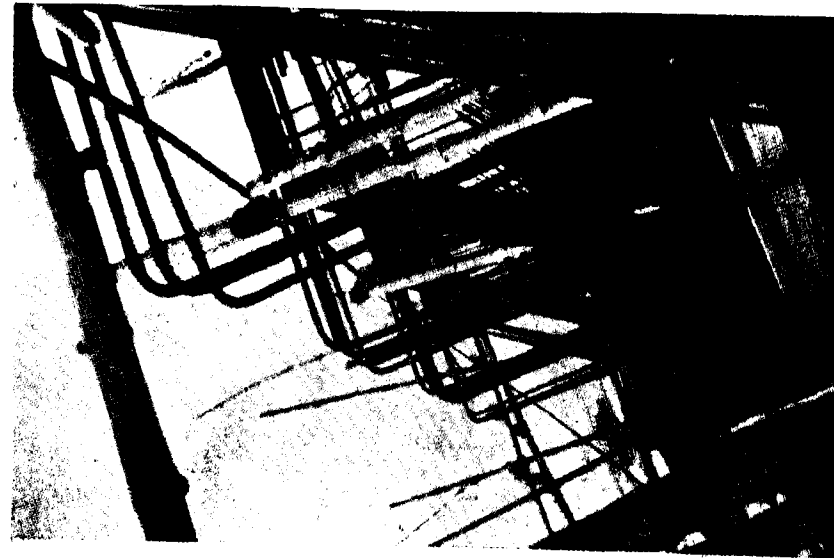
General Details of the Bridge with particular reference to Special Features

The bridge has a super-structure of reinforced concrete balanced cantilever of hollow-box type. There are 3 openings, the end openings being 120 feet each and the central opening 180 feet which, to the best of information, is the longest of this type so far constructed in India. Each end span (i.e., the anchor span) has a cantilevered arm of 50 feet projecting into the central opening and supports a freely suspended span of 80 feet in the middle of the bridge.

The super-structure rests on the abutments and the piers where suitable bearings have been provided. Steel bearings, which are generally used in such cases, are sometimes left unattended to for a long time due to difficulty of access to such bearings. In this particular bridge



Elevation of Kaljani bridge looking from (S. to N.)



Reinforcement at articulation



Shuttering of cross-diaphragms of Box-girder



Abutment casting

steel bearings have, therefore, been done away with wherever possible and reinforced concrete bearings used instead both at the abutments and at the piers. The space available at the articulations for such bearings being very restricted cast steel bearings have been used in these positions only. These steel bearings have, however, been completely enclosed in a grease-box which would give necessary protection to the bearings and ensure smooth working. Moreover, arrangement for easy access to these bearings for inspection and attendance has been provided.

For the structural arrangements adopted in this bridge it is usually necessary to anchor the super-structure to the abutments and for this reason roller bearings are provided over the piers. With the adoption of R.C. bearings it has been possible in this case to reverse the arrangement, i.e., to use R. C. roller bearings at the abutments and rocker bearings at the piers resulting in considerable economy in the cost of bearings, on account of the fact that the capacity of the bearings necessary at the abutments is considerably less than that necessary at the piers where the reaction is the heaviest. In this particular instance anchoring at the abutments was not found necessary for the theoretical design load; nevertheless, anchorage has been provided through the concrete rollers to give the necessary factor of safety in case of any likely overloading.

The rocking arrangement at the piers has been made very simple by providing a curvature at the top of the piers and anchoring the super-structure thereto with steel dowels sheathed in copper. The pier cap has been reinforced with spiral reinforcement at the positions of the ribs of the super-structure, i.e., at the load-concentration points. The arrangement of bearings so formed would allow rotation but no translation.

The carriage-way of the bridge is 22 feet wide with 3 feet 3 inches clear foot-paths on either side. The overall width of the decking is 30 feet and is supported by 23 feet 6 inches wide box-girder having 4 longitudinal ribs and cross diaphragms about 24 feet apart. In order to minimise the difference in temperature of the at-

mosphere inside and outside the box-girder, ventilation arrangements in the form of holes in the soffit slab have been provided. Openings in the diaphragms allow internal circulation. Manholes have been provided in the deck slab to enable access into the boxes so that inspection of any part of the bridge, if so desired, is possible. In fact, it is possible to cross the river through the bridge.

The expansion gap in the concrete structure at the articulations have been kept 6 inches, which is much more than what is necessary for temperature movements. This large gap would allow for any possible tilt of the substructure in future. The design of the joint is a special feature of the bridge and is so formed as to provide a smooth riding surface without any bump whatsoever. The expansion gap of 6 inches is spanned over by a chequered steel plate resting on a corresponding steel bearing plate on the other side. In plan the gap between the two steel plates is of serrated shape and is formed in such a way that in crossing the gap some portion of the tyre width will always be on the top-surface.

The superstructure is supported on two piers and 2 R.C. open-type abutments.

The substructure rests on twin-D wells of concrete sunk to a depth of 60 feet from the river bed. R.C. curb with steel cutting edge has been used at the bottom of the wells. The wells have been plugged with weak concrete up to curb height and 2 feet 6 inches thick R.C. slab has then been provided over the mass concrete plug to ensure positive bearing.

As a departure from the usual practice of having return walls on open foundations, these have been, in this particular bridge, cantilevered out from the main abutment. With this arrangement no part of the bridge structure will be damaged in any way even if the approach banks are attacked and breached by the river.

This bridge is practically in the town of Alipur Duar and as such special attention has been given to architectural features. The return walls at both the approaches have been widened out so as to provide a space for visitors to stand and enjoy the

sight without any interruption to the normal flow of traffic either on the roadway or on the footpaths. The footpaths have been provided with paving tiles in a different colour so that these stand out in contrast to the grey surface of the concrete roadway. The niches in the pylons are provided with sculptural works in coloured concrete.

Some Facts at a Glance

(1) Total length	... 477 feet (including approach slabs).
(2) Length between end bearings	... 420 feet.
(3) Design loading— Roadway	... One lane of I. R. C. Class 'AA' or two lanes of I. R. C. Class 'A', whichever produces worse effects.
Footpaths	... Crowd load as per I. R. C. specifications.
(4) Super-structure—Type	... R. C. balanced cantilever hollow box girder, having anchor spans of 120 feet, cantilever arms of 50 feet, and a suspended span of 80 feet, making a total central opening of 180 feet.
Width	... 30' 0" wide 22' 0" carriageway and 3' 3" clear footpath on either side.
Box-girder	... 23' 6" wide, top and bottom slab formed into box with 4 longitudinal ribs.
Top slab	... 8" uniform thick.
Bottom slab	... Varying from 6" to 15" thick.
Longitudinal ribs	... Thickness varying from 9" to 12"; depth varying from 7' 0" to 14' 3" in anchor span and 6' 0" to 14' 3" in central span.
Diaphragms	... Thickness varying from 8" to 2' 6".
Footpaths	... Cantilevered out from box-girder.
(5) Bearings—At articulations	... Cast steel bearings of 80 tons capacity.
Roller bearing (with 9" dia. single-roller) on Alipur Duar side.	... 4 Nos.
Rocker bearing on Patlakhowa side	... 4 Nos.
At abutments	... R. C. Roller bearings. 7 Nos. of rollers on each abutment; each roller 2' 0" dia., 2' 6" total length, 2' 3" effective length, capacity 50 tons.
At piers	... R. C. rocker bearing (1,200 tons capacity) with steel dowels sheathed in copper.
(6) Piers—Type	... R. C. solid type resting on wells.
Height	... 27' 3".
Thickness	... 4' 6" at top and 6' 8" at bottom.
Length	... 28' 2" at top and 30' 4" at bottom.
Cap	... 3' 0" thick.

(7) Abutments—Type	... R. C. open type resting on wells.
Height	... 35' 6"
Cap	... 3' 6" thick.
(8) R. C. Pylons	... Two at each abutments.
(9) Return walls with approach slabs	... Approach slab supported on 4 ribs, two of which act as return wall, the ribs are cantilevered out from abutment columns.
Depth of ribs	... 13' 0" at abutment column reduced to 2' 9" at ends.
Thickness of ribs	... 1' 3".
Approach slab	... 9" thick.
(10) Wells—Type	... R. C. twin-D shaped.
Number of wells	... 4 (2 for piers and 2 for abutments).
(a) Well curb	... R. C. with steel cutting edge.
Length	... 33' 6"
Height	... 7' 3".
Thickness at top	... 3' 0".
(b) Well steaning— Thickness	... Peripheral wall 4' 0". Internal wall 5' 0".
Dredge holes	... 10' x 9'.
(c) Depth of wells	... 60 feet.
(d) Well cap	... 2' 0" thick for abutment wells. 3' 6" thick for pier wells.
(11) Wearing course—On roadway	... Cement concrete, 3" average thickness.
On foot-paths	... Coloured paving tiles.
(12) Approximate quantities of materials consumed.	

	Concrete (c. ft.).	Cement (cwt.).	Steel (cwt.).	Shuttering (s. ft.).
In super-structure	32,500	7,475	4,631	53,670
In piers	8,500	1,020	118	3,570
In abutments	19,500	3,510	1,011	23,650
In wells	94,500	11,340	2,776	38,660
Total :	155,000	23,345	8,536	119,550

	Rs (In lacs)
(13) Approximate cost of bridge proper	
(a) 4 wells	6.40
(b) 2 abutments with return walls and pylons	1.66
(c) 2 piers	0.42
(d) Super-structure including bearings, pavements, railings, etc.	4.68
Total :	13.16

	Rs
Approximate cost per running foot of bridge.	2,760

ENGINEERS COULD INCREASE OUTPUT 25 PERCENT

RE-DEPLOYING AVAILABLE MANPOWER

The engineer is now applying the same technique to the solution of his manpower shortage that he has always applied to his technical problems, says Mr. Robley Winfrey, Chief, Personnel and Training, Bureau of Public Roads, in a paper prepared for the American Road Builders' Association.

