TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

AUGUST 1956—No. 112

INDIAN ROADS CONGRESS, NEW DELHI.

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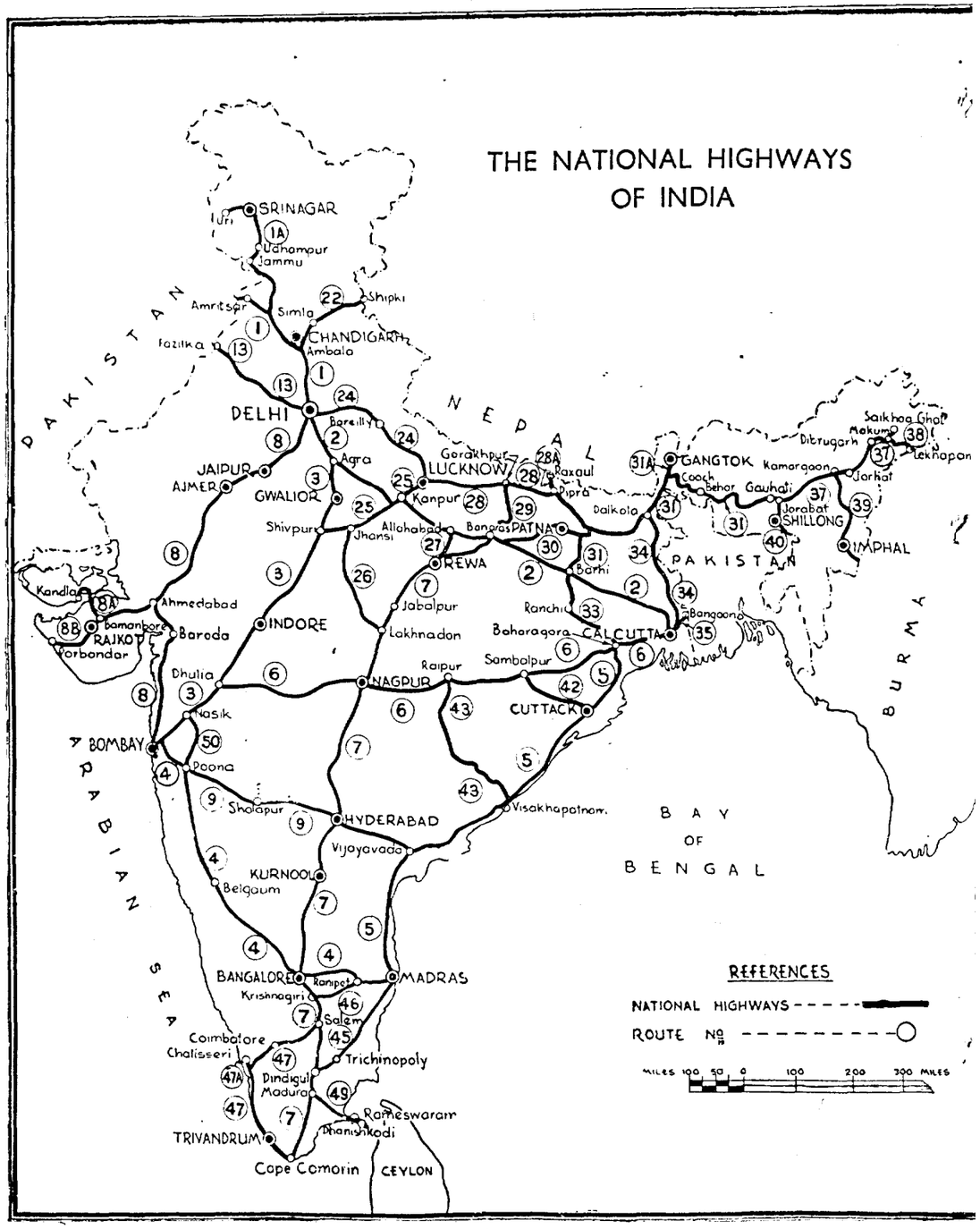

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

AUGUST 1956

THE NATIONAL HIGHWAYS BILL

ON 7-8-56, the Union Minister for Transport and Railways, Shri Lal Bahadur introduced in Parliament the National Highways Bill. The introduction of this Bill constitutes a significant landmark in the development of road communications in India. The Bill (Appendix) provides for the declaration of 39 routes as National Highways, and for their development, construction and maintenance. Power is proposed to be taken, subject to approval of the Parliament, to make additions to or deletions from the proposed National Highway Systems. Authority is proposed to be given to the Central Government to enter into agreements with State Governments or Municipalities in respect of development or Maintenance of any portion of the system or of any muuicipal link to the system. The normal agency for the execution of the work will be the State P. W. D., but the Centre will have freedom to entrust the work to any other agency as at present.

Commending the Bill to the Lok Sabha, on the 13th August 1956 Shri O. V. Alagesan, Union Deputy Minister for Transport and Railways, said "The National Highways Bill represents another landmark in the history of India's development. This is a unique occasion inasmuch as this is the first time that the Central Government proposes to take over direct statutory responsibility for certain highways in the States."

During the discussion, members welcomed the Bill and suggested additions to the proposed system of National Highways. After a clause-by-clause discussion the Bill (Appendix) was passed by the House. It is hoped that the Bill will be enacted shortly.

BRIEF HISTORY

The importance of the development of land communications has been recognised in India from early times. During the early days of the British period, i.e., before the development of railways, a number of trunk roads were constructed for administrative and strategic purposes. But soon the emphasis shifted to railway development and roads were considered to be of local importance. So, in the Government of India Act of 1919 roads became a provincial subject. In the various Provinces, planning, construction and maintenance of roads were left to Local Bodies in varying degrees. Poor resources and lack of a co-ordinated development was the result and the construction of roads received a setback. Even trunk roads were allowed to fall into a State of disrepair.

After the first world war the motor vehicle came to use the Indian Roads.

Insistent demands for more and better roads were made. These demands culminated in a resolution of the Indian Legislature passed in 1927 for the appointment of a committee to examine the question of road development in India.

The Committee which was presided over by Shri M. R. Jayakar, recommended the creation of a Central Road Fund from the proceeds of an additional customs and excise duty on petrol to be used for road development. This Fund came into existence on the 1st of March 1929. The economic depression between the world wars resulted in money for the roads being cut to the core and in some cases the Central Road Fund was used even for maintenance.

In 1933, the creation of a Federal Trunk Road System was considered and it was proposed that this system might be, in some measure, a Federal charge. But due to the emphasis on provincial autonomy, roads continued to remain a provincial subject in the Government of India Act of 1935.

The second World War brought into prominence the necessity for an integrated road system. Lack of well-developed through routes and bridges at important crossings, and the fact that there was a limit to what the railways could carry, emphasized that the trunk roads could be properly developed only if the Centre took over their development and maintenance. That co-operation between the Centre and the States, and States and Local Government units, each functioning in its own sphere, was productive of excellent results was also evident from the history of road development in other countries, notably in the U. S. A., France and Australia.

On the conclusion of hostilities, the Indian Roads Congress, as a body premarily interested in the development of road communications in India, considered the postwar planning for road development and the Council passed the following resolution in October 1943.

> Roads be divided into four classes—National (or All India) Highways; Provincial main roads; District roads and Village roads; and that
>
> (1) *All-India Highways* be planned by the Government of India.
>
> (2) *Provincial Main Roads* be planned by Provinces to standards, e.g., widths, bridging, etc., uniform as nearly as possible, suggested by the Government of India.
>
> (3) *District Roads* be planned by the Provinces on 'Pilot Survey' lines to standards, uniform as nearly as possible, approved by the Government of India.
>
> (4) *Village Roads* be planned by or under the supervision of a special Engineer Officer or Officers responsible to the Provincial Government, from the 'Pilot Surveys' prepared for district roads, to uniform standards as nearly as possible.

This resolution may be said to be the first move to classify roads on an All-India basis.

The experience during the second World War led the Government of India to convene at Nagpur a conference of Chief Engineers of Provinces and States to prepare a road development plan for the whole of India. This conference recommended among others that:

(a) roads should be divided into four classes, namely, National Highways, Provincial or State Highways, District Roads and Village Roads. The National Highways were defined as highways running through the length and breadth of India connecting major ports, foreign highways, and capitals of Provinces and of large States, being the framework for the country's road system; and

(b) the Centre should assume financial responsibility for the construction, development, and maintenance of National Highways and they should have an effective say in the use and control of these Highways.

(*Continued on page 32*)

Appendix

THE NATIONAL HIGHWAYS BILL, 1956

(AS PASSED BY LOK SABHA)

A BILL

to provide for the declaration of certain highways to be national highways and for matters connected therewith.

STATEMENT OF OBJECTS AND REASONS

UNDER an agreement entered into with the then existing Provinces, the Government of India provisionally accepted entire financial liability, with effect from the 1st April 1947, for the construction, development and maintenance of certain highways in the Provinces which were considered suitable for inclusion in a system of national highways. Upon the creation of the Part B States and the new Part C States under the Constitution, the national highways scheme was extended to those States also.

Under entry 23 of the Union List, Parliament has exclusive power of legislation with respect to highways which are declared to be national highways by or under law made by Parliament. It is, therefore, proposed that the highways comprised in the Schedule annexed to this Bill should be declared to be national highways. Such a declaration would help the Central Government in exercising its powers with respect to the development and maintenance of these highways more effectively. Power is also sought to be vested in the Central Government to declare by notification other highways to be national highways. Power should also be given to the Central Government to enter into agreements with the State Governments or municipal authorities with respect to the development or maintenance of any portion of any national highway and fees may have to be levied in respect of certain types of services rendered on national highways.

