Transport-Communications

MONTHLY REVIEW

No. 63 July 1952

In this issue

Annual Subscription: Rs Fourteen Including Postage. PRICE RUPEE ONE
For Members of the I.R.C. and Subordinate Engineering Staff: Rs Eight.
Copies can be had from the Secretary, Indian Roads Congress, Jamnagar House, Shahjahan Road, New Delhi-2.

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

CORRIGENDUM

REVIEW FOR JUNE 1952.

line 4 on page 8

For "30 feet"

Read "13 feet".

COMPLEMENTARY USE OF RAIL AND ROAD FOR FREIGHT TRAFFIC

(Abstract of a Paper read to the Metropolitan Section of the Institute of Transport. Extracted from "The Indian & Eastern Engineer"—March 1952.)

RAILWAYMEN have been aware of the usefulness of road transport for a long time. The former North Eastern Railway (U. K.), for example, obtained road transport powers so far back as 1871, and in 1905 these were strengthened to enable the company to employ mechanical vehicles. The British Railways Act of 1921 confirmed those and other powers subsequently obtained by the railways generally for the collection and delivery of rail-borne traffic, while the Acts of 1928 enabled all four railway companies to carry traffic throughout by road.

The North Eastern Railway introduced some steam wagons for a country cartage service in the North Riding of Yorkshire in 1904, expanding it to Co. Durham in 1906. In 1907 the Tyneside motor service for rail transhipments was started and this was probably the first time that a railway company carried traffic by road for part of its journey apart from ordinary collection and delivery. By 1921, 64 motors were employed for complementary road service and the old company's successor, the L. N. E. R., set about the provision of widespread country services in North-East England.

The whole of the area, except sparsely populated moorland regions, had regular collection and delivery facilities based upon road service links between railheads and wayside stations. There was throughout road service for racehorses and other livestock traffic and for imported timber traffic which could not be satisfactorily carried by a mixture of rail and road service. Many motors were employed to carry traffic on part of the journey by road, thus reducing rail transhipment.

This achievement was paralleled in other parts of the country. The railways had thus set about the creation and development of a complementary use of rail and road transport which began before road competition was any more than a cloud on the horizon. The subsequent pressure of road competition forced the pace and direct cartage by the railways, expanded through the years, was supplemented by association with owned or partly owned road transport undertakings. A few rail trunk haul schemes were started and the associated cartage companies were encouraged to make a bid for traffic which rail service did not attract. They were also employed by the railways for specific work, such as heavy haulage, radial distribution and the packing and unpacking of furniture removals.

THE COLLECTION AND DELIVERY SERVICE

The British Transport Commission has inherited the most comprehensive collection and delivery service in the world. This was made clear during the course of the International Railway Congress in Rome in 1950. We are far ahead of any other country in this way. The bulk of railway cartage work consists of the ordinary service of collection and delivery within two or three miles of the station. This, in itself, is an important form of complementary service, but interest is being focussed upon the use of road service for what was at one time regarded as part of the job of the railway and of rail service for what has in recent years come to be looked upon by some as proper traffic for the road.

What is now called zonal collection and delivery was conceived on a country-wide scale soon after the war ended and its development is now nearing completion. An essential part of it, as of its pre-war forms, is the movement by road in place of rail of very large quantities of "smalls" between local stations and railheads forwarding the traffic and between receiving railheads and local stations from which delivery is made. This part of the service is already occupying many vehicles full time and many more part-time.

Road Traffic by Container

Concurrently, the Commission has inherited a large road business in parcels traffic or in "smalls"—the two things not being quite the same—and the road arm of the Commission has started to rationalise this work. Thus two arms of the Commission are both providing increasingly comprehensive services for the same classes of traffic in this as in other ways, but rail is extending the use of road for the feeder and distributor service and road has begun to revive and extend the employment of rail for the trunk haul. The container services successfully operating between London and Manchester and between London and Glasgow are well known. Many other arrangements of this kind are in prospect.

It sometimes works the other way. Cross-country service is notoriously difficult on the railway and trunking by road is often a better method. Rail is using road for its "smalls" traffic, for example, from Chelmsford to Manchester, at least a day being saved in the overall transit. Many other schemes are being developed, all of them designed to produce both economy and a better service.

Is it Utopian to suggest that no consignment should even be transferred from one railway wagon to another? Could not every consignment be railed in such a way as to need the use of one wagon only? This would mean more concentration at the forwarding end and longer range delivery at the other. Is there scope for more of this than we have so far attempted? Is that how zonal collection and delivery should develop, especially if it embraces what is now separate rail and road traffic? Ought there to be a maximum concentration in forwarding zones with all the concentrating done by road, usually in three distinct operations; initial collection, sorting and then a road journey in bulk to the zone centre? Such concentration ought to increase the opportunities for through wagon loading on fast trains connecting the principal traffic centres.

We may not have enough zone centre sheds capable of loading heavy concentrations of forwarded traffic on a country-wide scale. We may, therefore, have to decide which of these zone centres should become the principal concentration points and apply the limited available capital, labour and materials to enlarging and equipping them.

Need we think of concentrating only such of the day's collections as can be carted to the zone centre in time for despatch the same evening? On the contrary would it pay to go on concentrating through the night and the following morning? The loss of a day at the forwarding end might be more than saved on the way, and the overall cost of movement might be reduce by cheaper handling at modern sheds, coupled with the avoidance of rail transhipment. Road concentration and distribution is, of course, expensive, but is not to-day's duplication of throughout rail and road service far more costly?

