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TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

FEBRUARY 1957—No. 118



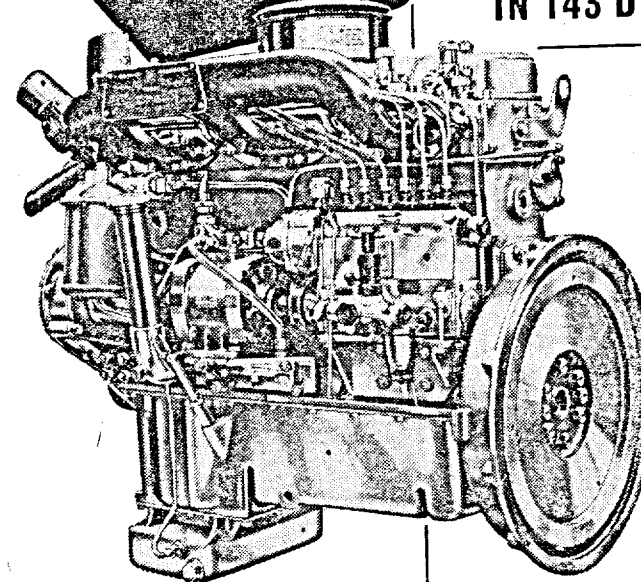
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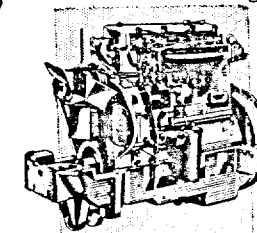
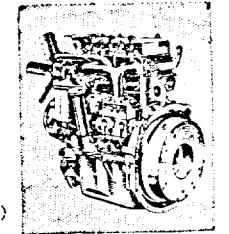


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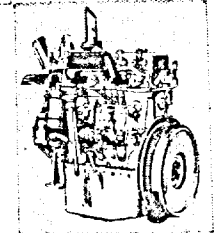
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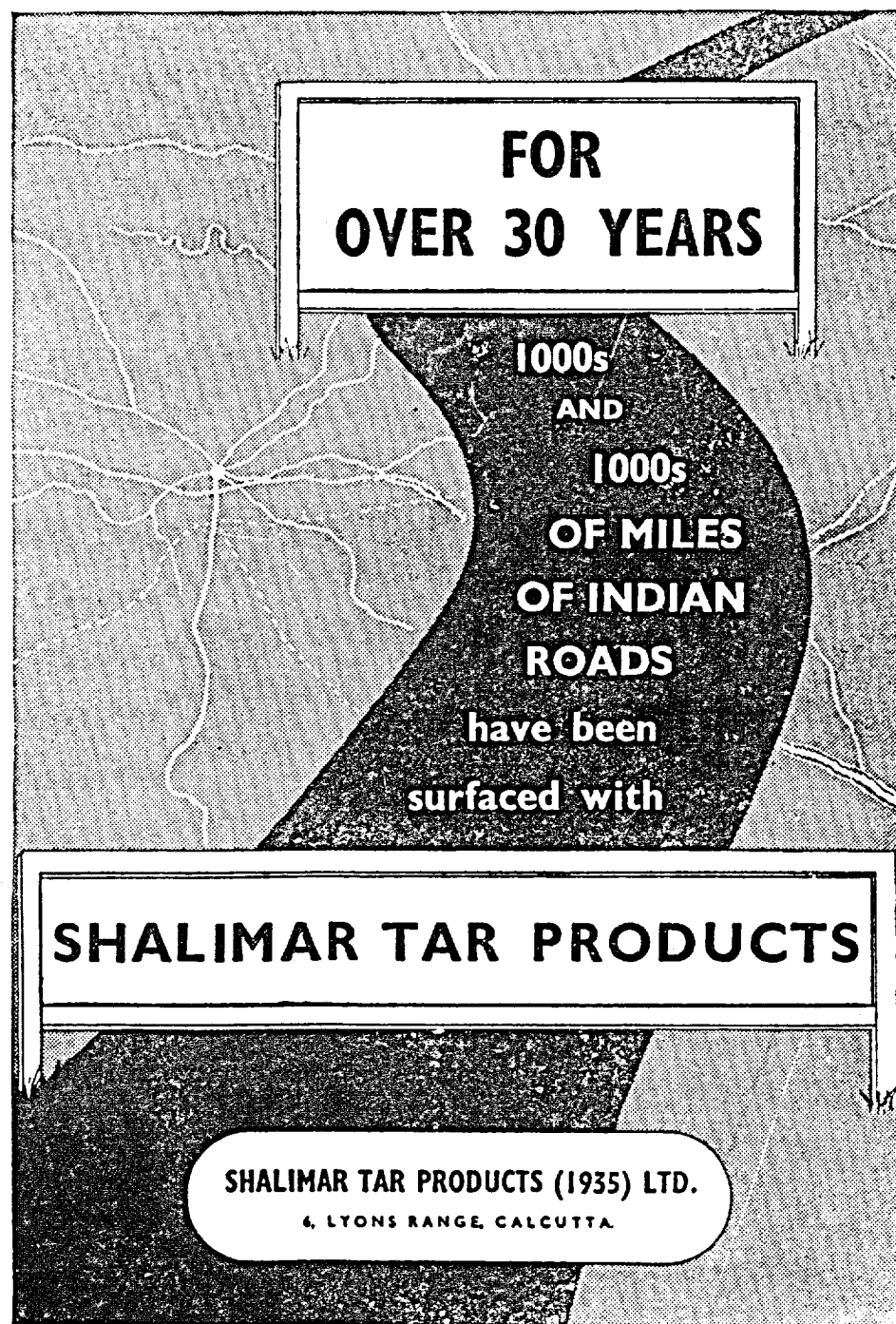


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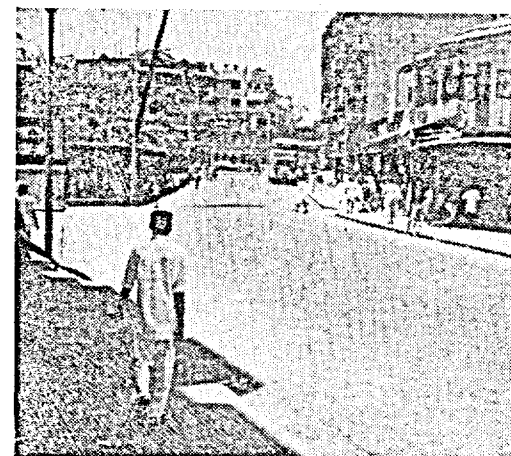
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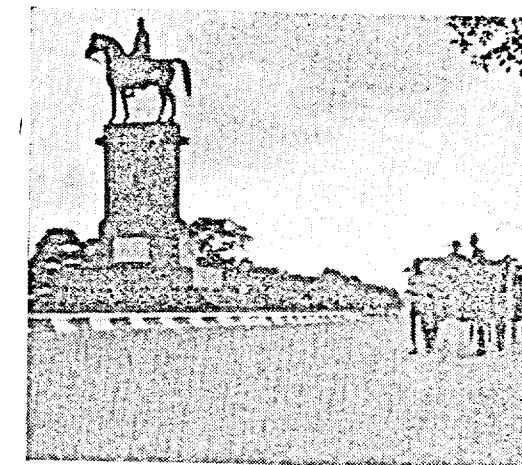
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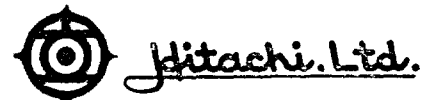
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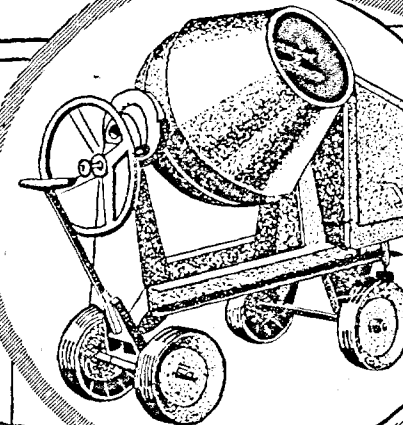
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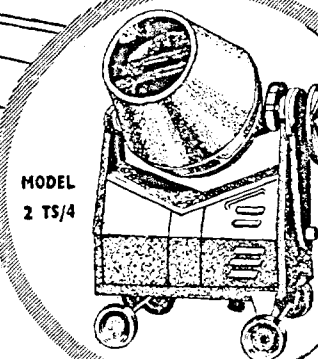
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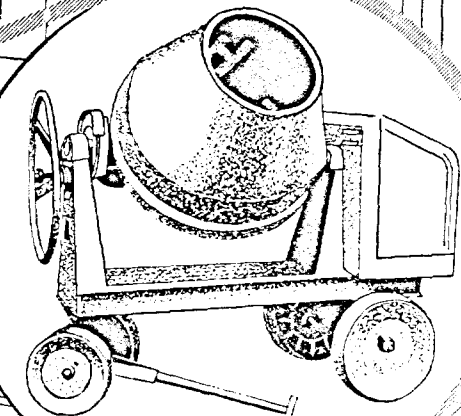
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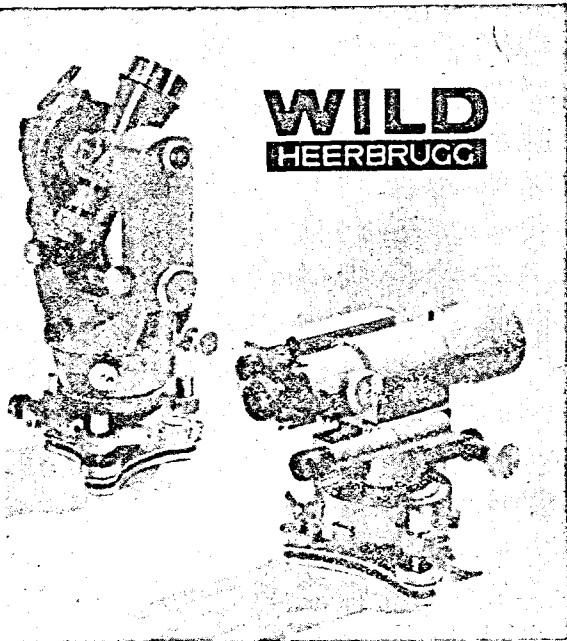
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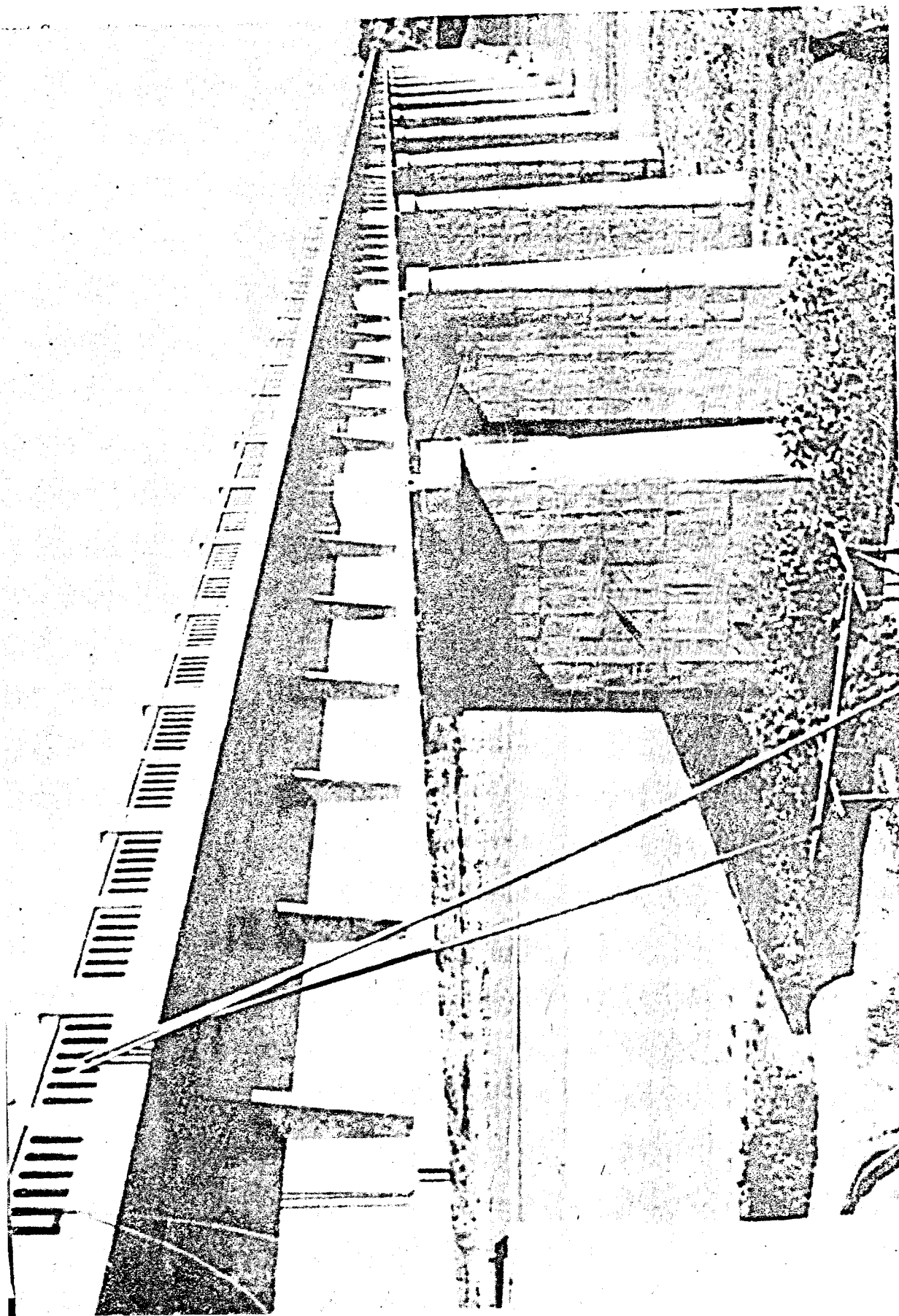
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TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

FEBRUARY 1957

BRIDGING INDIA'S RIVERS

THE PRESTRESSED CONCRETE BRIDGE ACROSS THE MAHI RIVER

THE Mahi river, popularly known as Mahisagar, forms a natural boundary between North and South Gujarat. The National Highway connecting Delhi with Bombay via Jaipur, Ahmedabad and Baroda (N. H. No. 8) crosses this river at Vasad a town about 12 miles north of Baroda. Prior to the construction of the Mahi Bridge the road traffic between North and South Gujarat along this important highway used to remain suspended for about six months of the year when the river was in floods.

Site of the Bridge

The site of the bridge is about 800 ft upstream of the existing railway bridge near Vasad.

