TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW (TCMR)

MARCH 1962—No. 179

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TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

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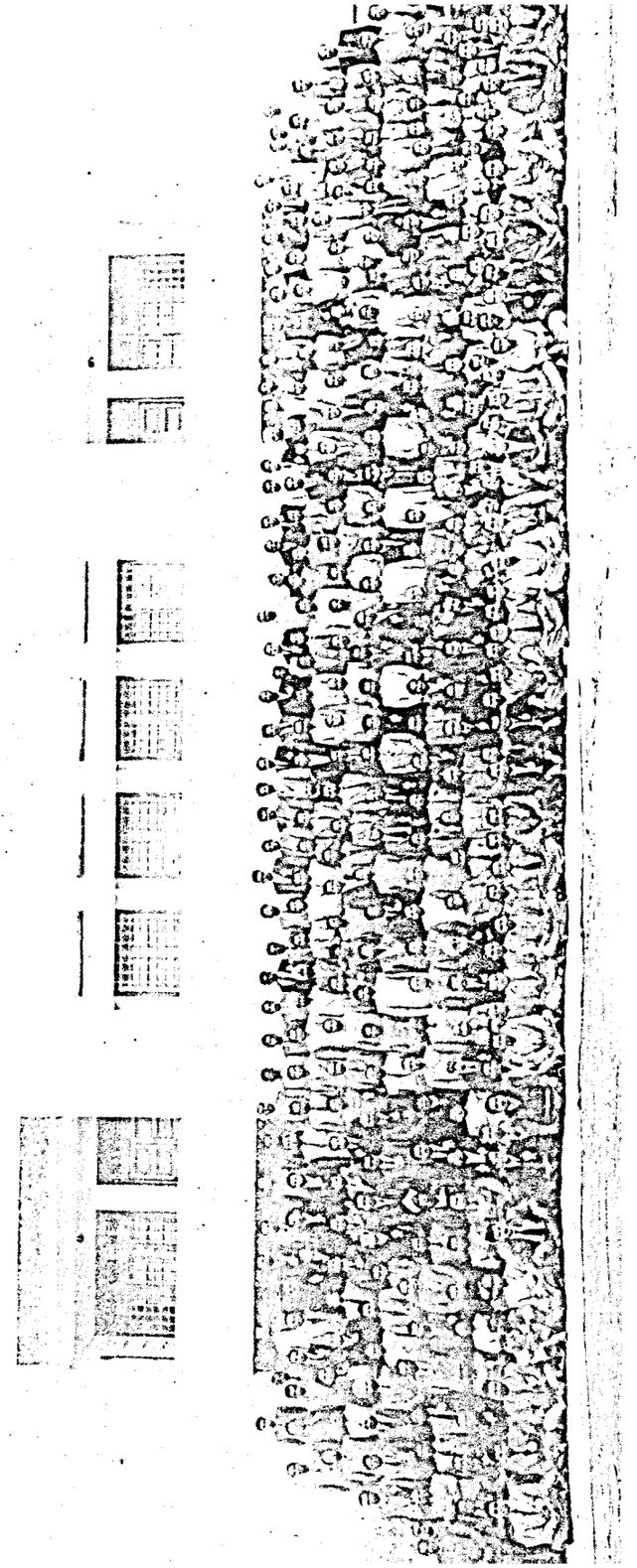


GROUP PHOTOGRAPH OF THE TWENTY SIXTH SESSION OF THE INDIAN ROADS CONGRESS HELD AT PATNA FROM THE 13TH TO THE 20TH DECEMBER, 1961.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

MARCH 1962

GENERAL SESSION OF ZONAL WORKING GROUP OF EXPERTS ON INTERNATIONAL HIGHWAYS

ASIAN HIGHWAY

" Asian Highway Project is bound to go through ; but with the assistance of every one it will go through earlier," says Shri H. P. Sinha.

1. ECAFE ZONAL EXPERTS TAKE UP REPORT ON ASIAN HIGHWAY SURVEY

The results of a reconnaissance survey carried out earlier this year by top engineers from Burma, India and Pakistan over 1,260 kms of the international highway between Calcutta and Imphal and the Indian-Burmese border were reported to a joint session of three zonal groups of highway experts at Bangkok.

The survey carried a stage further the ECAFE-sponsored project for an Asian Highway which, using ancient caravan routes in some stretches and modern main roads in others, will link the countries of Asia from Teheran in the west to Saigon and Singapore in the east.

The entire network will have a total length of some 50,000 kms of which 29,000 will be priority routes.

The first stage in the project is to link up existing road systems where gaps occur and to bring these priority sections of the highway upto accepted minimum standards.

Some 500 kms of missing links have to be completed and the task of assessing the economic and engineering feasibility of constructing these links and the cost involved, was assigned by ECAFE to three zonal groups of experts. From their members, a reconnaissance team was selected to survey the route between Calcutta and Bangkok.

Besides other subjects connected with the development of the international highway, the experts dealt with additions to the code on a uniform system of road signs and signals, and pavement markings in the ECAFE region ; and the question of the inclusion of Indonesian highways within the International highway network.

The Session was attended by highway experts from Burma, Ceylon, India, Indonesia, Iran, Laos, Nepal, Pakistan, Thailand and Viet-Nam.

2. ZONAL EXPERTS ADOPT RECOMMENDATIONS FOR SPEEDING ASIAN HIGHWAY DEVELOPMENT

Meeting together for the first time in joint session, three zonal groups of Asian highway experts, in a three-day session in Bangkok which ended Sunday February 11, agreed on recommendations for speeding the realisation of the Asian Highway Project.

This project, a major undertaking in regional co-operation, was launched by ECAFE in November, 1958 to provide a network of international road routes to link Asia from Teheran in the west to Singapore and Saigon in the east. Westwards from Iran the Highway would join up with European highways.

One of the recommendations adopted by the joint zonal meeting was to include in the Asian network, the Indonesian highways running across Java to the eastern tip of the island and extending to the island of Bali. The steamer service between Djakarta and Singapore would link the Indonesian roads to the rest of the continental network.

With the Java-Bali sections included, the Asian Highway will run some 51,500 kms of which approximately 30,000 kms are classed as priority routes. In many places the Highway follows ancient Caravan trade routes; in others, it uses modern main roads.

Before the Highway is complete, 500 kms of missing links have to be bridged, a task to which co-operating countries and ECAFE are giving priority.

Of special interest to the experts meeting in Bangkok was a report of a survey undertaken in January this year by an international team of road engineers who inspected 1,260 kms of the international highway between Calcutta and Imphal and the Indian-Burmese border. Their task was to examine the condition of the highway in this section and to assess the feasibility and the approximate cost of constructing links now missing to complete the international highway in this zone.

The survey team estimated that the total cost of work to be done in India, Burma and Pakistan to fill in existing gaps and to bring the routes up to minimum standards, would require a total of 127.5 million dollars, of which 33.7 million dollars has been earmarked by the countries concerned. Local labour and materials would account for 64.6 million dollars, leaving 25.2 million dollars to be provided by foreign exchange components.

Discussion of the survey report in the joint session emphasised, as a basis for seeking financial support from international agencies and outside governments, the need for detailed pre-investment surveys that would demonstrate the economic and engineering soundness of the project.

The meeting therefore unanimously recommended that the Executive Secretary of ECAFE be requested to use his good offices to explore the possibilities of obtaining financial assistance from the UN Special Fund, or other appropriate fund, preferably on a sub-regional basis for India, Burma and Pakistan, for the required equipment and pre-investment surveys, indicated in the survey, as early as possible.

Covered by the explorations the Executive Secretary is asked to undertake would be one million dollars for equipment needed for widening and completing the international highway for the section in India between Silchar and Imphal; 700,000 dollars for a pre-investment survey regarding the construction of nine bridges in the East Pakistan section of the highway; and one million dollars for consultants' services in respect of new construction, realignment and bridge building needed in various sections of the Highway in Burma.

Commending the usefulness of the preliminary survey conducted in January 1962, the joint session decided to recommend that a similar reconnaissance survey be carried out in Afghanistan, Iran and part of West Pakistan and urged that this reconnaissance be made not later than April 1962. At an appropriate time in the future, it was felt that similar surveys should also be made in Laos, Cambodia and Viet-Nam.

In other action, the joint session agreed on specifications, as to the dimensions, shape, colour, lettering and siting of road markers and mile/kilo metre stones on the International Highway.

It agreed that road markers should be rectangular, with white markings on blue and should be placed at village and town junctions and at in-between stretches where distances exceeded 50 kms.

The experts considered that for the international road user it was necessary to have distinctive mile/kilometre stones which would also serve to emphasise the international character of the highway. It was agreed they should be rectangular in shape, with the top part coloured United Nations blue, but of a darker shade to offset the fading effect of sun and rain. To avoid duplication of cost and effort, it was felt that countries be asked to colour existing mile/kilometre stones at distances of not more than 20 kms.

Besides noting reports from individual countries recording, with the exception of Burma, extensive works of improvement or new construction undertaken in pursuance of the Asian Highway Project, the Session approved a programme of future work and priorities.

Attending the session were experts from Burma, India, Indonesia, Iran, Laos, Malaya, Nepal, Pakistan, Thailand and Viet-Nam. The International Road Federation was also represented.

The session unanimously elected Dr. Sirilak Chandrangsu, Deputy Director-General of Thailand's Department of State Highways, as Chairman, and Mr. S. Rahman, Chief Engineer, Works, Housing and Settlement Department, Dacca, East Pakistan, as Vice-Chairman.

The report of the session was be submitted to the Inland Transport and Communications Committee of ECAFE that meets in Bangkok, February, 12—19.

3. CLOSING THE GAPS IN THE ASIAN HIGHWAY

Of 50,000 kilometres of the Asian Highway network, only 500 kms remain to be completed.

Welcoming this fact and the progress reported in the construction and improvement of existing stretches of the Highway carried out by countries through which the international network passes, the ECAFE Inland Transport and Communications Committee has recommended that international aid be sought in the priority task of completing the missing links.

The opinion of the Committee was summed up by the Chairman, Mr. H. P. Sinha, the representative of India, who declared: "This Asian Highway project is bound to go through; but with the assistance of everyone, it will go through earlier."

The recommendations unanimously approved by the Committee at its session in Bangkok had been originally put forward by a joint session of zonal highway experts.

In adopting them, the Committee requests the Executive Secretary of ECAFE to use his good offices in exploring the possibility of obtaining from the United Nations Special Fund, or other appropriate fund, 1,700,000 dollars required for two pre-investment surveys to be made in East Pakistan and Burma, and 1 million dollars for equipment in India.

In the case of East Pakistan, 700,000 dollars is sought for a pre-investment survey covering the construction of nine bridges. For Burma, 1 million dollars is required for a similar survey of proposed new roadway construction, re-alignment of existing roads, and for bridge building. In the Indian section of the Highway, 1 million dollars in equipment is needed for widening and completing the route between Silchar and Imphal.

As the Chairman of the Committee pointed out, the sum now being sought is a fraction of the estimated overall cost of the work to be done to complete the missing gaps and to bring the roads up to minimum standards.

An international team of highway experts who earlier this year carried out a reconnaissance survey of the eastern portion of the Highway, put the total cost at 127.5 million dollars of which 25.2 million dollars would have to be met from foreign exchange.

The Committee recognized that aid-giving agencies and countries would require to be satisfied that the project was justified economically as well as feasible from the technical standpoint. As a first step, therefore, the Committee is recommending an exploration of the possibility of international aid to finance expert pre-investment surveys.

It agreed that a preliminary reconnaissance survey, similar to the one made in the eastern part of the International Highway, should be carried out in Afghanistan, Iran and part of West Pakistan, beginning April 1962.

It also agreed to the recommendation of the zonal experts that the Indonesian routes running through Java and across to the islands of Sumatra and Bali should be included in the Asian Highway network.

When finally completed, therefore, the Highway will provide a through route from Teheran in the west to Saigon and Singapore in the East and will be linked, by the steamer service between Singapore and Djakarta, to Indonesia. Extending westwards from Iran to Turkey, the Asian Highway will also be linked to the European road system.

To review the progress achieved in the project and to consider all outstanding financial and technical problems, ECAFE is proposing to convene in the latter part of this year a meeting of ministers of transport and other high level experts.

1. *Roundup of the Tenth Session of the ECAFE Inland Transport and Communications Committee Meeting at Bangkok from 12 to 19 February 1962 will be published in the next issue.*

2. *For phased Development and minimum geometric standards of Asian Highways by Shri S. Ahmad, please see T. C. M. R. for January, 1960—EDITOR.*

BRITAIN IS ATTACKING ROAD PROBLEMS VIGOROUSLY. CURRENT PROGRAM CALLS FOR SPENDING 560,000,000 DOLLARS

JOHN ROBINSON
Editor, National Builder, London

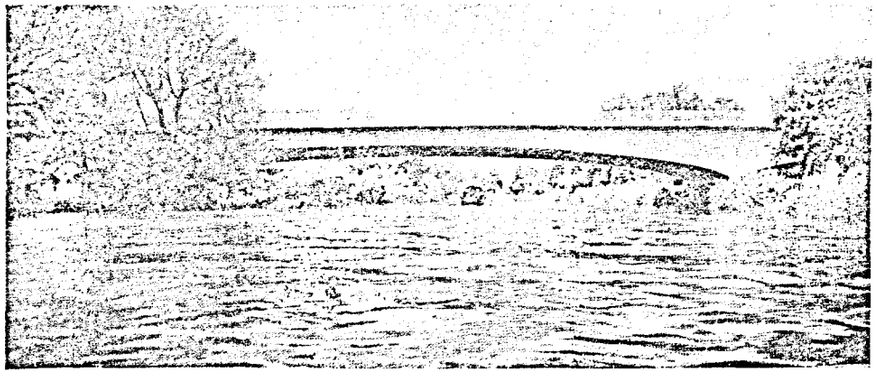
AFTER A SLOW START, Britain is now making a vigorous attack on the problem of congested and obsolete roads. The Minister of Transport, Ernest Marples, announced early in 1961 a "Spring Offensive" of road construction and improvement in England and Wales costing more than 560,000,000 dollars.

The projects include a start on a new bridge spanning the Severn River, a 8,400,000 dollars section of new highway in South Wales, a 2,800,000 dollars improvement of Route A.40 in Oxfordshire and a 2,800,000 dollars bridge structure in Yorkshire.

This is one of the highest levels of construction so far. With an additional 210,000,000 dollars a year being spent by the United Kingdom Government and Local Government authorities on maintenance and minor improvements of roads, it is clear that Britain is accelerating the drive for a modern highway system.

