Transport-Communications

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TRANSPORT IS CIVILIZATION

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In this issue

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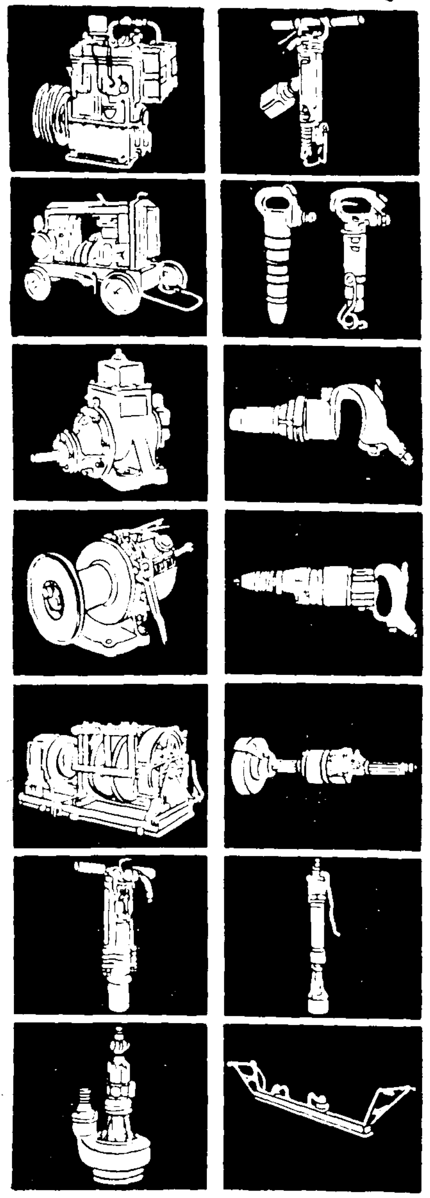

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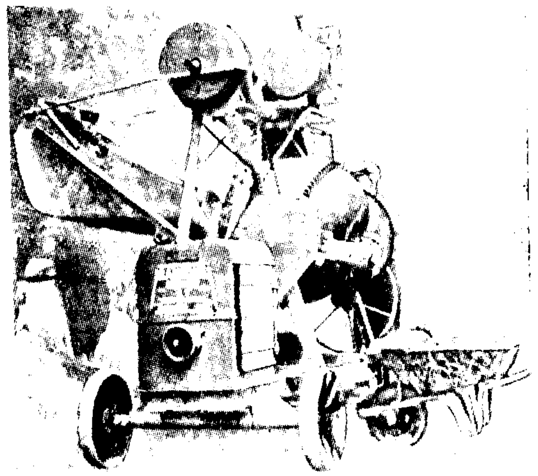
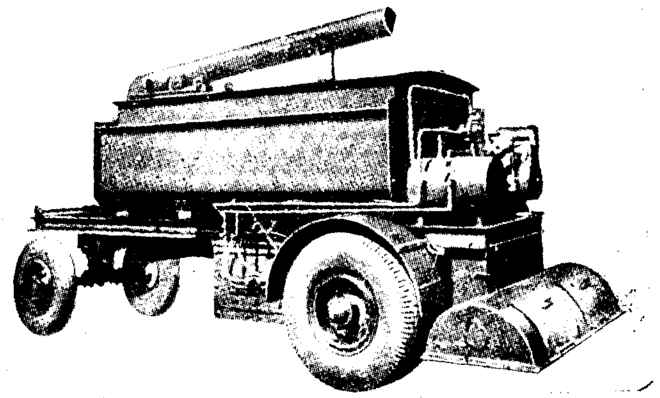
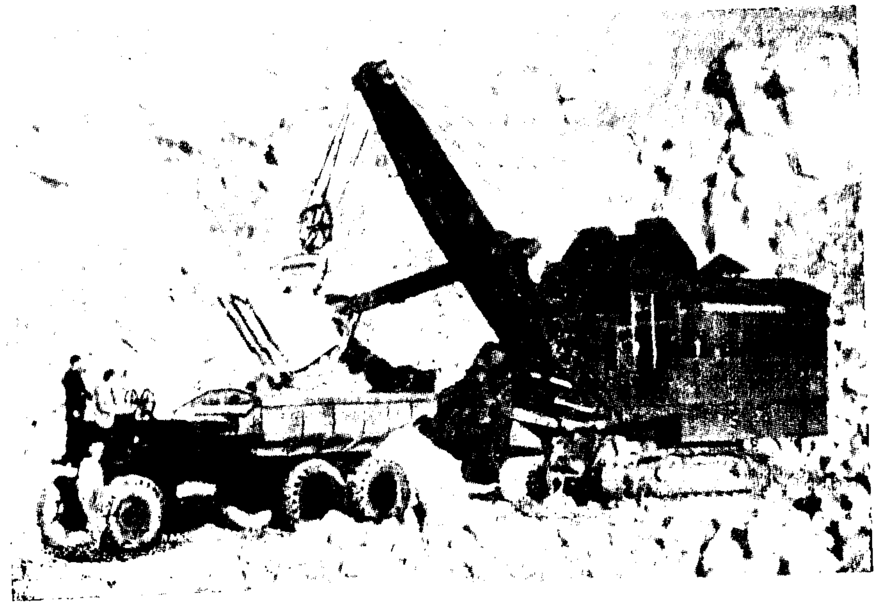




BITUMEN SPRAYING MACHINE

Above: RAPIER CONCRETE MIXER

Right: RAPIER EXCAVATOR



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ROAD DEVELOPMENT IN ASSAM 1912-1950

History

IN 1912 numerous administrative changes were made in Eastern India. The province of Eastern Bengal and Assam was broken up. Eastern Bengal, with the Commissionerships of Burdwan and the Presidency, formed the Presidency of Bengal under a Governor, thus ending Lord Curzon's partition of Bengal. Bihar, Chota Nagpur, and Orissa were formed into a separate province. Assam became a Chief Commissionership again.

Under the Indian Reforms Act of 1919 the status of Assam was raised to that of administration by the Governor-in-Council and the State was ranked with the older major States of India.

Population, Climate, etc.

Before the partition of India in 1947, Assam was composed of 12 districts. Of these almost the whole of the district of Sylhet, which had a Muslim majority, was awarded to Pakistan. As a result the area and the population of the portion of Assam in India were reduced. A rough estimate of the present position is :—

Area in square miles	54,084
Population in lakhs	91.29

Assam is mostly a hilly country. Rainfall ranges from 54 to 258 inches in a year, leaving aside the highest recorded rainfall in the world reached at Cherrapunji. Temperatures are moderate.

Earthquakes of great severity have taken place in Assam, by far the worst in living memory being those which occurred in 1897 and 1950. Extensive damage to buildings, roads, and other communications was done on both occasions.

Road Communications

The development of road communications in this State may be said to have started in 1912 when it was constituted as a separate province under a Chief Commissioner. This development may be conveniently divided into four stages which are described below.

1912-16

The Beginnings

In 1912 the Chief Commissioner of the newly formed province convened a meeting of its leading personalities and, with their advice, drew up a programme for the improvement of communications in the province. According to this programme a sum of Rs 41½ lakhs, contributed by the Government of India, was spent on the execution of the following works :—

(1) Improvement of roads 640 miles
(2) New construction of roads 240 miles
(3) Metalling of roads 96½ miles
(4) Construction of bridges, length totalling 4845 feet
(5) Number of temporary bridges built 150
(6) Number of culverts built 400

For the next ten years, which included part of the first world-war and post-war periods, there appears to have been a lull in road and bridge building activity in Assam.

1926-33

The Motor Car Appears

With the advent of motor transport in the early twenties, the need for the improvement of roads to a better standard was keenly felt and, by a resolution in the Assam Legislative Council, the first **Road Board of Assam** was constituted in the year 1926. On the advice of the Road Board a scheme estimated to cost Rs 17 lakhs for the metalling of 76½ miles of road was drawn up and completed by 1930-31.

The Dawn of a New Era

To ensure the improvement and construction of roads in a systematic manner the second Road Board, in their meeting in 1927, classified the roads under different categories such as metalled, gravelled, and "kutcha"; they decided that bridges should receive priority, and that road maintenance machines like tractors, graders, and rollers should be purchased. The year 1928 thus marked the beginning of a new era in the execution of bridge and road works in Assam by the introduction of mechanical methods for the improvement and maintenance of earth roads.

In 1929 the third Road Board approved the construction of 49.1 miles of metalled road costing Rs 15,45,000/- 69 miles of gravelled roads at a cost of Rs 7,74,000/-, and 617.46 miles of "kutcha" road at a cost of Rs 52,61,000/-; but on account of the general depression of 1929-30 the programme could not be implemented to the extent desired. Only 16 roads and 31 bridges were completed by 1930. Thereafter the work was accelerated and the improvement programme was completed by the year 1933. At a cost of Rs 33 lakhs, 97 miles of road were improved and 191 bridges were built. As a result, many of the roads in Assam became fit for all-weather motor traffic.

Government of India Comes to the Rescue

Funds, however, again, fell short of requirements, the expenditure being disproportionately high compared to the revenues of this poor province. Fortunately, the Government of India agreed to give Assam a loan, and with this money several important roads and bridges were constructed. Of the bridges built out of the 'Bridge Loan Fund' the 560-ft screw-pile bridge over the Dhansiri river near Numaligarh, costing Rs 1,54,560/-, and the 540-ft Chalkhowa bridge at Borpeta, costing Rs 1,50,324/-, are specially worthy of mention. Simultaneously a big road project, viz., the construction of the Shillong-Sylhet Road*, was undertaken in 1929 out of a "Special Loan Fund" and completed in 1933 at a cost of Rs 20,64,620/-. Out of this, Rs 1,84,993/- were spent on the construction of the longest suspension bridge (350 ft) in Assam, spanning the deep gorge of the River Umngot just before it debouches into the plains at Dawki.

In 1929-30, the Government of India instituted the Road Fund by virtue of which a special cess of two annas per gallon of petrol sold was levied. The proceeds of the cess were earmarked for the development of road communications. During period 1930-38, a total sum of Rs 58.67 lakhs was received by Assam from the Road Fund.

Tea-cess Helps to Build the First Black-top Road

A special "Tea Cess Road Fund" was created by the Local Government in 1927 to finance the construction of roads leading to Assam's world-famous tea gardens. During the ten years which followed its inception, receipts from this fund amounted to Rs 14.26 lakhs and paid for improvements to 130 miles of road and the construction of 10 bridges. Of the roads built out of this fund, the Jorhat-Mariani Road, the first black-topped road in the province, deserves special mention. Other works in order of importance were the Somairkoua-Goglachera metalled road in Cachar and the reinforced concrete bridge over the Manu river in Maulaibazar.

During this period several miles of the Dimapur-Imphal road in the Naga Hills were painted with two coats of colas, and 19 experimental lengths (one furlong each), treated with various materials, were laid out in the town of Shillong.

1933–45

In 1934, the name of the Assam Road Board was changed to Assam Road-Communication Board. Most of its members were elected by the Legislature. In 1935, a road improvement programme, estimated to cost Rs 30 lakhs, for the improvement of 22 roads was approved by the Government of India and financed from the Central Road Fund Reserve. This programme provided for the improvement of 345½ miles of roads and 30 bridges totalling 5,043 running feet. The work was completed in 1938.

* This project is described in detail in I. R. C. Paper No. 30 entitled "The Construction of the Shillong-Jaintiapur Road" by F. E. Cormack—(I. R. C. Journal Vol. II, p. 890) out of print.