General Description of the Bridge

The bridge consists of 16 spans of 110 ft each (centre to centre of piers) with piers founded on twin circular wells. The deck slab in each span is carried on two precast, prestressed, I shaped girders, simply supported at the ends. The prestressing is done by the Lee McCall system, a system perhaps used for the first time in India on such a major work. Another unique feature of the bridge is the unusual height of the piers which rise to a height of about 66 ft above the bed of the river.

Foundations

Borings at the site revealed the presence of stiff clay overlying sand at depths varying from 25 feet to 30 feet below bed. Therefore twin-well foundations shaped like the numeral '8' with dredge holes of 14 ft diameter and a thickness of steining of 2 ft were adopted. The mix of the concrete used for the steining is 1:2:4. The curbs are of reinforced concrete with cutting edges consisting of 4 ins. by 4 ins. by 5/8 in. angles strengthened by 12 ins. by 1/2 in. plates. The wells were cast in stages of 4 ft using steel shuttering. The sinking of the wells was done by means of open dredging using a crane and a grab. Whenever there was difficulty in sinking, divers were sent in to scoop out and clear obstruction beneath the cutting edge. Sometimes even pneumatic breakers had to be used for clearing the obstruction. Also, a kentledge of about 600 tons was used for sinking through stiff clay. The wells were taken down to about 5 ft into stiff clay and plugged with 1:2:4 concrete for a thickness of 6 feet. Then they were filled with sand and plugged at the top with cement concrete 1:2:4 laid to a thickness of 2 ft. A reinforced concrete well cap 35 ft by 18 ft by 3 ft, reinforced with about 2 per cent of steel, was cast over the wells. This cap had a width of 13 ft at the waist.



Photo 1.
Open dredging in well.

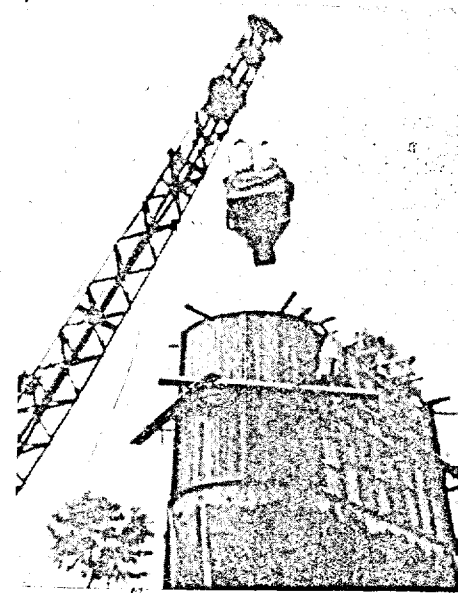


Photo 2.
Pier concreting inspection at
30 feet elevation.

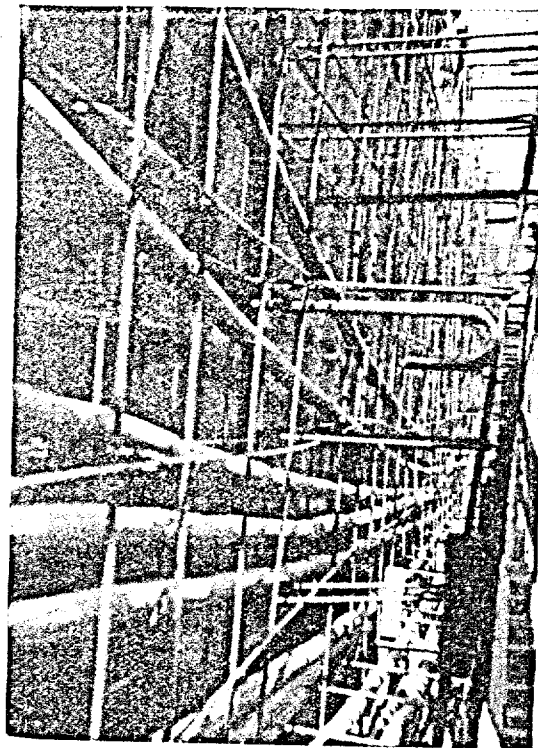


Photo 3.
Macalloy bars in position.

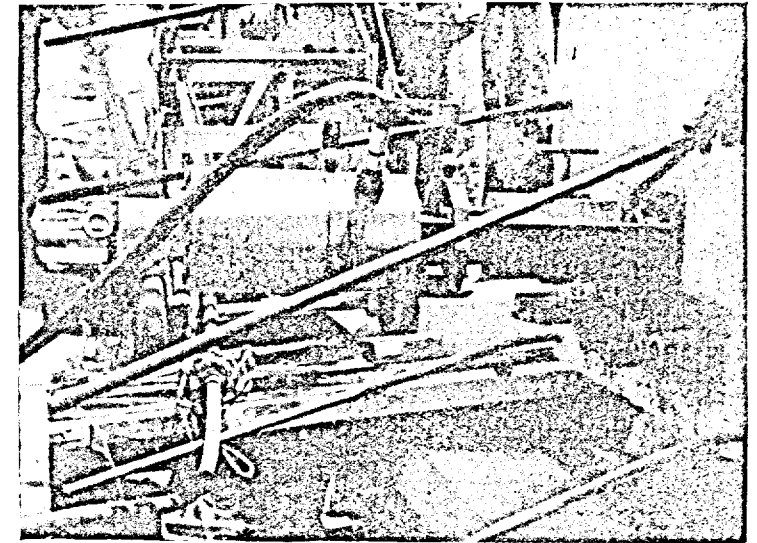


Photo 4.
Prestressing Jack.

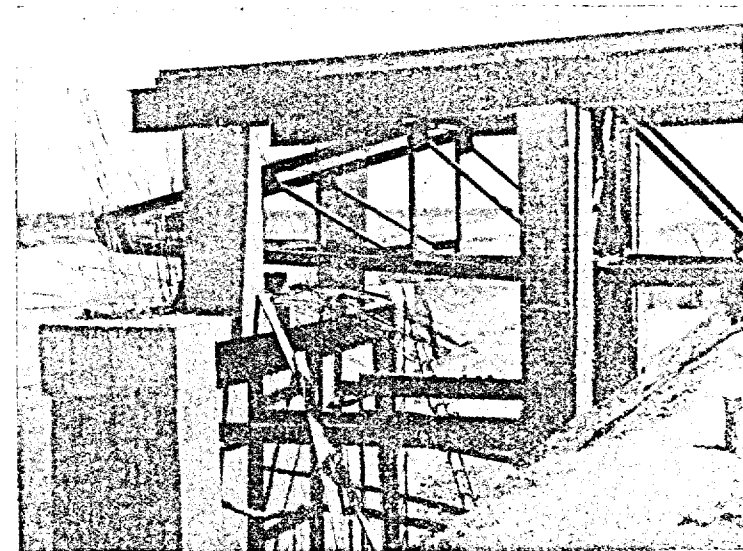


Photo 5.
Steel launching
Girder moving to
position.

A longitudinal section of the bridge and the details of the wells are shown in Plate I.

Piers

The piers 66 ft high are 10 ft 6 ins. by 27 ft 6 ins. at their base and 5 ft by 22 ft at the top with side batters of 1 in 24. They are of 1:3:6 cement concrete reinforced with $\frac{1}{4}$ in. diameter bars at 12 in. centres both horizontally and vertically to resist temperature effects. Steel shuttering, providing lifts of 5 ft, was used for casting the piers. Because of the unusual height of the piers, concreting at heights more than 30 ft from the bed was done by employing a tower and a steam winch. The concrete was vibrated by internal vibrators. R.C.C. pier caps 3 ft thick and projecting 6 in. all round are provided over the piers.

Superstructure

The superstructure of the bridge comprises of two I-shaped precast prestressed girders at 13 ft 6 in. centres, connected by R.C.C. diaphragms at 15 ft intervals. A cast *in-situ* high grade reinforced concrete (950 lb working stress) slab 9 ins. thick carries the 24 ft wide carriageway. The girders are 9 ft deep and have flanges 54 ins. wide at the top and 30 ins. at the bottom. The web of the girder is 8 in. thickness. The top flanges are 4 ins. at the edges and increase uniformly in thickness to 8 in. at their junction with the web. The junction is rounded by a 6-in. diameter curve to avoid sharp changes in the section. The bottom flange is 12-in. thick at the edges and 14 in. at its junction with the web. The girders are post-tensioned with fifteen $1\frac{1}{8}$ in. diameter Macalloy bars each. Of these fifteen, thirteen were stressed in the casting yard before launching and the other two after casting the deck slab. The two girders of each span are connected by stiffeners 8 ins. thick spaced at 15 ft centres cast at the site after they were placed in position. Each of the girders has solid end blocks for a distance of 4 ft 8 in. at each end. The girders were cast in a casting yard at the bank and launched into position.

The maximum compressive strength permitted in the design of the pre-stressed

girder was 1,500 lb per sq. in., and 5,000 lb per sq. in. at 28 days was specified for the concrete. The strength of the concrete of the girder at the time of prestressing was to be 4,000 lb per sq. in. The mix adopted was 1:1:2 for the first 2 ft of the end blocks and 1:1.4:3 by weight for the remaining length of the girder. A water-cement ratio of 0.4 was used. Steel shuttering, five internal vibrators and two external vibrators were used for the concreting.

Tests on cubes showed that a strength of 5,000 lb per sq. in. was attained at 7 days. However, to be on the safe side, prestressing was carried out only after 10 days.

Prestressing

The Lee McCall bars used for prestressing had an ultimate tensile strength from 64 to 72 tons per sq. in. and a 0.2 per cent proof stress of 58 tons per sq. in. The bars 15 in number, of which 13 were prestressed before launching, were stressed in the sequence shown in the

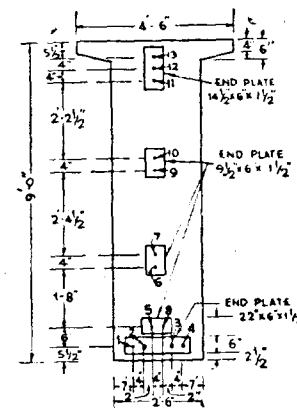


figure above. This sequence was such that there were no unsymmetrical stresses in the beam.

Using a Macalloy special jack of 42 ton capacity, each of the bars was stressed until the required relative elongation was obtained. The prestressing of 13 bars took about 4 hours and in one day of 8 working hours two girders could be prestressed.

Immediately after the full prestress was applied on the 13 bars, grouting of

the bars, which were inside sheaths, was done with mortar, consisting of two parts of cement and one part of water using special pumps for the purpose.

Launching

The precast beams each weighing 95 tons were placed in position by using launching girders and trollies. These girders were of the lattice type 9 ft deep and braced together at 6 ft 6 in. centres. They were 182 ft each in length. When these girders spanned 2 piers with a 10 ft bay overhanging towards the rear end, a 56 ft light weight nose was overhanging at the forward end. Rails were fixed on to the top chords of the

from the yard up to the first pier. At first, the trolley was put on the track and the rear end of the launching girder was fixed to it. A wire rope tied to the nose of the launching girder was fixed to a winch. When the winch was worked, the launching girder moved into position. Plummer blocks were used over the piers for running the launching girders.

Further launching consisted of the following operations:

The first pair of prestressed beams was picked up by the two trollies which ran in the longitudinal direction on the approach. The trollies then ran along the launching girder until the two prestressed beams were in the correct longitu-

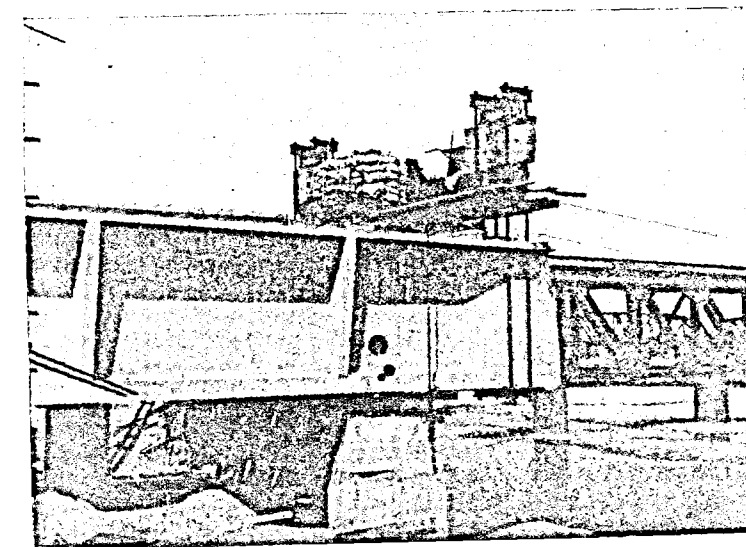


Photo 6.

Precast prestressed girder being launched.

launching girder and trollies ran on these. Another pair of wheels at 13 ft 6 in. centres was fixed to the trolley and these wheels were used to run the trollies on the girders already placed when the launching girders moved into the next span. The trollies had arrangements for moving the girders transversely also.

A rail track 13 ft 6 in. centres supported on pillars was made for the trolley line

dinal position. Then they were moved by transverse gear arrangement and jacked down to their final position on the first span.

When the beams were in position, the rear end of the launching girder was fixed to the trolley so that it travelled along the rails on the top of the prestressed beam to the next span. The operation was repeated.

In-situ Work

The deck and the diaphragms were cast in-situ using steel shuttering. The diaphragms were of 1 : 2 : 4 concrete mix. The concrete of the deck was vibrated by needle vibrators.

Plate II shows the details of the prestressed girders.

Cast steel roller bearings were used at the ends.

Costs.

