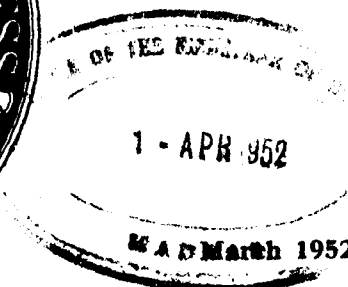


Transport-Communications

MONTHLY REVIEW



13
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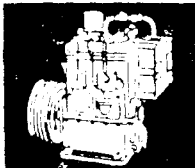
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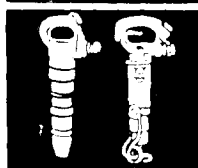
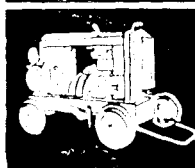
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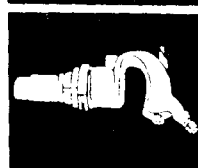
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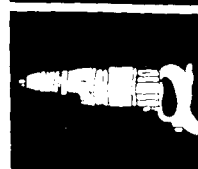
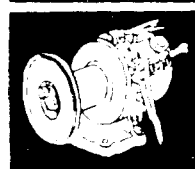
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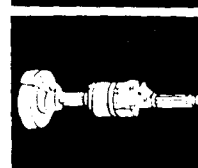
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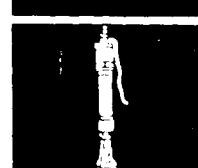
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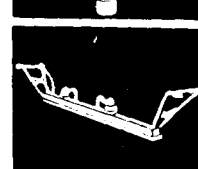
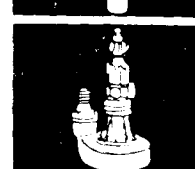
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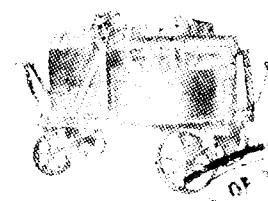
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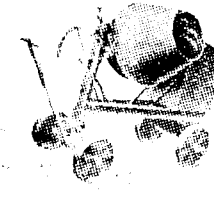
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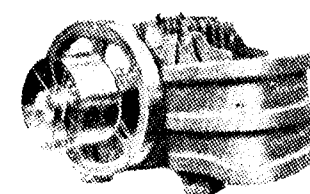
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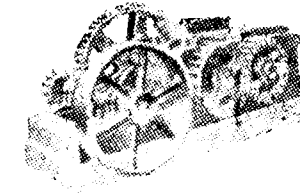
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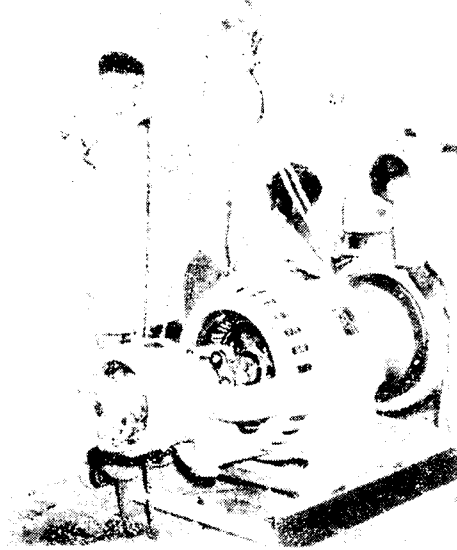
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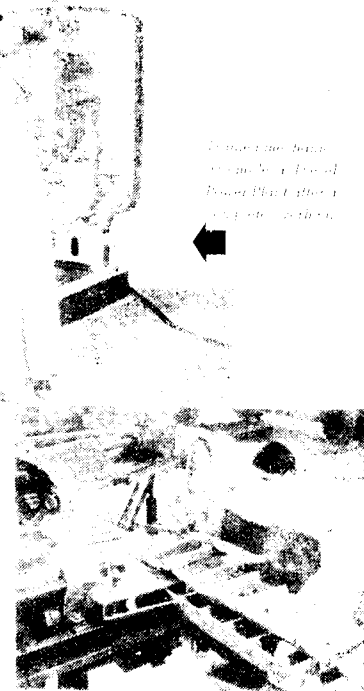
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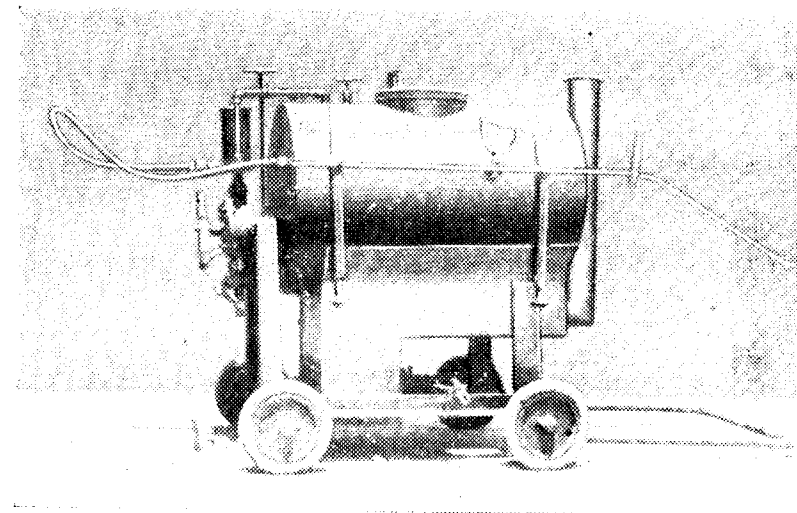
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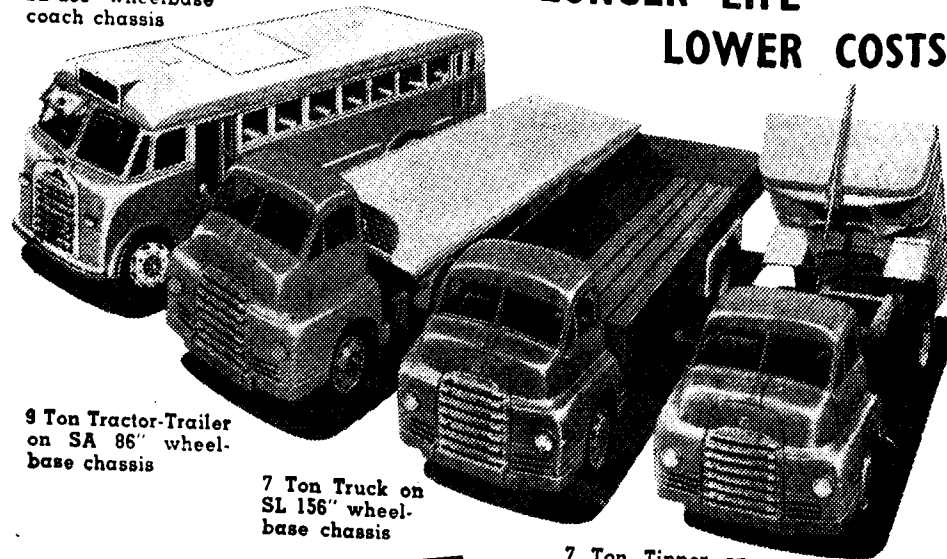
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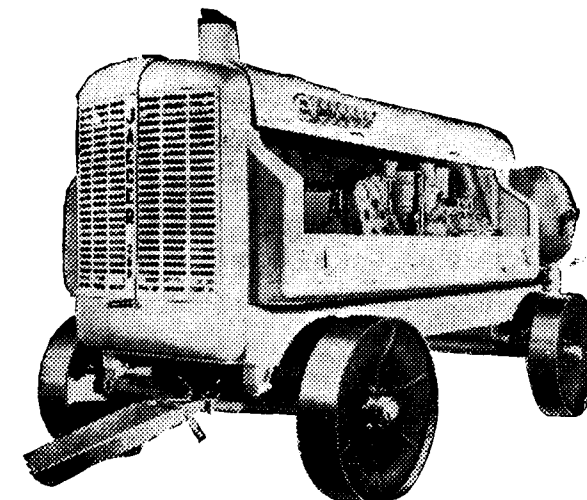
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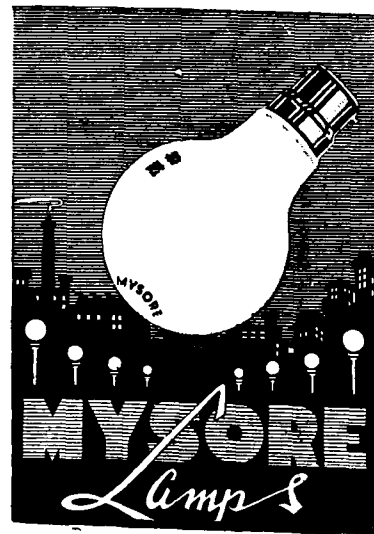
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RECENT DEVELOPMENTS IN CIVIL ENGINEERING

(Extracted from 'The Surveyor'—June 9, 1951)

It is no exaggeration to say that the experience of engineers within recent years has been that, in order to keep up to date, they have had to put in a lot of time in endeavouring to keep abreast of the many new things which are constantly being brought to the notice of the profession.

Both in print and in practice there are to be seen departures of a radical nature from tradition.

It is not within the scope of this article to go into the intimate details of what has happened but to review generally its effect on the art and science of engineering.

Soil Mechanics

The ground just under and around the foundation of a structure is not from a statical point of view outside the structure at all, but is an integral, and perhaps the most important, part of it. It forms the cushion between the man-made foundation and the solid earth, and as such must be capable of resisting the stresses and strains imposed upon it.

The rather intricate and empirical subject of soil mechanics has emerged into the limelight from its wartime obscurity and engineers find that it is now established as one of the new branches of science of which they must take cognisance. There is a vocabulary to be mastered. There are samples to be taken and laboratory tests performed. Terzaghi and Casagrande cannot be relegated to the background. A curious thing about a course of study in soil mechanics is that it reveals one's woeful deficiency in knowledge of geology.

The Plot Thickens

Earth pressures have always been a source of trial and tribulation to engineers, and now the whole plot has thickened and deepened whilst Rankine with

his attractive simplifications can no longer bring much-needed succour.

There is enough in this subject alone to fill every odd moment of an engineer's spare time, and odd moments do not suffice; hours of concentrated study are what is needed.

The time may not be far afield when there will be specialist consultants in foundation problems. There are already, in the narrower sense, advisory and analysing laboratories in existence which supply reports, like the longer-established testing laboratories.

There is no gainsaying the fact that there are great possibilities of effecting economies on a big scale in constructional works such as roads, reservoirs and airports by the application of the principles of soil mechanics in stabilising soils. Some of the most unexpected things have been done and the most unlikely materials used in stabilising sub-grades of roads and aircraft runways. Combinations of bitumen, cement, vegetable fibre and so on with natural soils have served valuable purposes.

There is almost limitless scope for the further development of this subject and the working engineer will follow with the keenest interest the researches of the scientists into its further intricacies.

Restless Souls Discover Prestressed Concrete

Not content with the opening up of the field of soil mechanics, other restless souls have probed further and further into the alliance of concrete and steel which has held sway in the form of reinforced concrete for half-a-century. Here again, as in the days of Coignet, Considere and Hennebique, the French have taken the lead and this time it is the genius and industry of Monsieur Freyssinet which has startled the world of structural engineering.

Never before has such a gathering been held as when M. Freyssinet addressed the Institution of Civil Engineers in London, and revealed to the members the "fait accompli" of revolutionary progress which he had made in the use of prestressed concrete. The paper which he presented on that occasion is a classic of conciseness and erudition in the subject in which he is the world's acknowledged leader. He gave the profession such food for thought that the full implications of all he said will take years to digest.

A series of bridges over the River Marne built under Freyssinet's supervision and to his designs have shaken all previous notions of ferro-concrete work. The very flat arch at Esbly has a span of 240 ft and a thickness at the crown of 40 in., whilst the horizontal thrust at each abutment is 1,820 tons.

* * *

It is not only the application of prestressing which is novel but also the whole concrete designing and making technique. Working stresses more than double those to which we have been accustomed are employed in the concrete.

