TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

MARCH 1957—No. 119

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Transport - Communications Monthly Review is published on the 25th of each month by the **Indian Roads Congress, New Delhi.**

This Review is sponsored by the Roads Wing of the Ministry of Transport, but the Government of India accept no responsibility for any views or opinions expressed.

Subscriptions. Annual subscription including postage is Rs Fourteen. Single copy including postage is Rs one and annas four.

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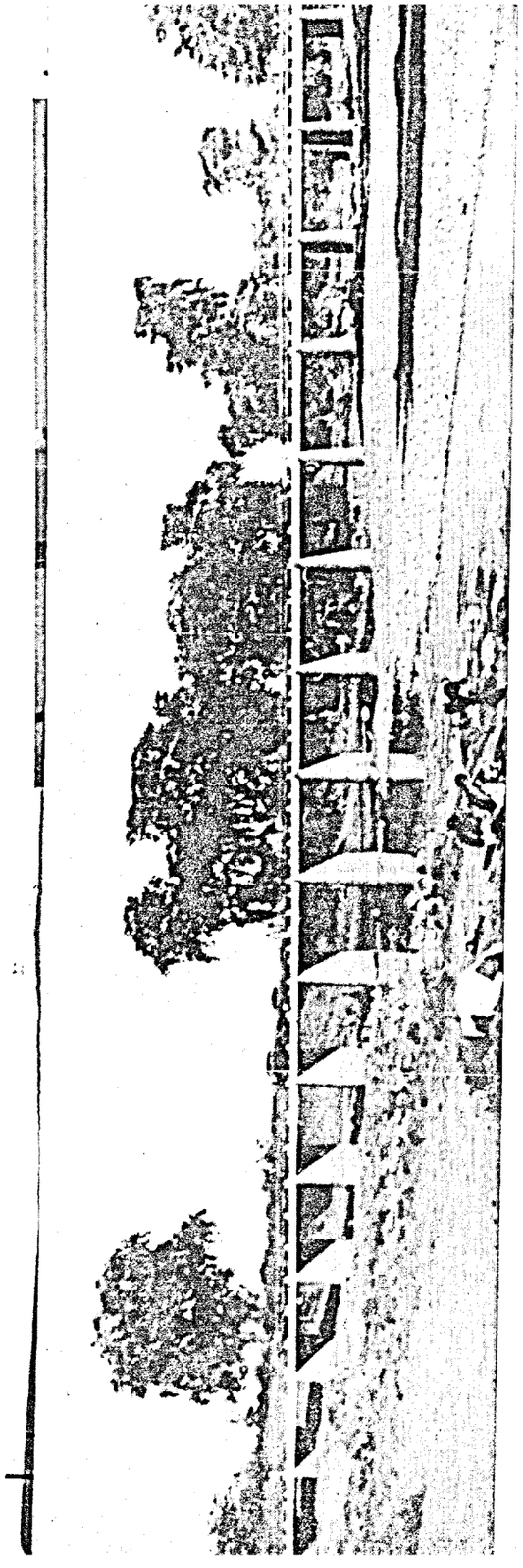
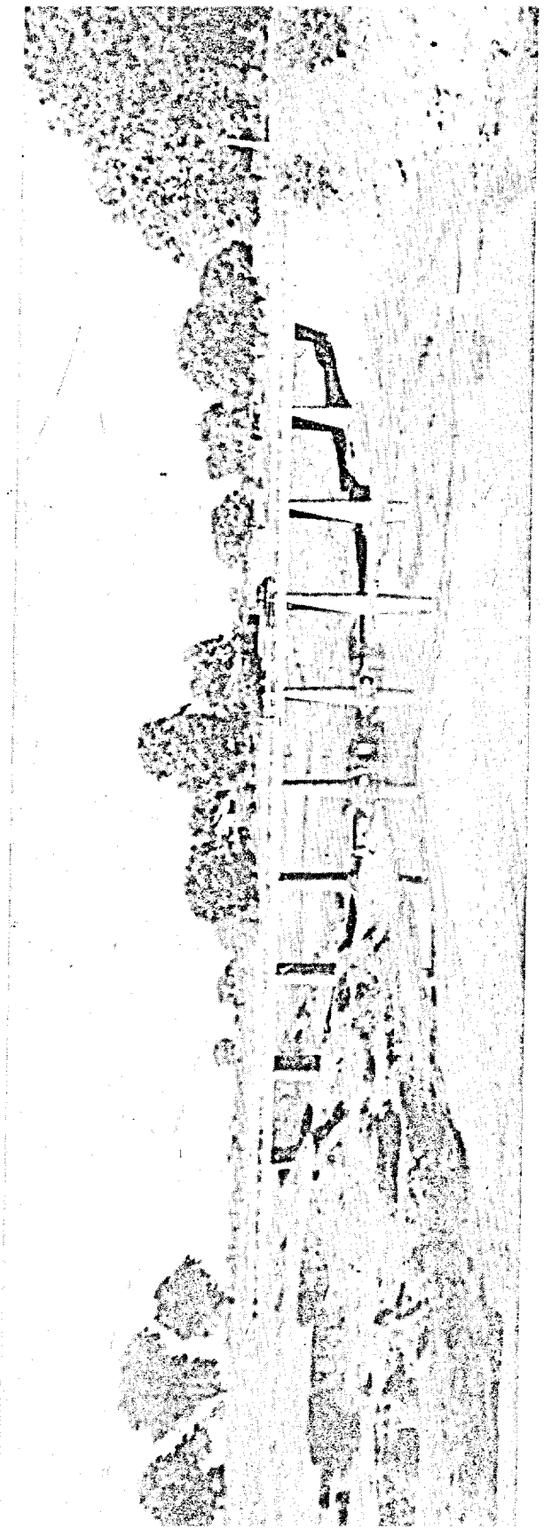


Bridge over the Machak River at Mile 230 of Hoshangabad-Harsud Road, Madhya Predesh. Sixteen spans of 20 feet each. R. C. C. slabs.



Bridge over the Ajnal River at Mile 218 of Hoshangabad-Harsud Road, Madhya Predesh. Nine spans of 20 feet each. R. C. C. slabs.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

MARCH 1957

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PROGRESS OF ROAD DEVELOPMENT IN INDIA

THE NAGPUR PLAN & AFTER

THE Conference of Chief Engineers held at Nagpur, which for the first time in the history of road development in India drew up an integrated plan, envisaged the construction of 25,000 miles of National Highways, 65,000 miles of State Highways, 160,000 miles of District Roads, and 150,000 miles of Village Roads. Modified to apply to the Indian Union, the milage of different classifications of roads is as under :—

	Miles		Miles
National Highways	20,750	Surfaced Roads	123,000
State Highways	53,950	Unsurfaced	
District & Village Roads	256,300	Roads	208,000
Total	331,000	Total	331,000

In 1951, the beginning of the first Five-Year Plan, the country had a surfaced road milage of 97,546 and the unsurfaced roads were 150,963 miles. Thus, at the beginning of the first Plan, there were 248,509 miles of roads.

By 31st March 1956, i.e., the end of the first Five-Year Plan, total milage of roads in the country was 316,668. This figure includes 61,020 miles of surfaced roads and 38,139 miles of unsurfaced roads constructed under the Community Development Projects and the National Extension Schemes. Table 1 gives the growth of road milage from 1943.

Table 1

Growth of Road Milage

	Surfaced miles	Unsurfaced miles	Total miles
Nagpur Plan	123,000	208,000	331,000
In 1943	88,000	132,000	220,000
In 1951	97,546	105,963	248,509
In 1956	121,617	195,051	316,668

In Table 2, the milages of different types of surfaces at the end of the first Plan in the various States are given.

Table 2

Milage of different types of road surfaces at the end of the first Plan in the various States.