The present Bill is designed to achieve the objects set forth above.

Be it enacted by Parliament in the Seventh year of the Republic of India as follows:

SHORT TITLE, EXTENT AND COMMENCEMENT

1. (*1*) This Act may be called the National Highways Act, 1956.

(*2*) It extends to the whole of India.

(*3*) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint.

DECLARATION OF CERTAIN HIGHWAYS TO BE NATIONAL HIGHWAYS

2. (*1*) Each of the highways specified in the Schedule except such parts thereof as are situated within any municipal area is hereby declared to be a national highway.

(*2*) The Central Government may, by notification in the Official Gazette, declare any other highway to be a national highway and on the publication of such notification such highway shall be deemed to be specified in the Schedule.

(*3*) The Central Government may, by like notification, omit any highway from the Schedule and on the publication of such notification, the highway so omitted shall cease to be a national highway.

DEFINITION

3. In this Act, "municipal area" means any municipal area with a population of twenty thousand or more the control or management of which is entrusted to a municipal committee, a town area committee, a town committee or any other authority.

NATIONAL HIGHWAYS TO VEST IN THE UNION

4. All national highways shall vest in the Union, and for the purposes of this

Act "highways" include—

(*i*) all lands appurtenant thereto whether demarcated or not;

(*ii*) all bridges, culverts, tunnels, causeways, carriageways and other structures constructed on or across such highways; and

(*iii*) all fences, trees, posts and boundary, furlong and mile stones of such highways or any land appurtenant to such highways.

RESPONSIBILITY FOR DEVELOPMENT AND MAINTENANCE OF NATIONAL HIGHWAYS

5. *It shall be the responsibility of the Central Government to develop and maintain in proper repair all national highways; but the Central Government may, by notification in the Official Gazette, direct that any function in relation to the development or maintenance of any national highway shall, subject to such conditions, if any, as may be specified in the notification, also be exercisable by the Government of the State within which the national highway is situated or by any officer or authority subordinate to the Central Government or to the State Government.*

POWER TO ISSUE DIRECTIONS

6. The Central Government may give directions to the Government of any State as to the carrying out in the State of any of the provisions of this Act or of any rule, notification or order made thereunder.

FEES FOR SERVICES OR BENEFITS RENDERED ON NATIONAL HIGHWAYS

7. (*1*) The Central Government may, by notification in the Official Gazette, levy fees at such rates as may be laid down by rules made in this behalf for services or benefits rendered in relation to the use of ferries, temporary bridges and tunnels on national highways.

(*2*) Such fees when so levied shall be collected in accordance with the rules made under this Act.

(*3*) Any fee leviable immediately before the commencement of this Act for services or benefits rendered in relation to the use of ferries, temporary bridges and tunnels on any highway specified in the Schedule shall continue to be leviable under this Act unless and until it is altered in exercise of the power conferred by sub-section (*1*).

AGREEMENTS WITH STATE GOVERNMENTS OR MUNICIPALITIES

8. Notwithstanding anything contained in this Act, the Central Government may enter into an agreement with the Government of any State or with any authority entrusted with the control or management of any municipal area in relation to the development or maintenance of the whole or any part of a national highway situated within the State or, as the case may be, in relation to the development or maintenance of any such part of a highway situated within a municipal area as is referred to in sub-section (*1*) of section 2, and any such agreement may provide for the sharing of expenditure by the respective parties thereto.

POWER TO MAKE RULES

9. (*1*) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

(*2*) In particular and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:

(a) the manner in which, and the conditions subject to which, any function in relation to the development or maintenance of a national highway or any part thereof may be exercised by the State Government or any officer or authority subordinate to the Central Government or the State Government;

(b) the rates at which fees for services rendered in relation to the use of ferries, temporary bridges and tunnels on any national highway may be levied and the manner in which such fees shall be collected;

(c) the periodical inspection of national highways and the submission of inspection reports to the Central Government;

(d) the reports on works carried out on national highways;

(e) any other matter for which provision should be made under this Act.

LAYING OF NOTIFICATIONS, RULES, ETC., BEFORE PARLIAMENT

10. All notifications or agreements issued or entered into under this Act shall be laid before both Houses of Parliament as soon as may be after they are issued or entered into and all rules made under section 9 shall be laid for not less than thirty days before both Houses of Parliament as soon as may be after they are made, and shall be subject to such modifications as Parliament may make during the session in which they are so laid or the session immediately following.

THE SCHEDULE

[See section 2]

NATIONAL HIGHWAYS

Serial No.	National Highway No.	Description of national highways
1	1	The highway connecting Delhi, Ambala, Jullundur, and Amritsar and proceeding to the border between India and Pakistan.
2	1A	The highway connecting Jullunder, Madhopur, Jammu, Banihal, Srinagar, Baramula and Uri.
3	2	The highway connecting Delhi, Mathura, Agra, Kanpur, Allahabad, Banaras, Mohania, Barhi and Calcutta.
4	3	The highway connecting Agra, Gwalior, Shivpuri, Indore, Dhulia, Nasik, Thana and Bombay.
5	4	The highway starting from its junction near Thana with the highway specified in serial No. 4 and connecting Poona, Belgaum, Hubli, Bangalore, Ranipet and Madras.
6	5	The highway starting from its junction near Baharagora with the highway specified in serial No. 7 and connecting Cuttack, Bhubaneswar, Visakhapatnam, Vijayavada and Madras.
7	6	The highway starting from its junction near Dhulia with the highway specified in serial No. 4 and connecting Nagpur, Raipur, Sambalpur, Baharagora and Calcutta.
8	7	The highway starting from its junction near Banaras with the highway specified in serial No. 3 and connecting Mangawan, Rewa, Jabalpur, Lakhnadon, Nagpur, Hyderabad, Kurnool, Bangalore, Krishnagiri, Salem, Dindigul, Madurai and Cape Comorin.
9	8	The highway connecting Delhi, Jaipur, Ajmer, Udaipur, Ahmedabad, Baroda and Bombay.
10	8A	The highway connecting Ahmedabad, Limbdi, Morvi and Kandla.
11	8B	The highway starting from its junction near Bamanbhore with the highway specified in serial No. 10 and connecting Rajkot and Porbandar.
12	9	The highway connecting Poona, Sholapur, Hyderabad and Vijayavada.
13	10	The highway connecting Delhi and Fazilka and proceeding to the border between India and Pakistan.
14	22	The highway connecting Ambala, Kalka, Simla, Narkanda, Rampur and Chini and proceeding to the border between India and Tibet near ShipkiLa.
15	24	The highway connecting Delhi, Bareilly and Lucknow.
16	25	The highway connecting Lucknow, Kanpur, Jhansi and Shivpuri.
17	26	The highway connecting Jhansi and Lakhnadon.

Serial No.	National Highway No.	Description of national highways
18	27	The highway connecting Allahabad with the highway specified in serial No. 8 near Mangawan.
19	28	The highway starting from its junction near Barauni with the highway specified in serial No. 23 and connecting Muzaffarpur, Pipra, Gorakhpur and Lucknow.
20	28A	The highway starting from its junction near Pipra with the highway specified in serial No. 19 and connecting Sagauli and Raxaul and proceeding to the border between India and Nepal.
21	29	The highway connecting Gorakhpur, Ghazipur and Banaras.
22	30	The highway starting from its junction near Mohania with the highway specified in serial No. 3 and connecting Patna and Bakhtiyarpur.
23	31	The highway starting from its junction near Barhi with the highway specified in serial No. 3 and connecting Bakhtiyarpur, Mokameh, Purnea, Dalkhola, Siliguri, Sivok, and Cooch Behar and proceeding to its junction with the highway specified in serial No. 28 near Goalpara.
24	31A	The highway connecting Sivok and Gangtok.
25	33	The highway starting from its junction near Barhi with the highway specified in serial No. 3 and connecting Ranchi and Tatanagar and proceeding to its junction with the highway specified in serial No. 7 near Baharagora.
26	34	The highway starting from its junction near Dalkhola with the highway specified in serial No. 23 and connecting Berhampore, Barasat and Calcutta.
27	35	The highway connecting Barasat and Bangaon and proceeding to the border between India and Pakistan.
28	37	The highway starting from its junction near Goalpara with the highway specified in serial No. 23 and connecting Gauhati, Jorabat Kamargaon, Makum and Saikhoa Ghat.
29	38	The highway connecting Makum, Ledo and Lekhapani.
30	39	The highway connecting Kamargaon, Imphal, and Palel and proceeding to the border between India and Burma.
31	40	The highway connecting Jorabat and Shillong and proceeding to the border between India and Pakistan near Dawki.
32	42	The highway starting from its junction near Sambalpur with the highway specified in serial No. 7 and proceeding *via* Angul to its junction with the highway specified in serial No. 6 near Cuttack.
33	43	The highway connecting Raipur and Vizianagaram and proceeding to its junction with the highway specified in serial No. 6 near Vizianagaram.
34	45	The highway connecting Madras, Tiruchirappalli and Dindigul.
35	46	The highway connecting Krishnagiri and Ranipet.
36	47	The highway connecting Salem, Coimbatore, Trichur, Ernakulam, Trivandrum and Cape Comorin.
37	47A	The highway starting from its junction near Trichur with the highway specified in serial No. 36 and connecting with the West Coast Road near Chalisseri.
38	49	The highway connecting Madurai and Dhanushkodi.
39	50	The highway connecting Nasik with the highway specified in serial No. 5 near Poona.