Then there is the railborne traffic in "smalls" which is carried for such short distances as to incur terminal costs which are out of all proportion to the receipts. It is only necessary to see an analysis of the "smalls" traffic which passes through some of the main railway termini on short throughout journeys, and to reflect upon the cost of handling and carting this traffic, to appreciate what uneconomical use is probably being made of the railway for it.

Wagon Load Traffic

The foregoing deals with less-than-wagon-load traffic. What of full wagon loads? Those who would drastically reduce the use of the railway do at least concede that coal and other heavy traffics generally are best carried by rail, and speaking broadly, there is not much obvious scope for complementary rail and

road service for these classes of traffic. General merchandise is another matter.

The railways in Great Britain have never attempted any rail-road service for full wagon loads except in particular cases of branch-line closure or in carrying certain streams of perishable vegetable traffic.

In 1946 the L.N.E.R. set about improving its service for perishable traffic from Lincolnshire to North East England. It could not give a next-morning delivery at all the leading markets from each of the forwarding stations if the traffic were railed throughout, but they could and did provide a fast service which picked up at a few concentration points and dropped off wagons at selected stations in the North East. The concentration points were fed by the growers and the traffic was taken by road between destination and railheads and the market towns. The Commission's rail and road arms have co-operated in continuing this service in an amended form since nationalisation. A similar service for new potatoes from Pembrokeshire to the Midlands and Lancashire has operated during the 1950 and 1951 seasons, complementary road service being provided at both ends of the trunk haul. Other services of this kind are in prospect for 1952.

Coming to the wider problem, pictures are painted from time to time of a streamlined railway system with about 100 or so central goods stations covering the whole of the country and a network of feeder and distributor road services. These central goods stations would be served by a small number of mechanised marshalling yards, fast trains running from yard to yard and a speedy pilot service between each central goods station and its nearest yard. All very nice and simple. If freight traffic consisted entirely of general merchandise which had to be collected and delivered, such a simple scheme of things might be made to work, given the accommodation, but what of coal and mineral traffic, which looms so large in the total picture? Could this traffic be segregated from the rest and wayside stations kept open for it?

Benefits of Containers

Continental opinion is veering towards a belief that it would be better to concentrate wagon load traffic on a limited number of stations and to close down intermediate stations even on main lines. Transference of traffic between wagon and vehicle is a source of difficulty. If a container which can be craned is being transferred there need be no serious problem. The loose contents of a wagon are obviously a different matter. Some way has to be found to reduce the cost of handling.

The alternatives of carting rail wagons through the streets or carrying road trailers on wagons involve hauling about a considerable weight of wagon frame, bogies and wheels in the process of doing a job which a demountable container or flat ought to be able to do just as well. The carriage of road trailers on rail wagons has its drawbacks for the same kind of reason. The ideal is a maximum general utility of container, rail wagon and cartage unit, each having as unrestricted a use as possible, always subject, of course, to meeting the requirements of the traffic offered in relation to the net revenue to be earned.

Large-scale Experiments Needed

Experiments on a big enough scale may show that rail-cum-road service for full wagon loads with longish road hauls is unsound. We may be driven to a simpler division of function based upon mileage limits which will vary with the class of traffic and other circumstances, but there are no simple short cut answers to this problem. All manner of schemes have to be tried to suit the needs of trade and industry with a willingness to make mistakes in the process of finding out which are the best methods. It is of the greatest importance to record and watch the costs of these methods, since it would be easy to go on duplicating expenditure and even add to it.

What are the things which are delaying progress with the development of complementary transport? It is well known that we have yet to solve the staff problems which arise from changes of method which alter the employment of staff, but it will inescapably become understood that the wasteful arrangements now operating are impeding the evolution of an efficient

(*Continued on page 12*)

HOW THE HIGHWAYS OF NEW YORK STATE ARE ADMINISTERED AND FINANCED

(Extracted from 'Roads & Engineering Construction'—July, 1950).
[From a Paper presented before the Ontario Good Roads Association]

THE financing, building and maintaining of highways and traffic control are subjects of international interest, but I would not be surprised if New York State has more trouble with finances than Ontario has. Probably neither has serious difficulties with the various items of design, engineering, construction and control.

In 1895, there were five automobiles in America; today there are 44 million autos, trucks and buses—about one to every three persons. New York State alone has 3 million automotive vehicles. Ownership is not confined to cities, but the heaviest traffic is in the cities, and in a circle, say 25 miles in diameter, around the cities. Our traffic counts, however, show that cross-country travel is sufficient to warrant the rebuilding and improvement of the inter-state highway system.

Sources of Highway Funds

New York collects 150 million dollars a year from gasoline tax and automotive registration fees, but this money does not go directly for state highways, but rather into the general fund of the treasury of the state from which appropriations for highways are made by the legislature under budgetary control by the governor.

It is my understanding that the gasoline tax money in Ontario goes directly for highways. That is the method in vogue in some of our states, but not in New York.

Out of the total gasoline tax collected, 5 per cent goes to New York City for general purposes and 20 per cent to the up-state counties on a proportionate milage basis. Of the registration fees, 25 per cent goes to the country where collected and 75 per cent to the state treasury. Thus, 75 per cent of the money collected goes to the state treasury—none, however, directly for state highways.