Without Tears

The chief disciple of Freyssinet is a Belgian—Professor Magnel of Ghent University. Magnel has evolved his own system of prestressing which differs from the prototype principally in the mode of anchoring the ends of the cables after they have been stretched. Magnel, like Freyssinet, has also lectured at the Institution in Great George Street, and moreover has written a book in English treating of the theory and practice of prestressed concrete. The theory as propounded by Magnel has the great merit that the average engineer can master it without tears and higher mathematics.

There are other systems of prestressing besides the two already mentioned, such as the Lee-McCall, according to which high tensile steel bars instead of cables are stretched, and there is the Hoyer system in which individual wires are pretensioned before concrete is cast around them, and in which bond takes the place of end anchorages.

In conclusion it may be said that prestressing enables full use to be made of high quality concrete combined with high tensile steel in a manner which has never hitherto been possible with ordinary reinforced concrete on account of the cracking of the concrete encasing the tensile reinforcement. Prestressing has the effect of keeping all the concrete in compression for which it is eminently suited, although on occasions a little tension is allowed without detriment under maximum live load, and if any cracks are formed they close up again as the live load moves off.

The Shell Roof: A Mystery

The British tradition of solidity in methods of construction received a somewhat severe shock when some venturesome pioneers introduced the shell barrel-roof for industrial buildings. Hitherto nothing so worthy of the name—membrane—had been seen in reinforced concrete. It must be confessed that the theory holds a good deal of mystery to the writer, but like the zip fastener it is one of those things which work out all right in practice but would never have been thought possible in imagination.

Segmental barrel vaults of so little a thickness as 2½ in. of high-grade concrete, and having spans of 30 ft or more, have become normal practice. The reinforcement consists, as a rule, of a combination of hard drawn steel wire fabric to resist the bending stresses and high tensile bars arranged in a helical form to take the shear stresses.

In order to save top shuttering the concrete may be placed by pressure spraying from a cement gun. The outside of the shell is normally waterproofed by covering it with a layer of bituminised felting secured with hot bitumen as an adhesive. Sometimes two or even three thicknesses of felt are used.

These thin cylindrical shells are grouped side by side and are supported on rather deep edge beams, and what seems most remarkable is that tie frames are provided only at the ends. Whether the shells act as curved beams or as arches seems to be problematical; a combination of both actions seems probable.

Very learned dissertations on the theory have been produced by German professors and some of our English enthusiasts have followed suit, but **this type of construction would appear to be an illustration of practice preceding theory as it used to do before the advent of this mathematical era.**

Buildings having plan dimensions of the order of 300 ft by 150 ft with the whole of this vast floor area unimpeded by columns have been erected wherein commercial and public service vehicles can be housed. The temporary work is considerable and probably costs a good deal more than the permanent structure, but thanks to steel scaffolding and light steel plates as shuttering, only labour charges are involved as the material is all reusable over and over again.

It is too early yet to be dogmatic about the durability of a shell roof; time only will tell.

Aluminium

The aluminium industry was developed to a phenomenal extent during the war in order to provide for aircraft construction on an unprecedented scale, and when the war ended other uses for the material had to be found.

The industry lost no time in turning swords into ploughshares, and we are all now familiar with many new uses to which aluminium alloys are put. First and foremost are the temporary houses constructed of thin sheet metal, then come the truck bodies permitting the burden to be increased. There was the bascule bridge at Sunderland, and the Clunie footbridge in Scotland, and now before all eyes is to be seen the roof of the Dome of Discovery at the South Bank Exhibition of the Festival of Britain.

The alloys have a strength approximately equal to that of steel, and they weigh about one-third the weight of steel.

Advantages

Aluminium has many advantages which are peculiar to itself.

When pure, its resistance to corrosion is very great since an oxide speedily forms which has a protecting effect. The various alloys, incorporating such elements as silicon and magnesium, are also resistant to corrosion but not quite to the same extent as the pure aluminium, which is seldom painted. It is frequently the practice for alloy products to be clad with a skin of the pure metal with the object of avoiding the necessity for painting or other surface coating.

Its small self-weight has obvious advantages for many kinds of work. Any type of opening bridge where kentledge is required to balance the weight of moving parts, such as the trunnion bascule bridge already mentioned, vertical lift bridges, and some types of swing bridges, can all be of considerably lighter construction in aluminium than in steel. Less power is required to overcome friction and inertia.

The cages of elevators, lifts and hoists are more easily and cheaply operated when they are light than when they are heavy.

The fact that extrusion is the process for manufacturing aluminium bars and not rolling, as in the case of steel, makes it possible to produce sections of a more complicated profile with resultant saving in riveting or welding. Re-entrant angles present no difficulty when bars are extruded and as an example it is easy to make a single section equivalent to the plates and two angles of the flange of a plate girder.

Dies can be made to produce almost any required section provided it can be contained within the compass of a 15 in. diameter circle. Rivets are driven cold, but the bigger sizes require a more powerful squeeze than equivalent steel ones.

Argon-arc welding is the latest process for welding aluminium work, and is simpler and quicker than the older established system of the metallic arc welding.

BRIDGING INDIA'S RIVERS

THE KATHJURI BRIDGE

THE river Mahanadi traverses very hilly country throughout the upper part of its catchment of more than 50,000 square miles. Immediately after it debouches into the plains through the narrow (2,800 ft wide) gorge at Naraj, it bifurcates into two arms called the Mahanadi and the Kathjuri. Further down each of these arms, in its turn, bifurcates and throws out two more arms, the Birupa and the Kuakhai, and all these arms branch out again and again to form the Mahanadi delta.

Cuttack, the "old" capital of Orissa, is situated at the head of the delta between the first named arms of the river, the Mahanadi and the Kathjuri. During the monsoon, when the rivers on each side of the town are in flood, direct road communications used to be cut off from all sides and access was obtained by rail or power-ferry.

To-day the Kathjuri arm is bridged and a temporary roadway is available for seven months in the year under the anicut on the Mahanadi arm of the river. These improvements have been carried out with National Highway funds.

Looking at the map it is easy to visualise the Mahanadi as a huge monster, with its weak and powerless victim, Cuttack, in its jaws. A constant struggle has been going on between the two for centuries. Although it is impossible to extricate the victim entirely, engineers have managed to keep it alive. Bunds, dams, and dykes prevent the monster from closing its jaws and swallowing up the victim, and two lifelines have been thrown in to keep it going and rescue it gradually.

One such lifeline is the railway built at the end of the last century. The road was there even before the railway, but recently two large bridges have been built to make the roadway to the south over the Kathjuri and the Kuakhai effective as a lifeline. These bridges have enabled the State to start life afresh with its "new" capital at Bhubaneswar.

Cuttack, from all accounts, has perhaps the worst crowded "bustec" of all the State capitals in India. Hedged in by the river, it has no room to expand. Always menaced by floods, the people and the Government might well hesitate

to build for the future. Large parts of the town are as much as 14 ft below the flood level of the river. It is not surprising that the place is congested, badly built, unhealthy, and malarious. But with all its defects it is a large town and will be there for a long time to come. It must have communications with the outer world.

Four Bridges

To achieve this purpose at least four bridges will be required on the four branches of the river. The Kathjuri and Kuakhai bridges have been built first to link up the new and the old capitals.

The Kathjuri bridge is sited 800 ft downstream of the railway bridge. This site was selected so that the road should not have to cross the railway track twice and so that the approaches should run outside the congested part of the town and at the same time avoid the unstable bank area upstream of the railway bridge.

The superstructure of the bridge consists of 1:2:4 vibrated reinforced concrete balanced cantilever and suspended spans, supported on piers and abutments made of 1:3:6 mass concrete, lightly reinforced and founded on wells.

The main dimensions and other particulars of the bridge are :—

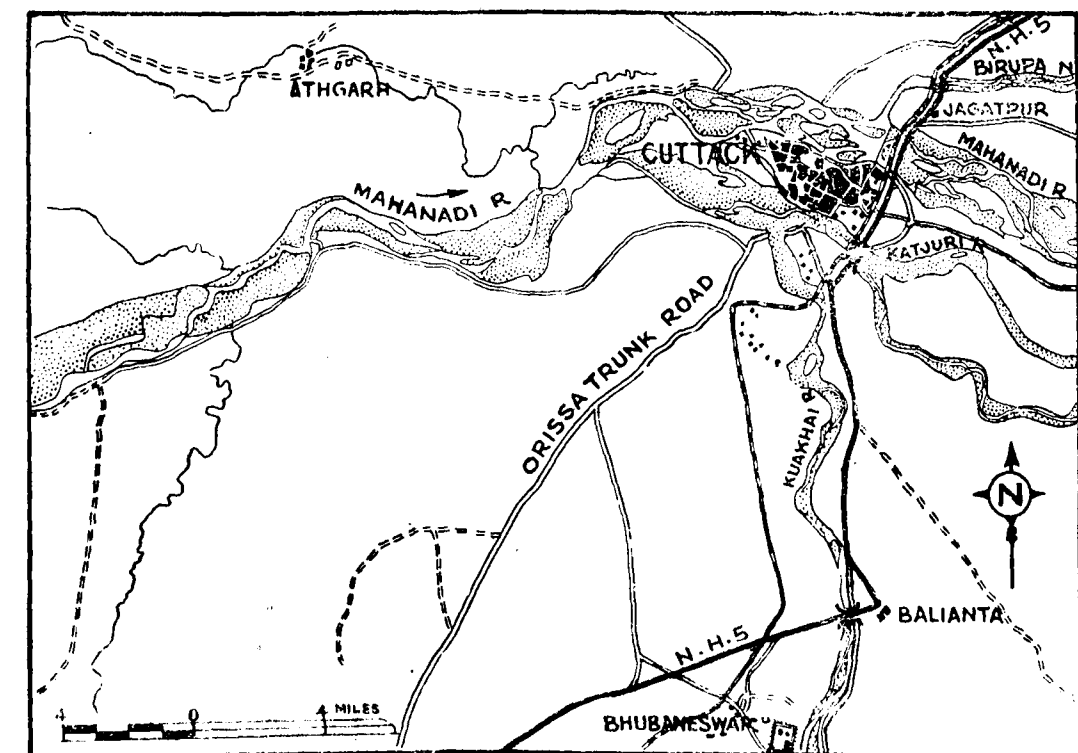
Overall length face to face of abutments, 2828 ft; 17 spans, 160 ft each; 2 end-spans, 54 ft each; height of pier shaft from plinth level to level of bearing seat, 32.5 ft; width of pier shaft at plinth level, 9'-7"; length of pier shaft at plinth level 36'; batter in piers, 1 in 24

Live load, Indian Roads Congress Class AA on the carriageway; live load on the footpath, according to Clause 207 of the Indian Roads Congress Bridge Code;

Average pressure intensity on foundations under piers at R.L.



The Kathjuri Bridge.



minus 35.00, 7 tons per sq. ft.; under abutments, one ton per sq. ft.;

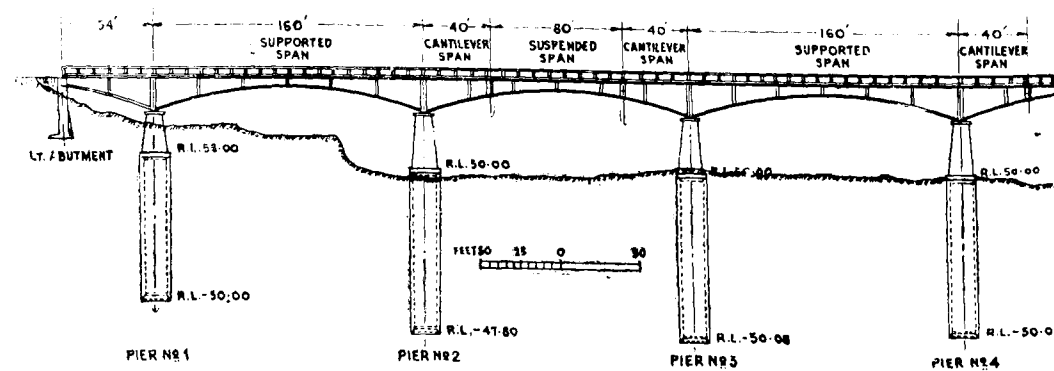
Temperature variations. ± 30 deg. F.