Prominent in the accomplishments that save engineering manpower and speed up the total engineering process, he continues, are:—

1. Aerial surveying and photogrammetry as aids to highway location, map making, and design.
2. Electronic and other types of business machines for making all types of arithmetical calculations and arrangements of data.
3. The self-levelling level and other recently developed types of surveying instruments.
4. Standard plans and standard portions of plans.
5. Photographic processes of printing plans to save both time and expense over the time-honoured blueprinting process.
6. Radio communication between head quarters and field personnel and between field project headquarters and mobile units on surveying, construction and maintenance.
7. Longer mileage projects under one contract.
8. Design Tables to save calculation time.

Fifty percent Man-hour Reduction

These techniques, procedures, and instruments represent just a few of many possibilities that each highway department has available for application to its daily operations. By judicious selection and full application of these and other ideas, the total man-hours devoted to the

engineering processes within a highway department could be reduced from 10 to 50 per cent.

There is no greater nor more important material in engineering than engineers and their assistants. They are the ones who will apply new devices, procedures, and techniques if given the opportunity by top management. But we use our engineers and their assistants at a level far below their abilities.

Use Engineers More Effectively

In engineering work we endeavour to utilise materials and equipment to their greatest advantage. We consider it poor design to use thicker sections or more steel than is required to carry the design loads. We do not use a 10 ton truck to carry a two-ton load. In fact, the whole of engineering is primarily an effort in engineering economy. And we follow this precept in application of our training and education to our technical designs and construction and maintenance processes. There we seem to let the matter rest.

If we apply our concept of the engineering process to the use of engineering man-power we could easily save 25 percent of the time of professional engineers. Under such a plan we would need to hire additional assistants—engineering aids and general office help—but our higher type material—the engineer—could then be used in a manner more nearly approaching its best and most economical use.

Avoid Sub-Professional work

In every highway department there are the usual operations of surveying, drafting, plotting of survey notes, estimating construction quantities and construction costs, calculating, tabulating engineering information, assembling and checking of engineering papers and reports, sampling and testing of materials, inspecting cons-

(Continued on page 14)

THE BEGINNING OF THE SPACE AGE

THE launching of the artificial Earth satellite, Sputnik, by the Soviet Union October 4 definitely marked the beginning of the Space Age. About 10 days following this event, a distinguished astronomer, writing in the New York Times, prophesied that animals would be carried into space by satellites by 1964. Three weeks after the publication of this prophecy the Soviet Union launched a second satellite reported to weigh more than half a ton and carrying a live dog. From now on anything can happen. Perhaps even before this article is printed a rocket will be shot to the moon. These are really shattering events, and it is difficult for us to realize their importance and implications.

In order to appreciate to some extent the magnitude of the Russian's accomplishment, it is worth while to consider our own plans for an Earth satellite. Writing in the November, 1956, issue of the Scientific American, Dr. James A. Van Allen, who has been chairman of the United States Upper Atmosphere Rocket Research Panel since 1947, stated that the first Earth satellite would be in its orbit by early 1958. At this time it did not occur to Dr. Van Allen, or to any one else in the United States, that the Russians might launch the first artificial Earth satellite. In his article, Dr. Van Allen briefly and clearly outlined the plans for the launching of a small Earth satellite. This satellite was to be approximately 20 inches in diameter and to weigh 20 pounds. The finless three-stage rocket which would launch it would weigh 11 tons and be approximately 72 feet long and 45 inches in diameter.

As is proposed (I assume the plans have not been changed) the first stage is to be an improved version of the Viking rocket, burning a mixture of alcohol and gasoline with liquid oxygen. This first stage would deliver a thrust of 27,000 pounds for approximately 140 seconds, the rocket would be launched in a vertical direction, but would gradually be tilted to a 45-degree angle; at burn-out of the first stage, the vehicle is expected

to attain an altitude of 36 miles and a velocity of approximately one mile per second.

The second-stage rocket is to be an improved version of the Aerobee, which would be powered by hydrazine and nitric acid. This stage is expected to accelerate the vehicle to a velocity of about three miles per second (1100 miles per hour). At burn-out, an altitude of about 140 miles is to be reached. The vehicle would then coast to an altitude of some 300 miles, during which time its velocity would decrease to about 2½ miles per second. The plan is to have in the second stage the control mechanism for all three stages. Just previous to the launching of the third stage, which is to be housed in the nose of the second stage, some pinwheel rockets will be activated to start the vehicle spinning on its long axis.

The third stage (a solid-propellant rocket) will accelerate to a velocity of 5 miles per second or 18,000 miles per hour (orbital velocity at this altitude), and finally the satellite will be separated from the shell of the third-stage rocket and they will both continue to circle the Earth in approximately the same orbit until they are slowed down by outside forces (for example the resistance of the rarified atmosphere which may be present at this elevation). When they have been slowed down appreciably they will begin to spiral in towards the Earth, being continually accelerated by gravity, and on striking the denser portions of the atmosphere will no doubt be consumed by the intense heat generated by friction with the atmosphere.

All this sounded tremendously impressive and seemed to present almost insuperable problems, but now it is obsolete and out of date. Let us compare the size of the satellite which the Russians have already launched to the one which we have proposed. Sputnik No. 1 was reported to weigh 184 pounds, almost nine times the weight of our proposed satellite. Assuming the fuel which the Russians used is no more efficient than our rocket fuel, this

would mean that the vehicle which launched this satellite would have weighed, at take-off, nearly 100 tons. Sputnik No. 2 is reported to weigh 1120 pounds, or 56 times the weight of the satellite planned for launching by means of the Vanguard vehicle. By the same calculations, we can conclude that the rocket which launched Sputnik No. 2 must have weighed more than 600 tons. Such calculations as these have led some American scientists to believe that the Russians have a more efficient rocket fuel than any which is presently available to us.

The Russians will undoubtedly obtain, from observations made on these two satellites, much data that will have important bearing on space flight. As a physiologist, I am interested in the reactions of this Russian dog which had the distinction of being one of the first living things to be propelled from our Earth into space. Among the problems which may eventually be solved by such satellite experiments are: (1) the reac-

tions of animals to the gravity-free state; (2) the best method by which to pressurize and air-condition the sealed cabins to be used in space flight; (3) the effect of cosmic radiation on living animals; and (4) the tremendous problem of re-entry into the atmosphere of the Earth. Not until this last problem has been completely solved will we be able to get our space travellers back to this planet alive.

It is not my place to attempt to point out the tremendous political and economic implications of these happenings. However, it is appropriate to point out that these scientific advances are of tremendous importance, certainly no less important than the development of atomic energy, and from the view-point of modern history they might well be considered comparable to the discovery of the Western World by Christopher Columbus.

(From "News in Engineering", November, 1957.)

(Continued from page 12)

truction, and other operations that should be performed by engineering aids and technicians under the direction of the engineer rather than by the engineer. Within the offices, there is to be found a host of typing, filing, reviewing of papers, answering of correspondence, record keeping, errand running, and receiving of visitors that can be done satisfactorily by general administrative help.

Close attention to the assignment of man-power in accordance with the specific abilities and training and the determination on the part of top management to prohibit professional engineers from doing sub-professional operations should, as an estimate, result in the saving of 10 to 50 per cent of the professional engineer's time as now utilised. The engineers would then have more time to spend upon the truly engineering responsi-

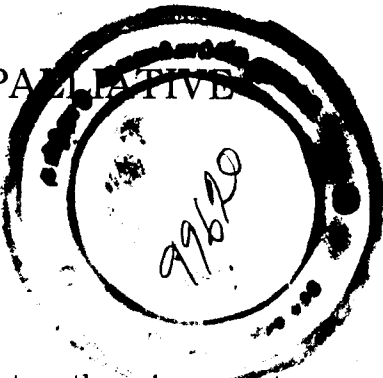
bilities to the achievement of better engineering and happier engineers.

The adoption of new devices, procedures, and techniques and the shifting of duties from engineers to engineering aids and general assistants will require additional training and education of those employees who are to undertake the new assignments. The language barrier between engineers and their non-technically trained secretaries may come to an end, in the Pittsburgh, Pennsylvania, area at least. A business school there has a new two-year course which will produce engineering "secretary-assistants" who can double as office girl and lab. assistant. Students will learn the specialised vocabulary of the engineering profession, lab. work in physics and chemistry, and will carry a full curriculum of secretarial studies.

(From "Highways and Bridges and Engineering Works" November 6, 1957).

USE OF WASTE OIL AS A DUST PALLIATIVE FOR ROAD BERMS

By
L. R. CHADDA



OILING of earth roads as a dust preventing measure has been extensively tried in some countries with ample success. Dusty berms on both sides of the road usually prove a great nuisance to the pedestrians and passengers alike. Stabilizing road berms with soft aggregate is no doubt the proper and lasting solution for overcoming dust nuisance, but considering the expenditure involved, its immediate adoption on a large scale may not be possible. Due to nationalisation of road transport service in most

of the Indian States, there is a great possibility of getting waste crank oil at a cheap rate and this may prove to be of some use as a dust palliative on road berms after mechanical stabilization. In view of this consideration some small field trials were conducted at the P. W. D. (B & R) Research Laboratory, Karnal, with different types of soils commonly found in the Punjab. The physical characteristics of the soils selected for the study are given in table 1.