Thirty-four years ago the federal system of highways was set up, and $16,000 a mile became available from the federal government toward the construction of the highways located on this federal system. Recently, federal aid money has been greatly increased.

Our total highway system is made up of three parts, state, county and town. In addition, of course, we have city and village streets, and presently I shall speak of arterial routes in cities, the Thruway and other facilities.

New York Highway Systems

Our State highway system covers the principal traveled road in all sections of rural New York. It consists of approximately 14,000 miles out of a total highway milage in the state of 90,000 miles. The Thruway, although a special highway, is legally a part of the regular system.

Each county has its own system. This consists of the important county roads, the milage varying between 200 miles and 1,200 miles per county.

Most of the remaining rural roads in the state are on the town system.

Town and County Funds

The towns receive some state aid under what we call the Lowman Act, amounting to $37.50 per mile on the basis of the town highway milage in the town. Additional town funds are raised by

direct taxation. Each town has its own highway building, maintenance equipment and snow-removal organization.

Many of the counties appropriate funds for their roads and bridges in addition to the amount received from the gasoline tax and registration fees. Each county has a superintendent of highways, a considerable force of men, and much equipment for construction, maintenance and snow removal.

The villages raise their own funds for streets except for the state or county roads that cross the villages.

The New York State Thruway

The Thruway is something new, construction having been authorized six years ago. It will be comparable to the Queen Elizabeth Way in Ontario. It will run across the state from the Pennsylvania state line, skirting Buffalo, Rochester, Syracuse, Utica and Albany and thence going southward to New York City—a distance of about 475 miles. There will be three regular branches, the largest and most costly of which will run through the city of Buffalo, thence along Buffalo's water-front—across Grand Island to the Rainbow Bridge for a direct entry to Canada at Niagara Falls. Cities along the route will have connections like the road into Niagara Falls from the Queen Elizabeth Way. The total cost will probably exceed 500 million dollars.

Arterial Routes

Another recent major venture for the state is the arterial-route programme in cities. It was inaugurated five years ago. Now, within certain legal limitations, the state can build streets or highways into and through cities. Previously, our activities were confined to the rural areas. The funds available for work in cities are such that this will be one of our largest activities for many years to come.

The state urban policy is that the development in each city should be on an orderly and long range planning and design basis and that each constructed project should materially improve traffic conditions. Simply to rebuild or rehabilitate wornout city streets or pavement is not a part of the programme. Such work is considered a city task.

Before any work is done in a city, a comprehensive study is made and a report is issued based on origin and destination surveys, time flows, traffic counts, land use, population densities, industrial developments, and expected comparable factors during the next fifteen years. The needs for each city as developed from these data are published, and after local approval, the projects are undertaken on a priority basis within each city.

One-half of the cost of these arterial roads in cities is being paid for by the federal government and one-half by the state, except that the cities pay one-half of the right-of-way costs. When completed, the new facilities will be maintained by the state.

Grade Crossings and Parkways

Grade-crossing elimination projects in New York State have been financed by bond issues.

The parkway system is extensive and is under the jurisdiction of the Conservation Department, with the Department of Public Works acting as engineers.

Federal Aid

During the last of the war years, under the expectation that many people might be out of work, the federal government appropriated approximately 500 million dollars for each of three years, and then 450 million dollars for each of the next two years — a total of nearly $3 billion for five years for highway work.

The appropriations were split into three sections:

1. Primary rural roads.
2. Secondary rural roads.
3. Arterial routes in cities.

Of these funds New York's share was 10 million dollars for primary, 4 million dollars for secondary and 18 million dollars for urban areas. The sum in round figures is between 30 and 33 million dollars for each year. To obtain this money, New York is required to match it equally, that is, on a 50-50 basis. Some of the western states are having trouble meeting their share of the federal funds, and hence have not received them fully.

There is set up at Washington within the Department of Commerce, a Bureau of Public Roads. This Bureau receives the funds and supervises the allocation pursuant to the formulae stated in the law. The Bureau has a fair-sized administrative force in Washington and sub-offices throughout the states.

The highway departments in the states prepare the plans for federal-aid highways and present them to the Bureau for criticism or approval. The states award the contracts and supervise the construction work. The Bureau has district field inspectors who visit the federal jobs from time to time, say, once a month. In that way the Bureau is assured that the contract work performed meets the plans and specifications that their engineers have previously approved.

Suburbs

I am not familiar with the suburban situation in Ontario, but I have heard enough about it to know that it is different from ours. Buffalo, for example, is surrounded by the city of Lackawanna, four townships and the village of Kenmore, all quite built up at the city limits. Take the village of Kenmore as an illustration. State and county highways crossing the village serve as village streets and the municipality, in addition, has its own streets which are paved, curbed and sewered. The state builds and maintains the state highways and the county does the same for the country highways. The village builds and maintains all streets within its corporate limits, except the state and county roads.

Increased Costs

Before the war a substantial two-lane highway could be built for $50,000 per mile, but the present cost of a two-lane pavement of a modern design is $125,000 to $150,000 per mile. A million dollars is eaten up by seven miles of new highway.

At the end of the war there was great need for rebuilding and rehabilitating the system. Fortunately, Governor Dewey had laid aside a large nest egg of which about 200 million dollars was made available for highways, the remainder going for public buildings, schools, hospitals and other state operations.