BUREAU OF PUBLIC ROADS, U. S. A.

THE PART IT PLAYS IN THE CONSTRUCTION OF HIGHWAYS

THE following extracts from an article by J. M. Page, District Engineer, Bureau of Public Roads, Texas, are given to illustrate the manner in which the Bureau of Public Roads co-operates with the State Highway Departments to build a State Highway System in accordance with sound engineering principles. The Bureau of Public Roads is an agency of the Federal Government under the Department of Commerce whose chief function is the administration of Federal funds appropriated by Congress for the construction of highways and apportioned to the several States. It had its beginning in 1893 as "The Office of Road Inquiry" in the Department of Agriculture. It was in the year 1916, when the first Federal-aid Highway Act was passed, that the Bureau was constituted as it exists today. In 1916 there were very few paved roads in the United States outside cities and actual construction of the highway system of the United States under the supervision of various State Highway Departments began only in 1919.

The Bureau operates through a Washington staff headed by the Commissioner, with a Deputy Commissioner in charge of each of the major subdivisions. This same scheme of organization is reflected in each of the ten divisions into which the country is divided, each headed by a division engineer whose jurisdiction covers several States.

There is a district engineer in charge of each State. He is assisted by adequate staff of engineers and clerical establishment. The primary purpose of the division and district engineers is the legal responsibility to administer the expenditure of Federal funds in accordance with the Federal Highway Act and the governing rules and regulations. To this end, field inspections are made in conjunction with the State's engineers to determine acceptable routes, locations, and details of design.

In planning a Federal-aid construction programme under the Federal legislation, the Highway Department of the State has the right of initiating the projects proposed for inclusion in the programme. The district engineer examines the project proposed for construction, for compliance with Federal requirements, justification from the standpoints of benefits to the public, traffic requirements and continuity of the system, and withholds approval to any proposed project which cannot meet such criteria.

The regulations of the Bureau of Public Roads require also that its concurrence in the award of each contract be obtained, except those in the secondary or farm-to-market category, before Federal funds are made available for construction. The award of contract must go to the lowest responsible bidder in every case, and the low bid must be considered to be reasonable. Following the award of contract and start of construction, inspecting engineers of the Bureau visit each active construction project except farm-to-market projects at least once each month and file a written report concerning it. On farm-to-market projects the Bureau's engineers make final inspections only. The work accomplished must be satisfactory and in accordance with the plans and specifications. The materials used must have been subjected to laboratory tests and found to meet specification requirements before Federal reimbursement vouchers are issued to the State. Normally the State claims reimbursement for the Federal pro-rata share of the cost of the work accomplished on each project once each month. Since there are usually a large number of projects throughout a State for inspection, the engineers attach-

ed to the district office have to be busy inspecting works. They are also required to make maintenance inspections and compile reports because the Federal Highway Act requires agreement upon the part of the State to maintain all completed projects in a manner satisfactory to the Commissioner of Public Roads.

Since World War II, Federal funds have been allocated in three separate and distinct categories and apportioned to the States in specific percentages based upon a formula applicable equally to each State : (1) For projects on the Federal-aid primary highway system, (2) for projects on the Federal-aid secondary or farm-to-market highway system, and (3) for projects on the Federal-aid highway system in urban areas. Recently a fourth category has been added—the interstate highway system. The interstate highway system is a very limited system of only the most important highways of the United States, totalling approximately 40,000 miles, but which carry a large proportion of the total traffic. This system was selected very carefully by the several State Highway Departments and the Bureau of Public Roads and in co-operation with the Department of Defence, both for its economic importance in time of peace and its strategic value to the nation in time of war.

The interstate system is visualized as a co-ordinated system of a heavy-duty, controlled-access, freeway type of facility, so designed and constructed on rights-of-way of sufficient width that the adequacy of the highway will not be adversely affected by future development along the roadside. To realize this goal, the interstate system must be fully comparable to the best of the toll roads—but without the tolls.

The evolution of the American highway from the so-called all-weather road of the early years of this century to the multi-laned, intricately designed expressways and freeways of today is the natural result of the evolution of the automobile from its early beginnings and the perfection of mass production methods in its manufacture. The Bureau of Public Roads have throughout these years consistently insisted upon a high standard of quality of both design and construction on all works in which Federal funds have been expended.

When thinking people get together to formulate plans or procedures, there is always diversity of thought and disagreement that should be settled through debate. If there were no disagreements it would be a good evidence that one of the co-operators was lacking in those qualities that make a good engineer. Oftentimes, conflicting personal opinions of the State and the Bureau of Public Roads administration must be co-ordinated even though design standards and engineering fundamentals are not always involved. It is here that the division and the district staff of the Bureau of Public Roads play an important role.

In India, the Roads Wing of the Ministry of Transport at the Centre can be likened to the Bureau of Public Roads and the Engineer-Liaison Officers of this Organization in the various States to that of the district engineers in America.

(Adapted from "Texas Highways" December, 1955.)

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

SPRAYER : An equipment for distributing fluid materials as a film, either by gravity or pressure over a road surface.

SPREADER : A machine mounted on wheels for distributing, while in transit, loose material over a road.

AN EXPERIMENT ON THE USE OF CALCIUM CHLORIDE FOR MAINTENANCE OF WATER-BOUND MACADAM SURFACES

By

A. C. Dutt

DURING the hot and dry periods of the year, the binder soil of water-bound macadam surfaces gets crushed under the action of traffic and is blown away by the wind. This results in loosening of road stone. In order to prevent disintegration of the surfaces it is necessary to prevent the blowing away of the binder soil. Obviously, the simplest solution is to spray water, but unfortunately due to evaporation, water spraying does not produce enduring results and frequent applications would be very costly. To reduce evaporation, hygroscopic and deliquescent chemical may be used. Calcium chloride is a suitable chemical and is used for similar purposes in Europe and the United States. When calcium chloride flakes are spread over a dusty surface, they absorb moisture from the atmosphere. This moisture helps the compaction of the water-bound macadam under traffic.

Use of calcium chloride prevents rapid evaporation of moisture

Calcium chloride ($CaCl_2$) is a white salt. It has the property of absorbing moisture from air and finally dissolving itself ; in other words, it is deliquescent. Also, it possesses the property of retaining moisture without necessarily becoming liquid for a comparatively long time, in other words, it is hygroscopic. Temperature remaining constant, it absorbs more moisture with higher humidity. Also, the higher the humidity, the lower the temperature at which the chemical dissolves.

As the speed of evaporation is directly affected by temperature and the concentration of the materials in question, water in the solution of calcium chloride would evaporate comparatively slowly than pure water. Therefore, soils containing calcium chloride solution would remain moist longer than soils moistened with pure water.

Also solutions having high surface tension tend to evaporate less rapidly than those with low surface tension. So calcium chloride solution which has higher surface tension than pure water, will have less evaporation than plain water.

If, therefore, dry soil is moistened with water, evaporation will take place until the soil becomes dry again. But if the water be mixed with an equal quantity of calcium chloride solution, which is in equilibrium as to temperature and relative humidity, it will stay continually to be moist.

By field and laboratory tests, the Bureau of Public Roads of the U.S.A. arrived at the following conclusion regarding the use of calcium chloride.

1. Calcium chloride migrates through soil. During high temperature, it tends to concentrate near surface and is carried down by leaching during wet weather.

2. Vapour pressure or evaporation rate is lessened by calcium chloride, thus moisture essential for stability is retained.

3. Compaction is facilitated by the presence of moisture during use by traffic.

4. Aggregate loss is reduced and hence tendency to dusting is also lessened.

5. During wet period, the calcium chloride is leached down along with the rain water but with rise of temperature, the salt from lower layers tends to pass on to the surface and thus keeps the soil moist.

6. Spraying of calcium chloride over the water-bound surface will reduce the tendency of the blindage getting dry and minimises the formation of dust and resultant displacement of metal.

Calcium chloride does not occur in nature except in buric salt solutions and in certain mineral springs and in a few minerals of no commercial importance. It is a by-product in the manufacture of Ammonia or Ammoniam Carbonate. Until its use for dust laying and soil stabilization and for concrete hardening was discovered, the chemical was considered a waste product.

Specifications for the material

The following are the tentative specifications issued by the American Society for Testing Materials for calcium chloride for road use.

(a) Physical Properties: The calcium chloride shall be in the form of flakes and when tested shall conform to the following requirements :—

Passing $\frac{3}{8}$ in. mesh	100 per cent
Retained on $\frac{1}{4}$ in. mesh	not more than 20 per cent
Passing 20 sieve	not more than 10 per cent

(b) Chemical Composition: The calcium chloride shall conform to the following requirements as to chemical composition :

$CaCl_2$ (anhydrous)	77 per cent
$MgCl_2$	0.5 per cent
Total alkali chlorides	2.0 per cent
Other impurities	1.0 per cent

A 3 per cent variation in content of $CaCl_2$ from the chemical composition shall be permissible.

Calcium chloride shall be delivered in moisture proof bags. Material which has become caked or sticky in the containers shall be rejected.

Methods of use of calcium chloride on roads

Treatment with calcium chloride consists of simply spreading the flakes, as evenly as possible, over the surface to be treated.