Some idea of how the program has been intensified is seen from the expenditure approved on roads since 1953. In that year, it was announced that expenditures to be authorized in the 3 years from 1954 would be about 140,000,000 dollars. In 1955, it was stated that 411,600,000 dollars would be authorized in the 5 years 1955 through 1959 and that these funds would include the first section of limited access road on the London-Yorkshire route.

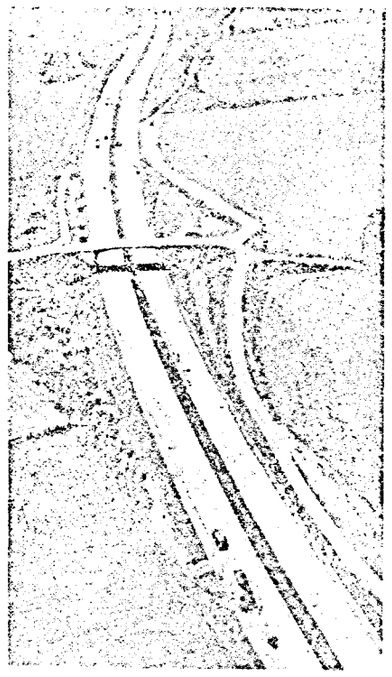
In July, 1957, another 4-year program was announced to cost 672,000,000 dollars and to include the expenditure of funds on "Major projects of National Importance." An additional 112,000,000 dollars was to be spent on roads in Scotland. In July, 1960,



This graceful, all-welded steel bridge spans the River Thames near Bray in Berkshire. It will carry part of the proposed London-South Wales Motorway. About 700 tons of structural-steel work have gone into the bridge. On the next page this highway and interchange structure are typical of the highways and bridges that will be built under Britain's expanded program

the Minister of Transport announced that the amount to be spent on highways would go up from 182,000,000 dollars in 1960-1961 to 212,800,000 dollars in 1961-1962 and 246,400,000 dollars in 1962-1963, and that much of the increase would be spent on schemes designed to relieve urban congestion. Five major projects upon which the present program largely hinges were to receive top priority :

1. Modernization of the Great North Road (Route A. 1) from London to the North East coast.



2. Completion of the limited-access road from London via Birmingham to the North-West.

3. Improve routes from London to the English Channel Ports, including the 26-mile Medway Motorway.

4. The northern part of the Birmingham-Bristol Motorway to link with the Ross Motorway and improve routes from Ross-on-Wye to South Wales.

5. The South Wales Motorway from London to London Airport and on to Maidenhead, with, at the western end, the Severn Bridge and Newport Bye-pass.

Projects 2, 4 and 5 are designed to connect the important centres of London, South Wales and the Midlands by a triangle of highways, mainly limited access roads, to which is joined the industrial North-West. These five projects will constitute the principal routes for road transport in England and Wales. It is hoped that all five projects will be completed by the mid 1960's.

The problems of highway construction in Britain are made no easier by the regulations that must be observed before a new motorway or trunk road can be built. The line of the proposed route and its effect on side roads must be advertised. Then land must be purchased. Objections may be lodged by interested persons or organizations to all or part of the plan and these may have to be thrashed out at a public enquiry.

There are about 1,300 local governmental authorities controlling highways in Britain and the Central Government must decide between their conflicting needs as well as the overall national needs.

Government grants for highways are voted annually and Local Government authorities also raise money for road projects from local rates. The revenue from car licenses and from the automobile fuel tax has increased considerably over the years, keeping pace with the increase in the number of vehicles and the vehicle mileage. Last year, these revenues, together with the purchase tax on cars, amounted to 1,649,000,000 dollars compared with about 280,000,000 dollars actually spent on road projects by the Central Government in England, Wales and Scotland.

As the organizations of road users in Britain point out, the money is there. It is merely a question of putting road works in their alloted place in line, waiting to use the country's available construction resources, both labour and material.

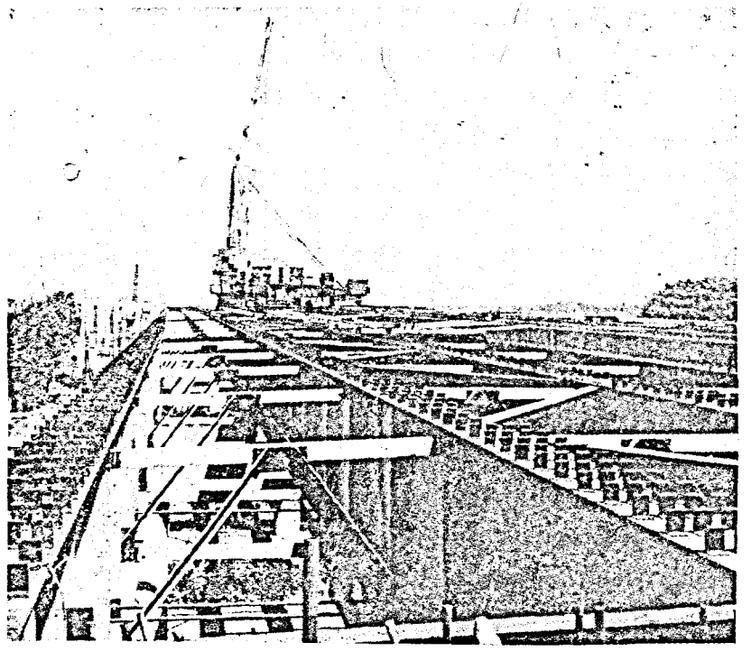
IT IS NOT to be supposed that the road programs now under construction will be sufficient to solve Britain's road traffic and transport problems, which are considerable, but at least it is a beginning.

Motor vehicles in Britain have trebled since 1939, and the number continues to rise. The country possesses a network of complicated but, generally speaking, well

constructed and well-maintained roads, a number of which were modernized between the two World Wars. They were, however, designed in the days of the stage coach, and many of them are now over-loaded.

Britain's Road Research Laboratory found in a survey that on 62 per cent of trunk rodas, 2 per cent of Class I roads and 6 per cent of Class 2 roads, present traffic exceeds the design capacity. Another finding was that 1 per cent of the road system carries 25 per cent of the traffic and 10 per cent of the system carries 60 per cent of the traffic. This indicates that the other special purpose roads and provided the necessary authority for their construction.

Among the new projects the most novel in conception is the limited-access road from Chiswick, London to Langley, Buckinghamshire. From Chiswick the road will be carried on a viaduct about 20 ft above the Great West Road for more than 1 mile, then will rise to a height of 60 ft over a factory before descending gradually to ground level. Another feature of the highway will be the spur connection into Heathrow (London) Airport.

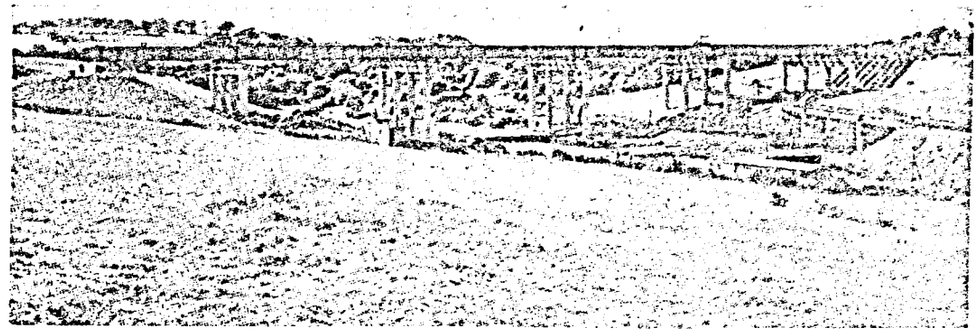


The current expressway or motorway construction program in Britain calls for the construction of 450 bridges. This one, the Thelwall Viaduct at Warrington in Lancashire, will stretch 1¼ miles across River Mersey and Manchester Ship Canal

most urgent work involves the main roads and trunk routes.

The ministry of transport is responsible for the trunk roads and has complete financial liability for them, although Local Government authorities are employed as agents to carry out work on the trunk routes to ministry specifications. An act of Parliament recognized the principle of limited-access roads (or motorways) and

The new motorways will have the same standards of alignment and gradient and the same lane widths as Route M.I., the first of the motorways that runs from London to Birmingham. These features have attracted favourable comment from engineers abroad. The hard shoulders will be widened to 10 ft. They will be of the same basic construction as the highway, but surfaced in a contrasting color. There will be wider median strips.

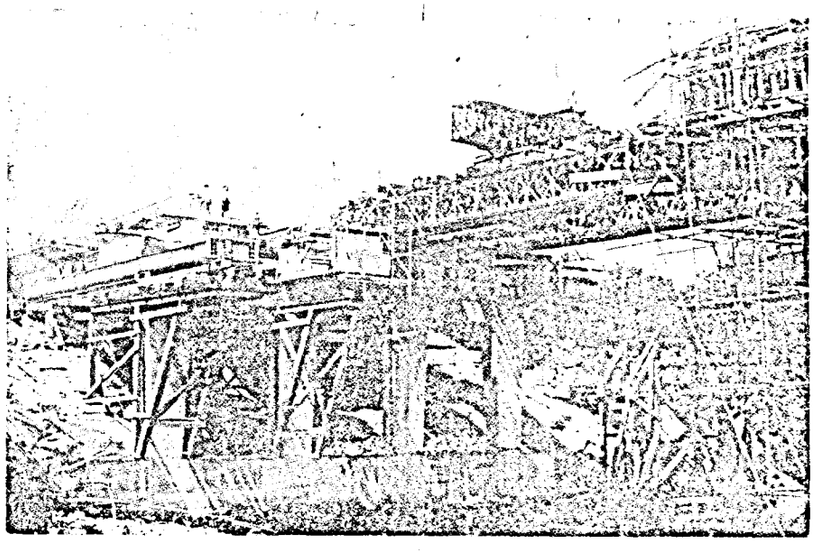


This is the Gathurst Viaduct in Lancashire, England, which will be part of one of the new motorways designed to transform the country's road system. The motorway will extend from Birmingham to Preston. The viaduct, more than ¼ mile long, spans a river, a canal and a railway on 85-ft-high reinforced portland-cement-concrete piers. Motorways are limited-access highways built to highest standards

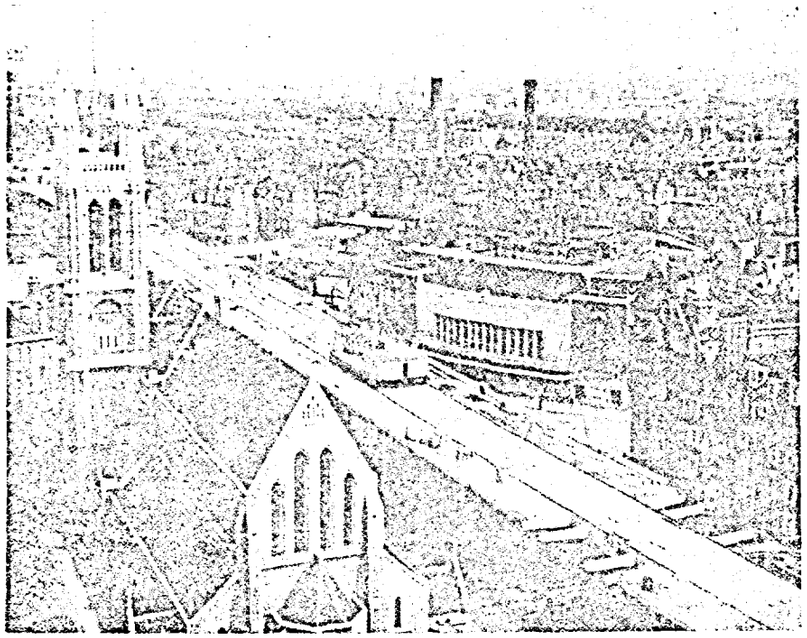
Other motorway projects, totalling 700 miles, are in varying degrees of preparation. Among those to be started in the near future are the Darlington-Barton bypass and the extension of Route M.I. to Doncaster, both in the north of England. Plans also are being prepared for the construction of vital connecting roads to join the London-Birmingham, Birmingham Preston and Birmingham-Bristol motorways.

Modernization of existing trunk roads, notably the Great North Road, will be continued and a start will be made on several new projects.

Work on the Great North Road will be continued at top speed. So far, about 70 miles of dual highways have been built under the present program. More than another 70 miles are under construction,



One of Britain's new motorways will connect London to the River Medway district in Kent. This photograph shows work in progress on a 325-ft bridge that will span the river. The bridge program is largest undertaken in Britain since middle of last century



One of several overpasses being built in London to help relieve the city's traffic congestion. This one, shown under construction, is at Hammersmith. It was completed and opened to traffic in 8½ months. It took approximately 17 days to build each of the 16 Spans

including bypasses around Leeming, Aberford and Brotherton, all in Yorkshire, Intersections between roads of varying classes are gradually being abolished on the Great North Road, and two-level junctions and crossings on the motorways bypasses on this route—at Durham in County Durham, Doncaster in Yorkshire and Stevenage in Hertfordshire—will be a standard feature.

In some instances, several smaller projects on one route add upto a progressive improvement over a long stretch. This is what is happening on Route A. 38 in Gloucestershire between Bristol and Gloucester where 1,400,000 dollars is being spent on several projects to widen and improve the road.

THE BRIDGE BUILDING PROGRAM is the largest undertaken in England and Wales since the great railway development in the middle of the last century. On motorways alone 450 bridges are at present under construction. These structures span other roads, railways, rivers and canals.

Prestressed portland-cement concrete is being widely used, enabling strength to be combined with lightness to produce an aesthetically pleasing result. An outstanding example is the Medway Bridge, near Rochester, in Kent, which will be completed early in 1963. This 7,000,000 dollars bridge, more than 1/2 mile long, will be the largest prestressed portland-cement-concrete structure in Europe.

A big spurt in urban road improvement is beginning, with the first year of a planned 420,000,000 dollars 5-year road program designed to relieve urban congestion. These projects are being carried out to the highest modern standards with increasing use of two-level junctions wherever they are the best answer to the traffic situation.

The landscape treatment of newly built motorways and trunk roads involves the immediate planting of 500,000 trees and shrubs. This planting program, the largest of its kind ever undertaken in Britain, is now in progress under plans approved by the Landscape Advisory Committee on roads. In 12 months the committee has examined and approved 85 landscape plans.

(From 'Better Roads,' October, 1961.)