The important bridges improved or constructed during this period were :—

Name of Bridge	Length (ft)	Total cost Rupees ('000)	Cost per R. ft.
1. Dehing bridge	750	310	
2. Dikhow bridge	520	258	
3. Ronganandi bridge	1,040	245	
4. Desang bridge	500	233	
5. Keane bridge (in Sylhet)	1,150	463	
6. Nonai Suspension bridge (at Bhutiachang)	200	66	
7. Kopili bridge	420	207	
8. Earle bridge at Karimganj	304	87	
9. Borgaon bridge	825	114	

In September 1937, a further road development programme, covering 23 schemes, and estimated to cost Rs 55.13 lakhs was approved.

The Second World War Speeds up Road Construction

The Second World War converted the North-Eastern frontier of India into a war zone, necessitating a speedier system of road communications throughout the province of Assam. Numerous "Defence works" were carried out by the Assam P.W.D. as agents of the Defence Department, and strategic points in the province were connected by a network of roads, most of which were black-topped. The trunk road from Dhubri to Saikoaghat via Goalpara and Gauhati and Dibrugarh was widened to carry heavy military traffic and black-topped up to Numaligarh. Many Local Board and Municipal roads were also improved and many new roads were constructed. The most important of these roads are :—

(1) Numaligarh to Dimapur,

(2) Dimapur to Imphal,

(3) Imphal-Palel to Tamu,

and (4) Makum to Lekapani.

1945–51

A post-war programme of road development, estimated to cost five crores of rupees, was drawn up in 1945-47. It aimed at developing 525 miles of district roads and 1,400 miles of village roads, including the construction of important new roads in the backward areas. Work was started on 1,040 miles of roads and 210 miles were practically completed, but in 1949 there was a sudden reduction in the post-war development grants. The work which was being done on 830 miles of roads had to be suspended. Though these roads could not be completed, a little over 600 miles are being used by traffic throughout the year.

The Problems of Partition

On the separation of Sylhet, the road link between the Cachar district and the Assam Valley was suddenly cut off. In order to remove this grave handicap three roads, viz., the Shillong-Jowai-Haflong-Silchar Road,* the Medhipara-Phulbari-Tura Road, and the Lowairpowa-Churaibari Road* were taken up for construction and improvement. The first one, 218 miles long, though still incomplete, has cost Rs. 1,30,00,000/- and is a fair-weather road*. The other two are all-weather gravelled roads. The Government of India contributed about two thirds of the cost of the first road and the whole of th cost of the third road.

The Present

In 1950 a programme for completing sixty roads, totalling 586 miles and estimated to cost about Rs 56 lakhs, was undertaken. It is to be financed from Assam's share in the Central Road Fund, and mainly envisages the completion of roads, work on which was suspended in 1949.

In addition improvement work on the following roads is on the programme :—

(1) Ten roads covering 72.95 miles and costing Rs 9,83,874/- from

* This project is described in I. R. C. Paper No. 158 entitled "The Construction of the Shillong-Silchar Road" by S. C. Paul and R. C. Das—(I.R.C. Journal Vol. XVI-2). Price Rs. 8/-

the Rice Procurement Fund. This programme when completed will enable easy movement of rice to the deficit areas;

(2) Nine roads covering 28.06 miles and costing Rs 3,80,000/- from the Motor Vehicles Tax Fund;

(3) Twenty roads covering 208.49 miles and costing Rs 27,48,000/- from the State revenues;

(4) Various roads damaged by the earthquake of 1950, at a cost of Rs 19,35,900/-;

(5) Roads in the Scheduled Districts-allotment by the Government of India (Rs 11.33 lakhs);

(6) Another important work in progress is the construction of a new road from Shillong to Silchar by a route shorter than that via Haflong, viz., the Shillong-Jowai-Kalain-Badarpur-Silchar road. The Government of India has agreed to meet the entire cost of construction of this road.

The development of road communications in Assam since 1912 may thus be summarised as in the table below:—

Mileage of roads maintained by P.W.D.

Year	Metalled	Gravelled	Earth	Total
1920	441.18	...	1582.48	2023.66
1930	494.06	...	1531.17	2025.23
1940	626.80	1281.40	721.60	2629.80
1950	999.53	1737.21	1186.18	3922.92
Total	2561.57	3018.61	5021.43	10601.61

—o—

OUR DELEGATES

First I. R. C. Delegate meeting a Friend *" I say, old man, you are not looking too well."*

Second Delegate : " Yes—it's insomnia."

First Delegate : " Insomnia, that's bad, not sleeping at nights "?

Second Delegate : " Oh, I sleep all right at night. It's the afternoons I can't sleep, we are so busy."

BRIDGING INDIA'S RIVERS

THE CAUVERY BRIDGE AT PUGALUR

WITH the opening of the bridge over the Cauvery at Pugalur in Madras in December last, dreams more than two decades old came true. As long ago as 1936 Vipan* included a bridge at Pugalur in his scheme. But before that scheme could be put into force, the second World War intervened. Then, fortunately, came the National Highway Scheme and the alignment of National Highway No. 7 from Banaras via Rewa, Jabalpur, Nagpur, Hyderabad, Bangalore, and Madura on to Cape Comorin passed over the Cauvery in this neighbourhood. A bridge already badly needed, became all the more necessary.

The river Cauvery divides two very prosperous districts of Madras, viz., Salem and Trichinopoly, and is unbridged in this area for almost a hundred miles of its course. Before the bridge at Pugalur was built there were only two bridges over this river, one at Trichinopoly and the other about 100 miles upstream at Bhavani. That at least one more intermediate bridge was needed immediately was obvious, but it was not equally obvious where this bridge should be sited. For years a controversy raged about the actual location of the bridge. No less than five different sites were considered and their merits and demerits debated in detail. Finally the issue narrowed down to the two sites at Nanniyur and Pugalur.

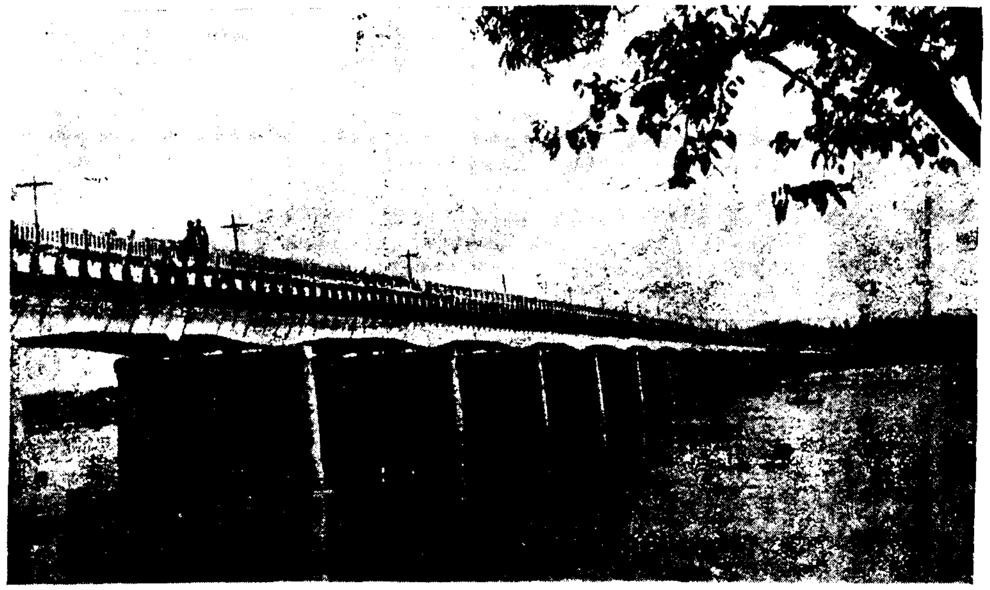
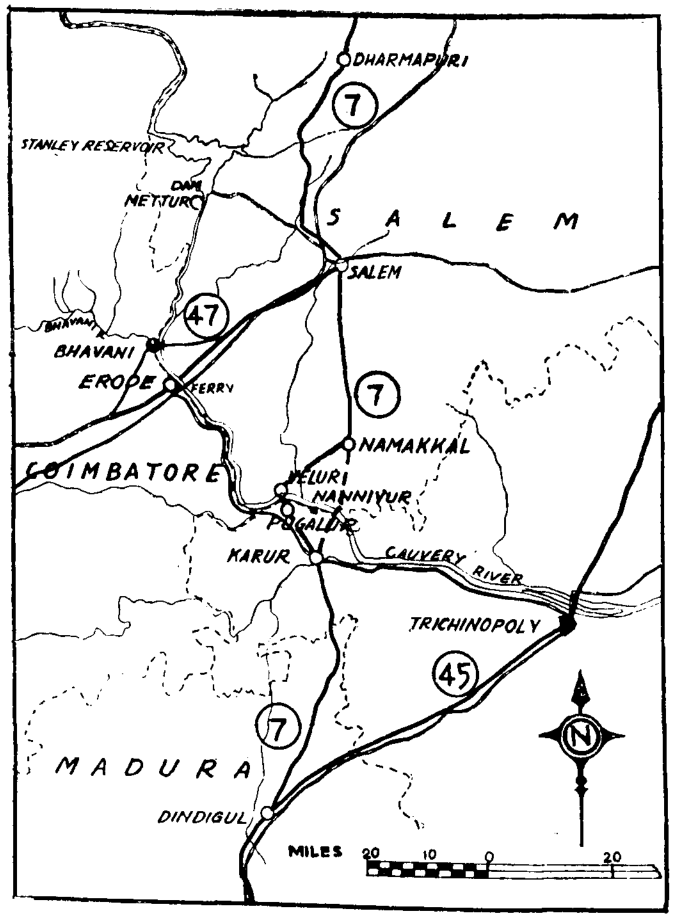


Photo No. 1—The Completed Bridge.

* " Scheme of Road Development for the Madras Presidency " by A. Vipan, M. Inst. C.E., Special Engineer Road Development, Madras, (1935) pages 32.

The Government of India, who had to pay for the work, favoured the Nanniyur site because the road along that route was practically the shortest distance between the obligatory points of Karur and Namakkal. Moreover, the river at that site was narrower than at Pugalur. The adoption of the Pugalur site was expected to cost Rs 6 lakhs more than the alignment via Nanniyur. But Madras wanted the bridge at Pugalur for various reasons. Finally, as a compromise, the Central and State Governments agreed to split equally the excess expenditure to be incurred by adopting the more costly route via Pugalur. According to this arrangement the Centre paid Rs 27 lakhs out of the total estimated expenditure of Rs 30 lakhs.



The bridge was designed as a reinforced concrete structure with continuous Tee-beams supported on piers and abutments

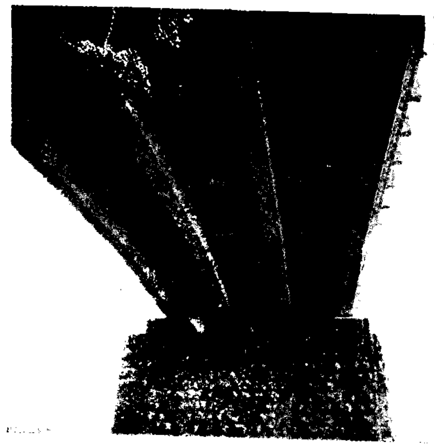


Photo No. 2—T-Beams and Stiffeners.

of coursed rubble masonry in cement mortar. The continuous girder type was selected as rock foundations at a reasonable depth were found under most of the piers. There were 12 units, each continuous over three spans, and one unit of four spans in the middle. Construction started on the 9th May 1949.