States	SURFACE				Unsurfaced	Grand Total
	Black Topped	Concrete	Water Bound Macadam	Total Surfaced		
Part 'A'						
Andhra	1162*	146*	11055*	12363*	2795*	15158*
Assam	1210	1	189	1400	11468	12868
Bihar	3374	12	1348	4734	30005	34739
Bombay	1676†	796†	11842†	14314†	11124†	25438
Madhya Pradesh	1062†	1†	6837†	7900†	4728†	12628†
Madras	4732	222	12200	17154	8450	25604
Orissa	572	—	2351	2923	5210	8133
Punjab	3036	2	418	3456	6819	10275
Uttar Pradesh	3195	537	7430	11162	26192	37354
West Bengal	2460†	154†	1986†	4600†	21268†	25868†
	22479	1871	55656	80006	128059	208065
Part 'B'						
Hyderabad	208	62	5574	5844	2063	7907
Jammu & Kashmir	439†	—†	617†	1056†	1037†	2093†
Madhya Bharat	550	25	4022	4597	208	4805
Mysore	1294	164	7712	9170	3249	12419
Pepsu	815	1	25	841	240	1081
Rajasthan	1725	22	3481	5228	9504	14732
Saurashtra	84	165	2231	2480	2300	4780
Travancore Cochin	105†	45†	2586†	2736†	4044†	6780†
	5220	484	26248	31952	22645	54597
Part 'C'						
Ajmer	176	—	109	285	396	681
Bhopal	128	—	448	576	572	1148
Coorg	151	—	217	368	24	392
Delhi	268	5	2	275	43	318
Himachal Pradesh	61	—	13	74	2921	2995
Kutch	39	—	168	207	321	528
Manipur	207	—	37	244	372	616
Tripura	18	—	134	152	272	424
Vindhya Pradesh	130*	3*	1225	1358*	1287*	2645*
	1178	8	2353	3539	6208	9747
Part 'D'						
Andaman & Nicobar Islands	—	—	—	—	—	—
Grand Total	28877	2363	84257	115497	156912	272409

* 1954 data † Provisional figures

National Highways

The system of National Highways, which are maintained and developed at the cost of the Union Government, is at present 13,800 miles.

When the Centre took over liabilities for National Highways, the selected routes had approximately 1,600 miles of missing road links and thousands of missing culverts and bridges, out of which about 150 were bridges on large rivers. In addition, about 9,000 miles of these roads had low-grade surface. During the first Plan period, construction of 636 miles of missing links, 30 major bridges and the improvement of 4,000 miles of existing sections of National Highways was completed. In addition, the construction of about 614 miles of missing links, 42 major bridges and the improvement of 3,000 miles of National Highways was in progress at the end of the first Plan period.

Bridges

The first Five-Year Plan provided for the construction of 75 major bridges and a large number of minor bridges and culverts. Thirty major bridges on National Highways and 3 on Other Roads have been constructed during the Plan period in the Central sector.

Expenditure

The estimated cost of the Nagpur Plan for the Indian Union was Rs 371.8 crores. At hundred per cent increase over pre-war rates, the present cost of the Nagpur Plan would be of the order of Rs 744 crores. In comparison, actual expenditure incurred from 1943 up to end of 1955–56 is as below:—

National Highways	Rs 28 crore
Other Roads	Rs 131 crore

Table 3 gives the State-wise expenditure on roads other than National Highways during the first Plan period.

The States were re-organized on 1-11-1956. The distribution of the milage of National Highways among the new States is given in Table 4.

Table 3

Expenditure on Other Roads 1951–56.

Name of State	1951–56 Rs Lakhs	Name of State	1951–56 Rs Lakhs
Andhra	222.59	Rajasthan	497.70
Assam	274.59	Saurashtra	428.39
Bihar	1078.05	Travancore-Cochin	264.45
Bombay	2440.18	Ajmer	21.69
Madhya Pradesh	203.17	Bhopal	56.59
Madras	297.36	Coorg	24.77
Orissa	237.57	Delhi	25.00
Punjab	356.24	Himachal Pradesh	219.43
Uttar Pradesh	541.95	Kutch	47.36
West Bengal	1368.71	Manipur	55.32
Hyderabad	145.85	Tripura	72.87
Jammu & Kashmir	254.97	Vindhya Pradesh	104.48
Madhya Bharat	220.89	N. E. F. A.	79.67
Mysore	527.43	Sikkim	—
Pepsu	184.37	Community Projects	29.48
		Total —	10251.64

Table 4

National Highway Mileages in various States after Reorganisation

Name of State	N. H. Milages
Andhra Pradesh	1410
Assam	796
Bihar	1173
Bombay	2386
Delhi	44
Himachal Pradesh	222
Jammu & Kashmir	324
Kerala	286
Madhya Pradesh	1269
Madras	1035
Manipur	98
Mysore	525
Orissa	851
Punjab	769
Rajasthan	470
Uttar Pradesh	1390
West Bengal	722
	13,770 or 13,800

THOMAS TELFORD

THOMAS Telford, the first President of the Institution of Civil Engineers, London, and the builder of many roads and bridges, was born in August 1757, the first child of a poor young shepherd John and his wife Janet. Before the child was a year old, his father died. When Telford grew big enough for work he lived with a relative of his father, who was also a shepherd. He did all sorts of odd jobs like herding cows, running errands, etc., for which he received food and sometimes 5 shillings for purchase of shoes.

At the nearest parish school he learned reading, writing and arithmetic. When he was 15 and had finished study at the elementary school, his mother decided to send him to work for a stone mason in the village of Lochmaben. But the stone mason treated Telford badly and he ran back home. Next, Telford was apprenticed to a stone mason at Longholm, a nearby town. Here he enjoyed his work and learnt the first rules of construction. During his stay in this town, Telford attracted the attention of an elderly lady, Miss Pasley, who had money and culture. Soon he had access to the collection of books she had. "Like a hungry bear, Tom pounched upon her shelves. Through the long winter evenings he trudged back and forth, reading first one book and then another, until he knew all the books in Miss Pasley's library almost by heart. Like Abraham Lincoln, Telford had to read by the light of the fireplace." At Longhold, Telford helped to build a fine new stone arch bridge across the river Esk and had learnt enough about construction work. Bidding good bye to Eskdale with an introduction letter from Miss Pasley to her brother, Mr. John Pasley, a merchant, Telford went to London. Mr. Pasley gave him a letter of introduction to Sir William Chambers, an architect, who hired him as an ordinary stone cutter. During the period of his work under Sir William Chambers, Telford saved money, spent his spare time in studying and was ambitious to become the foremost man in his profession. He wanted to start a building business of his own but did not have enough money for the purpose. Jumping at the opportunity offered for assisting in the superintendence of a building work at Portsmouth, Telford made a name for himself there. Through the help of Pulteney a rich Earl, Telford became the surveyor of public works for the County of Salop, where he built road bridges and all kinds of public buildings. He earned a reputation of being a first class engineer in the neighbourhood and the Ellesmere Canal Company engaged him as their Chief Engineer. He was responsible for building the large Caledonian Canal in Scotland and became so famous for this type of engineering work that in 1808 he was invited by the King of Sweden to build the Gotha Canal there. Telford was also a great road builder. Between Carlisle and Glasgow he built 69 miles of new road and a 100 miles stretch on the Great North Road south of York. Telford can also be said to be the father of the suspension bridges. The Menai Straits Bridge, with a total length of 1,710 ft and a span of about 550 ft, was perhaps his greatest work. After the finishing of this Menai Straits bridge when friends went to congratulate him, they found him on his knees thanking God.

He was modest and unselfish and as if remembering his own struggles and the treatment he had received from Sir William Chambers, Telford was always interested in ambitious young men and helped them all he could. In 1820, he became the first President of the Institution of Civil Engineers. In 1834 when he was nearly 77 years old, a sudden illness brought about his death. He was buried in the Westminster Abbey.

From his writings, it is seen that he always conducted investigations on the nature of the soil before a project was

designed. For the Gloucester bridge with a span of 150 ft, Telford placed the foundations of the wing walls at a shallower depth than the piers; they were constructed on the "rich loam" at a depth of 8 - 10 ft below ground surface. It is evident that the foundation loading of the eastern wing walls and approach embankment caused excessive consolidation of the silt and peat, for Telford stated that:

"They have sunk considerably, so that instead of conducing to the support of the masonry of the abutments, the wings have receded, created fissures and tend to weaken it. I therefore take blame to myself for the injudicious parsimony of omitting the piling and platform, and now mention this as a useful caution to practical engineers. On the Western side, the ground was sufficiently firm, and the wing walls and retaining walls remain immovable."

Telford then records that:

"When the centering was removed and the whole weight of the arch left to press on the abutments, its crown sunk about two inches, and afterwards, from the before-mentioned receding of the eastern wing-walls, suffered a further depression of eight inches.....that the sinking of the Gloucester arch of 150 ft span took place from the pressure upon the upper part of the eastern abutment, when deprived of the resistance of the wing walls, is evident from the front not having sunk, and the courses of the stone facing towards the river remaining quite level. On the western side of the river, the abutment and walls, being upon firmer ground, remain unmoved."

"Upon the whole, although the sinking of this large arch is small, in comparison

(*Continued on page 11*)

Thomas Telford, 1812

(With Acknowledgements to "Geotechnique", Sept. 1956.)