TABLE No. 1

Soil No.	Liquid Limit	P. I.	Sand per cent	Sulphate	Optimum moisture
1	35.8	15.4	11	Nil	13.0
2	31.3	12.1	33.7	0.1	12.0
3	30.0	11.5	41.8	Nil	14.0
4	26.2	9.4	54.8	Nil	14.0
5	26.8	8.5	53.0	Nil	12.0
6	23.4	6.7	60.0	Nil	11.5

A circular 7 ft wide track (Fig. 1) covering an area of 415 sq. ft. was prepared for the above experiment. The area was divided into 6 Nos. equal segments and each of the above type of soil 4½ in. loose thickness was compacted at Optimum Moisture with rammers in each segment to 3 in. thickness. In portions using soil No. 4, 5 and 6 grafting with brick-ballast passing 1 in. gauge was also

carried out at the top surface in half of each segment.

The compacted experimental portions were cured for a short period with light sprinkling of water.

After a lapse of 24 hours, used mobile oil was applied in single and double coats at the following rates.

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D4) m2, N48
NSA-13)

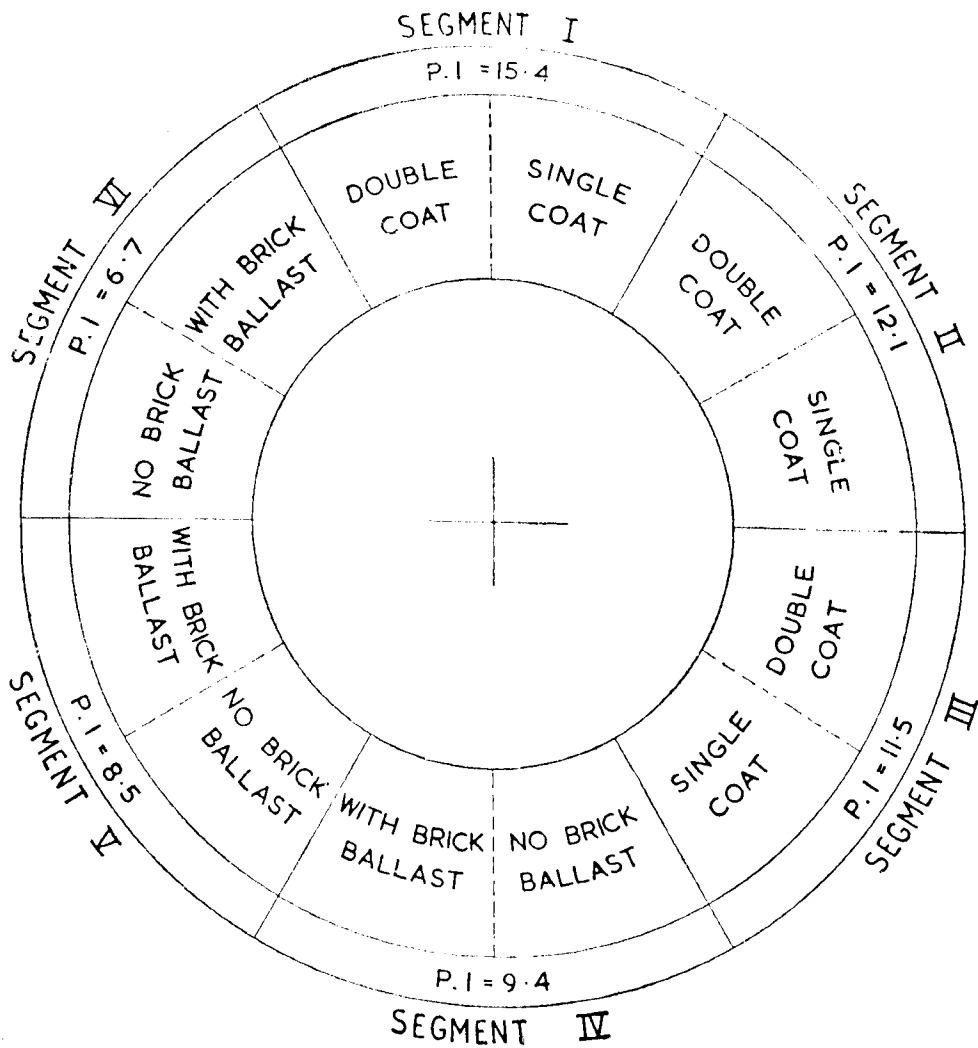


Fig. 1.

Portion No.	P. I.	Number of Coats.	Rate of application.
1. 1st half	15.4	Single coat	2.1 gallons/ 100 sq. ft.
2nd half		Double coat	3.4 -do-
2. 1st half	12.1	Single coat	2.1 -do-
2nd half		Double coat	3.4 -do-
3. 1st half	11.5	Single coat	2.1 -do-
2nd half		Double coat	3.4 -do-
4. 1st half	9.4	With brick-ballast	3.0 -do-
2nd half		Without -do-	2.5 -do-
5. 1st half	8.5	With brick-ballast	3.0 -do-
2nd half		Without -do-	1.5 -do-
6. 1st half	6.7	With brick-ballast	3.5 -do-
2nd half		Without -do-	3.0 -do-

The waste oil was allowed to soak for 24 hours in each of the above experimental portions. After this the track was tested by allowing a loaded cart (2200 lbs) to move over it. The width of the iron wheel of the cart was 2.5 inches and the track was subjected to 900 trips of the loaded cart at the rate of 300 trips per day. The condition of each experimental portion was carefully examined. Least damage was observed in portions laid with soil having P. I. 15.4 and the extent of damage increased with decrease in plasticity index or say with clay content. Presence of high clay content offers greater resistance to disintegration under slow moving bullock cart traffic. In case of sandy soils the gratted portion behaved

better than the other ones where no brick-ballast had been used. It shows that for the protection of sandy berms, addition of some soft aggregates like brick-ballast is rather desirable.

Further experiments were continued in the laboratory to find out the effect of waste oil on the abrasive resistance of compacted soil blocks. For this purpose, compacted soil blocks were prepared with the soils mentioned in table I, at optimum moisture. After drying, the blocks were coated with waste oil at the rate of 20 lb per 100 sq. ft. and later on tested for abrasive resistance on Dorry's type Abrasion Machine. The results obtained are presented below :—

Soil No.	P. I.	Abrasion in gms. per sq. inch of the surface area after 1000 revolutions	
		Blank	With waste Oil
1	15.4	16.2	9.2
2	12.1	20.5	11.1
3	11.5	16.95	9.3
4	9.4	26.7	12.6
5	8.5	52.8	15.2
6	6.7	70.95	2.79

It will be seen from the above results that application of waste oil has appreciably improved the abrasive resistance of soils after compaction. This indicates that the use of waste oil may prove to be of immense value as dust palliative for road berms when applied after mechanical compaction.

Field Tests

The use of waste crank case oil, procured from Punjab Roadways was tried on a short length between M 24/0 to M 24/4 of Ambala-Kalka Road. Four different types of soil were collected from the road sides and spread on the berms raising its level upto that of the main road. Portions

having different soils were demarcated and rolled with 1½ ton roller. The oil was sprayed with spray pump at the rate of 3-4 gallons per 100 sq. ft. and it was allowed to penetrate.

The behaviour of the berms was noted after a period of 2 weeks and it was observed that lengths where graded soil (P. I. 10.3 and sand 28 per cent) and clayey soil (P. I. 17.9 and sand content 7.0 per cent) were used gave performance in comparison with silty soil (P. I. 10.5 and sand content 23.1 per cent) and sandy soil (P. I. 7.1 and sand content 52.2 per cent) stretches. It is felt that rolling with heavier rollers say 6-8 ton would have given better performance.

DOMESTIC

“ Since I started talking to you, John, I’ve lost my headache.”
“ It’s not lost, dear—I’ve got it.”

TEMPORARY ROADS OF REINFORCED CONCRETE
SLABS*

THE construction of temporary roads on building sites is always a difficult problem, particularly where porous clay soils are involved. An interesting example is afforded by the Lenin works at Nowa Huta, near Cracow. In past years, before the construction of permanent roads, a few days continuous rain covered the whole area of the metallurgical plant with a layer of mud several inches thick which made movement of personnel difficult and of vehicles impossible. Under such conditions the construction of temporary roads of clinker or broken

stone was not satisfactory, in spite of frequent repairs carried out at great expense of time and money.

Such experiences led to the use, in the latter half of 1955, of roads prefabricated from portable reinforced concrete slabs. These elements, designed by W. Dubiel, were tried out for the first time on the building site of the cold-rolling mill at the Lenin works.

