TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW (TCMR)

APRIL 1962—No. 180

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BULLETIN NO. 7

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TRANSPORT-COMMUNICATIONS

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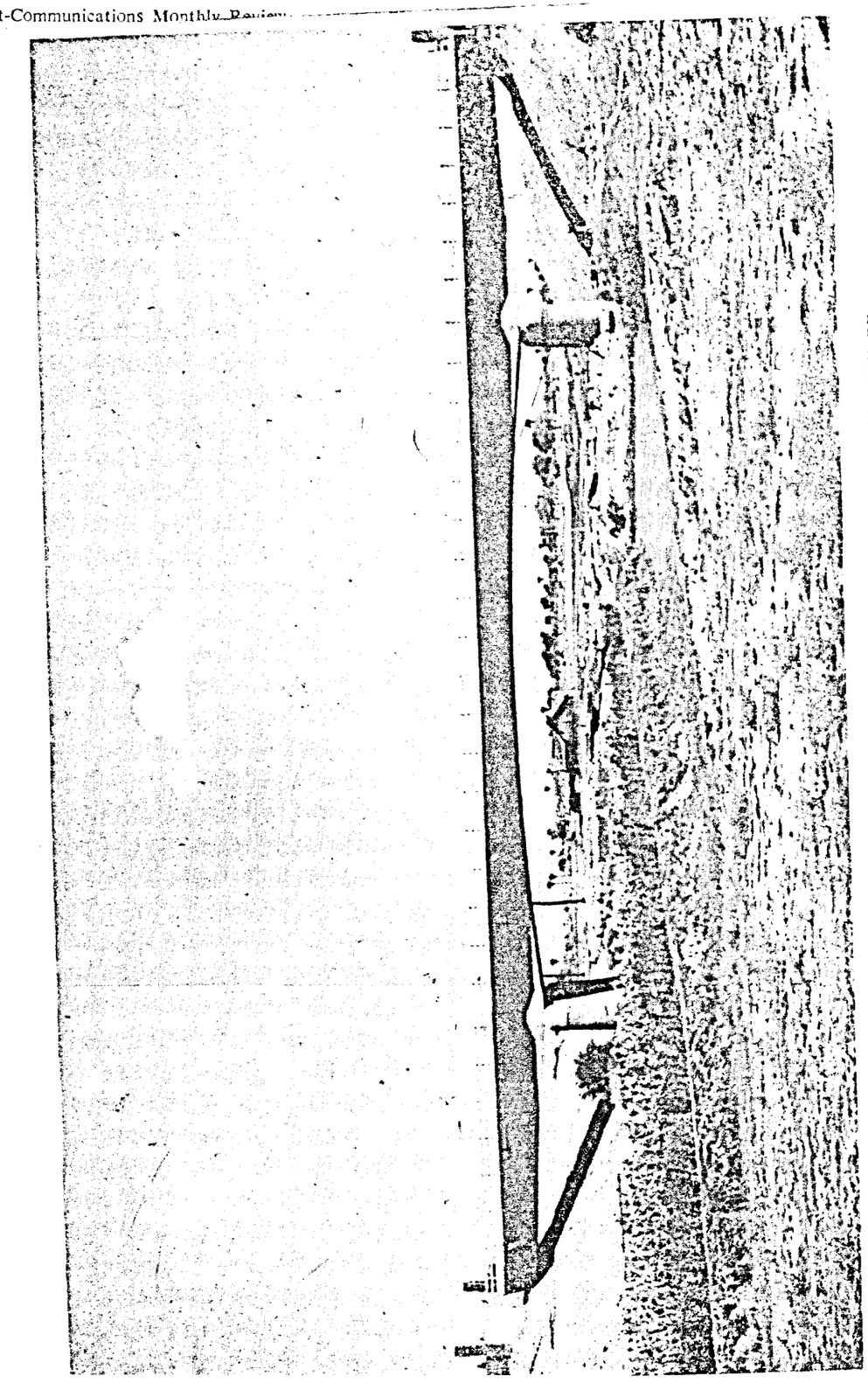


MATWALI BRIDGE ON MORADABAD SIDE APPROACHES TO GASH BRIDGE

TRANSPORT-COMMUNICATIONS
MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

APRIL 1962

ROUNDUP OF THE TENTH SESSION OF THE ECAFE INLAND TRANSPORT AND COMMUNICATIONS COMMITTEE

Bangkok, February 12—19, 1962

RECOMMENDATIONS for speeding the completion of the Asian Highway, promoting tourism and developing road, rail and inland waterways transport in countries of Asia and the Far East were adopted by the ECAFE Inland Transport and Communications Committee at its tenth session held in Bangkok February 12—19.

The session was opened by the Minister of Communications of Thailand, Lieut. General Pongse Punnakanta who read a message of welcome to the representatives of 20 Governments from Prime Minister Sarit Thanarat.

On the Asian Highway, the Committee noted with satisfaction that of the 50,000 kms of this international network only 500 kms remained to be completed. It unanimously approved recommendations submitted by a joint session of zonal experts by which international aid would be sought for pre-investment surveys in East Pakistan and Burma and for equipment in India to expedite the completion of missing links in the Highway.

The Committee requested the Executive Secretary of ECAFE to advise and assist the countries concerned in obtaining external assistance for the project.

Specifically $ 1 million is required for a pre-investment survey in Burma; $ 700,000 for a pre-investment survey in East Pakistan and $ 1 million for equipment in India.

The Committee agreed that Indonesian Highways should be included in the Asian Highway network and also agreed that a preliminary reconnaissance survey, such as that carried out between Calcutta and Bangkok, should also be made in Iran, Afghanistan and West Pakistan. (Fuller details on the Committee's actions with regard to the Asian Highways are given in Press Release G/273).

Discussing the basis for taxing road transport, the Committee felt that motor transport should contribute its fair share to the cost of the road system but doubted whether levelling comparatively higher taxes in urban areas and on congested roads would in effect be fair and practicable in the present state of transport in the region. It felt that most countries of the region would prefer to base taxation of motor vehicles on the cost involved, usually measured by the wear and tear caused by specific vehicles to the road system. In line with this approach, it felt that there was a case for taxing non-mechanised slow moving vehicles.

In view of the anticipated development of traffic on international highways, the Committee considered it desirable that

countries of the region should develop a common approach to road transport taxes. The question of taxation was one aspect of the relationship between public authorities and the transport industry and, in view of the important and complex problems involved in this relationship, the Committee favoured further consideration of the wider question on the basis of a case study of a specific country.

On the question of statistical procedures, the Committee considered that agreement should be reached on the type of statistical data to be collected, on statistical standards and methods of collection. It stressed the importance of international comparability and recommended further consideration by the Conference of Asian Statisticians of the problem.

The importance of suitable cost accounting systems for the various branches of the inland transport industry as a basis for improving efficiency and a means for implementing transport coordination policies was emphasized and the Committee recommended that the subject be further reviewed by the Highways and Highway Transport Sub-Committee and the Inland Waterway Sub-Committee which might consider the possibility of developing some kind of standard accounting system, preferably in the form of a manual for transport operators.

Regarding freight rates, the Committee was of the opinion that the introduction of rates with a margin between maximum and minimum rates was desirable to allow for flexibility. It stressed the desirability of countries in the region developing freight rate policies on a common basis and suggested that further studies on freight rates might be undertaken on a country basis.

The Committee commended the report of the Second Study Week on Traffic Engineering and Highway Safety held in Manila in August-September 1961. Noting that with the rapid development of road traffic in the region, the number of accidents was steadily increasing with consequent economic and social loss, the Committee urged countries which have not already done so to adopt the recommendations of the Manila meeting as a help in the solution of their traffic problems. It strongly recommended that similar study weeks should become a regular feature of regional traffic safety programmes in the region.

The Committee also reviewed the report of the Seminar on Highway Passenger Transport, held in Madras in October 1961. It felt that the seminar had served a very useful purpose in providing a forum for highway transport experts to pool their knowledge and experience in a vital sector of economic activity. Similar seminars, it held, would be beneficial, and it particularly recommended the holding of a seminar on highway goods traffic.

The Committee drew attention to the fact that as almost all countries of the region were faced with the need for rapid expansion and improvement of their highway networks, the allocation of revenues from road user taxes alone would not be sufficient to finance road development programmes. It considered that it was essential to allocate funds from general revenues, or other sources, so that these programmes could be more adequately financed and completed.

Relaxation of import restrictions on vehicles and spare parts would, it was felt, reduce the problem of high operating costs and low vehicle utilization.

AUTO OUTPUT IN 1960 AND 1961 IN UNITED STATES AND INDIA

THE automobile industry in the United States manufactured 6,653,286 vehicles comprising 1,131,344 trucks and buses and 2,521,942 passenger cars in the year 1961 as against 7,905,123 vehicles produced in the year 1960. In India we manufactured 53,661 Motor vehicles in 1961 and 52,115 in 1960. The following table gives the break-up of the various models manufactured by the various firms during these years.

UNITED STATES OF AMERICA		
	1961	1960
American Motors Corp.	372,485	485,475
CHRYSLER CORP.		
Plymouth	310,446	483,969
Dodge	220,701	411,666
Chrysler	104,747	87,420
Imperial	12,699	16,829
FORD MOTOR COMPANY		
Ford	1,345,121	1,511,504
Mercury	311,635	359,818
Lincoln	33,180	20,683
GENERAL MOTOR CORP.		
Chevrolet	1,604,824	1,873,618
Pontiac	360,336	450,206
Oldsmobile	321,838	402,612
Buick	291,285	307,804
Cadillac	148,298	158,941
Studebaker-Packard	78,664	105,902
Checker Motors	5,683	6,980
TRUCK & BUS PRODUCTION:		
Chevrolet	342,659	394,017
GMC	74,996	104,327
Diamond T.	1,818	2,468
Divco	1,783	3,573
Dodge & Fargo	64,886	70,305
Ford	338,988	337,469
FWD	989	881
International	142,873	119,696
Mack	9,012	14,438
Studebaker	7,642	12,314
White	17,596	121,856
Willys	123,761	121,856
Other Trucks	4,336	4,750
Total	6,653,286	7,905,123

INDIA		
	1960	1961
Hindustan Motors	16,296	15,152
Premier Automobiles	12,863	12,725
Tata Engineering & Locomotive Co.	9,665	12,090
Ashok Leyland Ltd.	2,084	2,371
Mahindra & Mahindra	6,930	80,004
Standard Motors	3,364	3,409
Total	52,115	53,661

Total number of automobiles manufactured in India in

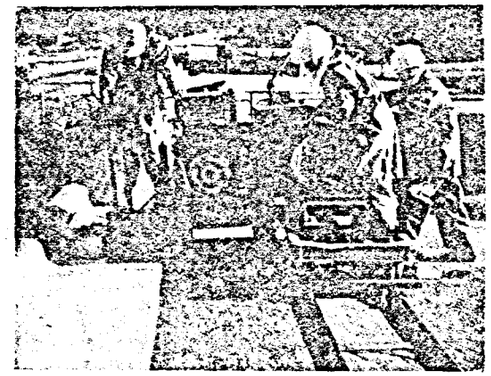
1957	31,929
1958	26,788
1959	36,304
1960	51,202
1961	53,661

We are terribly behind and need more and more vehicles and right type of Commercial Vehicles to cope with the demand on Road Transport. If we fail to gear up to produce the number of Commercial Vehicles required, development of our country will be seriously throttled.

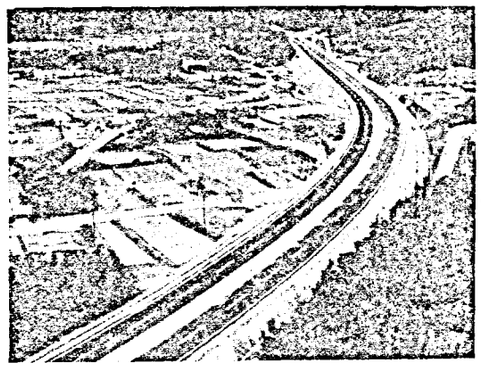
A JAPANESE EXPRESSWAY

THE World Bank has made a loan equivalent to $ 40 millon to assist in financing completion of the express highway being built between Kobe and Nagoya in Japan. The expressway will relieve increasingly severe traffic congestion in one of Japan's most highly industrialised regions, stimulate the dispersion of industry and population out of over-crowded cities, widen the effective area of food supply for urban communities, and substantially reduce the operating cost of highway freight and passenger traffic. A-Bank loan of $ 40 million was made in March 1960 for a 45-mile section of the expressway and the new loan will be used for the construction of the two remaining sections to complete the expressway over its entire planned length of 115 miles.

In the past five years truck traffic in Japan has doubled and bus and automobile passenger traffic has increased by nearly as much. The area to be served by the Kobe-Nagoya Expressway contains four of Japan's six largest cities (Kobe, Osaka, Kyoto and Nagoya), 15 per cent of the total population and over a quarter of the nation's motor vehicles. Industries, agriculture and trade of the area contribute about a fourth of the national income and its factories produce about 40 per cent of the value of the country's exports.