A REPORT ON THE SECOND INTERNATIONAL STUDY WEEK IN TRAFFIC ENGINEERING

THE study week on traffic engineering organized under the joint auspices of the World Touring and Automobile Organization and the Permanent International Association of Road Congresses was held at Stresa, Italy, in October last. The object of the conference was to provide a medium for engineers, administrators, traffic and police officers, statisticians and research workers, to maintain contacts and exchange views and information. Nearly 560 delegates from 30 countries participated in the study week. From India, four delegates attended the conference.

The following extracts from the report by Shri B. Prasad, one of the delegates who attended the conference, give some of the conclusions of the conference :

1. Change in social, geographical and economic conditions brings about a corresponding change in the distribution of traffic.

2. The numbers of motor vehicles have rapidly increased throughout the world in recent years. Estimation of the future traffic of motor vehicles is very difficult as it will depend upon very many factors such as population, economic and social conditions of the people, their recreational habits, the taxation structure of the country, the degree of control exercised on the production of motor vehicles, etc.

Forecasting of the future trends of motor vehicles increase could be done when it is tied up with national income and industrial productivity.

3. Accurate census of traffic using the various sections of a road is very essential for road design. It is found that a 14-day count distributed between periods of low and heavy traffic intensity gives an accurate appraisal of the traffic when the census is taken category-wise according to the load carrying capacity of vehicles.

4. Outside towns, traffic grows at a faster rate than the number of vehicles registered, whereas in the towns the daily traffic increase is approximately at the same rate as the increase in the number of motor vehicles.

5. Roads should be designed for a maximum traffic capacity expected in the next 20 years.

6. Accident studies in the European countries have revealed that women drivers are the less prone to accidents. Ten per cent of the accident-prone drivers are responsible for as much as 90 per cent of fatal accidents. Young and inexperienced drivers and those older than 65 in age have bad accident records.

In the United States, many schools offer a course for driving practices. Students who undergo this course have been observed to be less prone to accidents.

In Russia, there are three grades of training in safety for drivers. While a third class training diploma is essential for driving a private car, driving of buses and trucks requires further training i.e., at least a second class diploma. Only persons aged more than 17 years are licensed as drivers. Medical examination is done before licences are granted.

7. Studies in Great Britain have shown that pedestrians can cross easily a carriageway 20-ft wide in 7 seconds. Only agile persons can cross a road 20-ft wide when the time available is less than 4 seconds. Sometimes pedestrians prefer convenience to safety. Therefore, whenever subways or overbridges for pedestrian traffic are planned, the crossing habits of the pedestrians have to be studied. If the time taken by an overbridge is less than that required for crossing the road, almost all the pedestrians use the overbridge.

8. A rough surface produced by use of finer material is the most suitable for giving best visibility in street lighting. Rough surfaces also help visibility of a road when lit by headlights.

9. A road project is considered to be sound when the current annual saving to traffic from improvements to the road divided by the sum of capital cost of improvements multiplied by the rate of interest and increase in maintenance charges is 2 or more.

10. In Great Britain, roads are designed for 75 per cent increase in traffic over that of August 1954. This volume is expected to be reached in 20 to 25 years if the present trends are maintained.

11. The average operating costs of vehicles under conditions in Great Britain are as under :

		Rs	As	Ps
For a car or light goods vehicle	2.7 pence	0	2	5
Medium and heavy goods vehicle	5.5 pence	0	4	1
Buses and Coaches	7.5 pence	0	6	8

12. Study of accidents in European countries has revealed that accident rates are higher with higher percentages of trucks. So, it is recommended that there should be separate lanes for movement of trucks.

13. Gradients of 6.8 per cent produce four times as many accidents as gradients of 2 per cent or less.

14. For light cars, lanes greater than 12 ft in width and lanes greater than 13 ft for lorries are dangerous.

15. Study in New Zealand has revealed that 10 seconds gap is required for pedestrians to cross in front of approaching vehicles. Pedestrians become impatient when they were kept waiting longer than 40 seconds.

The New Zealand Safety Council recommended the following warrants for a pedestrian crossing :

(a) A minimum of 300 vehicles per hour on the carriageway with the product of vehicles and pedestrian in one hour not less than 45,000.

(b) Properly designed and carefully sited sign posts are conducive to safety of traffic.

Based on the experiences gained at the conference, the following recommendations are made for application to Indian conditions :

It is very essential to build up data of traffic census for economical design of road crust. The 14-day count distributed between periods of low and heavy traffic intensity and taken according to the load carrying capacity of vehicles should be made for Indian conditions.

There has been some increase of motor vehicles in India also. In view of the economic development that is now taking place, it is necessary to have a long-term road planning policy by the various administrations. If the difficulties which the more advanced countries are now experiencing due to increase in the number of motor vehicles are to be avoided, the specifications adopted in India should be such that they are capable of stage development, so that when the motor traffic increases in the next 20 years or so, the crust could be developed to the required thickness.

It is desirable to carry out investigations on the relationship between national income, industrial productivity, the number of motor vehicles and the traffic volume using the roads.

Taking advantage of the studies in other countries, stricter control of licensing young persons and persons older than 65 years is necessary. It is also necessary to educate school children in traffic rules and methods of road use. About 10 hours of class-room instruction and 5 hours of operation should be sufficient when the training is imparted by experienced teachers.

Investigations in foreign countries have revealed that a gradient of 3.5 per cent for tunnels and bridge approaches is favourable as regards journey time. But 3 per cent grade is favourable for fuel consumption. So, bridge approaches should preferably be between 1 in 30 and 1 in 33.

THE CONSTRUCTION OF FLEET BRIDGE

A prestressed concrete bridge of 60 ft span replacing the two smaller bridges was recently completed in Derbyshire, England. Details of the Superstructure of the bridge are given below.

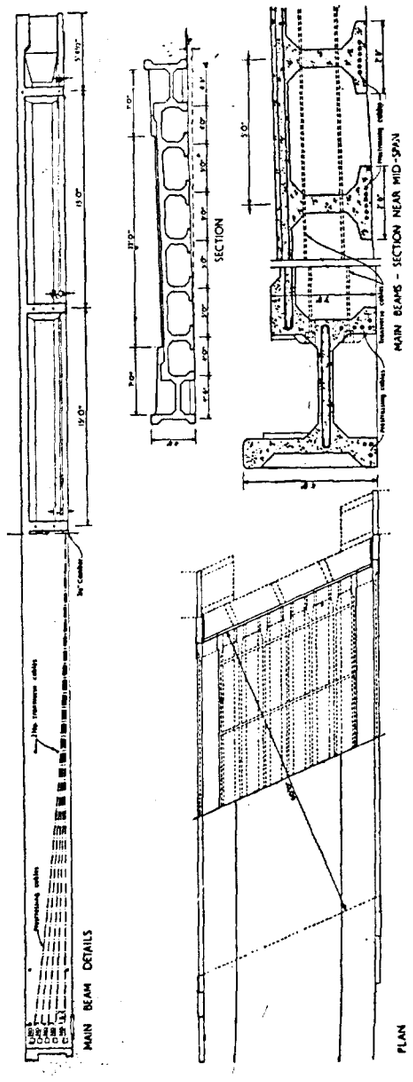
The bridge is at an angle of skew to the river of 23 deg.; its width, between the wrought iron railings of the parapet, is 36 ft. The carriageway is 22 ft wide and there are two 7 ft wide footpaths.

The bridge consists of nine prestressed concrete longitudinal beams, which have a span between bearing points of 67 ft 5$\frac{3}{8}$ in. or a clear span between abutments of 65 ft 2$\frac{1}{4}$ in. There are five main I-section central beams, 3 ft 4 in. deep, placed at 5 ft centres. The top flanges are 6$\frac{1}{2}$ in. thick and form the deck slab of the bridge; the bottom flanges are 2 ft 6 in. wide and 6 in. thick.

The two outer beams at both sides of the bridge are of different cross section. These pairs of beams are connected at approximately their centre points by a diaphragm so that in section they appear together as an "I" lying on its side and form a trough for gas mains and other services. The outer parapet, beam of the pair is 4 ft 8 in. deep with 12 in. flanges top and bottom. The seven inner beams are connected by 6 in. diaphragms at approximately 15 ft centres. In design all the beam sections were proportioned to ensure that their centroids lay in the same plane across the bridge.

The formwork for the beams (and deck slab) was erected on the reinforced concrete invert. The deck is reinforced transversely with two layers of $\frac{5}{8}$ in. dia. bars at 4 in. centres, and longitudinally with $\frac{1}{2}$ in. dia. bars at 12 in. staggered centres. Reinforcement for the central connecting diaphragm (or floor) of the service bays is provided by double layers of $\frac{3}{8}$ in. bars spaced transversely at 6 in. centres and longitudinally at 12 in. staggered.