In next Issue "Some Technical Aspects of elevated Highway construction" will be published-Ed.

PRESTON MOTORWAY AFTER THREE YEARS MAGNIFICENT ACCIDENT-FREE RECORD

BRITAIN'S first motorway, the Preston by-pass, was officially opend three years ago on December 5 and has not had a single fatality.

Total vehicle mileage – 65 million miles.

Motorway used by – 10 million vehicles.

Maximum traffic – 21,000 vehicles per day.

The average daily traffic in the summer – 12,500 vehicles per day.

The accident rate on the by-pass is very low indeed – less than one-tenth of the frequency on the old route.

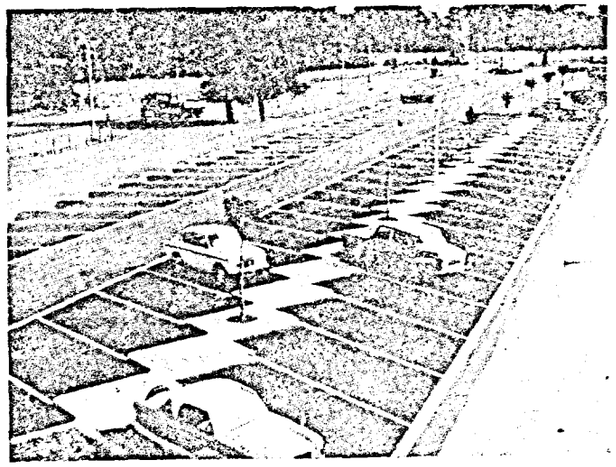
The 8¼ mile motorway cost more than 3 million pounds. Construction started in 1956 and it was officially opened by the Prime Minister, Mr. Harold Macmillan. It runs east of Preston from Walton-le-Dale on A6 and rejoins the A6 at Broughton.

There are two access points on the motorway, compared with 1,898 on the old route through Preston.

(From "Highways & Bridges and Engineering Works", December 13, 1961.)

CAR PARK IN NEW TOWN

NORTHWAY Car Park, Bracknell, completed earlier this year, presents a new look befitting a new town. Designed by Mr. J. T. Kendal, M.I.C.E., M.I. MUN. E., Chief Engineer to the Development Corporation, it features precast concrete kerb units



Northway Car Park, Bracknell

laid to a saw-toothed pattern, which not only ensures tidy parking, but with cobbled centre boxes and trees planted down the middle, creates a most decorative effect. The carriageways and approach roads are in pink coloured bitumen macadam.

Aesthetic appearance, however, has not been achieved at the expense of durability. Because of its high resistance to oil-spillage, a ⅜ in. granite tar macadam has been used as the wearing course on the parking bays which can accommodate a total of 159 cars. This wearing course was to B.S. 802, Table 3, with a high percentage of fines, and contained a tar binder of 38°C. e.v.t. It was laid on a base-course of gravel tar macadam to B.S. 1241.

(From "Roads and Road Construction", December, 1961.)

PREFABRICATED PORTABLE FLYOVER TO RELIEVE TRAFFIC BLACK SPOTS

DESIGNED to solve some of the traffic jams at road junctions, the "Carbridge" is the first prefabricated and portable flyover to be built. The advantage with the Carbridge is the speed of building—complete sections of roadway, with kerbs and side barriers in place, are carried on telescopic trestlees. The finished unit can be erected in a matter of days at a fraction of the cost of the conventional flyover and is strong enough to support a line of double-decker buses running nose-to-tail.

The Carbridge is built from standard steel eomponents. It is a multi-span, through-type bridge of plate girders supporting a battledeck construction floor, and carried on telescopic portal trestles. The deck components are fabricated in 5 ft panels spanning the main girders which incorporate steel kerbs. The main girders are stiffened to withstand the impact of vehicles using the bridge.

Longitudinal rod bracing is provided between the trestles in at least one bay per 200 ft length and more frequently if the track is curved. The variation in length due to temperature differences is also catered for.

The trestles are adjustable in height in steps of 12 ft. The concrete foundations are built to give the actual deck-line and the structure is fixed down to the foundations by bolts in taper boxes. It is claimed that the design presents a clean, uncluttered appearance and if colour schemes, lighting and other fittings are carefully chosen there is no reason why the amenities of an area should be spoilt.

Short ramps, 30 to 40 ft long at the ends of the bridge, are provided by the highway authority to bring vehicles on to the ramped approach portions of the steel bridge. The carriage width is 10 ft between kerbs, parapets set back 10 inches from kerb face, the nominal length of steel structure may be any multiple of 10 ft. Four types of main girder are used to give spans of 20, 30, 40 and 60 ft nominal length. The maximum height of the telescopic trestles is arranged to give clearance of 16 ft 6 in. under the bridge in all conditions. Clear pedestrian head room is obtainable through the taller trestles.

The design loading has been based on a train of four axle vehicles, each of 32 tons gross. The surfacing is ¾ in. thick, resin bonded Ceresk Epoxy surfacing macadam laid on to the steel plate.

The first Carbridge was assembled at Camp Hill, Birmingham, during a weekend last month, when constructional work was completed in under 30 hours. It consists of a single 10 ft wide carriageway and includes two bends over its 790 ft length. Twenty-three sections were used, and the 48 steel erectors were assisted by two 25-ton cranes. Progress of construction is given in the photographs. A conventional flyover at this point would have cost about 500,000, pounds but the total cost of the Carbridge was 80,000 pounds.

The Carbridge is designed to last 25 years but it may be taken down if it is no longer required and used on another site.

Patent application for portable flyover Carbridge has been filed by Major Eric Strogal and sale license to manufacture has been granted to Messrs John Lysaght's, Bristol Works Ltd.

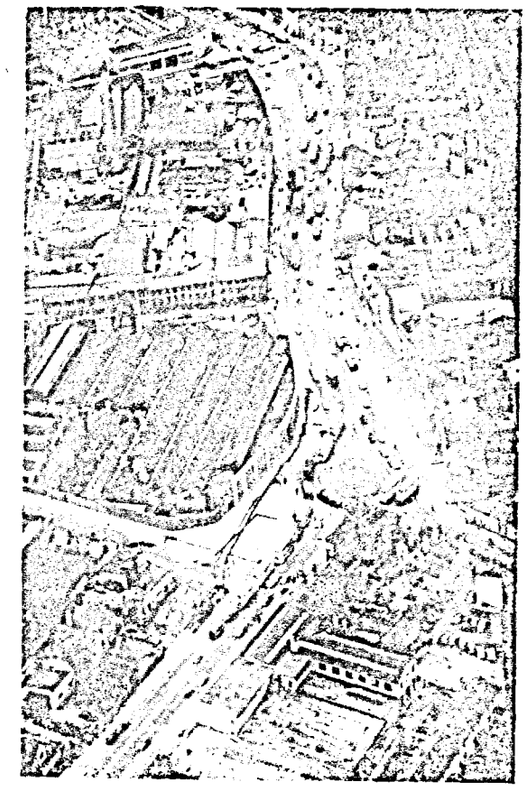
(From "Engineering", dated 17th November, 1961 and republished with their kind permission).

A Problem at Birmingham

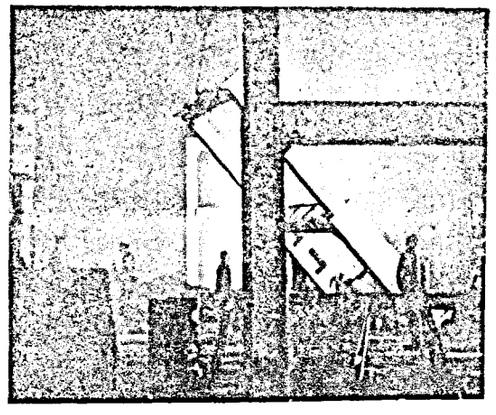
Camp Hill ronndabout was the site of one of the worst traffic jams in Birmingham. And permanent road improvements were not scheduled for there until 1975.

As many as 1,600 vehicles an hour poured from the city centre (top of picture) towards the junction. At the roundabout 900 forked left into the Coventry Road (A45), leading to M1, and the rest turned the roundabout into Camp Hill, leading to Stratford (A41) and Warwick (A34), crossing dense incoming traffic from the Coventry Road.

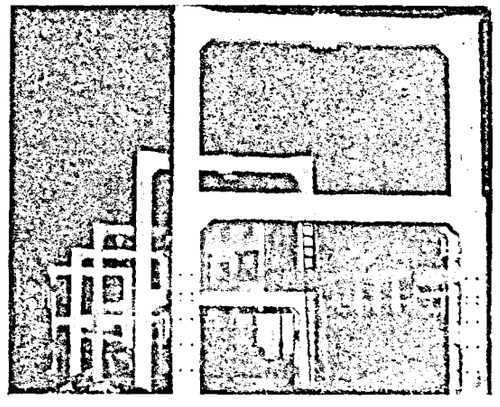
It was a serious situation that called for radical measures if the problem was to be solved.



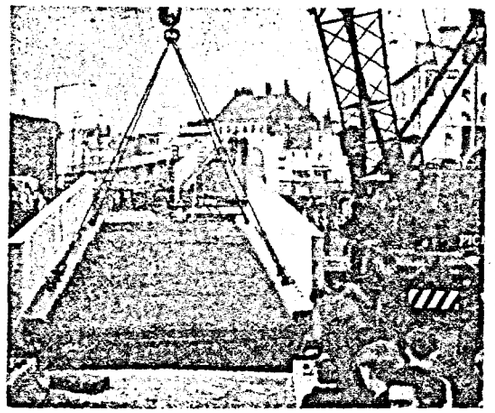
BRIDGE BUILDING . . . AT 8 YARDS AN HOUR



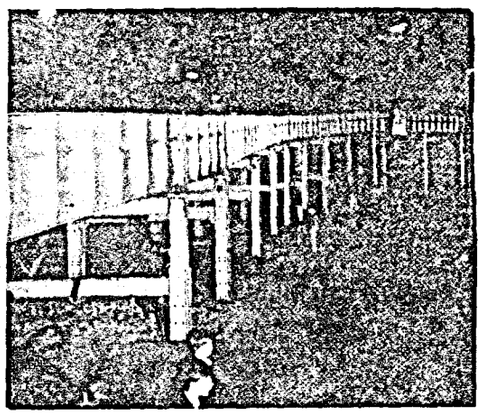
7 p.m., Friday: Forty-eight men, split into two shifts, take turns to work around the clock. The nearby cafe is staying open night and day, throughout the whole period, to cater for the workmen engaged on the project.



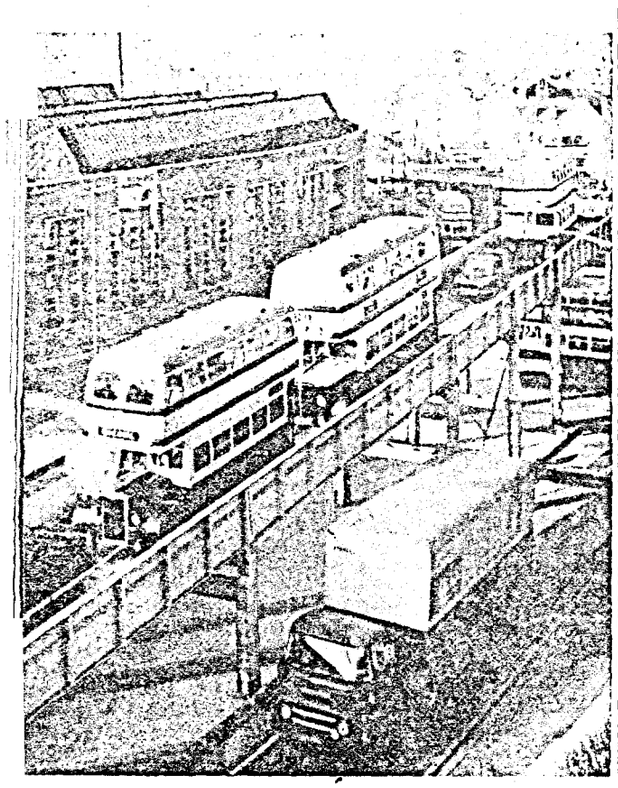
Midnight, Friday: Five hours later the grey skeleton of the structure is taking shape. Every 30 minutes the lorries and trailers arrive with prefabricated parts from the Corporation's depot one-and-a-half miles away.



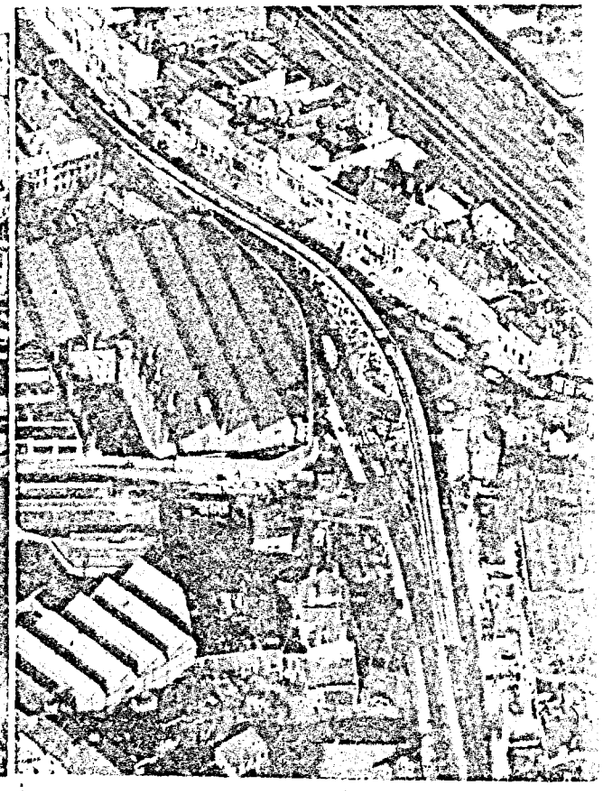
4 p.m., Saturday: Another of the 23 sections of carriageway is lowered into position. The last section is the biggest problem. Bolts have to be tightened along the whole length so that it fits exactly into the final gap.



Midnight, Saturday: The erection work is over. When a final coat of paint has been applied and fittings have been installed, traffic at the choked junction will be able to use an extra road—a road built in 30 hours.



8.15 a.m., Monday, immediately after the opening: This is the morning peak hour, but there are no jams. The portable flyover Carbridge which has dramatically solved a grave traffic problem, speeds a line of buses over the roundabout.



Flying Over
The Carbridge snakes along the centre of the road over the roundabout. Traffic travelling in the direction of Stratford-upon-Avon and Warwick no longer has to edge through the incoming stream from Coventry. It is flying high—non-stop.