Cutting expansion gaps in the cast concrete kerb of the new expressway



A section of the new expressway which runs from Amagasaki to Ritto in Japan

In general, roads in the area are built to inadequate standards and are heavily congested. Most of them cut through built-up industrial, commercial and residential districts where reasonable speeds are impossible and serious delays cannot be avoided. The railways are being used to full capacity; furthermore, the large volume of inter-urban and commuter passenger traffic restricts their ability to carry any but long-haul freight. The new expressway will not only relieve congestion and expedite the movement of freight, particularly of short-haul, high-value goods, but will generally contribute to the economic growth of the region as a whole.

The expressway will be a four-lane, divided, limited access highway. The first 45-mile section, from Ritto to Amagasaki, is now about 45 per cent complete and should be finished on schedule in March 1963. The sections now to be built consist of a five-mile extension from Amagasaki to Nishinomiya and a 65-mile extension from Ritto to Ichinomiya. The Amagasaki-Nishinomiya section traverses the heavily-built up Hanshin industrial area along Osaka Bay between the cities of Osaka and Kobe, necessitating the construction of urban viaducts and bridges. The Ritto-Ichinomiya section connects the Kyoto and Nagoya area. The part upto Hikone traverses rolling terrain, another part crosses steep mountainous country which will require tunnels, and the final part runs through the industrial outskirts of Nagoya.

The two new sections being financed with the help of the Bank loan will be built to the same modern expressway design standards as the Amagasaki-Ritto section. Construction will include earthworks, bridges, viaducts, tunnels, paving, interchanges, service areas, bus stops, toll stations and traffic control facilities, access and appurtenant works.

All construction will be done by contractors supervised by the Highway Corporation's staff with the advice of foreign consultants. Foreign contractors with experience in expressway construction will be given the opportunity to bid for all major works. The expressway is scheduled for completion by 1964.

The cost of the whole expressway is estimated at the equivalent of 356 million dollars; in addition, the equivalent of 108 million dollars will be invested by the Government and local authorities in access roads. The cost of the two sections for which the loan was made will be equivalent to 212 million dollors, of which the Bank is providing 40 million dollars.

(*From "Roads and Road Construction", January, 1962.*)

WEST GERMAN ROAD EXPENDITURE

OVER 8,500 MILLION POUNDS 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 modernizing 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.*)

INTER-AMERICAN TRAFFIC SEMINAR

URGE UNIFORMITY OF TRAFFIC REGULATIONS

THE First Inter-American Traffic Seminar, meeting in Washington, D.C., has recommended that a uniform system of traffic laws and regulations be set up throughout the Americas.

The Seminar, which took place September 4–8 at the Pan American Union, was attended by delegates from 20 American republics and was under the sponsorship of the Organisation of the American States and the permanent secretariat of the Pan American Highway Congresses.

Among the specific points brought up were recommendations that a much more strict set of regulations for the issuance of driving permits be adopted and that road signs, as well as control over the maximum weights and dimensions of motor vehicles be standardized.

The delegates emphasized the importance of highway transportation as a basic step toward the successful implementation of national development programs undertaken by the " Alliance for progress ".

They also urged the OAS to assist member states in highway development by planning and helping set up national highway organizations. In return, the delegates pledged their active support, advice and co-operation in carrying out their part of the task.

The establishment of a Permanent Committee of Traffic Experts within the frame work of the OAS was also asked. Members of the proposed committee would be responsible for such things as the study, compilation and preparation of laws and regulations, as well as the selection and preparation of texts and other publications.

The eight areas of discussion in the agenda and a brief summary of the conclusions agreed upon included.

Traffic Safety: OAS members should adopt a uniform, integrated code of traffic laws, including the stiffening up of regulations pertaining to the issuance of drivers' permits. To this end, various groups would be set up to study and report on growing traffic problems of all types. More emphasis should also be placed on educating the public about the basic rules of traffic safety and good driving practices.

Need for Comprehensive Traffic Programs and their Relationship to Urban and Regional Planning: The importance of good highway programs as one of the keys to sound economic and social development for nations participating in the Alliance for Progress program was stressed. Adaptations of successful highway and planning techniques in growing cities should be promoted among Latin American engineers in order that these expanding areas receive the maximum benefit from the progress alliance. Precise techniques and concrete programs should also be undertaken in small and medium-sized cities undergoing rapid growth. Traffic congestion and the possible banning of cars in downtown areas should be given consideration.

Traffic Engineering: Each country in the Americas should consider establishment of a traffic engineering department or division which could be adapted to suit the various governments. Highway and traffic engineers should adopt a uniform set of standards and road signs at the earliest possible moment and the educational systems of the member states should include solid programs of Traffic engineering at the university level. A Permanent Committee of Traffic Experts should be established within the OAS.

Responsibilities of Traffic Police: Special training for traffic policemen, such as the method followed by the Traffic Institute of Northwestern University, should be adopted by OAS member states. Each nation should provide legislation which would promote understanding and co-operation between the engineer and the traffic policeman. Principles of organization within effective police departments

should be adapted to fit the needs of the individual communities, and deserving police officers should be granted recognition.

Improving Traffic Conditions through Modern Street and Highway Design: A paper by D.W. Loutzenheiser, of the research division in the U.S. Bureau of Public Roads, dealing extensively with this topic, is to be distributed throughout the Americas.

International Co-operation Programs: Appropriate authorities in the several nations should take full advantage of the various training and technical services offered by International agencies. Papers and other documents brought out at conferences, seminars and meetings, should be made available to interested officials. The possibility of setting up a travel fund for qualified individuals desiring to attend International Co-operation conferences should be considered.

Progress on Traffic Ideas Presented at the Inter-American Meeting of Traffic Experts and the Eighth Pan American Highway Congress: The seminar delegates approve of traffic resolutions adopted at these meetings and recommended that they be implemented as soon as possible. Particularly endorsed were resolutions for the creation of a traffic institute in Latin America, an accelerated training and education program at the university level and adoption of uniform vehicle and safety standards.

Practical Decisions Growing out of the 31st Annual Meeting of the Institute of Traffic Engineers, the International Sessions on Traffic Engineering and the First Inter-American Traffic Seminar: Participants recommended that the exchange of information and technical data be continuously maintained; that encouragement be provided for the use of scientific methods of research in traffic engineering and safety; that the individual nations concerned establish local and governmental traffic engineer departments; and to continue to develop and publish simple methods for gathering needed traffic data.

(*Abstracted from " World Highways ", October, 1961.*)

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NOTES & NOTABLES

SWEDEN is considering changing its law which calls for driving on the left hand side of the road. Sweden and Great Britain are the only European nations where motorists must keep to the left...Japanese police are trying to establish English language signs in Tokyo—but are running into difficulty. Their most recent efforts came out, "May parking"; "May stopping;" " section for sound of horn "; and " Right turn toward immediate outsides."

(*From " Highway Highlights ", December, 1960.*)

SOME TECHNICAL ASPECTS OF ELEVATED HIGHWAY CONSTRUCTION

DIPL. ING. PETER MISCH'S COMMENTS TO I.H.E.

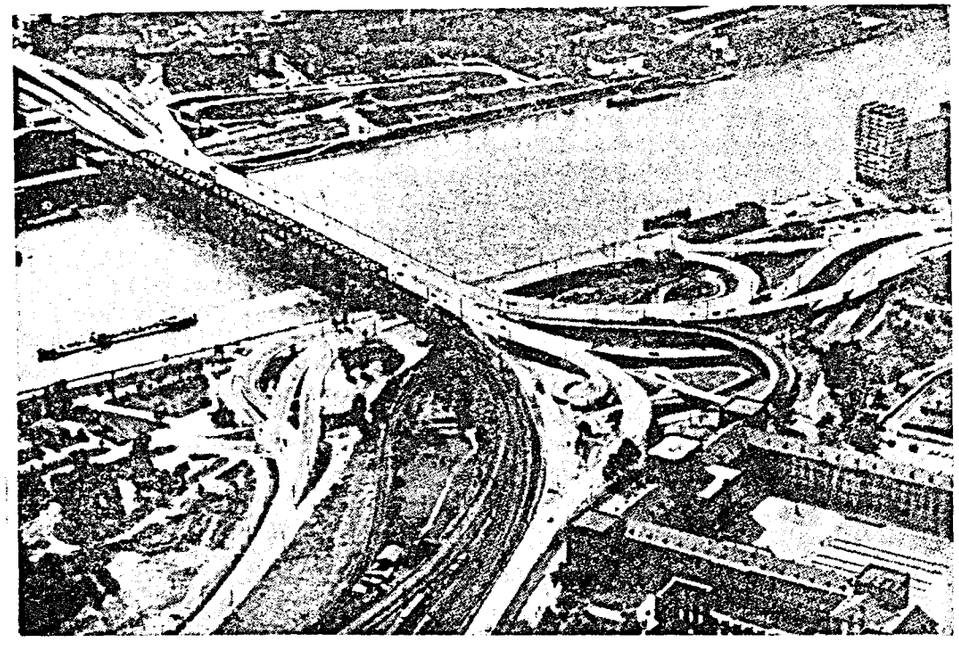
MANY interesting comments on the technical aspects of elevated highway construction on the Continents were made by Dipl. Ing. Peter Misch in a paper read to the Institution of Highway Engineers at a special meeting in London on December 7.

The elevated highway, he said, was in Germany a universally accepted instrument of traffic planning. More than DM. 100m. had been spent on such highways in the seven years which had elapsed since Germany's first elevated motorway was built at Dusseldorf. However, the majority of the elevated highways were in rural areas. Dipl. Ing. Misch continued:

Economy

The elevated road is the more economic, as an analysis has proved, if it is to be more than 10 to 13 ft high. It also offers greater flexibility in ground plan; alterations in height are less costly; a good visibility underneath is maintained; less space and lower ground costs are involved, and the space of the lower level can be utilised economically.

These and other considerations led to the construction of an elevated road in Plymouth; and embankment was planned originally, which would have been cheaper,



The Ludwigshafen-Mannheim Bridge over the Rhine

but this would not have permitted the utilisation of the lower-level space for the waiting rooms, etc., of the adjoining bus-terminal.

In Germany, all elevated roads erected so far have been built in prestressed or rather post-tensioned concrete. This does not surprise us, as prestressed concrete is more economical than steel for bridges up to a considerable span—a span which is never exceeded in this type of construction. But it is more surprising that even in the U.S.A., where the situation is less favourable to concrete for bridge construction, a very large number of elevated roads have been, and the vast majority are now being built in concrete.

The difficulties brought about by the multicurved shape of the constructions and their access ramps can be solved easily as is shown in the photograph of the Ludswigshafen-Mannheim Bridge over the Rhine.

Technical Development

The development of prestressed concrete to its present maturity is of great importance. It is true that reinforced concrete would in principle be equal to the tasks set by the elevated roads, but solutions in prestressed concrete become lighter and more appealing aesthetically, a point which must not be ignored in urban construction. Most important, though, in this connection is the fact that prestressed concrete permits constructions without joints, while at the same time full use can be made of the advantages of building in sections.

A significant factor in the design and aesthetics of the elevated road is the development in the field of design and construction bearings. The movements of the bearings of these long and very often curved structures are large, and require careful consideration, and the design of the bearings is also affected by the problem of torsion.

In one of our elevated roads the weight of the conventional bearings was equal to one-third of the weight of the prestressing steel used. In their search for improvements the German bearing-manufacturers have adopted an old idea of concrete bearing construction. They have used surface-hardened bearing rollers and bearing plates, so that the permissible Hertz-pressure could be increased two to three times. The roller-diameter can thus become four to nine times smaller.

The same result is obtained by a firm in Esslingen with their Corroweld-bearing. They weld layers of stainless steel to the mild steel rollers and plates, but only at the contact-zones. Both these products are widely used in Germany.

The smaller bearings can be placed wider apart in the same space, and thus can take up larger torsional moments. This becomes particularly important in structures supported on a central row of columns.

For hinged bearings some engineers prefer concrete hinges. These comprise either genuine hinges achieved by reducing the cross-section to a fraction of that of the column (such hinges can be used for angles of rotation up to 1/300), or columns which act as hinges because of their low stiffness or lower moment of inertia.

Lead hinges, which were supposed to cope with larger angles of rotation than concrete hinges, are going out of fashion in Germany. Experiments have shown that they are rolled flat if the rotation is repeated many times, even if the angles of rotation are kept small. This can lead to highly unwelcome displacements of the line of application of the load, resulting in cracks in the bridge girder. A big step forward was brought about by the development of the rubber-pot-bearings. These differ fundamentally from the French rubber-bearings consisting of alternate layers of Neoprene-rubber and steel-plates or steel-mesh.