The detailed structure of a single element is shown in Fig. 1. The slab is 3 x 2.5 x 0.17 m, and thus can be used for

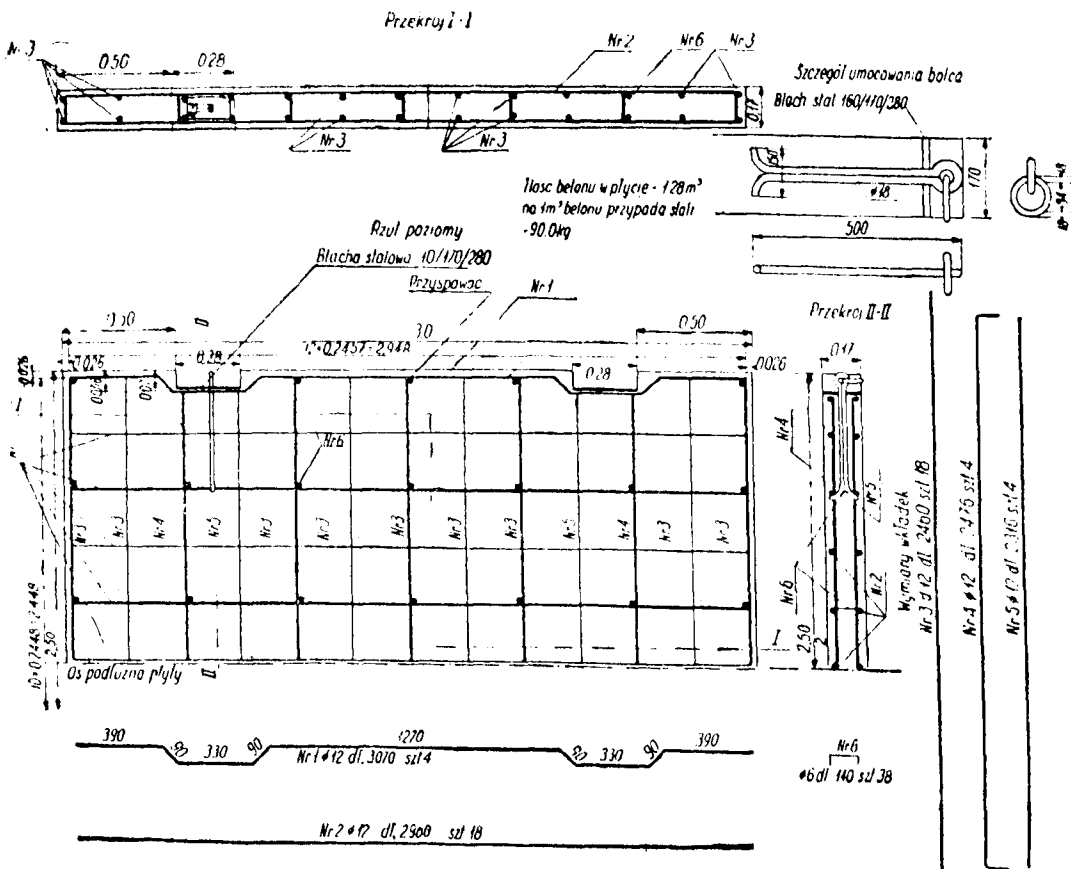


Fig. 1. Structural details of a prefabricated reinforced concrete road slab.

* Translated from an article in "Przegląd Budowlany" Vol. XXVIII, No. 11., Warsaw, 1956.

single track roads having a width of 3 m or double carriageways either 5 or 6 m wide (Fig. 2). The weight of each slab is 3,020 kg, and handling is done by means of lorry-mounted cranes with a lifting

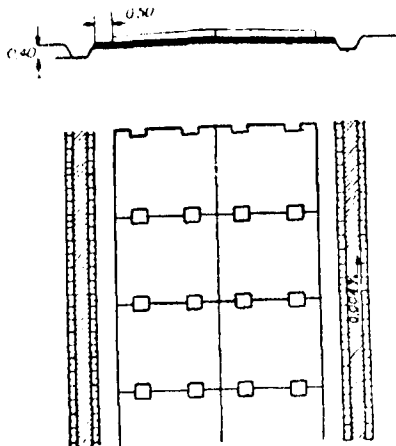


Fig. 2. Above, a cross-section showing shoulders and drainage ditches and below, a road composed of prefabricated slabs seen from above.

capacity of 3 tons. Hooks are used to grapple the slabs, each of which has four sockets to take the steel tongues which join the elements (Figs. 3 and 4).

Speed and ease of assembly are characteristic of the construction of roads from

these elements. The preliminary operations consist of levelling, the preparation of a foundation of sand, gravel or slag, and the cutting of drainage trenches. On the above-mentioned building site, in summer conditions an average of 38 prefabricated elements (95m of road, single track, 3m wide) were laid per shift. The record number per shift in summer conditions was as high as 56 elements, or 140m of single track road. In winter conditions, the output drops a little, amounting to an average of 34 elements per shift.

Dismantling is a somewhat slower process because of the difficulty of getting the steel tongues out of the sockets which fill up with compacted soil. The average speed of dismantling in summer conditions is about 30 elements per shift. In winter conditions when the subsoil is frozen the speed of dismantling depends on the material laid as foundation under the slabs. Thus a sand and gravel foundation allows not more than 10 slabs per shift (25m of road) to be dismantled, and much better results are obtained from a slag foundation, which reduces the cost of building and facilitates dismantling even in the worst winter conditions, because the slabs do not freeze to the dry slag. In such conditions the rate of dismantling amounts on an average to about 20 slabs per shift or 50m of single track road.



Fig. 3. Front view of a surfacing slab being laid.

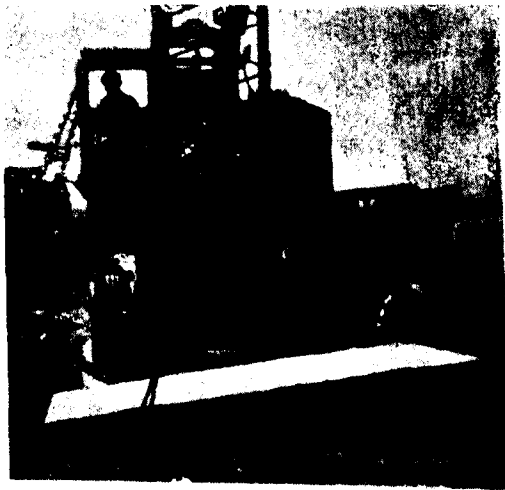


Fig. 4. Side view of the surfacing slab (photos, Przegląd Budowlany, Warsaw).

Roads constructed from these prefabricated slabs proved successful in use on the site of the cold-rolling mill. Thanks to the durable and smooth surface the speed of transit of lorries was much greater, and their movement was unaffected by atmospheric conditions.

The cost of building roads from prefabricated concrete units is about three times higher than that of building them from broken stone. However, the durability of the prefabricated roads is five times greater, their life span being further prolonged if heavy building equipment is not taken over them. Methods of preparation of the foundation also have a great effect on the durability of the elements, as does the type of concrete used. Each slab can be used several times over in the construction of new roads. Complete data on this cannot as yet be given, however, since tests are not concluded. Up to the present the slabs have been used five times and are still fit for further use. It is assumed that on an

average each slab will be used 7 or 8 times. They can be laid for the first time on either side. In later use, the less worn side should be put uppermost. When the slabs are laid on freshly dug ground or moist soil, concrete plates are introduced under the edges of the slabs to avoid unequal settling and the creating of steps at the joints.

The following are the major drawbacks observed in the use of the slabs:

1. Their great weight demands the use of special cranes, thus adding to costs. Further research is indicated with a view to reducing their weight without reducing linear dimensions or durability.

2. The sockets used for assembly were badly positioned. On single track 3m roads the wheels of lorries pass over the socket holes and this causes jarring.

(From "Civil Engineering and Public Works Review", July, 1957.)

TEAM WORK

The road engineer can and will do his job properly only when all the others (the road user, the vehicle maker, the traffic controller, the insurer, the administrator, etc.) are enabled to do their jobs properly. Then he will be part of a team properly ordered in the national interest.

J. A. EGANON

"Present day Road Organisation" — Journal of the Institution of Municipal Engineers, January, 1958.

WISDOM

Life insurance is a plan which keeps you poor all your life so that you can die rich.

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INDEX

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HERE AND THERE

1. SPECIAL SHORT INTENSIVE COURSE ON THE DESIGN
OF SHELL STRUCTURES

● THE Indian Institute of Technology, Kharagpur have decided to conduct a Special Short Intensive Course on "Design of Shell Structures" from the 12th to the 21st May 1958. The object of the Course is to give practical benefit to engineers in the design and application of Shell Structures. The Course will consist of lectures, tutorial discussions, design and drawing. The scheme of lectures will be as follows :

Scheme

1. Shell as a three dimensional structure— Historical development—Types of shells and their structural action—Examples of typical shells built.
2. Stress resultants in a shell— Membrane theory—Development of the D.J.K. differential equation for the Cylindrical Shell.
3. Loads on a shell—Solution of the differential equation for self-weight.
4. Edge beams— their function— calculation of edge disturbance— stresses in the shell due to edge condition.
5. Gables—forces in a gable—design of gables.
6. Approximate method of preliminary dimensioning of shells by means of beam theory.

7. Example of design of shells.
8. Pre-stressing of shells—advantages—method of design.
9. Method of design of multiple shells.
10. Method of design of continuous shells.

The Course will be conducted in the building of the Indian Institute of Technology, Kharagpur, 25 members will be admitted to this Course. In the selection of candidates, preference will be given to those sponsored by their employers. A fee of Rs 50/- only per head will be charged to meet the organising charges, etc. Additional charges for board and lodging will be at the rate of Rs 4/- per day in the Bidan Chandra Roy Hall of residence. All communications about the Course should be addressed to :

Prof. P. C. Varghese,

General Organiser,

Special Short Course on Design
of Shell Structures,

Indian Institute of Technology,
Kharagpur.

(Telegrams — Varghese — Technology,
Kharagpur).

2. CHEMICAL STABILIZATION DATA RELEASED BY MONSANTO

● USE of phosphoric acid as a soil stabilizing agent in construction projects may overcome problems of heavy clays. So states an announcement by the research department of Monsanto Chemical Company's Inorganic Chemicals Division.