The main dimensions of the bridge are :—

Length between abutments, 2634 ft ; 40 equal spans of 60 ft clear at the top of the piers ; pier thickness, 6 ft at the top ; batter : 1 in 12 for abutments and 1 in 24 for piers ; height of piers, about 20 ft ;

Roadway, 22 ft between kerbs ;

Depth of Tee-beam rib, 6½ ft at support and 5 ft at midspan : thickness of rib, 15 inches ; 12 in. x 12 in. cross-beams for stiffness, 10 in each span ;

Thickness of slab, 7½ inches ;

Wearing surface, 1 : 1½ : 3 cement concrete 3 in. thick ;

Total depth of well sinking, 2256 ft ; average depth of well, 36 ft ; maximum depth, 40 ft ;

Expected maximum discharge under the bridge, 2,86,100 cusecs.

Costs

Total cost including approaches, Rs 25.87 lakhs ; cost of substructure, Rs 8,09,000 ; cost of piers, Rs 2,81,000; cost of superstructure, Rs 11,40,000, cost of approaches, Rs 1,95,000.

The cost per running foot of the bridge is Rs 965 ; per square foot of carriageway, Rs 44.5 ; cost per square foot of the entire elevation (that is, the area enclosed between the line connecting the uppermost point of the superstructure and the line connecting the lowest parts of the foundations) is Rs 20/-.

Mettur Dam Affects Design

A design finalized in 1940 contemplated building 48 spans of 60 ft each, that is, a bridge about 3,200 ft long catering for the highest known discharge of 4,85,500 cusecs. This flood had passed down the river at the bridge site in 1924, the year of phenomenal floods in Southern India. But, since the completion of the Mettur Dam in 1934, the discharge in the Cauvery below the dam was fairly controlled. In 1940, the knowledge of the extent of this control was yet incomplete and the bridge was designed for the full river width. But by 1949 the flood absorbing effect of the dam was known fairly well. The maximum discharge let down in the Cauvery at Mettur after 1934 had been only 1,64,000 cusecs. With the maximum discharge of the Bhavani added to it (1,22,000 cusecs), the flood in the Cauvery at the bridge site could not be expected to exceed 2,86,000 cusecs. The length of the bridge was, therefore, reduced from 48 to 40 spans, and this gave a saving of about Rs 6 lakhs.

Foundations and Piers

For the left abutment and piers 1 to 8 and 10, where rock was available at shallow depths, open foundations were adopted. The right abutment and the remaining 30 piers were founded on wells.

The piers were built of first class coursed rubble masonry in 1 : 4 cement mortar below low water level, and in 1 : 5 mortar above that level. But in piers 4 to 8 and 10, where heavy springs were encountered, the substructure below low water level was mass cement concrete (1 : 3 : 6).

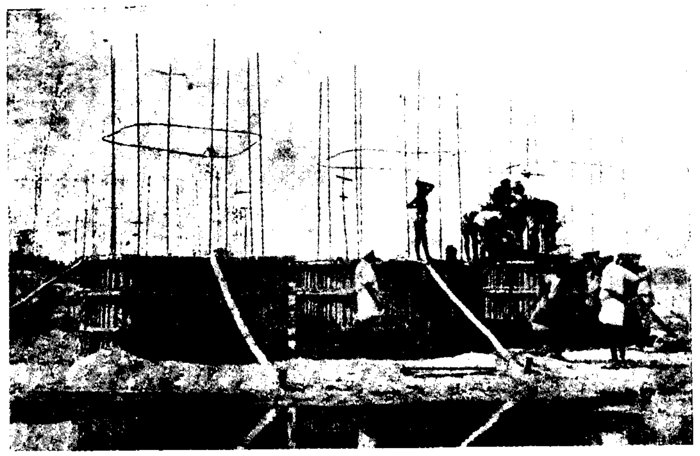


Photo No. 3—Wells.

Elsewhere the well foundations under each pier consisted of three separate rectangular, lightly-reinforced cement concrete wells with rounded corners (Photo No. 3). The outer size of a well was 8 ft x 9 ft (8 ft x 9 ft 6 in. under the right abutment) with a 2-ft thick steining. The three wells under each pier were capped with a continuous reinforced concrete slab 32 ft 6 in. x 8 ft 6 in. x 1 ft 6 inches.

Bearings

Eighteen inch thick reinforced concrete bed blocks placed on the piers carried cast steel roller and rocker bearings.

In each 3-span unit the expansion bearings at the end supports were 2-roll assemblies ; one intermediate support a 4-roller assembly, and the other a rocker bearing. Rollers of the same diameter were not available for all the bearings. Three different diameters were to be had, viz., $6\frac{1}{4}$ in., 7 in., and $7\frac{3}{4}$ in. This difference in size was put to good use in raising the level of the two intermediate bearings a id thereby providing camber in the surface slab.

An **expansion joint** was provided in the deck slab at the end of every unit.

Anchoring Wells

According to the approved specifications the foundations of the piers were to be taken at least 2 ft into rock. This was done as far as possible. In a few cases, however, some wells could not be embedded into rock and rested on sloping strata. Such wells were anchored to the foundation rock by means of 1 in. steel bar dowels (one dowel for every 2 sq. ft of dredge hole area) embedded $3\frac{1}{2}$ ft into the rock and extending $3\frac{1}{2}$ ft into the well.

As boring anchor holes into rock under deep water was a difficult operation, the wells on reaching rock were plugged with about 2 ft of cement concrete and de-watered. The holes for the dowels were then drilled through the concrete plugs so as to extend $3\frac{1}{2}$ ft into rock.

Dowel bars were placed in the holes and a rich cement mortar was packed round them to prevent rusting,

Transplanting Wells

Wells built for one pier as explained below, were shifted bodily and used under another pier. According to the design, pier No. 10 was to have had open foundations, but as de-watering was troublesome and costly the contractors obtained per-

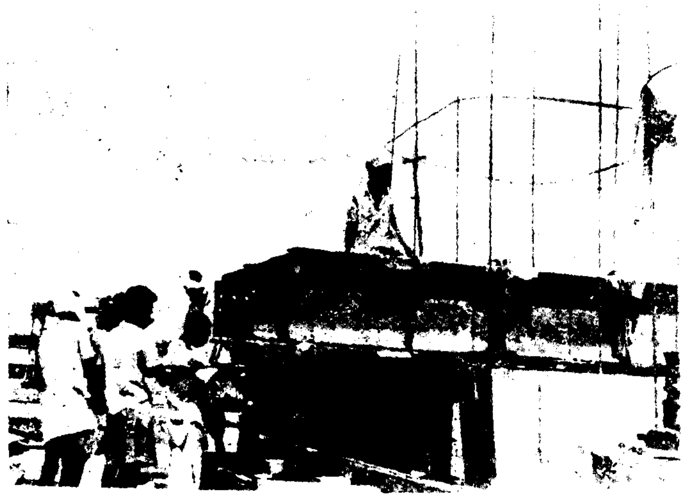


Photo No. 4—Lifting a Well.

Photo No. 5—A well travels to the next pier.

mission to adopt well foundations. The well had gone down hardly 6 ft when rock with a steep side slope was encountered. Fortunately, work on the wells for pier No. 11 had not commenced. The contractors decided to transplant all the three wells to that pier.

Wire ropes were passed under the kerb and their ends tied to two rolled steel joists placed at the top of the wells, which were pulled out by means of four 10-ton jacks (Photo No. 4). When the

kerbs were clear of the ground level the wells were dragged by means of winches to the next pier on $1\frac{1}{2}$ in. round steel bars used as rollers (Photo No. 5). Each well weighed about 24 tons. The whole operation cost only Rs 750/-.

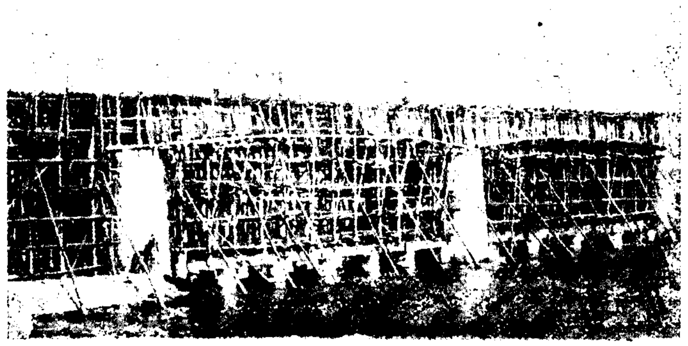


Photo No. 6—Ordinary timber staging and centering completely obstructs the channel and cannot be used in the flood season.

Suspended Centering Saves 8 Months

When the working season in 1951 came to an end, water from the Mettur Reservoir was let into the river for irrigation. The superstructure for 10 spans still remained to be built. Postponement of the work to the next season would have meant the loss of eight valuable months. Parts of a 120 ft span Callendar-Hamilton bridge were available and they were used to build eight continuous trusses, two for each Tee-beam. The outer two trusses were erected on the top of the noses of the piers of a completed unit and rolled out into position. The other six trusses were erected on the deck of the last completed unit and rolled out on timber " horses " and then lowered into position.

Photo No. 7—Special centering leaves the river unobstructed and work can go on in all seasons.

The use of this centering saved a whole working season. The bridge was opened to traffic on the 23rd December 1951.

—o—

MAKING AN EASY CHOICE

" Say, Pat...what's this I'm hearing about ye joining up with them communists? Be ye daft, man? "

" It's the truth, Mike...I signed up last week. Ye see, the doctor told me I had but 10 days to live and 'tis better one o'thim communists die than a good Irishman."

—o—

BRICK BALLAST FOR ROAD WORK

UTTAR Pradesh is very rich in the raw materials required for modernising her roads and producing dustless surfaces. Unfortunately, however, these raw materials are found only at the perimeter of the State, in the foothills of the Himalayas and in the Vindhyas. The prosperous central region, where most of the roads run is an alluvial plain and has nothing harder than **kankar** (nodular limestone) found in beds which provide the only natural material locally available for water bound macadam surfaces. As this material is rather soft, stone and shingle are brought from the Himalayan foothills and the Vindhyas for the more heavily trafficked roads. The transport of these materials over such long distances is both expensive and difficult.

For a number of years P.W.D. engineers have been experimenting with the various substitutes for stone with a view to make the maximum possible use of local materials, thereby avoiding costly transport of stone by rail and road. Overburnt brick ballast is one of the materials that has been experimented with and has proved successful on roads where traffic is not very heavy. Long stretches involving the use of this material have been in use for ten to twelve years now and have stood traffic very satisfactorily. In fact, these roads show that overburnt brick ballast is in no way inferior to hard stone ballast under similar conditions of moderate traffic.

There have been some failures too, but these can be attributed almost entirely to the following causes :—

(i) Use of inferior material, that is, under-burnt brick ballast or brick ballast from merely first class (not overburnt) bricks.

(ii) Excessive bullock cart traffic which only a cement concrete road could stand.

If these two factors are kept in view, and only overburnt brick ballast is used under suitable conditions of traffic, the road performance is very good.

HINTS

Here are some hints for making a successful brick ballast road :—

(1) A "pajawa" kiln must NOT be used for burning bricks needed for this purpose. The ballast produced from bricks burnt in this type of kiln is soft and useless.