Supports

The shape and construction of the supports is closely linked with that of the bearings, but at the same time with the form of the cross-section of the bridge. Single legs aligned along the axis of the bridge are widely favoured nowadays. This arrangement has the advantage that the skew of the slabs, which is practically unavoidable in the structures, is eliminated from the statistical analysis. It also has the further advantages that little space is required; there is very little impediment to view in the lower traffic level, and the structure becomes architecturally more appealing.

Single supports can be employed for bridges upto about a width of 60 ft. The chief construction problem as against twin supports is the absorption of torsion. Either the columns must be wide enough to take up two bearings in the transverse plane, or the cross-section of the bridge must be stiff enough to divert the torsion forces to the ends of the bridge. In the latter case the legs of the bridge can be made extremely slender.

Fixed bearings at the top and movable at the bottom (the bridge on "roller skates") have been used several times, as for the ramps of the Severing bridge Cologne-Deutz, on the right-hand side of the Rhine.

For specific reasons I have used the Hammersmith flyover as an example of this type of support. German "Kreutz"-bearings were used for this structure. The features of this construction are briefly; temporary strutting of the columns by Jacks and plates; additional buffers in case of failure of the bearings; possibility of corrections to the vertical alignment in case of uneven settlement.

The roller-skate type of support avoids the need to camouflage the bearings at the top, and will be an advantage wherever bad subsoil conditions prevail. The stressing upon the foundation becomes more favourable, but the bridge deck has to take up corresponding extra stresses which will as a rule increase the cost.

Just as popular—or even more popular—are the pin-pointed supports which can be made very slender indeed, because of their axial stressing.

There are many German examples

Cross-Sections

We come across every conceivable type of cross-section in bridge construction:

Massive slabs for spans upto about 70 ft. Hollow slabs between 60 and 100 ft. Grillages of main and secondary beams, T-beams, single box beams between 65 and 5 ft. Multi-cellular box beams for spans over 100 ft. The construction depth increases almost linearly with increasing span, from 3 ft 4 in. for 60 ft span to 5 ft for 100 ft span, with plus or minus 1 ft.

The proportion of prestressing steel in that figure varies between 30 to 50 per cent. It depends amongst other things on whether or not transverse prestressing is used. Transverse prestressing is very useful if the bridge deck cantilevers out very far, but it also seems to be used by designers even when that is not the case, although a transverse mild steel reinforcement will in general be cheaper. The reason for this use of prestressing is most probably the desire to take advantage of multi-axial stresses within the concrete.

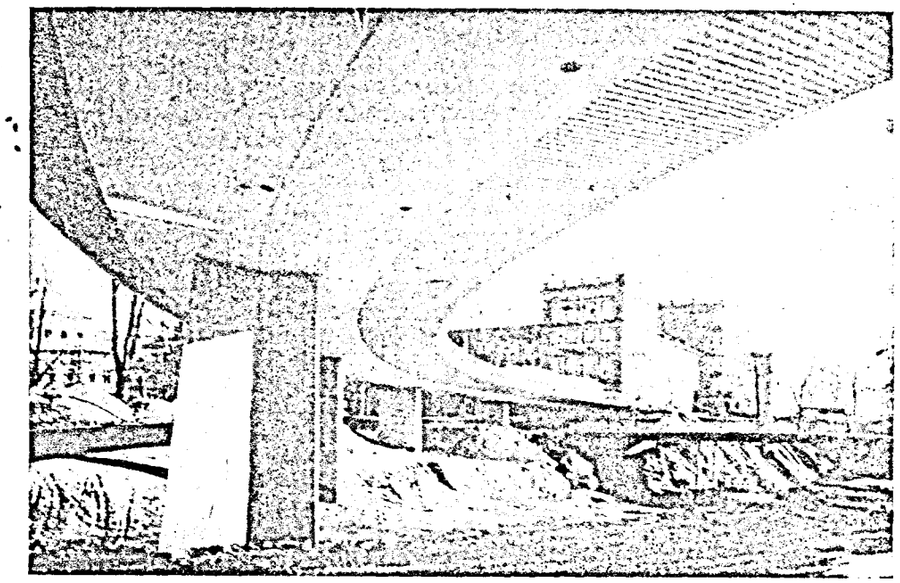
By far the most popular cross-section in Germany (used in 40 per cent of all the examples I have collected) is the single cell box girder. This seems to show a clear design tendency. The box girder is particularly suitable for single-leg-support because of its high torsional stiffness. An example is at Hannover-Dohren.

Branches to ramps and other sudden changes in width of a bridge bring about difficult problems of both construction and aesthetics. One of the good examples is Munich-Friemann (the city's access to the Nurnberg-Berlin-Autobahn) with widths varying between 87 and 180 ft. It can be said that a satisfactory solution was found here with a multi-cellular box girder (or, if you prefer it a multi-webbed T-beam). As in nearly all the other cases, the bottom slab is closed to enhance the appearance from below. There are no intermediate transverse beams, and the cross-section acts like a Vierendeel-beam elastically supporting the longitudinal beams.

With one or two exceptions all the German elevated roads have been built as continuous beams with a multitude of bays, avoiding joints as far as possible, because they always require maintenance. Contrary to the Hammersmith flyover, for example, the fixed point is usually chosen in the middle of the bridge or the middle of a construction section in order to halve the movements of the deck at the ends.

So far the largest length of a bridge without a joint is the elevated road Prinzenallee in Dusseldorf, with 2,000 ft jointless sections. It is a single-box-girder, supported on single pin-pointed legs of elliptical cross-section.

The elevated road in Brussels has been built as a series of simply supported box



Part of the Rhine Bridgehead complex, Manheim: the curved concrete ramp carrying the tramway on to the bridge

girders 4,300 ft long. The side cantilevers are reinforced. The complication of the multitude of joints was set off against the resulting simplification of the construction of the supports. A thin layer of neoprene rubber proved sufficient. The girders are dowelled to each other, and there is a copper insulation underneath the paving. Two contractors built the bridge, starting in both directions from the middle; one contractor worked conventionally girder by girder, concreting the following girder after prestressing its predecessor. The other contractor put up one girder at its final height, the next in a raised position, and was thus able to manufacture several girders at a time.

For over half of the examples have been concreted in sections, the longitudinal cantilevers producing strains during construction which are somewhat similar to those in final stage. The new prestressing tendons are coupled to the old ones, and this can be done with the majority of our prestressing systems these days. Otherwise continuity is achieved by overlapping the tendons, or by threading tendons through ducts previously left open and prestressing the "seams" between sections.

This was the principle used in Baden-Baden, where the gaps between the tealb sections were closed and stressed last.

The continuous repetition of work when a structure is built in sections permits savings of framework and centering and a reduction of the number of men on the job.

Cantilever Method

There are examples where a large number of bays have been constructed at a time, and where the outer bays, built on double form work with a sliding layer between, were pushed away from the inner bays, that is to say they were used as prestressing blocks for the Leonhardt prestressing system with concentrated cables. They are exampled in Mannheim.

The cantilever method of construction can undoubtedly solve many a traffic problem met in the construction of urban elevated roads. The shutter trolley needs hardly any more construction depth underneath the bottom of the bridge girder than does a centering with I-beams. And this limit to the height of traffic passing underneath, only applies to a part of the width of the road underneath, corresponding to the length of the shutter trolley.

With some deep study, even varying widths and quite sharp curves can be tackled with the cantilever method.

Another method of construction was developed with elevated roads particularly in mind. The equipment required for this method consists of the following:

Two steel girders, which can cantilever out for one bay under their own dead load;

4 centering trusses with cross-ties and steel form work rolling on the girders as on "curtain-rails"; and 2 crane trolleys.

After completion of one bay, the centering trusses are lowered and the "curtain-rails" pushed forward to the next bay and settled on the next columns. Then the trusses can be pulled into the next bay. Slight curves of over about 1,700 ft radius can be coped with by this method. A construction depth of 5 ft is required below the bottom surface of the concrete. In all probability both these methods will only be used in exceptional cases. One of their economic advantages, the saving of centering, seems to be of less importance in elevated road construction than in bridge construction, where centerings are usually higher and cannot always be re-used for bay after bay.

Precasting: Nervi Example

Finally, I must make some mention of precasting. I must admit that as far as elevated roads are concerned Germany is far behind in this field. America leads the way. This is explained not only by the necessity of reducing the obstruction to traffic to a minimum, but chiefly by the desire to reduce labour costs on the site. Undoubtedly precasting can offer speed of erection, and designs which are aesthetically pleasing can certainly be found; the conditions are favourable for precasting, if there are few changes in width, and few curves.

There is the 3,000 ft elevated road "Corso Francia" in Rome, built by Pier Luigi Nervi; this has V-shaped prestressed precast beams, simply supported on hammer-head cast-in-situ-columns with a cruciform cross-section twisted over the height of the column.

"Certain difficulties have to be overcome when designing for precasting. A series of simply supported beams will necessarily have a larger construction depth. You have to strive at a minimum number of elements, and they have to be straight. With these elements it is difficult to tackle curves and changes of width. I am afraid that not even Nervi's genius has found the ideal solution in this case.

"The German nation can be proud to leave our bridge constructions to posterity as genuine examples of the taste of construction of our time. (I doubt whether this goes for the majority of our other—say office buildings). But we pay a high price for this in Germany, by shaping each bridge individually; by crossing the Autobahnen with bridges which fanatics of rationalisation would rather buy wholesale in a department-store. But I think this effort is worth its price, especially where elevated roads are concerned."

(From "Highways Bridges and Engineering Works"—20th and 27th December 1961.)

PROTECTION OF STEELWORK ON FORTH ROAD BRIDGE

DETAILS OF TREATMENT UNDER CONTROLLED CONDITIONS

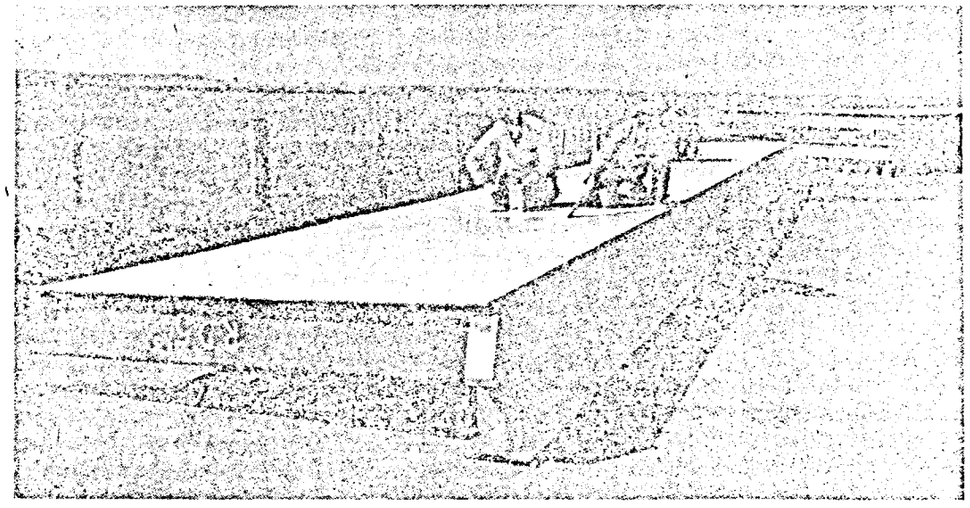
THE new Forth Highway Bridge will not provide constant work for an army of painters, for the steel work, including the boxes, girders and steel plates, is being treated prior to erection with Ferrodor Metal Protection system developed by Griffiths Bros. & Co., London Ltd., of Wednesfield, Staffs.

The bridge, the longest single-span bridge to be built in Great Britain, has been designed by Messrs Mott Hay and Anderson and Freeman Fox and Partners, for the Forth Road Bridge Bond. It will require a total weight of metal of approximately 39,000 tons.

The main span of 3,300 ft will be suspended between two giant towers over 500 ft high, which have already been completed. Each tower has two legs built in eleven sections and each of these sections incorporates three steel boxes of about 30 tons each.

The steel work is delivered by road to the war-time airfield at Drem a few miles east of Edinburgh. Here, the A.C.D. Bridge Company have arranged facilities for the proper treatment of the steel before it is delivered for erection at the new bridge site at Queensferry.

The Ferrodor metal protection system is the outcome of research and experience in the field of industrial paints and anti-corrosion materials. It is a painting system based on micaceous iron oxide which has been proved a most effective anti-corrosive protective coating when used as a pigment in paint.



Applying primer to girder sections at Drem.

Indestructable Pigment

The pigment itself is indestructable, and it is combined with specially-formulated media to produce the Ferrodor paint. The effectiveness of this is due mainly to the

natural properties and unique particle of the pigment itself. The particles are flat or plate-like and interleave in a manner somewhat similar to the scales of a fish.

Since micaceous iron oxide is impervious to moisture and highly resilient to ultra violet light it is not necessary to use as much medium in the manufacture of the paint as with an amorphous pigment.

This, together with the leafing properties means that the pigment content can be—and in fact is—very high enabling an exceptionally thick film to be obtained in one coat, without impairing its brushability or the elasticity of the paint film when dry.