An initial application of 1 to 1.5 lb per sq. yd. is usually recommended, followed by a lighter application later on preferably during mid-summer.

The surface to be treated should be moistened by sprinkling water. If possible, the initial application of the flakes may be done immediately after a light shower. When it has to be applied at a time when showers are not expected, the flakes may be spread very early or very late in the day. For best results, calcium chloride should be applied before the surface disintegrates and becomes dusty. The effectiveness of the application would depend on the extent of dry spells, intensity of traffic and looseness of the metal, etc. Very loose or sandy surface will keep better if a little clay is worked in ; on the other hand, surfaces liable to become muddy during rain may be improved with a "dash" of sand.

Where reasonably clean water is available, calcium chloride may be mixed with water and sprayed. Fill a barrel upto half of its height with water, say 25 gallons, and add 100 lb of calcium chloride and stir until it dissolves. This will yield approximately 32 gallons of solution.

For initial application, the rate recommended by manufacturers is a solution about one quarter of a gallon to the square yard. For subsequent light treatments, one pint per square yard is recommended.

Since calcium chloride will spread on dissolving, it is sufficient to treat the surface leaving one foot on the outer sides. For example, provision for a 6 ft width would actually cover 8 ft width of road.

A spreader or a sprinkler, as the case may be, may easily be improvised out of old drums by fixing an axle through the centre of halved (longitudinally) drums with wheels at each end, and the

contrivance may be fixed to the rear of an ordinary truck.

The speed of the truck may be so adjusted that the recommended quantity is sprayed on the road surface.

Since it is the nature of calcium chloride to absorb and hold moisture, containers and spraying equipments have to be washed with clear water following use. This should be in addition to regular routine lubrication and painting.

Field trials

As an experiment, a length of two furlongs in the 10th mile of Purbabishnupur, Raidighi Road in the 24-Parganas District of West Bengal was treated with calcium chloride. The application in the first furlong was by the dry method and that in the second furlong was by the wet method. Details are given below :

Treatment by dry method : Treatment was taken in hand on 9th February 1955 when the water-bound surface which was 10 ft in width started disintegrating. The condition of the surface before the application is shown in photos 1 to 3. Loose and floating materials were picked up and re-set in crevices, "likhs" and potholes as far as possible, photo 4. Water available in the borrow pits was sprinkled on the surface, photo 5, prior to blinding with earth as shown in photo 6. Empty 4-gallon diesel tins were filled with exactly

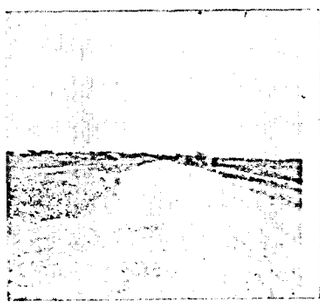

Photo 1.
Starting of displacement of the Road Stone.

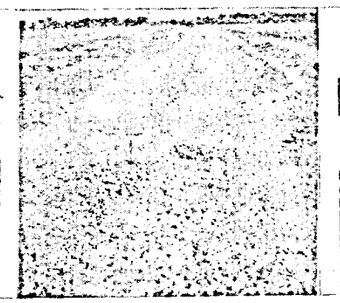

Photo 2.
Floating metal and development of Pot holes.

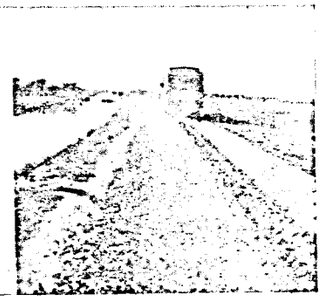

Photo 3.
Dust clouds formation & displacement of metal.

Photo 4.
Picking up & resetting loose metal.

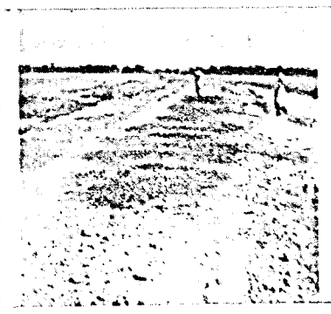

Photo 5.
Sprinkling water.

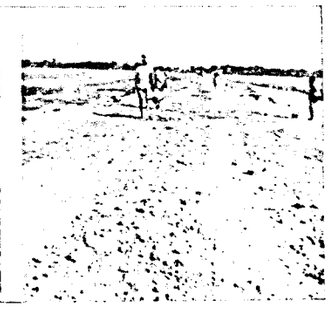

Photo 6.
Earth blinding.

13.4 lb of calcium chloride in each tin, photos 7 and 8. The surface to be treated was then moistened with water, photo 9. The surface was also marked longitudinally by two lines 8 ft apart i.e. one foot from the edge of the metaling on either side and every 10 ft transversely giving panels 8 ft by 10 ft. Over the 80 sq. ft area of one panel the content of one 4-gallon tin, namely 13.4 lb, was spread as evenly as possible, photos 10 and 11.

After the spreading of calcium chloride was completed, the road was kept closed for 8 hours and then opened to unrestricted traffic.

All the above operations were carried out by eight mazdoors in one day and thus the total cost for treating one mile by dry method was Rs $(8\times2)8+(3.52$ tons of $CaCl_2$ @ Rs 600$)=$Rs 2,240 per mile.

Wet method of treatment: The treatment of the second furlong was taken up on the 16th February 1955. Details are given below:

An empty barrel was half filled with clean water, say 25 gallons. One hundred pounds of calcium chloride was poured into this water and the whole stirred until completely dissolved, photos, 12, 13 and 14. The volume after thorough mixing

Photo 7. **Calcium Chloride being taken out of drums.**

Photo 8. **Weighing & filling of 4-gallon tins.**

Photo 9. **Moistening of the surface with water.**

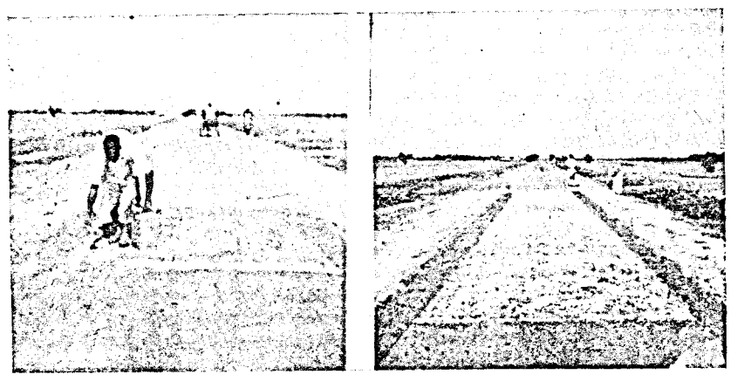

Photo 10. **Dry spreading of Calcium Chloride.**

Photo 11. **Spreading completed in 8 ft width.**

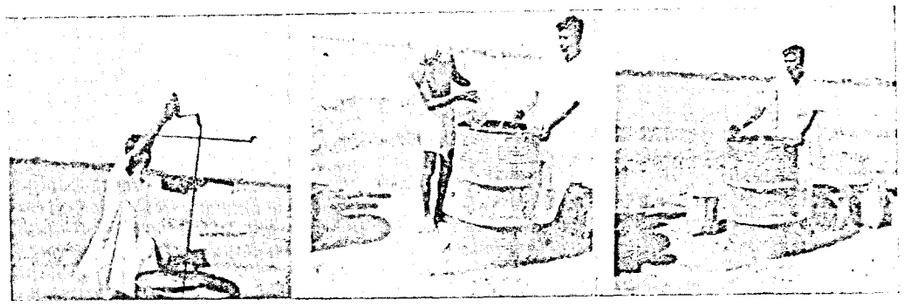

Photo 12. **Stirrer for mixing.**

Photo 13. **Calcium Chloride being poured into drum.**

Photo 14. **Solution being stirred.**

was found to be 32 gallons. The water-bound surface was then divided into panels of 75 ft in length and 8 ft in width which is 2 ft less in width than that of the surface on the assumption that the solution would spread and ultimately cover the entire 10 ft. The surface was then moistened prior to sprinkling of the solution The 75 ft long panels were subdivided into eight parts and in each part 4 gallons of the solution was spread as uniformly as possible, photos 15 and 16. Finally, the treated surface was kept closed to traffic for 8 hours and then opened to unrestricted traffic.

Labour employed for the work was 8 mazdoors at Rs 2 per furlong, i.e. $16\times8=$ 128 per mile. Approximately 3.52 tons of calcium chloride at Rs 600 per ton costing Rs 2,112 was used. Thus the total cost was Rs 2,240 per mile.

Behaviour of the treated road

It was seen that by absorption of moisture from the atmosphere the entire 10-ft width was evenly coated. The surface remained as if treated with asphalt.