Average velocity of water under the bridge, 5 ft per second; velocity under certain piers, 8 ft per second; discharge, 577,000 cusecs.

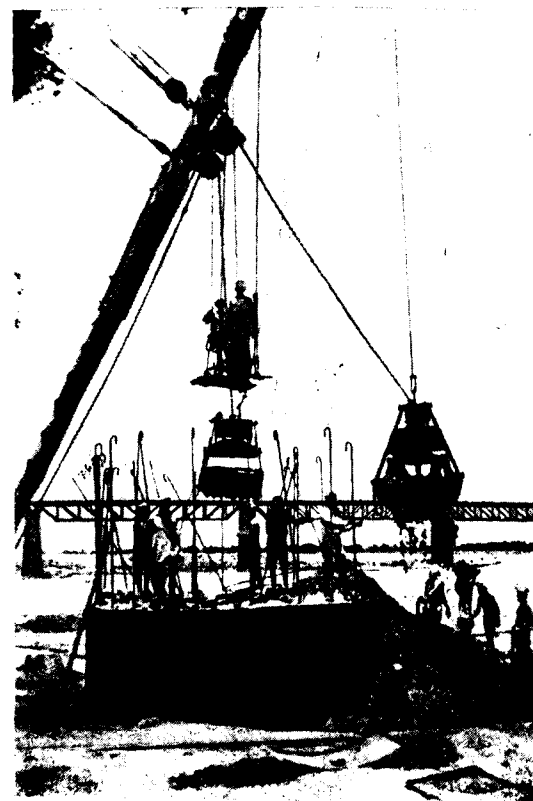
Costs

The total cost of the bridge was Rs 45,89,000/-. The foundations cost Rs 20,36,000/-. piers and abutments Rs 3,13,000/-. bearings Rs 1,30,000, and superstructure Rs 17,60,000/-.

The cost per running foot of the bridge was Rs 1,623/- per square foot of carriage-



Part Longitudinal Elevation.

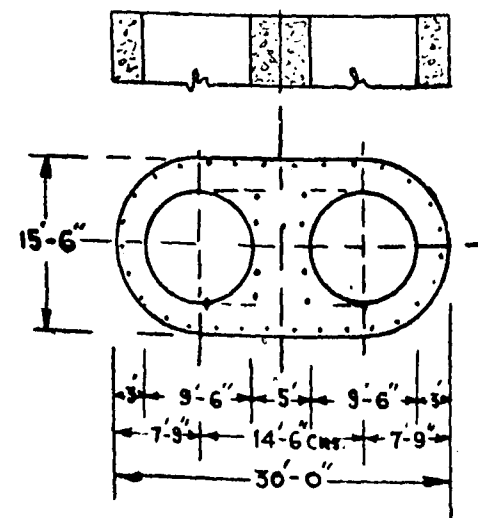


Dredging in Progress.

way (excluding footpaths), Rs 67/-; per square foot of roadway (including footpaths), Rs 45/-. The cost per square foot of the entire elevation (that is, the area enclosed between the line connecting the uppermost points of the superstructure and the line connecting the lowest parts of the foundations) was Rs 102/-.

Foundations

Each pier was founded on a twin well sunk to the approved depth, so as to rest



Plan & Section of well.

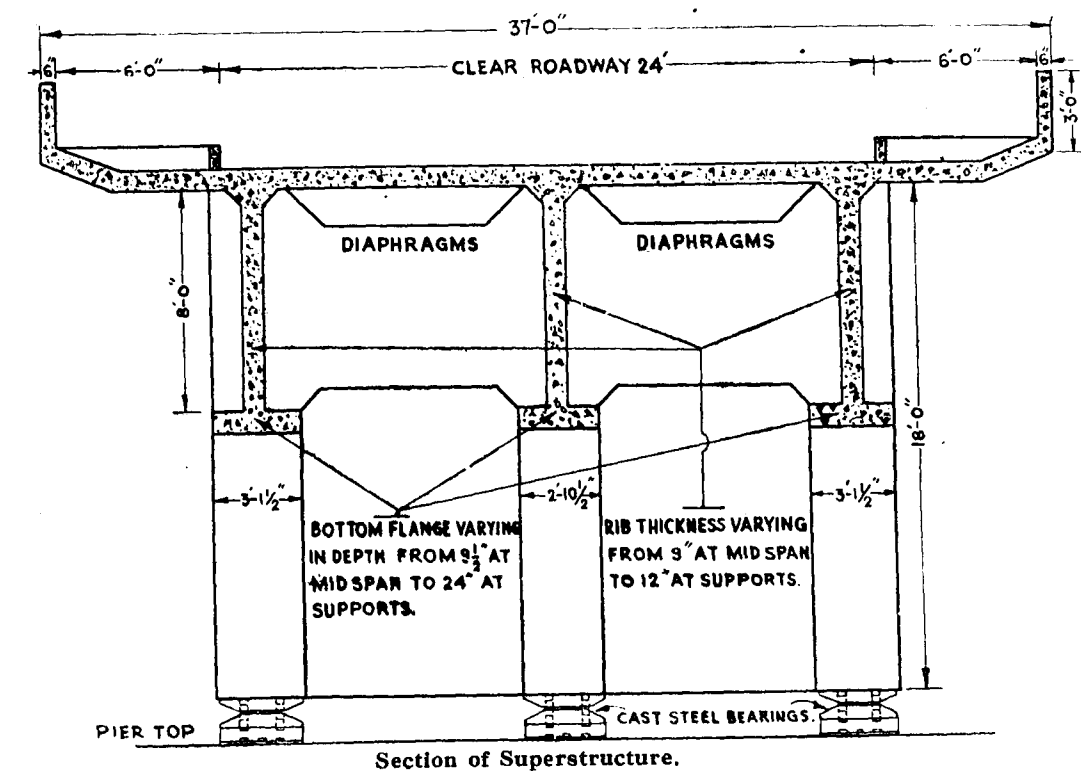
on stiff black clay. The well had on overall size of 30 ft by 15 ft 6 in. and were of lightly reinforced concrete (1:3:6).

Superstructure

The superstructure consisted of three reinforced concrete girders spaced 11 ft centre to centre, with a 9 in. thick reinforced concrete deck slab, covered with a 3 in. wearing coat of 1:2:4 cement con-

crete. The girders were 18 ft deep at the support and 8 ft at the centre, and were of a web and flange type with a web thickness of 9 inches.

Roller and Rocker bearings were provided on the piers and sliding plate bearings at the free end under each of the three girders of the suspended spans. Each roller or rocker bearing was designed for a load of 400 tons.



Section of Superstructure.

Well Sinking Difficulties

The engineers responsible for the construction were faced with numerous problems in the course of sinking wells for the foundations. Many wells went out of plumb and shifted from their correct positions. They were corrected by regulating the dredging, pulling and pushing into position during sinking, and eccentric or cantilever loading. These methods were not completely successful in every case.

The feature which caused special headache on this work was that in some of the wells Artesian springs were encountered. The water level in these wells rose and



Concreting the Superstructure.

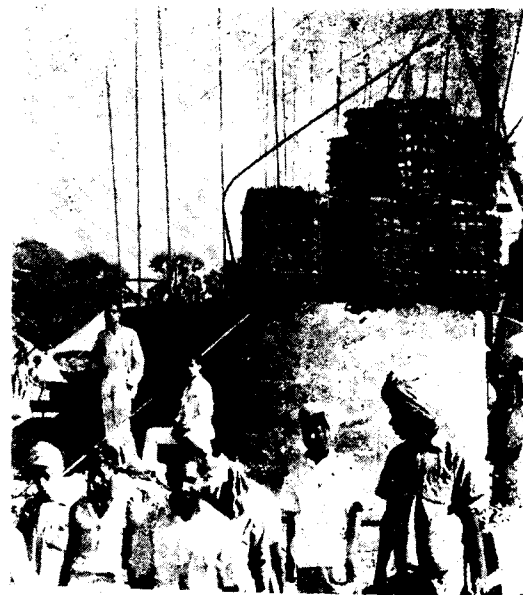
water began to overflow at a tremendous rate. The wells began to sink abruptly under their own weight. A detailed description of the devices adopted to overcome these difficulties is given in the Indian Roads Congress Journal Vol XIV-2.

Test Loads

The wells where artesian conditions had been met with, were load tested. The test loads which ranged from 1,000 tons to 1,200 tons on a twin well, were so calculated as to give the same unit pressure under the steining as would develop under the whole area of the well after the bridge came into use.

SUPERSTITIONS

During the construction of this bridge the usual rumour that at such big bridge works the river god is propitiated by a human sacrifice took hold of the populace and led to a minor riot. The Government had to issue a press note to dispel the impression from the public mind.



Eccentric Loading.

Work on this bridge commenced in 1-11-1947 and the bridge was opened to traffic on 31-8-1951.

RECKLESS YOUTH

Drivers in the 20-30 year age group are the most frequent offenders, and those aged 22 to 23 are the worst.

SPECIAL ARTICLE NO. 3

WIDTHS OF HIGHWAY PAVEMENTS

(Abstracted and Adapted from the I. R. C. Standards)

IN this, the third article of the series on Standards for Highways it is proposed to review the I. R. C. standard on widths of highway pavements issued as Paper No. 113, and published in Volume XI-Part I of November 1946 of the Journal of the Indian Roads Congress.

While the Railways generally confine themselves to the construction of two standard widths of track known as the Broad Gauge and the Metre Gauge, highway construction has long been, at least partially, subject to the personal predilections of individual engineers. Any one who travels widely in India may be surprised to find the many different widths of carriageways, varying from 6 ft to 20 ft or more, that have been adopted. Some times the selection of carriageway widths may appear to have been made without a proper appreciation of the factors that should govern such selection.

The factors that enter into consideration while designing a carriageway width for a road have been discussed at some length in I. R. C. Paper No. 113 referred to above. These factors are summarized in brief below.

Factors Governing Carriageway Widths

Carriageway lane-widths and the number of lanes required for a highway should take into account the following factors:—

- (1) maximum overall width of vehicles using the road;
- (2) transverse placement of vehicles while travelling free, passing vehicles in opposite directions, or overtaking vehicles in the same direction;
- (3) speeds of different types of traffic;
- (4) minimum widths for safe driving;
- (5) effect of pavement widths on accidents;
- (6) effect of an "edge-concentration" of wheel loads on pavements and the subgrade;

(7) existing and expected volume of traffic in type, total volume, peak hour intensity, and the daily average;

(8) economics of increasing the pavement widths by shoulders of a lower type.

Width of a Traffic Lane:—The traffic-lane width is influenced by the type of traffic. Where a road is subjected only to slow-moving animal-drawn vehicles with a track of about 4 ft 6 in., it will be sufficient to have a single lane of width of 6 to 7 feet, provided no overtaking or passing takes place. On the other hand, if a road is also to cater for mixed traffic from the bullock-cart to the military lorry, the overall maximum width of any user vehicle will be a controlling factor on the determination of suitable width.

Vehicle Width:—Before a traffic-lane can be designed, therefore, it is necessary to fix the maximum widths of the vehicles that are to be permitted to use the road. As will be seen later, it will also be necessary to fix all the dimensions of these vehicles, their weights and speeds.

Fortunately international conventions in this regard have now been fixed. The question is fully discussed in I. R. C. Paper No. 138 (Vol. XIII-2 of January 1949) and India has accepted these conventions.

Incidentally these conventions will form the subject of another article in the series being published in this Review.

Transverse Spacing of Vehicles:—Another important consideration in fixing a lane width is the lateral spacing of vehicles on a road cross-section. Studies on this point were conducted in the U.S.A. and observations were made of lateral spacing of different types of vehicles passing or overtaking each other when travelling at different speeds on roads with carriageways ranging in width from 18 ft to 24 ft.

The results of the study are given in some detail in the I.R.C. Paper referred to above and may further be generalised by the statements that passenger cars overtaking can be contained in a total width of 14 to 15 ft while lorries require 17 ft to 20 ft width depending on speed.

It may be noted that in the case of high-body lorries a slight sideways tilt causes a large lateral displacement of the top and as tilt can be caused by unevenness of road, or by unequal deflections of springs either through age or unequal distribution of load, the lateral displacement of the tops of fast moving vehicles is a very important factor in determining the safe clearances between vehicles.