(2) Proper "Bull" type kilns should be set up and the brick earth to be used in making the bricks should be carefully chosen.

(3) Contracts for burning and supplying bricks should be given to experienced brick manufacturers who alone can be depended upon to produce the right type of material. Excessive overburning will produce spongy "jhama" bricks which are unsuitable for this work. Under-burning of bricks is just as bad.

Copper-coloured bricks are suitable and neither red nor black bricks are any good. Properly burnt bricks are heavy and copper-coloured bricks have the maximum weight.

(4) Correctly overburnt bricks must first be collected in the mile where they are to be used, and approved by the engineer-in-charge. Any under-burnt or vitrified bricks should be rejected and removed. Breaking should be allowed only when bricks have been sorted out to the satisfaction of the engineer-in-charge. This will ensure that only the right type of material is collected and broken at site.

(5) Consolidation of brick ballast must not be started until stone grit has also been collected, as surface dressing must be done within a month of consolidation. Otherwise the water bound macadam will break up under traffic and the surface dressing will yield an uneven and wavy surface.

(6) Nothing less than a $4\frac{1}{2}$ in. coat of brick ballast will give satisfactory results.

Experience of work done in Allahabad showed that 2 in. thick bricks yielded excellent ballast.

LIMITATIONS

The Chief Engineer ef the Uttar Pradesh, Pubiic Works Department (Buildings & Roads Branch), in a departmental circular, discusses the use of brick ballast in highway improvement work and advises the engineers of the State that brick ballast should be used instead of stone only where the latter is too expensive and costs (at the prevailing price levels) more than Rs 50/- per 100 cu. ft. at the site of the work. Brick ballast is superior to sandstone and is as good as hard quartzite, but success will be achieved only if proper precautions are observed at every stage of the work.

The cost of brick ballast on the roadside varies from Rs 30/- to Rs 40/- per 100 cu. ft., depending on the locality, cost of labour, and freight on coal needed for brick manufacture.

—o—

MEDIOCRITY AND ACCOUNTANCY

Improvement of the railways and reduction in the cost of maintaining the way and works can only be achieved by combining hard-headed experience with a progressive spirit of research and development. This involves investigation of the problems by skilled and well trained engineers. Mediocrity and accountancy will not be sufficient.

(Extracted from 'The Engineer'—Nov. 9, 1951).

THERE'S NEVER TIME

The politician was late arriving at the meeting where he was to make an address. As he was about to walk on to the platform, a reporter tugged at his sleeve. "What do you think of the tax situation?" the reporter inquired.

"Don't bother me now," the politician replied testily. "I haven't time to think........I've got to talk."

SPECIAL ARTICLE No. 4

MAXIMUM DIMENSIONS, WEIGHTS, AND SPEEDS OF MOTOR VEHICLES IN INDIA AS RELATED TO ROAD STANDARDS

An Article Explaining the I.R.C. Standards Relating to Road Vehicles*

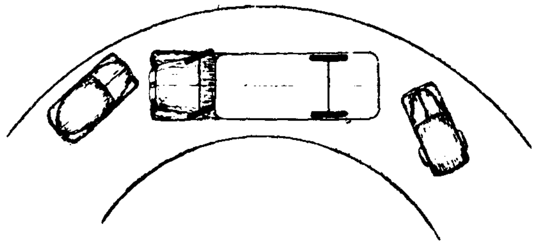
IN the previous Article in this series were discussed the recommended widths to which carriageways were to be constructed. To the critical reader it would have appeared obvious that these widths should have some relation to the maximum dimensions of vehicles using the roads; to the engineer in charge of minor roads the question would have suggested itself why a roadway should be 12 ft wide when the bullock-carts mostly using his roads were only 4½ ft or 5 ft wide; and to the dreamer of road caravans and articulated road trains, the 12 ft limit would have acted as a serious damper on his enthusiasm for inventions.

Roads and the Vehicles Plying on the Roads are Part of the Same Problem

The famous Nagpur Report of 1943 called on the Indian Roads Congress to lay down standards for roads and bridges. When the Roads Congress came to consider this question through its various technical committees it became at once apparent that it would not be possible to fix road standards until limiting standards as to sizes and weights were fixed for road vehicles.

A reference has been made in the opening paragraph of this Article to the widths of road vehicles. But lengths and weights are equally important and so are many other factors. Consider the question of a long vehicle going round a curve.

If the curve is sharp, a long vehicle will not be able to get round it without "dragging" its rear wheels. Also, a long vehicle going round such a curve will block the way for vehicles coming in the opposite direction or overtaking it unless the road is made very wide at the curve.



With regard to weight, it is obvious that all the bridges and culverts will have to be made strong enough to carry the heaviest vehicles that would be permitted to use the road.

The question of permissible grades also depends on the type of vehicles that would use the road. For example, while a motor vehicle might be able to climb a grade of 1 in 5, a bullock-cart could with difficulty negotiate a grade of more than 1 in 20.

Then the question of permissible speeds has to be considered. In a previous article it was explained that high speeds called for wide and therefore expensive roads. On the other hand, to restrict speeds unduly would be bad for transport economy.

Various other subsidiary issues had also to be considered. A superelevation at curves required by a vehicle travelling at high speed might be too steep for a loaded bullock-cart with a high centre of gravity.

* I.R.C. Paper No. 138 printed in Vol. XIII-2 of the Indian Roads Congress Journal for January 1949.

High speeds would call for clear visibility, passing places, absence of sharp changes in grades, a smooth surface, etc., etc. The iron shod bullock-cart wheel would require a hard, abrasive-resisting surface, and so on.

International Standards of Vehicle Dimensions, Weights, and Speeds

It soon became apparent that before design standards could be fixed for roads and bridges, limiting dimensions, weights, and speeds would have to be fixed for the vehicles that were to use the roads.

At first it did not appear that the solution to this problem would be easy. Most types of motor vehicles are not yet made in India and international standards would apply to these. Then, consideration had to be given to the types (and weights) of the vehicles likely to be used by the army. Finally, there was the bullock-cart (8 millions of these carts) unchanged for thousands of years and largely unchanging.

Fortunately other countries were faced with similar problems and it soon became apparent that international limits would have to be fixed for vehicle dimensions, weights, and speeds. The Indian Roads Congress, therefore, through its Committees got into touch with road engineers in other countries and evolved their road standards after taking into account the proposed international limiting standards for road vehicles.

The limiting standards for vehicles finally evolved in India were discussed in Paris during August 1949 and were found to agree, other things being equal, with the limiting standards ultimately accepted internationally. The following paragraphs discuss how the problem was tackled from the Indian angle and how the final standards were arrived at.

Current Practice And Recommended Standards

General

The Motor Vehicles Act of 1939 came into force in July 1939. Model Rules framed under this Act recommended certain maximum dimensions and weights of motor vehicles. The recommendations have been generally accepted by the States, subject to certain limitations within the maximum, to suit their existing road and bridge conditions.

These maximum limiting dimensions, though adequate at the time of passing the Act, did not take fully into account modern trends in vehicle design and, in some particulars, are inadequate. Roads and bridges have to be designed for the future, at least in so far as the "geometrical" standards of roads are concerned (i.e. their general layout) and the load-bearing capacity of the bridges. The Standards recommended in the I.R.C. Paper are therefore in some cases in excess of the permissible maximum legal dimensions in force at present in India.

It is to be also noted that the use of certain types of Army vehicles exceeding the legal dimensions has to be permitted in emergencies. But many restrictions are imposed in the operation of such vehicles, such as speed regulations, spacing of vehicles, suspension of opposing traffic during the movement of convoys in one direction, and prohibition of overtaking and bye-passing, etc. These over-dimensioned vehicles are not to be considered for the design of roads for normal use. On the other hand, the roads should be capable of carrying the vehicles more commonly used by the Army.

In the following paragraphs certain details considered by the Indian Roads Congress Committees are discussed:—

Width (Overall)

The existing regulations specify that the width of a vehicle at right angles to the line joining the centres of axles shall not exceed –

		ft	in.
(i)	in the case of a motor vehicle other than a passenger vehicle but including a motor cab	7	2
(ii)	in the case of transport vehicles other than a motor cab	7	6

The Standard accepted by the Indian Roads Congress for new or reconstructed highways is a vehicle width of 96 inches. This is slightly less than the international standard.

Height (Overall)

The height regulations in force in India lay down that the overall height of a motor vehicle shall not exceed 11 ft except in the case of a double-decked motor vehicle which shall not exceed 15 ft 6 inches.

With a view to accommodate the double-decked vehicle, the height clearance for bridges recommended by the Indian Roads Congress for adoption is 16 ft 6 in.

Length (Overall)

The existing regulations in India for overall lengths of motor vehicles are as under :—

	Overall length ft	in.
(i) For a vehicle having not more than two axles	27	6
(ii) For a rigid frame vehicle having not more than two axles	30	0
(iii) For an articulated vehicle having more than two axles	33	0

The design of highway curves is affected by the overall lengths of vehicle combinations. The standards for curves recommended by the Indian Roads Congress prescribe a minimum radius of curve of 100 ft in extreme cases, with a view to provide for the eventual accommodation of vehicles of greater length than permissible at present. After discussing the regulations and recommendations of Road authorities in other countries, the committee recommended that the dimensions given at the end of this Article should be accepted.

Permissible Loads

The natural tendency of motor vehicle manufacturers is to build vehicles up to the maximum permissible legal dimensions and weights. Since, with increase in pay-loads, a saving in transport costs can be effected by commercial transport interests.

Fortunately there is an economical optimum limit to the weight, beyond which it does not pay to increase it. Research in Australia indicates that the "Economic wheel loading" above which the trasport-operation will secure relatively less advantage and up to which road-making costs will not become excessively high is about 8,000 lb for six-wheeled vehicles (3 axles).

For a large mileage of roads where light traffic predominates, this economic wheel load ranges between 6,500 to 7,000 lb.

Clause 72 of the Motor Vehicles Act of 1939 contains the regulations on the "Limits of weight and limitations on use of motor vehicles in India."

It is in the prescribing of these laden weights of the vehicles and of an axle, that there is the greatest divergence between States. It is understood that the gross load prescribed varies from 3½ tons to 8 tons. Though there might be variations due to road conditions, it is believed that the large variations from 3½ to 8 tons could not be due to this alone as the capacity of some of the roads, at least in the States where lower limits are prescribed, is not inferior to that of roads in certain other States where a higher limit is allowed.

Recommended Standards for Loadings

From the extracts given in the I.R.C. Paper it will be seen that the axle weight which largely influences the design of the road pavement is generally limited to 18,000 lb in most of the advanced countries though, in the United Kindom, there is a proposal to raise the axle load to 20,160 lbs.

The wheel-load is the main factor which decides the structural design of the pavement. It is proposed to base this in India on the rated capacity of the tyres. In the extreme case of two single tyres on an axle and with the maximum axle load of 18,000 lb, the size of the tyre will have to be 14 by 24 (20 ply) with extra ply low-pressure and dual-marked type. Where this type is not available dual tyres will have to be used.

A recent analysis of 163 truck specifications and 62 car specifications used in India indicated that in four cases alone, single tyres of size 12.00 by 20 (14 ply) were provided with a rated capacity of 5,275 lb and that tyres of higher rated capacities were not fitted to vehicles. Where the wheel loads exceed 5,000 lb, dual tyres are generally adopted.

The load-standards accepted by the Indian Roads Congress are given at the end of this Article.