It is estimated that each properly applied coat consists of approximately 20 layers of these interleaved particles cemented by, and themselves protecting, intermediate layers of medium of proved durability. Therefore, protection is afforded long after the outer film of medium has weathered away.

The steel work for the bridge is first shot blasted and sprayed with zinc to a thickness of .003 in. The first coat of the painting treatment comprises an etch or wash primer, Armourseal "E". This is a two pack system having a colourless transparent activator supplied in a one quart size polythene bottle and the base in a one gallon can.

Application

The painter does not have to measure the material at all. When ready for application he simply tips the activator into the can containing the base and stirs thoroughly. The resulting colour of the mixture is a pale yellowish green and it is very transparent in appearance.

This primer is applied by brush, but subsequent paint coats are applied by a felt covered roller which avoids the possibility of discrepancy in application and weakness in film thickness which might otherwise occur due to unevenness of brush application.

The second coat to be applied is Armourseal No. 608, which is a zinc chromate paint having a phenolic resin based medium.

Within 24 hours of the application of this coat, the third coat which is No. 29 natural steel grey Ferrodor paint, is applied and the final coat which follows is No. 33 silver grey Ferrodor paint, these two finishing coats also have a phenolic resin based medium.

Between coats, film thickness tests are made to ensure adequate deposit of the protecting material and to check on evenness of application.

Selection of this painting system was made after discarding many hundreds of tests under the most severe artificial weathering conditions thus selecting the best examples of new techniques in steel protection.

As far as manufacture is concerned, all possible steps are taken to see that every batch of paint made for this important project conforms to a tight quality-controlled specification.

Each coat is distinct in colour so that work in progress can be easily checked at all points during supervision.

However, careful control of manufacture, cannot by itself ensure perfect results. Control of application in suitable conditions is the key to success, but it has often been argued that as far as bridge construction is concerned control of site application of paint is impossible.

The builders of the new Forth Road Bridge have proved that protective coatings can be applied under controlled shop conditions where all arrangements can be made to ensure that high standards of performance are maintained.

It is confidently expected that the system approved by the engineers for this project will afford a long term protection which will reduce frequency of re-painting of the new road bridge structure substantially

(From "Highways & Bridges and Engineering Works", October 4, 1961)

SUBMERGENCE EFFECT ON BRIDGE PIERS UNDER EARTHQUAKE—MOHAKA BRIDGE

C. P. O. TURNER*, B.E., D.I.C., A.M.N.Z.I.E.

1. Introduction

THE magnitude of earthquake forces on high bridge piers is affected significantly by the extent of this submergence in water. However, direct application of Westergaard's theory for dams leads to highly uneconomic pier structures. A practical design approach is developed, taking account of boundary and dynamic conditions, by consideration of the piers as pendulums and making use of the concept of additional virtual mass of the piers when submerged. This approach can be applied to the design of any submerged structure.

The Mohaka bridge is an interesting and important example of the above.

2. Effect of Site Conditions on Design

A high level bridge 700 ft long was necessary to cross the Mohaka river on the Napier-Taupo state highway, the design being governed by the following factors:

(a) The foundation, though of massive papa, is not sound enough to sustain the lateral thrusts of an arch bridge.

(b) Any structural steel substructure was undesirable because of possible future hydro-electric development on the river, the final lake levels of which were not exactly known.

Hence from both these considerations, (a) and (b), reinforced concrete piers were considered the best solution, the splay-legged type being passed over in favour of the more simply constructed straight rectangular piers.

(c) The highway runs through difficult country and this, along with economic considerations, set the deck grading on a vertical curve. The height above river level precluded a concrete beam superstructure because of the difficulty of erection, and thus a steel truss design, which can be erected by cantilevering, was adopted. For aesthetic reasons the truss was shaped so as to offset to some extent the sagging vertical curve.

3. Adopted Design

The adopted design is shown in Fig. 1. The superstructure is fixed by pins to the right anchor abutment and to the two piers. It is held down at the left abutment by a two-pin. link allowing free longitudinal† movement. The piers designed as semi-

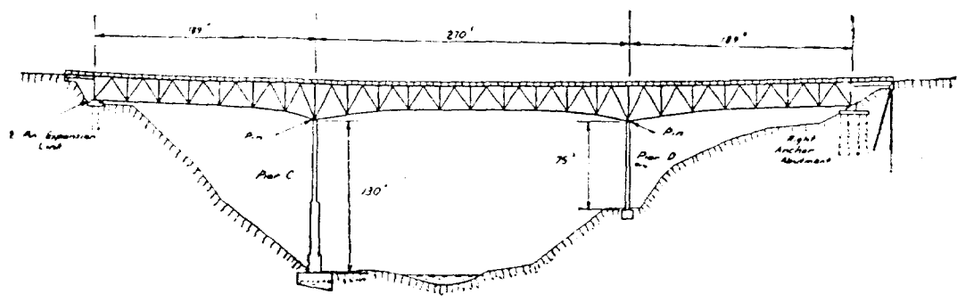


Fig. 1. **General elevation, Mohaka bridge**

* Ministry of Works, Wellington.

† Throughout this discussion, "longitudinal" is parallel to bridge centre line, "transverse" is perpendicular to bridge centre line.

flexible, so that they take most of the truss temperature movement without considerable increase in stress.

4. Assumed Load Distribution to Piers and Abutments

Under longitudinal earthquake loads the two piers are assumed to act as propped cantilevers. The horizontal loads from the superstructure and the prop loads from the piers are transferred by the truss to the right anchor abutment.

Under transverse earthquake the truss acts as a three-span continuous beam on free supports, transferring load to the two piers and abutments through windshoes and thrust blocks. The piers are then assumed to be pure cantilevers transversely, subject to their own seismic load and the seismic reactions from the truss.

5. Design for Unsubmerged Conditions

Analysis of this problem is straightforward for unsubmerged conditions. The pier is designed as a cantilever with an elastic prop, and the orthodox analysis for concrete structures subject to combined compression and bending is used. The deflected shape of the structure gives effective lengths from which allowable stresses may be determined.

6. Submerged Conditions

For submerged conditions it might be thought that, as the water would provide a damping effect on any pier movements, the seismic loads would be less than before submergence. However, if the base is moved horizontally by any given earthquake acceleration, the force on the pier is greater when moved through water than moved through air. (It requires much more effort to move an oar through water than it does through air!). The water does, however, damp out resonance.

An assessment of the relative forces involved can be made by using the concept of virtual mass.

7. Virtual Mass

The increased force due to submergence may be considered as due to an apparent increase in mass of the structure. This is a similar concept to that used in dam design, where using Westergaard's methods (2) the effects of submergence may be treated as an increase in seismic mass of the dam.

The sum of the apparent increase in mass and the actual mass is known as the virtual mass of the structure.

If the pier wall were treated exactly as a dam wall, using Westergaard's approach, the resultant calculated increase in virtual mass would be tremendous. However, boundary conditions govern, and the assumed virtual mass of the pier is in fact very much less than that of a dam of similar height.

8. Determination of Virtual Mass

Earthquakes are dynamic phenomena, and virtual mass may be determined by use of the simple dynamic formula derived from the study of pendulums. The apparent mass can be found experimentally by swinging a scale model of the structure as a simple pendulum, first in air, and then submerged in water.

The respective periods of oscillation are given closely for small displacements by the formulae:

$$T_A = 2\pi \left(\frac{L}{g}\right)^{\frac{1}{2}} \text{ in air}$$

and

$$= T_W 2\pi \left[\left(\frac{L}{g}\right)\frac{(1+a)}{(1-r)}\right]^{\frac{1}{2}} \text{ in water}$$

where:

M = mass of body

aM = apparent additional mass due to submergence

$$r = \frac{\text{(weight of fluid displaced by body)}}{\text{(weight of body)}}$$

and in the case of a non-hollow body

$$r = \frac{\text{(density of fluid)}}{\text{(density of body)}}$$

hence total apparent or virtual mass submerged

$$= M(1+a)$$

$$= \left(\frac{T_A}{T_W}\right)^2 (1-r)$$

9. Values of Virtual Mass

Although it would be necessary to determine virtual mass experimentally for complicated or elaborate structures, an experimental study (3) has been made of the effective inertia (i.e., virtual mass) of some simple shapes when submerged. The experimental results compare closely with the theoretical for those shapes which are amenable to analysis using classical hydrodynamic theory. For instance, both theory and experiment show that a sphere is increased in virtual mass by half the mass of fluid displaced, and a long cylinder accelerated transversely is increased in virtual mass by the mass of fluid displaced.

10. Use of Virtual Mass in Design of Mohaka Bridge Piers

The same experimental series showed that a long rectangular plate accelerated broadside on in a fluid has an apparent added mass approximately equal to that of the fluid displaced by the circumscribing cylinder.

Thus the Mohaka piers, when submerged, were assumed to have an additional longitudinal mass equal to the weight of water in the 20 ft diameter circumscribing cylinder (see Fig. 2). This roughly doubled the virtual mass of the tall piers, and the shorter pier similarly increased in virtual mass to about 2½ times that of the unsubmerged mass. These increases are of the same order as those found by Savage (1) where tapered piers were increased in mass by the water displaced by the circumscribing truncated cone, and the virtual mass roughly doubled.

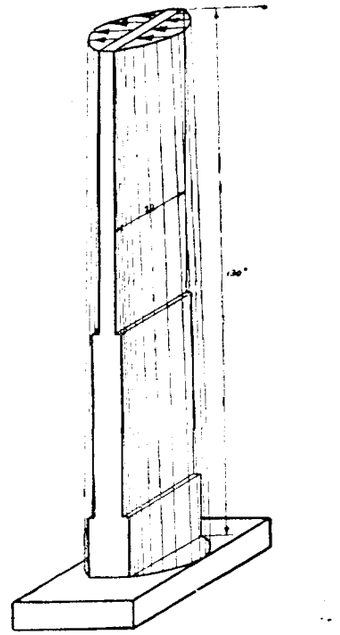


Fig. 2. **Additional seismic mass of circumscribing cylinder of water acting on submerged pier**

The subsequent design analysis for the Mohaka piers then followed along the same lines as in Section 5 above.

Transversely, the pier would be little influenced by water forces and the final design could in fact resist an increase of about 70% in the seismic moment at the base. Following Savage, the vertical virtual mass for a submerged pier under horizontal earthquake forces was taken as the mass of the buoyed structure.

11. Periods of Vibration and Damping

Using the approximate energy method, the periods of vibration in air of the taller and shorter piers were respectively 1.7s and 1.3s. These are within a range normally regarded as not subject to severe resonance under earthquake. When the piers were fully submerged, these periods were reduced to 0.9s and 0.6s respectively, coming within a range which could be dangerous under normal circumstances in air. However, the damping effect of the water rules out any large resonant effects.

12. Overturning and Stability

In submerged conditions there is a safety factor against overturning of at least 3. When fully submerged, the tall and short piers have safety factors against overturning of 2.7 and 2.3 respectively.

Savage (1) found that the stability of high piers is only slightly affected by earthquakes that have proved destructive to other types of structure, as the high rotary moment of inertia opposes the various impressed motions of the foundation.

13. Assessment of Design Approach

From his studies on the Pit River bridge, Savage developed the following design criteria:

(a) Design the pier base with strength and stability for the usual lateral loads,

such as wind and traction forces, without any consideration of earthquake effects.

(b) Design the pier above the base for lateral earthquake forces of such intensity that the resultant is at the edge of the base.

The Mohaka bridge design more than meets these requirements and must be considered conservative. However, the resources were not available for an exhaustive confirmatory testing and analysis of the Mohaka bridge similar to that carried out by Savage on the Pit River bridge. Also, the Mohaka bridge is to be a vital link in what is at present one of the most dependable Auckland-Wellington highway routes and with the possible future submergence of the piers in a hydro-electric lake in a seismically prone area a conservative design is well warranted.

14. Conclusion

With the continued development of hydro lakes in similar country with foundations unsuitable for arch bridges, a similar design approach may be useful from time to time in the future. It is understood that a similar treatment has been used by the U.S. Bureau of Reclamation in the design of submerged hydro structures.

Attempts to apply Westergaard's theory for dams directly to structures other than dams can give tremendous forces leading to highly uneconomic design.

Submergence effects can be very important in hollow structures. For instance, the U.S. Bureau of Reclamation found that the upper portion of the intake structures of Trinity Dam, with intake openings closed, was increased in virtual mass by more than eight times the mass of water displaced by this portion of the structure.

15. Acknowledgments

This work was carried out in the chief designing engineer's office of the Ministry of Works, and the writer wishes to thank the Commissioner of Works for approval to present this paper.

Particular thanks are due to the U.S. Bureau of Reclamation for making available various pertinent unpublished data and for readily giving their assent to reference in the paper to this data.

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(*From "New Zealand Engineering", January 15, 1962.*)

WIT AND WISDOM

A home owner, wearing his oldest clothes, was out mowing his lawn when a woman in a brand new car stopped and shouted: "What do you get for doing yard work?"