FAST, SMOOTH PAVING JOINTS

CONTRACTORS raised their eyebrows three years ago when a new product was introduced as a "cure-all" for bumpy transverse and longitudinal joints. Called Unitube, this formed galvanized steel stripping was designed to replace all conventional joint-making methods.

Made of specially treated 30-gauge electro-galvanized steel sheet, and shaped in a hollow wedge shape. Unitube is installed with the top flush with the roadway, the two sides of the wedge coming together at the base and curving up to provide hook, like anchors at each side. This operation is carried out by a two-man crew on a self-propelled machine in the paving train. It immediately establishes a "plane of weakness", and eliminates the danger of uncontrolled cracking.

After the concrete has cured, the tubing is crimped or folded down into itself, leaving a $\frac{1}{2}$ in. deep slot which is then easily sealed. Movement due to contraction and expansion of the concrete does not disturb the top section which remains fixed in place and a mechanical seal is provided to hold the sealer up where it belongs, offering little fluctuation of sealer height and accumulation of foreign matter, resulting in no "crown" on the joints and no thumps for motorists.

Close-up of Unitube shows how tube flanges open with contraction of concrete

(*From "Roads and Engineering Construction," November, 1961*).

I.D.A. WORKS IN BIHAR

BRIDGE OVER THE RIVER SONE ON NATIONAL HIGHWAY NO. 2

CONSTRUCTION of high level bridge over river Sone at Dehri-on-Sone between miles 335 to 338 of the Grand Trunk Road (National Highway No. 2) in Bihar has been approved for being financed from I.D.A. Credits.

The catchment area at the bridge site is 26,500 sq. miles. The calculated discharge is 1.2 million cusecs with 24.5 ft as greatest depth of water. The sub-strata consists of sand.

Global tenders for the construction of this Bridge have been invited by the Additional Chief Engineer, Bihar Public Works Department, 4, King George Avenue, Patna-1, Bihar, to reach him not later than 2nd May, 1962.

According to the departmental design the proposed bridge will be 10,460 ft between faces of abutments (longest in India) and will consist of 96 spans each 108 ft centre to centre and one end span 92 ft centre to centre.

Each pier will rest on 23 ft external diameter, 15 ft internal diameter and each abutment on twin D type wells with 22 ft × 35 ft external dimensions of Foundation wells will be taken down 64 ft below the bed level and will rest on sand. The piers and abutments will be made of reinforced concrete. The piers are proposed to be 4 ft wide at the top and 5 ft at the base.

On each span the super-structure to provide 24 ft wide road-way between the faces of kerb and 5 ft wide foot-path on either side will consist of 7 inches thick reinforced concrete slab plus concrete wearing coat supported on two simply supported (each 9 ft deep 4.5 ft wide at top, 20 inches wide at bottom, 7 inches thick web) pre-stressed concrete beams spaced about 14.25 ft centre to centre, diapharagms 9 inches wide 4.6 inches deep spaced 10 ft apart will be provided.

(By Courtesy of Shri S.N. Sinha, Addl. Chief Engineer, World Bank Project Wing, Bihar P.W.D., Patna.)

PERSONAL AND MISCELLANEOUS

Dr. F. P. Antia. has been elected President of the Indian Roads and Transport Development Association for the Current Year.

Shri N. N. Shah, Deputy Chief Engineer, has taken over as Chief Engineer. Madhya Pradesh P. W. D., from Shri S. N. Tripathi, who has proceeded on leave preparatory to retirement.

Shri S. N. Sinha, has taken over as Additional Chief Engineer; World Bank Project Wing. Bihar P. W. D., Patna.

Shri S. B. P. Sinha, has been appointed as Superintending Engineer works, Bihar, Patna.

Shri N. D. Mirchandani, has been posted as Planning Officer, I D A Works at Bombay.

Shri B. P. Patel, has been posted as Planning Officer. I D A Works at Patna.

FOURTH INTERNATIONAL CONGRESS ON PRESTRESSED CONCRETE IN ROME AND NAPLES FROM 26 MAY TO JUNE 2, 1962.

PROVISIONAL PROGRAMME OF THE CONGRESS

Saturday, May 26, 1962

15.00 opening of the Secrearíat Office and Registration Office

Sunday, May 27, 1962

11.00 Opening Session (Congress Palace, EUR)

19.00 Reception at the Campidolia

Monday, May 28, 1962

9.00—11.00 1st working session } Subject 1

11.30—13.30 2nd working session }

Afternoon Technical visit
(optional lunch at Tivoli or at Prascati.

Tuesday, May 29, 1962

9.00—11.00 3rd working session—Subject I

12.00 Visit to the Vatican

16.30—19.00 4th working session—Subject III

21.00 Visit to the Borghese Museum

Wednesday, May 30, 1962

9.00—11.00 5th working session } Subject I

11.00—13.00 6th working session }

Afternoon free

20.00 Cold supper in Castel S. Angelo (or at the Terme di Dieleziano)

Thursday, May 31, 1962

Morning—Starting for Naples

17.00—19.00 Reception

Friday, June 1, 1962

9.00 7th working session—Subject V

10.45 First lunch

11.00 8th working session—Subject V

13.00 Lunch at the Overseas Fair

16.00—18.00 9th working session—Subject V

21.00 Showing of technical films

Saturday, June 2, 1962

9.00—13.00 Technical visit

11.00 Lunch in the Borgo Marinaro di S. Lucia

15.00 Visit to the Politechnico and to the Materials Testing Laboratory

17.00 Visit round the town

21.00 Closing supper

Sunday—Monday—Tuesday

Two optional tours with technical visits, one tour towards the north and one towards the south.

Excursions

Excursion will be arranged to works in the North and South of Italy; details will be announced later.

Fee

The Membership fee for the Congress will be 15.00; this fee will entitle each member to a set of the papers printed in advance, and to a complete set of the bound Proceedings.

The fee for ladies or other persons accompanying Members of the Congress will be 6.00 per person.

Exhibition

A special exhibition in the line of the Congress will be organised in the Congress premises accessible for the partaking of firms interested.

President of the Congress

Dr. Ing. Govanni Padoan

Chairman of the Higher Board

of the Ministry of Public Works, Rome.

ELASTOMERIC BEARING PADS IN BRIDGE CONSTRUCTION

By courtesy of Messrs Du Pont de Nemours International S. A.

THIS report is published to acquaint State Highway officials, construction engineers and consulting firms regarding this promising new application. It contains facts to assist in selecting and specifying the proper elastomeric compounds for use in bridge bearing pad fabrication.

1. ELASTOMERIC BEARING PADS— A NEW CONSTRUCTION TREND

At the present time, most bridge girders are supported by either a rocker or a roller, or sliding plate assembly. All three are mechanical means of accommodating thermal expansion and contraction. Careful consideration is being given to a relatively new method, the use of a flat, molded elastomeric pad, to replace these mechanical assemblies.

Operation. An elastomeric bearing pad has no movable parts. It is simply a flat, rubber pad, about one inch thick, that is placed between the girder and the abutment. Thermal expansion and contraction as well as girder rotation are absorbed by the pad's ability to "give and take" in shear. As the girder expands or contracts, the pad deflects in shear. There is no sliding motion between pad and beam or between pad and abutment. (See Figure 1).

Advantages. Primary among the advantages of this new method is its marked economy over mechanical assemblies. Because of its simple design, ease of fabrication and low materials cost, an elastomeric bearing pad should cost approximately 1/4 as much as the average mechanical bearing device.

Another important advantage is that an elastomeric bearing pad requires no maintenance. Where nearly all mechanical devices require periodic lubrication and cleaning, the elastomeric pad is maintenance-free. Further, this type of bearing apparatus, because it has no movable parts, eliminates any possibility of "corrosion freezing".

Outlook. The future of this new application hinges almost entirely on the life of the bearing pad. Since replacement or, repair would entail jacking up the entire bridge structure, a long life in the face of continued weathering is of great importance.

Although relatively new in use, elastomeric bearing pads have been used in France since World War II. Their performance in that country has led authorities to estimate that a high quality elostomerci

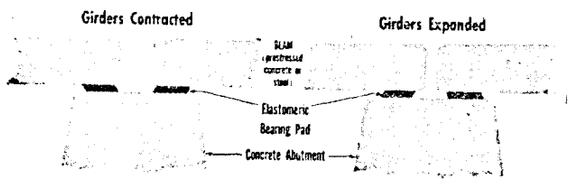


FIGURE 1

Elastomeric pad moves in shear to compensate for thermal movement and girder rotation. The pad provides an even load distribution to the abutment at all times.
Photo above shows placement of bearing pads between girder and abutment.

compound will give satisfactory performance for a minimum of 35 to 50 years.

In the United States, elastomeric bearing pads are being used in a growing number of new bridge constructions. Engineers on these projects are optimistic about the life of these pads. Many estimate that they will last the life of the bridge. Based on these forecasts and other reliable industry data, a number of state highway departments are already specifying elastomeric pads in some or all new bridge construction.

At any rate, this promising new application certainly merits careful consideration and investigation in future construction plans.

This report has been prepared to help you become better acquainted with the more important aspects of elastomeric pads and their use in bridge construction. Although design requirements are not dealt with, the importance of proper design must not be overlooked. Even the best elastomeric compound will not perform properly if the pad is poorly designed.

2. REQUIREMENTS OF A BEARING PAD COMPOUND

To insure a long life, the compound selected should display outstanding performance in the properties listed below. The American Society for Testing Materials has established definite procedures for measuring performance in these properties. Where applicable, these tests are described and optimum results are suggested.

Ageing properties: Good resistance to sunlight and weathering is by far the most important property of the compound you select. After long exposure to the elements, the compound should not crack or suncheck, and, internally, should retain a high degree of its original hardness, tensile strength and elongation properties. To predict the performance of a compound after long-term exposure an accelerated ageing test has been developed (ASTM D 573). This test measures the percentage change in tensile strength, elongation and hardness of the compound after it has been oven-aged in air.

A bridge bearing pad, after 70 hours in an oven at 212°F, should lose no more than 15 per cent of its original tensile strength or more than 40% of its original elongation-at-break. It should gain no more than 15 points in hardness.

Creep and Compression set: Creep is that characteristic of all elastomers to show gradual increase in deformation under constant load with passage of time. Low creep characteristics in a bridge bearing pad are important to keep the bridge surface level with approaches. But a creep test takes years to run and so is not practical to write into a specification for the pads.

It is practical, however. to measure the compression set of elastomeric compounds. Compression set is the residual displacement in a rubber part after a distorting load has been removed. To determine compression set a pellet of rubber is compressed to a specified percentage of its original thickness, held for a specified length of time at a specified temperature and released; compression set is the difference between the original thickness of the specimen and the thickness after testing, expressed as a percentage of the deflection employed (ASTM D 395). While the correlation between creep and compression set is casual at best, many engineers believe that if the compression set of bridge bearing pads is kept below 20 per cent no significant amount of creep will occur.

3. ELASTOMERS AND THEIR PROPERTIES

There are many types of elastomeric materials commercially available for use in bearing pad fabrication. They range from natural rubber, through the many synthetics (neoprene, nitrile, butyl) to the high temperature elastomers (HYPALON, siliconi rubber). In evaluating an elastomer for use in bearing pad fabrication, you should remember that many are "special purpose" elastomers—developed to perform under certain conditions of use. These rubbers tend to rank high in certain properties, at the expence of a poor showing in others. You will be most concerned with an elastomer that exhibits good performance in all the properties required of a bearing pad compound.

Now that you are acquainted with the properties required of a bearing pad com-

pound, look at figure 2. This chart, was compiled from published literature of leading rubber companies, compares performance of the major elastomers.

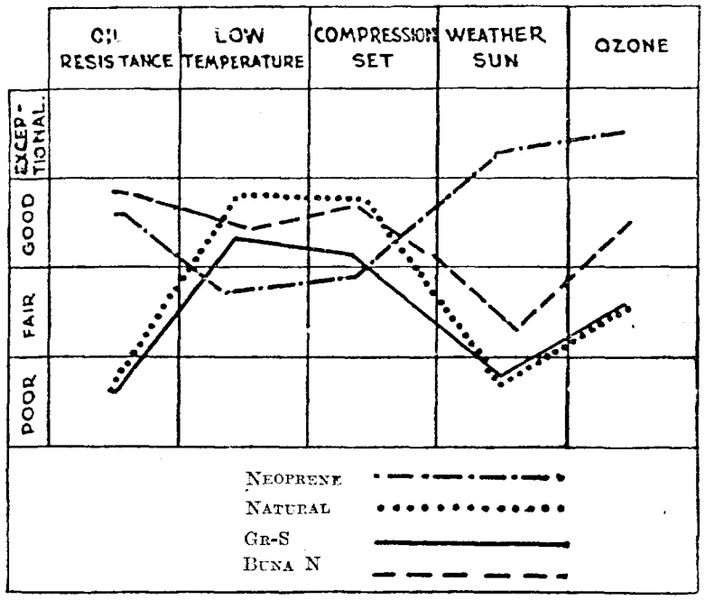


Fig. 2

Many Engineers who formerly used lead plate or steel roller assembly devices, employ neoprene bearing pads with metal separators made of galvanised sheet iron. The neoprene pads are adhered to the metal plates, and the pads are laid between the vertical support pillars and the upper concrete surface. The pads used on the Milan-Florence autostrada were 300 to 250 mm wide, 300 to 700 mm long and 12 mm thick. Up to four layers of neoprene were used in each pad to make up this thickness. Each layer of synthetic rubber is grooved so that the layers can be perfectly wedged into one another to constitute a single block. The metal separators grooved in the same way as the rubber plates, are interleaved between the neoprene. The use of the metal separators prevents any variation in vertical deflection when passing from static load to live load.

Each bearing is capable of taking a static compression strain of 25 to 30 kilograms per square centimetre. Under maximum live load, the bearings can take a compression strain of 50 to 60 kilograms per square centimetre. Since the bearings with their metal separators work in parallel, horizontal movements are reduced to a safe minimum.

Other reasons for choosing neoprene for these bearings were its maximum resistance to oxidation, oil and abrasion, its tensile strength, its superior ageing properties and exceptional resistance to weather conditions.

* * *

NOTE BY EDITOR: Neoprene is manufactured by the Du Pont Company as raw material for industry.

TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

INDEX

January to December 1960
(Issue No. 153 to 164)

INDIAN ROADS CONGRESS, NEW DELHI.