The end anchor portions of all the beams are reinforced with $\frac{1}{4}$ in. and $\frac{3}{8}$ in. dia. bars. Prestressing was applied by the Gifford-Udall-CCL system through cables consisting of 12 wires, each 0.276 in. dia.; the cables were sheathed in flexible steel tubing. Six parabolic cables are used in the main beams, five in the inner "trough" beams and three in the outer, parapet beams—a total of 46 cables.



The anchorage pattern for the main beams was arranged with two cables side by side in the base of the section, and with the remaining four cables in line above them. Anchorages for both the outer beams and the inner service trough beams are in line in the web of the beam ends. At mid-span the cables of the main beams lie side by side in the bottom flange of the T; those of the trough beams form an L pattern with four cables in the vertical position; and those of the parapet beams form a reversed L.

To prevent secondary stresses arising, the prestressing was applied in sequence through one cable at a time in each beam.

An extension of 4$\frac{1}{2}$ in. was specified for the cables in the centre beams. A nominal transverse prestress was also exerted through five pairs of two 0.276 in. dia. straight wires sheathed in steel. These pairs of cables are located across the seven internal beams of the bridge in the end blocks and in the transverse diaphragms at the half and quarter points.

The bridge was designed to the Ministry of Transport Standard Loading, the concrete stresses being 2,400 lb per sq. in. in compression and 130 lb per sq. in. in tension, during the prestressing, and of 2,000 lb per sq. in. in compression and without tension during service. The compressive strengths specified for the mix for the beams were 6,000 lb per sq. in. minimum, and 7,000 lb per sq. in. average, at 28 days. The lowest cube strength obtained was 6,050 lb per sq. in. and the average, 7,800 lb per sq. in., the co-efficient of variation for the range of cubes tested was 12 per cent. A 1:4 mix by weight was used with a blend of the same aggregates as used in the abutments, and water/cement ratio of 0.40. Poker-type vibrators were used for compaction.

(From 'Civil Engineering and Public Works Review,' November, 1956).

(Continued from page 7)

with what took place in M. Perronet's Neuilly bridge (23 in.—a span of 128 ft) yet I much regret it, as I never had occasion to state anything of the sort in any other of the numerous bridges described in this volume; and I more especially take blame to myself for having suffered an ill-judged parsimony to prevail in the foundations of the wing-walls, leaving them unsupported by piles and platforms —because, if so secured, I am convinced that the sinking of the arch would not have exceeded three inches."

These few extracts from Telford's "Life" suffice to reveal the breadth of his experience, and his understanding of the problem of earthworks and foundations. They also reveal his humility and honesty in admitting to errors of judgment. He did not hesitate to record his mistakes as a warning to others.

(From "The Story of Telford" by Sir Alexander Gibb and Geotechnique, Sept. 1956.)

DESIGN OF FOUNDATIONS FOR BITUMINOUS SURFACED ROADS

IF the foundation of a bituminous surfaced road has insufficient stability, the surface will become uneven, and crazing of the surfacing will occur. An uneven surface usually results from permanent deformation of the foundation occurring over a period of time, while crazing can occur if either the elastic or the permanent deformation is excessive. These deformations usually take place in the subgrade, but can sometimes occur in the base if unsuitable material has been employed or if the material has been inadequately compacted. In the design of the foundations of a bituminous-surfaced road the aim is therefore to provide a road crust which will reduce the traffic stresses in the subgrade to a value low enough to avoid large elastic and permanent deformations. The design must therefore, for any given set of traffic conditions, take account of the load-spreading capacity of the road structure and the strength of the soil.

At present it is usually assumed that the load-spreading capacities of different combinations of flexible base and bituminous surfacing are the same, so that the load-spreading capacity of any bituminous-surfaced road is taken to be directly proportional to its thickness. The design of such roads thus reduces to one of estimating the thickness of the road structure for different strengths of subgrade and different conditions of traffic. It may well be, however, that when more complete information has been obtained from experiments now in progress, it will be possible to extend present methods of design by adjusting the thickness of construction according to the types of surfacing and base used.

The principal method of designing bituminous roads in the U. K. is the California Bearing Ratio method. It is the method most widely used throughout the world, and the one which experience has shown gives reliable results as long as the design is based on the correct traffic and soil stability conditions. Where unsatisfactory results have been obtained with the method they have usually arisen from incorrect estimates being made of one or both of these conditions.

The California Bearing Ratio method is based on past experience of the thicknesses of construction required to enable the road structure to carry without deterioration traffic of different intensities on subgrades of different stability. The method involves the measurement of the strength of the subgrade soil by a simple penetration test. Once the strength is known the design thickness is obtained directly from curves which relate the strength to the required thickness for different intensities of traffic, Fig. on page 13.

Apparatus has been developed for carrying out the California Bearing Ratio test both in the laboratory and *in situ* in the field. For design purposes, the laboratory method should usually be employed, since it permits adjustments readily to be made in the moisture content and state of compaction of the soil, that is not usually possible with the field method. Considerable differences can occur between the California Bearing Ratio measured *in situ* and that existing under a road structure as a result of differences in moisture content and the large rate of change of strength of most soils with moisture content.

The procedure for carrying out the California bearing ratio test is given below.

The soil is statically compacted into the 6-in. diameter cylindrical mould at the required moisture content and state of compaction. A load-penetration test is then made with the cylindrical plunger of 3 sq. in. cross-sectional area. The loads required to produce penetrations of 0.1 and 0.2 in. are then used to calculate the California Bearing Ratio of the soil as percentages of standard loads which produced these penetrations on a compacted sample of crushed stone. The higher of the two values obtained is usually taken

as the California Bearing Ratio of the soil.

Particular care must be taken in determining the design moisture content of the soil at which the test is made. The design moisture content is the highest moisture content the sub-grade soil is likely to have during the life of the road, since this will determine its lowest strength.

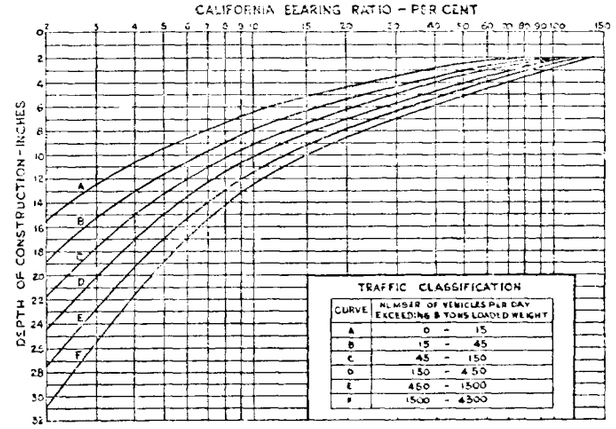
Both the method of construction and the time of year at which the road is built will affect the design moisture content. When the surface soil is comparatively dry, the moisture content of the subgrade soil will usually increase after the road has been completed. In this case the moisture content of the same subgrade soil under existing roads in the locality should be determined since it will correspond closely to the design moisture content.

When roads are built at other times of the year, the moisture content of the surface soil will usually be higher than any moisture content it will possess after the road has been constructed. The actual moisture content at the time the road is constructed is then the design moisture content.

In both the above cases it has been assumed that the prepared soil formation will be immediately protected from weather. If this is not done the soil should be prepared in the California Bearing Ratio test as described above, but should be soaked for four days before making the penetration test in order to simulate the deterioration in subgrade stability that occurs when soil formations are left exposed in rainy weather.

The state of compaction employed in the California Bearing Ratio test should be the dry density corresponding to an air content of 5 per cent at the selected moisture content. This assumes that the soil formation is to be well compacted during its preparation.

Proposed design curves for determining the thickness of a bituminous-surfaced road in terms of the California Bearing Ratio of the subgrade and the intensity of the traffic are shown in Fig. below. Six curves A, B, C, D, E and F are shown relating the thickness of construction to the California Bearing Ratio of the subsoil for roads carrying six different intensities of traffic. This classification of traffic into 6 groups is based on the number of vehicles using a road per day having a loaded weight exceeding 3 tons.



Design Curves for Flexible Pavements

Curve A is a new curve which has been proposed for roads carrying 0 to 15 vehicles per day weighing more than 3 tons. It refers to cul-de-sacs on housing estates and to isolated roads built in connection with limited private housing development.

Curve B is another new curve for roads carrying 15 to 45 vehicles per day weighing more than 3 tons. If refers to minor through roads on housing estates which carry a fair amount of traffic during the period of house construction, but which carry no heavy lorry traffic or public service vehicles subsequently.