The owner looked back at his house and then at the woman in the car, "The lady of the house lets me live with her," he said.

DETERMINATION OF WET DENSITY AND DRY DENSITY AND MOISTURE CONTENT OF SOILS IN PLACE BY MEANS OF NON-DESTRUCTIVE RADIO ACTIVITY MEANS

By J. Huet

Research Report No.75/JH/1961

ROAD RESEARCH CENTRE BRUSSELS

SUMMARY

1°) Wet density γ_h.

THE measurement of density is based on the interaction of gamma rays and the orbital electrons of atoms. Gamma rays from a radioactive source when in contact with a material are scattered in all directions as a result of collisions between the rays and electrons in the outer orbits of atoms comprising the material. Since the number of electrons present per unit volume of material is approximatively proportional to the density of the material, the relative number of gamma rays scattered back to the detector is a directly correlated measure of density.

During the last few years, the Centre de Recherches Routieres (Road Research Centre) studied the experimental determination of density of soils by using surface gauge and depth radioactive probe equipments. This study was carried out with the instruments of the Nuclear-Chicago Corporation and till now we have considered the application of the radioactive method to soils of different types such as sand, silt sandy loam, silty sand and sand stabilized with cement or tar cement. The calibration curves of the density probes permit easy conversion of the scaler reading to wet density over a range from 1.1 to 2.2 T/m³. On an examination, for most of the types of soils usually met with in Belgium, it appears that chemical nature of these soils has no influence. From experiments made in this study it is clear that the least significant differences in density that may be measured are about one-hundredth T/m³ which is, of course, often better than any field method in existence today, like the core-cutter or sand-replacement method. Thus the density determination by a suitable radio active equipment is now really a very interesting method to control the process of soil compaction.

2°) Dry density γ_s and moisture content = w.

Since the density probes give the wet density of the examined soil, the dry density is obtained by merely substracting the volume moisture content determined with the moisture probes (ref. *21* and *22*),

$$\gamma_s = \gamma_h - \frac{w_v}{100} = \frac{w_v}{w}$$

where w_v is the volumetric moisture content and w, the standard moisture content of a soil defined as the ratio of the weight of water present in the soil to thedry weight of the solid soil particles determined, for example, by the oven-drying method.

If we consider the experimental results obtained with the most of the soils used for roads in Belgium (sand, silt, sandy loam and silty sand), we may conclude that, in the examined cases, the determination of the moisture content and the dry density by the non-destructive radioactive method is sufficiently accurate. A single trained person can successfully determine the moisture content and the density in five to ten minutes after the probes are in their measurement position.

CHARACTERISTICS OF INSTRUMENTS FOR MEASUREMENT OF WET DENSITY BY RADIOACTIVITY METHODS

Characteristics	Surface Gauge	Radio sonde
Type	Model P-22	Model P-20
	of The Nuclear-Chicago Corporation	
Source	About 3 millicusies of Cesium^{137}	
Detector	A Geiger-Miiller counter with an admixture of organic vapour of absorption	Three Geiger-Miiller counters connected in parallel and with an admixture of vapour of absorption of halogons
Principle of Measurement	Absorption of gamma rays by Compton diffusion	
Impulse counter	Portable model 2.800 of the Nuclear-Chicago Corporation	
Supply voltage	115 volts, 50–60 cycles or 6 volts continuous (1. Amp).	
High tension supply of the detectors	1,425 volts (1)	1,000 volts (2)
	(with impulse counters)	

(1) For surface gauge model P-22, series 64.

(2) For Radiosonde probe, model P-20; series 39.

SALIENT EXPERIMENTAL DATA OF THE SCOPE OF APPLICABILITY OF THE RADIOACTIVITY MEANS FOR THE DETERMINATION OF WET DENSITY

Experimental data	Surface gauge	Radiosonde
Magnitude measured	Wet density	
Zone of influence	Hemisphere of radius (cm) $= 4.17\,\gamma_h^2 - 22.5\,\gamma_h + 43{,}33$	Sphere of radius

(*Continued*)

Experimental data	Surface gauge	Radiosonde
Calibration equation	$\gamma_h = -1.70\,R + 3.04$ (1)	$\gamma_h = -1.94\,R + 2.82$ (2)
	Where R is the total number of impulses registered per minute when the measuring instrument (surface gauge or radiosonde probe) is, say in contact with the material under test and standardized, taking into account the correction due to loss by coincidence.	
Scope of applicability of the calibration equation	1.3 to 2.2 g/cm^3 (or ton/m^3)	1.05 to 2.2 g/cm^3 (or ton/m^3)
Departure type (dispersion of individual values about the standardized strength	$\sigma = 0.01$ g/cm^3 (or ton/m^3	$\sigma = 0.02$ g/cm^3 (or ton/m^3)
Time necessary for measurement	3 to 5 minutes	
Nature of soil	The chemical constitution of the soil has practically no influence.	

(1) For the surface gauge model P-22, series 64.

(2) For the radiosonde probe model P-20, series 39.

CHARACTERISTICS OF THE INSTRUMENT FOR MEASUREMENT OF GRAVIMETRIC MOISTURE CONTENT BY MEANS OF RADIOACTIVITY

Characteristics	Surface gauge	Radiosonde probe
Type	Model P-21	Model P-19
	of the Nuclear-Chicago Corporation	
Source	5.18	5.3
	^{226} millicusies of Radium – Berylium	
Detector	Ten tubes B^{10} F^3 connected in parallel	One tube B^{10} F_3

(*Continued*)

Characteristics	Surface gauge	Radiosonde probe
Principle of measurement	Source : $^{4}_{2}He + {}^{9}_{4}Be \rightarrow {}^{12}_{E}C + {}^{1}_{0}n$ (rapid) Soil : $^{1}_{0}n$ (rapid) $\xrightarrow{\text{hydrogen}}$ $^{1}_{0}n$ (slow) Detector : $^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{4}_{2}He + {}^{7}_{3}L_i + Q$	
Impulse counter	Portable model 2.800 of the Nuclear-Chicago Corporation	
High tension supply	115 volts, 50-60 cycles or 6 volts continuous (1 amp).	
High tension supply with the detectors.	1,350 volts(1)	1,450 volts(2) (with the impulse counters)

(1) For surface gauge model P-21, series 62.

(2) For radiosonde probe model P-29, series 55.

SALIENT EXPERIMENTAL DATA OF THE SCOPE OF APPLICABILITY OF THE RADIOACTIVITY MEANS FOR THE DETERMINATION OF MOISTURE CONTENT W_v

Experimental data	Surface gauge	Radiosonde probe
Magnitude measured	Volumetric moisture content W_v (%)	
Zone of influence	Hemisphere of radius $r = 11.5 \sqrt[3]{\frac{100}{W_v}}$ cm	Sphere of radius $r = 17 \sqrt[3]{\frac{100}{W_v}}$ cm
Calibration equation	$W = 71.43\ R$ (1)	$W = 41.15\ R$ (2)
	Where R is the total number of impulses registered per minute when the measuring instrument (surface gauge or radiosonde probe) is, say, in contact with the material under test and standardized taking into account in both cases the correction due to loss by coincidence.	

(*Continued*)

Experimental data	Surface gauge	Radiosonde probe
Scope of applicability of the calibration equation	From 0 to 50%	From 0 to 100%
Departure type (dispersion of individual values about the standardized strength)	$\sigma = 0.6\%$	$\sigma = 1.2\%$
Time necessary for measurement	3 to 5 minutes	
Nature of soil	The chemical constitution of the soil is, generally a negligible factor, but it is desirable to have preliminary chemical analysis of both the organic as well as the mineral constituents.	

(1) For the surface gauge model P-21, series 62.

(2) For the radiosonde probe model P-19, series 55.

HERE AND THERE

1. LIME TRANSFORMS CLAY INTO USABLE SUBGRADE MATERIAL

By

RAY DAY

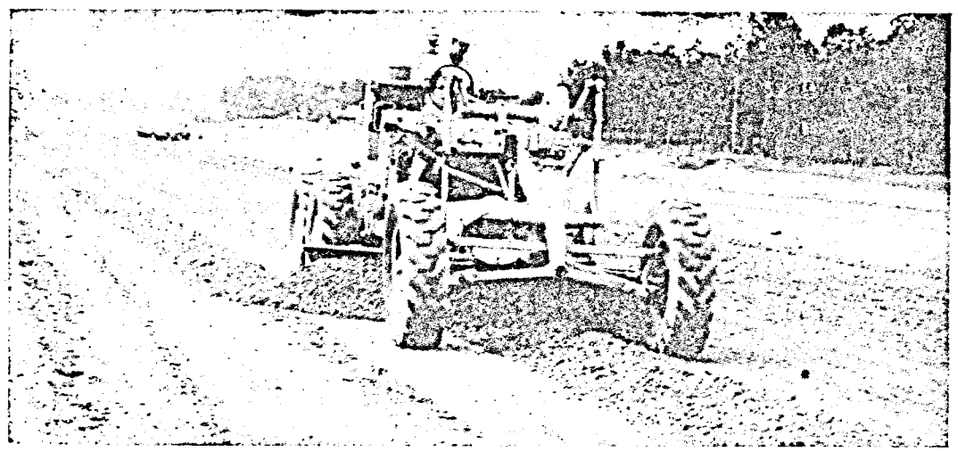
● TAKE A HEAVY CLAY topsoil in south Texas, where the plasticity index of native material is 37. Locate a four-lane divided inter-state freeway in the area. Then search in vain for good aggregate or gravel within reasonable hauling distance. Sounds as if you have all the ingradients for trouble, doesn't it?

It didn't work out quite that way on a project north of Conroe. Two types of native clay were used practically where they occurred, to make not only subgrade material but sub-base material as well. The only extra material hauled in was hydrated lime. The lime was given a special mixing treatment by one rotary mixing machine.

That treatment, only 6 in. deep, broke the plasticity index of 37 by 25 points in less than 36 hours. The material was topped by another 6 in. of imported iron-ore, and altogether the treatment met inter-state standards for sub-base construction under a 10-in. portland-cement-concrete pavement.

Although the use of lime to lower the plasticity index is not a new procedure in Texas, it never ceases to amaze engineers and contractors who work with it. On this particular job there were two principal types of soils—a fairly good lean red clay, somewhat on the sandy side, and a very bad sticky black gumbo. These materials were the only ones for miles around out of which to build a road.

Engineers have noticed a certain peculiarity in treating a clay soil with lime. The worse the soil—in other words the higher its plasticity index—the more dramatically the addition and mixture of lime with it will reduce its index. For example, if 4 per cent lime is added to a soil whose starting index is 10, a final result of between seven and eight can be expected. On the Conroe job, where the starting index was 37, it was broken down to 14 by the addition of the same amount of lime.



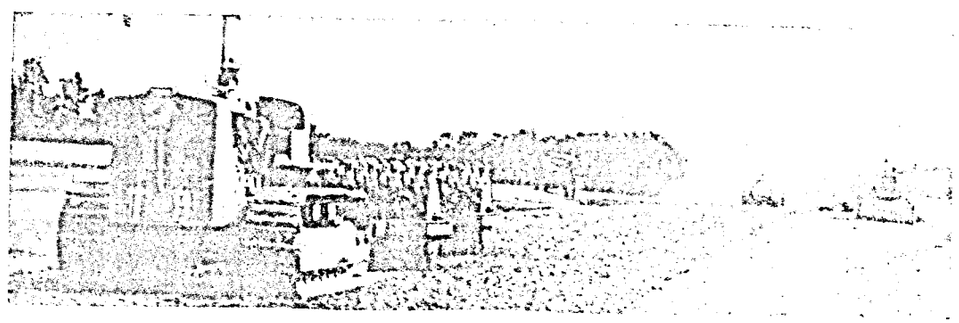
A motor grader shapes base to final cross-section

After a great number of before and after tests had been conducted on the material, the two general soil types averaged out about as shown in the accompanying table.

Control over the material during processing was assured by writing the specifications so that the subgrade had to be shaped and compacted true to surveyor's blue-tops before any mixing began. Then the upper 6 in. of in-place material was ripped up, the lime was added on the surface, and one mixing pass put the chemical all the way through to the bottom of the lift. After the material rested for a day to allow the lime to work, a final pass with the mechanical mixer completed the mixing.

Good Quality Clay	*Before Lime Treatment*	*After Lime Treatment*
Liquid limit	39	30
Plastic limit	16	23
Plasticity index	23	7
Linear shrinkage	10	1.7
Maximum density	116.3 per cu. ft. at 12.7 per cent optimum moisture	
Black Gumbo		
Liquid limit	51	39
Plastic limit	20	25
Plasticity index	37	14
Linear shrinkage	16	6
Maximum density	106.1 per cu. ft. at 18 per cent optimum moisture	

The contractor, Oscar Howard, shaped the grade in a hurry because the highway is in flat country and neither cuts nor fills were very big. Three rubber-tired scrapers handled the shaping operation. The same sheep's foot rollers that compacted the lime stabilized material were used for soil compaction.