Index to Transport-Communications Monthly Review, Volume Nos 153 to 164 (January, 1960 to December, 1960)

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*The first number represents the issue number and the second within brackets the page of that issue.

Regd. No. M-7343

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REFRESHER COURSES FOR SENIOR HIGHWAY ENGINEERS

THE Council of the Indian Roads Congress at its meeting held at Patna on the 18th December, 1961 approved the syllabus for Refresher Course prepared by Education Committee of the Indian Roads Congress and recommended that these courses should be commenced as early as possible.

The first Refresher course for Senior Highway Engineers is proposed to be started at the Central Road Research Institute, New Delhi from the 9th April, 1962. It will be possible to accommodate 20 officers for this course. The duration of the course will be about twelve days in all.

On the recommendation of the Indian Roads Congress, the Government of India have requested all State Governments to nominate officers to attend this course. Approved syllabus for this course is given below. Refresher courses for Junior Highway Engineers will be run in due course.

SYLABUS FOR REFRESHER COURSES FOR SENIOR HIGHWAY ENGINEERS

1st day

10.00—11.00	Introduction to the Course.
11.00—12.00	Soil Survey, Classification and testing.
12.00—13.00	Soil Compaction and its application to embankments and pavements.
14.00—17.00	Laboratory testing of soils.

2nd day

10.00—11.00	Moisture movements in the subgrade and their effect on pavement behaviour and design.
11.00—12.00	Road aggregates—tests and usages.
12.00—13.00	Design and construction of water-bound macadam roads.
14.00—17.00	Laboratory testing of Aggregates.

3rd day

10.00—11.00	Soil stabilization techniques and application to Roads and runways.
11.00—12.00 12.00—13.00	Bituminous materials and tests with their significance.
14.00—17.00	Laboratory practice on testing of bituminous materials.

4th day

10.00—11.30	Concrete mix design.
11.30—13.00	Bituminous mix design.
14.00—17.00	Laboratory Practice on Bituminous mix design.

5th day

10.00—11.30	Design aspects of stabilized soil for low cost roads.
11.30—13.00	Design techniques of flexible pavements and drainage considerations.
14.00—17.00	Laboratory Practice on Cement Concrete mix design.

6th day

10.00—11.30	Design techniques of Cement Concrete Pavements.
11.30—13.00	Relationship between Bituminous Binder and aggregate for surface dressing.
14.00—17.00	Problems on the design of flexible pavements.

7th day

10.00—11.30	Stabilized soil road construction practices including gravel roads.
11.30—13.00	Concrete road construction practices and specifications.
14.00—17.00	Problems on the design of rigid pavements.

8th day

10.00—11.00	Eeorge design considerations in roads.
11.00—12.00	Design of overlays.
12.00—13.00	Role of Machinery for the stabilized soil road construction—relative economics of mechanised and manual construction.
14.00—15.00	Problems on the design of overlays.
15.00—17.00	Bituminous and construction practices and specifications.

9th day

10.00—11.00	Accidents and traffic census.
11.00—12.00	Design and construction of hill roads.
12.00—13.00	Mechanised methods related to Bituminous and cement concrete pavements—their advantages and economy.
14.00—17.00	Investigation of Road failures and demonstration of field tests.

10th day

10.00—11.00	Quality Control and role of field laboratory in road coustrubtion.
11.00—12.00	Road constructiou in black soil regions and water-logged areas.
12.00—13.00	Economics of different types of roads—Roads maintenance.
14.00—17.00	General discussions and winding up of the Course.

Depending upon the extra time available, the following field inspections (preferably during the intervening holidays) may be considered:—

1. Inspection (Bituminous pavement construction).
2. Inspection (Cement Concrete Pavement construction.
3. Inspection (Stabilished Soil construction).
4. Inspection (Overlay construction).

DESIGN CONSIDERATIONS OF TOWN ROADS OF CUMBERNAULD NEW TOWN IN GREAT BRITAIN

By
L.W. Buck Thorp

IN the case of the outer ring road, where the maximum flows are approximately 1,000 v. p. h. (practically unidirectional) or less than 700 v.p.h. (approximately equal opposing flows), it was considered that a 33-ft single carriageway would be adequate. There are considerable lengths were a 24-ft carriageway would be considered adequate, if assessed purely on lane capacity, but the frequency of side road junctions and the consequent turning traffic, as well as the need for visual continuity, favoured use of the 33-ft carriageway throughout. This is a three-lane carriageway of which two are through lanes and one for turning and has since been adopted for all feeder/distributor roads. Provision for turning traffic has been given priority over provision for overtaking.

For radial roads a maximum capacity of 1,000 v.p.h. per 12-ft lane was adopted which in the case of dual 24-ft carriageways, assumes a practical capacity of 1,750—2,000 v.p.h. in each direction. As some sections will carry volumes requiring three lanes in one direction, 33-ft carriageways have been assumed with practical capacities of 2,250 v.p.h. It is possible, however, that where three-lane unidirectional carriageways are required, 12-ft wide lanes may be adopted when designs are actually carried out.

Radials and Radial Links

It has already been stated that these roads are similar in character to urban motorways and, as such, it is considered that initial formation widths should take into account the possible future need for hard shoulders. When the initial earthworks are carried out it is proposed to allow for a 12-ft wide verge to both carriageways. In the event of hard shoulders being required, this will allow a maximum shoulder width of 10-ft.

Some thought has already been given to the construction of the hard shoulders. While conventional forms of construction have been employed on the motorways, experiments are being carried out in Cumbernauld with galvanised steel reinforcing fabric laid in the verges in an attempt to reduce costs. The initial results suggest this may be successful for the relatively small amount of traffic use to which the shoulders will be subject.

Central reservations to be normally 10 ft in width, inclusive of battered kerbs. When the road crosses structures exceeding 200 ft in length, the central reservation may be reduced to 6 ft minimum width. A similar reduction may be made under bridges where there are no central piers.

Design speed to be 50 m.p.h. associated with a running speed of 50 m.p.h.

The minimum horizontal curvature to be $7\frac{1}{4}°$ (790 ft radius) with an associated superelevation of 7 per cent.

For curves between 2°-30′ (2,300 ft radius) and 0°-30′ (11,500 ft radius) the adverse camber to be reversed and curves out with this range to retain the normal camber.

Transitions to be inserted for curves between $2\frac{1}{2}°$ and $7\frac{1}{4}°$.

Maximum gradient to be 5 per cent.

Crest vertical curves to be minimum radius of 10,000 ft.

Sag vertical curves to be minimum radius of 5,000 ft.

Stopping distance = sight distance = 350 ft.

The width of all speed change, i.e., acceleration, and deceleration, lanes to be 10-ft and the length, which includes the taper, to be based on the design speed of the turning roadway.

Lane lengths to be similar to the Standards recommended in U.S. Practice (width modifications). Tables have been produced which cover all circumstances.

Feeder/Distributor Roads

Design speed to be 40 m.p.h. associated with a running speed of 34 m.p.h.

The minimum horizontal curvature to be $10\frac{3}{4}°$ (533 ft radius) with an associated maximum superelevation of 5 per cent.

For curves between 4° (1,432 ft radius) and 1° (5,730 ft radius) the adverse camber to be reversed and curves outwith this range to retain the normal camber.

Transitions not required up to and including 4° curve.

Maximum gradient to be 5 per cent.

Crest vertical curves to be minimum radius of 6,500 ft.

Sag vertical curves to be minimum radius of 3,500 ft.

Stopping distance = sight distance = 250 ft.

Passing sight distance = 1,200 ft.

Ramps and Slip Roads

Design speed dependent upon available space. Minimum radius normally 150 ft (speed 25 m.p.h.). Minimum internal radius of loop to be 60 ft.

Maximum superelevation to be 7 per cent.

Maximum gradient to be 7 per cent.

Should the combination of gradient and superelevation result in an absolute gradient exceeding 7 per cent, consideration to be given to sub-surface heating. Sight distance and vertical curve values to be related to anticipated speed at any section, e.g., 40 m.p.h. where slip leaves radial and 30 m.p.h. where slip approaches roundabout.

Normal width to be 20 ft with 6 ft verge on either side. Greater width to be provided if warranted by traffic flow or if ramp is long enough to justify provision for overtaking. All ramps to be widened on curves.

Grade-Separated Roundabouts

Design capacity to be 75 per cent of the values obtained from the formula recommended by Wardrop.

Normal width at throat of weaving section to be 30 ft.

Width of carriageway between slip roads to be 24 ft.

Normal entry radius 90 ft.

Normal exit radius 120 ft.

In case the wisdom of employing relatively high design speeds should be doubted, it should be borne in mind that the radius and radial links will be located and treated in such manner that pedestrian access to them will be completely barred and such speeds could be obtained with perfect safety. In many built-up areas roads of similar character to the outer ring road already have a speed restriction of 40 m.p.h. without the same limitation of access to pedestrians.

Treatment of Underground Services

In the case of feeder/distributor roads a continuous services reservation will be provided on one side of the road in which will be located all the statutory companies apparatus, but it may be frequently necessary to provide space for a duplicate lighting cable in the other verge.

It is anticipated that provision for lighting cables only need be made in the radial roads. Consideration will be given to the siting of the town's main services outside the boundaries of the radials, possibly along the line of a main footpath lying parellel to the radial route.

Lighting

In the interest of safety and appearance it is hoped that adequate illumination can be provided without siting colums in the central reservation.

Initial suggestions favoured the use of different lighting sources in radial, feeder/distributor and residential roads to emphasise the different functions of each. Subsequent consideration has shown the wisdom of not confronting the night driver with a variety of different coloured lighting sources throughout the town and it now

seems likely that flourescent or flourescent type lighting will be used throughout.

While the feeder / distributor and residential roads will be illuminated to the standards recommended in the Codes of Practice for groups 'A' and 'B' lighting respectively, it is anticipated that a higher intensity of illumination will be achieved for the radial roads and, in particular, on the grade-separated interchanges.

Landscaping

Integration of a motorway type road with the surrounding urban development presents its own problems and the solutions depend almost entirely on very careful landscaping. In many cases the road becomes a deep gash cutting through a densely developed residential area and it is often entirely out of scale with the surrounding houses. Obviously the landscape treatment of the cuttings or embankment must serve the dual purpose of separation of the function as well as the integration of the two elements in the town scene.

Cumbernauld's solution to this problem will be the provision of tree belts separating the main roads and the houses. It had been hoped that tree planting might extend over the slopes of the cutting and embankments, but we were advised against planting on steep (1 : 2 to 1 : 3) slopes in clay sub-soils. Pit–planting may be the answer on these gradients, but the increased costs of both planting and drainage will have to be considered. On the other hand, if the gradients are made less steep, increased excavation will be necessary, as well as a wider strip of land for road construction. The most likely solution seems to lie in the reservation of a strip of land, some 70 ft in width, at the top or bottom of the slopes on which planting can take place, although it is felt that limited planting of the steeper slopes is justified on an experimental basis.

Grade-separated interchanges are bound to occupy a fairly large area by virtue of their correct functioning, and the landscaping treatment applied to them must recognise the need to conserve land. If grass slopes are to be mechanically moved their gradients should not exceed 1:3, but slavish adherence to these slopes would consume even greater land areas. Whilst retaining grass banks in the interchange complexes, the extent of the grass will be limited by the introduction of small retaining walls, or steeper slopes varying from 1 : 3 to 1 : 1, which will be paved in some form. It is not proposed to carry out any planting within the interchange complexes as these are purely functional and depend upon form for the visual effect.

Preliminary ground exploration have revealed the presence of considerable quantities of subsoil which, when excavated, are unlikely to be satisfactory for compaction in embankments. This surplus material will be used in mounds, and other forms, adjoining the main roads to provide a directional effect, or barrier, where no natural barrier exists. An interesting example of use of spoil for this purpose is described by G. A. Jellicoe and similar treatments have been applied to several continental motorways.

Restriction of pedestrian access to the radial roads is made easier by provision of the adjoining tree belts. Not only can the planting be thickened where it abuts on the road, but the dense growth can form a screen for some form of unclimbable fence which, it is felt, will be necessary to discourage children from wandering on to the roads. In the case of the outer ring road, housing on the boundaries of residential developments will form a natural barrier and this will be supplemented by a strategic planting and the use of pedestrian barrier railings.

The Development Corporation attach considerable importance to the landscape treatment of the town and have decided that all earthworks connected with main road construction shall be completed during the initial stages of the town development, in order that the comprehensive landscaping may mature along with the general building development.

(From "The Journal of the Institution of Municipal Engineers," December, 1961).

ROUND THE ROAD RESEARCH LABORATORIES

INFLUENCE OF SODIUM SULPHATE ON THE ENGINEERING PROPERTIES OF SOIL : LIME MIXTURE

By

Dr. I. S. Uppal* & S. N. Rampal†

SYNOPSIS

Popularity of use of local soil for the construction of roads and buildings is increasing due to economical and durable product produced. To make such constructions more resistant to softening effects of water, the use of lime as a stabiliser is gaining popularity.

Presence of some soluble salts like sodium sulphate in the natural soil, very adversely affects the engineering properties of the soil.

Investigations were therefore undertaken to study the influence of such salts on the engineering properties of soil mass stabilised with lime.

It has been found that the lime is neither suitable nor economical for stabilising soils rich in sodium sulphate for the structures likely to be exposed to atmosphere. However, lime is suitable for improving the penetration resistance of the soils rich in sulphate in wet conditions when confined and not exposed to the atmosphere as in the case of sub-base course of roads.

Investigations carried out on the use of lime for improving the alround engineering properties including bearing capacity of natural soils under dry and soaked conditions have yielded encouraging results both in the Laboratory as well as in the field for the construction of roads.

The quantity of lime required for the desired results in field in the case of alluvial soils has been found to be small, generally about 2 per cent by weight of the soil. Accordingly importance of the use of small proportions of hydrated lime for improving bearing capacity of the bases and sub-bases of the roads in the waterlogged areas is now being increasingly recognised.

It has been observed that in the highly water-logged areas, adequate thickness of the sub-base consisting of the natural soil stabilised with 1 to 2 per cent hydrated lime under the usual 6-in. to 7-in. hard crust, a very stable road capable of withstanding heavy traffic without becoming wavy or showing any other signs of distress or failure can be constructed. This technique has actually been tried in the Punjab at a number of places and the results have been very satisfactory. A comprehensive note on these roads has already been communicated to the Indian Roads Congress.