An analysis of the cost of the bridge is

given below :

1.	Cost per sq. ft of carriageway	...	Rs A. P.	82 0 0
2.	Cost per linear foot of bridge	...	2,000	0 0
3.	Cost per sq. ft of elevation above bed level	...	25	0 0
4.	Cost per cu. ft up to the lowest level of foundation without deduction for span opening	...	0 10	0
5.	Cost per cu. ft. of bridge of actual construction	...	6	0 0

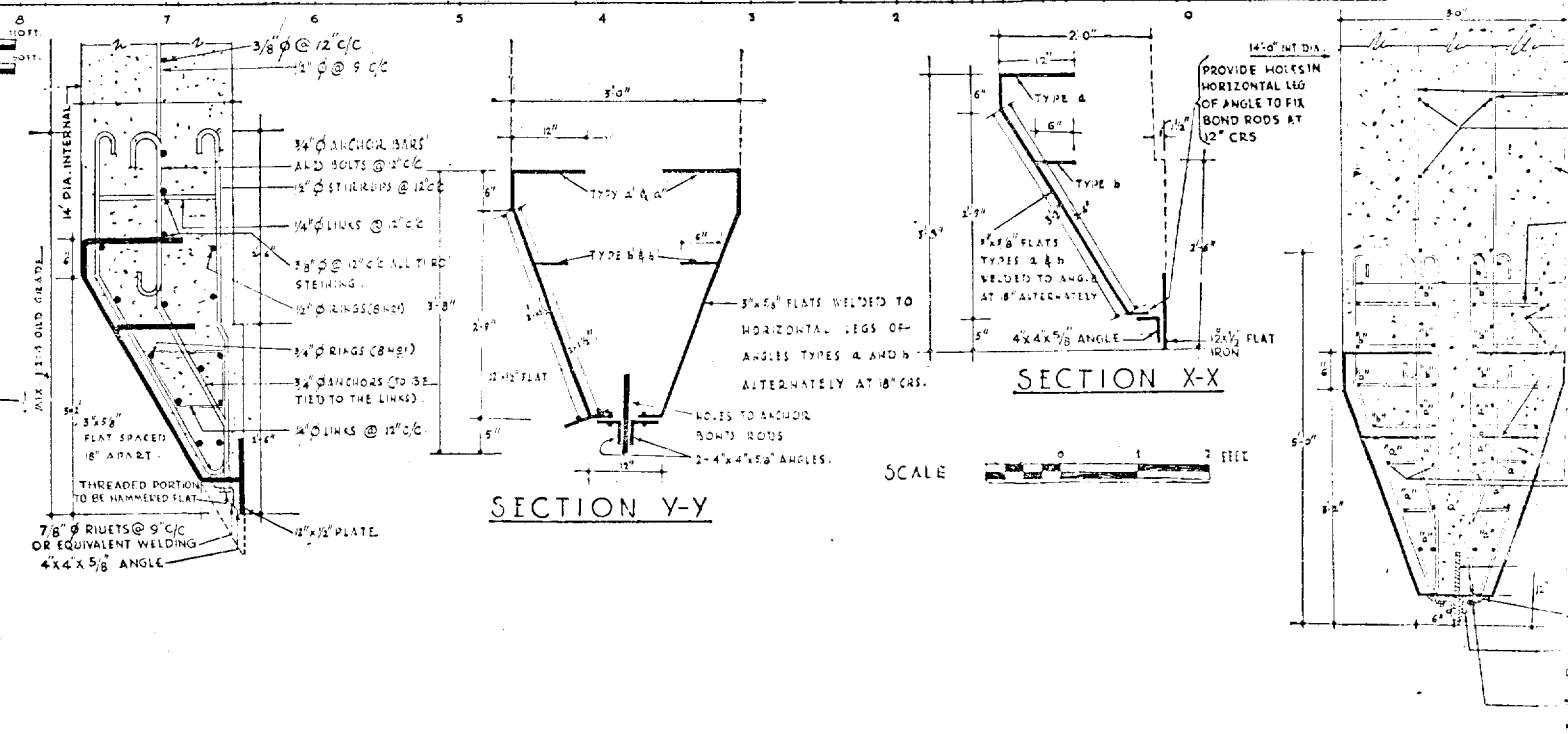
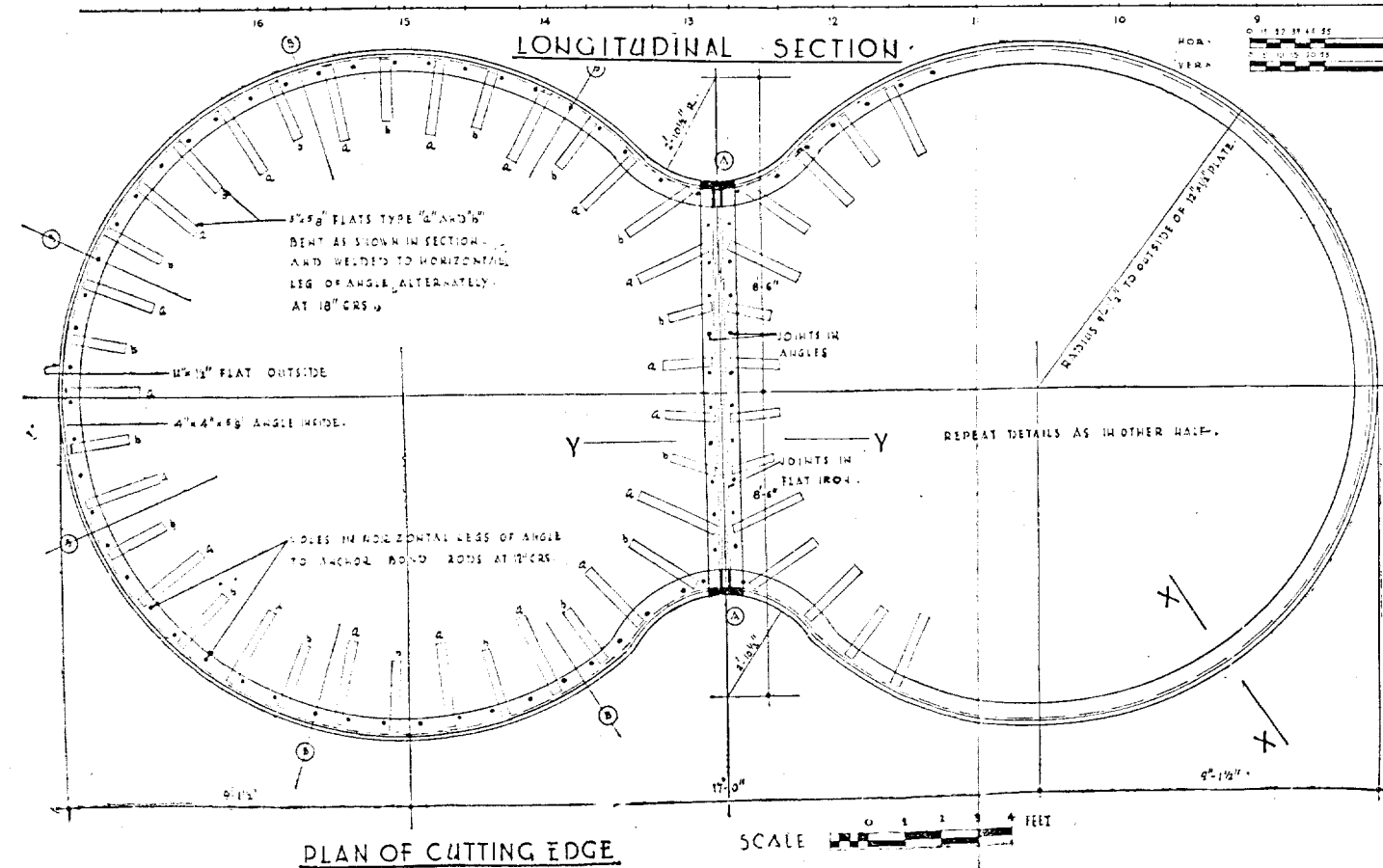
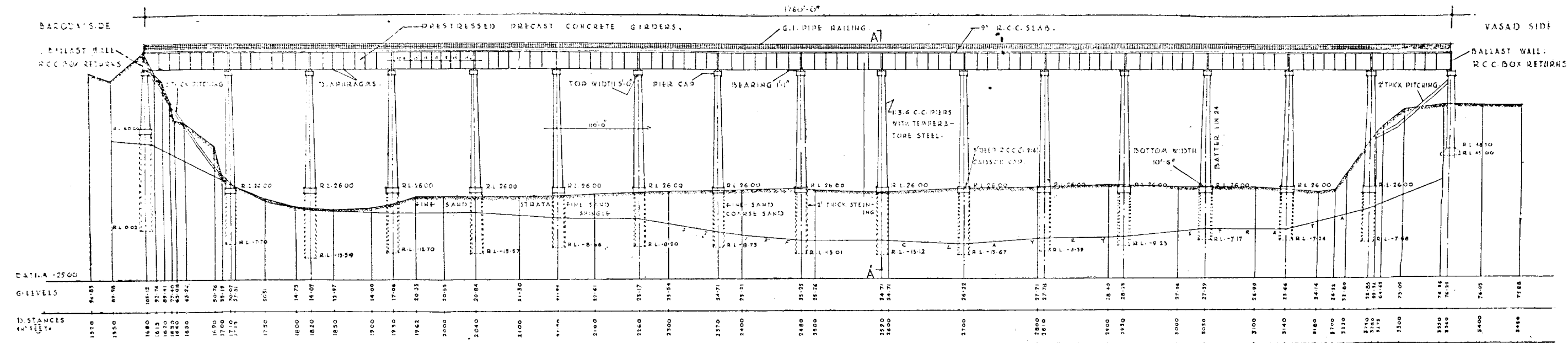
DEFINITIONS OF HIGHWAY ENGINEERING TERMS

RETAINING WALL : A wall constructed to maintain in position material capable of exerting lateral pressure, generally a mass of earth.

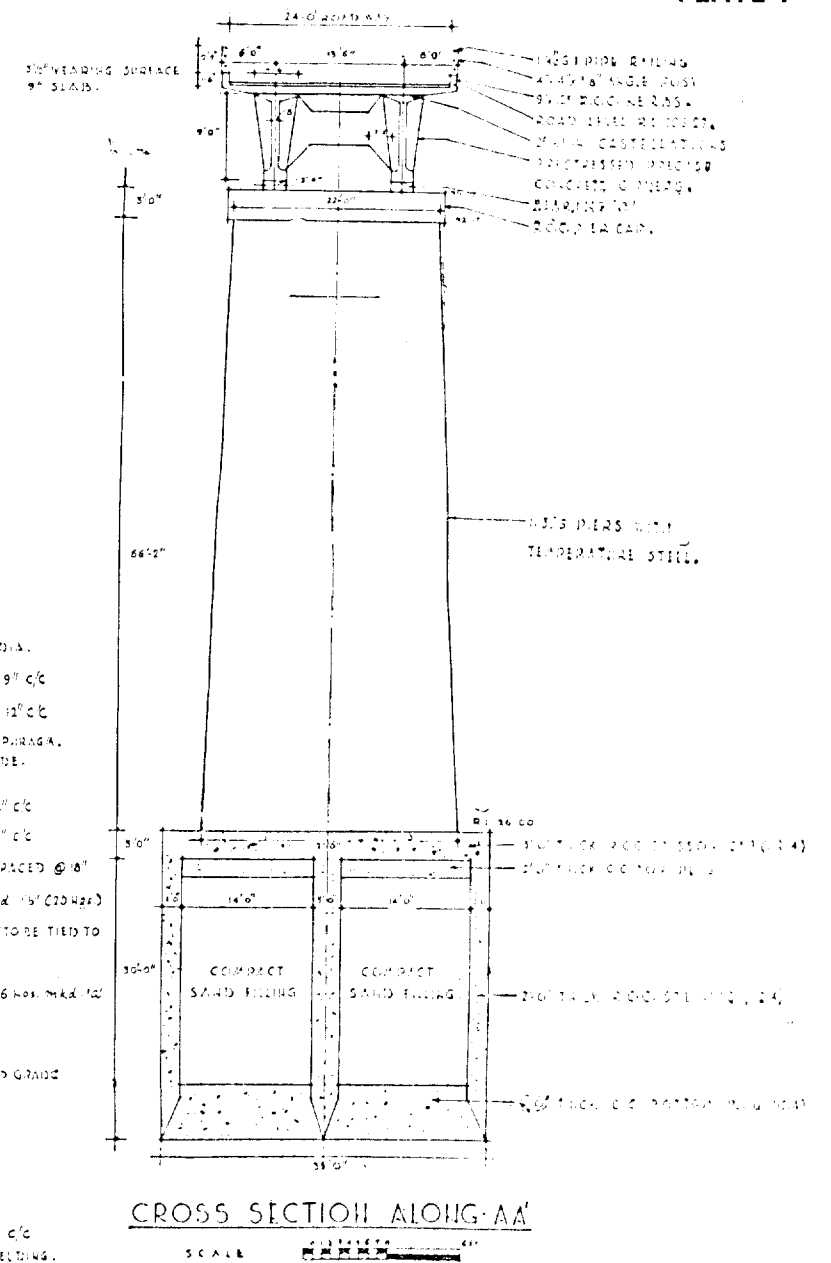
RETURN WALL : A retaining wall built parallel to the centre line of a road and in continuation of an abutment or wing, to retain the embankment.

A PRESTRESSED BRIDGE IN AUSTRALIA

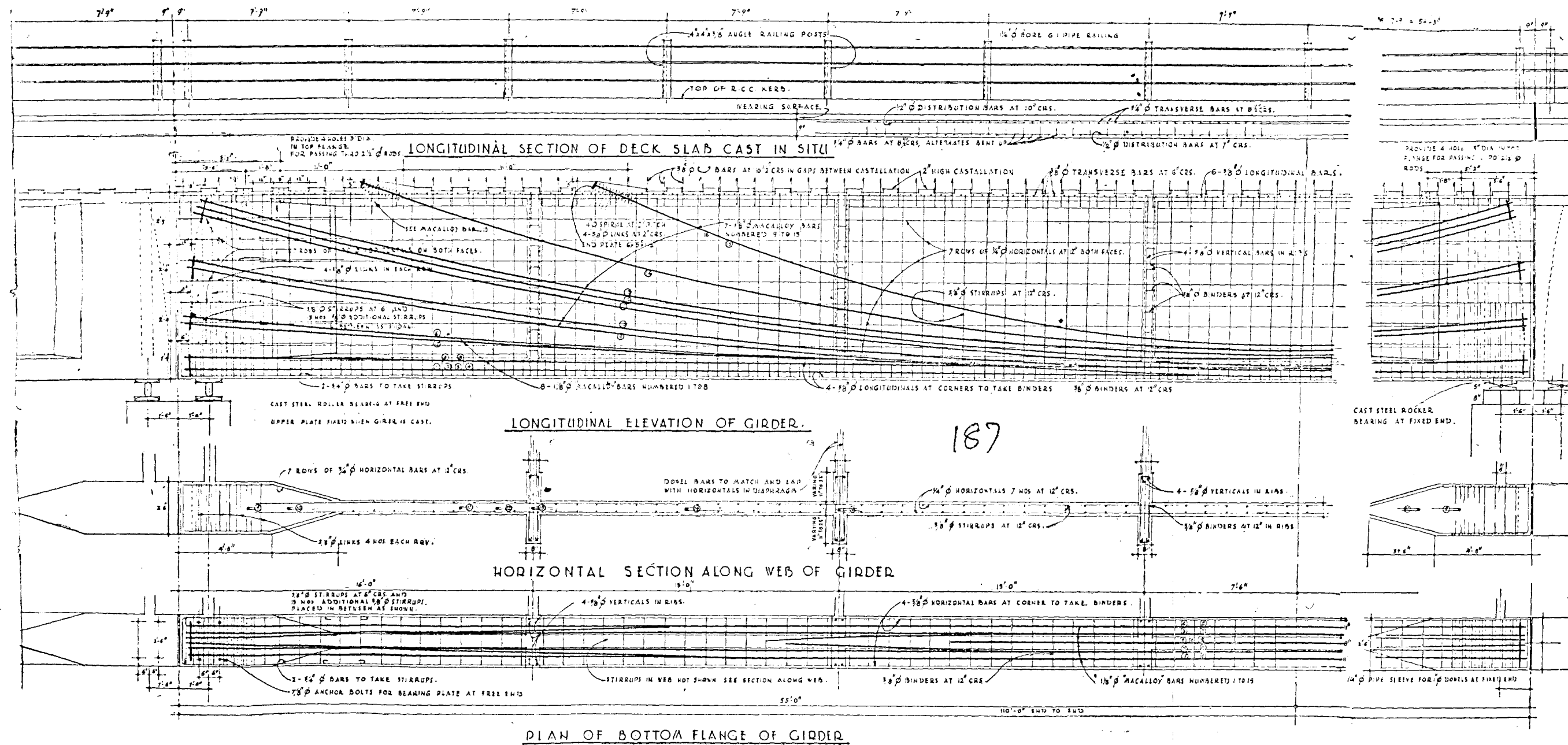
The Government of Western Australia had approved proposals for a highway bridge, to be completed in the next three years, across the Swan river at Perth. The bridge, which is to be of prestressed concrete, will have a carriageway 70 ft wide and two footpaths each 10 ft wide. The length between abutments will be 1,100 ft, in five spans of which the longest will be 320 ft.