The surface as it appeared on 7th May

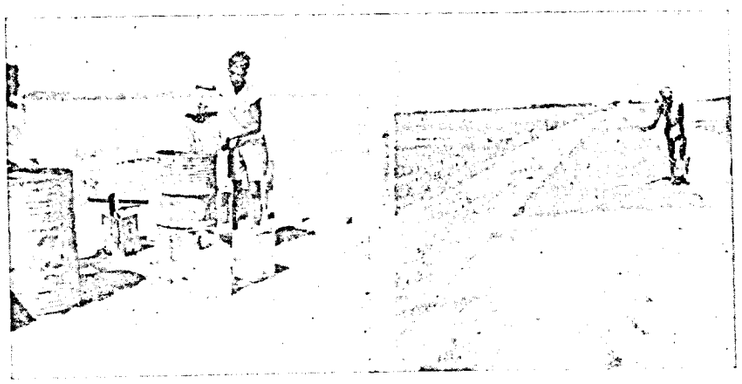

Photo 15. **Four gallons tins being filled.**

Photo 16. **Spreading of solution.**

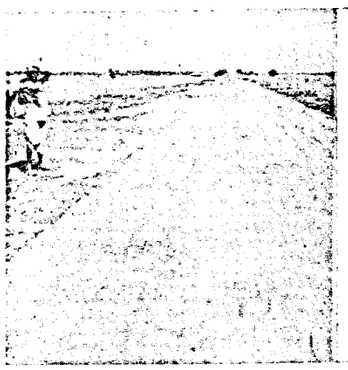

Photo 17.
Treated surface as in mid summer.

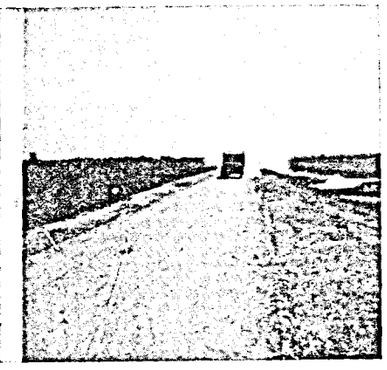

Photo 18.
Treated surface.

1955, i.e., nearly 2½ months after the treatment, is shown in photos 17 and 18.

Not only is the treated surface keeping its shape even though no maintenance has been done since treatment, the fast-moving vehicles do not raise any dust.

The traffic using the road is:

	Nos. per day
Lorries	50
Buses	30
Cars	10
Rickshaws	30
Taxis	20
Bullock carts	30

Till September 1955, no maintenance was found necessary and the condition of the surface was good, being practically the same as when the surface was treated.

In October 1955, the road was given one coat surface dressing with road tar RT 3. In the Author's opinion, the surface in the two furlongs treated with calcium chloride is much superior to the surface in the portion not treated.

In actual practice it was found that the wet method was more easy for application than the dry method. Also, there were chances of wastage of the calcium chloride in the latter method.

For extensive application, a sprinkling arrangement mounted on a 3-ton truck would be economical and would give a more uniform result. An estimated cost of such a sprinkler arrangement would be of the order of Rs 300.

CRACK DOWN ON TRAFFIC OFFENDERS IN SAUDI ARABIA

Just a few months back the Government in Saudi Arabia issued another decree to keep the wayward motorist in line. According to this decree, if an accident occurs as a result of speeding and negligence, but no one is killed in the accident, the offending driver is imprisoned for one year and has his licence taken away. If anyone is killed in the accident, the offending driver has to be summarily executed.

Since the passing of this decree, points out the National Automobile Club, drivers in Saudi Arabia have been conspicuously sober and sedate. Some of them have even put the car away in the garage and hung the key up on a high place by the door.

BRIDGES AND RIVER CONTROL USE OF HYDRAULIC MODELS

By
D. V. Joglekar & S. D. Phansalkar

IN olden times, rivers were the chief means for inland transport. When roads and railways came to be used as the principal modes of transport, unbridged rivers were impediments to speedy transportation.

Bridge-building, developed rapidly in India as elsewhere in the world during the last century along with the expansion of roads and railways. Methods of design varied according to the type of river to be bridged.

Broadly speaking, rivers in the Deccan flow through deep channels with stable banks. Generally good rocky foundations are available, no special difficulties are experienced about the safety of the structures.

The rivers in the Indo-Gangetic and other flood plains flow through deep alluvial beds which are unstable. Their channel widths are very large, though only a small fraction is occupied by the cold weather flowing channel. In the monsoon when they are in spate, full section is occupied though a substantial part of it, is fairly shallow and carries only sluggish flow. Also due to unstable bed, the position of the main channel carrying bulk of the discharge keeps on changing.

Bridging from bank to bank of these wide rivers is costly. Also the difficulty of protecting the bridges and their approaches from the ever wandering courses of these rivers is a major problem confronting the bridge engineer.

Narrowing the river

Narrowing has the advantage of controlling the river by preventing its swings over a wide region. Artificial narrowing of the river has been found to be possible and economical. Such artificial narrowing is achieved by constructing heavy embankments called guide banks near the abutments and closing the remaining portion of the river by approach banks. The main idea is that the river flow should approach and pass through the bridge smoothly.

With this object in view the different aspects of the bridge design that need consideration are as follows:

(1) Selection of site.
(2) Determination of waterway.
(3) Design of guide banks, approach banks etc.
(4) Bridge piers.

Hydraulic models place before the designer a vivid picture of what the state of affairs would be after the bridge is constructed. All these aspects can be studied at a negligible cost, consistent with stability and strength in the initial outlay and also reduce maintenance.

Model study helps selection of suitable site

An ideal bridge site should be in a narrow, straight and stable reach of the river. The orientation should be such as to have a normal flow through it.

But conditions in nature are generally not ideal and the model helps the engineer to select the alignment that approaches the ideal. Hence a site is first roughly selected by considering the layout of the river channels, changes in the meander positions in the past, proximity of a modal region, availability of a rigid bank, existence of a narrow meander belt and the river bed material, and then tested on the model. After detailed examination of currents on the model the exact site and the orientation can be easily fixed.

In the case of the proposed bridge at Mokameh Ghat, similar model studies were carried out at the Central Water and Power Research Station, Poona. The selected alignment of the bridge was confirmed as the flow conditions were found to be quite satisfactory.

Similar studies were carried out at the Poona Research Station in 1952, in connection with the proposed road bridge across the Gautami area of the Godavari at Alamuru in Andhra State. A site was selected in 1948, but, on inspection in 1951, a site about 6 furlongs upstream appeared to be better. Both these sites were investigated on a model and from the pattern of flow at both the sites it was seen that the new site offered distinct hydraulic advantages and was recommended.

The waterway to be provided for a bridge is determined, taking into account the maximum expected flood in the river. In alluvial rivers, the flood waters scour the river bed and carve out a deep channel. The extent of this scour and the sufficiency or otherwise of the waterway provided can be seen on the model. An insufficient waterway is likely to cause a very high afflux and thus endanger either the structure itself or adjacent earthen embankments. Normally in an alluvial river, a gradually rising flood causes practically no afflux, because the river, by scouring its bed can adjust its section to the changing requirements. But in case the floods are sudden and rise rapidly before the river gets sufficient time to scour out its bed dangerous consequences might follow.

The Luni bridge

The Luni river railway bridge No. 3 on the Samdari-Raniwara Branch of the former Jodhpur Railway is an example of this class. Before the construction of this bridge, in 1927, the river width at this site was 3100 ft. The bridge constructed was 1295 ft in length and had a clear waterway of 1160 ft with 29 piers. During the flood of 1944—the maximum recorded since 1917—water rose up to the underside of the end span girders and the flow was actually obstructed in the middle portion. Due to high intensity of rainfall over the catchment in a very short time, the flood was so sudden that the river did not get a chance to scour its bed and the afflux reached a value of about 6 ft. Large breaches resulted in the guide bunds and 612 ft length of the railway embankment was severely damaged. Also, because of undesirable curvature causing concentration of flow heavy damage was caused to the three end piers on the left bank, one of which collapsed altogether. The bridge was then tested on a hydraulic model at Poona, and as a result of the tests it was recommended that the waterway should be increased by 300 ft.

Alexandra Bridge

On the other hand the Alexandra bridge, Wazirabad on the Chinab river, is an example where an excessive waterway was initially provided, but curtailed later on. Originally this bridge was provided with 64 spans of 145 ft each i.e., a total length of 9280 ft but subsequently 20 spans from one end and 16 spans from the other end were closed leaving only 28 spans to function i.e., a length of 4060 ft. Excessive waterway is likely to lead to undesirable shoal formation upstream of the bridge with the accompanying wandering of the main channel. If the channels are allowed to have uncontrolled movement any of the piers may be subjected to a strong oblique attack. Such an occurrence can be prevented by proper studies on a model.

When the waterway to be provided for a bridge is less than the natural river width, an artificial gorge has to be constructed for guiding the river flow past the bridge, without causing any damage to the structure. This is achieved by constructing one or two embankments with stone facing. The purpose which properly designed guide banks serve at a bridge is two fold. Firstly they protect the approach embankments of the bridge from attack and secondly they control the river and induce it to flow more or less axially through the bridge. The length of a guide bund, and curvature and sweep of the mole head are dependent on a number of factors such as river width on the upstream side, location of the bridge on the cross-section, nature of river banks in the vicinity, river discharge and slope etc. The effect of these various factors is studied best in hydraulic models.

Lengths of the guide bunds were tested in the model and a length of 5000 ft was found to be most suitable as it gave a fairly uniform distribution of flow throughout the bridge. Moreover in this case the velocity concentration being nearer the guide bund, coupled with lower velocities near the south bank, there are more chances of the south bank remaining safe and requiring less protection. It was also found to give sufficient protection to the north approach embankment.

Simultaneously with the above tests different curvatures and sweeps were tested for the mole head and a 3° curve was found to satisfy the requirements. But with a view to keep down the cost a sharper curve was introduced at a place where it was tolerable. It was finally recommended to have a 3° curve up to 90° sweep and then a 5° curve from 90° to 120° sweep. This curve was found to be suitable particularly because it reduced the attack on the unprotected south bank by guiding the flow smoothly along the guide bund itself.