Our designs were ready and New York advanced a large construction programme on a state-wide basis which now has exhausted the post-war fund. Hereafter, direct appropriation or the raising of funds through the sale of bonds will be required. The Governor, the legislature and our state officials have this subject prominently before them at present, with no answer in sight at the moment.

During the past year the Department of Public Works of New York has been making a complete, detailed factual survey of the entire highway system of the state to ascertain the shortcomings, deficiencies and funds annually needed over a term of years for rehabilitation purposes. The method of making this survey is based on the Moskowitz method used on a similar survey in Arizona and on the lane capacity manual by Norman.

The resulting data have just been published in an elaborate report and it shows that New York needs in excess of 140 million dollars annually in addition to federal aid or other contributions for each of the years up to 1963 to rehabilitate the system and complete the New York Thruway and the arterial route system in cities.

Maintenance Organization

The state maintains a complete highway repair organization divided into districts, and the annual appropriation for this work is about 25 million dollars per year.

Finances are not available to rebuild all the streets and highways which are deficient for one reason or another. Hence we must pay attention to improving what we have wherever this is possible. This type of work encompasses resurfacing and widening the old pavements, building new shoulders, extending culverts and bridges. It can be performed for about a quarter of the cost of a new pavement on new grade and perhaps new alignment. Sometimes five miles of resurfacing can be done for the cost of one mile of new work. The final results are not the same, of course, but it affords a practical method of keeping the system in working order and is pleasing to the public. Usually this work is done by contract, and when located on federal routes, the federal government participates.

Good Roads Association

As engineers we can erect control devices for better traffic regulation and control; we can design highways for safety and compute the costs to raise the system to correct standards, but that is about as far as we can go. From there on, it is the problem of someone else.

"Engineering News-Record" recently stated: "Too many people are inclined to think of roads and streets as conveniences that happen. It must be dispelled if any adequate road system is to be a reality." The editorial goes on to say that associations are needed to arouse the local people as to the need for more adequate financial structures.

The executive secretary of the Iowa Good Roads Association recently made the statement that good roads organizations are needed today more than ever before, in order that the public may be more fully awake to the needs of the present and to mobilize the people for intelligent and constructive action.

Ontario has been ahead of us with its good roads association. It began in 1894 which was prior to New York's first highway bond issue. Our good roads association was started about a year ago and is headed by Charles H. Sells, an outstanding administrator, who was formerly state superintendent of public works.

Similar associations are set up in about one-third of our states. At the last convention of the American Association of State Highway Officials special prominence was given to the subject of good roads associations, particularly because of the work to be done to obtain funds, local, county, state and federal, to counteract the retrogression of our highway system, and the delegetes voted to encourage the establishment of associations in every state.

—o—

BUMBLEDOM

THERE was an amusing account in the Scarborough Evening News recently of officialdom in action on the location of two bus shelters. Nearly a year ago the inhabitants of Marishes, a village off the main Malton-Pickering road, decided to erect at their own expense two shelters, one on either side of the main road to which they have to walk to catch the buses.

When the villagers applied for planning permission "the fun began," and a few weeks ago no fewer than 16 representatives of official bodies met at the spot to decide the exact location of the shelters. Although the villagers have for years past got on and off the buses at the junction itself, authority decided that the shelters and stops must be away from it, and apparently there was a lot of argument about the exact distance before any decision at all was reached.

As the Scarborough paper concludes: "When officialdom can wrangle over two country bus shelters for the better part of a year can any one doubt that this is a country fit for bureaucrats to run riot in?"

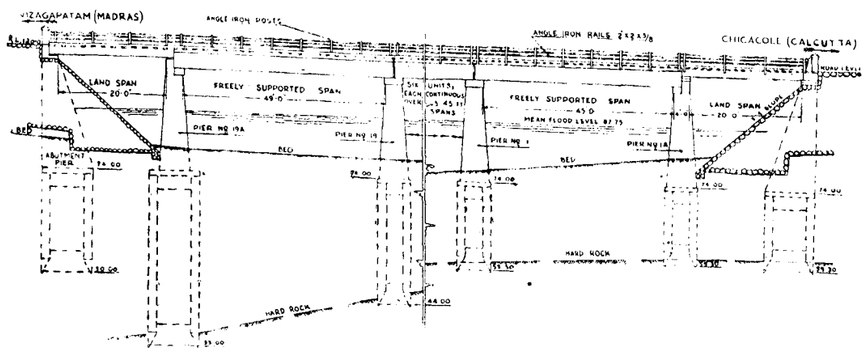
ANYBODY wishing to telephone the Transport Tribunal about an appeal under the Road and Rail Traffic Act must be careful to dial the right number. The slightest mistake in a certain one of the four figures will produce a reply. "Are you a client of ours?" When the mistake becomes apparent, a sweet voice proceeds to say "We are the—marriage bureau." I will give only the Tribunal number—Trafalgar 6782.

[From Motor Transport]

BRIDGING INDIA'S RIVERS

THE CHAMPAVATI BRIDGE

THE river Champavati is one of the the thirteen major rivers that cross National Highway No. 5 linking Madras and Calcutta. At the bridge site its catchment area is about 520 sq. miles and, because of its swift current during the monsoon and the shallows existing in its bed during the dry weather, it has always presented difficulties to ferry traffic.