Curve C, for roads carrying 45 to 150 vehicles per day weighing more than 3 tons, has been in use for many years. It applies to lightly-trafficked county roads and to roads on housing estates carrying

(*Continued on page 24*)

HERE AND THERE

1. SPECIAL ORGANIZATION FOR TRAFFIC SURVEYS

THE Department of Main Roads in New South Wales, Australia, had in the past conducted traffic counts from time to time by means of automatic traffic counters. Realising that accurate knowledge of volume, type, and direction of traffic is very essential in planning road improvements, in order to have at all times an accurate information on traffic the Department has now established a special organization for the purpose. The organization comprises a field party and a small office staff. The field party is epuipped with automatic traffic counters. The staff at the office manages the surveys and makes an analysis of results. In addition, ten permanent stations for recording traffic have been established in the various parts of the State.

(From a Report of the Department of Main Roads, for the year 30th June, 1956.)

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2. AN UNUSUAL PLAN FOR ARGENTINA HIGHWAY FINANCING

AN unorthodox method of highway financing has been announced by the National Highway Administration of Argentina. The plan involves expropriation of large tracts of land adjacent to the right-of-way, as well as the land needed for the road-bed itself. By later sale—at considerably increased prices—of adjacent lands, the Government figures it can build the road for nothing and show a profit besides.

First stretch of road to be financed under the new plan is a 38-mile two-lane highway running from Buenos Aires to La Plata. Total cost of the road, including purchase price of all land to be acquired, is estimated at Rs 13.3 crores. From sale of the excess 2,750 acres left after the highway is built, the Government expects a return of Rs 13.4 crores yeilding a net profit, after paying for the road.

(From 'Engineering News-Record,' October 18, 1956).

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3. TIMBER BRIDGES FOR COUNTY ROADS IN AMERICA

PRESSURE treated timber is being used fairly widely for county roads in America. Its use is due primarily to the following factors:

(1) Ease of handling and installation;

(2) Short time required for erection;

(3) Low cost;

(4) Durability — It is found that a timber bridge has a life of 30 to 40 years. Forty to 50-year old railway bridges of timber are still in use.

(5) Ease of salvage.

Round wooden piles are most commonly used for pile bents. When rocky foundations are met with, the rock is either drilled or blasted for about 3 to 4 ft and the pile is carefully embedded into the concrete filled into this hole.

Low cost abutments consisting of piles with a backing of timber planks are adopted.

TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

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January to December 1956
(Issue No. 105 to 116)

INDIAN ROADS CONGRESS, NEW DELHI,

Index to Transport-Communications Monthly Review, Volume Nos. 105 to 116 (January, 1956 to December, 1956)

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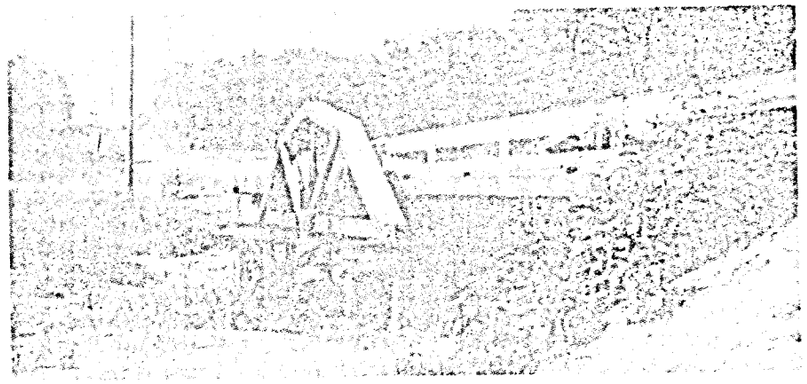
Printed by K. S. Krishnan at The Progressive Printers, 17, Coral Merchant Street, Madras-1, Edited & Published by J. Subrahmanyam, Hony. Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi-2—950.

Also, the use of steel beams and floors of timber is a popular method because such a bridge could be erected in a very short time. In long spans, because the steel beams are generally spaced wide apart, laminated wooden floors about 6 in. thick are employed. A bituminous surfacing is generally the wearing coat.

Longitudinal laminated deck developed about 20 years ago provides continuous wood slabs in spans up to 20 ft. The basis of the design is 3 × 8-in. or 3 × 10-in. planks, placed on edge and jointed in a uniformly staggered pattern so that two-thirds of the floor pieces are spliced at opposite quarter points and one-third over the caps. Except in end spans, all floor strips are full span length.

Now-a-days, water-proof glues have been developed. The use of such glues permits the erection of a long bridge without the necessity of using bolts.

Experience has shown that when piles are entirely embedded in earth for support of masonry piers, it is essential that their tops should be well below the low water level. When the tops of the piles have to be above the lowest water level, it is desirable to use pressure-treated piles. It is desirable that all the bridge timbers are fabricated before they are treated. This would prevent field cuts which may open up the interior, making the piece liable to decay. If, however, such cuts are made after treatment, it is necessary that a hot preservative be repeatedly applied to such cuts. It is found that care in the erection and maintenance of treated timber bridges results in a low cost drainage structure, and when the bridge is salvaged, a maximum value is obtained.



A 40-foot treated timber truss

The photograph shows a 40-ft truss of treated timber supported on pile piers with approach spans. The deck of the bridge is of 3 by 10 in. planks.

(*From "Better Roads," October 1956.*)

4. EVALUATION OF SHAPE AND SURFACE TEXTURE OF SANDS

THE shape of the particles of sand used in various engineering constructions, specially in bitminous mixtures, is important. Usually, sand having sharp angular grains is specified.

With a view to measure the shape factor, the Bureau of Public Roads in the United States of America has developed a simple test by which the shape of sand could be ascertained. The test is based on the

principle that a specified amount of sand having rounded shape takes a shorter time to run out than the same amount of sand having an angular shape. 500 grams of the sand to be tested are put into a one pint Mason's jar, to which is screwed a conical aluminium piece with a slope of 30 degrees to the vertical. To the end of this conical piece a tip made of aluminium and having an orifice of $\frac{3}{8}$ in. in diameter is screwed. A stopper of cork is inserted in the orifice and the whole assembly is then inverted on a stand. The period of time for the emptying of 500 grams of sand from the jar is a measure of the shape and surface texture of the sand. The coarser the particle the greater is the time that will be needed for emptying the jar. The index of the shape is obtained by dividing the flow rate of any one sand by the flow rate of standard sand. The flow rate is calculated in seconds per 100 cubic centimeters of solid volume of sand.

(Digest from "Public Roads," December 1956.)

5. A NEW JAPANESE CEMENT

A research scientist of the Ministry of Construction is credited with the discovery of a new type of cement, said to be very cheap, highly waterproof once it has set, and proof against temperatures up to 400 deg. C. The cement is made from limestone and blast-furnace slag, pulverised separately and mixed equally or in the ratio of 40 to 60. The cement is said to be slower in hardening than portland cement, making it easier to handle. Its use is not considered suitable for ferro-concrete works, since it corrodes iron faster than ordinary cement.

(From 'Highways and Bridges and Engineering Works' November 28, 1956).

6. MOVING-VEHICLE METHOD OF ESTIMATING TRAFFIC VOLUMES

FOR use in urban and suburban areas where traffic is high, a method of estimating the number of vehicles from a moving vehicle has been developed. In this method an observer travels in a motor car over the street for which traffic volumes are required. The time of travel of the selected route, the number of motor vehicles met by the study vehicle which are travelling in the opposite direction and the number of vehicles travelling in the same direction which either pass or overtake the study vehicle are noted. From these observations the average daily traffic is obtained by the formula :

$$V = K\frac{M + (O - P)}{t}$$

V = estimated volume during period of study

K = the minutes during period of study, normally 10 A.M. to 3 P.M.

M = the numbers of vehicles met

O = the numbers of vehicles overtaking an observer's vehicle

P = the numbers of vehicles passed by observer's vehicle

t = time in minutes elapsed traversing the route.

(From "Traffic Engineering," December, 1956).

7. SKIDDING RESISTANCE

UNDER wet conditions, skidding resistance depended upon speed, and vehicle characteristics played an important role in determining the risk of a skid. Similarly, road layout, by its influence on the kind of manoeuvres drivers had to make, was also important in assessing skid liability. Consequently, no simple dividing line could be drawn between a satisfactory and unsatisfactory road surface resistance to skidding.

If brakes and steering were badly adjusted, or the distribution of braking effort at the wheels uneven, the minimum skidding resistance needed for a given manoeuvre would be further increased. For example, difficulties arose with unladen goods vehicles, where the braking effort applied to the rear wheels caused them to lock and skid, allowing the tail of the vehicle to swing violently sideways.

(From 'Motor Transport,' 25 October, 1956.)