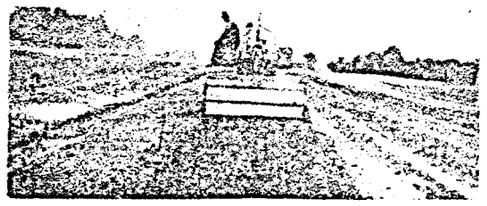


Two sheep's-foot rollers work with grader on base-course work

To HANDLE the important lime-mixing job, the contractor used a mechanical mixer that has the ability to reach down through very heavy soil and blend it with a variety of admixtures. The machine has been successfully worked to depths of 15 to 18 in. in some of the worst clays in Texas.

On this job, where 6 in. was the mixing depth, about $8\frac{1}{2}$ in. of actual mixing was very easy for the machine to handle. In fact, it often pushed right along without being towed by the crawler tractor in front.

The mechanical mixer works in lime in clay soil



Mixing job done by mixer shows in strip behind machine

Bulk hydrated lime was supplied from a commercial plant in Austin. This company used a screw-type spreader, tailgated from a dump truck, to put the material on the graded surface. Lime was spread after the scarifier teeth of a motor grader had ripped up the upper 6 in.

Complete dispersal of the lime through the lift was a reality after one mixing pass. The mixer has a centre plowshare that opens up a small furrow to let the drive axle through. Heavy whirling tines then mixed the soil and lime to a good blend, and let it flow out under the skidmounted mixing hood. After the second pass, the material was ready to compact by sheep's-foot rollers to 96 per cent of modified Proctor density.

Because the entire process was so dependable and results could be measured accurately as the work went on, the contractor was able to set the operation-up on a well-planned schedule where interruptions were few and far between.

Rolling was kept on schedule close behind the mixer just in case it rained. If a fill was caught in a shower, it was easy to aerate the mix by raising the tailboard and throwing the wet material out behind the machine. Good organization prevented this-from happening except in a few isolated instances.

Following immediately behind the lime-stabilization operation, were large size cable-dump trailers that had hauled in and then spread the iron-ore base material. In a matter of only few weeks, the base work was out of the way, and the freeway was ready for the paving contractor. Because of the fast job that had been done on the base, there weren't any delays for the paving fleet.

(*From "Better Roads" January, 1962*)

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2. "THE VERRAZANO-NARROWS BRIDGE IN NEW YORK— THE MOST PONDOROUS (DIFFICULT) BRIDGE OF THE WORLD"

(*Original in German*)

● EVERY one who comes from Europe to New York by a ship must pass through the "Narrows".

That is why it is known as "the Gateway of the New World", the famous Straight between Long Island in the East and Staten Island in the West. Its breadth is about 1.6 km.

New Bridge would be completed by 1965

The bridge over the Narrows brings to realisation a 50 years old dream. The new Verrazano-Narrows Bridge construction started in August, 1959 is one of the two gigantic bridges which are planned in New York, its design was prepared by Dr. O.H. Ammann, the builder of the George-Washington Bridge. The other proposed bridge is that over the East River.

The twin worded name of the Verrazano-Narrows Bridge is in memory of the Italian seafarer and explorer Govannida Verrazano who in 1524 explored the North American Shores from Maine to North Carolina and was probably the first European, who penetrated into New York harbour.

It is estimated to take ten years to complete the bridge and the approaches. The bridge would be opened to traffic in the beginning of 1965. Estimated cost will be 32 million dollars.

The Verrazano-Narrows bridge connects Fort of Hamilton in Brooklyn to the Fort Wadsworth on the Staten Island at the middle of the Manhatten road net work running towards south and the traffic can by-pass the central part of New York. The construction of the new bridge is a great step towards the opening out of the Staten Island, which at present occupies a possition of a step-child under the Borrough of New York.

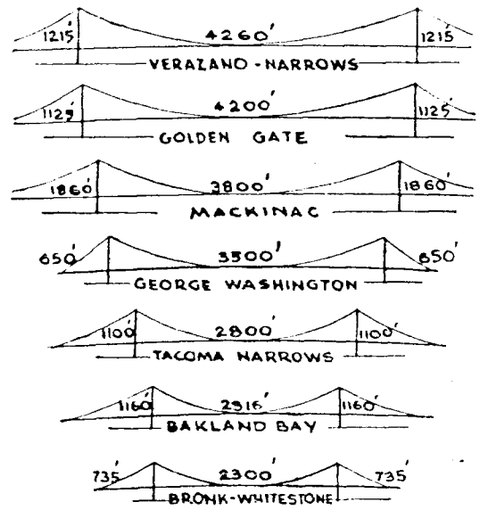

Fig. 1. Lengths of various large suspension bridges in America.

Engineering Particulars of the New Bridge

At the Bridge site the Narrows has a 700 m wide and 35 m deep sailing channel. From the engineering point of view the bridge is treated as a double decked suspension bridge with 12 traffic lanes. In the first instance only the lower deck would be constructed. However provision have already been made so that without any special difficulty the upper deck could be added on when the traffic makes this necessary. Each of the two decks would have six traffic lanes.

The length of the bridge and approaches will be nearly 3 miles. The biggest span viz. the suspended mid-span will be 1420 m long.

The designed height of the bridge towers is 230 m over the hightide level as campared to 195 m high pylons of the George-Washington bridge. The height of the underside of the decking over the normal water surface will be about 76 m which will permit to pass under it without hindrance the largest ocean-liners and warships. When the increasing traffic demands it, the access ramps to the upper deck will be built.

The erection of the bridge towers on the banks and under water on the Brooklyn side as well as on the States Island side constitute very big excavation work that had been undertaken, reinforced concrete caissons had been sunk for the foundations.

The pylons rest on firm granite foundations and for this 90 m long I section had been driven deep into the granite through the caissons and anchord. The caissons would then be filled in with concrete. The weight of steel in the bridge has been estimated to be 15,000 tons.

The access ramps to the bridge

Every seven years it is necessary that bridge is given a rust proof coating. This work each time will take about 40 months and would cost about 300,000 dollars. At the pylons, steel girders have been fixed to facilitate mountings for the rust proof coating.

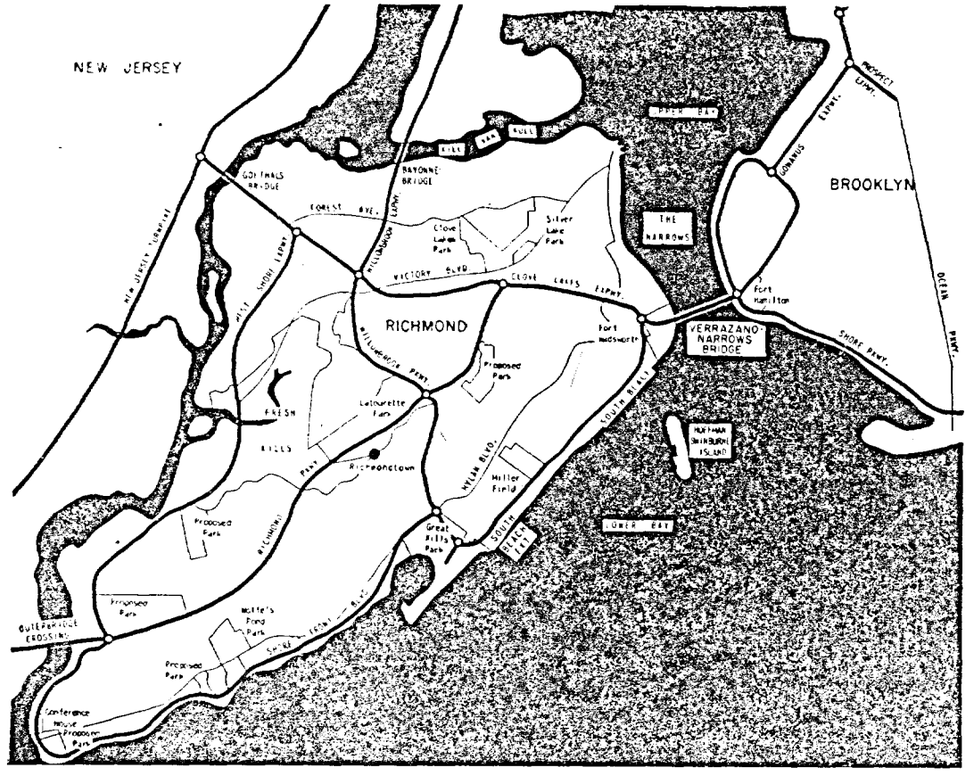

Fig. 2. **The Verrazano-Narrows-Bridge in New York between Staten Island and Brooklyn**

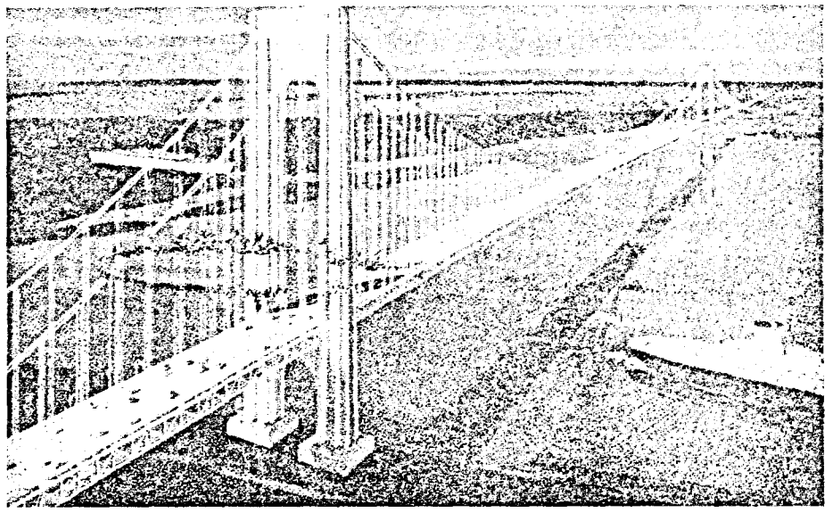

Fig. 3. **Artist's View of Verrazano-Narrows-Bridge Linking Staten Island with Brooklyn accros the Lower end of New York Harbour**

In the Staten Island, a new highway, the Clove Lakes Expressway provides access to the bridge. The New York Authority by whom this work has been undertaken and financed is vested with the construction of this new highway. The cost of new highway over the Staten Island side will be about 40 million dollars.

In Brooklyn, the new Gowanus Expressway would fulfil the same function. Its cost amounts to about 84 million dollars. Since both the highway systems form a section of the National Inter State Highway System 90% of the construction costs would be borne by the Federal Government and the rest 10% by the State of New York.

Traffic over the Verrazano-Narrows Bridge

According to the preliminary estimates of the traffic experts, it has been computed that in the first year of its normal functioning (according to present estimation in 1965) about 16,300,000 vehicles would go over the bridge. When both the decks of the bridge are in commission, the maximum capacity of the bridge would be at about 48 million vehicles per year.

The objective of the new bridge, as already mentioned, is to connect the city section of Staten Island with the residual section of the New York and thereby make it composite. Up till now only ferry services exists between Staten Island and Manhatten or Brooklyn. It is, however, important that the traffic through Manhatten be relieved by the new Expressways and the bridge.

So this system will apply to the Verrazano-Narrows bridge and Throg-Neckbridge about the two Expressways. The vehicles will normally bypass over the Manhatten and therefore the through traffic intolerably retarded hitherto would decidedly be speeded up. These two expressways are still in planning stage. The construction cost of each would be 100 million dollars.

When one sees the incredibly bold balanced silhouette of the new Verrazano-Narrows Bridge, he can be sure that here exists not only a nascent profitable work of art but also a work that architecturally a gift of beauty.

Dr. W. Sch.

(*From "Strassen Und Tiefbau", November, 1961.*)

[*The above article has been very kindly translated from German to English by Shri S. K. Rajagopalan, Divisional Engineer Consultant, Ministry of Transport & Communications, Department of Transport (Roads Wing), New Delhi.*]

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3. FLOATING BRIDGE

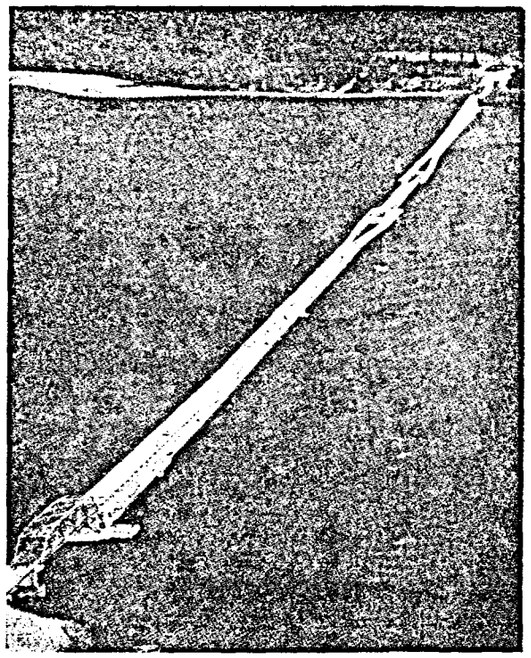
The New 7,861-Foot Hood Canal Span In Washington State Rests On Pontoons

MOTORISTS who drive across the new 7,861-foot Hood Canal Bridge in Washington State literally float across the water.