"Chemical stabilization of highway subgrades and base courses seems to hold great promise for development in the near future," said M. J. Scott, assistant

director of research for the division, who pointed more specifically to the increasing need for additives to alter soil properties.

Clay soils, when dry, exhibit exceedingly high bearing strengths and would be suitable for subgrade or base course construction. When wet, however, the soil structure expands considerably and much, if not all, of the bearing strength is lost.

Monsanto experiments have shown that if two per cent of phosphoric acid is added to a fat plastic clay and the material compacted, a hard, durable mass is produced that will withstand prolonged exposure to water and to wintering. When a second material, such as Monsanto's Amine ODT, is added, an even more stable soil results.

In laboratory evaluation of this new soil treatment, test cylinders (2 in. diameter $\times$ 4 in.) were compacted from "problem" soils. Testing consisted of immersing the specimens in water for 48 hours, draining briefly, measuring and breaking in unconfined compression. Other tests included volume change measurements. Untreated soils either slaked or failed completely; the same soils, treated with two percent phosphoric acid and cured five days, had an immersed strength of 110 psi and less than one percent of volume change, Scott said.

Several dozen test cylinders were buried outdoors through a New Eng-

land Winter and Spring. Untreated cylinders were reduced to a soft, mushy consistency, while the phosphoric acid treated samples resisted the exposure and gave strengths comparable to the immersed strengths found in the laboratory test cylinders.

No major difficulties are foreseen in the field application of this method of soil stabilisation, according to Scott. Generally, the construction procedure would be similar to the methods now employed with present commercially available stabilisers. The treatment of soil with phosphoric acid appears to hold several economic advantages over conventional methods, including lower storage, hauling and processing costs.

In an effort to demonstrate more fully these and other points, Scott said, Monsanto is conducting further laboratory investigations in close co-operation with several state highway departments.

(From "Roads and Streets", December, 1957).

3. PILES RESTORE BRIDGE PIER IN FRANCE

● GERMAN demolition efforts during World War II have been haunting French engineers near Grenoble, as they struggled

to put a river crossing back in service. According to the French magazine TRAVAUX the job has just been completed.



TILTED PIER is protected from further scouring by a belt of concrete piles,

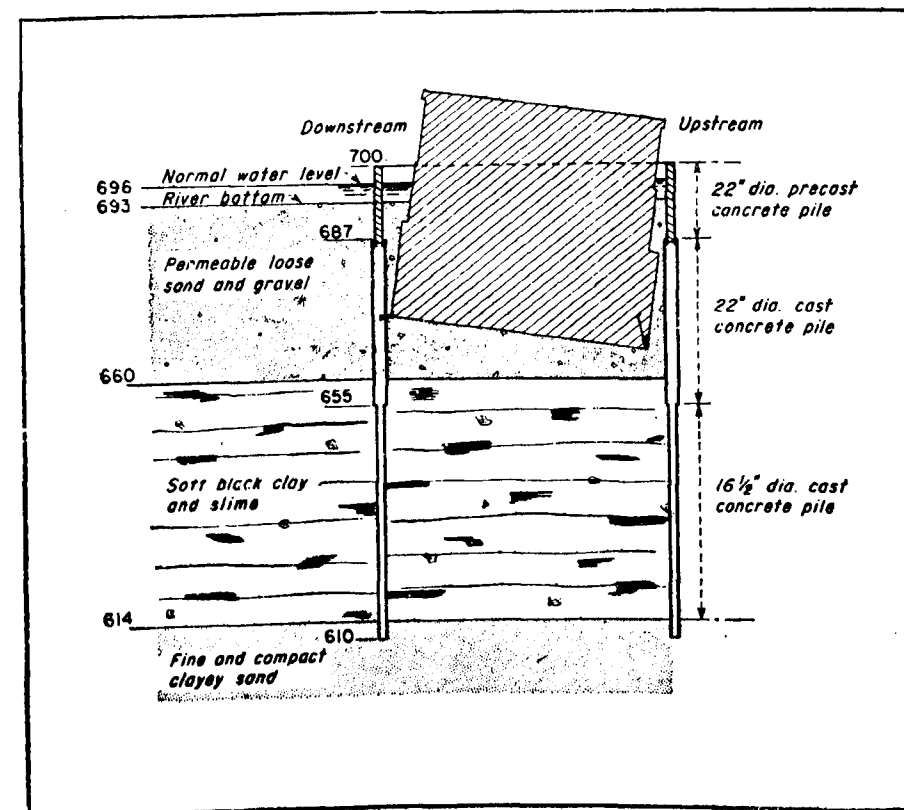
When the Drac River went on a rampage in December of 1954, its flood waters put the Cours Berriat Bridge—which is located between Grenoble and Fontaine—out of service. The pier near the left bank of the stream tilted and sank about 5½ ft, moving horizontally about 4½ ft in the process and, at the same time, twisting two adjoining spans.

Cause of the accident was turbulence set up by the wreckage of an older bridge, destroyed by the German Army in 1944. Wreckage of this structure was left in the stream bed when the bridge was rebuilt after hostilities were ended. The heavy eddy created by the submerged wreckage caused scouring under the bridge pier.

populated area surrounding it, and since the other pier and the spans themselves remained in relatively good condition, the French engineers made up their minds to reconstruct the existing structure.

The first task was to straighten out and realign the two sagging spans. This was done with two 200 ton jacks, bearing on the tilted pier. When raised to the proper height, the spans were blocked on to the pier with reinforced concrete blocks separated by lead sheeting in order to assure proper load distribution.

Ultra-sonic inspection of the reinforced concrete spans confirmed the fact that they were basically sound excepting at



CONCRETE PILES form a firm foundation structure for the rebuilt pier.

Restoration Plans

How to reconstruct the bridge at the least cost was the problem turned over to Enterprise Pascal, of Grenoble, under a reconstruction contract.

Since demolition of the entire bridge would have been difficult in the heavily

the points of visible fracture, where they could be repaired satisfactorily. The decking itself suffered only a few minor separations.

Reconstructing the Pier

While the tilted pier had come to a position of stable equilibrium, renewed

scouring during the reconstruction always was to be feared.

Two means of protection were possible: Either the old wreckage could be removed, which would mean sinking a caisson, or the tilted pier could be surrounded with joined piles for protection from further scouring. The latter method was chosen.

The normal depth of the Drac River is about 3 ft. Below this extends a 33 ft layer of permeable sand and gravel, and then a 40 ft layer of soft clay. And below this is a fine and compact clayey sand.

The engineers also decided to use the piles as a foundation for the rebuilt pier. To serve this purpose, the piles reached a length of 88 ft, to extend into good ground.

To form each pile, a temporary tube was driven into the river bottom and the inside was scraped clean. A 22 in. dia. bit then was driven to penetrate the clay layer some 4 ft. Then a smaller bit of 16½ in. was driven about 44 ft more until the compact sand was reached.

By use of a central tubing lowered into the driven hole, concrete was placed and the tubing then progressively raised. When the bore had been completely filled, it was topped with a precast section of 13 ft length and 22 in. in diameter. Reinforcing steel anchorage set into the fresh concrete assured adequate bond.

After the piles were cast and placed, they were joined to their neighbours at the top by means of lateral grooves and angle irons in the precast head.

Finally, the piles were surrounded with riprap and the space between the pier and piling was grouted.

Once this was done, the job of extending and widening the existing pier was carried out, and a structure to support the spans then was completed.

Then a 30 ton jack shoved the spans into horizontal alignment. After this was done, the work proceeded in repairing and reconcreting the decking and the spans.

(From "Engineering News Record" January 2, 1958).

4. ELECTRONIC COMPUTER FOR DESIGNING ROADS

● THE development of a new method for the design of highways is now being completed at the Massachusetts Institute of Technology. By this method the information obtained by aerial photogrammetry is stored in an electronic computer. The direction and cross-sectional profile of the proposed road are then inserted

into the computer, which calculates the geometry of the centre-line of the road, the cross sections, and the quantities of earthwork. An attempt is being made to produce a method that will also estimate the cost of the work.

(From "Concrete and Constructional Engineering", January 1958).

5. THE INTER-STATE HIGHWAYS in U.S.A.

● AS a result of the Federal Aid Highway Act of 1956, the United States is now engaged in building a net work of 41,000 miles of Inter-State roads. This system will connect 90 per cent of all cities having a population over 50,000. Though it covers only about 1 per cent of the Nation's road mileage, it is expected to carry about 20 per cent of the traffic. Much research and experience have been

utilised in evolving the standards for these highways.

The most important design feature of the system is controlled access. The building of roadside business with direct entrances to the Inter-State system will be prohibited by law. Entry will be permitted only at carefully selected locations. All grade crossings will be eliminated and

replaced by grade separations or interchanges.

The design speeds are 70, 60 and 50 miles per hour for flat, rolling and mountainous topography respectively. When the Design Hourly volume for 1975 exceeds 700 vehicles, the highway will be a divided highway. Medians in rural areas in flat and rolling country will be at least 36 feet wide. In urban and mountainous country this will be at least 16 feet.

It has been estimated that about 70 per cent of the system will be built entirely on new location, as the experience in the States is that the improvement of lengths of highways here and there and the buying up of extra property required for establishing controlled access results in higher expenditure than in building entirely new roads. And in every case the alignment of a wholly new location will be better than a patched-up job.