Speed

It may not be possible or economical to design all roads for very high speeds. Investigations, however, indicate that ninety per cent of vehicles move at speeds less than the average speed of all the vehicles.

Roads are now designed for specified speeds known as "Design Speeds" which vary for different roads classified according to their importance. The design speed is the safe uniform speed that is permissible on a road from considerations of the type and condition of surface; the nature, type, and intensity of traffic; the nature of the terrain, and of curves and sight distances.

Higher design speeds are possible in flat rolling country than in hilly areas with steep gradients. Also, in urban areas the speed tends to be lower than in open country as in the latter case greater visibility and freedom from traffic interruptions and road crossings are secured than in urban areas.

Existing Regulations of speed

Section 71 of the Motor Vehicles Act of 1939 and Schedule 8 of the Act prescribing the limits of speed have been reviewed by a Select Committee and they have recommended certain slightly increased speeds over the existing regulations.

It is, however, possible that permissible speeds might further be reviewed in the light of progress in transport and the speed standards recommended by the Indian Roads Congress for road design given at the end of this Article.

The desirability of adopting these standards has been fully dealt in I.R.C. Paper No. 119 on Horizontal and Transition Curves for Highways.

It will be seen that these standards are much higher than the speeds permissible by regulation for transport vehicles, and also higher than what the existing roads can take. The aim, however, is to bring the roads to a standard that will be adequate **eventually** to accommodate higher speeds that will be necessary with the growth of motor traffic.

The existing regulations do not take into account various classes of roads which are to different design and construction standards.

Recommended Standards

From the discussion indicated very briefly above of the various factors affecting vehicle dimensions, speeds, and weights, the Indian Roads Congress recommended that road design, both structural and geometric, should be based on the standards indicated below.

All roadways and structures should provide initially or in their feasible modification for the movement of maximum size of vehicles described below.

	Maximum Permissible
Widths ...	96 inches
Heights :—	
(i) **Vehicles other than double-decked**	12 ft 6 in.
(ii) **Double-decked vehicles**	15 ft 6 in.

	Maximum length (overall) Ft.	In.
Lengths:		
(a) **Single Units**	35	0
In the case of single-unit passenger buses, the maximum length may, with the approval of the controlling authority in consultation with highway authority, be increased up to 40 ft, provided that a bus in excess of 35 ft overall length shall not have less than 3 axles.		
(b) **Semi Trailers**	50	0

(c) **Two-unit, Tractor Trailer** 60 0

(d) **No other combinations** of vehicles shall consist of more than two units, and no such combination of vehicles, unladen or with load, shall have an overall length, in excess of 60 feet.

Loads

(i) **Axle load** (i.e. the total load on wheels whose centres may be included between two parallel transverse vertical planes 40 inches apart) on pneumatic tyres. 18,000 lb

(ii) **Gross load** on any vehicle or combination of vehicles not to exceed that given by the equation $W = 1025 (L+24) - 3L^2$, for $L = 8$ ft and more. Where

W = weight in lb.

L = distance between the extreme axles measured longitudinally to the nearest foot, for values of L equal to 8 ft and more. For values of L up to 8 ft, the gross load should not exceed 32,000 lb.

(iii) No group of axles shall ever carry weight in excess of the value given in Appendix I of the I. R. C. Paper.

(iv) The size of the tyre shall be regulated according to the ratings of the Tyre and Rim Manufacturers Association based on 140 per cent of the total of the standard tyre ratings and reduced by 25 per cent for normal control and 20 per cent for forward control.

(v) The maximum loads prescribed above for a single axle, a group of axles, or for tyre loads are subject to reduction at the discretion of the appropriate Highway Authority during periods when road sub-grades have been weakened by water saturation or other causes.

(vi) The operation of vehicles or combinations of vehicles having dimensions or weights in excess of the maximum limits herein specified shall be permitted only if authorized by special certificate issued by an appropriate road authority.

Speeds.

The "design speeds" for various classification of roads shall be as indicated in the Table below.

Speed Standards for Design

Road Classification	Design speed-miles per hour	
	Flat or rolling country	Hilly and mountainous country
National and Provincial Highways	50	30
Major District Roads	40	25
Other District Roads	30	20
Village Roads	20	15

Conclusion

Before they could arrive at their road standards, the Indian Roads Congress had to decide on Standards for the vehicles that would use their roads. The vehicle standards discussed in this Article were taken by the Indian Roads Congress as limiting standards for the next 50 years and more. No road built in India to I.R.C. Standards will take vehicles that exceed the limiting vehicle standards laid down in I.R.C. Paper No. 138 of January 1949 and referred to briefly in this Article.

Most of the existing roads in India are not built to I.R.C. Standards but all new roads and those improved in future (with negligible exceptions) will be so designed that, when traffic warrants, they will be able to carry vehicles designed within the limiting standards described above.

HERE AND THERE

1. DELEGATING AUTHORITY

FIFTY years ago, Dr. Albert Shaw, writing on municipal government in the larger cities of the United States and Great Britain, referred to the prolonged delays which, in his opinion, emerged from the relations between the committees of our more responsible local authorities and their chief officers, on the one hand; and, on the other, from the comprehensive overriding powers of inhibition even then enjoyed by the Central Departments of Goverement.

Not many persons, having wide experience of an administrative system, would maintain that the pace, between the initiation of a project and its realisation in fact, has been much accelerated since Dr. Shaw ventured his rather caustic criticism.

Indeed, were all the facts brought together, there is reason to believe that not only is more time now required for legal preliminaries, and for the consultations precedent to any considerable scheme of constructional work with which a chief officer is engaged, but more time and labour are occupied in these days in conversation with his chairman, at committee meetings, and in discussions with their members. In a county borough, with a quarter of a million population, what proportion of the engineer's time and the time of his staff is taken up by the preparation of reports and information not really essential for the council to receive? Might not speed in getting things done, and efficiently done, be accelerated if responsible officers had larger freedom?

In some quarters these notions are regarded as heretical. That is not, apparently, the view of the General Purposes Committee of the London County Council. Its members, perhaps, are more busy men. They hold that both the council and its committees could be relieved of much of the business which, in accordance with tradition, has for long been brought before them. Essential democratic control, it is conceived, could be preserved while delegating more authority to sub-committees and chief offiicers. How often have the members of a committee, competent to form constructive judgments, found their chief officer's authority curtailed, or frustrated, by objection from a member who does not, and could not, understand the matter in hand?

The reply may be that it is over-dangerous to give too much authority to an officer. That answer is not an explanation. A responsible officer, qualified by training and temperament for the office he fills, does not exercise "too much authority," even though it be offered him. A man's quality, actual or potential, is discovered by the way he responds to the confidence reposed in him. That lesson municipal democracy has to learn perennially. If a man can fall below the level expected of him it is just as well he should be found out.

(Extracted from 'The Surveyor'—September 8, 1951).

2. A DEADLY WEAPON—THE AUTOMOBILE

JUDGE Edward C. Fisher, of the municipal court of Lincoln, Neb., is a man of plain words. "Although threatening or injuring a person with a gun or a blunt instrument is universally held to be a criminal assault and classed as a felony," he told a session of the National Safety Congress last month, "running into a person recklessly with an automobile is only a traffic offence—merely a misdemeanour—unless you kill him dead. And even then your chances of a jury verdict of acquittal on a manslaughter charge are bright indeed." In the hands of a drunken or reckless driver, he summed it up, the automobile is a deadly weapon; and his wanton indifference to consequences indicates some element of criminal intent. That is language that jars us, as it was meant to. Judge Fisher's indictment is something to think about.

(Extracted from 'Better Roads'—November 1951).

3. WHY PRESTRESSED CONCRETE ?

WHY prestressed concrete ? This question was posed and answered at the first conference on prestressed concrete held in America a few months ago.

Some of the reasons advanced by one of the speakers why prestressed concrete should result in better structures were reported in "Concrete" for September 1951. They were :—

1. Prestressing makes concete crackless, which is conducive to greater durability under severe conditions of exposure.

2. Prestressing makes it possible to use efficiently higher strength concrete of correspondingly better quality.

3. Prestressing makes it possible to use thin-web concrete members of "I" and "T" sections, thereby obtaining the most effective distribution of the material.

4. Prestressing minimizes deflection and reduces the depth of beams and girders and the thickness of slabs, thus affording greater under clearance.

5. Prestressing results in maximum rigidity under working load and maximum flexibility under excessive overloads.

6. Prestressing makes it possible to design each structure to fit job requirements.

A complete answer, said the speaker, would be found only "after a long period of work in the laboratory, in the design office, and finally in the proving ground of competitive bidding and actual construction performance."

General use of prestressing, he continued, will be determined by its economy. Its use in Europe had been found economical because of the scarcity of materials and the cheapness of labour. "On the other hand," he said "the opposite has been the situation in years past in this country (U.S.A.)" Under a war economy demanding shrewd use of available materials and a low cost of construction, "every new type of construction offering possibilities for economy must be thoroughly tried to determine its merits..."

4. THE DEVELOPMENT OF HIGHWAY TRAFFIC IN EUROPE

WE give below, according to the Road Union of France, the percentage increase in the number of motor vehicles from 1938 to 1950 for the various countries of Europe, with the figures for 1950 in brackets :—

	Private vehicles	Coaches	Lorries
Great Britain	15% (2,237,000)	50% (80,000)	85% (910,000)
Belgium	45% (227,000)	90% (2,176)	70% (138,000)
Switzerland	90% (146,998)	40% (1,900)	80% (37,500)
Netherlands	40% (138,625)	30% (5,973)	50% (77,694)
Italy	45% (371,000)	25% (9,400)	175% (220,000)
Sweden	25% (200,000)	50% (7,500)	45% (84)

[*Translated from* **Routes et Aerodromes,** *Sept. 1951*].

5. ACCIDENTS CAN BE REDUCED

ALL figures of accident causation issued by the Ministry of Transport indicate that 99 per cent of accidents are due to human error and 1 per cent to road defects. Before the war the author investigated the stories of all the fatal road accidents in Oxfordshire over a period of four years. He came to the conclusion that 75 per cent of these might have been prevented if roads had been laid out in accordance with the Ministry's own ideal recommendations. It is considered that the Ministry, by insisting that all accidents are due to human failure, unwittingly deceives the

public into believing that better roads will not reduce, but may even increase, accidents. This is one of the reasons why money is not made available for improving the road system.

Spurred, indeed horrified, by the results of the above investigation, the author made improvements at 60 road junctions in the county. Accidents were counted before and after. The fatal accident rate fell by 75 per cent, and serious accidents by 66 per cent. This experiment has been widely represented as startling and original. Actually the improvements were carried out on standard lines and there was nothing original except the execution of 60 improvements at once and the counting of accidents before and after. This experiment was done to dispose of the Ministerial theory referred to above. The author thought the results had gone some way in that direction.

(*Extracted from an article "Traffic Flow and Safety" by G.T. Bennett, Surveyor, Buckinghamshire – 'Modern Transport' – December 1, 1951*).

[*Will our Indian Engineers go and do likewise ?—Ed.*]

6. TRAFFIC ENGINEERING

* * *

SOME 30 speakers took part in the discussion. It was the consensus of opinion that traffic engineering was part of highway engineering, which is itself a part of civil engineering, and that those who practice it should be primarily civil engineers and should work under the aegis of the county or borough surveyor.