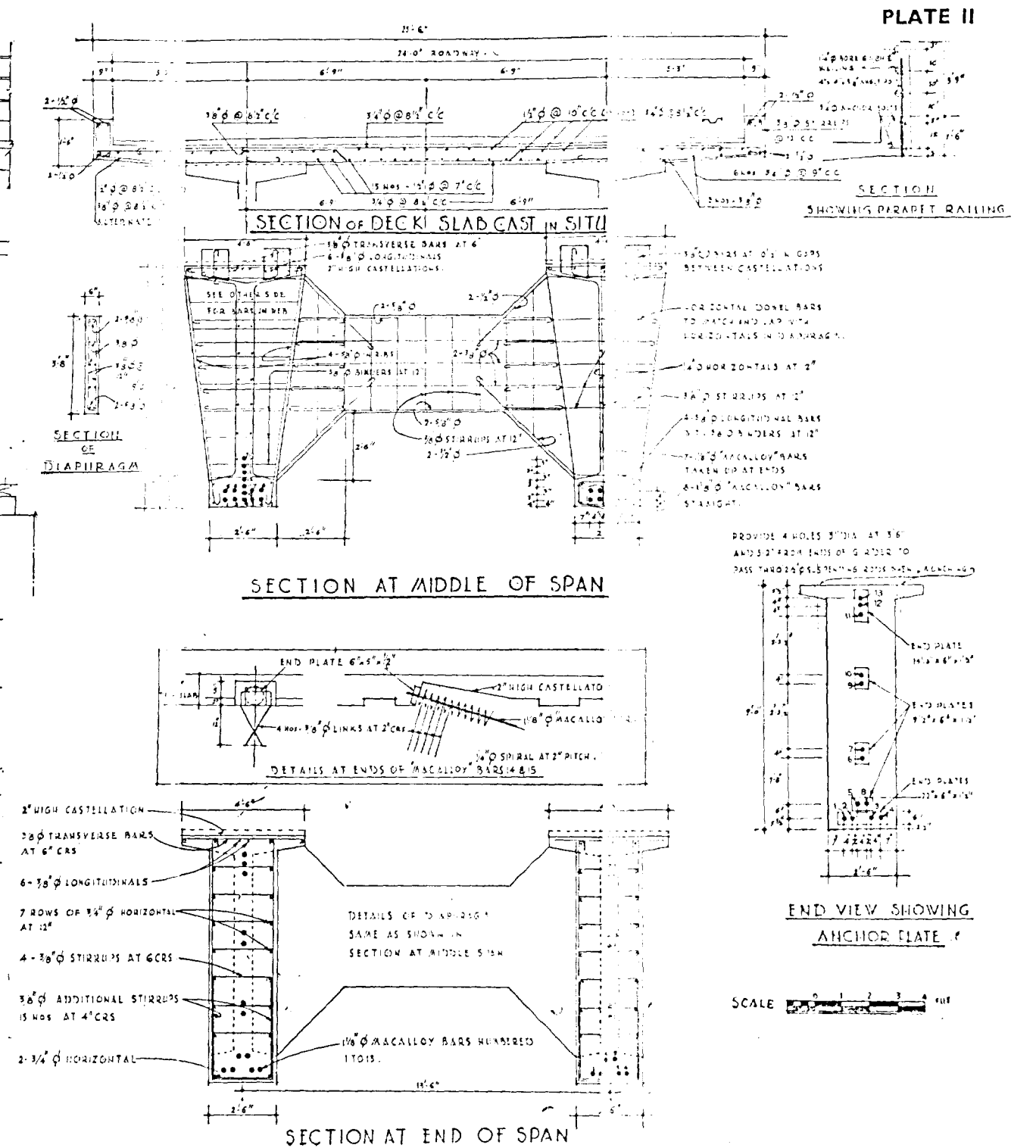
DETAILS OF CUTTING EDGE TO FOUNDATION WELL



LONGITUDINAL SECTION AND DETAILS OF WELL KERB



DETAILS OF PRESTRESSED GIRDER AND CAST IN SITU DECK SLAB



JOHN LOUDON McADAM

JOHN LOUDON McADAM shares with the Earl of Sandwich and a certain Mr. Macintosh the immortality derived from the use of their names as common nouns in everyday employment. But while we are apt to forget the originator of the laminated snack of bread and meat while taking a hasty lunch, or the patentee of the waterproof on our back when walking in the rain, the name McAdam, in its alternative form "Macadam", is permanently and indissolubly associated with road construction.

John Loudon was born at Ayr on September 21st, 1756. He was the son of James McAdam, a former landowner then in reduced circumstances, and was the youngest of ten children. Though never trained as a highway engineer, he is said to have taken a great interest in roads when a school boy, and according to his biographer, Devereux, "it is related that on one occasion he exhibited to admiring schoolmates a model he had made during his holidays of the Girvan road between Maybole and Kirkoswald."

At the age of fourteen he was sent out to New York where his uncle has established a prosperous business as a merchant, although at this period, of course, the new colony was in a very unsettled state. The McAdams and their friends were loyal to King George, as were many prosperous New York merchants, and in 1772 John Loudon's uncle became President of the New York Chamber of Commerce and John Loudon himself became treasurer two years later.

In 1778 he married Miss Gloriana Margaretta Nicoll, of Long Island, a well-connected young lady 'of great beauty and merit with a large fortune' and although he enlisted in the royalist army it seems that his military service was of short duration owing to his appointment as Commissioner of Naval Prizes.

At the close of the War of Independence he returned to Scotland with his wife and two children and purchased Sauchrie House, between Ayr and Maybole. Here

he soon became a public figure, being appointed a Deputy-Lieutenant of Ayrshire and holding a major's commission in the local volunteer force.

McAdam as a Tar Distiller

In the course of his public duties McAdam was compelled to travel all over the south of Scotland and he became very dissatisfied at the condition of the roads. At the same time he acquired an interest in an ironworks and tar Distillery at Muirkirk through the Earl of Dundonald, to whom he was related, and in 1931 a memorial cairn was erected on the site of one of his tar kilns. The production of tar, apparently, was not a paying proposition at this period although the iron-works continued to function and it is a thousand pities that McAdam, who, at this time was giving much thought to road improvements, did not hit on the idea of using tar as a binder.

However, he was appointed Government agent for the victualling of the Navy and left Scotland for Bristol, leaving the Muirkirk business in the hands of his son, William. After a short stay at Falmouth his official appointment with the Navy terminated and he returned to Bristol where his interest in roads and in the failure of the turnpike trusts to perform their duties efficiently became much intensified. He was well-known and respected in the city and in 1816 he was invited by the Bristol Corporation to act as General Surveyor of roads at a salary of £ 400 per annum. It is an extraordinary fact that his first official connection with road construction did not occur until he had reached the age of 60, nowadays regarded as a suitable age for retirement.

McAdams Method of Road Construction

Whether we agree with McAdam's non-rigid foundation, or not, the fact remains that when his method was adopted there is ample evidence that the condition of the road was immediately improved. In

fact, the highest praise was showered on him from all sides, although he was not immune from criticism now and again, sometimes on technical grounds, and sometimes on the grounds that, as his work extended to many different parts of the country, he brought in his three sons as assistants,

6 ounces; (2) a comparatively flat camber, not more than 3 inches being permitted for the rise from channel to crown on an 18-foot road; and (3) good drainage underneath. In this latter requirement he was in perfect agreement with his rival Telford, who, as a traditional engineer,



JOHN LOUDON McADAM (1756-1836)

(With acknowledgments to Road International, Summer, 1952.)

thus establishing what, to some people, was rather too much of a family concern.

It is well-known that the basic principles of "macadamising", as his method soon came to be called, were (1) the use of small angular stones, the maximum size being specified as 2 inches, or alternatively, maximum weight of

believed in a solid foundation and was sceptical of McAdam's flexible base.

Giving evidence before a Select Committee in 1819 McAdam was supremely confident that his method was right. "It matters not if the soil be clay, sand morass or bog," he said, "I should not care whether the substratum was soft or

hard; I should prefer a soft one to a hard one. If it was not such a bog as would not allow a man to walk over it, I should prefer it...I never use large stones on the bottom of a road; I would not put a large stone in any part of it."

In the surface layer he recommended a maximum stone size of one inch, in these words:

"The size of stone used on a road must be in due proportion to the space occupied by a wheel of ordinary dimensions on a smooth level surface; this point of contact will be found to be longitudinally about an inch, and every piece of stone put into a road which exceeds an inch in any of its dimensions, is mischievous".

The point of this argument is not quite clear but his remarks on the qualifications of highway surveyors are still eminently appropriate.

"The General Surveyor must be a gentleman of talents, education and station in society; he must be at the trouble to acquire the necessary knowledge both of the principles and practice of the profession, his character and rank must be such as to ensure the honourable feelings of a gentleman; the spirit to resist improper applications, and to defend the public against private interest".

Interest in Railways

It is not generally realised that McAdam was interested in railways as well as roads and investigated a possible route for a railway between London and Bristol some years before Brunel made his survey in 1833 on behalf of the newly formed Great Western line. McAdam's route followed the vale of the White Horse, subsequently chosen as a suitable location by Brunel himself, but McAdam further proposed that a new turnpike road should be built alongside the railway from end to end.

McAdam left Bristol in 1825 and at the age of 71, after being a widower for two years, he married again, his second wife being Anne Charlotte Delancey, then in her fortieth year. He then made his home in a spacious Georgian house at Hoddesdon, in Hertfordshire, where he lived to the ripe age of eighty.

It is noteworthy that in 1830 the French Government reported favourably on the McAdam system after thirteen years of trial on the roads of France. Some years earlier, when a committee of the House of Commons was debating the possibility of making the celebrated road-maker a grant in recognition of his services, the Postmaster-General was loud in his praises of the macadamised highways, and Thomas Hood wrote a somewhat fulsome and slightly satirical ode in honour of the "Colossus of Roads".

Some biographies state that McAdam was presented with £10,000 by a grateful Government, but Devereux states that he received no more than a fifth of this sum. There is also some doubt as to whether he was offered a knighthood and, if so, why he refused it. All we know for certain is that his son, James Nicoll McAdam, received this honour and was an important witness at an inquiry into the use of steam carriages on the public roads conducted by a Select Committee of the House of Commons in 1831.

Unique History

The life story of John Loudon McAdam is unique in the history of road making. Here was a man, untrained in civil engineering, who at a time when many people are thinking of slipped ease in a comfortable chair, started an active new career in highway engineering which involved an immense amount of travel in days when travel was really strenuous. Furthermore his efforts won universal praise and in the sphere of road construction he almost over shadowed the great Telford, one of the founders and first president of the Institution of Civil Engineers and one of the acknowledged leaders of the profession.

As Thomas Hood wrote in his "Ode to Mr. McAdam":

"Who shall dispute thy name?

In sculpt in stone in every street,

We soon shall greet

Thy trodden down, yet all-unconquered fame!"

(From 'Highways and Bridges and Engineering Works' September 19, 1956.)

CHILE AND ITS ROAD SYSTEM

CHILE, the long and narrow country in the south-west of South American continent, lies between the Andes mountains and the Pacific Ocean. It stretches from 17 to 53 deg. south latitude. Further south, there are the many islands belonging to the country and the Chilean sector of the Antarctica.

By climate and topography the country could be divided into three different regions. (1) The dry north zone is mainly devoted to mining. Here nitrate of Chile, copper, gold and silver are mined for export. (2) The central zone extending between 32 to 47 deg. latitude is the main agricultural area containing nearly 80 per cent of the total population of the country. (3) The southern zone, below 47 deg. latitude, is mainly pastoral.

Santiago, the capital of the country, lies in latitude 31½ deg. at the foot of the Andes mountains. It is 62 miles from the coast. The chief ports of the country are Valparaiso and San Antonio. The principal towns are generally located in the central valley between the coast and the Andes mountains.

Roads in the Country

The road system of the country consists nearly of 24,800 miles of all-weather roads. Of this, nearly 2,170 miles are of concrete or have an asphalt surface. The rest is water-bound macadam as a step towards later conversion into surfaced roads. Because of the special topography of the country, the main road system is like a tree with one trunk road running from the port of Arica in the north to Puerto Montt in the south, a distance of nearly 1,520 miles. Many transverse roads running east-west from the coast to the mountains cut across this trunk route which forms part of the Pan American

highway system. In the central agricultural region there are roads parallel to this trunk route running along the coast and at the foot of the mountains.

The principal port, Valparaiso, is connected with Santiago by means of a concrete road. There are many steep gradients and sharp curves on this road. Improvements with a view to reduce the steep gradients are under execution. Two tunnels, one at Zapata which is 3,937 ft long has recently been completed and a tunnel at Lo Prado, which will be 16,400 ft long, is under construction. It is expected that these two tunnels would reduce the distance between the two cities by nearly 18.5 miles and will permit of a greater speed in travel.

Another road connecting the capital with Los Andes on the mountains is also being improved to reduce gradients. A tunnel 6,560 ft long is under construction and when this is complete the distance between the two cities will be reduced to 44 miles against the present distance of 53 miles.