The necessity for a bridge to span this river was felt as early as 1931 when a screw-pile bridge of the through Pratt-girder type with eleven 60-ft spans was built at a constricted site near Nathavalasa about 508 miles from Madras. Unfortunately, this bridge was washed away the same year due to unprecedented floods which followed breaches in a series of tanks and raised the maximum high flood level for which the bridge had been designed from 87.75 to 102.42.

Eleven years later, i.e., in 1942 another attempt was made to bridge this river at a point about 1,600 ft downstream of the previous site. Twenty spans each of 45-ft reinforced concrete T-beams and slabs were proposed. The construction of the bridge, financed from the Road Development Fund, was undertaken by the Vizagapatam District Board. Owing to a dispute between the contractors and the District Board the work had to be abandoned after the wells for the right-hand side abutment and seven piers had been partially sunk.

It was not till 1951 that work on this bridge was re-started as a part of the first 5-year road-development programme.

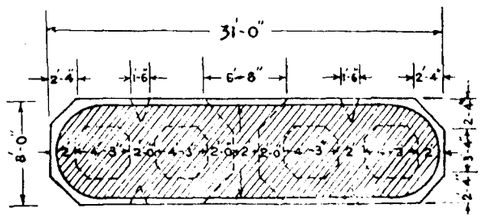
The Site

After thorough investigation it was decided that the new bridge should be built at the site of the unfinished bridge which lies on the approved alignment of National Highway No. 5. Here the river has wider banks and hence a comparatively lower velocity of flow than at the site selected in 1931. Besides, some saving will be effected by making use of part of the work executed during 1942.

The maximum flood level reached during 1931 was due to exceptional circumstances not likely to be repeated. To design a bridge for this maximum flood would entail the construction of very high and expensive approaches resulting in the locking-up capital to insure against a remote risk. The ventway of the new bridge as now designed will be sufficient to pass a flood discharge corresponding to a maximum flood level of 87.75, the maximum recorded before and since 1931, but a free-board of 9.5 ft has been allowed as a margin instead of the usual 3 feet and the approaches have been designed to be safe against overtopping by floods.

Foundations

Nature of the soil at the bridge site is sandy, but hard rock is met with at depths varying from 18 to 33 ft below the bed with an intermediate layer of clay. Well foundations for all the piers and the abutment pier on the Chicacole side have been taken at least 2 ft into the hard rock. Where this was not possible, 1-in. diameter anchor rods were embedded at least 3 ft 6 in. deep into the hard rock below the bottom plug. The abutment pier on the Vizagapatam side has its wells resting on hard clay.



PLAN OF FOUNDATION-WELL UNDER PIER.

between the wells, whereas each pier has two twin octagonal wells each 14 ft 6 in. × 8 ft (outer dimensions).

The wells have cement concrete (1 : 3 : 6) steinings 2 ft thick with bond rods and flat ties, and R. C. C. (1 : 2 : 4) curbs 3 ft deep and 2 ft thick at the top with cutting edges of mild steel T-sections 6 in. × 4 in. × 2 in. The inside of the wells were plugged with 5 ft cement concrete (1 : 2 : 4) at the bottom and with 3 ft cement concrete (1 : 4 : 8) at the top, the space in between being filled with clean river sand. The wells and the abutment piers have a continuous cap 1 ft 6 in. thick reinforced at top and bottom.

Substructure

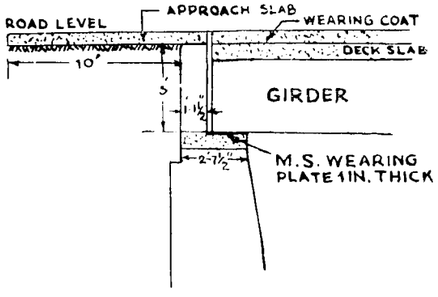
At first it was proposed to have piers and abutments of coursed rubble masonry in cement mortar. Calculation should, however, that to keep the tensile stress in the masonry and all the forces indu-

Beginning the day.

ced by traffic and temperature within the permissible limits the section would have to be very massive, necessitating widening of the wells that had been partly sunk in 1942. It was finally decided, therefore, to use mass cement concrete 1 : 3 : 6 for the abutments and piers.

A reinforced cement concrete (1 : 2 : 4) approach slab will be provided to disperse the live load over the fill behind each abutment.

Piers under construction



Superstructure

The superstructure consists of reinforced concrete T-beams and deck slab. The bridge, designed for two lanes of "I. R. C. Class A" loading or one lane of "I. R. C. Class AA" loading, has six units, each continuous over 3 spans and two simply supported units, one at each end. In addition, there are two land-spans. Holes will be left in the deck slab to allow the entrapped air to escape, should the bridge be submerged at any time in the future.

Bearings

Three of the supports of each continuous 3-span unit will have sliding plate bearings while the fourth support will be fixed. The simply supported spans will have sliding bearings at one end and fixed bearings at the other.