Another important improvement in existing standards is in raising the separation line between culverts and bridges. According to the old classification, only structures not longer than 20 feet were required to be as wide as the road including shoulders. But the standards for the new Inter-State system required that "the width of all bridges, including grade separation structures, of a length of 150 feet or less between abutments or end supporting piers shall equal the full roadway width on the approaches including the usable width of shoulders." The other important width requirements for longer

bridges are: "Barrier curbs on bridges longer than 150 feet between abutments or end supporting piers, and curbs on approaching highways, if used, shall be offset at least 2 feet. Offsets to face of parapet or rail shall be at least 3½ feet measured from the edge of through-traffic lane, and apply on right and left. The lateral clearance from the edge of through-traffic lanes to the face of walls or abutments and piers at underpasses shall be the usable shoulder width but not less than 8 feet on the right and 4½ feet on the left." These requirements are, of course, the result of accident experience with high volumes of fast moving traffic and are based on the general maxim that "any highway feature which happens to be substantially below the standard of that generally prevalent on a given highway introduces a surprise element with resultant higher accident occurrence."

If the width standard is somewhat lower on a road section, the width can be increased later when the traffic volume increases. But it is extremely difficult to make any such alterations on bridge structures. The life of bridges is of the order of 100 years and there is no guarantee that the traffic volume in 30 or 40 years will not justify the same width standards as are required in U.S.A. today. The additional cost of these improvements will not be over 3 per cent for bridges longer than 150 feet.

A rough comparison is made below of the Inter-State system (U.S.A.) and the National Highway system in India.

Item	United States	India.
Name	The National system of Inter-state and defence highways.	National Highways.
Mileage	41,000	13,800
Ownership	State	Union Government.
Proportion of Cost borne by Federal Government.	90 per cent	Full cost including cost of supervision.
Agency bearing cost of maintenance.	State	Union Government.

Rural or Urban	Rural & Urban	Mainly rural.
Probable annual expenditure by the Federal Govt. in the near future.	Rs 10,000 million	Rs 100 million.
Control of access.	Full	Only in short lengths near centres of population.
Percentage of new length.	Not known yet ; but may be of the order of 70 per cent of the total length	About 10 per cent only

(Extracted from a Report by Shri N. S. Surya on his training in the U. S. A. in "The Design and Construction of Highways" under the Auspices of The International Co-operation Administration).

6. O & D STUDY MADE BY CONTINUOUS SAMPLE TECHNIQUE

THE first application of the continuous sampling technique to vehicular origin and destination studies will be inaugurated by The Port of New York Authority in early December for automobiles and trucks moving into and out of the New York—New Jersey metropolitan region at its six inter-state vehicular crossings. The new system, in which a limited number of interviews will be conducted with motorists throughout the year, will furnish more accurate and faster data than the former method of intensive questioning for a relatively short period of time.

The results of interviewing a small but representative sample on a continuing basis will be used to determine the patterns of travel of the traffic using the Lincoln and Holland Tunnels, the George Washington Bridge, Goethals and Bayonne Bridges, and the Outer-bridge Crossing.

Changes in traffic patterns due to population shifts, the opening of new highways and other vehicular facilities, and the steadily increasing number of cars on the road make the most accurate and up-to-date origin and destination information essential in the planning of new facilities and the most effective use of the present ones. The continuous

sampling program measures seasonal traffic variations and minimizes inaccuracies caused by unusual weather or other unique circumstances often encountered in the three-day surveys used previously.

Less inconvenience will result to the motorist under the new scheme than was the case under the former "blanket" survey. Formerly, origin and destination surveys were held at three-year intervals. During these surveys about one in every four motorists using Port Authority crossings were questioned in a three-day period. Under the new system, the chances that any particular motorist will be questioned during the period of a year will be about one in 650. It is estimated that the entire interview will take about fifteen seconds and will not delay traffic.

It is planned to interview on a twenty-four-hour schedule during the entire year at the various tunnels and bridges. There will, however, be only one interviewer questioning motorists at any facility at any one time. The information to be gathered will include the origin of the trip; the destination; the type of vehicle, i.e., auto, truck, tractor-trailer, etc.; the number of people in the vehicle; and the state in which it is registered. The purpose of the trip will also be determined.

The method was worked out by the Port Authority in co-operation with officials of the United States Bureau of Public Roads, and with the Survey Research Centre of the University of Michigan.

Extensive field tests were made to ensure that the method was actually practical in advance of inauguration of the program.

(From "Traffic Engineering," December, 1957).

7. THE FRENCH HAD A WORD FOR IT

WHEN the horseless carriage first appeared on the American scene, we had a problem on our hands: We had to figure out what to call it.

It wasn't easy figuring out what to call this new gadget and some of the things that went with it. We made some abortive attempts with such awkward words and phrases as "quadricycle," "motorcycle," "autocar," and "motor wagon," but none of these seemed to fit quite right.

When we began to look around we found that the Greeks had no word for it but the French did, "Automobile," according to the National Automobile Club, seemed to be a natural one and we took it for our own.

From the French

The French had words for other things, too. They had "chassis" for the under-part of the automobile, the part comprised of wheels, frame, and machinery. We took "chassis" but had our troubles with the plural. We didn't know how to pro-

nounce it. The French had "garage" for the building in which the car was kept. "Garage" we took over right away.

The French had "chauffeur" for the man you hired to drive your limousine. This gave us real trouble. We couldn't pronounce it. We tried to replace it with "motorman" but this seemed to include the operator of the streetcar or of the "tuppenny tube". Perhaps in desperation most of us took to driving our own cars and left the hiring of chauffeurs and the pronouncing of "chauffeur" to the select few.

One word, however, the French really offered in vain. That air-filled rubber tube that cushioned the wheel they called "le pneumatique". Even when they shortened it to "le pneu" it was too much for us. We settled for "tire". The British stuck with "tyre".

So much for Paris and the parts of your car.

(From "California Highways and Public Works," May-June, 1957).

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

DUST:	Fine, dry, pulverised soil particles that can be lifted and carried by wind.
DUST RATIO:	Percentage of material passing Sieve No. 200 (A.S.T.M. & B.S.) Percentage of material passing sieve No. 40 (A.S.T.M.) or sieve No. 36 (B.S.)

CURRENT LITERATURE

ABSTRACTS

INDIAN STANDARD SPECIFICATION FOR COMMON BURNT CLAY BUILDING BRICKS.

THE Indian Standards Institution has issued an Indian Standard Specification for Common Burnt Clay Building Bricks, IS: 1077-1957.

The Brick is not only one of the oldest but most extensively used building material. It is essentially a local building material and the qualities of bricks are bound to vary from place to place depending upon the raw material used and the method of manufacture adopted. This Standard is aimed to provide a guide for obtaining the uniform quality in the manufacture of brick, both in regard to its strength as well as dimensions. The dimensions of bricks influence to a large extent dimensions of walls, sizes of rooms, etc., and, therefore, some rational basis for fixing dimensions of bricks will make it possible to use bricks with other building components more conveniently and with greater economy and efficiency in construction.

The Indian Standard specifies the general quality of bricks, dimensions and tolerances and compressive strength and takes note of the principles of modular co-ordination as specified brick dimension conforming to a module of 10 cm. The adoption of a 10 cm module for dimensions of bricks is also in conformity with the decision of the Government of India to adopt a uniform system of weights & measures based on the metric system in the country. It is hoped that conformance to the standard on a country-wide basis will lead to production of better and more uniform quality of bricks in the country.

THE EFFECT OF PULVERIZATION ON THE QUALITY OF CLAY-CEMENT; F. J. Grimer, B.Sc. and N. F. Ross, B.Sc. Road Research Laboratory, Department of Scientific and Industrial Research, Harmondsworth, Middlesex, England.

THIS paper describes a laboratory investigation to determine the effect of the degree of pulverization (size of aggregation) on the quality of a heavy clay soil stabilized with Portland cement.

Aggregations ranging in size from about 0.1 to 5 mm were simulated artificially. The clay aggregations were mixed, by hand, with from 15 to 30 per cent of cement and with water, and the mixed material was moulded into cylindrical specimens. After 7 days' curing in wax at constant moisture content, and 7 days' curing in wax followed by 7 and 28 days' immersion in water, the cylinders were tested in unconfined compression.

The results showed that: (a) the strength of clay-cement increased linearly with increase in cement content; (b) the strength of clay-cement decreased with increase in aggregation size; (c) the clay-cement specimens remained intact in the presence of water except for those made with 3/16 in. (= 5 mm) aggregations.

THE VIRTUAL STRESSES AND THE POTENTIAL SURFACE RESISTANCE TO SLIDING WITHIN THE INTERIOR OF A SOIL MASS; De L'Institute Technique, Du Batiment Et Des Travaux Publics, December, 1957.

THE purpose of the method presented in this paper is to determine the virtual stresses which could exist within a soil body made from a granular material or a material having but a weak cohesion.

(Continued on page 31)

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2. **Epoxy Adhesives as Structural Repair Material**; HERBERT A. ROONEY and E. D. BOTTS, *California Highways and Public Works*, Vol. 35, No. 9-10, September-October, 1956, pp. 48-50.
3. **Sonic Method proves valuable for testing Concrete Specimens**; C. C. ARMSTRONG, R. B. ULP, K. C. LARSON, *Civil Engineering*, Vol. 26, No. 11, November 1956, pp. 58-61.
4. **Runways at Airfields**; *Concrete and Constructional Engineering*, L1, No. 12, December 1956, pp. 584-592.
5. **The Thickness of Concrete Road Slabs**; *Concrete and Constructional Engineering*, L 11, No. 2, February 1957, p. 72.
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17. **Further Investigations on "Aerosin" Hr's-Air Entraining Agent Developed at the Hirakud Research Station**; S. BALASUBRAHMANYAM, M. R. VINAYAKA, R. L. KUMAR & K. P. NAIR, *The Indian Concrete Journal*, Vol. 31, No. 6, June 1957, pp. 191-195.
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(Continued from page 28)

1. It will be shown that a rather simple procedure gives the possibility of determining which of the various modes of equilibrium, compatible with the boundary and loading conditions of the considered body, is associated with the least strain energy and would be therefore the least stable.