Similar studies were carried out in connection with the proposed bridge across Gautami Godavari river at Alamuru and a guide bund 2500 ft long was recommended.

Model study helps design of Foundations

Similarly the problem about the foundations and protection to the bridge piers can be solved with help of models.

Having worked out the possible maximum scour around a pier its foundation level can be calculated so as to give it a proper hold under worst conditions. For new construction it is possible to take foundations deep with the help of modern equipment. But where the foundations of old bridges are shallow prevention of deep scour is achieved by dumping stones round the piers.

The higher the level at which the stones are laid, the less will be the depth of pier exposed after scour. But at higher levels as observed in the Hardinge bridge on the Ganga river this stone is likely to be lost by being washed away. If the dumping is excessive the stones may virtually act as a weir causing dangerous scour downstream and the pitching stone may be washed away into the scour hole.

The proper levels at which stone pitching around piers should be maintained can be worked out with the help of hydraulic models.

Examples of this class dealt with by the Poona Research Station include, the Hardinge bridge on the Ganga (now in Pakistan), the railway bridge over the Godavari at Rajahmundry and the Hope bridge over the Tapti at Surat etc.

Some examples of model studies to check erosion

In September 1933 a breach occurred in the right guide bank of the Hardinge bridge over the lower Ganga and in subsequent years about a crore of rupees were spent in dumping stone for making good the breaches and other protection works but the stone continued to be washed away. The Central Water and Power Research Station, Poona, after a thorough analysis of the conditions and exhaustive model studies found that the best solution lay in giving up the Sara protection bank, upstream of the Hardinge bridge, which was found to cause very undesirable flow conditions.

Since 1938, the Rupnarain river upstream of the former Bengal Nagpur Railway Bridge at Kolaghat had eroded 1400 ft of its left bank and by the beginning of 1944 was only 1500 ft from the railway embankment. This progressive erosion of the left bank not merely endangered the railway line approaching the bridge from Howrah, but also led to deteriorating flow conditions at the bridge, due to increased concentration of flow near the right bank. The ferry service upstream of the bridge had to be suspended due to part of the Orissa Trunk Road having been eroded. As a result of the model studies it was recommended to construct a groyne 1100 ft long facing 60 degrees upstream at about a mile upstream of the left abutment. This groyne was constructed, and it fulfilled its immediate object with signal success. After the 1945 floods the main flow of the river was about a mile away from the point where dangerous erosion was taking place in 1943.

Model investigations have their own limitations and interpretation of the results must be done with due care. Models can only supplement thinking and not substitute it.

The Authors are thankful to Shri Kanwar Sain, I.S.E., Chairman, Central Water & Power Commission for his kind permission to publish this article.

HERE AND THERE

1. STRANGER TO A CONTRACT NOT LIABLE FOR DELAYS

TWO conditions must exist before a person can be held liable for interfering with performance of a contract: (1) knowledge of the existence of the contract and (2) intentional interference.

In April 1946, General Electric Co. entered into a contract with the United States Bureau of Reclamation to manufacture and supply electrical generators. The various units covered by the contract were delivered between October 1948 and February 1949.

In September 1949, the Bureau entered into a contract with Donovan Construction Co. to install the generators supplied by General Electric Co. Apparently the generators had been defectively constructed with the result that it became necessary to disassemble the generator equipment several times before it would operate properly. In fact, some parts of the equipment had to be sent back to the manufacturers' plant in order that the necessary repairs could be made.

As a result of the defects, the performance of the installation contract was delayed, resulting in increased cost of the work by the installation contractor.

The contractor brought an action against General Electric to recover the damages sustained, claiming that the defects in the equipment resulted from negligence on the part of the manufacturer. The action was dismissed, the court holding that there was no privity of contract between the manufacturer of the equipment and the contractor who installed it.

The court stated: "There are a multitude of cases which sustain the principle that, as an indispensable condition precedent to liability for interference with the performance of one's contract, not only must there be knowledge of the contract, but there must be an intentional interference therewith." The court also pointed out that the contract to install the equipment was not entered into until after the equipment had been delivered, so that there could not have been any intent on the part of the manufacturer to interfere with the performance of the installation contract.

If the installation contractor had brought an action against the Government for delays caused by the failure on the part of the Government to provide proper equipment to be installed, the Government would have counter-claimed against the manufacturer and some settlement of the matter might have resulted.

(*From 'Engineering News-Record,' June 7, 1 56.*)

2. A BARRIER OF FEATHERS

AN excavation in a street for a water pipe was four feet wide, fifteen feet long and from one to four feet deep. A single wooden horse placed at one end of this ditch and flares extinguished later by a rain were the only warnings.

Early one evening a motorist hit this wooden horse and threw it aside. Two hours later another car dived into the ditch and one of the occupants was seriously injured.

In its affirmance of this judgment the appellate court said, "A barricade to be effective must be constructed of such material that it will by size, weight and conspicuousness offer visual and reasonable resistance to the elements and to fortuitous invasion. A contractor who erects a barrier of feathers around a dangerous crater cannot defend so ephemeral a protection on the ground that he had no reason to expect a high wind.

"One who creates a dangerous situation on a highway and then ostensibly plants flares against nocturnal mishap, does not absolve himself from responsibility unless he exercises some reasonable foresight as to weather possibilities and mechanical defects as well. It is futile to speak of warning flares which lack illumination. It is common knowledge also that an intense rain, especially in combination with the obscurity of night, will carpet the surface of the ground with shadows that conceal irregularities, depressions and cavities."

(*From 'Roads and Streets,' May, 1956*).

3. INCREASING THE LIFE OF SURFACE DRESSING

EXPERIENCE in Berwickshire has shown that the application of bituminous mortar increases the life of surface dressing. The process consists in applying a bituminous sand mortar, mixed in a concrete mixer, with 9 lb of bituminous emulsion with 1 cu. ft of sand. The sand of the following grading has been found suitable:

Passing No. 7 sieve	...	98·4 per cent
,, No. 36 sieve	...	86·6 ,,
,, No. 100 sieve	...	27·4 ,,
,, No. 200 sieve	...	7·8 ,,

The suggested rates of application are one cu. ft of mortar for 70 sq. ft of surface dressing when $\frac{3}{4}$ in. chippings are used, and 90 sq. ft of surface when $\frac{1}{2}$ in. chippings are used.

The traffic action works the mortar into the interstices of the surface very quickly and any surplus material is thrown to the sides of the road. Experience has shown that surfaces so treated do not 'fat' up readily and no instances of bleeding have been observed. In the experience of the Divisional Surveyor, the life of the tar-sprayed surface has been extended at least 8 years on a medium traffic road.

This application can be used for open type surfaces also, but a slightly richer mix will be necessary.

(*From 'The Surveyor & Municipal County Engineer' - April 7, 1956.*)

4. REDUCING THE NOISE OF PILE DRIVING

A METHOD of reducing the noise of a steam-hammer during pile driving is to mount the sound-absorbent skirt comprising two layers of asbestos-cloth padded with glass-wool on the hammer. The skirt is attached to a steel belt which is strapped round the hammer. It is stated that the skirt absorbed about 80 per cent of the sound energy and halved the apparent loudness of the noise.

(*From 'Concrete and Constructional Engineering, February 1956, Vol. LI. No. 2.*)

5. PRESTRESSING A STEEL GIRDER

A STEEL girder of an overbridge across a busy railway line near Birmingham, England, had to be renewed due to severe corrosion because of smoke from the railway engines. The truss of the girder was 115 ft long and the cross girders which were cantilevered beyond the truss carried a footpath 7 ft 6 in. wide. The bridge was built in 1906.

In addition to the weakening of the girder it was difficult to keep in place the road surface because the flat steel plate decking got polished because of movement of the thin layer of metalling which was less than 5 in. in places.

On detailed examination it was found that the top chord and web members were not affected by corrosion and were in good condition. Therefore it was decided to strengthen the truss by prestressing the bottom chord after restoring the sectional area by the addition of steel flats welded to the vertical legs of the chord angles where corrosion had been the most severe, and to reduce the unsupported length of the compression chord by

the addition of portal frames spanning the footpath and connected to the extremities of three pairs of the cross girders.

The reconstruction was undertaken in the early part of 1955. With the road closed to traffic, the decking was stripped, and while the old cross girders, underslung from the panel points of the truss and spaced at 8 ft 4 in. centres, were still in position and after the web members and the tension chord had been repaired, the tension. in the bottom chord was reduced by a prestressing force of 230 tons applied through eight Macalloy steel bars of 1 in. diameter, four on each side. The rods were anchored to massive welded mild-steel brackets secured by high-strength bolts to the chord plates and flanges at points 3 ft from each end of the girder. Two Lee-McCall jacks were used to stress the bars, one bar on each side of the chord being stressed simultaneously. The load applied to the first pair was greater than that applied to the next pair which in turn were stressed more highly than the next and so on, so that ultimately the load was the same on all eight bars. Prior to stressing and throughout the operation the bars were temporarily supported at intervals of 14 ft throughout their length. As a result of the pre-stressing, the chord shortened half an inch, the sliding bearing moving by that amount across the bedplate on the retaining wall; the camber of the girder increased by 7/8 in. at the centre of the span. Changes of strain in the girder members were measured with electric resistance strain gauges and were found to agree closely with those expected. Subsequently, the prestressing bars were wrapped in canvas and protected with bitumen before being encased in a concrete filling which covered whole chord.