8. GRANULAR BASES SETTLE UNDER TRAFFIC

IN Germany it has been standard practice for many years to construct the concrete slabs on a base of sand varying in thickness mainly to prevent frost heave. Although the sand under the pre-war motorways was compacted reasonably thoroughly by the standards then prevailing, it has since been realised that full compaction was not, in fact, obtained. The vibration due to traffic has further compacted this granular material and some differential settlement affecting the slabs has occurred.

(From 'The Reinforced Concrete Review, Vol. IV, September, 1956').

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

SIGHT DISTANCE	The distance along the road surface at which a driver has visibility of an object, stationary or moving, at a specified height above a carriageway.
SKIDDING DISTANCE	The distance required to bring a vehicle to rest with all wheels looked under specified conditions.

DISCARD BLINKERS

Blinkers are put on horses to confine their vision solely to what lies immediately in front of them. If the engineer is to be more than a horse, if indeed he is to occupy the driver's seat, he must discard his technological blinkers and comprehend, in its entirety, this vast and complex world.

CURRENT LITERATURE

ABSTRACTS

SIMPLIFIED ANALYSIS OF RIGID FRAMES by Robert M. Barnoff Journal of the Structural Division, Proceedings of the American Society of Civil Engineers, November 1956.

A procedure to reduce the time required to analyse rigid frames is presented in this paper. Formulas for balanced moment at the joints of four types of rigid frames are derived, and coefficients from these formulas are plotted on diagrams to simplify the numerical computations.

NO-FINES CONCRETE AS A STRUCTURAL MATERIAL by R. H. Macintosh, J. D. Bolton, and C. H. Douglas Muir. Proceedings of the Institution of Civil Engineers. Part I-Vol. 5, No. 6, November 1956.

NO-fines concrete has for a number of reasons developed extensively in recent years as a material for building houses. Expanding production has encouraged research into the characteristics of the material and has led to advances in technique of building with it.

The Paper details these characteristics, the most important of which are specific weight, compressive strength, resistance to moisture penetration, and thermal and sound insulation values. The advantages provided by these characteristics, and also the limitations, dictate that economic architectural and structural design must proceed with full recognition of them; the best manner in which to utilize these characteristics is discussed.

Methods of construction adopted in Great Britain have usually involved the use of formwork constructed in very large units and have been accompanied by a high degree of mechanization. Methods of mixing and placing are described, also protection from the weather, and comparison is made with traditional methods of building in respect to economy and speed of construction. The Material is especially advantageous where manpower is scarce or expensive.

Where the maximum potentialities of no-fines concrete in compression must be developed, as in tall buildings, careful mix design and control of quality is essential. It has been found that compressive strength bears a clear relation to relative specific weight, that the latter can vary considerably in practice, and that this can cause important variations in the compressive strength of walls. The degree of compaction in these circumstances is an important factor in control, and if capable of measurement can be used to interpolate the range of compressive strength obtained in practice. (Author's Summary).

EXPERIMENTAL RESEARCHES ON RECLAIMED AND NATURAL RUBBER BLENDED ASPHALT AND ASPHALT MIXTURES by Chuzo Itakura and Teruo Sugawara, Memoirs of Faculty of Engineering, Hokkaido University, Vol. 10, No. 2 (No. 44).

IN recent years, the use of the several types of the rubber asphalt roads has been promoted intensively. The principal advantages of the addition of rubber are lower susceptibility to temperature change, the occurrence of less ravelling and abrasion by cold-weather traffic, and greater resistance to skidding.

Investigations were made at low temperature down to -40° C on the effects of the inclusion of various sorts of rubber, natural rubber powder "Mealorub" and two kinds of reclaimed rubber powder, with the petroleum asphalt used in

(Continued on page 21)

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

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2. **Stability Chart for Designing Earth Slopes**; C. Y. LI, *Civil Engineering, Vol. 25, No. 12*, December 1955, p. 54.

3. **Considerations Affecting the Design and Construction of Stabilised-Soil Road Bases**; D. J. MACLEAN, *Roads and Road Construction, Vol. 34, No. 397*, January 1956, pp. 10-16.

4. **The Construction of Road Bases in Scotland Using Local Materials**; J. O. TRESIDDER, *The Journal of the Institution of Highway Engineers, Vol. III, No. 9*, January 1956, pp. 40-60.

5. **Some Investigations Associated with the Design and Construction of Flexible pavements for Aerodromes Runways in Greensland**; O. C. C. WHITE, *Journal of the Institution of Engineers, Australia, Vol. 27, No. 10-11*, October-November 1955, pp. 263-272.

6. **Slip Circle Method of Stability Analysis of Earth Dams**; J. H. H. GALLOWAY, *New Zealand Engineering, Vol. 10, No. 11*, November 1955, pp. 378-381.

7. **Flow of Water through Rock Fill and its Application to Design of Dams**; J. K. WILKINS, *New Zealand Engineering, Vol.10, No. 11*, November 1955, pp. 382-387.

8. **Shear Strength of Rock Fill**; J. G. LEWIS, *New Zealand Engineering Vol. 10, No. 11*, November 1955, pp. 388-389.

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10. **Results of Some Investigations on Two Sensitive Clays**; P. L. NEWLAND and B. H. ALLEY, *New Zealand Engineering, Vol. 10, No 11*, November 1955, pp. 403-406.

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12. **A Study of the Shear Strength of Saturated Sand, and Sand Clay Mixtures, in Triaxial Compression**; D. H. TROLLOPE AND S. M. LAFAR, *New Zealand Engineering, Vol. 10, No., 11*, November 1955, pp. 417-424.

13. **Experience with a New Direct Shear Machine with an Automatic Recorder**; C. R. M. IMMAGUIN, *New Zealand Engineering, Vol. 10, No. 11*, November 1955 pp. 424-429.

14. **The Seepage Line in Embankments and Earthen Dams**; DR. G. SUPINO, *Die Bautechnik, Vol. 33, No. 1*, January 1956, pp. 1-5 (in German).

15. **Some Observations on the Stability of Dams and Embankments**; DR. HERBERT BRETH, *Die Bautechnik, Vol. 33, No. 1*, January 1956, pp. 9-12 (in German).

16. **Consolidation of a Swampy Ground for Rhein Embankment at Alsm through Installation of Vertical Card Board Drains**; DR. W. AHRENS, *Die Bautechnik, Vol. 33, No. 1*, January 1956, pp. 13-16 (in German).

17. **Uses of Aerated Cement Grout and Mortar in Stabilization of Slips in Embankments, Large-Scale Tunnel Repairs and Other Works**; MAXWELL CHARLES PURBRICK and DOUGLAS JOHN AYRES, *Proceedings of the Institution of Civil Engineers, Part II, Vol. 5*, February 1956, No. 1, Railway Paper No. 59, pp. 52-84.

18. **Road Embankments on Yielding Subsoil**; Dr. LUTZ ERLENBACH, *Die Bautechnik, Vol. 33, No. 2*, February 1956, pp. 42-44 (in German).

19. **Determination of Pressure in Soil under Complex Rectangular Bodies in Simple Cases**; Dr. EBERHARD LUSSER, *Die Bautechnik, Vol. 33, No. 2*, February 1956, pp. 58-59 (in Germen).

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22. **Evaluation of Coefficients of Subgrade Reaction**; KARL TERZAGHI, *Geotechnique, Vol. V*, December 1955, No. 4, pp. 297-330.

23. **Particle Size Determination through Settling Process**; H. R. PRAMANIK, *Journal of the Institution of Engineers (India) Vol. 36, No. 8, Part I*, April 1956, pp. 1674-1682.

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25. **Pier Settlement of Godavari Bridge**; S. S. VARMA, *Journal of the Institution of Engineers (India), Vol. 36, No. 10, Part I*, June 1956, pp. 1809-1831.

26. **Economical Use of Soil Cement Piles**; *Highways and Bridges and Engineering Works, Vol. XXIII, No. 1140*, May 23, 1956, p. 10.

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28. **Compaction of Embankments and Efficiency of Plants**; *Revue Generale des Routes at des Aerodromes, No. 291*, April 1956, pp. 93-101 (in French).

29. **The C. B. R. Test and its Application to the Design of Flexible Pavements**; M. D. ARMSTRONG, *The Journal of the Institution of Municipal Engineers, Vol. 82, No. 10*, April 1956, pp. 385-392.

30. **An Elementary Introduction to Soil Mechanics**; P. L. CAPPER, *Engineer, Vol. 180, No. 4676*, 9th September 1955, pp. 348-350.