That is because most of the bridge is erected on pontoons. It is described by the Washington State Highway Commission as the "world's largest" pontoon bridge. It replaces a state-operated ferry which crossed the canal three mile south of the span.

Construction of the bridge began in January, 1958, and it was opened to traffic last August. During construction, the span was plagued with trouble. Two pontoons sank in December, 1959, at a dock in Seattle where they were being constructed, and during the same winter, severe storms badly damgaged pontoons in place at the bridge site. As a result, consulting engineers were retained to review the circumstances and analyze the structure as a whole. Their recommendations led to strengthening of the pontoons and their connections.

Reasons for choice: The pontoon-type bridge was selected over more conventional type structures because of the unusual physical conditions at the bridge site. One of the main factors was the weather. Winds in excess of 80 miles an hour sometimes whip across the canal, causing waves five feet high and with 35-feet crests. Another important consideration was the great depth of the water in Hood Canal. From 70 feet at the shoreward ends of the



An aerial view of the new Hood Canal bridge in Washington State's puget sound area. Of the total length, 6.471 feet of the bridge float on pontoons

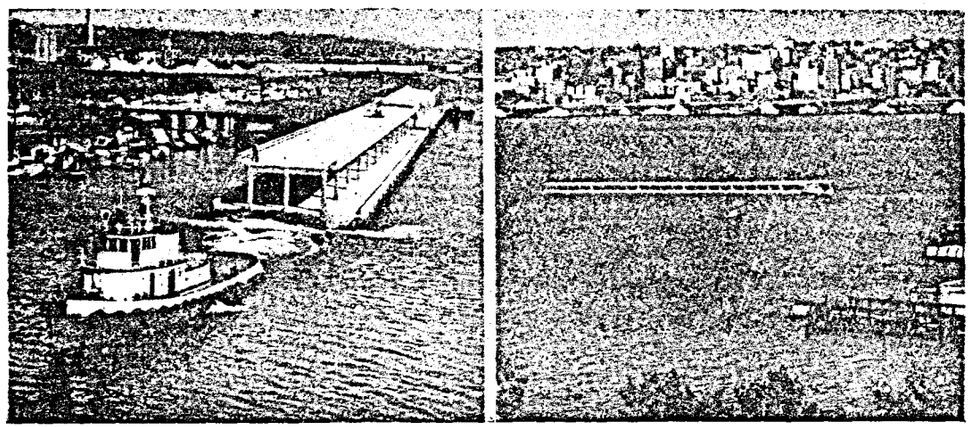
floating structure, the water drops to a maximum depth of 340 feet in the centre of the canal. In addition, these depths exceed 180 feet for a length along the axis of the bridge of about 4,000 feet. Economical construction of a bridge supported on piers, including the suspension type, are precluded by such depths.

Provision had to be made in the design of the bridge for passage of the largest naval vessels on their way to and from the ammunition depot at Bangor. A draw span provides a 600-foot channel.

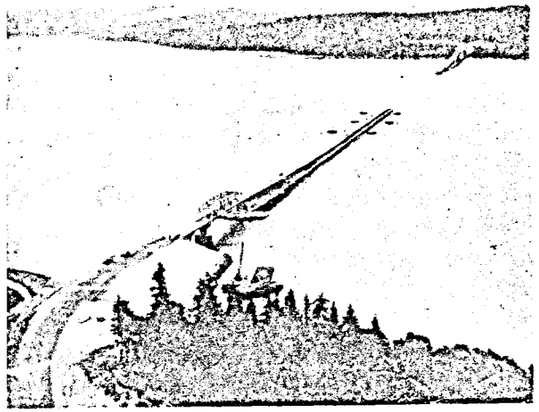
At a point where the pontoons approach the centre span, special flanking pontoons split off in the form of a prong or "U". These pontoons connect with the 470-foot draw pontoons located in the centre of the channel. When a large ship approaches—even the largest aircraft carrier—electric power moves the draw pontoons back into the space between the flanking pontoons to make the 600-foot opening.

Smaller craft move under stationary transition spans near the east and west shorelines.

The Tides: A major problem that had to be overcome was lateral movement, caused by the current and up-and-down action of



In picture at left above, two pontoon sections are being towed out of the dockyard to Seattle harbour. At right, Seattle skyline provides a backdrop as pontoon sections are towed to the bridge site to be attached to other sections



This is how the bridge appeared during construction. Notice the tug boats in upper left of the picture, where another pontoon section is being attached to the bridge

the high and low tides. A unique hinging technique was decided upon to adjust for an 18-foot rise and fall of the tide. The hinge was fixed to both ends of the steel-truss transition spans which connect the pontoons with the fixed approaches.

The lateral forces of the strong tides in the canal, where an extreme velocity of 2.5 miles an hour has been recorded, were surmounted by attaching cables to 42 concrete anchors, weighing up to 900 tons each. The anchors are attached to special steel cables located in the centre of each pontoon. There are two anchors to each pontoon and they are placed opposite each other on the floor of the canal directly beneath the pontoons. Because of the variations in the tides, the cables were designed so they would all have the same maximum stress at high tide. The bridge designer calculated that the maximum sideways movement of the bridge due to wind and wave action would be approximately six feet. Because of the movement, the cables have to be adjusted periodically by 100-ton hydraulic jacks.

The floating structure as a whole consists of 23 pontoon units, which connect to fixed structure approaches on each side of the canal. To prevent salt spray from interfering with vehicular traffic, the roadway is elevated a minimum of 14 feet 5 inches above the pontoon deck. The roadway deck increases in height at each end of the floating structure, at the fixed approaches, to provide the required navigational clearances under the transition truss spans.

Two Traffic Lanes: The pontoons were constructed at a graving dock in Seattle and hauled by tug to the construction site, where they were bolted to the fixed approaches. Of the total bridge length, 6,471 feet are floating and 1,390 feet are in fixed approaches. The 28-foot wide roadway carries two lanes of traffic.

The bridge, which cost $26,750,000, makes accessible vast areas of Washington State which previously had been mostly wilderness and gives promise of spurring industrial development and the opening of new residential areas for families in crowded Puget Sound.

(From "Highway Highlights", December, 1961)

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4. ROBOT TELEPHONE

A LONDON plant hire and sales company, Harrison Plant Ltd., of Old Ford Road, E. 3, has employed a robot to answer its telephone calls day and night when the office staff are not available to do so.

"The service we are providing for our customers is now second to none," said Managing Director, Mr. T. A. Harrison, last week, "A lot of business can be lost if the telephone goes unanswered—especially in day time, but at night too. Apart from when the lines are engaged, it is now impossible for us to miss a telephone call throughout the day and night."

Harrison Plant Ltd., supplies all types of plant to building and civil engineering contractors. It owns all its plant and much of it is for specialist jobs on highway construction.

The company has installed the new Robophone telephone answering equipment and generally this is brought into operation when the office closes at 6-30 p.m. and maintains the all night vigil until the office opens at 7-30 a.m. All messages recorded receive immediate attention.

The way in which the machine works is quite simple. In looks it closely resembles a compact tape recorder. It records on magnetic tape all incoming calls without disturbing in any way those going out. When there is an incoming call, the machine does not come into operation until after four double rings.

If the call is not answered in the normal way during this period, the machine automatically engages and transmits a pre-recorded announcement to the caller. This gives the telephone number, the name of the subscriber and any other information before inviting him to dictate a message which will be recorded and played back to the subscriber when he returns. When the caller hangs up after giving his message, the machine will wait for a few seconds and then close down and reset itself for the next call.

The Robophone has been accepted by the General Post Office for use in conjuction with its telephone equipment. It is being manufactured in London and made available by Robophone Ltd., of 179, Tottenham Court Road, W.1, on a contract-hire basis for periods of 3, 5 or 1 years duration. Installation and maintenance is free.

(From "Highways and Bridges and Engineering Works," 3rd January, 1962.)

5. HIGH-FLYING POLE PLANTER

MOTORISTS in the Bitterroot Mountains, Idaho, were slightly startled when a Hiller 12E helicopter flew overhead with a 900 lb telephone pole suspended on an 80 ft long rope sling. Busy installing 40 poles along a three-mile section in the mountains, the helicopter was picking up poles at the foot of the slope and "planting" them amidst high trees at the rate of one every 15 minutes.

The chief stumbling block to building the 40 pole stretch by ground crews was the 45 degree slopes at this part of the almost mile-high Bitterroot Mountains.

Dense forest necessitated extra long slings, consequently the helicopter was never close enough to the ground, when hovering or lifting, to take advantage of "ground effect" (the returning cushion of downwashed air that acts as a booster), but the Hiller, weighing only 1,750 lb easily lifted the 900 lb fully-fixtured poles and hovered motionless as it zeroed in for planting.

Once all the poles were placed, the pilot made two runs along the line to lay two manila lead lines for stringing operations to follow. Flight time for this capping-off operation—12 minutes.

Ground crewman has a hard time maintaining his equilibrium on steep mountain slope as he directs helicopter pilot during installation of telephone poles

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

6. INDIAN STANDARDS CONVENTION 1961

THE Indian Standards Institution organized the Sixth Indian Standards Convention at Kanpur from 25 to 30 December, 1961. 452 delegates with 40 accompanying lady delegates attended.

The Convention was inaugurated on 25th December by Shri C. B. Gupta, Chief Minister of Uttar Pradesh. Shri Gupta laid stress on the problem as to how and in what measure the adoption of proper standards could be made mandatory for products intended for export.

Shri K. C. Reddy, President of ISI and Union Minister of Commerce and Industry, presided over the inaugural function. Shri Reddy presented the K. L. Moudgill Prize for the year 1961 to Shri T. V. Ramamurti, Assistant Director, National Physical Laboratory, New Delhi for his outstanding contribution to standardization work in India.

Another distinguished participant in the Convention was Dr. M. M. Salama, Director, Egyptian Organization for Standardization (EOS). Speaking at the inaugural function, Dr. Salama gave a broad idea about the activities of UAR in the field of standardization, and expressed hope that our mutual co-operation in this major scientific and technical field will lead to more prosperity and progress for our great old countries.

This convention was the Sixth in the series of Conventions which ISI has been holding annually for the past few years. Previous Conventions were held successfully at Calcutta, Bombay, Madras, Delhi and Hyderabad.

Besides the inaugural session, the Convention comprised nine technical sessions where as many as 120 technical papers were discussed and important recommendations made.

Shri C. P. Malik, Director of National Buildings Organization, New Delhi, presided on the Session on *Productivity in Building Design and Construction* held on 26 December 1961, and laid emphasis in his opening remarks on achieving higher productivity in the following works:

The other Technical Session on that day devoted to '*Housing and Preservation of Documents*' was presided over by Dr. S. R. Ranganathan.

The problems of standardization and certification marking for export goods and small scale industry were discussed in the technical session '*Review of Indian Experience in Certification Marking*' held on 27th December 1961. The Chairman, Shri Prabhu V. Mehta, the Chairman of ISI Certification Marks Advisory Committee, reviewed the progressive development of the ISI Certification Marking Scheme being operated under an Act of Parliament.

The recommendations of the Session included:—

(a) Building up more active co-ordination between handicraft boards, ISI and State Governments;

(b) Methods to promote quality-consciousness among consumers;

(c) Price preference for certified goods over non-certified goods; and

(d) Compulsory quality control for export goods.

'*Standardization of Packages and Packaging Materials*' was discussed on 28 December presided over by Col. V. N. Pillay, Chief Inspector of General Stores, Ministry of Defence. It was recommended that means should be provided to ensure the quality of packaging materials produced in the country and more facilities given for studying problems associated with packaging of individual stores as well as for assisting various industries in their packaging problems in a co-ordinated manner. He also suggested that a code also be brought out to cover the packaging requirements of practically every industrial product in order to ensure its safe delivery to its destination.

The other Session held on 28th December concerned with the *Safe Use of Electricity in the Homes* presided over by Shri S. S. Kumar, Chairman, Central Water and Power Commission. There was consensus of opinion that adequate measures should be taken to ensure that only safe and standard equipment are manufactured and sold. If necessary, legislative measures should also be taken to ensure this aspect.

The Session on '*Non-destructive Testing of Metals*' was held on 29th December 1961 under the Chairmanship of Shri S. K. Nanavati, General Manager, Tata Iron and Steel Co., Ltd. Jamshedpur. Non-des-

tructive testing, as the name implies, is the method of testing materials or product without having to destroy it or impair its properties in any way. A strong plea was made that an Indian Society for Non-destructive testing and a central training institute for training of personnel for conducting non-destructive tests could be established.