On further Laboratory investigations it was observed that the soils rich in harmful salts like sodium sulphate show less response to this treatment. For instance a sulphate free soil of L.L. 37.5 per cent, P.I. 17.2 per cent and sand content less than 10 per cent which showed a soaked CBR of 18 per cent with 2 percent lime showed only 2.3 and 1.6 per cent soaked CBR when 0.5 & 1.0 per cent sodium sulphate respectively was added to the soil before mixing with lime. Hence systematic Laboratroy investigations were undertaken to determine the maximum sulphate contents of soil which will respond to stabilisation with economical percentage (2 per cent) of lime and also to determine the increased quantity of lime required for stabilisation of soil with higher sulphate contents.

EXPERIMENTAL

A typical natural silty-clayey soil having L.L. of 34 per cent, P.I. 13.7 per cent and sand content 8.5 per cent was selected and mixed with varying quantities of sodium

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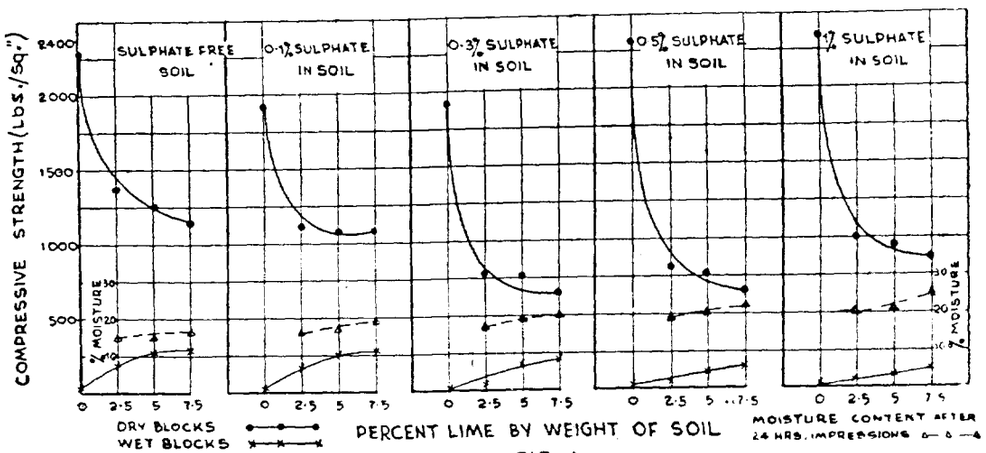

FIG-1

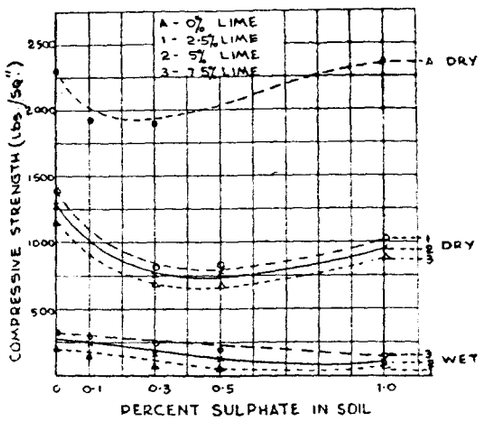

FIG-2

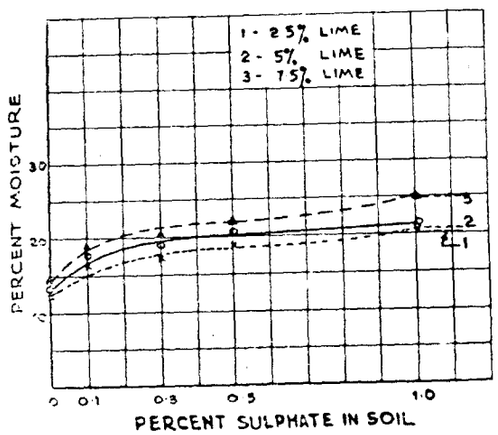

FIG-3

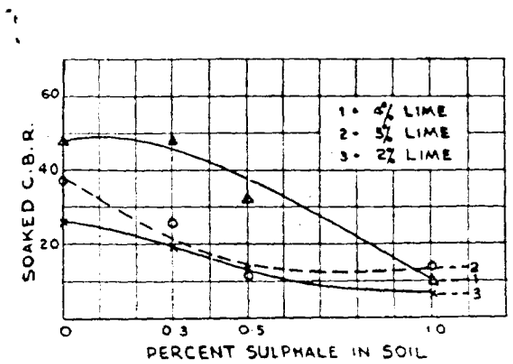

FIG-4

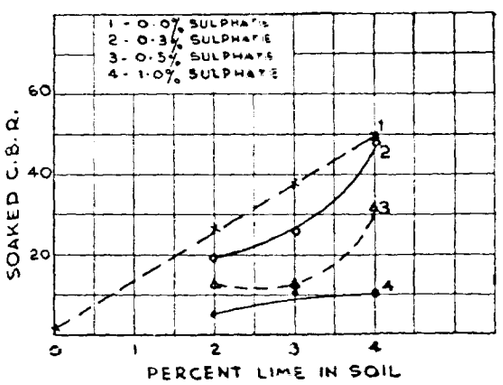

FIG-5

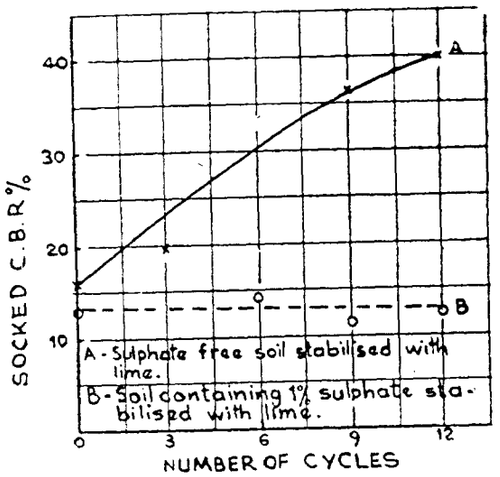

FIG 6

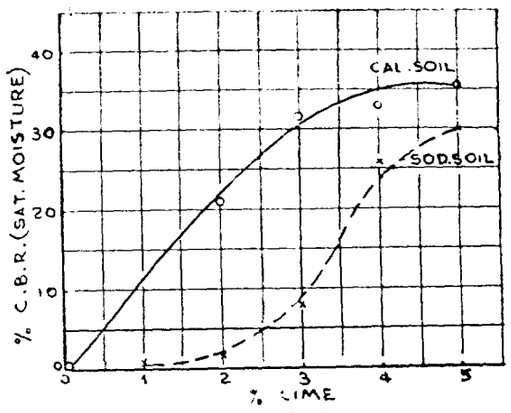

FIG-7

sulphate to produce soils with 0.1, 0.3, 0.5 and 1 per cent sulphate contents. Each of these soils was mixed with varying proportions (0 to 7.5 per cent) of commercial hydrated lime and subjected to the usual CBR tests in the Laboratory. In addition twelve blocks of each soil: lime mixture were prepared at optimum moisture in the Modified Abbott's compaction apparatus[2] and subjected to the following tests:—

(a) Resistance to disintegration when immersed in water.

(b) Compressive strength in dry and wet state.

(c) Drying and wetting cycles (effect of weathering).

(d) Appearance of efflorescence.

The observations made are recorded in the Tables I to IV and discussed below:—

(a) Disintegration Test

The blocks were first dried in the oven at about 70°C to constant weight and cooled to room temperature (20°C). These were then immersed in water in a trough and time of their actual disintegration noted. It was observed that blocks containing no lime completely disintegrated within twenty five minutes after contact with water while in the case of blocks containing lime the disintegration was less depending on the percentage of the lime. It was, however, noticed that for the same lime content the blocks containing higher percentage of sulphate disintegrated more rapidly than those containing less sulphate. The blocks containing 1 per cent sulphate and 5 per cent lime remained completely intact even after twenty days immersion.

(b) Compressive strength

The results of compressive strength of the dry and wet (soaked in water for 24 hours) blocks are shown in Table I and represented in Figures 1&2.

TABLE I

Serial number	Percentage Additive in Soil Mixture		Compressive Strength lb./sq. in.		Percentage Moisture in Wet blocks
	Sulphate	Lime	Dry	Wet	
1	2	3	4	5	6
1.	Nil	Nil	2314	Disintegrated in water	
2.	Nil	2.5	1389	214	15.4
3.	Nil	5.0	1284	268	15.4
4.	Nil	7.5	1150	298	17.4
5.	0.1	Nil	1940	Disintegrated in water	
6.	0.1	2.5	1120	180	16.82
7.	0.1	5.0	1102	256	17.6
8.	0.1	7.5	1075	268	19.1
9.	0.3	Nil	1908	Disintegrated in water	
10.	0.3	2.5	775	64	17.2
11.	0.3	5.0	775	180	18.8
12.	0.3	7.5	705	240	20.3
13.	0.5	Nil	2329	Disintegrated in water	
14.	0.5	2.5	806	48	18.9
15.	0.5	5.0	788	132	20.6
16.	0.5	7.5	654	156	22.4
17.	1.0	Nil	2359	Disintegrated in water	
18.	1.0	2.5	1000	60	20.4
19.	1.0	5.0	985	80	20.8
20.	1.0	7.5	896	136	25.3

It would be seen therefrom that the compressive strength which decreased with increasing quantity of lime in dry blocks, improved steadily when the blocks were wet. However, the strength of the wet blocks was adversely affected with the increasing quantities of sulphate so much so that the soil blocks containing 7.5 per cent lime and no sulphate which showed a compressive strength of 298 lb per sq. inch, showed only 156 lb per square inch strength when 0.5 per cent sulphate was present in the mixture and only 136 lb when the sulphate content was higher i.e., 1 per cent. In the case of dry blocks, however, the strength decreased with the increasing percentage of sulphate upto 0.3 per cent and thereafter became almost constant.

It would also be observed from col. 6 of Table I and Figure 3 that the per cent moisture absorbed by the blocks generally increased with the increasing quantities of sulphates as well as lime. But in spite of the increased moisture with increasing quantities of lime alone the compressive strength of wet blocks steadily increased while it considerably decreased with the increasing quantities of moisture absorbed due to the presence of sulphates.

Resistance to weathering: The dry blocks were subjected to wetting and drying cycles, each cycle of five hours immersion under water and 42 hours drying in the heating chamber at about 50°C. The loss in weight after 3,6,9 & 12 cycles was determind and the results are recorded in Table II.

It will be seen therefrom that while with the increasing percentage of lime the per cent loss due to disintegration decreased, there was more loss as the percentage of sulphate in the same mixture increased. A soil containing 0.5 per cent sulphate needed at least 7.5 per cent lime to make it retain its stability to weathering conditions. Even as much as 5 percent lime by weight of soil was not found to be adequate for stabilising the soil containing 0.5 per cent SO_4 so far as resistance to weathering was concerned.

TABLE II

S. No.	Percentage Additive in Soil mixture		Percentage Loss at the end of each test			
			No. of cycles			
	Sulphate	Lime	3	6	9	12
1.	Nil	Nil	100	—	—	—
2.	Nil	2.5	1.5	18.7	Finished in 9th cycle	—
3.	Nil	5.0	No loss	No loss	2.9	3.9
4.	Nil	7.5	-do-	-do-	No loss	No loss
5.	0.1	Nil	100	—	—	—
6.	0.1	2.5	27.4	Finished in 6th cycle	—	—
7.	0.1	5.0	1.5	3.6	8.9	17.2
8.	0.1	7.5	No loss	No loss	No loss	No loss
9.	0.3	Nil	100	—	—	—
10.	0.3	2.5	100	—	—	—
11.	0.3	5.0	1.5	4.9	15.7	28.9
12.	0.3	7.5	No loss	No loss	.5	1.9
13.	0.5	Nil	100	—	—	—
14.	0.5	2.5	100	—	—	—
15.	0.5	5.0	No loss	No loss	2.5	10.0
16.	0.5	7.5	-do-	-do-	1.0	1.93
17.	1.0	Nil	100	—	—	—
18.	1.0	2.5	100	—	—	—
19.	1.0	5.0	10.9	Finished in 5th cycle	—	—
20.	1.0	7.5	2.0	3.9	7.8	11.8

Appearance of Efflorescence: This test was performed with a view to find whether the addition of lime to soils rich in sulphates could check the rise of sulphate through capillary action or counteract the harmful effect of such salts. The blocks were placed in cylindrical moulds with false bottom and kept over wet sulphaty subgrade containing 0.5 per cent sulphate. It was observed that in the case of blocks containing 2.5 per cent lime the sulphate started appearing after two days while in the case of blocks containing 5.0 and 7.5 per cent lime the appearance of efflorescence at the top was somewhat delayed. Within a month, however, all the blocks were found covered with thick fluffy layers of soil mixed sulphate and disintegrated at the top. The disintegration of all the blocks increased with the lapse of time.

In another set where the blocks were kept over a sulphate free subgrade, there was no appearance of efflorescence at the top, though concentration of a whitish crust and slow disintegration was noticed on the sides.

The above observations on the various tests reveal that for the structures which are likely to be exposed to atmospheric conditions, the use of lime for the stabilisation of soils rich in sulphate is neither suitable nor economical.

INFLUENCE OF SOLUBLE SULPHATE ON BEARING CAPACITY OF SOIL-LIME MIXTURE AS DETERMINED BY CBR TEST METHOD

The soil samples prepared as mentioned earlier were moulded at optimum moisture to dry density of 1.8 in the standard CBR moulds and then subjected to the usual Laboratory CBR test under soaked conditions. The results are given in Table III and Figures 4 and 5. It would be seen that the soaked CBR of soils containing 0 to 1 per cent sulphate steadily decreased from 26.3 to 6.3 when only 2 per cent lime was used while the saturation moisture increased from 18.4 per cent to 25.3 per cent. When, however, 3 per cent lime was used in all these soils, the CBR of the soil mass containing highest percentage of sulphate (1.0 per cent) increased to 13.0 per cent *i.e.*, about double of that obtained with 2 per cent lime. When the lime was further increased to 4 per cent the CBR of the mixture containing upto 0.5 per cent sulphate considerably improved, while in the case of soils containing 1.0 per cent sulphate it was almost the same as that with 3 per cent lime. It will be seen from these results that the soils containing higher sulphate content would need higher proportions of lime for improving their bearing capacity. For the type of a silty-clayey soil, actually tested, an addition of 3 per cent hydrated lime by its weight is considered sufficient for sulphate content upto 1 per cent.