The new cross girders, hog-backed and all-welded, were placed in position by cranes operating from the railway tracks below. Spaced at 4 ft 5 in. centres, they are pin-connected to new steel hangers passing through and bolted to the chord at points intermediate between the panel points of the truss; this arrangement allowed the steel work to be fitted clear of web gussets and prior to the removal of the old cross girders. The portal bracings giving lateral support to the top chord have been connected to the ends of three pairs of the cross girders near the middle of the span. The roadway, finished with a 3 in. thick layer of rolled asphalt on concrete, is carried on pre-cast reinforced concrete jack-arches bedded on concrete skewbacks pre-cast on the bottom flanges of the cross-girders at the makers' works. The footpath consists of a layer of asphalt on pre-cast prestressed concrete planks, 12 in. by 3 in. thick, spanning between a continuous shelf angle on the steel plate parapet and a channel stringer adjacent to the truss girder. All exposed steel work under the bridge has been protected with a coating of Ruberoid Plastic Compound No. 201 applied directly to the steel. During the prestressing, the changes in strain in the various members of the truss had been measured with electrical strain gauges. It was perhaps significant that during the operation, it had been observed that the end of the girder where it rested on an expansion bearing had not moved as it should have done, and the gauge readings had confirmed that the girder was not, in fact, being prestressed as intended. The reason was, of course, obvious. In spite of a phosphor-bronze sliding surface, rust, had prevented the expnsion bearing from moving. As soon as the girder had been jacked up and the end freed, the prestressing operation had been repeated, aud fresh readings from the strain gauges confirmed that the girder had been strengthened, as planned. The result was a shortening of the girder by $\frac{1}{2}$ in., and a $\frac{7}{8}$ in. increase in the camber at the centre as mentioned above.

(From 'Engineering' — May 25, 1956).

6. BRICK SURFACING FOR BUS STOPS

BUS stops generally receive extra stress under the action of the wheels when the buses stop and start again. If the surface is black-topped, due to the constant stopping and starting of buses which are heavily loaded the bituminous binder loses its stability, specially in the summer months when the road temperature is very high. Also, grease and oil droppings from the buses soften the bituminous binder. In Rochester in America, with a view to find out a satisfactory surfacing for a bus stop experiments with brick paving have been conducted. These have proved to be a success and, as a policy, the Rochester County is adopting brick paving for all their bus stops. The brick surface gives a non-skid smooth surface and it is said the drivers like it. At one of the bus stops, as many as 418 buses use the stop in one hour.

It has been observed that the colour contrast between the paved carriageway and the bus stop helps the drivers to come to a halt at the correct place.

(From "American City," June 1956.)

7. REINFORCED CONCRETE ROLLERS FOR BRIDGE BEARINGS

ROLLED or cast steel seemless pipes about one in. thick, and 8 in to 16 in. diameter filled with spirally reinforced concrete with an admixture called "Embeco" to prevent its setting contraction, have been largely used as roller bearings for concrete bridges. These are much cheaper than the conventional solid cast steel rollers.

(From the Report by Shri Jacob Thomas Kallarachel on his visit to Canada).

8. EFFECT OF LETTER WIDTH AND SPACING ON NIGHT LEGIBILITY OF HIGHWAY SIGNS

A STUDY was undertaken to determine the effect that spacing between letters of words, used in highway signs, had on their night time legibility. More than 2,500 observations were made by 36 observers while driving an automobile at 30 miles per hour. White reflectorized letters, 10 inches high, were displayed on a black non-reflectorized background. Three different types of alphabets were used. The spacings between letters were increased as the lengths of the six test words were extended from normal to 20, 40 and 60 per cent above normal.

As inter-letter spacing was increased, the legibility distances also increased for all three alphabets until word lengths were 40 per cent above normal. The resulting gain in legibility at this point ranged from 7 to 16 per cent. Beyond the 40 per cent increase in word length, legibility levelled off or declined.

Also studied was the probable effect of increasing the letter height of the narrower alphabet until the legend area equalled that of the wider alphabet. At the point of equivalent legend area and spacing, the two alphabets proved to be equally legible.

The findings of the study point to the importance of sign proportions and provide an improved means for efficient determination of legend design. Where vertical dimensions restrict sign letter heights to something less than desirable, increased spacing between letters can help to compensate for the loss of legibility distance that would otherwise occur.

(From "Public Roads," April, 1956).

DRIVING NEAR PARKED CARS

When driving near parked cars, drive with care. Drive as far away from the line as conditions will permit. And look ahead. Practice the habit of anticipation. Be alert for any indication of movement among the cars, for any indication of erratic movement among the adults or children on the sidewalk.

CURRENT LITERATURE

ABSTRACTS

SYMPOSIUM ON PERMEABILITY OF SOILS, Special Technical Publication No. 163 of the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

PERMEABILITY is an important property of the soil and this symposium contains 9 Papers on the subject, which discuss the importance, evaluation and field control of the many factors which influence this property. Field permeability tests are described and correlation between permeability and density and gradation of the soil are presented. In one Paper "Principles of Permeability, Testing of Soils", D. M. Burmister discusses in detail the principles involved in the testing. An extensive bibliography is also included.

THE SUPERVISION OF CIVIL ENGINEERING CONSTRUCTION, Including the Preparation of Contract Documents by A.C. Twort, Edward Arnold Ltd., London.

THIS book is divided into three parts, site organization, work progresses, and preparation of contract documents. The first part deals with duties and responsibilities of a resident engineer and his relationship with the contractor and the designing engineer. The second contains practical hints on situations requiring the resident engineer's consideration which arise at the site. The subject of extra works and the validity of claims generally made by contractors for extra payments are also discussed. The third gives suggestions as to how specifications and contract documents should be drawn up to give maximum clarity to those supervising the work.

SPECIFICATIONS FOR GENERAL PROVISIONS (CONTRACT DOCUMENTS), American Association of State Highway Officials, Washington, D.C.

THESE specifications form part of the standard specifications for road and bridge construction. Since no set of detailed specifications can be prepared for use throughout the country (U.S.A.), the specifications contained in this book are meant only as a model subject to local conditions and policies.

The subject matter is dealt exhaustively under the following heads:

> Bidding requirements and conditions such as notice to contractors, qualifications of contractors, etc.; award and execution of contract; scope and control of work; control of materials; legal responsibilities to the public; progress; measurements and payments; and wages and conditions of employment.

MECHANICAL METHODS OF STRUCTURAL ANALYSIS by B.V. Ramaswamy. Journal of the Institution of Military Engineers, Poona, April 1956.

THIS article deals with the theory and experimental technique of the following two methods of mechanical analysis:

(1) The Deformeter Method.

(2) Stress Analysis by Brittle Lacquer Method.

In the Deformeter method, the forces and moments on the prototype are obtained indirectly from the measurements made on models. Scale models are made ordinarily on material different from that of the prototyoe. Detailed description of the Beggs Deformeter Gauge, together with diagrams explaining the working of the apparatus, is given. Discussion of the materials commonly employed for the manufacture of the models and the principles involved in the testing of models are enumerated.

When a member subjected to stress is coated with a film of paint or lacquer, at a certain stage of loading the film begins to develop thin crack lines. The pattern of these cracks gives an indication of the concentration of the stresses in the material. The experimental procedure involved in this method is described.

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

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2. **Prestressed Counter-balanced Log Span Provides Wide Opening for Floods**; *Engineering News Record, Vol. 154, No. 4*, January 27, 1955, p. 60.
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5. **Long Prestressed Concrete Bridges - Bridges in United States and Asia**; *Engineering, Vol. 174, No. 4646*, February 11, 1955, p. 190, *See also— The Surveyor, Vol. CXIV, No. 3284*, February 12, 1955, p. 138.
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18. **Ribless Cylindrical Shells**; MARIS G. SALVADOR and A. D. ATESHGLOA, *Journal of the American Concrete Institute, Vol. 26, No. 5*, January 1955, pp. 457-460.

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BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF UTTAR PRADESH BUDGET FOR 1956-57

The following extracts relating to Civil Works have been taken from the U. P. Government Budget for the year 1956-57.