* * *

It was stated that universities would have difficulty in adding traffic engineering to their already overloaded curriculum but that it might well be a subject for research and post-graduate study. Occasional lectures by visiting speakers could do much to make university students more aware of the subject and of its possibilities. It was suggested that traffic engineering was not a subject for an ordinary technical college course.

* * *

(*Extracted from 'Indian Concrete Journal' —15-9-51*).

7. PERFORMING CYCLISTS

THERE was a good deal he would like to say about cyclists. They had a special problem in Lincoln. If any theatre in London were short of a trick turn, there were boys, youths, and girls in Lincoln who would surprise London by what they could do on a cycle. They were accustomed to winding through the railway gates. Often as many as 150 cyclists were waiting around the cars at the gates.

In Lincoln there were experts at riding cycles without their hands on the handlebars, and Mr. Bell had even seen a boy riding a cycle and eating fish and chips. He had seen, too, cyclists carrying planks. He had asked the Education Committee whether anything could be done about it through the police or the Safety First Committee, but the stock answer from the police was that they could not trace that there had been any serious accident arising from this cause.

Mr. Bell agreed that they could not trace such an accident, because if the cyclist was not hurt he jumped on his bicycle and slipped off. He did not mind at all whether as a result of his action two cars had been in collision. So far as boys who rode without their hands on the handlebars were concerned, at the very least it did no good ; it was only swank and it affected a simple law which could easily be obeyed. The police said they could not help to do anything about it, but Mr. Bell considered that was a mistake.

(***Extracted from Discussions on a Paper entitled "Aspects of Road Safety" by Alec Aldington, presented at the Annual Meeting of the Institution of Municipal Engineers at Margate, June, 1951.***)

8. THE ALL-EMBRACING HIGHWAY SYSTEM

IT is sometimes difficult for us to realize how deeply the economy of the country is becoming dependent upon the highways. About 85 per cent of inter-city passenger movement is over highways; inter-city bus traffic is over 50 per cent of rail passenger traffic; inter-city truck transportation apparently is earning the equivalent of about 50 per cent of rail freight revenue. Mr. MacDonald will go into the vital part highways play in the economy in more detail. I simply wish to emphasize that the reason our highway traffic problems are increasing is the fact that a growing economy is becoming increasingly dependent upon the flexible all-embracing highway system for which the members of this Association have the major responsibility.

Maj. Gen. Phillip B. Fleming who advised India on her road problems in 1946.

(From an article "America's Highway Problem" published in 'American Highway'—January 1951).

9. OVER-STANDARDISATION

IN an organization so vast care is needed to ensure that centralised instructions and standards, necessary and desirable as they are, do not discourage the inception and development of new ideas amongst the staff of the Regions. Good engineers live and thrive on the success of their ingenuity and inventiveness and the morale of the many excellent men, young and old, on the engineering staff would be lowered if their initiative were unduly restricted.

(Extracted from 'The Engineer'—Nov. 9, 1951).

10. ROAD COMPETITION COMPELS RAILWAY EFFICIENCY

IN Europe the transit time (by rail) of perishable products moving from Italy to Brussels has been reduced since the war from forty-eight hours to twenty eight hours. From Italy to London via the Dover ferry, the time has been reduced from fifty-eight hours to forty-four hours; from Italy to Frankfort from fifty-one hours to twenty-eight hours, and to Amsterdam from sixty-eight hours to forty-three hours. In the United States, similarly, overnight services have been set up by the railroads between a number of the principal metropolitan centres throughout the country, as indicated in the sample listing below :

Overnight services	Distance (miles)
Between New York and Pittsburgh, Pa	426
Between New York and Buffalo	429
Between Chicago and Kansas City	449
Between Chicago and Columbus	308
Between Chicago and Memphis	510
Between Montreal and Toronto	335
Between San Francisco and Los Angeles	469

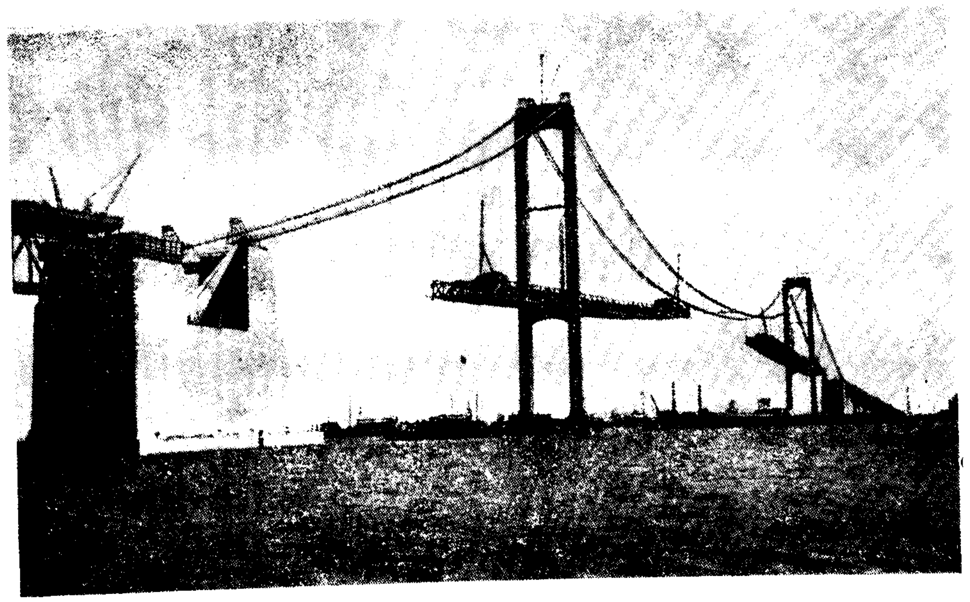
These services are not confined to perishable products, but include merchandise and frequently other commodities.

[From an article headed "Some Aspects of Rail Transport Service" by Herbert Ashton C.E., Ph. D. in the U.N.O. Transport and Communications Review, Jany-March 1951]

WHAT DOES A SUSPENSION BRIDGE COST ?

FROM time to time there is hopeful talk in India of constructing suspension bridges across some of our big rivers. There seems to be an impression that such bridges will be much cheaper than those constructed to a more conventional design. We reproduce a photograph of the Delware Memorial Bridge, New Jersey, which appeared in June 1951 issue of the Chicago magazine "Better Roads" and append a few notes on the dimensions and cost of the bridge.

Under clearance above mean high water at centre	175 ft
Deepest foundation below mean low water level	115 ft
Cables diameter	19½ in.
Cable weight	68 lakhs pounds
Length of wire in cables	12,850 miles



The Delaware Memorial Bridge

Span

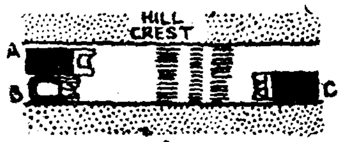
Central suspended span	2,150 ft
Side suspended spans, each	750 ft
Approach spans : 10 deck trusses, 33 deck plate girder spans	
Total length	7,000 ft
Total of all spans	10,650 ft

Weight of steel used	36,400 tons
Traffic per annum	3·6 million vehicles
Cost	$ 44,000,000 (Rs 22 crores)

AVOIDABLE ACCIDENTS

Most road accidents can be avoided if motorists will observe the ordinary rules of the road, or will exercise their commonsense. A slovenly signal, a last-second change of mind, parking in a wrong place, or just bad manners can lead to serious accidents. The accidents described in this article actually took place but they ***need never have happened***. *These cases have been selected out of a much longer list which appeared in " Motor Transport " for the 1st and 8th September 1951.........Ed.*

(1) *A* was a lorry and *B* a small car, both approaching a hill crest. *A* signalled *B* to pass, and *B*, although he could not see over the crest, assumed that the driver of *A*, high up in his cab, could and that the road was clear. He passed confidently and thus caused the accident to be worse when he hit *C*.



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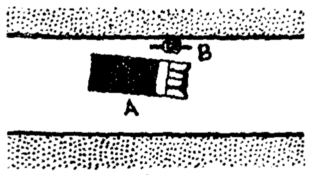
B, in fact, trusted his life to a complete stranger. Broadly speaking, it was he who took the bigger chance of the two.

(2) The lorry *A* passed the cyclist *B*, giving very little clearance. The cyclist swerved and was knocked down.

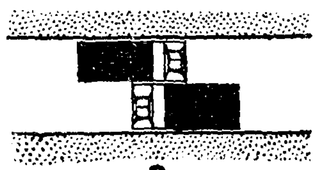
Cyclists must swerve, if only slightly, in the process of keeping their balance. They should therefore, be passed by a margin wider than any possible swerve.



2

(3) Two lorries grazed when passing in a narrow lane. The driver of each said he was doing only 10 m.p.h.

But if two vehicles are each doing 10 m.p.h., their relative speed of approach is 20 m.p.h. yet it is probable that neither would have driven through an equally narrow gap at a speed of 20 m.p.h.

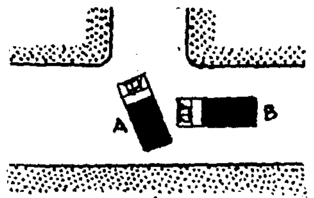

3

(4) In describing the accident which followed this position *A* said that he (I) gave a signal, (II) changed down, and (III) *turned* off.

A should have changed down before giving his signal, as he could then have continued to give it until the moment of turning. Also, on many lorries the body projects a foot beyond the side of the driver's cab, so that a signal does not begin to be visible from the rear until the drivers are some way out. As *B* was emphatic that no signal had been given it is probable that driver on *A* did not put his arm out far enough to be seen.

A should have edged towards the centre of the road before he actually turned off.

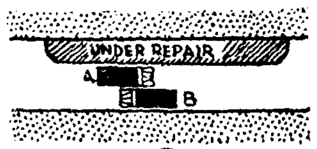
On the other hand, *B* should not have tried to pass *A* till *A* was beyond the corner, i.e., till there was no possibility of *A* turning off.



4

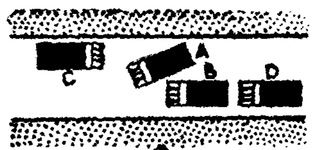
(5) *B* entered the section which was under repair before *A* did. Instead of waiting for him *A* pushed in and the two fouled in passing.

Right of way was *B*'s, because he was on the left of the road and he had entered the narrow part of the road before *A*. The accident was due to *A*'s lack of road courtesy. He should have waited until *B* was clear.



5

(6) A cut in, apparently counting on *B* and *C* checking in order to make room for him, for he could not have got through otherwise. *B* and *C* checked, but *D* was close behind *B* and ran into him.



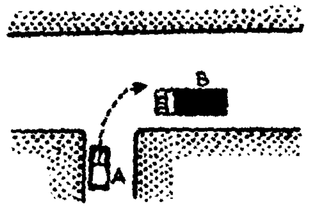
6

The accident was due to *A*'s discourtesy and dangerous driving. He deliberately made *B* and *C* brake hard with the alternative of being hit.

Nevertheless *D* had only himself to blame for his accident, because he was too close to *B*.

(7) The accident happened on the fringe of a town at dusk. *A* sounded his horn and considered that he had thereby established his right to come out on to the other road with the result that he was struck by *B*.

The chance that *A* took is obvious, but apart from that, if he had put on his head lamps before reaching the corner there would have been no accident. *B* had not heard the horn, but he must have seen the beam of light.



7

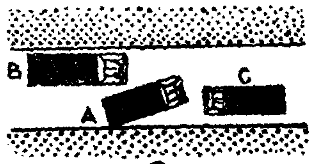
From dusk onwards the head lamp is the best horn.