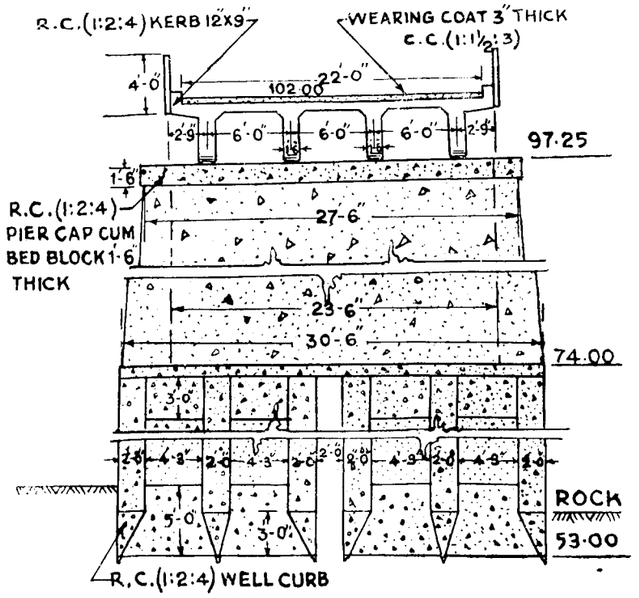
Approaches

On the Vizagapatam side the length of the approach is 348 ft whereas on the Chicacole side the length is 368 feet. The width of formation of the approaches will be 32 ft with side slopes of 1½ to 1.

To guard against breaches if the approaches are submerged during high floods their slopes and berms will be protected with 9 in. stone pitching laid over 3 in. shingle wherever the height of submergence is likely to be more than 3 feet. The approaches will be level for a distance of at least 50 ft on either side of the bridge.

Salient Features

Spans, 19 of 45 ft, one span of 49 ft, and two land spans of 20 ft: lineal waterway, 944 ft: length of the bridge from abutment-pier to abutment-pier, 1033½ ft:



CROSS SECTION

thickness of the reinforced cement concrete (1 : 2 : 4) deck slab, 7½ in; reinforced cement concrete T-beams, 1 ft 6 in., × 4 ft 6 in.; piers, 4 ft wide at the top and 7 ft wide at the bottom: abutment-pier, 4 ft wide at the top and 12 ft wide at the bottom.

Width of carriageway, 22 ft between kerbs: R. C. C. (1 : 2 : 4) kerbs, 12 in. ×

A view showing the bridge under construction.

9 in.; wearing surface, 3 in. thick cement concrete slab (1 : 1½ : 3).

The bridge has been designed for a discharge of 68,800 cusecs flowing with a velocity of 8½ ft per second. The anticipated afflux is 8 inches.

Cost

The bridge, work on which is still in progress, is estimated to cost Rs 13.2 lakhs. Per running foot the bridge is estimated to cost Rs 1,277/-, excluding the cost of the approaches.

—o—

(Continued from page 3)

service at a price which will command public support to mutual advantage of all concerned. Nevertheless, to convince people of this, we shall have to go to a lot of trouble to explain what has to be done and why.

There are also the severe physical limitation imposed by the inadequate size and equipment of many of the railway goods stations which might otherwise be called upon to deal with far more traffic than they handle today. Many of our larger goods stations need more up-to-date equipment, but heavy capital outlay is required, and neither the money nor the material is likely to be available for more than a few of them for a long time.

—o—

Definition of a Politician

One who is always thinking of the next elections for selfish reasons.

[From "Road to Happiness" by Mr. C. Wicksteed Armstrong.]

—o—

EDUCATION OF THE HIGHWAY ENGINEER.

(Extracted from the "Highways & Bridges & Engineering Works-April 23, 1952")

THE usual college course leading to a degree in engineering until comparatively recent times occupied three years. Now at many colleges, it has been extended to four years.

At the end of his four-year college career a graduate will now be well equipped with the general basic knowledge essential for a civil engineer, but a further post-graduate year is needed if a student wishes to acquire a sound working knowledge of highway engineering, or, indeed, of any other specialised branch of the civil engineering profession. It may be added that the institutions which provide post-graduate courses in highway engineering can be counted on the fingers of one hand.

Modern Tendencies

A difficulty confronts the authorities who are called upon to formulate the curriculum for engineering courses. Even if four years are allotted, there is so much to be learnt that courses tend to become overcrowded and it is a question of what shall be included and what left out.

The problem then arises: shall the course be so designed that graduates have all the detailed practical knowledge required by a resident engineer or agent on a large job, or shall the theoretical side be emphasised rather than the practical so that a graduate is more fitted to become a brilliant designer, able to tackle difficult problems on scientific and mathematical lines?

At most universities the latter idea is favoured. Most people in the academic world consider that the function of a university school of engineering is to teach basic principles, to train students to think and to develop their critical faculties, and to encourage research which will ensure that engineering knowledge is kept ahead of established traditional practice.

In some of the engineering courses at colleges of university rank the one subject which likely to be of immediate practical use to an ex-student during the early part of his career on an outside job is surveying. This subject is frequently dealt with during the second year of the Course, but the technique of surveying fieldwork, including the use of the theodolite and level, once learnt, is not readily forgotten.

The college man, at first, may be rather ignorant of certain details of practical work, but his mental training should make it easy for him to pick up the necessary knowledge reasonably quickly. Lack of familiarity with work-a-day practical matters can be remedied, to some extent, by vacation work on suitable contracts. At many engineering colleges it is more or less compulsory for students to spend 8 weeks of the summer vacation on approved jobs.

Theory and Practice

Anyone who has looked over the examination papers which craftsmen in the building industry are expected to tackle for such diplomas as the National Certificate, or those granted by the City and Guilds of London Institute cannot fail to have been impressed by the high standard required.