2. Knowing direction and magnitude of the principal stress we are in a position to determine shape and location of the potential sliding surface, i.e. of the surface along which the sliding resistance is a minimum. The ratio $\frac{\tau_i}{\sigma_i}$ of the tangential stress τ_i to the normal stress σ_i , acting on such a surface is variable and not identical to the limit value $\left(\frac{\tau}{i}\right)_{\max} = \tan \phi \pm c$, which in the conventional analysis is assumed to materialize in each point of a sliding surface.

3. With this new method it is possible to examine to what extent the principal stresses, occurring in the immediate vicinity of the slope or any other surface free from external forces, are compatible as well with the mechanic properties of the material of the fill as with the properties of the supporting body along or below the sliding surface. Further more one can determine the bearing capacity of the body in terms of a critical overburden and the weight of the body mass

which would come into motion if a sliding would occur along the potential sliding surface.

The results of such an investigation do provide a sound basis for a realistic evaluation of the stability of the slope and the safety of the soil body.

SOME ASPECTS OF GOODS TRANSPORT BY ROAD IN THE DELHI REGION. Occasional Papers No. 2 of the National Council of Applied Economic Research, New Delhi.

THIS monograph is the second in the series, 'Occasional Papers,' prepared by the National Council of Applied Economic Research, New Delhi.

Designed to throw light on hitherto neglected factors affecting the structure and future growth of the road goods transport industry, it is a report of investigations carried out on the composition of the vehicle fleet, the operational characteristics of vehicles, their potential capacity, the types of goods actually moved and their volume, and the costs of operating the vehicles under different conditions in the Delhi region.

The study is confined to the Delhi region. This limiting of the scope of enquiry to one region initially has made it possible to explore the problems thoroughly and has thus helped to evolve a procedure for the extension of such useful studies to other areas.

HOPE OF THE FUTURE

Without an abundance of science and technology and without establishing them on a self-perpetuating and exponentially expanding basis, I see little hope of progress.

M. S. THACKER

(Forty-fifth Session of the Indian Science Congress, 1958)

RECENT ADDITIONS TO THE LIBRARY OF THE INDIAN ROADS CONGRESS

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BUDGETS AND ADMINISTRATION REPORTS

(i) MADRAS STATE BUDGET FOR 1957-58

The following extracts relating to Civil Works have been taken from the Madras State Budget for the year 1957-58.

Revenue (Civil Works)

Heads	(In lakhs of Rupees)		
	Actuals 1955-56	Revised Estimates 1956-57	Budget Estimates (Revised) 1957-58
Rents	8.65	4.85	4.50
Receipts from work-shops	0.53	0.75	0.69
Recoveries of expenditure	90.76	54.94	37.59
Grants from the Govt. of India for the Development of State Roads of Economic or inter-State Importance	—	30.32	22.07
Ferry receipts Highways Department	2.14	1.60	0.21
Tolls on roads	—	0.24	—
Miscellaneous	13.84	11.74	16.05
Deduct-refunds	-1.25	-2.50	-0.72
Total	114.67	101.94	80.39

Expenditure (Civil Works)

Buildings			
Original works	19.15	23.31	41.86
Repairs	36.43	39.88	37.81
Communications			
Original works	3.67	3.45	29.88
Repairs	232.55	221.86	203.20
Miscellaneous			
Original Works	0.02	0.17	0.01
Repairs	0.30	1.14	1.20
Lumpsum deduction for probable savings	50.45	44.83	—
Development Schemes	-4.53	-14.58	-5.48
Suspense	—	—	0.10
Lump addition for regrant of lapses	—	—	—
Repayments to the contingency fund of advances taken but not recouped in the previous year - Major District Roads & Bridges	—	—	3.28
Lumpsum provision on account of revision of the rates and dearness allowance	—	1.20	—
Provision for Kanya Kumari District	—	15.00	—
Establishment	57.69	117.64	44.73
Tools and Plant	35.09	—	27.90
Grants-in-aid	74.16	30.63	36.60
Deduct supervision charges	-2.34	—	—
Total	502.64	513.69	431.01

Heads	In lakhs of Rupees		
	Actuals 1955-56	Revised Estimates 1956-57	Budget Estimates 1957-58
Capital Account on Civil Works outside the Revenue Account			
Original works			
Buildings	28.59	86.23	252.41
Communications	*	1.78	53.51
Miscellaneous	*	2.61	4.66
Tools and Plant	*	13.58	10.00
Grants-in-aid	—	—	48.76
Development Schemes	19.19	171.74	*
Establishment	.04	.01	0.38
Lumpsum deduction for probable savings	—	—	-22.73
Lumpsum addition for regrant of lapses	—	—	0.20
Lumpsum provision on account of revision of the rates of dearness allowance	—	0.60	—
Provision for Kanya Kumari District	—	7.00	—
Add-Pro-rata charges shown under Civil Works—Establishment, etc.	4.33	—	20.04
Total	52.15	283.55	367.23
Revenue from Roads			
Receipts under the Indian Motor Vehicles Act	16.90	14.97	14.12
Receipts under the Madras Motor Vehicles Taxation act, 1931.	326.13	328.67	310.92
Receipts under motor vehicles (Taxation of Passengers and Goods) Act, 1952.	59.56	64.62	58.97
Other receipts	0.93	0.03	0.02
Deduct-refunds	-2.65	-2.41	-1.81
Receipts from Kanya Kumari District	—	3.00	—
Receipts under the Madras Sales of Motor Spirit Taxation Act, 1939	110.74	114.56	100.03
Total	511.61	523.44	482.25

* Included under Expenditure—"Civil Works"

MADRAS STATE BUDGET FOR 1957-58

(A brief review with reference to Civil works)

THE estimated revenue receipts of the state for the year 1957-58 is Rs 5798.63 lakhs. The expenditure on revenue account is estimated at Rs 6132.19 lakhs, resulting in a deficit of Rs 333.56 lakhs. The revised estimate for 1956-57 showed a revenue of Rs 5708.05 lakhs and expenditure on revenue account of Rs 6086.98 lakhs, with a consequent deficit of Rs 378.93 lakhs.

Expenditure on Civil Works during 1957-58 is estimated at Rs 431.01 lakhs which form 7.4% of the total State revenue.

The corresponding ratio of the previous year was 9.0%. Out of the total revenue expenditure on Civil Works Communications (original works and repairs only) account for 4.02% of estimated revenue for 1957-58 while it was 3.95% for 1956-57 (Revised estimate).

The provision for Capital expenditure on Civil Works outside the revenue account is estimated at Rs 367.23 lakhs for 1957-58, while the revised estimate for 1956-57 is Rs 283.55 lakhs.

(ii) GOVERNMENT OF UTTAR PRADESH BUDGET 1957-58.

The following extract relating to civil works have been taken from the Uttar Pradesh Government Budget for the year 1956-'57.

Revenue (Civil Works)

Heads	In lakhs of Rupees		
	Actuals 1955-56	Revised Estimates 1956-57	Budget Estimates 1957-58
Rents of Buildings	2.99	2.68	2.29
Ferry receipts	24.75	19.90	19.90
Tolls on roads	0.43	0.40	0.40
Recoveries of expenditure	1.87	1.65	1.65
Transfer from Central Road Fund	35.57	—	—
Miscellaneous	28.80	14.80	20.27
Subventions from the Central Government for Budha Jayanti Road works	75.97	18.00	5.47
Subvention from the Central Government for unemployment relief schemes for road projects.	—	40.00	67.10
Deduct—refunds	-1.75	-0.75	-0.75
Total	168.63	96.68	116.33

Expenditure (Civil Works)

Buildings			
Original works	55.47	33.90	27.89
Repairs	14.50	15.58	16.33
Communications			
Original works	124.97	111.82	95.34
Repairs	238.95	273.40	266.09
Miscellaneous			
Original works	0.98	3.62	3.11
Repairs	2.14	2.75	2.92
Tools and plant			
Suspense	4.57	5.09	3.49
Establishment			
Grants-in-aid	-29.51	-1.00	-1.00
Deduct-Recoveries adjusted in the accounts in reduction of expenditure	23.28	26.00	18.00
	64.36	26.43	64.51
Total	456.16	429.50	444.11

Capital Account of Civil Works outside the Revenue Account
Original works

Heads	(In lakhs of Rupees)		
	Actuals 1955-56	Revised Estimates 1956-57	Budget Estimates 1957-58
Buildings	156.53	351.64	644.50
Communications	146.08	344.81	292.80
Miscellaneous	15.78	18.75	14.75
Tools and Plant	4.14	6.49	5.80
Suspense	-12.06	-7.00	-3.00
Establishment	21.23	29.43	40.61
Deduct: Recoveries adjusted in the account in reduction of expenditure	-77.20	-137.18	-91.11
Total	254.50	620.94	910.35
Revenue from Roads			
Receipts under the U.P. Motor Vehicles Taxation Act	119.83	114.00	116.00
Receipts under the Indian Motor Vehicles Act	—	4.50	5.00
Taxes on Sale of Motor Spirit	26.99	26.44	26.44
Deduct—refunds	-1.33	-2.00	-2.20
Total	145.49	142.94	145.24

Government of Uttar Pradesh Civil Works Budget 1957-58
(A brief review)

THE estimated revenue and expenditure figures for the year 1957-58 are Rs 9666.45 lakhs and Rs 10833.31 lakhs respectively. The anticipated deficit on the revenue account is therefore Rs 1166.86 lakhs. The revised estimates for the year 1956-57 ended with a balanced budget; the revenue and expenditure both being Rs 9479.64 lakhs. In the year 1955-56 the actual revenue collection amounted to Rs 8552.99, while the sum spent amounted to Rs 8423.09 lakhs. Thus the year 1955-56 ended with a revenue surplus of Rs 129.90 lakhs.