Nearly 100 mechanized units are working on the Pan American highway and it is expected that it would be complete by 1960.

Because of the mountainous nature of the country and the many rivers which run from the mountains to the coast, construction of roads is very costly. Large quantities of earthwork and expensive bridges are necessary. The government have decided that tolls be levied for the use of tunnels under construction on Santiago and Valparaiso road and on the road between Santiago and Los Andes.

(Adapted from Bulletin No. 114 of the "International Association of Road Congresses" Paris.)

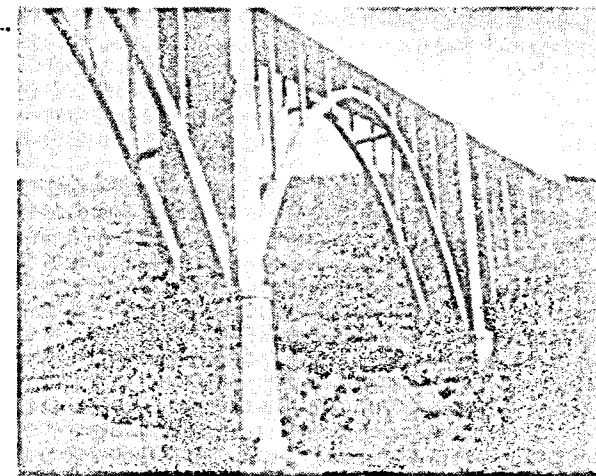


Photo 1.
Reinforced concrete bridge
across a Ravine in Pan
American Highway.

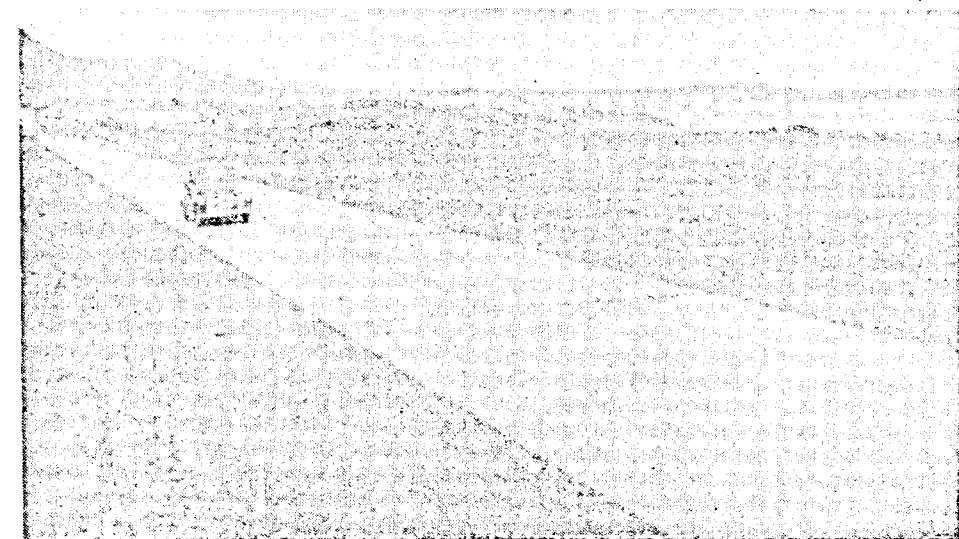


Photo 2.
A Section of the Pan American Highway.

BITUMEN AND BITUMINOUS PAVEMENTS IN HIGHWAY ENGINEERING*

By

SUJAN SINGH

PREMIX

IN grout or penetration method, the object is to coat the stone in position while in premix the aggregates are coated with bitumen before spreading. In full grout sufficient open space, i.e., voids, are left for bitumen to reach full depth of the stone. So more bitumen is required for full grout work than for premix work, with the result that full grout work is costlier than premix.

The larger the aggregates used the more stable the pavement. So stone sets have definitely high stability but still they are not widely used. This is because of the possibilities of uneven wear, difficulties of making repairs and expensive renewals involved.

The objective in premix is to improve the density and in specifications like asphaltic concrete attempt is made to attain maximum possible density.

There are two popular methods of premix:

- (1) Hotmix
- (2) Coldmix

In hotmix both the aggregate and the binder are heated and mixed, while in coldmix binder is heated and aggregate is not heated. Ordinarily, aggregate particularly sand even though appearing dry carries some moisture. In hotmix by heating aggregate all moisture is driven out and better bond between the binder and the aggregate is achieved. In certain parts of the country, in summer, aggregates are dry and coldmix could be done without any risk.

Asphalt Macadam. In this specification stone is coated with bitumen before laying. In order to increase density, graded stones are used. After compaction the surface is given a seal coat. Seal coat may be a premixed or a liquid one. In premixed seal work the fine aggregates are mixed with bitumen, spread on the surface and rolled. In liquid seal work bitumen is sprayed and the surface blinded with dry stone chippings.

In asphalt macadam usually aggregates passing 10 mesh are not used so that all the voids in the structure are not filled. When aggregate passing 10 mesh are incorporated along with coarse aggregate it is termed asphaltic concrete. Asphalt macadam may be designed on the same lines as asphaltic concrete. In asphalt macadam, small fragments of stone are used to fill voids, while in asphaltic concrete a dense structure could be obtained by the use of sand and filler.

Asphaltic Concrete. In this specification, coarse aggregate (stone), fine aggregate (sand) and mineral filler are uniformly mixed with bitumen. The mix is laid in one or more courses to obtain the required thickness. Pavements constructed to this specification are very dense and are therefore suitable for heavy traffic.

There are several methods of designing premix work such as:

- The Marshall Method
- The Hveem Method
- The Hubbard-Field Method
- The Smith Triaxial Method

A method simpler than any one of the above mentioned ones based on volume and voids of the aggregate is explained below.

The principles governing the design are:

- (a) The ingredients in a concrete mixture except the binder, should be proportioned according to voids.
- (b) Before proportioning the fine aggregate for filling the voids in the coarse, or the finer aggregate for filling the voids in the fine, an allowance should be made for the amount of binder required to coat the aggregate whose voids are sought to be filled.
- (c) For the purpose of proportioning the quantities of the fine and the finer aggregates, it is their bulk volumes and not the volumes of their solid contents which should be the basis of calculation.
- (d) The amount of binder should be proportioned, not by the extent of voids in the aggregate, but by the amount required to coat the particles and that its total quantity should, in any case, be less by about 2 per cent than the voids in the mixture.
- (e) The ultimate volume of a concrete so proportioned should not exceed the original volume of coarse aggregate i.e., stone; if it does, then the gauge of the fine aggregate should be changed.

Example

Stone used on a particular job is $1\frac{1}{2}$ in. to $\frac{3}{4}$ in. gauge for which we have to find out proportion of sand, filler and bitumen.

Aggregate:

Weight of 1 cu. ft. of loose stone	= 90 lb
Specific gravity of stone	= 2.9
Weight of 1 cu. ft. of sand	= 94 lb

Specific gravity of sand	= 2.6
Weight of 1 cu. ft. of filler	= 90 lb
Specific gravity of filler	= 2.96

Voids:

One cu. ft. solid stone will weigh	= 62.3×2.9 = 181 lb
Therefore volume of solid in one cu. ft. of loose stone	= $\frac{90}{181} = 0.5$ cu. ft.
Therefore voids	= $1.0 - 0.5$ = 0.5 cu. ft. or 50 per cent
One cu. ft. of solid sand weighs	= 62.3×2.6 = 162 cu. ft.
Volume of solids in one cu. ft. of loose sand	= $\frac{94}{162}$ = 0.58 cu. ft.
Therefore voids	= $1.0 - 0.58$ = 0.42 cu. ft. or 42 per cent
One cu. ft. of solid filler will weigh	= 62.3×2.96 = 184.4 lb
Volume of solid in one cu. ft. of loose filler	= $\frac{90}{184.4}$ = 0.49 cu. ft.
Therefore voids	= $1.0 - 0.49$ = 0.51 cu. ft. or 51 per cent

Bitumen also takes some space. Before calculating the proportions of aggregate it is necessary to work out volume of bitumen required to coat aggregate. To start with, the quantity of binder for coating stones is determined by preparing a few trial batches. For determining the amount of binder required to coat sand and filler a method known as 'Pat' stains is employed. The final adjustment in binder quantities is made after proportioning calculations are complete.

* A lecture delivered at Roorkee University as part of a Refresher course for Civil Engineers. Concluded from pages 17 & 18 of January 1957 issue of the TCMR.

For example, assume the following amounts of binder :

- For stone 3 lb per cu. ft.
- For sand 11.25 lb per cu. ft.
- For filler 13.5 lb per cu. ft.

Proportioning :

- 1. Voids in one cu. ft. stones = 0.50 cu. ft.
- Volume of Bitumen for coating @ 3 lb per cu. ft. = 0.046 cu.ft.
- Therefore voids in coated stones = 0.500—0.046 = 0.454 cu.ft.

0.454 cu. ft., therefore, represents the volume of sand 1 cu. ft. of coated stone will carry.

- Volume of Bitumen coating for 1 cu. ft. sand 11.25 lb = 0.174 cu. ft.
- Therefore Volume of bitumen for 0.454 cu. ft. sand = 0.454 × 0.174 = 0.079 cu. ft.

- The volume of voids in 0.454 cu. ft. of sand having 42 per cent voids will be = 0.454 × 0.42 = 0.191 cu. ft.
- Volume of Bitumen = 0.079 cu. ft.
- Therefore the volume of filler required will be = 0.191 — 0.079 = 0.112 cu. ft.

- Volume of Bitumen for coating filler @ 13.5 lb per cu. ft. = 0.209 cu. ft.
- Volume of Bitumen for 0.112 cu. ft. of filler = 0.112 × 0.209 = 0.023 cu. ft.

All ingredients are now known and are as given below :

	lb
1.00 cu. ft. stone, weight at 90 lb per cu. ft.	= 90.0
0.454 cu. ft. sand, weight at 94 lb per cu. ft.	= 42.7
0.112 cu. ft. filler, weight at 90 lb per cu. ft.	= 10.1
0.148 cu. ft. bitumen, weight at 64.8 lb per cu. ft.	= 9.6
	152.4

Air space and solid content
Solid Content

1 cu. ft. stone solids @ 50 per cent	= 0.500 cu. ft.
0.454 cu. ft. sand solids @ 58 per cent	= 0.263 cu. ft.
0.112 cu. ft. filler solids @ 49 per cent	= 0.055 cu. ft.
Total	= 0.818 cu. ft.

Air Space

- This leaves 0.182 cu. ft. of voids.
- Voids filled with bitumen = 0.148
- Therefore unfilled voids = 0.182 — 0.148 = 0.034 cu. ft. = 3.4 per cent

This is satisfactory as it provides room for bitumen to expand.

Another important factor to be checked up after proportioning is that there is no 'bulking' that is the ultimate volume of all the ingredients does not exceed the original volume of main aggregate.

—Concluded.

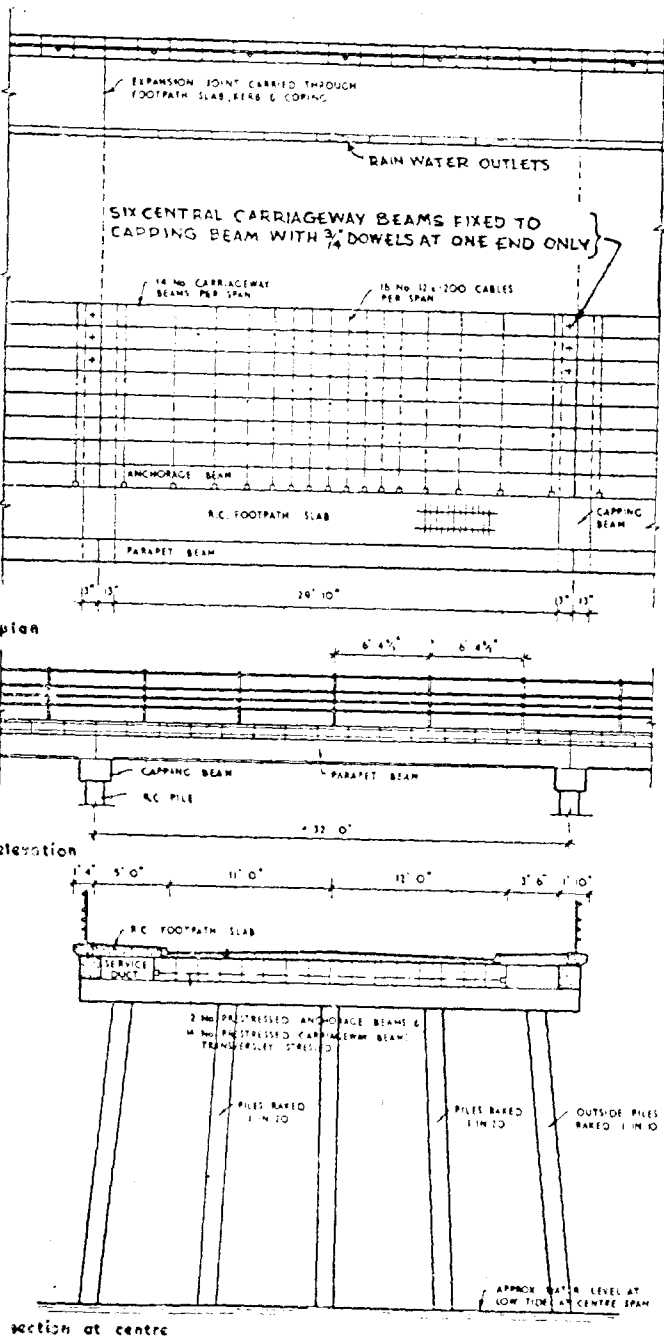
A PRESTRESSED CONCRETE BRIDGE ON PILES

A prestressed and reinforced concrete bridge in replacement of the old wooden bridge built in 1824, connecting Hayling Island with the mainland (U. K.) was recently opened.

The bridge is 958 ft long and the approaches are 2,542 ft long, making a total length of 3,500 ft. The bridge has a single carriageway 22 ft wide with two 5 ft wide footpaths.