(8) *B* drew up behind *A* at a cross-road, controlled by traffic lights. He had recently been through a heavy thunder shower and he put on his brakes, but they did not act and he ran into *A*.

The accident was due to mechanical failure, possibly preventable. A driver should always try the brakes of a vehicle, particularly of a strange one after it has been washed or after passing through very heavy rain. Also a good driver starts to put on his brakes lightly at first while still some way from where he wants to stop. He thus finds out in time any failure, besides saving tyres and brake linings.

8

(9) *A* cut in. It was grossly bad manners and very dangerous, besides being only possible if both *B* and *C* checked, which *A* apparently counted on their doing. *B*. however, retaliated by accelerating so as to stop *A* getting by. The result was a collision between *A* and *C*.

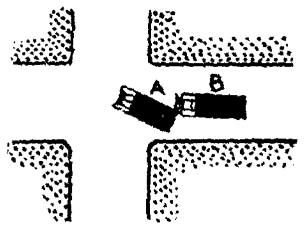


9

A's driving was criminal, but that would not justify *B* in practically provoking an accident, which, moreover, involved the innocent *C*.

(10) *A* gave a slovenly signal, which *B* took to imply a turn to the left. The signal had, however, been meant to indicate a turn to the right. *B* had slightly pulled out in anticipation of *A*'s turning off, and was consequently fouled when *A* went in the opposite way to that anticipated.

The primary fault was a careless signal, but the fact does remain that if *B* had held back till the cross road was passed he would have made quite sure, and would have escaped.



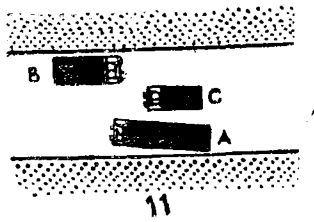
10

(11) Vehicle *A* was a bus, *B* a car, both being stationary. *C* came up at 12 m.p.h. and *A* gave him a signal to pass, but at once moved off, pulling out as he did so. *C* swerved to avoid being hit by *A* and hit B :

(i) Either *A* or *B* stopped in a stupid place. A vehicle should never park opposite where another is already halted.

(ii) *C* should never have attempted to pass at 12 m.p.h.; 4 m.p.h. would probably have been the limit for safety.

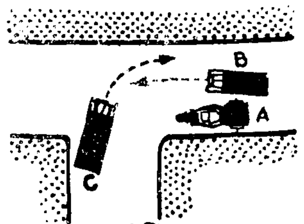
(iii) *A*, having given a signal, should not have changed his mind.



11

An accident due to lazy thinking on the part of every one concerned.

(12) *A* had halted too near to the corner. C came fast up to the corner and hit *B*, who was in the act of passing *A*.

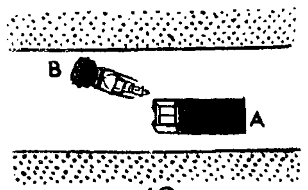


12

It is unfortunate that, when vehicles are parked in foolish places, they are very rarely involved in the accidents for which they are responsible.

C approached the corner too fast and was in that respect to blame, but the chief cause of the accident was the parking of *A* close to the corner.

(13) The horse-drawn cart *B* was standing, unattended, by the roadside. *A* passed it at about 15 m.p.h. and was convinced that it was all the horse's fault that it moved slightly towards his line and that he hit it.

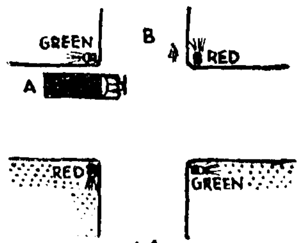


13

The accident was due to his lack of imagination. If he had visualised the likely contingency of the horse's moving, he would have driven well clear of it and dead slow.

(14) *A*, approaching the cross roads, saw the traffic light at green and assumed there was a clear road. He drove by without either steadying down or drawing out away from the edge of the road.

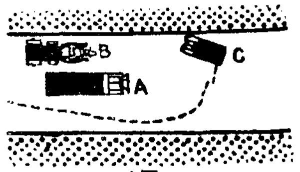
B, a child on a bicycle, came out and was struck.



14

If the two maxims had been adhered to of taking nothing for granted and always retaining the ability to stop or to manoeuvre, there would have been no accident.

(15) *A* passed *B*, in a town, on a wet road. At the same time *C* passed both *A* and *B* and, in drawing in, started to skid. He turned completely round and ended up against the kerb.



15

The double pass was dangerous and the resulting skid should have been foreseen.

There would be fewer accidents if drivers took greater account of the prevailing conditions.

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PUNJAB ROADS DURING 1949-50

A REVIEW OF THE ADMINISTRATION REPORT

THE Punjab has the distinction of possessing good roads and the Department continued to maintain that reputation in spite of financial stringency, says a review of the annual administration report of the Punjab P.W.D., Buildings and Roads Branch, for the year 1949-50.

The total length, on the 31st March 1950 of roads in the state maintained by the P.W.D. is given in the table below. Besides these there was a large mileage of district board roads and village roads.

	Concrete	Metalled and surface painted	Unsurfaced waterbound macadam or stablised soil	Un-metalled	Total
National Highways	2	783	4	20	809
Other Roads	–	1,379	73	896	2,348
Total	2	2,162	77	916	3,157

The total cost of maintenance of these departmental roads during the year amounted to Rs 53,50,744. Out of this, the cost of maintenance of National Highways, which is entirely paid for by the Central Government, amounted to Rs 15,91,707, or Rs 1,968 per mile. The expenditure on "Other Roads" was Rs 1,601 per mile.

On account of financial stringency, no new roadworks of any magnitude were undertaken during the year. The total expenditure incurred on the development of roads amounted to Rs 64,63,975 out of which Rs 21,22 055 were spent on National Highways.

The Rupar-Guzar Nangal road, which gives access to the works connected with Nangal and Bhakra Dam, was completed during the year. Only the bridge on the Sirsa Nadi on this road remained unbuilt. A road was built from Amritsar to Bhikiwind.

Apart from the work described above, the activities of the Department on the improvement of roads were connected mainly with the widening of different sections of National Highway No. 1 (the Grand Trunk Road) from 12 to 22 feet. This widening was completed during the year from Karnal to Ambala and from Jullundur to Amritsar.

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TOO PARTICULAR

"Congratulate me ... I won the election."
"Honestly?"
"Well ... darn it, I won."

—

HOPEFUL .

A certain U.S. Senator wondered exactly what his constituent meant when he penned a letter reading as follows :

"For many years, your colleague, the distinguished Senior Senator from this State did many favours for me. But now he is deceased, and I hope I may eventually say the same for you."

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TECHNICAL INFORMATION

1. QUALITY OF CONCRETE: CAUSES OF VARIATION

(Extracted from 'Commonwealth Engineer'—Jan. 1, 1951.)

IN a paper presented to the Reinforced Concrete Association and published in "The Reinforced Concrete Review," October 1949, F. N. Sparkes, M. Sc., of the Road Research Laboratory (England), discusses the causes of variation in the quality of concrete. He lists the variations as under :—

Factors causing variation	Total variation in concrete strength as a result of this factor.
Quality of cement	Up to 50 per cent or more.
Grading of aggregate	20 per cent maximum.
Bulking of fine aggregate	10 per cent
Batching—	
(a) by weight	8 per cent
(b) by volume:	
(i) good	16 per cent maximum
(ii) normal	70 per cent maximum
(iii) bad	108 per cent maximum
Compaction	20 to 50 per cent
Handling-mixing and transporting	Unknown, but may be completely eliminated by attention to detail.
Temperature	Unimportant after 28 days, provided temperature is above freezing.
Other Factors	About 30 per cent

Remedies

To give maximum control and reduce variations as far as practicable the author makes the following suggestions :

(1) Use cement from one mill only whenever possible.

(2) Obtain the coarse aggregate in several sizes and recombine them in the correct proportions at the batching point

(3) Make regular grading tests of the fine aggregate and apply corrective measures if any drift occurs away from the specified grading.

(4) Batch all materials by weight and not by volume.

(5) Insist on regular maintenance of of the weighing devices, keeping them clean with well-greased knife edges and bearings.

(6) Maintain stock-piles of aggregates, sufficient at any one time for at least 24 hours' working. Keep the stock-piles flat-topped and use the bottom 1-2 ft as a drainage layer.

(7) Make determinations of the moisture content of the aggregates at as frequent intervals as experience shows to be necessary.

(8) Adjust the quantity of water added at the mixer as may be necessary from the results of (7).

(9) Adjust the weights of the aggregates in relation to their water content, to ensure that the equivalent weight of the dry material is correct to within ± 1 p.c.

(10) Mix each batch of concrete for the specified period.

(11) Study all transport and handling arrangements to enable any tendency to segregate to be arrested before it develops.

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2. PRECASTING HIGHWAY BRIDGES

RECENT DEVELOPMENTS

(Extracted from 'The Surveyor' – November 3, 1951.)

A research paper by Mr. R.B. McMinn. Senior Highway Engineer, U.S. Bureau of Public Roads, Portland, Oregon, describing recent developments in precasting of highway bridges and structures, has been issued in Bulletin No. 39, published by the Highway Research Board, Washington, D. C.

The importance of precasting, as an advance in bridge construction, is set forth in the paper, together with its advantages and possible use in the future. A plea is also made for its ready acceptance by engineers and those in the construction industry.

This report points out that prior to 1948 the precasting of highway bridges consisted principally of precasting units, complete in themselves, which when placed or assembled constituted a complete spanr. The writer describes later developments with respect to bridges as consisting of two different systems of precasting.

The first system consists of combining precast stringers with cast-in-place floor slabs, thus resulting in Tee beam spans. This system is illustrated in the Turnagain Arm Project, Alaska, discussed at length in the paper. This system has also been employed in bridges constructed at Lowell, Mass., with spans up to 55 ft; and in 800 linear ft of trestle approach to the South Yamhill River Bridge in Oregon.

Welding with Concrete

The second system is described as consisting of the field assembly of precast beams or stringers and floor slab panels separately, which, when assembled, are welded together with concrete to form an integral structure. This system is illustrated in the Baker River Bridge which was constructed in the State of Washington by the Bureau of Public Roads.

Interesting applications of precasting of highway structures are presented in this study, such as the precasting of the roofs of two snow-sheds now being constructed by the Depa·tment of Highways, State of Washington. The use of precast members in culverts and tunnel lining is also discussed.

Recommendations regarding precasting and a discussion of the important advantages of precasting highway bridges and structures are included in this paper.

Precast Bridges are Successful

In this report the common acceptance and use of precast members for building construction is contrasted with the some what slight interest and only occasional usage of the precasting method for bridges and highway structures. The writer points out that experience in precasting bridges has proved that this method is satisfactory, and that it results in saving of time, labour, and money. Only by actual use of precasting can enthusiastic interest be engendered. Active participation in such projects by more state highway departments and greater interest on the part of constructing engineers would lend impetus to this method of bridge construction.

The writer concludes that if precasting is to take its proper place in the highway industry it will be necessary for bridge engineers to initiate projects, develop the details, and actually construct some precast structures. The situation appears a challenge to the ingenuity and progressive instincts of those in the engineering profession. Contractors and concrete products manufacturers should also co-operate, for their own benefit as well as for the good of the highway industry as a whole.