Revenue expenditure on Civil Works in 1957-58 is estimated at Rs 444.11 lakhs, which form 4.59% of the total

revenue for the year. The corresponding ratios for the years 1956-57 (revised) and 1955-56 (actuals) are 4.53% and 5.33% respectively.

The proportion of expenditure on communications (original works and repairs) to total Revenue for 1957-58 (estimate) is 3.76%, while for 1956-57 (Revised estimate) and for 1955-56 (actuals), the corresponding figures are 4.06% and 4.23% respectively.

The total outlay on Civil Works outside the revenue account for the year 1957-58 is Rs 910.35 lakhs, out of which Rs 292.80 lakhs are proposed to be spent on Communications alone.

LIST OF APPROVED WORKS ON NATIONAL
HIGHWAYS

Sr. No.	Job No.	Name of work	Amount (Rs in lakhs)
ANDHRA PRADESH			
1.	1839 AH 5	Construction of culvert in mile 7/1 of Bhimodal-Chabrol Road, in diversion of National Highway No. 5.	0.07
BIHAR			
2.	1812 BR 31	Construction of first four miles of the southern approach road to Ganga bridge at Mokameh	13.02
3.	1813 BR 31	Construction of southern approach road-cum-rail bridge at Mokameh beyond 4th mile on N. H. No. 31.	24.49
4.	1824 BR 31	Widening of Bakhtiarpur Barh-Mokameh Road (N. H. No. 31) for two lane traffic.	17.93
BOMBAY			
5.		Eight Works each costing less than 2 lakhs	3.39
JAMMU & KASHMIR			
6.	1825 JK 1-A	Restoration of flood damages and widening of Jammu-Srinagar Road, N.H. No. 1-A in miles 154, Ch: 9-22.	2.19
7.	1840 JK 1-A	Restoration of flood damages to Jammu-Srinagar Road, National Highway No. 1-A between miles 89-123.	2.52
8.	1846 JK 1-A	Improving and developing miles 190 to 199 (Sector Jammu Udhampur), National Highway No. 1-A.	3.00
9.		Nine Works each costing less than 2 lakhs	6.05
MADHYA PRADESH			
10.	T.A. No. 100 CP 26	Black topping of Narsinghpur Lakhanadon road mile 3 to 43 (41 miles) section of National Highway No. 26.	6.51

Sr. No.	Job No.	Name of work	Amount (Rs in lakhs)
MYSORE			
11.	1823 MY 4	Improvements to sharp curve in mile No. 170/3-4 of Poona-Bangalore Road, N. H. No. 4.	0.91
BISSA			
12.		Three Works each costing less than 2 lakhs	1.99
PUNJAB			
13.	1826 PB 1	Providing junctions of Karnal bye-pass with Grand Trunk Road at Karnal.	0.14
RAJASTHAN			
14.	1844 RJ 8	Construction of a bridge over Bandi River Crossing in mile 26 on Jaipur-Ajmer Road, N. H. No. 8.	3.24
UTTAR PRADESH			
15.	1837 UP 2	Construction of approaches to the Over-bridge over the Central Railway in place of level crossing at Farrah in mile 772 of Bombay-Delhi Road, N. H. No. 2 in Mathura District.	2.41
16.	1849 UP 28	Construction of a bridge across the Rapti river near Gorakhpur on National Highway No. 28.	41.43
17.		Two Works each costing less than 2 lakhs	1.70

PERSONAL AND MISCELLANEOUS

Shri K. K. Nambiar, Chief Engineer (Highways), Madras retired and took over as Chief Engineer, Concrete Association of India in the place of Shri E. A. Nadirshah.

Shri K. V. Ekambaram, ISE., assumed charge as Chief Engineer (Highways), Madras vice Shri K. K. Nambiar with effect from 24-2-58.

Shri W. X. Mascarenhas, ISE., Chief Engineer, Public Works Department, Bombay retired from the post on 15-2-58. He has joined as Chief Engineer and Executive Director, Life Insurance Corporation of India.

Shri U. J. Bhatt has taken over as Chief Engineer, P.W.D., Bombay.

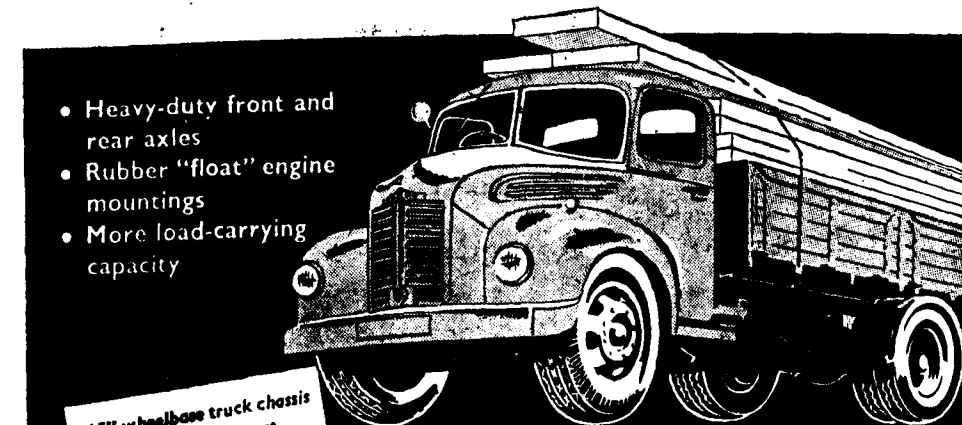
Shri T. G. Sadarangani, Planning Officer, Ministry of Transport & Communications, retired from the post on the 21st March 1958.

A meeting of the Executive Committee of the I.R.C. was held on the 8th March 1958, Messrs W. X. Mascarenhas, J. M. Rijhwani, Sujan Singh, H. P. Sinha, D. G. Bhagat and A. J. D'Costa attended the meeting.

A meeting of the Road Research Committee of the Central Road Research Institute was held on the 12-3-58.

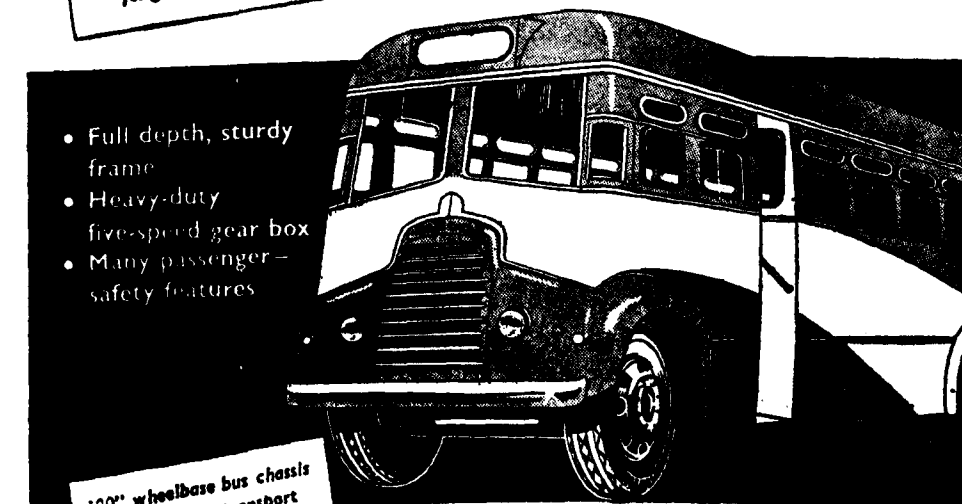
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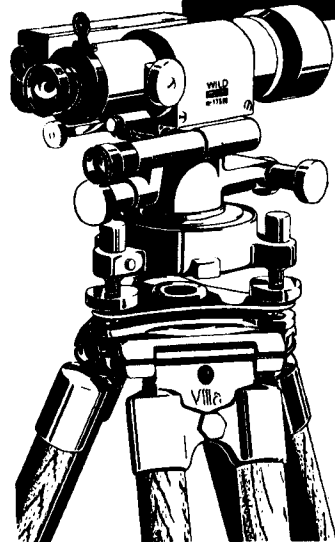
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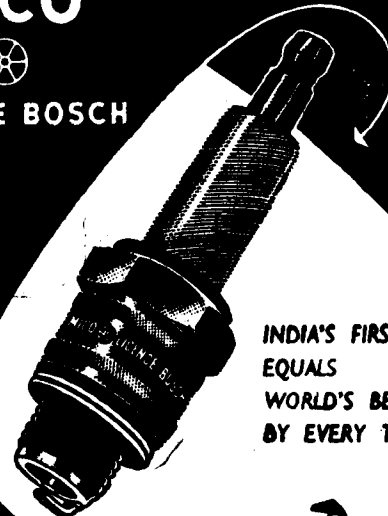
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(Sd.) A. J. D'Costa.
Secretary,
Indian Roads Congress.

Date the 21st March 1958.

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