Another session *'Company Standardization Practices'* was held under the Chairmanship of Mr. R. G. D'Costa, General Manager, Tata Engineering and Locomotive Co., Ltd., Jamshedpur. A unanimous conclusion was reached that in the context of industrial development in the Third Five-Year Plan, there was an urgent need to set up standardization departments in manufacturing enterprises.

On the concluding day, *Adoption of Universal Count System in Textile* was presided over by Shri Srinagabhushana, Principal, S.K.S.J. Technological Institute, Bangalore. In his opening remarks, Shri Srinagabhushana drew attention of delegates to the unnecessary multiplicity of existing systems of measurements in different sections of textile industry and the need for introducing a simple, direct, unified system. He advocated, the adoption of Universal Count System also known as 'Tex' System which has been evolved after considerable thought and study at the international level and which is based on the metric system.

The Session comprising representatives from the cotton, jute, coir and other textile industries and handloom industry unanimously approved the adoption of the tex system, specially in view of the current change-over to the metric system.

Introduction of Metric System in Engineering Industry was the subject of the other Session presided over by Shri K. V. Venkatachalam, Joint Secretary, Ministry of Commerce and Industry. Engineers attending the Session emphasized the need for rationalization of designs in metric system for economy in production.

The Reception Committee organized very interesting and educative local visits to the following places :—

(a) Air Craft Manufacturing Depot ;
(b) BIC Cooper Allen Branch ;
(c) River Side Power House ;
(d) Kanpur Woollen Mills,
(e) Defence Research Laboratory ;
(f) H.B. Technological Institute ;
(g) Sugar Institute ;
(h) J.K. Rayon Mills.

Besides, there were two post-Convention excursions, one to Khajuraho and the other to Lucknow.

7. ALL INDIA MOTOR UNIONS' CONGRESS SILVER JUBILEE CELEBRATIONS

THE AIMUC, the representative national organisation of Commercial Road Transport Industry in the country, having completed its 25 years of service to the motor operators and the public, has now decided to celebrate during the year its.

Silver Jubilee Anniversary

by calling a big All India Conference of the bus and truck operators and others connected with or interested in the Road Transport Industry at a place and date to be announced very shortly.

Some of the other proposals under consideration in this connection are :

To set up a TRUST to raise funds for having a building of our own in Delhi, to be named 'TRANSPORT HOUSE', to be used as offices for the AIMUC and for providing accommodation to the visiting operators.

To bring out a SOUVENIR on the Road Transport Industry, giving a resume of progress made by at least 500 leading transport concerns in the country.

To bring out the 'ANNIVERSARY ANNUAL NUMBER' of our magazine, 'Motor Transport' on the occasion.

To set up National Trophies in safe Driving for the Bus and Truck Drivers.

To set up a Fund for giving stipends and scholarships for the study and research in Road Transport.

Your Suggestions, Co-Operation, Assistance, and Contributions are sincerely requested.

For further details, please write to :
Secy.-Genl.,
All India Motor Unions' Congress,
16-A, Asafali Road, New Delhi-1.

(The first instalment of these translations was printed in the May to July, 1960 issues of the T.C.M.R.—Editor)

LIST NO. 2 : 1961.

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BECKER (W).
New revision of the specifications for the quality of blended bitumen in DIN 1955. Insdoc Trans No. 4400. Trans. from German from "Bitumen, Teere Asphalt Peche" Vol. 2, No. 12, 1951, p. 325—326. 13985.

BECKER (W).
Cutback bitumen for surface treatment. Insdoc Trans. No. 4366. Trans. from German "Strasse und Autobahn", Vol. 1. No. 8, 1950, p. 30—33. 14363.

BOLOMEY (J).
Continuous or discontinuous Granulation of concrete. Insdoc Trans. No. 3155. Trans. from French from "La Techniques Des Travaux". Vol. 24, No. 7-8, 1948, p. 254—56. 11459.

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Composition of concretes. Insdoc Trans. No. 3132. Trans. from French from "R. Revue Universelle des Mines", Vol. 7, No. 2, 1951, p. 41—52. 11458.

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Recent researches on the composition of concretes used for coating of roads. Insdoc Trans. No. 3701. Trans. from French from "Via" No. 12, 1951. p. 39—45. 12157.

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On the use of cracked bitumin from lignite as a road building material. Insdoc Trans. No. 3000. Trans. from Germany from "Brauhkold." Vol. 35, 1936. p. 845—851 & 866—870. 11192.

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JAPPELT (A).
Creosote and Paraffin in low temperature coal tars. Insdoc Trans. No. 2887. Trans. from German from "Oel Und Kohle". Vol 16, 1940. p. 190—93. 11102.

JOISEL (A).
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Composition of Concrete. Insdoc Trans. No. 3445. Trans. from French from "Int. Asso. for Bridge & Structural Engineering, 4th Congress, Cambridge," 1952. p. 703—15. 11604.

LECHMCKER.
Traffic—worthy kerbstones at street crossings. Insdoc Trans. No. 3127. Trans. from German from "Die L-Kurve" p. 1—19. 11194.

OBITUARY

The Indian Roads Congress records with deep regret the death of Shri Nihon Doro Kodan, of the Japan Highway Public Corporation on the 14th March, 1962.

LIST OF PUBLICATIONS ADDED TO THE ROADS WING LIBRARY DURING OCTOBER AND NOVEMBER, 1961.

1. **Annual Conference on Community Department and Conference of States, Ministry of Community Department and Panchayat Raj at Hyderabad. Main Recommendation proceeding and agenda notes.**
2. **Statistical Year Book, 1960 U.N.O.** Publication.
3. **Der Bauingenieur Vol. 26, 1951; Vol. 28, 1953; Vol. 31, 1956; Vol. 32, 1957. Springer-Verlage Berlin /Guttingen/Heidelberg.** (Bound Vols).
4. **Annual Report, Council of Scientific and Industrial Research 1960-61.**
5. **Staff Car Rules 2nd Edition,** Government of India.
6. **Strassenbau Von A-Z IV/1961: 39 Nachlieferung.**
7. **Bulletin of Indian National Society of soil mechanics and foundation Engineering, August, 1961.**
8. **California Highway and Public Works, Vol. 30, 1951; Vol. 32, 1953; Vol. 36, 1957; Vol. 37, 1958.** (Bound Journal).
9. **Concrete Vol. 55, 1947; Vol. 56, 1948; Vol. 59, 1951; Vol. 61, 1953; Vol. 64, 1956. Concrete Publishing Corporation, Chicago 6—Illinois.** (Bound Journal).
10. **Contractors Record and Public Works Engineer, Vol. 4, 1952.** (Bound Journal).
11. **Civil Engineering, Vol. 11, 1941.** (Bound Journal).
12. **Civil Engineering Vol. 18, 1948. Vol. 19, 1949; Vol. 21, 1951; Vol. 25, 1955; Vol. 26, 1956; Vol. 23, 1953; Vol. 28, 1958.** (Feb. and June missing) **American Society of Civil Engineers.** (Bound Journal).
13. **Beton Und Stahlbetonbau, Vol. 45; 1950; Vol. 47, 1952; Vol. 48, 1953; Vol. 49, 1954; Vol. 52, 1957: Vol. 54, 1959.** (Bound Journal).
14. **Final report of the Highway cost allocation study, letter from the Secretary of Commerce, U.S.A.**
15. **Federal Pay—As-you-Go Highway Programme, U.S.A.**
16. **Report of the Commissioner for Scheduled Castes and Scheduled Tribes for the year 1959-60. Part I & Part II.** Manager of publications Government of India Press.
17. **Structural Engineer data book by Krieswell and King.**
18. **Colombo Plan story, ten years of Programme 1951-1961. Published by Colombo Plan Bureau, Colombo.**
19. **Adequate Rural Housing in India.** Published by Arch-En-Sars. India Architectures, 1/24, Kancon House' Asaf Ali Road, New Delhi.

    Technical Bulletin Oregon State Highway Department
20. **No. 11 Economic Analysis of short span suspension bridges for modern Highway Loadings.**
21. **No. 13 Rational Design methods for short span loadings suspension bridges for modern Highway.**
22. **No. 14 Derivation of designs constant suspension bridges analysis.**
23. **No. 15. Experimental verification of theory for suspension bridge analysis.**
24. **No. 18, Multiple span suspension bridges development and experimental verification of theory.**
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26. **1960 Economic Survey of Europe.** United Nations Publication.
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34. IS: 1191—1959: Glossary of Terms used in measurement of flow of water in open channels.

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36. IS: 1762—1961: Code for designation of steel.

37. IS: 398—1961: Specifications for hard drawn standard aluminium and steel code aluminium conductors for over-head power transmissions.

38. IS: 1646—1961: Code of practice for fire safety of buildings (General electrical installation).

39. IS: 1642—1960: Code of practice for fire safety.

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46. Evolution of Rigid Pavements performance with special reference to Air Ports by Iyengar.

47. Steel in India, economic and technological possibilities: by Dastur.

48. Road Research over-seas bulletin No. 13. An experimental stabilised soil road Mekuyu, Kenya.

49. Road Research over-seas bulletin No. 12. Road making gravels and soils in Central Africa.

50. Road Research Paper No. 45. Investigation for evaluating an airfield pavement.

51. Road Research Paper No. 46. Some preliminary trials for the improvement of wood tar for use in low cost road construction.

52. Road Research Paper No. 47. Study of parking problems Connaught Place and Connaught Circus area, New Delhi.

53. Road Research monograph No. 4. On lime stabilization with particular reference to the effect of lime on the physics and chemistry of soils.

54. Road Research Paper No. 48. Study of soft aggregates from different parts of India with the view point to their use in road construction, Part 3, Bombay.

55. Central Road Research Institute of India Annual Report 1960—61.

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BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF BIHAR—BUDGET FOR THE YEAR 1961-62

(A brief review with reference to Civil Works)

THE total revenue receipt of Bihar for the year 1961-62 is estimated at Rs 8446.81 lakhs and revenue expenditure at Rs 7907.73 lakhs with a consequent surplus of Rs 539.08 lakhs. The revised estimate for the year 1960-61 indicate a surplus of Rs 796.79 lakhs with a revenue amounting to Rs 8389.07 lakhs and expenditure to Rs 7592.28 lakhs. In the year 1959-60 (actuals) revenue amounted to Rs 6860,92 lakhs and expenditure met from revenue to Rs 6912.30 lakhs leading to a deficit of Rs 51.38 lakhs.

Revenue expenditure on Civil Works is estimated to be Rs 305.33 lakhs for 1961-62 while the revised estimate for the year 1960-61 and actuals for the year 1959-60 amounts to Rs 361.90 lakhs and Rs 290.36 lakhs respectively.

Expenditure on Civil Works outside the revenue account in 1961-62 is estimated at Rs 665.23 lakhs which includes expenditure on State Highways (roads and bridges) of Rs 254.37 lakhs under Five Year Plan.

Accepted Tenders

State	Name of work	Name of accepted tenderer	Tendered P.A.C. Rs	Remarks
Kerala	Semigrouting Kothamangalam-Thrikkariyoor Road.	Sri K. Kuriakose, Govt. Contractor, Vattakattupady, Perumbavoor P.O., Kerala State.	44,789	
Do.	Semigrouting Koothattukulam Market Road.	Sri K. V. Joseph, P.W.D. Contractor, Kunnummel—Edayar Thirumarady P.O. Kerala State.	35,941	
Do.	Communications - Reconstructing the bridge at 1/7 of Pazhambalakode Road—Talappilly Taluk.	Sri V. K. Varkey, P.W.D. Contractor, Chelakkara, Kerala State.	22,134	
Do.	Improvements to the road from 127th Mile, M. C. Road to Muvattupuzha Piravom Road Via Marady Church.	Sri K. M. Varghese Contractor, Mekkadampu, (Kerala State)	30,580	
Madhya Pradesh	Construction of a Bridge across the Son River near Dia-piper in mile 90 of the Rewa Shahdol Road.	S/Shri Jai Bharat Builders, 50 Malaviya Nagar, Bhopal.	6,05,000	

PERSONAL AND MISCELLANEOUS

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Shri M. DeMello assumed charge as Chief Engineer, National Highway Project, Orissa, with effect from 24-3-62 forenoon.

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Shri D. P. Malhotra, Executive Engineer, has taken over as Superintending Engineer, South Circle (R & B), P. W. D., Kashmir, from 30th June, 1961.

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The latest addresses of Sir Kenneth Mitchell and Shri G. M. McKelvie are given below for the information of the readers:

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44. A Policy on Roadside Advertisement			...	Rs	2	00	
45. Standard Specifications & Code of Practice for Road Bridges, Section I—General Features of Design (1960)			...	Rs	1	50	
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47. Bridging India's Rivers			...	Rs	7	00	
48. Paper No. 167—Design of Small Bridges and Culverts by Goverdhan Lal			...	Rs	2	00	

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