Heads	(In lakhs of rupees) Actuals 1954-55	Revised Estimate 1955-56	Budget Estimate 1956-57
I. Revenue (Civil Works)			
Rents	2.95	2.64	2.60
Ferry receipts	25.24	20.40	19.90
Tolls on roads	0.18	0.50	0.50
Recoveries of expenditure	1.16	1.65	1.65
Transfer from Central Road Fund Account	21.23	56.23	...
Miscellaneous	14.85	99.21	116.86
Deduct—Refunds	-0.31	-0.90	-0.75
Total	65.30	179.73	140.76
II. Expenditure (Civil Works)			
Buildings			
Original Works	33.51	86.70	35.76
Repairs	13.21	14.57	16.04
Communications			
Original Works	68.37	157.44	159.69
Repairs	258.67	234.42	243.64
Miscellaneous			
Original Works	0.53	1.31	0.11
Repairs	2.30	2.75	2.75
Tools and plant	6.64	4.61	3.22
Suspense	-4.45	...	...
Establishment	34.06	25.00	23.66
Grants-in-aid	109.01	28.30	25.81
Deduct—Recoveries adjusted in the accounts in reduction of expenditure	-77.41	-84.99	-82.80
Total	444.44	470.11	427.88

Heads	(In lakhs of rupees) Actuals 1954–55	Revised Estimate 1955–56	Budget Estimate 1956–57
III. Capital account on Civil Works outside the Revenue account			
Buildings (Original Works)	178.42	251.17	747.27
Communications	102.60	198.55	271.11
Miscellaneous	5.72	30.80	20.34
Tools and plant	1.68	4.00	5.22
Suspense	-23.60	-3.20	3.00
Establishment	8.38	23.20	38.43
Deduct-Recoveries adjusted in the accounts in reduction of expenditure	-85.81	-177.68	-134.98
Total	187.39	326.84	950.39
IV. Revenue from Roads			
Receipts under the U.P. Motor Vehicles Taxation Act	104.67	110.00	112.00
Receipts under the Indian Motor Vehicles Act	...	4.00	4.00
Taxes on Sale of Motor Spirits	26.54	26.35	26.35
Deduct—Refunds	-1.42	-1.20	-1.50
Total	129.79	139.15	140.85
V. Capital Outlay on Civil Works met from extraordinary Receipts	80.44	161.24	88.88

GOVERNMENT OF U. P. CIVIL WORKS BUDGET 1956-57

(A brief review)

THE estimated revenue and expenditure figures for the year 1956-1957 are Rs 8535.59 lakhs and Rs 9491.10 lakhs respectively. The anticipated deficit on the revenue account is therefore Rs 955.51 lakhs. The revised estimates for the year 1955-56 ended with a balanced budget. The revenue and expenditure both being at Rs 8597.16 lakhs. In the year 1954–55 the actual revenue collection amounted to Rs 7819.24 lakhs while the sum spent amounted to Rs 7758.18 lakhs only. Thus the year 1954–55 ended with a revenue surplus of Rs 61.06 lakhs.

Revenue expenditure on Civil Works in 1956–57 is estimated at Rs 427.08 lakhs which forms 5.0 per cent of the total revenue for the year. The corresponding ratios for the years 1955–56 (revised) and 1954–55 (actuals) are 5.5 per cent and 5.7 per cent respectively.

The proportion of expenditure on communications (original works and repairs) to total revenue (estimate) is 4.7 per cent for 1956–57; for 1955–56 (revised estimate) and 1954–55 (actuals), the corresponding figures are 4.5 percent and 4.2 per cent respectively.

The total outlay on Civil Works outside the revenue account for the year 1956–57 is Rs 950.39 lakhs, out of which Rs 271.11 lakhs are proposed to be spent on communications alone.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in lakhs
		BIHAR	
1.	1615 BR 28	Construction of a bridge in the Mile 23 of Muzaffarpur Champaran border Road, National Highway No. 28.	2.00
		BOMBAY	
2.	1620 BM 3	Construction of a bridge and its approaches across Godavari river on diversion of the Bombay-Agra Road N. H. No. 3, near Nasik City.	7.30
3.	1622 BM 4	Improvements to the Bombay-Poona Road Mile Nos. 65/2 to 66/0 passing through Khopoli Town—N. H. No. 4.	1.28
		DELHI	
4.	1619 DLH 2	Construction of bridges on the bye-pass connecting N. H. No. 1 with N. H. No. 2 in Delhi State from Railway Siding to Delhi-Mathura Road.	0.48
		HIMACHAL PRADESH	
5.	1624 HP 22	Construction of Class III Officers Rest room at Karcham on N. H. No. 22.	0.08
		HYDERABAD	
6.	1621 HD 7	Establishment for survey work of National Highway Nos. 7 & 9 for the work proposed to be taken up under Ist priority under Second Five-year Plan.	0.29
		MYSORE	
7.	1616 MY 4	Land acquisition charges on N. H. No. 4 in Tumkur Divison.	2.80
		ORISSA	
8.	1623 RS 5	Construction of an approach road to Mahanadi ferry from N. H. No. 42.	1.72

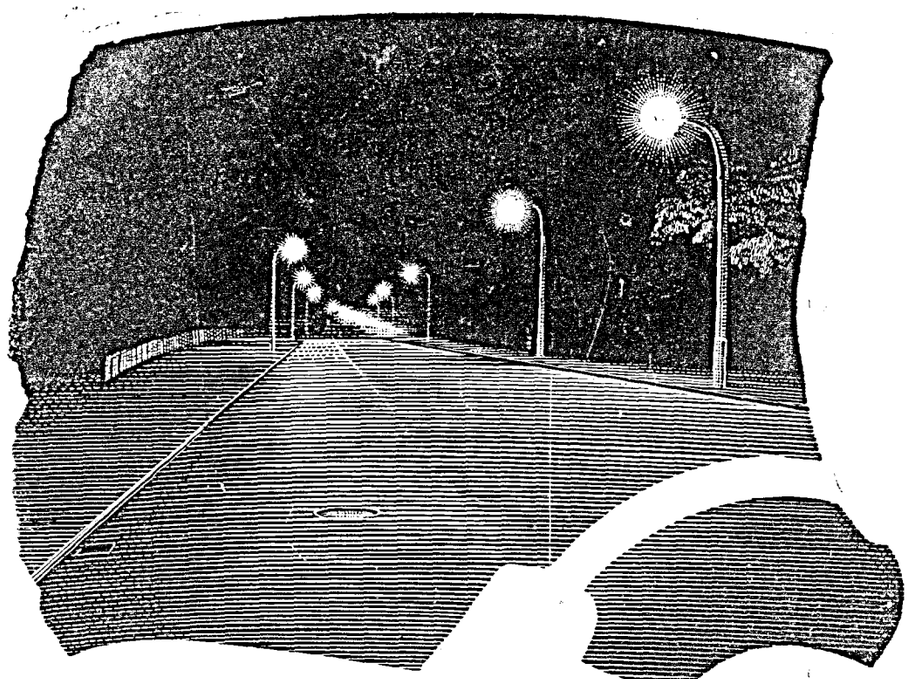
S. No.	Job No.	Name of work	Amount (Rs in lakhs)
		PUNJAB	
9.	1625 PB 22	Protecting Ambala-Kalka Road, (N. H. No. 22) in mile 23 against attack of Ghaggar river.	0.52
		SAURASHTRA	
10.	1617 SR 8 A	Taking trial borings with core drill in the bed of River Machhu on Wankaner-Morvi Section of N. H. No. 8-A, Kandla-Ahmedabad road.	0.03
11.	1618 SR 8 B	Construction of a bridge over the Minsar River near Rana Kadorna on Porbunder Jetpur Section of N. H. No. 8 B.	4.50

(*Continued from page 4*)

The conference also recommended a network of roads which, in their view, should form the National Highways.

After negotiation with the States, the Central Government assumed full financial responsibility with effect from the 1st April 1947 for the development and maintenance of certain routes approved by them provisionally as suitable for inclusion in the system of national highways. With the partition of the Country some of the routes ceased to be in the Indian national highway system and some new routes were added to it. The total number of such highways were 39 and these are the highways shown in the schedule to the Bill. Under the Constitution of India the subject "highways declared by or under law made by Parliament to be national highways" is a union subject. The present Bill seeks to declare the provisional national highways to be national highways under the Constitution and to provide for their development and maintenance.

The total milage of national highways included in the Bill is about 13,800.



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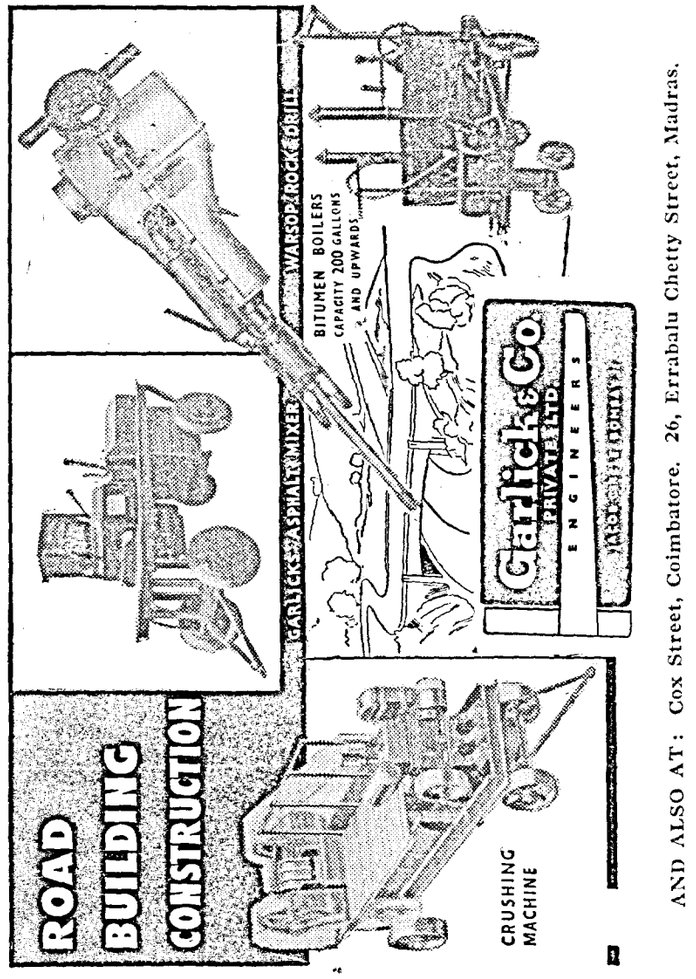

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