Speed.—Any one who drives a car knows that he can crawl past an obstruction leaving himself a six-inch clearance or less but if he is travelling at 60 miles an hour, he will want two or three feet clearance. This subject has also been studied and the clearances required on different speeds and types of vehicles has been laid down in the I. R. C. Paper under review.

Edge Clearance, or how far from the edge of the carriageway do vehicles keep has also been studied. Theoretical assumptions of the mudguard scraping a bridge rail are too conservative for this purpose. It was observed that while vehicles moved with greater clearances on wide roads they had a tendency to brush past each other on narrow widths. Thus while the clearance between vehicles was about 4 ft on 24 ft width it was only 1 ft 2 in. on a 18 ft carriageway.

Indian Conditions

In examining the results of research undertaken in other countries, the I. R. C. Standards Committee took into account the application of these results to Indian conditions. It was clear that while the U. S. A., for example, had most of its road traffic in motor vehicles, India had a mixture of motor vehicles and animal drawn vehicles, the latter often predominating.

The wheel loads of motor vehicles are the main factor in design of pavement thicknesses. As these would tend to break up edges of pavements it was decided that the edge clearance in India should not be too small.

From a final consideration of all factors the Standards Committee decided that the width in feet of a carriageway should be determined from the function $(10n+2^t)$ where n is the number of traffic lanes provided.

In the case of a single lane pavement, generally to be provided as the minimum, a width of 12 ft was recommended.

If the total traffic was such as to require room for overtaking and passing yet not sufficient to justify two lanes of carriageway, it was recommended that a total width of 18 ft carriageway should be provided by making the berms hard by one of many different ways but to a standard lower than that of the main carriageway. This condition contemplated a few bus or lorry services, a few passenger cars, and a large volume of bullock-cart traffic using the road.

If crossings or overtaking by motor vehicles became frequent, a two-lane width of 22 ft was recommended, the section and road-crust design depending on the maximum wheel load and total volume of each type of traffic.

Number of Traffic Lanes.—While maximum wheel loads and their frequency affect the selection of the type of road crust and its design, the traffic density both in volume and character influences the number of traffic lanes. An increase in traffic density indicates a more frequent passing of vehicles and the need for wider lanes.

It has been estimated in America that highways with single lane surfaces are suitable only where the traffic density classification is not greater than five motor vehicles per hour. If half the traffic travels in each direction vehicles will meet at an average of every 12 minutes. Meetings of vehicles are less frequent if more

than half the traffic travels in one direction and, when the traffic density is less than 5 vehicles per hour, the shoulders of a single lane highway should be such as to permit their being used for passing or overtaking.

Existing and expected volume of traffic.— In the absence of continuous traffic records, it is difficult to forecast with any precision the trend in the growth of the traffic. Estimates made seem to indicate that the rate of increase of traffic in every 10 years may, under average conditions, be taken at about 50 to 70 per cent over that of the previous decade parallel with general development in other directions.

Again it will be difficult to fix the percentage of increase of each type of vehicle. The general tendency will, however, be for a greater increase in motor vehicles. Therefore in designing a new road or improving an existing road, a fair estimate of the anticipated traffic should be made in each individual case on its merits.

Capacity of Traffic Lane.

The capacity of a traffic lane is influenced by :

- (1) variations in speed and composition of traffic; and
- (2) the hold up at the intersections.

Observations made in England at and just clear of controlled intersections, indicate that traffic density ranges from 1,200 to 1,800 vehicles per hour for town conditions. Maximum density is obtained when there is no overtaking.

The maximum number of vehicles which can pass in a given time with safety must depend on the minimum safe headway in seconds between one vehicle and the next, so that there may be sufficient time to bring the rear vehicle to a stop should the forward vehicle be seen to be slowing down or stopping. From theoretical calculations explained in the Paper the Table reproduced below gives the traffic capacity of a lane which may be taken to be 100% efficient.

Table No. 1

Max. theoretical vehicle capacity (Saturation capacity) per lane at various uniform speeds (all vehicles moving in one direction)

Vehicle type	Speed in miles per hour					
	10	20	30	40	50	60
No. of vehicles per hour						
Light	1584	1843	1780	1663	1534	1420
Heavy	1174	1427	1390	1288	—	—

The table given below quotes the results obtained by actual observation of the number of vehicles passing a section on a single traffic lane :

Table No. 2

Observed maximum number of vehicles per hour in a traffic lane for different types and speeds.

(Traffic unobstructed, moving at constant speed and in the same direction)

Speed miles per hour	Light Cars only	Mixed motor vehicles	Heavy motor vehicles only
	No. of vehicles.	No. of vehicles.	No. of vehicles.
11	876	847	828
14	1014	981	960
17	1125	1091	1060
20	1200	1165	1125
23	1242	1190	1136
26	1233	1173	—
29	1200	1143	—

It is also observed that the traffic capacity considering fast vehicles only is considerably reduced by the speed of the slowest type of traffic using the lane. For example, while the maximum observed capacity for light cars only moving at 23 miles per hour was 1242 (Table No. 2), the

capacity for light cars was reduced to 410 when horse-drawn vehicles travelling at 4 miles per hour were also on the lane, and to 867 when there were pedal bicycles travelling two abreast at 11 miles per hour.

Bullock-carts.—The effect of bullock carts, moving at only 2 miles per hour, has not been recorded but will certainly be even more pronounced. In the absence of data based on actual observations, it may be assumed that at the peak hours a traffic lane may accommodate about 200 slow moving vehicles and 250 motors, if these move only in one direction with no overtaking or passing by vehicles. With traffic in both directions, this will be further reduced. There will be a still further reduction at intersections and cross roads.

Specifications.—The following specifications have been recommended by the Ministry of War Transport, London and may be considered as a desirable target—

“Dual carriageways should be constructed where an existing road carried or a proposed road is expected to carry 400 vehicles at the peak hour, and will often be justified on less heavily trafficked roads solely on grounds of public safety. Where it is necessary to provide more than two traffic lanes the construction of dual carriageways, if practicable, is preferable to widening a single carriageway.

“The separation of dual carriageways should be effected by a reservation of the greatest width practicable. Endeavour should be made to secure a width of 26 ft between dual carriageways of 22 ft and not less than 10 ft between dual carriageways of 30 ft in order to provide a dimension of 70 ft between the outer kerbs, which would enable large vehicles to turn from one carriageway to the other without reversing.

“Reservations should be planted with low trees or shrubs with the object of avoiding glare from head lights. Where the central reservation is broken to allow of communication from one carriageway to another complete visibility across the ends of the reservation should be maintained for at least 50 ft back from each end of the opening.”

“The minimum width of pavement should be the overall width of vehicles using the road plus 2 feet 6 inches. Ordinarily the lane width if of single lane should be 2 feet extra. **“The normal width of a single lane pavement should be 12 feet,** except in the case of village roads and minor roads with predominantly slow type bullock cart traffic when the width may be reduced to 10 feet. Improved types should have a minimum width of 12 feet for pavements, as these induce greater speeds.

“Where the single lane pavement is inadequate, the next stage would be to either increase the pavement width to that of two lanes or provide suitable shoulders of adequate width to make an overall width of at least 18 feet. The latter is only to be a palliative and should be resorted to when funds for proper widening are not available.

“For 2 lane pavement the width should be 22 feet minimum. For more than 2 lanes the total width should be $(10n+2)$, where n is the number of lanes. Intermediate widths should not be encouraged.

“When traffic is not accommodated in two single lanes, attempts should be made to segregate slow traffic on to a trackway in the berms or off the road. In many cases, this will be economical, and the capacity of 2 lane pavement will be increased to a great extent.

“Where, however, even after segregation, traffic warrants more than two single lanes, it is desirable to have two single lanes with dual carriageways and a central reservation. Construction of a 3 lane pavement is hazardous, and should be avoided, even though dual carriageways may be comparatively more costly.

Where 3 lane pavements exist these should be marked by a central separation line to separate the opposing traffic streams.

“Separate cycle tracks should be provided near urban areas, industrial centres, etc., where the peak hour cycle traffic is of the order of 500 or more. The minimum width of a cycle track should be 6 feet, and any increase in multiples of 3 feet.

Suggested standards for widths of p

Serial No.	Nature of Traffic	Average Daily Tonnage Tons	No. of Lanes
1.	Slow bullock cart traffic up to 200 vehicles with only occasional cars and no commercial vehicles.	Up to 200	1
2.	Mainly slow traffic with a low percentage of motor cars.	201-500	1
3.	Slow moving traffic mixed with light motor traffic with a few commercial vehicles.	501-750	1
4.	Mixed traffic with a fair amount of both cars and commercial vehicles.	751-1000	1
5.	Mixed traffic as in 4 above.	1001-1500	1
6.	Mixed traffic	1501-2500	2 or 3
7.	Mixed traffic	2501-5000 (Exclusive of cycles) Cycle track where cycles exceed 400 at peak hour.	Dual consi 12 ft (b) 1 traffic all se
8.	Mixed traffic	Over 5000 Exclusive of cycles	Dual consi 22 ft 1 lan ffic (c (d) AL

Cycle tracks to be effective should have a better riding surface than that of the carriageway, otherwise cycles will not take to the special tracks.

Footpaths are recommended where the pedestrian traffic density per day is approximately the following :

Table No. 3

Number of pedestrians per day justifying the construction of footpaths.

Assumed Design Speed MPH	One footpath		Two footpaths	
	Vehicular traffic density classification		Vehicular traffic density classification	
	30 to 100 vehicles per hour	More than 100 vehicles per hour	50 to 100 vehicles per hour	More than 100 vehicles per hour
30, 40, 50	150	100	500	300
60, 70	100	50	300	200

Footpaths should be surfaced to encourage their use.

Indian Traffic :-It is to be remembered that the trend of investigation and results in other countries on the pavement and lane widths given above is mainly with reference to pneumatic tyred traffic without the slow animal-drawn traffic, that we have in our country. For a long time to come, most of our roads will have to cater for mixed traffic, consisting of bullock carts, pedal cycles, cars, buses, commercial lorries, etc. While, therefore, the capacity with mixed traffic is reduced, it may be necessary, for want of sufficient funds, to be content with one

lane pavement for a greater portion of our road system, with suitable shoulders to provide for passing and overtaking.

Keeping the above factors in view the suggested traffic capacities, lane widths, and types of surface recommended as suitable to our conditions, are indicated in Plate I. It should be remembered, however, that the type of surface is purely a function of the economics of different types in initial construction, annual maintenance, periodical repaintings or renewals, etc., and that every section should be considered on its own merits.

We have not got adequate data on the traffic intensities in many of our roads, their mixed character, the transverse placement of vehicles, and the effect of slow moving bullock cart as affecting traffic capacities of lanes. The standards indicated in Plate I have, therefore, been suggested as a rough guide.

Comments: Some members of the Committee while approving the Standards suggested in Plate I felt that the minimum width of concrete pavements might be reduced to 10 ft as this would enable greater milage being converted to a higher type; but the Committee felt that higher standards would induce higher speeds, and improved surfaces will automatically induce increase in traffic intensity.

In order to provide for the increase in traffic anticipated during the serviceable life of the pavement the minimum width of pavement should be 12 ft. Even where 10 ft concrete pavement for a single lane has to be resorted to as an expediency berms on either side should be metalled for a width of four feet thus providing a hard crust at least 18 feet wide.

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GENIUS

It is written that the genius doth seldom get married. Verily doth it take a genius to escape.

HERE AND THERE

1. ACCIDENTS TO PEDESTRIANS ON ROADS WITHOUT FOOTPATHS

THE Highway Code recommends that "if there is no footpath it is generally better to walk on the right so as to face oncoming traffic."

To assess the reduction in pedestrian accidents that might result from full observance of this recommendation, an examination of the habits of pedestrians on a number of such roads was made and, further, the respective proportions of casualties to pedestrians facing and with their backs to the traffic were found from accident data. The results are given in the following table.

	Pedestrian habits		Pedestrian casualties	
	Per cent facing traffic	Per cent with backs to traffic	Per cent facing traffic	Per cent with backs to traffic
Daylight	34	66	27	73
Darkness	35	65	18	82

It will be seen that the proportion of pedestrians who walk facing the oncoming traffic is about one-third, and that this proportion is the same in daylight as in darkness.