TABLE III

Stabilisation with lime of soils containing sulphates

SOIL—L.L = 33.95; P.T. 13.74; S.C. = 8.5

Percent sulphate in soil	Percent Lime in soil													
	0		2		2.5		3		4		5		7.5	
	CBR	Sat. moist. per cent	†CBR	Sat. moist. per cent	†CBR	Sat. moist. per cent	†CBR	Sat. moist. per cent	†CBR	Sat. moist. per cent	†CBR	Sat. moist. per cent	†CBR	Sat. moist per cent
0	0.66	19.8	26.3	18.4	30.0	18.8	37.5	18.9	49.0	17.6	50.6	18.5	30.0	20.6
0.1	0.66	20.4	—	—	22.5	19.7	—	—	—	—	37.0	20.3	44.1	19.3
0.3	0.86	20.2	19.0	20.9	18.2	20.1	26.3	20.3	48.3	19.4	35.0	18.9	35.5	20.0
0.5	0.8	19.9	13.0	21.8	8.7	23.7	12.3	22.9	32.3	20.2	12.3	23.1	33.8	20.2
1.0	0.7	23.24	6.3	25.3	6.0	26.0	13.0	24.3	10.0	25.3	12.0	24.9	6.0	26.4

† Per cent CBR at Saturation

EFFECT OF INTERMITTENT WETTING AND DRYING ON THE BEARING CAPACITY OF SULPHATY SOIL STABILISED WITH LIME

In order to find out the effect of intermittent wetting and drying on the CBR of the sulphaty soils in the presence of lime five CBR moulds of the soil containing 1percent sulphate and 3 per cent lime (compacted to 1.8 dry density) were subjected to wetting and drying cycles. Each cycle consisted of 24 hours drying (in the sun during the day and in a warm chamber at 50°C at night) and 72 hours soaking in water. One mould was tested for its CBR value straight away after soaking it in water for 72 hours. The second mould was subjected to three wetting and drying cycles and then subjected to CBR test at saturation. Third mould was subjected to 6 wetting and drying cycles, while the 4th and 5th moulds were subjected to 9 and 12 cycles respectively before performing the CBR test on them. In all these cases the final CBR was of the saturated soil-lime mixture. The results are given in Table IV below and graphically represented in Fig. 6B. It would be seen that the CBR value of the moulded soil remained almost unaffect at the end of 12 cycles. This shows that the effect of lime in improving the bearing capacity of the soils in wet and confined state is quite lasting.

TABLE IV

No. of cycles	Per cent CBR.	Per cent moisture
0	13.0	24.3
3	18.5	24.4
6	14.8	22.5
9	11.3	22.1
12	12.5	24.9

A similar weathering test conducted on a natural sulphate free silty soil stabilised with 2% hydrated lime showed that not only the effect of lime treatment is very lasting but the stabilised soil mass also gains in bearing capacity with ageing. This would be seen from data given below in Table V and Figure 7.

TABLE V

No. of cycles	Per cent CBR	Per cent Moisture
0	15.3	21.0
3	19.3	19.8
6	32.6	18.3
9	36.0	16.8
12	40.0	19.3

This experiment was also repeated on field scale by building 8 ft × 6 ft × 6 in. thick stabilised soil base (on the natural subgrade) with different soils containing lime and performing CBR test on undisturbed samples at intervals of 15 and 45 days. In all the test sections containing lime, the CBR value at saturation moisture was found to be higher with the lapse of time. The results are indicated below in Table VI. Incidently these results also indicate the effect of curing of the soil-lime mixture on its bearing capacity.

TABLE VI

Nature of soil	Per cent lime	CBR after 15 days.	CBR after 45 days
Silty	0	1.7	0.63
Silty	1	8.8	12.20
Silty	2	18.0	21.30
Clayey	0	0.5	0.00
Clayey	2	10.2	16.20
Sandy (N.P.)	0	1.6	1.06
Sandy	2	5.1	9.70

INFLUENCE OF EXCHANGEABLE-IONS ON THE EFFICACY OF LIME FOR IMPROVING THE BEARING CAPACITY OF SOILS

During the investigations it was felt that the sodium soils responded less to the lime treatment than the calcium soils. In order to confirm this natural soil was converted into calcium and sodium soils by suitable treatments for this purpose. The Laboratory soils so prepared were then subjected to the CBR test after adding various propor-

(Continued on page 39)

TRAFFIC SIGNAL TIMING UTILIZING PROBABILITY CURVES

By

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Assistant Dean, College of Engineering University of Wisconsin

IN selecting the proper cycle time based on the known traffic volumes approaching the intersection it is often inconvenient to use tables from which to establish the required green time to develop a satisfactory reliability of performance. Since the selection is by a trial and error method, graphical means of solution can speed up the process of selection.

Since the design traffic volume, when divided by the number of cycles per hour, gives only the average number of vehicles per cycle, it is necessary to inject a factor which will increase the reliability of performance above 50%. By use of statistical data based on Poisson's series one can predict the probability that X or more vehicles will accumulate within a given average interval.

Generally, if possible, about 95% reliability is preferred. That is to say, that the design of the signal system should be such that sufficient green time is allotted to traffic movements so that in 19 out of 20 cycles the intersection will be cleared of all vehicles which approached the intersection during the cycle. However, in some instances where traffic is heavy or the signal timing is predetermined in order to integrate the intersection into an existing signal system, it may not be possible to maintain design standards permitting 95 per cent reliability. Where the cycle time is predetermined, the available green time may be divided so as to provide the maximum efficiency under the conditions of the problem.

Figure 1 graphically shows the relationship between the average hourly traffic volume, the cycle length, and the required green time (in seconds) depending upon the desired reliability or probability level. For example, a volume of 360 vehicles per hour through an intersection requiring a 60 second cycle would require, on the average, green time to take care of six vehicles. However, the number of vehicles approaching an intersection during a complete cycle varies and therefore it is necessary to consider the probability that queues of greater than six vehicles will approach the intersections. Those vehicles in queues in excess of six vehicles will be delayed unless the green time is extended. By using probability curves it is possible to ascertain the required green time to provide for these queues of varying length. In the example, if 26.8 seconds of green time were allotted, it would accommodate eleven vehicles. Queues of greater than eleven vehicles occur only 5 per cent of the time and hence the allotted green time permits the intersection to clear itself of vehicles with delays of less than a cycle 95 per cent of the time.

The following are typical problems which are solved by the use of Figure 1 :

Problem 1. Given: 400 veh/hr in E-W direction. 300 veh/hr. in N-S direction. If required to use a 60 second cycle, what is the percentage efficiency of the intersection ?

Solution: By use of Figure 1 move to the right on the 400 veh/hr. line and then down from its intersection with the 60 sec. cycle line to the 96 per cent probability line and then left to the average requirement for green time which happens to be 28.9 seconds. Following the same procedure for the 300 veh/hr volume we find that 24.7 seconds of green were given. If 6 seconds of amber are added in order to clear the intersection (3 seconds for each phase) the total is 59.6 seconds. This intersection can, therefore, operate on a 60 second cycle with traffic volumes split 400/300 veh/hr at 95 per cent reliability utilizing the time as shown above.

Problem 2. Given: The traffic in Problem 1 is increased to 500 and 400 veh/hr. (It is obvious that a 60 second cycle cannot produce 95 per cent reliability under these terms.) Find the reliability for the above conditions. Enter the graph from the 500 veh/hr line and drop down from its intersection with the 60 sec. cycle line until the 28.9 second line (see result from Problem 1) is intercepted. This point falls midway between the 80 per cent and 90 per cent curves for an estimate of 85 per cent. For the 400 veh/hr the intercept point on the 24.7 sec. line also falls at about the 85 per cent curve. Reliability is, therefore, 85 per cent for both directions.

Problem 3. Given: The volumes in Problem 2 are increased to 600 and 500 veh/hr. What is the reliability of performance ?

Solution: The intercept points now fall on the 70 per cent and 65 per cent reliability curves respectively. Therefore, increased volumes with fixed cycle times result in reduced reliability ratings

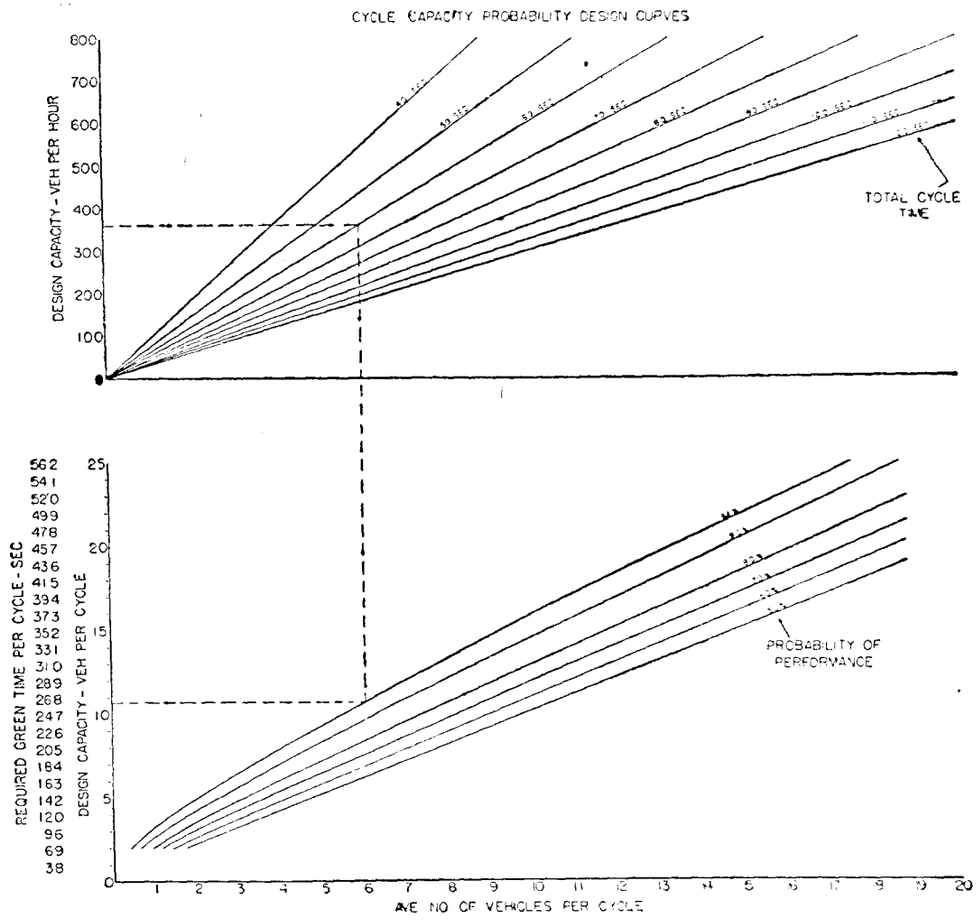


Fig. 1.

Problem 4. Given: Solve Problem 2 establishing 95 per cent reliability as a requirement.

Solution: Assume a 70 second cycle and repeat the process. The required green time to handle 500 and 400 vehicles is 36.2 and 31.0 seconds respectively, After adding six seconds of amber to clear the intersection, it is noted that 73.2 seconds are required. Since only 70 seconds are available, the solution is not acceptable. By assuming an 80 second cycle the required times become 40 and 34 seconds which, when added to the six seconds of amber, total 80 seconds. Therefore, an 80 second cycle will handle 500 and 400 veh/hr at 95 per cent reliability.

In some instances, where low volumes of traffic are involved it is important to remember that the pedestrian may be the controlling factor in deciding the amount of green time required. (Pedestrians require time at a rate of approximately .25 sec. per foot of street width plus 4 seconds to clear the curb.) Nor is it necessary to require the same degree of reliability for each approach. If in Problem 3, the traffic volumes were 700 and 300 veh/hr and if 95 per cent and 70 per cent reliability are acceptable limits, then the solution to this example for a 60 second cycle requires 41.5 seconds on the main street which leaves 13.5 seconds for the cross street with 6 seconds of amber to clear the intersection. Depending upon the width of the main street 16.5 seconds (13.5 green + 3 sec. amber) may be insufficient time for pedestrians to cross. If a 70 second cycle is selected, the time allotments increase to 46.5 and 17.5 seconds respectively. This should be enough to provide adequate pedestrian time.

One further point. The graph provides an excellent method of timing independent signals for traffic volumes which fluctuate during the day. It is possible to develop 95 per cent reliability for main street traffic with reduced reliability for side street traffic which may be less critical during rush hours and provide for an equal level of reliability during off-peak hours where side street traffic may be as important as main street traffic. In problem a main street volume of 700 vehicles/hr can be handled with 95 per cent reliability with side street traffic accommodated at 70 per cent reliability. During other hours of the day the volumes would be different and the 70 second cycle could be divided to give equal consideration in terms of reliability to both streams of traffic as was provided for in Problem.

(From 'Traffic Engineering,' November, 1961)

TENDERS ACCEPTED

State	Name of work	Name of accepted tenderer	Tendered P.A.C.	Remarks
Kerala	Resurfacing 70′ road portion from Banarji; road junction up-to Padma Theatre.	Sri T. J. John, Contractor, Perumanoor. Ernakulam.	Rs. 13,497	
-Do-	Constructing Manjoor Kurumaloor bridge.	Sri K. C. Joseph, P.W.D. Contractor, Kuruppanthara, Manjoor.	1,42,792	
-Do-	Constructing a road from Devicolam to Bodimettu portion from Santhampara to Bodimettu Ist mile.	Sri E. M. Paul, Contractor, Kotencherry.	56,621	

HERE AND THERE

1. WEST GERMAN ROAD EXPENDITURE

(Over £ 8,500 million in 12 Years

● WESTERN Germany is to spend over £ 8,500 million on its twelve year road programme which ends in 1971. In 1956 the West German Road network totalled approximately 214,000 miles. By the end of 1971, new construction will have increased this figure by 5,500 miles, 1,200 miles of which will represent autobahnen.

A breakdown of the predicted £ 8,500 million to be spent on the twelve year plan included £ 3,300 million for urban roads, £ 3,100 million for Federal Highways and autobahnen and about £ 2,100 million for provincial and local roads.

Included in the total is the cost of modernising and reconstructing roads, already in existence and an annual expenditure of nearly £ 100 million for the upkeep of city streets.