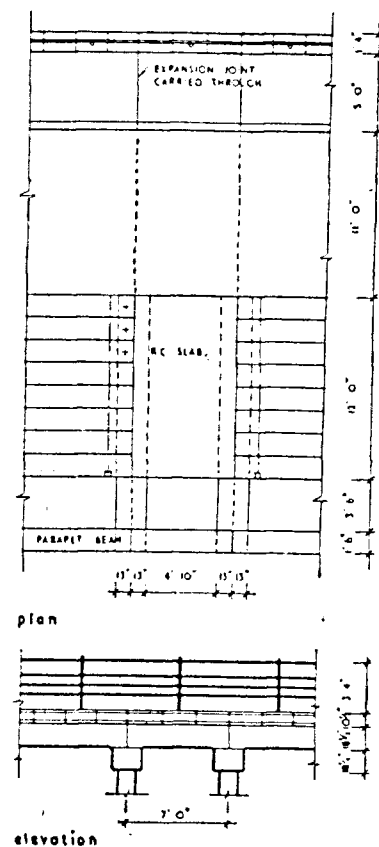
The base of the approach embankment at either end consists of quarry waste 1 ft thick, with layers of consolidated hard filling above it. Toe protection is provided by prestressed concrete sheet piling, and protection against tidal water by clay puddle and concrete pitching blocks 1 ft by 2 ft by 6 in. deep, sealed with bitumen. The side slopes of the embankments are generally 1 in 1½, except where it is 1 in 6 to provide mooring facilities.

The deck is made up of prestressed beams carried on a series of reinforced concrete piles, which were driven down in to the hard chalk underlying mud, chalk rubble and flint. There are in all thirty-three spans twenty-nine of 32 ft, and four of 7 ft. The 7 ft spans are at the fifth points in the length of the bridge. Each of the thirty-four pile trestles consists of five precast reinforced concrete piles, arranged in line across the width of the bridge, carrying an *in situ* reinforced concrete capping beam.



Typical Detail of 32 ft Span

The piles, 170 in. all, are 1 ft 4 in. square in section. In each trestle the outer pair of piles have a rake of 1 in 10, the inner pair have a rake of 1 in 20, and the central one is vertical. Lateral sway forces are taken by the raking piles, and the longitudinal forces are restricted by the means of the four double-pile trestles at the fifth points. The beam supported by the piles is 1 ft 6 in. deep and 2 ft 2 in. wide and carries the sixteen precast prestressed concrete deck beams and the two parapet beams which make up the deck in each span.



Typical Detail of 7 ft span

The deck beams are 1 ft 6 in. square in section, with slightly inclined sides to permit mortar to be packed between them in a narrow V-joint. They are post-tensioned in the longitudinal direction with two 1½ in. diameter Macalloy bars. Transversely they are prestressed on the

Freyssinet system, to create a monolithic slab. Twenty-four of the beams have been tested on site to 250 lb per sq. in. tension and have shown no defect; a further two beams are being tested to determine losses due to creep and their ultimate strength.

Between the slabs there are expansion joints consisting of bitumen and bituminised felt. One end of each slab is fixed to the pile cap by rustless steel dowel bars while the other end is free to move over a piece of bituminised felt laid on top of the pile cap.

A space has been left between the beams containing the anchorage of the transverse prestressing wires and the parapet beams; this provides a duct for services on each side of the bridge. Reinforced concrete footpath slabs are cast over the duct.

The parapet beams are also prestressed and are separated by expansion joints containing compressed rubber sheeting. They are surmounted by a cast stone coping. The hand-rails are 3 ft 4 in. high, of 1½ in. bore metal tubing, treated with a coating of flame-sprayed zinc and painted with zinc chromate primer and chlorinated rubber under coating and finishing paint.

All the piles and prestressed concrete beams were precast on the site, and casting beds were set up on the mainland. A cube strength of 6,000 lb per sq. in. at the time of stressing was specified for the concrete prestressed deck. The compressive strength for the concrete of the piles was 6,000 lb per sq. in. at seven days. The concrete for capping beams and footpath slabs was specified to have cube strength of 2,450 lb per sq. in. at seven days. A 1:3 mix with a water/cement ratio of 0.3 was used, and compacted by internal vibration in the moulds. The piles and beams were handled by a 7½ ton gantry in the casting yard and transported to the bridge by a diesel locomotive running on a narrow gauge railway.

(From 'Roads and Road Construction,' November, 1956).

CONTROL IN THE MANUFACTURE AND LAYING OF BITUMINOUS SURFACINGS*

CONTROL OF SURFACE DRESSING WORK

THE most important factor in the life of a surface dressing is the rate of spread of the binder. When too little binder is used, the chippings are not strongly held and the traffic dislodges them; this leads to failure of the dressing usually within a year or so. A typical failure of this sort is shown in photo 1.

On the other hand, when the rate of spread of the binder is too heavy a smooth fat surface will result within a year. When the correct technique is carried out, a surface dressing on a suitable base will provide, at a remarkably small cost, a waterproof surfacing of good texture lasting many years. The amount of binder required is determined largely by the size of chipping to be used.

CONTROL TO BE EXERCISED BEFORE WORK IS STARTED

The binder should be sprayed on to the road in a uniform film at the specified rate of spread. Variations from the mean rate of spread should be limited to 25 per cent. If mechanical sprayers are used they should be checked before use. Single-sized chippings give the best results in surface dressing work.

In surface dressing the most important property of the binder is its viscosity. This must be suited to the time of year when the surface dressing is laid, so that the binder is neither too viscous to wet the chippings nor so fluid that it does not hold them under the action of traffic. Mistakes occasionally occur and the viscosity of the binder should always be checked before use.

CONTROL TO BE EXERCISED DURING LAYING

Temperature of the Binder

The jets of a tank sprayer are calibrated when the temperature of the binder is within a particular range best suited to the operation of spraying. If the temperature drops below this range the rate of delivery of the binder will be affected;

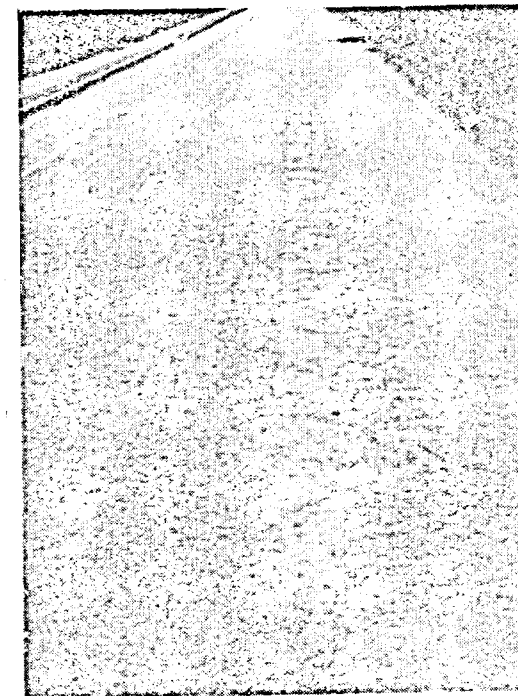


Photo 1.

A surface dressing showing loss of chippings due to the use of too little binder.

(Photograph three years after laying.)

* Paper read at the Public Works & Municipal Services Congress Session, by H. G. Barnes, 14-11-1956.

swirling-spray jets usually deliver more binder when the temperature falls and the cone of sprayed binder contracts, upsetting the even distribution from the spray-bar. The sprayer must therefore be equipped with an accurate thermometer, and throughout the whole of the spraying operation this thermometer should be watched to ensure that the temperature of the binder is within the specified limits.

Rate of Spread of Binder

A check on variations in the rate of spread of the binder in the longitudinal direction may be obtained by placing shallow metal trays, about 8 in. square, in the path of the sprayer on a selected line. The rate of spread at the location of the tray is obtained by weighing it before and after use on the road.

A method of determining the average rate of spread is to measure the area of road sprayed and the volume of binder delivered by the sprayer (by using a dip stick); it should be realised, however, that this method gives no indication of the uniformity of the binder film.

Traffic

Traffic moving at a steady slow speed is good for a newly-laid surface dressing

but fast traffic during the first few hours after laying is likely to cause considerable disturbance and loss of chippings particularly during hot weather when the viscosity of the binder is low. On main roads every effort should be made to restrict the speed of traffic while the dressing is bedding down; this may be done by the use of warning boards.

Weather

Very hot weather may mean that the fresh binder (even if of the highest viscosity normally used) is too fluid to hold the chippings under traffic and it is advisable to stop spraying under these circumstances if the road carries more than light traffic. It is also inadvisable to carry on spraying in heavy rain, but the advent of surface active agents now enables surface dressing to be carried out in unsettled weather without fear of damage by the combined action of rain and traffic. It must be emphasised, however, that these agents are only effective if used properly, and adequate control is essential. Further, the use of an agent does not eliminate the need to exercise good control over surface dressing; this is just as essential as when no agent is being used.

ROPES TO CHECK OVERSPEED

In 1905, Delaware traffic police would disguise themselves as workmen, post themselves along the highway, and then swing heavy ropes across the highway to stop any motorist who was exceeding the speed limit of eight miles per hour.

HERE AND THERE

1. LEADERSHIP AND RESPONSIBILITY IN A TIME OF RAPID ADVANCE*

● BECAUSE of a natural bent and instinct for their calling, engineers become entirely absorbed in the technical fascination of their work. Success in their academic training, first practical experiences and early appointments are measured almost entirely in terms of technical ability and so our young engineer concentrates on this to the exclusion of other interests. But times have changed. Specialists are no longer on a pedestal from which they can regardlessly view the value of the work of those outside their own particular domain. More than ever before, engineers are now members of a community to whom they owe a duty which must be reconciled with their purely engineering interests. For example, they must learn that social and economic, as well as engineering, considerations enter into modern design.

'A superior can make his subordinates responsible only to him for any work which he allocates to them but he cannot thereby divest himself of the responsibility for that work to his superiors. Responsibility cannot be passed downwards or sideways in the organisation but remains irreducible with the person charged with it.

Human principles

'There are certain human principles which must be followed if true delegation

is to be achieved successfully. Failure to delegate is often accompanied by an air of virtue and an 'I want to know what is going on' attitude; or 'if I want a job done properly, I must do it myself'; or 'it would take me longer to explain the job than to do it.' Such people usually never have a moment and are so bogged down with details that they cannot possibly formulate future plans or deal with principles. In such cases there are two serious failures. One is that the bottleneck at the top slows down action, the other that the staff's power of initiative is stifled. The good leader does all he can to get his staff to accept authority and show initiative. One of the most powerful stimulants to action is the personal satisfaction to be derived by thinking out a plan and ensuring its success. No manager can afford to dispense with the cumulative ideas and driving power of his staff to supplement his own; executives showing initiative must be encouraged and rewarded; full explanations should always be given when bright ideas cannot be used. Delegation and the inculcation of the spirit of enterprise may require the sacrifice of some personal vanity on the part of the senior. It requires tact to delegate authority and action and at the same time maintain discipline and control.

(From 'The Surveyor and Municipal and County Engineer, 17th November—1956').

2. OWNERS OF LAND ABUTTING ON ROAD ARE NOT ENTITLED TO COMPENSATION BECAUSE OF INSTALLATION OF A DIVIDING STRIP

● IN the Washington State of the U.S.A. had a motel in a premises which had a dividing strip was installed for the frontage of 500 ft. It was claimed that State highway. An abutting land owner the tourists travelling on the road had

* From the Paper entitled 'Essentials For A Modern Engineer', by A. S. Turner, presented on 12th November, 1957, at the Public Works & Municipal Services Congress.

to make a left hand turn across the highway (U. S. A. has a left hand drive) to enter the premises. Depriving the right of direct egress and ingress would severely damage the property and reduce the market value of the land.

The Supreme Court held that in spite of the installation of the dividing strip the owners still had free access to their property. Once on the highway, traveller would be in the same position and subject to the same police power regulations of the State as any other member of the travelling public. Re-routing and diversion of traffic are regulations within

the police power. The increased distance that some travellers had to make in this case was the outcome of the exercise of police powers. The Court, therefore, held that although the abutting property owners might be inconvenienced by the one-way traffic regulation immediately in front of their property, there was no remedy if the regulations were reasonably adopted for the benefit of the travelling public.

(From Circular No 328 of the Committee on Land Acquisition and Control of Highway Access and Adjacent Areas, Highway Research Board, U. S. A.)

3. WORLD CONFERENCE ON PRESTRESSED CONCRETE, SAN-FRANCISCO, 1957.

● THE University of California is arranging a World Conference on Prestressed Concrete in co-operation with the Prestressed Concrete Institute and other engineering and learned societies. The Conference will be held in San-Francisco, California, from the 29th July to the 2nd August, 1957.

The International Federation of Prestressing is one of the co-operating organizations and it will be represented at the Conference by an official delegation which is expected to be led by Professor

E. Torroja (Spain), the Deputy General Vice-President of the F.I.P.

Those who are interested in attending the Conference may obtain further particulars either from the Chairman, Prestressed Concrete Development Group of the Institution of Engineers (India), C/o. The Concrete Association of India, 121, Queen's Road, Bombay 1, or directly from the Department of Conferences and Special Activities, University Extension, Berkeley 4, California.

4. ROAD WORKS IN CENTRAL ASIA

● THE Central Asian Highway is being built across some of the most difficult country in the world to link the capitals of Uzbekistan, Kirghizistan, and Kazakhstan. Some sections are already in existence; one of these being built is the Great Kirghizistan Highway, otherwise known as the Tien Shan Road.

It runs between Frunze on the northern border with Kazakhstan of the Kirghiz Republic, and Osh, near its southern border with Tadzhikistan.

Some 125 miles of the road are already in use. When completed the journey between the two towns will take twelve hours by bus instead of two months by camel caravan.

While the communications inside the Central Asian Republics are being extended those between these Republics and Afghanistan lying on their southern borders, are also to be developed.

(From 'World Highways' International Road Federation, London, June, 1956').

5. ROADS AND TRAFFIC GROWTH IN TIBET

● A 3,000 mile motor road is now open to traffic in Tibet where no single highway existed in 1952. Motor vehicles are running from the western bank of the Kinsha river in east Tibet to Gartok in the westernmost area, and from the Tanglha range in north Tibet to Yatung in the south. Tibet now has five main highways namely: the Kangting and Chinghai routes into Tibet and three linking Lhasa, Shigatse, Gyangtse and Yatung, connecting major cities with principal agricultural and nomad districts.

Large quantities of modern factory equipment, heavy agricultural machinery and other materials, the transport of which has hitherto been impossible, are now taken into Tibet and Tibetan produce is also being transported to China in large quantities. It is possible to travel from the eastern to the western borders of Tibet in two months.

(From 'World Highways, International Road Federation, London, June, 1956').

6. THE THIRD INTERNATIONAL CONGRESS ON PRESTRESSED CONCRETE

● THE next, the Third International Congress on Prestressed Concrete, will be held at Berlin from the 5th to 10th May, 1958. The Executive Committee of the Congress has chosen the following subjects for discussion at the Session:—

- (1) Development in design methods—Contributions dealing with experimental work on shear stresses are particularly welcome.

General Reporter, Prof. Dr. Ing. H. Rusch, Munich.