A lower percentage of those who face the traffic become casualties than of those with their backs to it and this difference is even more marked during darkness.

2. BRIDGES EVERYWHERE

WHENEVER and whatever the Dutch build, their task is always made more complicated and costly because of the ubiquitous water factor. It is possible that even the railway authorities have given up counting the total number of railway bridges that cross Holland's large and small rivers, waterways, canals,

The results may be expressed as the relative risk R of walking with the back to the traffic, as compared with walking to face the traffic.

$$R = \frac{\text{Per cent casualties with backs to traffic}}{\text{Per cent casualties facing traffic}} \div \frac{\text{Per cent walking with backs to traffic}}{\text{Per cent walking facing traffic}}$$

From the above table the relative risk in daylight

$$R = \frac{73}{27} \div \frac{66}{34} = 1.4$$

and in darkness $R = 2.4$

These results show that in daylight it is about $1\frac{1}{2}$ times, and in darkness $2\frac{1}{2}$ times, as dangerous to walk with your back to the traffic as to walk facing it.

How important is this in the reduction of pedestrian accidents? There are about 1,200 casualties per year to pedestrians walking with their backs to traffic on roads without footpaths, and about 400 to the other group. If the former had all faced the traffic, then the above comparison suggests that their accidents rate would have been reduced by at least one-third, so that their number would have fallen from 1,200 to 800, a reduction of 400 or one-quarter of the total.

(Extracted from 'The Surveyor' - October 13, 1951.)

streams, polder ditches and marshes. The dimensions of these bridges run the complete scale from short spans across the drainage ditches surrounding most farms, to the 5,000-foot, 14-span Moerdijk Bridge between Rotterdam and Antwerp which took six years to build.

3. RUBBERISED ASPHALT ROADS

THE addition of small quantities of natural rubber to asphalt is said to enhance considerably the qualities of the wearing surface of a highway.

Powdered rubber, made direct from natural latex, is incorporated in the asphalt to the extent of 0.25 per cent of the finished carpet (5 per cent to 7 per cent of the bitumen content). No change is involved in normal paving specifications, the rubber grains generally being added to the aggregate, just after the aggregate enters the mixing chamber of the asphalt plant, before introducing the bitumen to the mix.

The resulting surface is said to possess a longer life and to require less maintenance than a corresponding surface without rubber. One of the main improvements is that the coefficient of friction of the surface is increased, thus reducing the likelihood of skidding. A point of particular importance in the United States is that the rubberised surface is less vulnerable to temperature changes, and is less brittle at low temperatures, so that it can withstand the severe winter conditions sustained by some U. S. highways with comparatively little deterioration. The full extent of the benefits has yet to be determined by future tests.

The action of the rubber is not completely understood, but it is thought to involve the absorption of the lighter hydrocarbons in the bitumen, the rubber swelling to five or six times its original size in the process. The result is that the melting point and softening point temperatures are both increased, and the penetration and flow are lowered, whilst the phenomenon of "bleeding" is reduced.

The method has been employed on a number of U. S. highways, and in view of the concern in that country about the huge expenditure on roads, possibilities of economy by its use have aroused considerable interest. However, the first road to be laid with this type of surfacing was in the Netherlands, and stretches of rubberised surfaces from 1200 ft to 3 miles in length have been laid in Holland, Denmark, Sweden, Belgium and France. In one instance, a heavily travelled road outside Rotterdam has been in use for twelve years and is still in good condition.

Only natural rubber is suitable for this process, synthetic or reclaimed rubber not giving the same results.

(Extracted from 'The Engineer' - May 5, 1950.)

4. MOST UP-TO-DATE PLANT

QUESTION: Which is the most up-to-date motor plant in the world?

Answer: The most up-to-date car plant in the world has been opened at Longbridge, Birmingham, by the Austin company which turns out about a fifth of Britain's total car production.

It cost Rs 2.6 crores and 4,000 cars can be assembled in it. The plant, built as an addition to the existing Austin factory, has

16 miles of conveyors which can handle over 700 tons. Its 100 miles of cables have 14,000 electrical connections.

The plant cuts to a minimum faults due to human carelessness. Components are not touched by hand after arriving from the departments where they have been made. Compounds are automatically fitted to the chassis as they pass through.

(From 'Auto-Spark' - September, 1951.)

5. C LICENCES AND THE LAW

CAN a trader allow one of his C-licensed vehicles to be used for conveying boy scouts to camp? This, said Mr. R. E. G. Brown, Secretary of the London and Home Counties Area of the Traders Road Transport Association, was typical of the questions about the use of C licensed vehicles.

Mr. Brown was speaking to the Croydon Chamber of commerce on "C licences and the law" and he answered his own question by saying: "Of course he can. The Road and Rail Traffic Act," he explained, "stipulates the conditions when

a carrier's licence is required. A C licence is necessary when the vehicle is being used for or in connection with a trade or business. If it is not being used in connection with a trade or business, so long as it is not being used for hire or reward, then no licence is required at all. It is, therefore, quite legal," the speaker concluded, "to carry boy scouts so long as no question of hire or reward to him arises.

(Extracted from 'Modern Transport' - July 7, 1951.)

6. RELATIONSHIP BETWEEN MINISTERS AND DEPARTMENTAL OFFICERS

HERE is a summary of what the late Harold Laski said on the subject: the business of ministers is to frame a policy which satisfies the largest possible volume of public demand and, on its acceptance by the legislature, to maximise its effective operation. Obviously, also, in the scale of the modern state, they can give no more than a general oversight to this task. They must be dependent upon their officials for knowledge of public demand, for information in detail upon the possible ways of responding to it, and for the daily and detailed work of carrying out the law. No matter what the complexion of the party in power, these tasks must be performed with a minimum of friction.

To this end officials need to be neutral; they must serve one party in power as wholeheartedly and as efficiently as another. To be neutral, they must be assured, granted their competence, permanence of tenure; and to give them encouragement to do their best, the system of promotion must give to ability the largest possible chance of being discovered and exercising a proportionate responsibility.

If you read Laski's *Politics* you will see that he never for a moment imagined that there might be such a thing as dishonesty. Everything turned upon "competence".

(Extracted from 'Capital' - August 2, 1951.)

7. TENACITY VERSUS RAPACITY

WHAT caused the Holland Iron Railway Company its biggest headache was the lack of any suitable law of eminent domain permitting condemnation or expropriation. Unlike the United States where the railroads preceded and stimulated the settling of empty territories, the Netherlands, especially the western part, was already* well populated and had reached that state of development where every acre of soil was under cultivation. The building of railways necessitated the purchase of farmland and rights of way for

which the owners could and did demand practically any price that struck their fancy. Prices of twenty-five times the actual land value were often asked and sometimes paid.

An amusing case

There was the amusing case of Mijneer Vandergaag who owned a little lane of about 300 square yards which the railway company needed for its line from Delft to Rotterdam. The company offered one

*The Company was founded in 1837.

hundred guilders. Vandergaag demanded 20,000 guilders an unheard of price for those days. For over two years the case languished in the courts: the company completed all of the remainder of the line but could not run its train because of Vandergaag's refusal. Finally, the company decided to build the line around the small property. For four days the trains

used the small circular route: then Vandergaag capitulated. Compelled by public resentment, he ceded the lane to the company without any indemnification whatsoever.

[India is unfortunately full of parasitic Vandergaags and public opinion is not as strong here as in the Netherlands.....Ed.]

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8. TOTAL ECONOMIES THROUGH MODERNISATION OF ROAD SYSTEM

TRANSPORT operators would save a large sum of money every year in running costs of their vehicles, through economies in time, fuel and lubricants, tyres, maintenance, and repairs, if proper roads were built. Let us quote some figures for the projected Birmingham-Bristol motorway which would be 76 miles long (as against 88 miles for the present route) and would cost some £7,000,000 to construct, giving an annual cost of £516,000.

The notional vehicle would be able to cover the 76 miles of an unobstructed motorway between Birmingham and Bristol in 2 hours, at an average speed of 38 m. p. h., thus saving 1 hour 15 minutes on the whole journey, equivalent to 0.75 d per mile run.

But the saving in time is by no means the only saving to be expected from a motorway. Owing to the easy gradients and curves and the possibility of maintaining an economical speed without any stopping or slackening, the fuel bill should be cut by at least 30 to 40 per cent, equivalent to 0.51 d per mile; the cost of tyres by 15 per cent (0.06d per mile); and maintenance and repairs by 10 per cent of 0.06 d per mile. Thus a total saving of 1.39 d per vehicle-mile for vehicles using the road should be possible and this amounts to £700,000 a year for all the vehicles running on the route, which compares favourably with the annual cost of the motorway of £516,000.

(Extracted from B. R.F. Bulletin "South Wales Roads".)

A census has been made of the traffic using the route. It amounts to 4,400 vehicles a day and, after allowance for the different operating costs of different types of vehicles, the expenditure incurred by this Birmingham-Bristol traffic is about £3,200,000 a year. In analysing this expenditure it is convenient if the numbers of the different classes of vehicle using the road are taken as weights to give a notional typical vehicle. On the present road such a vehicle would have an average speed of 27 m. p. h. and would cost 14 s. 7d. an hour or 6.5d. a mile, to operate and, of this sum, 3 s. 10 d. an hour would be a variable dependent solely on the time element.

9. DESIGNER'S FORMULAE

IN the lecture room the student who asks for a "formula" at the end of a discourse on the application of mechanical principles to a design problem is rightly chided. In the education of engineers the

object is to impart a grasp of fundamental principles applicable to a wide variety of subjects and it would be contrary to that aim to devote attention to numerous formulae each of limited scope.

In practical design, however, the position is quite different. There the designer is presumed to have already acquired a reasonably wide range of technical knowledge and the need is to use it to the best advantage in coping with his daily problems.

Allowable Loading

Regular use of formulae does tend to inhibit the desirable mental connection between figures on paper and the physical quantities that they represent.

(Extracted from 'The Engineer'—Aug. 3, 1951.)

10. COUNSEL OF DESPAIR

OPINION is gaining ground that price and other incentives offered under the "grow more food" campaign have so far failed to persuade the cultivator to raise bigger crops. In the absence of social consciousness and bad investment habits, and with the avenues of investment lacking, the farmer, instead of raising his

standard of living, has often reduced the cultivated acreage. The Government should therefore try the other alternative of increasing the burden of taxation on him.

(Extracted from 'Capital'—January 24, 1952).

NOW HE KNOWS

A case was being heard in court in which a farmer was claiming indemnity for a cow killed by a railway train. Counsel for the defence put many tedious and superfluous questions.

"Was the cow on the track?" he asked the engineer.

The engineer had had about enough. He replied: "No, of course not. She was in a field half a mile away. But when it saw her, the engine left the rails, jumped the fence, and chased her across the field and up a tree. There it strangled her to death."

TIT FOR TAT

A man who was fond of playing practical jokes, sent a friend a V. P. P. telegram which read: "I am perfectly well."

About a week later the joker received a heavy V. P. P. package with express charge. Opening it he found a big block of concrete on which was pasted the message: "This is the weight your telegram lifted from my mind."

PREPARATION OF SCIENTIFIC PAPERS

Sometime ago a Committee was constituted under the auspices of the Council of Scientific and Industrial Research and the National Institute of Sciences of India "to draw a set of instructions for the guidance of authors of scientific and technical papers."

The Committee have drawn up notes, which have appeared in the Journal of Scientific and Industrial Research for January 1952. We reproduce these notes here in the hope that they will help authors in preparing their Papers for publication in the Indian Roads Congress Journal.

1. Consistence.

Authors should consult a current issue of the periodical in which they wish to publish their paper and acquaint themselves with topographical and other conventions, use of headings, layout of tables and form of citations.

2. Scientific Paper—Its Parts

A scientific paper should comprise 3 main parts, viz., introduction, experimental or theoretical or mathematical part, as the case may be, with results and discussion, and conclusion. An abstract should precede the introduction; acknowledgment and references should follow the conclusion.

2.1 Abstract

The abstract should not ordinarily exceed 3 per cent of the length of the paper and, in any case, 200 words. It should give the main results of the investigation faithfully and adequately. It may be paragraphed if absolutely necessary, but paragraphs should not be numbered. The abstract helps the reader to get a preview of the content of the paper; it may be used by editors of abstracting periodicals as it is or after modification in their publications.