31. **Soil Mechanics Aspects of the Design of Foundations**; F. D. C. HENRY, **Part II-Bearing Capacities and Settlement**; *Engineering, Vol. 180, No. 4678*, 23, September 1955, pp. 413-416.

32. **Soil Mechanics Aspects of the Design of Foundations**; F. D. C. HENRY, **Part II—Distribution of Pressure at Foundations Level**; *Engineering, Vol. 180, No. 4679*, 30th September, 1955, pp. 454-456.

33. **Vertical Sand Drains**; J. LELLER and H. ZEINDLER, *Strasse und Verkehr, Vol. 42, No. 6*, June 1956, pp. 278-286 (in German).

34. **Foundations of Skyscrapers**; Dr. E. BACHUS, *Der Bauingenieur, Vol. 31, No. 5*, April 1956, pp. 187-190 (in German.)

35. **Determination of the Bearing Capacity of Soil and Road Subgrades by means of Loading Tests**; FEDERICS QUARANTA, *La Technique Routiere, No. 2*, July, 1956, pp. 9-17 (in French).

(*Continued from page 18*)

paving mixtures. These tests were concerned with the changes of physical properties that occur when the various sorts of rubber powder were blended with asphalt.

This report shows that the various rubber powders affect the physical properties of a given asphalt to cause it to become more stable.

In general, the impact resistance was increased by the addition of rubber, the rate of improvement of shock resistance at low temperature varied with the kind of rubber added, while the shock resistance varied with the heating and mixing time. Softening point and viscosity were increased by the addition of rubber, and ductility at low temperature was increased by the addition of natural rubber.

DYNAMIC TESTS ON THE STABILITY OF BITUMINOUS MIXTURES FOR PAVEMENT AT LOW TEMPBRATURE (II), EXPERIMENTAL RESEARCHES ON RUBBER BLENDED ASPHALT AND ASPHALT MIXTURES, by Chuzo Itakura and Teruo Sugawara, Memoirs of Faculty of Engineering, Hokkaido University, Vol. 10, No. 1 (No. 43).

INVESTIGATIONS on the effects of the the inclusion of rubber with the bituminous materials used in paving mixtures were made at low temperatures down to −50°C.

These tests were concerned with the changes of physical properties that occur when natural rubber powder was blended with petroleum asphalts.

This report shows that 3 to 10 per cent natural rubber powder affects the physical properties of asphalts. The changes in the physical properties of a given asphalt become more pronounced with increases in the rubber contents in the asphalt or in the asphalt mixtures.

In general, the impact resistance was increased by the addition of rubber, while the penetration was affected by the heating time and the method of blending. In some cases although the penetration decreased, values of other factors under test increased. Softening point and viscosity increased, ductility decreased.

It was only in the test of elastic properties of asphalt mortar measured by a sonic device, that marked differences were found.

The test pavement was constructed by the authors as a part of the Wattsu section between Sapporo City and Chitose Air Port. This test road was subjected to heavy service of winter traffic. After one winter of service, it was clear that the rubber blended asphalt pavement has high resistance to abrasion. Furthermore the utility of rubber blended asphalt pavement was confirmed.

The ultimate object of these studies is to improve the bituminous pavement in cold districts.

A SECRETARY'S VERSION

In stating that the engineer of a local authority would not need special transport to attend a sewage works inspection, a secretary typed: "He will be travelling down by drain."

FORCE OF HABIT

Thomas Edison, when asked how he would spend his time in Eternity, quickly replied, "Experimenting if there are facilities".

LIST OF PUBLICATIONS ADDED TO THE ROADS WING LIBRARY DURING NOVEMBER, DECEMBER 1956 AND JANUARY 1957

1. **Nationalised Road Services in Hyderabad by V. V. Ramanadham** (Published by the Orient Publishing Co. Ltd. (Regd.), Madras.)

2. **Translation No. 1741-42, Measurement of elongation on the prestressed concrete bridge across the Zollkanal in Hamburg** by Wilhelniburg (Translated by the Insdoc, National Physical Laboratory, Hillside Road, New Delhi-12),

3. **Bulletin No. 144** (issued by the Permanent Association of Road Congresses.)

4. **Conditions of Contract for overseas Works Mainly of Civil Engineering Construction (First Edition August 1956)** (The Institution of Civil Engineers, Great George Street, London S.W.I.)

5. **Bus-stops (Bushalten) Memorandum No. 13, Van de Verkehrafdeling Van de A. N. W. B., 1955, 1-16** (Translated from Insdoc, Physical Laboratory, Hillside, New Delhi-12).

6. **The Inter-Conversion of Inch and Metric sizes of Engineering Drawings (Reprinted from Machinery, April 1, 1955)** by L. W. Nickles.

7. **Foundations (Civil Engineering Code of Practice No. 4, (1954)** (Published by the The Institution of Civil Engineers, 1, Great George Street, Westminster, London, S. W. 1.)

8. **Proceedings of the 15th meeting of the Transport Advisory Council held at New Delhi.** (The Manager, Govt. of India Press, Nasik.)

9. **Influence of the Presence of Coarser fractions of Soils on the Atterberg Test Results** by J. S. Narasimham. (Indian National Society of Soil Mechanics and Foundations Engineering, New Delhi.)

10. **Annual Report (July 1954—June 1955)** (Indian National Society of Soil Mechanics and Foundations Engineering, New Delhi.)

11. **Bulletin October 1956 No. 1** (Indian National Society of Soil Mechanics and Foundations Engineering, New Delhi.)

12. **Runway Testing in India** by V. B. Tawadey and others (Engineer-in-Chiefs Branch, Army H. Quarters, N. Delhi.)

BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF PUNJAB BUDGET FOR 1956-57

The following extracts have been taken from the Civil Works Budget of the Government of Punjab for the year 1956-57.

Revenue (Civil Works)

Heads	(In lakhs of rupees) Actuals 1954–55	Revised estimates 1955–56	Budget estimates 1956–57
Rents	10.01	4.50	13.34
Recoveries of expenditure	0.66	0.49	0.60
Miscellaneous	50.98	50.15	94.46
Deduct-refunds	-2.74	-0.74	-0.95
Total ...	58.91	54.40	107.45

Expenditure (Civil Works)

Buildings			
Original works	22.86	26.45	41.53
Repairs	23.14	30.98	37.70
Communications			
Original works	32.34	74.23	36.47
Repairs	48.09	86.00	65.00
Miscellaneous			
Original works	2.47	0.18	—
Repairs	0.41	0.45	5.00
Establishment	20.15	17.11	31.54
Tools and Plant	13.64	4.14	3.16
Grant-in-aid	11.08	8.93	5.21
Suspense	-32.31	6.00	5.00
Development Schemes	62.39	51.89	97.80
Total ...	204.26	306.36	328.41
Capital Account of Civil Works outside the Revenue Account			
Buildings	33.20	39.13	51.21
Communications	2.09	12.53	—
Tools and Plant	9.30	7.39	0.85
Establishment	7.33	14.99	39.31
Suspense	—	-2.48	—
Development Schemes	72.03	194.83	421.73
Additions	—	0.66	1.40
Deduction-Lump cut and recoveries	-21.03	-48.72	-182.88
Total ...	102.92	218.33	331.62

A Brief Review of Punjab Budget for the year 1956-57.

THE Budget estimates for 1956-57 places revenue receipts at Rs 3,028 lakhs and revenue expenditure at Rs 3,075 lakhs thereby indicating a deficit of Rs 47 lakhs. According to Revised Estimates for the year 1955-56 revenue receipts and revenue expenditure were Rs 2,808 lakhs and Rs 3,076 lakhs respectively showing a deficit of Rs 268 lakhs.

Revenue expenditure on Civil Works for 1956-57 estimated at Rs 328.41 lakhs forms 10.8 per cent of the total estimated revenue. Corresponding percentage figure for the previous year is 10.9.

The expenditure on communications in 1956-57 (original works and repair) is estimated at Rs 101.47 lakhs which form 3.4 per cent of the total State revenue. Corresponding ratio for the previous year is 5.7 per cent. Estimated expenditure on Development Schemes on Capital Account outside the revenue account in the year 1956-57 is Rs 421.73 lakhs.

(*Continued from page 13*)

up to 50 public service vehicles per day together with a fair number of tradesmen's vehicles.

Curve D has also been in use for some time and is for roads carrying 150 to 450 vehicles per day weighing more than 3 tons. It refers to county roads carrying a medium intensity of traffic and to main roads in urban areas where from 50 to 150 public service vehicles per day are operating.

Curve E, for roads carrying 450 to 1,500 vehicles per day weighing more than 3 tons, has also been in use for many years. It refers to the principal shopping streets in large towns and to main country roads.