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PEPSU TO SPEND Rs 17,71,000 ON HIGHWAYS THIS YEAR

THE total revenue receipts of P.E.P.S.U. for 1951-52 are estimated at Rs 441.79 lakhs and revenue expenditure at Rs 440.12 lakhs, leaving a small surplus of Rs 1.67 lakhs.

Revenue expenditure on Buildings and Roads for 1951-52 estimated at Rs 38.24 lakhs forms nearly 9 per cent of the estimated total State expenditure for the year.

Expenditure on original works and repairs on Highways (including bridges) is estimated to be Rs 17.71 lakhs, which forms about 4 per cent of the total State expenditure.

The following details have been extracted from PEPSU Budget for the year 1951-52 :

I. Expenditure - Civil Works (Buildings & Roads)

	Revised Estimates 1950-51 (in lakhs of Rs)	Budget Estimates 1951-52 (in lakhs of Rs)
(i) Original Works	14.80	14.53
(ii) Repairs	20.61	21.67
(iii) Tools & Plant	0.39	0.19
(iv) Establishment	4.03	3.99
(v) Suspense	—	(-2.14)
Total	39.83	38.24

II. Expenditure—Roads (including bridges)

	Revised Estimates 1950-51	Budget Estimates 1951-52
(i) Original Works	3.20	3.41
(ii) Repairs	14.30	14.30
Total	17.50	17.71

III. Receipts from Roads

	Revised Estimates 1950-51	Budget Estimates 1951-52
(i) Receipts under Motor Vehicles Acts	4.00	3.50
(ii) Motor Spirit Sales Tax	2.00	2.00
Total	6.00	5.50

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THE NATIONAL HABIT

Message flashed on the screen of a London cinema theatre : *A five-pound note has been found in the stalls. Will the owner please form a queue outside the box office tomorrow night ?*

List of Approved Works on National Highways

S. No.	Job No.	Name of work	Amount Rs	Remarks
		BOMBAY		
1.	558 BM 4.	Acquisition of land for increasing land width of the diversion outside the Kagal town and realignment of the diversion on the Bombay-Poona-Bangalore Road.	52,130/-	
2.	560 BM 8.	Land acquisition for Pardi-Kim junction section of the Bombay-Ahmedabad Road.	54,400/-	
3.	561 BM 8.	Modernizing the South approach to the Narmada Bridge at Broach on the Bombay-Ahmedabad Road.	79,432/-	
4.	565 BM 50.	Earth Work for Construction of one-seated masonry latrine in the compound of the Inspection Bungalow at Sinnar National Highway No. 50.	1,400/-	
5.	566 BM 8.	Construction of Karjan-Baroda section of the Bombay-Ahmedabad National Highway No. 8.	20,000/-	
		UTTAR PRADESH		
6.	559 UP 28.	Painting miles 176-179 of National Highway No. 28 (miles 12-15 of Gorakhpur-Kasia Road.)	1,82,000/-	
7.	563 UP 29.	Painting miles 0/0-6/0 of National Highway No. 29 (Allahabad-Gorakhpur Road miles 165/2-159/0) length 6¼ miles.	2,30,000/-	
8.	564 UP 2.	Painting miles 225-244 of National Highway No. 2 (miles 90-109 of Agra-Etawah-Fatehpur Road) length 19 miles 6 fur.	7,74,000/-	
		PUNJAB		
9.	554 PB 1A	Construction of High level bridges in miles 15/7, 19/8 & 20/5 of National Highway No. 1-A, Section Jullundar to Tanda.	57,100/-	
		ORISSA		
10.	555 RS 6.	Remodelling a bridge in the 37th mile of National Highway No. 6 (Section II from Deogarh side)	24,400/-	

S. No.	Job No.	Name of work	Amount Rs	Remarks
Continued				
		ASSAM		
11.	556 AS 37.	Improvement of the road (within Goalpara Municipal area) leading to ferryghat near the Circuit House at Goalpara (1.53 miles)	33,200/-	
		DELHI		
12.	557 DLH. 2	Widening Delhi-Mathura Road from mile 5/0 to mile 11/5 in Delhi State.	87,700/-	
		KUTCH		
13.	A562 KH	Alignment of the Ahmedabad-Kandla Road in Kutch and Saurashtra Two alternative routes (i) Samkhiali -Shikarpur-Malya-Morvi and (ii) Samkhiali-Mancha-Vansara-jetpur-Morvi *via* Khakreji.	19,200/-	

ILLNESS TO ORDER

One of those society women with persistent ailments had been pestering a busy physician. When she showed up for her sixth call, she inquired of the doctor: " Don't you suppose I have a nervous condition, Doctor? "

" No," came the answer, " not the slightest trace of it, but here is a medical book with a whole chapter on nervous disorders. I'd suggest you take it, read it, pick out an ailment you'd like to have, and then start working on it."

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

1. **Report of the Commonwealth Standards Conference held at London from 12th to 15th June 1951—No. CN (OC) 3448.** (British Standards Institution, 24, Victoria Street, London, S. W. 1).

2. **Combined classified List and Distribution Return of Establishment (corrected upto 1st April 1949)** (Superintendent, Orissa Government Press, Cuttack 1949).

3. **A Note on Mechanical Construction Equipment generally used for Irrigation Projects.** (Superintendent Government Press, Madras 1951). (2 copies.)

4. **Annual Report of Central Water and Power Commission (Power Wing) Simla for the year 1950—51 (Cyclostyled)** (Ministry of Natural Resources and Scientific Research, C.W. & Power Commission, Simla).

5. **The Statics Ratio for Analysis of Frames that deflect Engineering Research Series No. 45, by Phil M. Ferguson and Ardis H. White.** (Bureau of Engineering Research, The University of Taxas, Austin, 1950).

The Council for Codes of Practice for Buildings, Construction and Engineering Services, Lambeth Bridge House, London, S.E.1.

6. **B. S. Code of Practice C.P. 113, 102 (1951)—Are welded Construction.**

7. **B. S. Code of Practice C.P. 121, 101 (1951) Brickwork.**

8. **The British Commercial Vehicle Industry** (Third edition). (Temple Press Ltd., Bowling Green Lane, London, E.C.I.) (2 copies)

9. **Relaxation of Constraints and Moment Distribution—Mechanical World Monographs No.—62.** by J. Jennings. (Emmott and Co., Ltd., 21, Bedford Street, London, W. C. 2.)

10. **Symposium of Papers—British Manufactured Mechanical Equipment for Road Construction and Maintenance. Ninth International Road Congresses, Lisbon, 1951.** (Permanent International Association of Road Congresses). (2 copies)

11. **An Analysis of the Highway Program by** Roy E. Jorgensen. (Prepared for National Highway Users Conference, May, 1951).

12. **Bibliography on Resistance of Bituminous Materials to Deterioration Caused by Physical and Chemical changes—Bibliography No. 9 — Annotated.** (Highway Research Board, Washington).

13. **Proceedings of 1950—Soil Mechanics Conference Technical Memo No. 19.** (National Research Council of Canada, Associate Committee on Soil and Snow Mechanics).

14. **Standard Specifications for the Design and Fabrication of Structural Glued Laminated Lumber, 1951.** (West Coast Lumbermens Association, 1410, S. W. Morrison Street, Portland 5, Oregon).

15. **Proceedings of the Second California Institute on Street and Highway Problems held at the University of California, Los Angeles, January 30 to February 1, 1950.** (The Institute of Transportation and Traffic Engineering, University of California).

McGraw Hill Book Co., Inc., New York.

16. **Petrography and Petrology-A Text book by F. F. Grout.**

17. **Introduction to the Theory of Statistics by A. M. Mood.**

U. S. Department of Agriculture-Soil Conservation Service Research in Co-operation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory.

18. **Capacity of Box Inlet Drop Spillways under Free and Submerged Flow Conditions—Tech. Paper No. 7 Series B, by F. W. Blaisdell & C. R. Dounelly.**

19. **Hydraulic Design of the Box Inlet Drop Spillways—Tech. Paper No. 8, Series B** by F. W. Blaisdell and C. R. Dounelly.

20. **Application of Cold Mastic Asphalt Compounds to the sealing of joints and cracks in Rigid Pavements.** (University of Kentucky, Lexington, 1951).

21. **Soil Testing for Engineers by** T. W. Lambe. (John Wiley and Sons, New York, 1951).

22. **Report by the Railway Board on Indian Railways for 1950-51 Volume II-Statistics.** (Manager of Publications, Delhi, 1952).

23. **Mechanism of Absorption of Bituminous Materials shell Bitumen Reprint no. 4 by Aggregate by J. A. Lettier, D. F. Fink, N. B. Wilson and F. F. Farley.** (Burmah Shell Oil Storage and Distributing Co. of India, Ltd.)

Editieur Dunod, Bonaparte, Paris 6.

24. **Treatise on materials of Construction Vol. 1** by M. Duriez.

25. **Treatise on materials of construction Vol. 11** by M. Duriez

26. **Treatise on Soil and Foundations** by R. Buchard.

27. **A Summary Report on Soil Stabilization by the use of chemical admixtures, Tech. Development Report No. 136,** by R. C. Maniford (Civil Aeronautics Adminstration Technical Development and Evaluation Centre, Indianapolis, Indiana, February 1951).

28. **Analysis for three-diamensional pipe structures by group relaxation by** R.C. Dehart and Nicholas Bassar Jr.—College Bulletin No. 9 November 1950—(Montene State College, Bozman, Montana).

29. **Accident Investigation Manual—** (The Northwest University Traffic Institute, 1704, Judson Ave, Evaston, Illinois).

30. **Proceedings of the recent South-eastern Regional Transportation Conference held at Atalanta.** (The Transportation and Communication Deptt., Chamber of Commerce, U. S. Washington).

31. **Aerial or Wire Ropeways by** A.J. Wallis-Taylor. (The Technical Press Ltd. Glouchester Road, Kingston Hill, Surrey, London, 1920).

32. **Bridge Architecture** by Wilbur J. Waston. William Helburn Inc., 15 East 55th Street, New York).

33. **Specifications for General Provisions.** (American Association of State Highway Officials, 917, National Buildings, Washington 4, D.C.)

American Concrete Institute, 18263, W. McNicholas Road, Detroit 19, Michigan.

34. **Building Code Requirements for Reinforced Concrete (ACI 318-51)—The ACI Building Code.**

35. **ACI Standard Specifications for Concrete Pavements and Bases (ACI 617-51.)**

36. **Studies of the Use of Previous Fence for Streambank Revetment Report No. A-70. 1** by John T. O 'Brien. (Hydro-dynamics Laboratories, California Institute of Technology Pasadena, California).

37. **Soils: Their Origin, Construction and Classification by Gilbert** Wooding Robinson. (3rd revised and enlarged edition) (Thomas Murby and Co., 40 Mussem Street, London W.C.I.)

38. **Transition Curve tables for realigning works on road curves.** Parts I & II. Editeur, Eyrollers, Paris (Ve).

PUBLICATIONS
OF THE
INDIAN ROADS CONGRESS

A limited number of copies of the following publications are available for sale

	Publications.	Price inclusive of postage, etc. Rs.	A.	P.
1.	Volume III—Lucknow 1937	4	0	0
2.	Volume IX—Part 4—October 1945	3	0	0
3.	Volume IX—Bound—Madras 1945	10	0	0
4.	Volume X—Part 1—December 1945	3	0	0
5.	Volume X—Part 4—August 1946	3	0	0
6.	Volume XI—Part 4—May 1947	3	0	0
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