Some of the questions dealing with brickwork, concrete and carpentry and joinery have a direct bearing on civil engineering. A candidate may be asked, for example, to produce dimensional drawings for the timber centre for a sizeable arch, or for a tricky bit of shuttering in a reinforced concrete job, or, to show in detail the bonding in an awkward piece of brickwork.

It is an ironical fact that the average university student in his final year, though fully competent at solving differential equations of considerable difficulty, would probably fail to satisfy the examiners in these practical subjects. They do not

figure in the syllabus for an engineering degree and if dealt with at all in the college curriculum, are treated very sketchily. Yet a young engineer, sent out on a job, should be able to judge whether the craftsmanship in bricklaying, or in the erection of shuttering, is satisfactory. The wise young man will endeavour to acquire the necessary knowledge as quickly as possible from the right kind of text-book and a great deal of useful practical information can be obtained from a competent clerk-of-works, but the apprach must be tactful and enquiries made in a judicious manner.

The graduate-engineer should score in one important respect: his wider outlook, and his freedom from the trammels of traditional practice, should enable him to tackle practical jobs in new ways. In thought, he should be a leader, not a follower. The engineering laboratories in all progressive colleges are busily engaged in applying new ideas to old problems and students are bound to benefit from the new facts which come to light.

The Requirements of the Highway Engineer

The normal college course for an engineering degree ensures that a successful student who wishes to take up highway work will find no difficulty in designing any type of bridge or culvert he is likely to encounter in the service of a highway authority. The theory of structures is usually regarded as a subject of prime importance and is supplemented by laboratory work and drawing-office practice thus enabling an excellent grasp of the subject to be obtained.

Surveying is almost invariably given adequate attention and the application of surveying to the preparation of plans and sections for some such project as a short length of road or railway usually figures as part of the fieldwork course. Earthwork quantities and curve ranging, including transition and vertical curves and superelevation follow on as appendages to the usual run of surveying lectures, just as they do in up-to-date surveying textbooks.

It is highly probable, however, that highway materials will receive very scanty notice. Civil engineers usually attend lectures on geology. This will normally be a general course extending over one session of three terms only and although road aggregates will naturally be considered, there are many other things to be included and there is no time for detailed study of road stones.

Concrete, being a universal constructional material, will doubtless be discussed in the appropriate structural lectures, but its particular application to roads may be omitted. It may even happen that road tars, bitumen, asphalt, slag and other specialised road materials will never be mentioned. Similarly, in soil mechanics, the course of instruction is likely to be general with no time for more than a passing reference to stabilisation, now-a-days a subject of great interest and importance to the road engineer.

Neither is there room in a general four year course for the detailed study of junction design, roundabouts, traffic capacity, signal installations and other highly specialised features of modern road design.

At one or two colleges these deficiencies are made good in post-graduate courses specially designed for highway engineers, but it is an extraordinary fact that highway engineering, as such, is completely neglected at the majority of colleges of university rank.

Another subject which is becoming of greater importance every day is plant organisation. The general principles involved in the successful and economic use of plant might well be studied in a college course, with particular reference, perhaps, to the application of time-and-motion investigations. But the only possible way to become familiar with the working and maintenance of plant is on the job and in the repair shop. For this reason it is strongly recommended that a civil engineering student should spend at least one eight-week vacation period in the plant maintenance depot of a big contractor, or in the service department of a plant manufacturer.

—o—

SPECIAL ARTICLE No. 7

HORIZONTAL AND TRANSITION CURVES FOR HIGHWAYS*

IN highway alignments changes in direction are often necessitated by restrictions imposed by topography, property, preservation of amenities, and by avoidance of monuments and religious rights-of-way.

Before the introduction of the internal combustion engine on our roads in the early twenties, the problem of suitable treatment of curves was not a serious one as the speed of the vehicles using the road was very limited. The advent of fast-moving traffic has focussed the attention in recent years of all concerned on the proper design and construction of curves for roads. Consequently, scientific principles are being applied now with a view to provide safe, comfortable, and accident-free driving at high speeds.

In the early phases of road development in all countries, greater emphasis used to be laid on the structural design of roads rather than on the "geometric" layout, i.e., location of the road, alignment, curves, superelevation, transition curves, intersection, sight distances—both vertical and horizontal, and the width of right-of-way. With the increase in the number and speed of motor vehicles, emphasis has shifted to the geometric layout. Improvement in road structure can be effected from time to time to suit the needs of traffic as they arise, but the relocation of an alignment to meet the requirements of safety and comfort at high speeds is often difficult and costly and may be economically impossible without building an entirely new road. Also, the initial layout to suit standards for higher speeds does not involve any appreciable extra cost. Experience has shown that much money can be saved if the geometric layout is properly planned in the beginning.

Principles of Curve Design

When a body W lb in weight travels at v ft per second along a curve of Radius R ft, it is subjected to an outward force called the Centrifugal Force, P, which is given in magnitude by the equation:

$$P = \frac{Wv^2}{gR} = \frac{W V^2}{15R} \qquad \ldots\ldots(1)$$

where V is the speed in MPH.

g is the acceleration due to gravity in ft per second per second.