2.2 Introductory Part

The introduction should set out the problem investigated and its background and disclose the purpose of the investigation. It should not be made into a literature review, but should indicate in the briefest manner possible the lacuna in what is known, which the paper attempts to fill up. Reference to previous work should be confined to what truly serves as the jumping off ground.

2.3 The Central Part

The main part of the paper, which should be presented under suitable subdivisions, should give the methods employed in the study, the results obtained and the discussion on the significance of the results. The validity of techniques and the logic of inferences or interpretation of observations should be clearly shown. Experimental results should be presented in a helpful order without regard to the sequence in which the experiments were performed. Sufficient information should be made available to permit repetition of the work by any competent reader of the paper.

If the methods employed in the study are well known, it is sufficient to give references to papers in which they have been described.

2.3.1 Tables.—Tables should be given compactly and should be properly arranged. Individual results of a number of similar experiments are not necessary. A statement of the number of individual results, their mean value, the standard error of the mean value, and the extreme range of values is usually sufficient. Some results lend themselves better to representation in the form of graphs or schematic diagrams and others are better presented in the form of tables. **Giving graphs as well as tables, both representing the same set of data, should be normally avoided.**

Tables should be complete in themselves and convey the information which they are designed to convey without reference to the text. They should be numbered consecutively in Arabic numerals and should bear brief titles. Headings of vertical columns should be brief and the

first letter of the initial word should be capitalized. Units of measurements should be abbreviated, typed in small letters (underlined), and placed below the headings.

Nil results also should be indicated and they should be distinguished clearly from absence of data. Ditto should be indicated not by ditto marks (") but by "do." Quantities less than 1 should be given in decimals giving only as many places as are significant. If the measure is less than 1, the decimal point should be preceded by a cypher.

Footnotes to tables often supply information otherwise requiring a column.

Marks drawing attention to notes and entries in a table should be of a species different from that used for the data.

Each table should be typed on a separate sheet of paper (foolscap size) and inserted as a numbered page to follow the page in which the reference to it is made. The reference to it in the text should be also indicated in the margin.

Tables should be specifically referred to in the text by their numbers and not by such expressions as 'above', 'below', 'preceding', or 'following'.

2.3.2 Illustrations—Line drawings should be made with Indian ink on white drawing paper (preferably Bristol Board), cellophane sheet, tracing cloth or graph paper ruled in pale blue or grey lines. Originals, not blue prints or photographic copies, should be sent.

The size of letters, numbers, lines, and dots used in drawings should be sufficiently large to permit reduction to the page or the column size as required in the periodical without loss of detail. Numbers and letters should be clear and neat. Graphs and line drawings should be drawn to approximately twice the size of the printed illustrations. If authors have special reasons for reproducing illustrations in particular sizes or according to a definite arrangement they should indicate their reasons for the guidance of editors.

Photographic prints intended for reproduction should be on glossy paper and show as much contrast as possible. Nega-

tives may be sent, but Kodochrome films are unsuitable for taking prints required for reproduction.

Keys to letters and numbers in text illustrations should be given in legends not written on illustrations. Legends should be typed on paper and pasted on the back. Illustrations should bear information required for their complete identification—name of author or authors, title of paper, figure number in Arabic numerals, and legend.

Illustrations to be printed as plates should not be numbered consecutively with text illustrations, but in a separate sequence and numbered Pl. I, Pl. 2, Pl. 3, etc.

Each figure and plate should be specifically referred to in the text by the number of the illustration and not by such expressions as 'above', 'below', 'preceding', or 'following'. References to them in the text should be indicated in the margin. The legend should be typed and included in the manuscript, separated from the text matter by a line above and a line below.

Linear magnification should be given wherever necessary by the sign X followed by a number indicating the magnification. Where awkward numbers have to be recorded for the magnification (after taking into consideration the final reduction in the printed page of the periodical), it is better to insert a scale in the illustration in the appropriate place.

Illustrations are not embellishments to a paper. They are visual aids to understanding, and are used to impart precision and to minimize description. Illustrations should be grouped together where possible, but photographs and line drawings should not be mixed up.

Illustrations should not be pasted to the pages of the text. They should be attached with art corners to numbered sheets and dispatched along with the typescript.

Explanations to plates should appear at the end of the paper after references.

Legends to all figures should be typed on a separate sheet of paper and included at the end of the paper.

Illustrations should be protected by thick cardboard packing against creases, folds, and broken corners during postal transit.

2.3.3 Discussion—In this section, the author should interpret the data and state clearly the meaning and implication of the results presented. He may indicate possible future developments. Controversial points, if any, should be dealt with objectively.

2.4. Conclusion

Conclusions deduced from the study should be given in numbered paragraphs in a separate section of the paper. Assertions are undesirable. Teleological statements and generalizations should be avoided.

2.4.1 Acknowledgment—Acknowledgments should be placed under a separate heading immediately before references. The names, initials, and official positions of individuals to whom acknowledgments are made should be given. Proper names should be spelt in the way they are spelt by those who bear the names.

2.4.2 References—Papers which have been referred to in the text should be listed under this section.

References should be indicated in the text by numbers placed above the line (superior), the reference being cited in a standard form under references against the appropriate number, and in the order in which they occur in the text.

In citing references:

If there are 2 authors to a paper, the names should be joined by an ampersand (&).

If there are 3 or more authors, the names should be given in full in the first citation; in later citations, repetition should be avoided.

Surnames and initials of authors should be given followed, in order, by the title of the periodical in the abbreviated form (underlined), the volume number (2 lines underneath), the year within circular brackets, and the page reference.

The abbreviations for the titles of periodicals are those given in the Indian

Standard for Abbreviations of Periodicals (IS: 18-1949). For terms not listed there, the abbreviations should be made according to the rules stated therein.

The page reference should be in inclusive notation. If the reference is not to the whole paper, it would be helpful if the page reference mentions only the actual page. Thus:

Kane, J. G. & Randive, G. M., *J. Sci. Industr. Res.*, 10B (1951), 62-66. [If the reference is to the "Effect of rancidity on aniline point", it would be helpful if the citation is given thus: Kane, J. G. & Randive, G. M., *J. Sci. Industr. Res.*, 10B (1951), 64.]

Where 2 or more references to the same authors are listed, the author's names should be repeated. Thus: Basu, S. N. & Ghose, S. N., *J. Sci. Indust. Res.*,

9B (1950), 151-156.

Basu, S. N. & Ghose, S. N., *Sci. & Cult.*, 15 (1949-50), 285-286.

If 2 or more consecutive references to the same periodical are cited, the title of the periodical should be repeated. Thus:

Kapur, S. L. & Sarin, K. K., *J. Sci. Industr. Res.*, 10B (1951), 94-97.

Mathur, H. H., Aggarwal, J. S. & Siddiqui, S., *J. Sci. Industr. Res.*, 9B (1950), 121-124.

If a paper has been accepted for publication, but the volume and page numbers are not available at the time the paper was communicated, the title of the periodical should be followed by the words "in press" within circular brackets under references. Thus:

Guha, P. C., *J. Sci. Indust. Res.* (in press).

References to books should include the names of authors, followed by the title (underlined), publishers and the city of publication within circular brackets, year of publication and the page number in the book to which reference has been made. Thus:

von Loesecke, H. W., *Drying & Dehydration of Foods*

(Reinhold Publ. Co., New York), 1943, 93.

Casual or irregularly appearing publications should be listed in the same manner as books.

Unpublished papers and personal communications should not be listed under references, but should be indicated in the text. Thus: Pande, A. B. (unpublished data); Pande, A. B. (personal communications).

Authors should carefully check the entries and satisfy themselves that the citations are complete and accurate before communicating the paper.

2.4.3 Appendix—Appendices should be included only if necessary. They should be numbered in Arabic numerals and should be specifically referred to in the text.

3. General Suggestions

Typescripts should be submitted on white bond paper, foolscap size (8×13 in.). Only the top copy should be submitted and, if possible, a carbon copy should also be sent. Authors are advised to retain copies, as publishing organizations are not custodians of manuscripts.

The text including Legends of illustrations, footnotes, and references should be typed with double space and on one side of the paper.

Sufficient margin should be left in typescripts for editorial use.

The title of the paper should be concise, consistent with the need for designating the contents adequately and precisely. It should permit of correct indexing. If the title contains a large number of words, a short title suitable for use as running title on the right hand page of the printed periodical should be supplied by the author.

The names of authors should be given below the title. Neither academic titles nor official positions need be given.

The names of authors are followed by the name of the organization to which the author is attached, and immediately below it, and within circular brackets, should be typed, "Manuscript received.....". (The editor will enter the date of receipt of the manuscript.)

If the paper consists of a number of headings and subheadings, a table of contents with heading numbers, not necessarily for printing, should be provided for the guidance of editors.

The numbering, types of lettering, and position of headings are governed by the length and complexity of sub-divisions in the paper. Each heading should contain a noun and the use of adjectives only, e.g. Experimental, as heading is undesirable.

A full point is not to be used at the end of any heading.

The spelling adopted should conform to that of the Oxford Dictionary. Uniformity should be observed in capitalization, hyphenation, abbreviation, and punctuation.

Pages should be numbered consecutively throughout the entire paper. Insertions should not be made on the back of a page. Extra matter for insertion should be typed on a separate sheet of paper (foolscap size) and numbered distinctively, for example, 8a. To assist the printer, page 8 should carry at the bottom the notation "Page 8a follows" and page 9 should carry at the top "Page 8a precedes". The position of the insertion in the page should be indicated in the margin. If a sheet is removed, the page preceding it should carry its own number and that of the page removed. The page preceding the one removed should carry at the bottom the notation "Page....removed" and the page following the page removed should have the notation at the top "Resumed from page....".

Footnotes should be avoided as far as possible. In most cases it is possible to weave the matter intended for footnotes into the text matter. If unavoidable, they should be given at the places referred to by a footnote reference mark and demarcated by lines drawn above and below across the page.

Appropriate footnote reference marks * † ‡ § should be inserted in the text and in the beginning of the corresponding footnote.

Cross references to statements made elsewhere in the text, e.g. (see page.....), should contain the page number of the

manuscript on which the statement referred to occurs, so that there may be no difficulty in locating the page when the proof is corrected and in inserting the appropriate page number of the periodical. Do not write "In another part of the paper", "As has been noted earlier", or "It will be explained later" without giving a cross reference.

A sentence should not commence with a number given in figures. Revise the sentence, and if this is impossible write the number in words.

The date of the month precedes the month, and the month precedes the year in Arabic numerals. Thus: 7 Dec. 1947. Abbreviations such as rd. st. th. are unnecessary. The name of the month is abbreviated if there are more than four letters in the name.

Directions to printers written on the copy should be enclosed by circles or curved lines.

Before despatching the manuscript, the author should satisfy himself that the length has been reduced to the minimum compatible with clarity of presentation and that all entries in tables and under-references have been checked and found correct.

Typescripts should be mailed flat. If illustrations accompany the typescripts they should be protected against creases,

folds, and broken corners by thick cardboard packing.

4. Special Fields

4.1 Mathematical Papers

Symbols and expressions should be written by hand neatly and exactly as they are to be set up by the compositor. Particular attention should be paid to superior and inferior symbols. Greek letters occurring in expressions should be re-written in the margin of the manuscript along with its name in English. The use of bars and dots above or below symbols should be reduced to a minimum.

4.2 Chemical Papers

The monograph by A. D. Mitchell-**British Chemical Nomenclature** (Edward Arnold, London), 1948 may be used as a guide.

In the text, the names of elements and compounds should be given in full and not referred to by their symbols.

Trade names of proprietary products should not be used unless the chemical identity of the product is also given. When used, the first letter of the trade name should be capitalized.

4.3 Biological Papers

In the naming of plants and animals the Rules of International Botanical and Zoological Nomenclature should be strictly adhered to.

VALUES

Wife: "Tony, this is't our baby. You've taken the wrong carriage."

Husband: "Shut up, you dope. This one's got rubber tires."