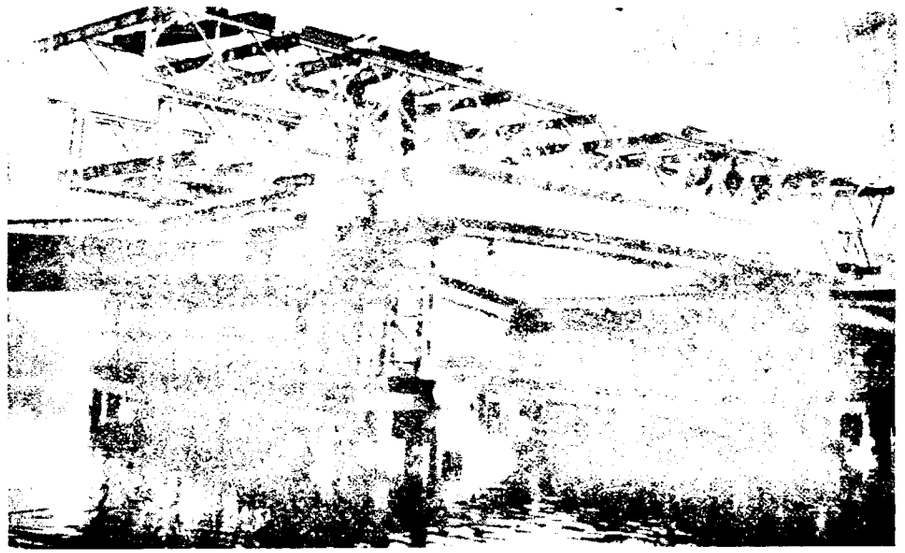
Plans call for financing the programme with £ 1,500 million from general funds, £ 5,300 million from highway user taxes and £ 750 million from special credits and highway taxes.

(From "British Road Federation Bulletin," January, 1962.)

2. DONNINGTON BRIDGE, OXFORD, CONSTRUCTION METHOD

ON the Donnington bridge and road works contract for the City of Oxford, Bailey bridge units are being used to solve a lifting and placing problem for precast concrete beams weighing 22 tons each.

The Bailey bridge units were assembled to form a 75 ft span travelling gantry. The purpose of this gantry was to pick up 22-ton centre beam sections, either single or in pairs, which were floated into the



Bailey Bridge units used to solve a lifting problem

river on Bailey pontoons. The beams had to be placed very accurately on a preassembled temporary trestle. This supports them untill the outer sections of the arch are completed, when the whole arch will, ofcourse, become self-supporting.

The gantry and trestling, illustrated, was designed and supplied on hire at short notice by Mabey & Johnson Ltd., of 54, Victoria Street, London, S.W.I. The main contractors are the Cementation Co. Ltd., and the Consulting Engineers are Travers Morgan & Partners.

(*From "Highways and Bridges and Engineering Works", December 27, 1961.*)

3. SONIC PILE DRIVER

● A REVOLUTIONARY new device which produces sound waves inaudible to the human ear, can drive pilings into the ground in one-twentieth the time it would take an ordinary steam-driven hammer to do the same job.

The sonic pile-driving process is the invention of Albert G. Bodine, Jr., of Southern California.

In one test, the sonic driver was pitted against a Vulcan No. 1, driving in identical ground about 20 feet apart. The piles were of 12¾ inch closed-end pipe, about 75 feet long. The steam-driven pile reached refusal at 67½ feet. Within the time it took to perform this operation, the sonic driver sank its pile to 71 feet, extracted it, swung a few feet away and repeated the driver-extract-swing routine seven more times.

(*From "World Highways," December, 1961.*)

4. ELECTRONIC PAVER

● A bituminous paver with electronic controls, which enables the road builder to take the human element out of producing a smooth pavement surface, is being tested on Interstate Route 80 near Iowa City, Iowa.

The electronic screed control system is being tested on an eight-mile section of road by a company called Highway Surfacers, Inc., of New Hampton, Iowa. The device follows a string line set to proper grade and automatically adjusts the pavement thickness, crown and grade. All the operator has to do is to start, stop and steer his machine. Using this electronic system of screed control, the paver is able to lay down as much as 700 tons of bituminous material in an hour.

(*Form "World Highways," December 1, 1961.*)

5. £ 1,92,000 CEMENTATION CONTRACT IN INDIA

● A Contract for a new mine shaft at Zawar, Udaipur Province, has been awarded by the Metal Corporation of India to the Indian branch of The Cementation Company. Valued at £1,92,750 the contract is for the sinking of a shaft some 990 ft deep at Zawar Mine, about 2,200 yards of drivage, and the construction of our insets and two ore pockets. Work will begin early next year.

The main shaft—a 17 ft by 12 ft rectangle—will be sunk with lightweight tubular headgear, and a mucking unit suspended from the surface.

(*From "Highways and Bridges and Engineering Works," December 20, 1961*).

BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF RAJASTHAN BUDGET 1961-62

(A brief review with reference to Civil Works)

The total revenue receipts for the year 1961-62 is estimated at Rs 4,326 lakhs and revenue expenditure 3,962 lakhs indicating a surplus of Rs 364 lakhs. The revised estimate for the year 60-61 showed a revenue receipt of Rs 4550.81 lakhs and an expenditure of Rs 4644.33 lakhs with a consequent deficit of Rs 93.52 lakhs. The actuals for the year 1959-60 revealed revenue receipts of Rs 3946.12 lakhs and an expenditure of Rs 4042.90 lakhs resulting in a deficit of Rs 96.78 lakhs.

Revenue expenditure on Civil Works in 1961-62 is estimated at Rs 210.41 lakhs which froms 4.9% of the total State revenue. It was Rs 192.75 lakhs (revised) in 1960-61 and Rs 183.26 lakhs (actuals) in 1959-60 which amounted to 4.2% and 4.6% respectively of the total State revenue for corresponding years.

The total outlay on Civil Works outside the revenue account for the year 1961-62 is Rs 393.79 lakhs out of which Rs 106.88 lakhs are proposed to be spent on communications.

(*Continued from page 33*)

tions of lime, the results are given in Figure 7. It will be seen therefrom that whereas the calcium soil responded to this treatment even when very small quantity of lime was used, the response by the sodium soil was fairly slow and much higher proportions of lime were required to improve bearing capacity.

NECESSITY FOR THE USE OF LIME FOR IMPROVING THE BASES AND SUB BASES OF ROADS

It is generally believed that the Bearing Capacity of soil can be considerably improved by controlled compaction.

The improvement achieved will not be high enough so as to replace entirely the sub-base and bases of roads. The soil thus improved in CBR will therefore have a limited part to play in replacing only part of the thickness of the road bases. The remaining thickness of road bases will still have to be built up with comparatively cheaper material without affecting the design. This can be profitably done by using soil stabilized with lime as dealt with in this paper.

It will be seen that, the addition of small quantities of lime viz., 1 to 2 per cent considerably improved the bearing capacity of the soils even at lower densities and with the further improvement in the density of the soil-lime mixtures the CBR also appreciably improves. These results indicate the importance and necessity of adding lime for strengthening the subgrade and flexible bases of roads particularly those situated in waterlogged areas.

References

(1) Strengthening the subgrade and flexible bases of roads by the use of hydrated lime by R.N. Dogra, I.S. Uppal&P.N. Vasudeva, Indian Roads Congress Journal Vol. XXV, Part I, November, 1960.

(2) Use of stabilized soil in engineering construction by S.R. Mehra & H.L. Uppal, Indian Roads Congress Journal, Vol. XIV, 1949-50.

(3) Stabilization of soils with lime. C.R.R.I. Annual Report 1958-59, Page 1.

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

Dated 11th March 1962.

Signature of
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Indian Roads Congress.

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1. **C.B.I. Publication No. 65. Symposium on spillway capacity of dams.** Published by Central Board of Irrigation & Power, New Delhi.
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3. **Proceedings of the Third Meeting of the Transport Advisory Council held at New Delhi on the 10th–13th December, 1957.** Published by Manager of Publications, Government of India, New Delhi.
4. **Irrigation in India through ages, 2nd Edition 1953.** Published by Manager of Publications, Government of India, New Delhi.
5. **List of members of the Constituent Assembly of India (Legislative) (Showing permanent addresses).**
6. **Annual Report 1960-61.** Government of India, Ministry of Transport & Communications, Department of Transport, New Delhi.
7. **Problems in the Third Plan—a critical miscellany.** Published by the Ministry of Information & Broadcasting, New Delhi.
8. **Bulletin De Lassiation Internationala Permanente Des. Congress De'L aroute. Bulletin No. 159.** Published by Editor Paw La Revue Travaux.
9. **Strassenbaulv Von A–Z.** Published by Winheu Vertrich Mallhias & Co., D.G.
10. **Third Five-Year Plan.** Published by Planning Commission, New Delhi.
11. **Building Science Abstracts, Vols. 23, 1950; Vol. 25, 1952: Vol. 26, 1953: Vol. 27, 1954: Vol. 29, 1956: Vol. 30, 1957: Vol. 32, 1959. (Bound Journal).** Published by H.M.S.O., London.
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13. **American Highways, Vol. 30, 1951; Vol. 32, 1953: Vol. 34, 1955: Vol. 36, 1959. (Bound Journal).** Published by American Association of State Highway Officials, Washington.
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15. **Annals Des Ponts Et Chaussess, Vol. 124, 1954; Vol. 125, 1955; Vol. 126, 1956: Vol. 129, 1959. (Bound Journal).**
16. **Civil Engineering & Public Works Review, Vols. 47, and 52.**
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18. **Second Five-Year Plan, Part II—Administration and Organisation.** Published by Manager of Publications, Government of India, New Delhi.
19. **Second Five-Year Plan Part V—Industries and Transport.** Published by Manager of Publications, Government of India, New Delhi.
20. **Second Five-Year Plan—Approach to the 2nd Five-Year Plan.** Published by Manager, Government of India.
21. **Annual Report (Technical), Vol. II.** Central Board of Irrigation & Power. Indian Publication No. 6.
22. **Standing Wave of Hydraulic Surveys—Central Board of Irrigation & Power Publication No. 7.**

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TABLE FOR FREELY SUPPORTED REINFORCED CONCRETE SLAB WITH THREE INCHES WEARING COAT SUPPORTING ONE LANE OF I. R. C. CLASS "AA" LOADING

CLEAR SPANS 3 FT TO 30 FT

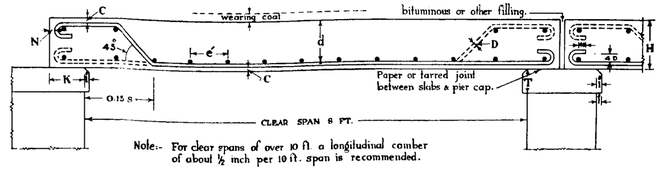
C = Clear cover minimum 1".

N = End cover or clearance $1\frac{1}{2}$" or 2 D whichever is more.

D = Diameter of main reinforcement bar (from tables).

e' = Spacing of distribution reinforcement (from tables).

L = Effective Span S + d.



Note:- For clear spans of over 10 ft. a longitudinal camber of about ½ inch per 10 ft. span is recommended.

K = Length of bearing
= 0.5 + 0.04s feet or 14" whichever is less.

T = Thickness of bearing slab or pier cap.
= 0.25 + 0.02s feet

H = Overall depth (from tables)
= d + c + D/2

d = Effective depth (from tables) measured to the centre of the main reinforcement

DESIGN STRESSES:—CONCRETE—750 LB. PER SQ. INCH.
STEEL—18,000 „ „ „

MODULAR RATIO:—15

Clear span	Overall depth of slab (assumed)	Effective depth of slab (assumed)	Effective span = S + d/12	l1/l	k	TRACKED VEHICLE						WHEELED VEHICLE								REINFORCEMENT											Clear span
								Live Load						Live Load						Main				Distribution							
																					Round Bars				Round Bars					
				l1 = width of the slab = (26.5 ft)	From I.R.C. Code Clause 207.2.2.	Effective width of slab perpendicular to span w = 2.75 + 2×3/12 = 3.25 ft	Dispersion length along span (i) l upto 12 ft = 12 feet (ii) For l greater than 12 ft. = 12 + 2(H+3)/12 but in case a > l the portion of a to be considered should be = l	(i) Loads do not overlap = 35×2240/e×a (ii) Loads overlap = 70×2240/e×a	Impact 0.25×w1	Live load including impact = w1 + w2	Live load bending moment due to	Effective width of slab perpendicular to span (All the four loads overlap) w = 1.0 + 2×3/12 = 15	Dispersion Length along span = 6 + 2(H+3)/12	(i) Loads do not overlap 20×2240/a×e (ii) Loads overlap 40×2240/e×a	Impact 0.25×W3	Live & wind load = w3 + w4	Live load bending moment due to	Dead load = 12.5 H+35	Total Live & dead load bending moment	Checking effective depth = √(M/12×126) should be nearly = d in Col. 3	Lever arm = 0.872 d	= M/18,000×jd	Dia:	Spacing centre to centre	Nos. of Main Bar cranked up at each end	Area of steel from I.R.C. draft Code III Cl. 333.2 Based on RM = 0.2 D.L.M + 0.3 L.L.M. Sq. Inch.	Dia:	Spacing Centres. Limited to 2×d	Total Shear force due to live, wind & dead loads	Shear stress = v/12×jd	Spacing of bars bent up = v/Σoj'd	
S Feet	H Inches	d Inches	l Feet			c Feet	a Feet	W1 Lbs./Sq. Ft.	W2 Lbs./Sq. Ft.	W4 Lbs./Sq. Ft.	W4 Inch lbs.	e Feet	a Feet	W3 Lbs./Sq. Ft.	W4 Lbs./Sq. Ft.	W5 Lbs./Sq. Ft.	W6 Inch. lbs.	Wd Lbs./Sq. Ft.	M Inch lbs.	Inches	jd Inches	A Sq. Inch	D Inch	Inches			Inch.	e' Inches	V Lbs.	s Lbs/in²	u Lbs./in²	N Feet
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15	16.50	15.00	16.25	1.63	2.89	20.87	15.25	492	123	616	2,43,067							241	3,38,525	14.95	13.08	1.438	1	6½	1 „ „	2	0.41	9	7483	47.7		15
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18	19.25	17.75	19.48	1.39	2.77	21.75	15.71	459	115	574	3,14,489	20.22	8.21	537	134	671	2,55,000	276	4,71,590	17.70	15.48	1.692	1	5½	1 „		10	7¼	8118	43.7		18
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h of bridges & culverts with a clear road width of not less than 2 traffic l[illegible]
bent up towards t[illegible] s should not exceed that indicated in the t[illegible]
[illegible] joints have to be provided, lap joints of length 40 D [illegible] ided no joint comes at midspan and all joints are well st[illegible]

By courtesy of the MUKHYA ABHI[illegible]
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