- (2) Advances in the technique of construction at site, with particular reference to grouting, anchorages, reduction of friction and safety measures.

General Reporter, Dr. Ing. G. F. Janssonius, Amsterdam.

- (3) Progress in the manufacture of prestressed concrete units in factories and the use and assembly of precast units on the site.

General Reporter, D. H. New, London.

- (4) Buildings and structures carried out wholly or partly in prestressed concrete since the 1955 Congress, in which important deve-

lopments in design or construction have been included.
General Reporter, P. Leblille, Paris.

Contributions on the first three of the above mentioned subjects, not exceeding 4000 words, should reach not later than the 15th of August 1957, the General Secretary, Administrative Office, Terminal House, Grosvenor Gardens, London, S. W. 1. The Contributions must be in one of the four languages of the Congress, viz., English, French, German and Spanish. A brief summary in all the four languages should be included. The Executive Committee of the Congress will decide the acceptance or otherwise of the contribution. Six copies are required. Contributions received before the above-mentioned date will be printed in the Preliminary Report. But those received after that date will be used by the General Reporter in his report to the Congress.

The contributions on the fourth subject mentioned above, should reach the General Secretary not later than the 1st October 1957.

Persons wishing to attend the Session should notify the German Organizing Committee, C/o. Deutscher Beton-Verein E. V., Wiesbaden, P.O., Box 543, or the General Secretary at London.

CURRENT LITERATURE

ABSTRACTS

INFLUENCE OF HYPOTHESES AND METHODS IN CALCULATIONS ON REINFORCED AND PRESTRESSED CONCRETE, J. Barets; 'Annales De L' Institut Technique Du Batiment Et Des Travaux Publics, Summaries (October 1956)'.

THE Author enumerates the causes of errors in the usual calculations on reinforced concrete.

After a short recapitulation of the theories of the strength of materials the author goes on to deal more especially with the theory of elasticity and its limitations in the calculations of materials as complicated as reinforced concrete. He then deals with the errors which result from hypotheses aimed at simplification.

The influence of shrinkage and safety-factor variations are then discussed in relation to the theories of probability (in French).

ULTRASONIC PULSE MEASUREMENTS TO STUDY THE RATE OF HARDENING OF SOIL-CEMENT, by R. Jones, Journal of Applied Chemistry, June, 1956, pp. 226-230.

THE ultrasonic pulse technique has been adapted for studying the rate of hardening of soil-cement. In this technique, the velocity of propagation of a pulse through the soil-cement is measured and its increase as the mixture ages indicates the hardening that occurs. The method has advantages over conventional methods in that being non-destructive, repetitive tests can be made on the same specimen.

The presence of organic matter can delay the set of sand-cement mixes for a matter of weeks, and the method has special advantages in studying the problem of the hardening process of such mixtures. Results have been obtained on

cylinders of soil-cement made from samples of sand which contained different amounts of organic matter. The rate of hardening varied considerably between the different batches of specimens tested. One particular series had not attained a satisfactory strength after six weeks whereas another series was satisfactory after only a few days. Over such diversity of behaviour the pulse velocity provided an adequate means for following the hardening process. The results indicated that, for the particular soil-cement tested, the compressive strength (C) and the pulse velocity (V) were related by an expression of the form $C = a V^3$.

DEMONSTRATION OF POSSIBLE FLOW CONDITIONS IN A CULVERT, M. R. Carstens and A. R. Holt-Bulletin 126, Culvert-flow characteristics, Highway Research Board, Washington, D. C.

IN this Paper the majority of possible flow profiles within a highway culvert were produced in a two-dimensional laboratory channel. In order to obtain a photographic record of the flow profiles, a two-dimensional model was constructed with side walls of clear plastic. With rear lighting through the transparent culvert barrel, the water surface was photographed. The culvert barrel was rectangular in cross-section, 0.167 foot wide by 0.300 foot high by 3.00 feet long. The culvert slope and the discharge through the culvert were adjustable. Slide gates could be inserted either upstream or downstream from the culvert barrel. A removable insert was used to alter the inlet from an unstreamlined inlet to a streamlined inlet. The outlet conditions were varied from that of a free outlet to that of a completely submerged outlet. This control was by means of the downstream slide gate and a perpendicular drop in the channel bottom at the barrel outlet section. The flow profiles are classified by the position of

the control section, and analysed in detail. Tabular information is presented delineating the conditions for which a given profile can exist.

STRENGTH OF A CONCRETE SLAB PRESTRESSED IN TWO DIRECTIONS, By A. C. Scordelis, K. S. Pister and T. Y. Lin, Journal of the American Concrete Institute, September, 1956.

ELASTIC behaviour and ultimate strength of a full size concrete slab prestressed in two directions were investigated. Prestressing was accomplished by means of unbonded post-tensioned cables. The slab was supported only at the four corners, simulating a lift flat slab. It was loaded uniformly by means of air pressure in plastic bags. Experimental deflections and strains were checked against the classical elastic theory. Observed ultimate strength was compared to that obtained by the crack-line theory as applied to prestressed slabs.

INFLUENCE OF THE PRESENCE OF COARSER FRACTIONS OF SOILS ON THE ATTERBERG TEST RESULTS, by J. S. Narasimham, published by the Indian National Society of Soil Mechanics and Foundation Engineering, New Delhi.

THE liquid limit and plastic limit determination of soils are made on soil mortar, i.e., material passing No. 40 ASTM mesh sieve, but in the field soil from borrow pits containing coarser fractions is used. With a view to investigate the effect of coarse fractions on the liquid limit and the plastic limit, 18 soils from different parts of Hyderabad, mostly belonging to A2-A7 Group of Highway Research Board classification, were tested and analysed. The conclusions of the study are:—

1. The liquid limit and the plastic limit of soils decreases with increase of coarse material.
2. In the case of soils belonging to A2 Group containing less than 4 per cent of clay, it is not possible to perform the liquid

limit and plastic limit tests on soils passing No. 10 sieve.

3. In soils coming under A4 classification, which are non-plastic, or moderately plastic silty soils, the addition of coarser fractions has no effect on the values of liquid limit and plastic limit.

The Author concludes that the use of material passing No. 40 mesh for determining the liquid limit and plastic limit is rational.

Details of the gradations and other characteristics of soils which have been tested are given in a tabular statement.

THE ULTIMATE STRENGTH OF REINFORCED CONCRETE BEAMS IN SHEAR, By Royston Jones, Magazine of Concrete Research, August 1956.

THIS Paper summarizes conclusions drawn from tests on a number of beams of identical dimensions but of different concrete strengths and from a re-assessment of tests on beams of various dimensions reported by Sunderland and Wilby. The limitations of recently advanced shear-compression moment theories are demonstrated and a new expression is developed on similar principles.

A theoretical analysis of shrinkage stresses is developed to predict the loads at the appearance of bending and diagonal tension cracks, whereby it is shown that the shrinkage stresses may have an effect on the ultimate shear resistance.

Three divided beams were tested in an attempt to measure directly the separate contributions to shear resistance made by the concrete, the web reinforcement, and the longitudinal reinforcement. In these beams a gap was pre-formed on the expected line of the diagonal tension crack and the concrete in the compression zone was replaced by a mechanical device to record direct force and shear force. The results are examined in relation to a mathematical analysis of the shear force resisted by the dowel action of the longitudinal reinforcement. (Author's Summary)

TRUSS ANALYSIS BY STIFFNESS CONSIDERATIONS, By H. C. Martin, Journal of the Engineering Mechanics Division, Proceedings of the American Society of Civil Engineers, October, 1956.

A general method of analysis, particularly advantageous for redundant structures, is developed in detail for the pin-connected truss. The proposed method enables deflections, member forces, and reactions to be determined for any arbitrary set of applied loads.

It is shown that equilibrium and continuity requirements can be satisfied by following a simple tabular procedure for writing the stiffness matrix of the entire structure. This is the principal task of the analyst and is sufficiently simple to be carried out by non-engineering trained personnel. No extra complications arise from the subsequent introduction of additional redundant members or reactions. Once the table representing the stiffness of the structure has been obtained, the complete solution follows from numerical calculation. This can be carried out using the slide rule, desk calculator, or automatic digital computing equipment.

Changes in design are accounted for by locally correcting the stiffness matrix.

Changes in external forces do not affect the analysis.

Any determinate or indeterminate structure may be solved by the suggested method. In this Paper the basic procedure is explained and then applied to several examples. (Author's summary).

DURABILITY OF CONCRETE, Bulletin 128: Highway Research Board, Washington, D. C.

THE bulletin contains the following two reports on durability of concrete.

The first entitled "Effect of Entrained Air on Strength and Durability of Concrete with Various Sizes of Aggregates." is the second report concerning a group of tests designed to provide quantitative information regarding the proper amount of entrained air for adequate frost resistance and the effect of the entrained air on the strength of concretes made with various maximum sizes of aggregate.

The second report is entitled "Resistance of Concrete Surfaces to Scaling Action of Ice-Removal Agents." This report is a resume of investigations conducted to test materials and procedures for protecting concrete pavements against scaling and disintegration caused by calcium chloride and other thawing agents used for ice removal.

A LOOK INTO IT

"Dear Sir,—My Dustbin has not been emptied for three weeks. If this matter is not cleared up soon, I shall have to look into it."

A BRIDGE

To bridge means to be ridge or erect an elevated structure over a depression.

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

I. GENERAL

1. **The Statistical Approach**: JAMES G. DOULL, *The Journal of the Institution of Municipal Engineers*, Vol. 82, No. 9, March 1956, pp. 345-357.
2. **Weighing Trucks in Motion and the Use of Electronic Scales for Research**; W. W. STIFFLER and R. C. BLENSLY, *Traffic Engineering*, Vol. 26, No. 5, February 1956, pp. 195-199 & 206.
3. **A Study of Highway Financing**; *Roads and Engineering Construction*, December 1955, pp. 62-66 & 123-126.
4. **Cycling Tests Proposed for Children**; *The Surveyor*, CXV, No. 3346, 9 June 1956, p. 402.
5. **The Economic Decline of Commercial Centres of Big Cities in United States—Consequence of the Inadaptability of Urban Roads to Motor Vehicle Traffic**; P. DOYEN, *Revue General des Routes et des Aerodromes*, No. 292, May 1956, pp. 73-84 (in French).
6. **Joints in Water-Retaining Structures**; P. L. CRITCHELL, *Indian Concrete Journal*, Vol. 30, No. 6, June 1956, pp. 198-199.
7. **Analysis of a Skew Diversion**; WEN HSIUNG LI, *Proceedings of the American Society of Civil Engineers*, Paper 870, H. W1, January 1956, pp. 1-19.
8. **Control of Highway Access—Experience in New York**; B. D. TALAMY, *Proceedings of the American Society of Civil Engineers*, H. W1, January 1956, Paper 872, pp. 1-6.
9. **Control of Highway Access—Experience in Indiana**; CARL E. VOGELGERANG, *Proceedings of American Society of Civil Engineers*, H. W1, Paper 873, January 1956, pp. 1-9.
10. **Control of Highway Access—Experience in Los Angeles**; HUGO H. WINTER, *Proceedings of American Society of Civil Engineers*, H. W-1, January 1956, paper 874, pp. 1-16.
11. **Control of Highway Access—Experience in Los Angeles**; RALPH A. MOYAR, *Proceedings of American Society of Civil Engineers*, H. W1, January, 1956, Paper 875, pp. 1-14.
12. **Design of Roads in Rural Areas**; *The Surveyor*, Vol. CXV, No. 3342, 12 May, 1956, p. 242.
See Also Highways and Bridges and Engineering Works, Vol. XXIII, No. 1139, 16 May, 56, p. 14.
13. **Turbulent Flow in Smooth and Rough Pipes**; T. CONSTANTINE, *The Journal of the Institution of Municipal Engineers*, Vol. 82, No. 10, April 1956, pp. 401-417.
14. **How to Organize and Write Effective Technical Reports**; RALPH A. RICHARDSON and C. A. BROWN, *Traffic Engineering*, Vol. 26, No. 4, January, 1956, pp. 160-162.
15. **Electrical Prospecting of the Sub-Surface**; M. M. DESERVILLE and GAMBIN, *Annales des Ponts et Chaussées*, Vol. 126, No. 2, March—April 1956, pp. 183-188 (in French).
16. **Use of Salt in Snow Removal**; R. P. DAFFERN, *The Surveyor*, Vol. CXV, No. 3347, 16, June 1956, pp. 420-421.
17. **A Direct Method of Model Analysis**; MORBERT E. LANDDECK, *Journal of the American Society of Civil Engineers*, Vol. 82, January 1956, Paper No. 869 (Structural Division), pp. 1-15.
18. **The Planning of Ring Roads with Special Reference to London**; F. A. RAYFIELD, *Road paper No. 49, Proceedings of the Institution of Civil Engineers, Part II*, Vol. 5, June 1956, No. 2, pp. 99-135.

19. **Up-to-date Applications of "Sampling Method (Rand Sampling Method)"**, with **Traffic Census**; THOMAS MURANYI, *Strasse und Autobahn*, Vol. 7, No. 6, June 1956, pp. 191-196 (in German).
20. **Brick Bus Stops**; KENNETH KNAPP, *American City*, June 1956, pp. 134-135.
21. **Arizona's Reflectorized Shoulder Stripe**; WILLIAM E. WILLEY, *The American City*, August 1956, pp. 161 & 196.
22. **An Outline of Statistical Methods**; J. J. LEEMING, *The Journal of the Institution of Highway Engineers*, Vol. III, No. 11, July 1956, pp. 7-19.
See also Discussion—Journal of the Institution of Highway Engineers, Vol. III, No. 12, October 1956, pp. 14-21.
23. **The Motorways and Bridges of Natal**; R. E. D. BURROW, *The Journal of the Institution of Highway Engineers*, Vol. III, No. 11, July 1956, pp. 48-62.
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27. **Highway Engineering from a County Angle**; *Highways and Bridges and Engineering Works*, Vol. XXIV, No. 1160, October 10, 1956, pp. 1 & 3.
See also The Journal of the Institution of Highway Engineers, Vol. III, No. 12, October 1956, pp. 4-14.
28. **Results of Benefit Analysis on American Highways**; *The Surveyor*, Vol. CXV, No. 3363, October 6, 1956, pp. 770-771.
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30. **Influence of Upgrades on the Economics of Road Construction**; A. SCHUHL, *The Surveyor*, Vol. CXV, October 6, 1956, pp. 769-770.
31. **Expressways for European Cities**; MAX-ERICH FEUCHTINGER, *International Road Safety and Traffic Review*, Vol. IV, No. 3, Summer, pp. 5-17.
32. **An Investigation into the Behaviour of Trucks on Upgrades**; J. F. L. VAN GILS, *International Road Safety and Traffic Review*, Vol. IV, No. 38, Summer, 1956, pp. 21-27.
33. **The Engineer as Policy Maker and Manager**; *The Surveyor*, Vol. CXV, No. 3365, October 20, 1956, p. 817.
34. **The Preparation and Supervision of Highway Contracts**; R. K. CONWAY, *The Journal of the Institution of Highway Engineers*, Vol. III, No. 12, October 1956, pp. 41-54.
35. **Effect of Motorway Design on Accidents in Germany; Highways and Bridges and Engineering Works**; Vol. XXIV, No. 1161, October 17, 1956, pp. 1 & 3 & 4.
36. **The Stability of Hydraulic Structures**; DIN, 19702, *Feton und Stahlbetonbau*, Vol. 51, No. 3, March 1956, pp. 69-71 (in German).
37. **Urban Motorways in Great Britain**; DR. W. H. GLANVILLE and J. F. A. BAKER, *Roads and Road Construction*, Vol. 34, No. 406, October 1956, pp. 290-306.
38. **Simplified Calculations for the Design of Drainage Pipe Lines**; K. WEISS, *Die Bautechnik*, Vol. 33, No. 10, October 1956, pp. 355 (in German).