Curve F is another new curve for heavily-trafficked trunk roads carrying 1,500 to 4,500 vehicles per day weighing more than 3 tons. The need for this curve has become apparent as the result of investigations of structurally weak sections of roads and of full-scale experiments on trunk roads. The greater thicknesses indicated by this curve are required to deal with the greater destructive effect of traffic due to the increase in the number of vehicles using the roads, particularly in the heavy commercial vehicle class.

(From "The Journal of the Institution of Municipal Engineers", January, 1955.)

URBICULTURE

"Urbiculture" is a newly-coined word. Just as "agriculture" refers to forms and farmers, so "urbiculture" means care of cities and city people.

GOVT. OF ANDHRA BUDGET FOR 1956-57

The following extracts relating to Civil Works have been taken from the Andhra State Budget for the year 1956-57.

Heads	(In lakhs of rupees) Actuals 1954-55	Revised estimates 1955-56	Budget estimates 1956-57
Revenue (Civil Works)			
Rents	3.21	3.34	3.06
Receipts from workshop	0.59	0.70	0.70
Recoveries of Expenditure	16.87	23.58	22.22
Transfers from Central Road Fund	8.68	—	—
Miscellaneous	5.25	5.74	7.19
Ferry receipts	1.82	1.78	1.78
Deduct—Refunds	-0.52	-0.25	-0.12
Total	35.90	34.89	34.83
Expenditure (Civil Works)			
Buildings			
Original Works	10.78	23.26	9.33
Repairs	15.67	12.60	12.64
Communications			
Original Works	5.23	8.49	0.04
Repairs	131.41	78.84	92.51
Miscellaneous			
Original Works	0.07	0.27	0.01
Development Schemes			
(In the first 5-year plan)			
(i) Buildings	2.09	2.52	0.12
(ii) Communications	20.90	13.65	5.47
(iii) Repairs	0.10	—	—
(in the Second 5-year plan)			
(i) Buildings	—	—	0.41
Suspense	-10.56	15.04	8.22
Lump addition for regrant of lapses	—	0.05	0.05
Lump sum deduction for probable savings	—	-7.00	-7.00
Establishment charges	53.86	52.88	47.56
Tools and Plant	16.90	19.88	19.44
Grants in aid	48.78	35.91	16.38
Add—Recoveries	66.76	144.16	236.13
Total	361.90	400.55	441.31

Heads	(In lakhs of rupees) Actuals 1954–55	Revised estimates 1955–56	Budget estimates 1956–57
Capital expenditure on Civil Works outside the revenue account			
Original Works			
Buildings	114.79	116.65	101.71
Communications	—	—	67.67
Establishment	3.72	3.25	4.20
Lump addition for regrant of lapses	—	0.10	0.10
Total	118.51	120.00	173.68
Receipts from Roads			
Receipts under the Indian Vehicles Act	27.98	18.94	18.94
Receipts under the Madras Vehicles Taxation Act	129.73	141.70	140.40
Receipts under the Madras Sales of Motor Spirit Taxation Act, 1933	48.38	50.04	52.04
Other Receipts	1.80	2.00	2.00
Deduct-Refund	-0.79	-0.83	—
Total	207.10	211.85	213.88

ANDHRA STATE GOVERNMENT BUDGET FOR THE YEAR 1956-57

(A brief review with reference to Civil Works)

THE total revenue of the State for 1956–57 is estimated at Rs 2371.42 lakhs as against Rs 2239.56 lakhs (Revised estimate) for the year 1955–56, and Rs 1982.35 lakhs in the year 1954–55. The corresponding figures of revenue expenditure are Rs 2695.49 lakhs for 1956–57 (Budget estimate), Rs 2637.06 lakhs for 1955–56 (revised estimate) and Rs 2500.02 lakhs in the year 1954-55. Thus in the Budget estimate of 1956–57 there is a deficit of Rs 324.07 lakhs and in 1955–56 (Revised estimate) and 1954-55 there were deficits of Rs 397.50 lakhs and Rs 517.67 lakhs respectively.

Revenue Expenditure on Civil Works including Development expenditure is estimated at Rs 441.31 lakhs for 1956-57 while the revised estimate for 1955-56 places it at Rs 400.55 lakhs and for the year 1954-55 it was Rs 361.90 lakhs. In terms of total state revenue the revenue expenditure works out to 18.6 per cent for 1956-57 (Budget estimate), 17.9 per cent and 18.3 per cent for 1955–56 (Revised estimate) and 1954–55 respectively. The total expenditure on communications alone (original works and repairs only) forms 4.1 per cent of the revenue for 1956–57 ; 4.5 per cent and 7.9 per cent for the years 1955-56 and 1954-55 respectively.

The provision for capital expenditure on Civil Works amounts to Rs 173.68 lakhs for 1956-57, while for the year 1955–56 (revised estimate) and 1954–55 are Rs 120.00 and Rs 118.51 lakhs respectively. Expenditure on Buildings forms the major item of expenditure under this head.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
		ANDHRA	
1.	1692 AH 7	Eliminating kink in mile 13/4+110 to 13/5+330 of Kurnool Gooty Road near village Ulinda Kanda—N.H. No. 7.	0.45
2.	1683 AH 7	Constructing a bridge across the Krishna River at Rangpur on Hyderabad Kurnool Road, National Highway No. 7.	36.39
		ASSAM	
3.	1684 AS 39	Improving the Dimapur–Kohima–Mao portion of N.H. No. 39 in Kohima Division.	9.82
4.	1686 AS 39	Providing R.C.C. decking and repairs and replacement of abutments of bridges on N.H. No. 39 between Dimapur and Mao in the District of Naga Hills in Kohima Sub-Division.	10.88
		BIHAR	
5.	1693 BR 30	Survey for the construction of Arrah-Mohania Section of N.H. No. 30.	0.13
		BOMBAY	
6.	TA 38 BM 8A	Providing second layer of metal with asphalt carpet and seal coat to the Bagodra—Deopura section (miles 37/0 to 43/4) of Ahmedabad — Kandla Road, National Highway No. 8A.	2.33
7.	TA 40 BM 8B	Improving and providing C.C. pavement with asphalt shoulders to Rajkot—Ribda Road miles 2/0 to 12/1 of N.H. No. 8B.	11.08
8.		Three works each costing less than 2 lakhs.	2.42
		JAMMU & KASHMIR	
9.		Three works each costing less than 2 lakhs.	3.78

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
		MADRAS	
10.	1688 MD 45	Constructing a culvert in the South Approach road to Ponniar Bridge at mile 104/2-5 of N.H. No. 45.	0.32
		MYSORE	
11.	1690 MY 4	Construction of a new bridge at 4/11 of Bangalore Kalore Road (Madras Cannanore Road), N.H. No. 4.	1.20
		PUNJAB	
12.	1677 PB 1	Construction of a bye-pass on G.T. Road (National Highway No. 1) at Ludhiana.	6.99
		KERALA	
13.	1678 TC 47	Improvements to miles 1/7 to 4/7 of the Trichur Vaniampada Road-N.H. No. 47.	3.73
14.	TA 39 TC 47	Improving Ernakulam Alwaye Road (From Ernakulam Municipal limits to C. K. Taluk Boundary) N. H. No. 47.	3.35
		UTTAR PRADESH	
15.	1679 UP 28	Widening culverts and road embankments on Gorakhpur—Kasia Road National Highway No. 28.	0 89
16.	1694 UP 2	Construction of an overbridge over Central Railway line (mile 870/18-19) on Mathura Bye-pass (N. H. No. 2).	2.42

Statement about ownership and other particulars about newspaper (TRANSPORT-COMMUNICATIONS MONTHLY REVIEW) to be published in the first issue every year after last day of February.

FORM IV

(See Rule 8)

1.	**Place of Publication:**	New Delhi
2.	**Periodicity of Publication:**	Monthly
3.	**Printer's Name:**	K. S. Krishnan
	Nationality:	Indian
	Address:	The Progressive Printers, 17, Coral Merchant Street, Madras-1.
4.	**Publisher's Name:**	J. Subrhamanyam
	Nationality:	Indian
	Address:	Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi-2.
5.	**Editor's Name:**	J. Subrahmanyam
	Nationality:	Indian
	Address:	Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi.
6.	Names and Addresses of individuals who own the newspaper and partners or Shareholders holding more than one per cent of the total capital.	Indian Roads Congress, Jamnagar House, Shahjahan Road. New Delhi-2.

I, J. Subrahmanyam, Secretary, Indian Roads Congress, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Signature of Publisher
(Sd.) J. SUBRAHMANYAM,
Secretary,
Indian Roads Congress.

Dated 29-3-1957.