PROFESSOR F. G. ROYAL DAWSON

PROFESSOR F. G. Royal Dawson's name has become a household word among highway engineers all over the world. But not many present day engineers in India know that, as an engineer, he belonged to this country. Before he retired in 1921 he had served India for more than 30 years as railway engineer.

In an obituary notice Mr. L. R. Robertson writes in "Highways and Bridges" for September 1951:

Professor Royal Dawson was trained at the Royal Indian Engineering College in London, obtaining practical experience on the construction of the Forth Bridge, and was appointed to the Indian State Railways in 1890. He was first employed on the construction of the Mu Valley railway in Burma, and soon made his mark as an energetic and capable engineer. There followed a wide range of appointments of rapidly increasing responsibility all over India until finally he was Chief Engineer to the Indian Railway Board and Chairman of the Indian Railway Bridges Committee. He retired in 1921, at which time he was best known in engineering circles for his strong views on the railway gauge policy for India, then a most controversial and vital subject and he read papers on this question before the Institution of Civil Engineers and the Royal Society of Arts.

Having pursued one career right to the top and retired, Professor Royal Dawson then commenced another, and it is an extraordinary fact that it is as a road engineer that his name has become almost a household word to a certain section of the present generation of civil engineers. He achieved this result, after emerging from his retirement to take the Chair of Road and Railway Engineering at Cairo University from 1926 to 1929, by his series of articles and books on road transition curves, culminating in the timely publication of the final volume, "The Highway Engineer's Pocket Book," only 11 months before his death. This subject also has been the centre of much controversy in the technical Press, though it is doubtful whether many of the contenders realised that they were dealing with an octogenarian, for many years almost blind.

In private life Professor Royal Dawson was an accomplished musician and a keen Volunteer, rising to the rank of Lieutenant. He was blessed with a vigorous constitution, great courage, and a pleasant wit, and he fully deserves his place on the list of eminent engineers who have served the profession well.

Professor Royal Dawson died on August 16, 1951 at the age of 84.

SAFEST WAY

The safest way to double your money is to fold it over once and put it in your pocket.

TECHNICAL INFORMATION

(1) MEASURING THE WATER-CEMENT RATIO OF CONCRETE

THE apparatus shown in fig. 1 enables the water-cement ratio of wet concrete to be ascertained or compared with the known water-cement ratio of a sample of wet concrete. It comprises a cylindrical canister on the end of a handle and an electrical recording instrument. The canister contains a vibrator operated by electricity

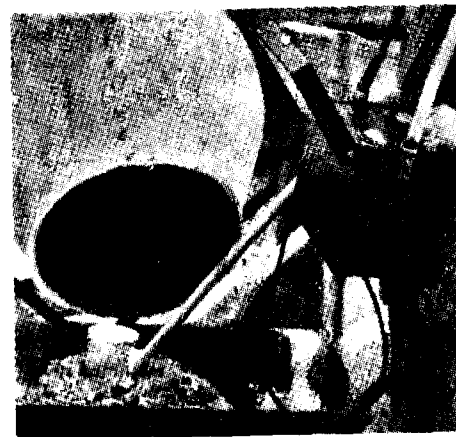


Fig. 1

from batteries in the instrument box or from the mains. The electrical resistance of the grout brought by the vibratory action to the surface of the concrete between two electrodes on the underside of the canister is a measure of the water content. The higher the water content the less the resistance and the higher the reading on the gauge of the instrument.

To ascertain whether concrete as made on a site has the required water-cement ratio, a batch of concrete having the required water-cement ratio is first made and tested and the position of the pointer on the gauge is noted. The canister is then immersed in the concrete to be tested, and the position of the pointer indicates whether the water-cement ratio is higher or lower than that of the specially-prepared concrete. To determine the actual water-cement ratio of a sample of concrete, this is tested and the number against the pointer is noted. With the same materials as are used for the sample, two or three batches of concrete each with different water-cement ratios are made and tested and the number against the pointer is noted in each case. From these numbers a curve is drawn to give the relation between the numbers and the water-cement ratio, and the ratio corresponding to the number of the sample is determined by reference to the curve.

Tests showed that a difference of 0.05 in the water-cement ratio is indicated by the apparatus, which was designed and is supplied by Civil Engineering Research Laboratories, Sunbury, Middlesex.

(Extracted from 'Concrete' - December, 1951).

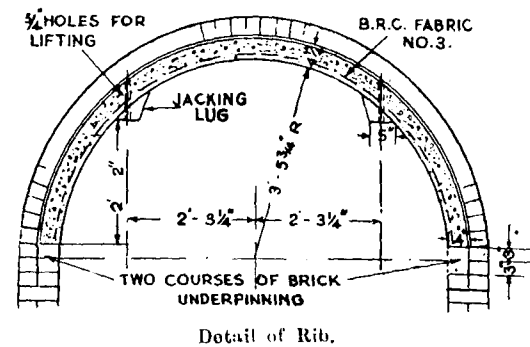
2. THE REPAIR OF A BRICK ARCH BRIDGE AN EXPERIMENT

(Extracted from the 'Surveyor'—December 15, 1951)

A county bridge, on a class III road in Buckinghamshire, which has a width of 20 ft, spans the river Thame by means of three 7 ft 6 in. brick arches. The intrados rings of the arches had been washed out as a result of repeated inundation by flooding

and quite large areas of the arches had completely disappeared, leaving the carriageway partially supported by the arching action of the fill only. There was little doubt of the urgent need for repairs if the structure was to be preserved.

It is unnecessary to impress highway and bridge engineers today with the need for economy in carrying out works when funds are so restricted. The problem was one which has to be faced so often in these hard times, of how to ensure the safety of the public with the minimum of expenditure.



Obviously the orthodox method of stripping the road surface and re-building the arches, involving not only considerable expense in reconstruction but also the additional cost of watching, lighting and

traffic control, was ruled out by force of circumstances for a class III traffic route.

Stated briefly, the method evolved to avoid this relatively heavy expense was to insert precast reinforced concrete arch rib linings to replace the fallen brick rings. This was done by erecting a temporary gantry under each arch to support a jubilee track, running the ribs in on a bogie and then jacking them up tightly against the extrados of the arches.

Careful measurements were made at the outset to check the size and shape of the arch barrels throughout their full width. In this instance the variation was small enough to admit of all the ribs being manufactured from one mould. A cross section of the ribs, each rib being 2 ft 4 in. in width, is shown in the figure.

(Extracted from "The Surveyor" December 15, 1951)

3. PRECAST SLABS TO REPLACE TIMBER DECK

FACED with the problem of redecking old timber bridges, the Florida State Road Department believes it has found an economical solution in precast concrete slabs 3 ft wide and 4 in. thick. Length generally equals half the width of the roadway—about 11 ft. Main reinforcing consists of six 1/2-in. bars placed at the centre of the slab.

Most of the timber spans being replaced are 15 ft long. Joists are 6 x 12 in. timbers on 2 ft centres.

In replacing worn-out decks, old deck planks are removed from half the roadway, leaving the other half open to traffic. Five new joists are generally added to each span—two under each lane and one in the centre of the roadway. Seriously deteriorated joists are also replaced.

Precast planks are then placed directly on the wooden joists, and are fastened in place by bolting to 4 in. x 8 in. hold-down timbers placed transversely to the roadway and beneath the joists. Three 5/8 in. hold-down bolts are used per slab.

This process is not expected to eliminate deck maintenance completely, but it has reduced it drastically. Some cracking of slabs is expected, and isolated slabs will probably have to be replaced from time to time. First cost of the slabs has averaged about 75 per cent of that for a comparable timber deck in Florida.

(From "Engineering News-Record"—June 14, 1951.)

Administration Report of the Buildings and Roads Branch P. W. D., Government of Madhya Pradesh for the year 1948-49

The main features of the Report are summed up below :—

I. Expenditure from the Road Development Fund.

	State's Share	(Rs lakhs) Govt. of India Reserve	Total
1948-49	.65	—	.65
1947-48	4.13	.04	4.17

II. Expenditure from sources other than the Road Fund.

(1) Expenditure on Central Works :—

Expenditure on Central Works, during the year under Report under the heads of Civil Works, Military Works, Archaeology etc. was Rs 12.63 lakhs out of which Rs 11.48 lakhs or about 90 per cent was incurred on communications. The expenditure on Central Works during the previous year (1947-48) was Rs 17.00 lakhs of which Rs 11.45 lakhs or nearly 67% went to communications.

The Central expenditure was divided between original works and repairs as follows :—

	1948-49	1947-48
Original Works	1.06	5.34
Repairs	11.57	11.66
Total	12.63	17.00

(2) Expenditure from the State budget, during 1948-49, is summarised below :—

	(Rs Lakhs)		
	Original Works	Repairs	Total
Buildings	55.98	10.99	66.97
Communications	29.88	34.49	64.37
Miscellaneous	.73	.01	.74
Civil Works not charged to revenue	31.99	—	31.99
	118.58	45.49	164.07

Of the total expenditure in 1948-49 of Rs 30.53 lakhs on Provincial Communications—original works, a sum of Rs .83 lakhs was met from Provincial Revenues; Rs .65 lakhs from Road Development Fund and Rs 29.05 lakhs from the Post-War Development Scheme.

III. Road Milage.

Comparative figures of road milage maintained from Provincial funds are as follows :—

	As on 31-3-1949	As on 31-3-1948
Class I Roads	5,624	5,469
Class II and Class III Roads	3,595	1,856
Total	9,219	7,325

The increase of milage during 1948-49 is mostly due to merger of erstwhile "princely" states, the roads of which have been taken over by the Department. According to the Report, no progress could be made on the improvement of the existing roads by providing bituminous or tar surface as the maintenance grants were not adequate even for the proper up-keep of the roads.

IV. Provincial Works executed through the Agency of Local Bodies.

	Expenditure	
	1948-49	1947-48
Buildings	1.07	1.46
Communications	5.88	6.91
Miscellaneous	.01	—
Total	6.96	8.37

The expenditure of Rs 6.96 lakhs during 1948-49 includes a sum of Rs .93 lakhs on account of supervision charges at 15½ per cent (Establishment 14 per cent and Tools and Plant 1½ per cent) paid to the local bodies.

ADMINISTRATION REPORTS OF THE P. W. D. Government of Bhopal for the years 1948-49 and 1949-50

DURING the year 1948-49 the Public Works Department was given a lump sum grant of Rs 1.98 lakhs for the maintenance of State buildings against which the actual expenditure incurred till the end of the year amounted to Rs 1.45 lakhs. The grants for the maintenance of Pucca and Katcha roads and the actual expenditure on them amounted to Rs 2.21 lakhs and Rs 2.04 lakhs respectively.

In addition to the above normal budgeted works the P. W. D. were given, during 1948-49, special grants to the extent of

nearly Rs 3.7 lakhs to carry out certain building schemes.

A 3-year programme of constructing four metalled roads totalling 49 miles and estimated to cost Rs 16 lakhs, was sanctioned during the year. This was intended to bring the countryside into closer contact with the towns and to facilitate agricultural marketing.

Till the end of the year 1949-50, a sum of Rs 3.14 lakhs had been spent under the 3-year programme at the close of the period under review.