RECENT ADDITIONS TO THE LIBRARY OF THE INDIAN ROADS CONGRESS

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2. **Steel Columns—A Survey and Appraisal of Past Works**; A. A. Jakkula & Henson K. Stephenson, Bulletin No. 91, June 1947, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
3. **Highway Loads & their Effects on Highway Structures Based on Traffic Data of 1942**, A. A. Jakkula & Henson K. Stephenson, Bulletin No. 116, January 1950, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
4. **Lime Stabilization of Clay Soil**; Bob M. Gallaway & Spencer J. Buchanan, Bulletin No. 124, January 1951, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
5. **Method of Converting Heavy Motor Vehicle Loads into Equivalent Design Loads on the Basis of Maximum Bending Moments**; Henson K. Stephenson & Kriss Cloninger JR, Bulletin No. 127, October 1952, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
6. **The Hot-Melt Plastic Stripe As a Pavement Marking Material**; by Charles J. Keese, Bulletin No. 130, March 1953, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
7. **Method of Converting Heavy Motor Vehicle Loads into Equivalent Design Loads on the Basis of Maximum Shears**; Henson K. Stephenson & Kriss Cloninger JR, Bulletin No. 131, July 1953, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
8. **Stress Producing Effects of Equivalent Design Loads on Modern Highway Bridges**; Henson K. Stephenson & Kriss Cloninger Bulletin No. 132, August 1953, Texas Engineering Experiment Station, College Station, Texas, U.S.A.
9. **Report of the Indian National Society on Soil Mechanics**; July 1950, - Dec., 1951. Indian National Society of Soil Mechanics and Foundation Engineering, Curzon Road, New Delhi.
10. **Report of the Indian National Society on Soil Mechanics**, January 1952 - June 1953. Indian National Society of Soil Mechanics & Foundation Engineering, Curzon Road, New Delhi.
11. **Glossary of Technical Terms in Daily Use (For the Layman)**; Leaflet No. 11, 1954, Central Board of Irrigation and Power, New Delhi.
12. **The Working of State Enterprises in India**; November 25, 1951. The Employers' Association, Calcutta.
13. **Planning and Financing Our Highways**; National Highway Users Conference Inc., 938, National Press Building, Washington 4, D. C.
14. **'Models Save Millions'**; Bulletin of Public Information No. 5, Central Water & Power Commission, New Delhi.
15. **River Improvement Plan of the River flowing Slowly in the Low Humidity Land**; No. 20, 1954. Ryoichi Hironaga, Tadashi Yashima & Shigenobu Sakano, Transactions of the Japan Society of Civil Engineers, Tokyo, Japan.

BUDGETS AND ADMINISTRATION REPORTS

Summary of the Administration Report of the Highways
Department, Government of Madras for the year 1953-54.

There were 15,650 miles of Government Roads and 25,838 miles of District Board roads at the commencement of the year 1953-54 i.e., 1st April 1953. Besides the regular maintenance of these roads, 27 miles were cement-concreted, 1,164 miles were black-topped, 447 miles metalled and 381 miles were formed under Government and District Boards during the year 1953-54. The position of various types of roads as on 31st March 1954, is indicated hereunder :—

	Government Miles	District Board Miles
Cement-concrete roads	244	...
Black-top roads	3,096	179
Metalled roads	5,205	7,904
Unmetalled roads	80	9,351
Total ...	8,625	17,434

The Five Year Plan: Under the first Five Year Plan the composite state of Madras had an allocation of Rs 5 crores under "Roads". Since the districts in Andhra area were separated and are functioning under a different Government with effect from 1st October 1953, the net allocation for the Residuary Madras State was Rs 251.64 lakhs and a scheme was prepared with the following provisions :—

	Rs
State Highways	119.30
Other roads	62.79
Tools and plant	69.55
	251.64

During the year under review, an expenditure of Rs 36.27 lakhs was incurred on State Roads and Rs 15.88 lakhs on other roads.

In respect of National Highways, the Government of India sanctioned a final allotment of Rs 30,79,800 inclusive of agency charges under original works; Rs 15,50,410 for the Residuary Madras State and Rs 15,29,390 towards expenditure incurred upto 30th September 1953 in respect of Andhra districts.

Road Mileage (as on 31st March 1954—Government and District Board Roads).

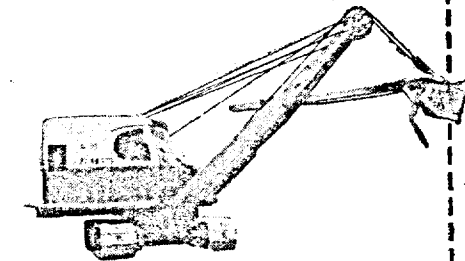
Classification	Cement concrete Roads	Black-top Roads.	Metalled Roads.	Unmetalled Roads.	Total.
National Highways	101	674	290	...	1,065
Provincial Highways	106	692	855	6	1,659
Major District Roads	37	1,845	6,930	305	9,117
Other District Roads	...	44	3,387	2,101	5,532
Village Roads	...	20	1,647	7,019	8,686
Total ...	244	3,275	13,109	9,431	26,059

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

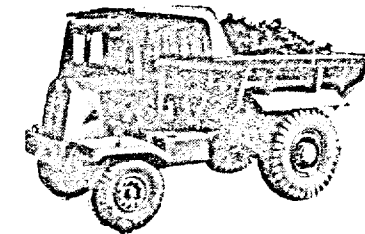
S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
ANDHRA			
1.	TA 42 AH 7	Constructing a diversion between miles 95/4 & 100/2 of the Hyderabad-Kurnool road in Mahradnagar District, N. H. No. 7.	2.97
ASSAM			
2.	1699 AS 39	Construction of a Mohurriys' shed at Zubya on Dinapur-Imphal Road, N. H. No. 39.	0.06
3.	TA 45 AS 37	Remetalling and surfacing certain miles of A. T Road East National Highway No. 37 in Nowgong Division.	3.48
BIHAR			
4.	TA 49 BR 28	Construction of a bye-pass in miles 21st-22nd of Muzaffarpur border, Champaran Sugauli Road, N. H. No. 28.	0.45
BOMBAY			
5.	TA 46 BM 8	Construction of Ghod bunder-Manor Section of the Bombay-Ahmedabad Road, National Highway No. 8.	35.65
DELHI			
6.	1701 DLH I	Improvement to Lower Bela Road link between Lower Bela and Upper Bela in Delhi State.	2.76
HIMACHAL PRADESH			
7.		Two works each costing less than 2 lakhs.	0.06
JAMMU & KASHMIR			
8.	1703 JK 1A	Widening the Qazigund-Srinagar Section of Pathankot-Jammu-Srinagar-Uri Road, National Highway No. 1A.	31.64
KERALA			
9.	TA 47 KR 47	Improvement to Road miles 22/0 to 25/0 of Trivandrum Quilon Section of N. H. No. 47.	2.63

S. No.	Job No.	Name of work	Amount (Rs in Lakhs)
MADRAS			
10.	1704 MD 4	Upgrading the B. T. crust in miles 16/0 to 47/0 of Madras-Chittor-Bangalore Road, National Highway No. 4.	2.91
11.	TA 44 MD 5	Widening the carriageway of National Highway No. 5 to 22' width in Chingleput Division.	7.24
MYSORE			
12.	TA 43 MY 7	Widening the B. T. surface from 12—to 22' in miles 25/0 to 29/4 of Bangalore-Devanahally Bagepally Frontier Road, N. H. No. 7.	2.68
PUNJAB			
13.	TA 50 PB 10	Reconditioning miles 84 to 89 of Delhi-Hissar-Sulemanki Road, National Highway No. 10.	4.31
14.		Two works each costing less than 2 lakhs.	0.75
UTTAR PRADESH			
15.	1702 UP 24	Survey of the proposed bridge over the river Ram Ganga near Moradabad on the Delhi-Lucknow Road, National Highway No. 24.	0.20
WEST BENGAL			
16.		Two works each costing less than 2 lakhs.	1.45

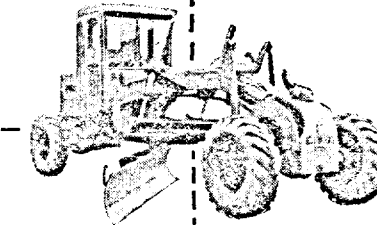
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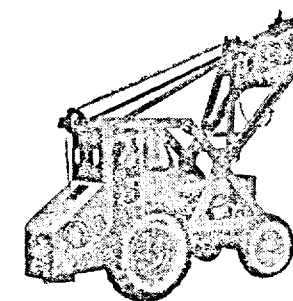
RUSTON-BUCYRUS
EXCAVATOR



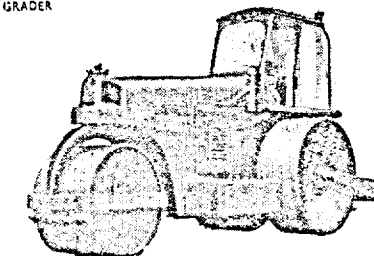
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TYPE 'GD' ROAD ROLLER

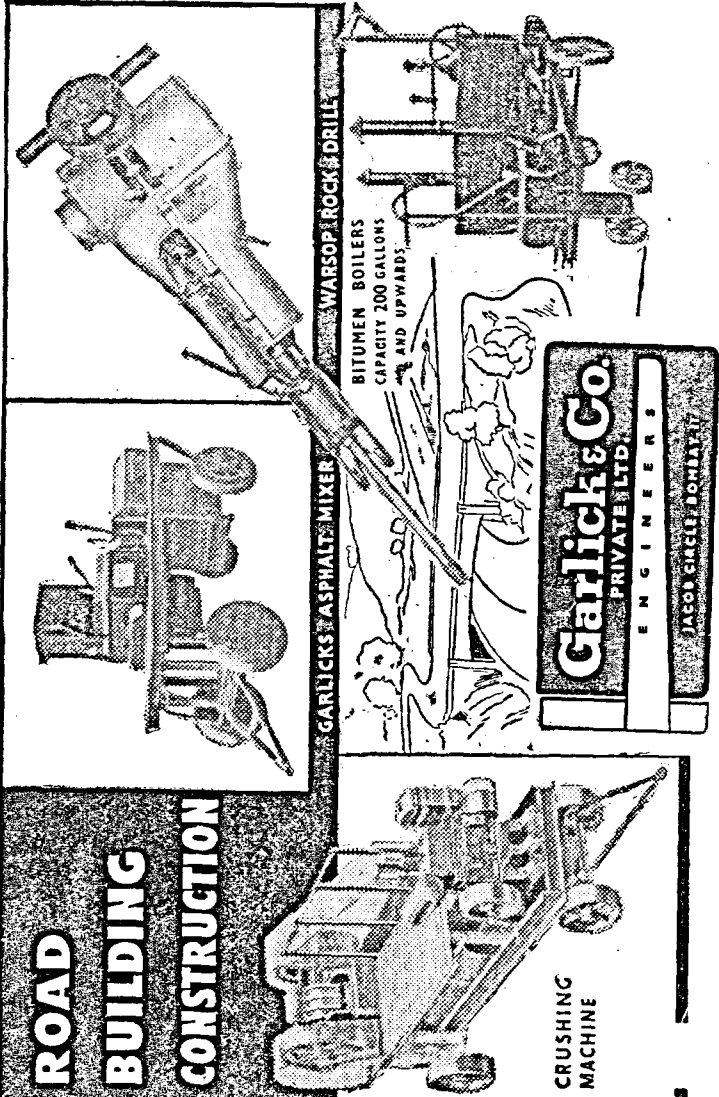


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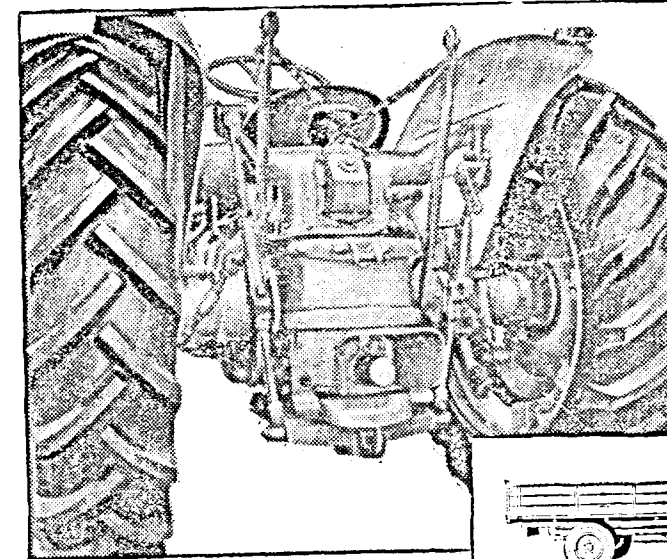
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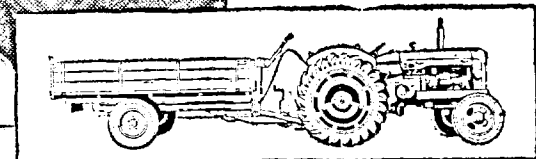
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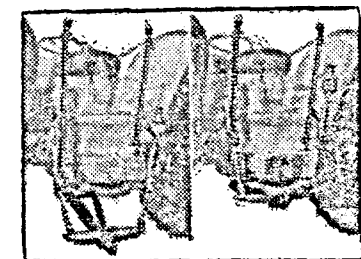
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*The automatic pick-up
hitch in the lowered position (left) and in the
raised position (right).*

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