List of Approved Works on National Highways

S. No.	Job No.	Name of work	Amount Rs	Remarks
MADRAS				
1.	550 MD 7	Converting the existing low level causeway across Koderu Venka into a high level perforated causeway.	78,700/-	
BOMBAY				
2.	532 BM 8	Land acquisition for Wareria-Karjan section of the Bombay-Ahmedabad National Highway.	2,99,563/-	
3.	536 BM 9	Improvements to the causeway over Janai Nalla in mile No. 37/4 of the Poona-Sholapur National Highway.	54,879/-	
4.	537 BM 8	Construction of remaining length of approaches to the bridge over the Dholdhara Khadi in mile 171/2 of the Bombay-Ahmedabad National Highway.	14,200/-	
5.	544 BM 8	Construction of the Hariala-Kanera-Bareja section of the Bombay-Ahmedabad - Rajaputna - Delhi National Highway.	50,000/-	
6.	552 BM 8	Model experiments for devising training works in connection with the Watrak river at Kaira-N. H. No. 8.	7,205/-	
7.	549 BM 4	Widening the bridge over the Indrayani river in mile 81/6 of the Bombay-Poona National Highway.	79,460/-	
WEST BENGAL				
8.	534 BG 34	Construction of a bridge over Behula river on Malda-Gazole section of National Highway No. 34.	2,16,800/-	
9.	535 BG 34	Construction of a bridge over the Tulia Nala on National Highway No. 34	1,42,300/-	
10.	538 BG 35	Construction of a bridge over the Falgoo river on Raghunathganj-Dhulian section of National Highway No. 34	3,48,468/-	
11.	539 BG 34	Construction of a bridge over Bhagirathi river in 8th Mile of Malda-Pagla Section of National Highway No. 34.	2,92,500/-	

S. No.	Job No.	Name of work	Amount Rs	Remarks
12.	540 BG 34	Construction of a bridge over the river Akheri on National Highway No. 34	2,34,362/-	
UTTAR PRADESH				
13.	551 UP 2	Painting miles 185-195 of National Highway No. 2 (Miles 52-62 of Agra-Etawah-Fatehpur Road) (length 11 miles)	3,50,900/-	
MADHYA PRADESH				
14.	553 CP 7	Construction of a Road from Dhoki to Hyderabad Border in Yeatmal District (Length about 5 miles and 6 furlongs)	2,60,000/-	
PUNJAB				
15.	A-533 PB 22	Levelling and surveying area for Ghaggar Bridge on Ambala-Kalka Road.	2,000/-	
ORISSA				
16.	531 RS 53	Construction of a bridge across Surligedda at mile 23/6 of the Borigumma-Bastar—Frontier Road.	1,91,200/-	
17.	542 RS 6	Construction of approach Road and link road to the bridge over the Brahmani river (1.1 miles)	38,800/-	
18.	548 RS 5	Realignment of the curve on the first mile of Baripada-Bamanghati Road	15,000/-	
HIMACHAL PRADESH				
19.	543 HP 22	Sanitary fittings in bath room of P. W. D. Rest House at Narkanda in Himachal Pradesh.	8,580/-	
RAJASTHAN				
20.	541 RJ 8	Construction of Kankroli-Dewair section of National Highway No. 8	1,56,700/-	
21.	545 RJ 8	Painting miles 16-19, 21, 23-28, 37 & 38 of Jaipur-Ajmer Road	87,650/-	
22.	546 RJ 8	Painting miles 25-27, 30, 31 & 36 of Jaipur-Delhi Road.	37,750/-	
23.	547 RJ 8	Surface painting of Miles 26-29 of Kankroli-Dewair Road.	28,200/-	

List of Books added to the Roads Organization Library during January 1952

1. **Economic Consequences of Divided India** by C. N. Vakil. (Vora & Co. Publishers Ltd., 3, Round Building, Kalbadevi Road, Bombay 2, 1950.)
2. **Special or Benefit Assessments for parking Facilities—Urban Land Institute, Technical Bulletin No. 15.** (The Urban Land Institute, 1737, K Street, N. W. Washington 6, D.C.)
3. **Three years of State Transport—Brochure No. 3** by Babubhai J. Patel.
4. **State Transport Looks Ahead—Brochure No. 4** by Vadilal Lallubhai.
5. **The Testing and Specification of Road-making Aggregates** by F. A. Shergold.
6. **Reproduction and Development Plans Maps—Town and Country Act, 1947—Circular No. 92.**
7. **Schedule of Suggested Minimum Street Widths for Carriageways and Footways of New Streets.**
8. **Progress Report by the Minister of Local Government and Planning on the work of the Ministry of Town and Country Planning, 1943-1951.**
9. **Concrete Block Making Machines—National Building Studies—Special Report No. 17.**
10. **Clay Brickmaking in Great Britain—A Survey of the Methods Used—National Brick Advisory Council Paper No. 6**
11. **The Firing of Common Bricks—National Brick Advisory Council Paper No. 4.**
12. **Aerated Concrete (Part II)—Building Research Digest No. 29—April 1951.**
13. **First Report on the Steel Structures Research Committee.**
George Allen and Unwin Ltd., London.
14. **Multi-channel apparatus for recording temperature—Reprint from the Journal of Scientific Instrument, Vol. 28, pages 15-17—January 1951.**
15. **Mathematical Recreations** by M. Kraitchik.
16. **A Full-scale Experiment in Bog Blasting for Road Construction—Session 1950-1951** by R. D. Deccan and others. (The Institution of Civil Engineers, Great George Street, Westminster, London, S. W. 1.)
17. **Document and Plan Copying With Ilford Materials—An Ilford Textbook.** (Ilford Ltd., Ilford, London, 1951).
18. **Advanced Strength of Materials** by D. A. R. Clark. (Blackie and Son Ltd., 16/18, William IV Street, Charing Press, London, W. C. 2)
19. **Dynamic Testing of Road Construction—by C. Van Der Pool - Shell Bitumen Publication No. 3.**
20. **Factors Influencing the Structural Stability of Sand Carpets—Shell Bitumen Reprint No. 1.**
21. **Physical Constants of Asphaltic Bitumens—Shell Bitumen Reprint No. 2.**
22. **A Handbook of Rocks for use without Petrographic Microscope** by James Furman Kemp. (D. Van Nostrand Company, Inc., New York).

The Brookings Institution, Washington, D. C., 1951.

23. Toll Roads and the Problem of Highway Modernization by Wilfred Owen and Charles Dearing. 2 copies.
24. National Transportation Policy by Charles L. Dearing and Wilfred Owen.
25. Automotive Transportation Trends and Problems by Wilfred Owen. School of Engineering Deptt. of Civil Engineering, University of Utah.
26. Proceedings of the 11th Annual Highway Engineering Conference—Bulletin of the University of Utah, March 1950.
27. Proceedings of the 12th Highway Engineering Conference—Bulletin of the University of Utah, April 1951. St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minnesota.
28. Hydraulic Data Comparison of Concrete and Corrugated Metal Culvert Pipes—Technical Paper No. 3 Series B, by Lorenz G. Straub and Henry M. Morris.
29. Hydraulic Tests on Concrete Culvert Pipes—Technical Paper No. 4 Series 'B' by Lorenz G. Straub and Henry M. Morris.
30. Hydraulic Tests on Corrugated Metal Culvert Pipes by Lorenz G. Straub and Henry M. Morris. Engineering Experiment Station, University of Washington.
31. Aerodynamic Stability of Suspension Bridges Bulletin No. 116—Part I—Investigations Prior to October 1941, by F. B. Farguharson.
32. Aerodynamic Stability of Suspension Bridges—Bulletin No. 116—Part II—Mathematical Analysis by Frederick C. Smith, George S. Vincent.
33. Recommendations of Technical Committee appointed to examine the building byelaws of various municipal bodies in Delhi urban areas. Swedish Cement and Concrete Research Institute, Royal Institute of Technology, Stockholm.
34. The Clay-Water System I—Crystal Structural and Water Absorption of Clay minerals—Bulletin No. 11 by Erik Forslind.
34. LA Vibration Du Beton—Bulletin No. 18 by Sven Bergstrom et Sven Linderholm.
35. Investigation of Load Distribution between Reinforced Concrete Floor Slabs and Their Formwork by Knud E. C. Nielsm.
36. Bibliography on Durability of Concrete Physical Reactions—Bibliography No. 8 (Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.)
37. Gasbeton Schaumbeton Leichtalk-beton (Gas concrete, foam concrete, light weight-lime concrete) by Otto-Graf. (Verlag Konard Wittwer in Stuttgart, 1949).
38. Paint Film Defects—Their Causes and Cure by Manfred Hess. (Chapman and Hall Ltd., 37 Essex Street, London, W. C. 2, 1951.)
39. Asia and the West by Maurice Zinkin—(Chatto and Windus, London, 1951).
40. Thirtieth Annual Report of the Commissioner of Main Roads for the year ended 30th June 1951. (Queensland Main Roads Commission, Brisbane, 1951). 2 copies.
- Directorate of Publicity, Govt. of Bombay.
41. Bombay Marches on—Civil Supplies.
42. Bombay Marches on—Industries.
43. Bombay Marches on—Labour and Housing.
- United Nations Economic and Social Council, Geneva.
44. Final Report of the United Nations Conference on Road and Motor Transport, N. E/CONF. 8/48, dated 16-9-1949.
45. Protocol on Road Signs and Signals Conference on Road and Motor Transport No. E/CONF. 8/50, dated 19-9-1949.
46. Convention on Road Traffic No. E/CONF. 8/47, dated 16-9-49.

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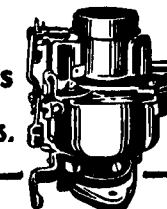
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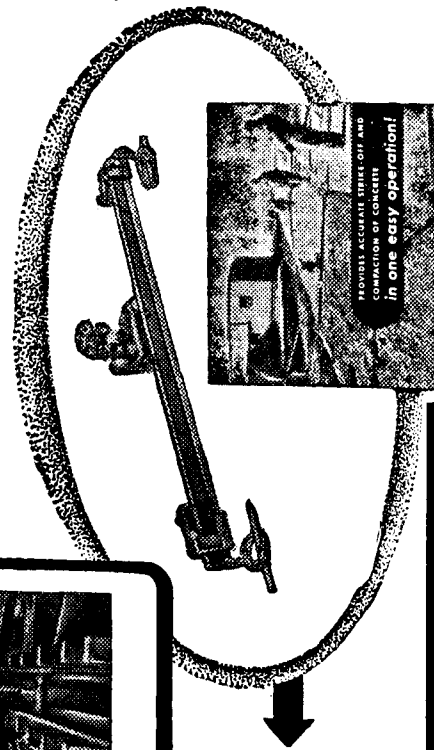
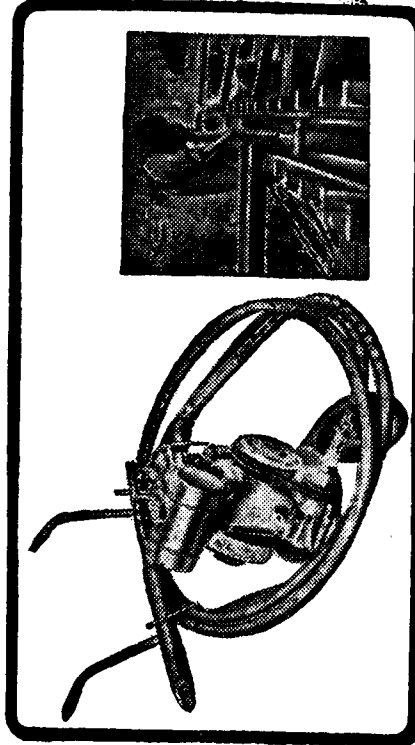
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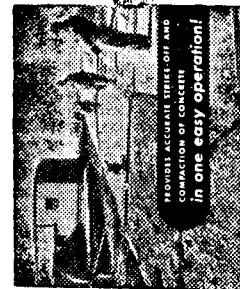
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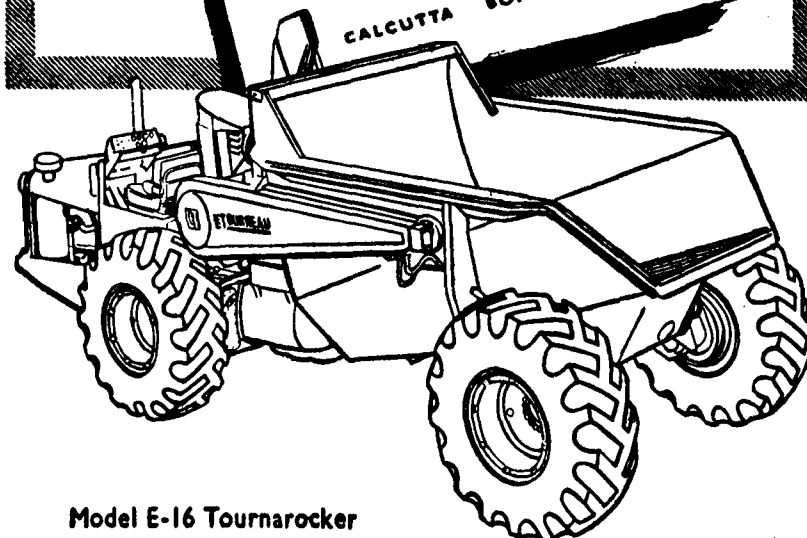


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