The centrifugal force is counteracted by the friction between the tyres of the vehicle and the road surface. When the amount of the centrifugal force is greater than that which can be resisted by friction, skidding takes place. Also, the centrifugal force induces differential pressure on the wheels of the vehicle thus causing greater wear and tear of tyres. In order to minimise the effects of wear and tear and the tendency to skid, the outer edge of the road is raised This inward tilt or the transverse inclination given to the cross-section of the road is called **SUPERELEVATION**.

For equilibrium the centrifugal force is assumed to be equal to the effects of superlevation and friction (see Paper No. 119 for proof). Expressed mathematically

* Adapted from I. R. C. Paper No. 119 published in Vol. XI-3 of the Journal of the Indian Roads Congress.

$$\frac{P}{W} = \frac{V^2}{15\,R} = e + f \text{.....(2)}$$

where, e = superelevation

f = friction between the tyre and the road surface.

The design of curves is, therefore, influenced by the:

(1) Design speed.

(2) Safe allowable friction.

(3) Maximum allowable superelevation.

(4) Permissible centrifugal ratio.

Design Speed

The speed of the vehicle governs the amount of superelevation required and the limiting radius of the curve, especially as the function (e+f) varies as the square of the speed. Investigations in the U. S A. indicate that the lowest speed of travel is 0.5 and the highest 1.9 times the average speed with 90 per cent of the vehicles travelling at speeds below the averages. It is, therefore, not possible to provide curves and superelevation, etc., to suit all the vehicles that may travel round a curve. All that can be done is to design roads or sections of roads for speed suited to the importance of the road and the volume of traffic that may be expected to use it.

The design speed of a highway, therefore, is the maximum, approximately uniform, speed that will probably be adopted by the faster group of drivers but not necessarily by a small percentage of the reckless ones. Thus, the design speed is the safe uniform speed that is permissible on a road from considerations of the type and condition of surface, the nature and intensity of traffic, the nature of terrain and of curves, and the available sight-distances. Higher design speeds are possible in flat or rolling country than in hilly areas with steep gradients. In urban areas the speed tends to be lower than in the open country where greater visibility and freedom from traffic interruption and frequent road intersections exist. The speed in urban areas may be taken as 0.7 times the speed in open country.

Taking into account the importance of the road and bearing in mind that the facility should not become obsolete within a reasonable period of years, the Specifications and Standards Committee of the Indian Roads Congress have recommended the design speeds shown in Table I for various categories of roads.

Table 1

Recommended Design Speeds

Classification	Design speed V, in M. P. H.	
	Flat or rolling country	Hilly country
National Highways and State Highways	50	30*
Major District roads	40	25*
Other District roads	30	20
Village roads	20	15

Friction

The value of the coefficient of lateral friction between the tyre and the road surface is a function of the speed, type and condition of the road surface and tyres, and weather conditions. All these conditions vary either individually or collectively. Tests indicate that the coefficient of friction may be as high as 0.92 for new tyres and asphaltic concrete at 30 m.p.h. or as low as 0.2 when the pavement is covered with mud. It may be even lower when the surface is covered with ice or sleet. The Committee considered that for Indian conditions a minimum value of 0.2 should be adopted. With a factor of safety $1\frac{1}{3}$ the value of safe working friction to counteract centrifugal force would be 0.15.

Maximum Allowable Superelevation

In India the practical maximum superelevation per unit of width is governed by the condition that the slope should not be too steep for slow moving vehicles. Taking into account the high centre of gravity of carts transporting bulk produce such as cotton or hay, the Committee have

* Where practicable.

recommended a maximum superelevation of 1 in 15.

Centrifugal Ratio

From Equation (2) it is seen that the centrifugal ratio is equal to the superelevation plus friction. When the latter two are fixed, the maximum allowable Centrifugal Ratio is automatically fixed.

Therefore, when $e = \frac{1}{15} = .067$ and

$f = 0.15$

Maximum allowable

centrifugal ratio $= .067 + 0.15 = 0.217$.

It has been observed that passengers generally feel some discomfort when the Centrifugal Ratio exceeds 0.25. The value (0.217) obtained above is, therefore, well within the limit required for comfort to passengers.

Radius of Curvature

From Equation (2)

$$\frac{V^2}{15\,R} = e + f.$$

Substituting the maximum values of superelevation and **safe** working friction, we get

$$\frac{V^2}{15\,R} = 0.217 \text{.....(3)}$$

$$\therefore \quad R = 0.307\ V^2$$

$$= 0.31\ V^2 \text{.....(4)}$$

Thus, for any speed the minimum permissible radius is fixed by Equation (4).

With the possible improvement in the design of vehicles, design speeds will tend to increase. Since it would be difficult and costly to re-align curves to suit increased speeds, it is desirable to set a ruling minimum greater than that given by equation (4). This is done by assuming a speed 10 m.p.h. and 5 m.p.h. greater than the design speed for plain-rolling country and hilly country respectively. Table 2 of Plate I gives the minimum radii of curvature, **Ruling and Absolute**, recommended for the various design speeds.

There is a common feeling that the adoption of larger radii results in increased cost. While this may be true of restricted locations and mountainous country where the adoption of large radii may result in increased earthwork, in ordinary locations the adoption of a large radius reduces the length of the road. Also, when the radius so adopted is large, superelevation may be unnecessary thus not only reducing the cost but also the wear and tear of vehicles. **Hence, provision of as large a radius as is economically possible should be aimed at.**

There is also a common belief that radii less than the absolute minimum radii should, under no circumstances, be adopted. There may be some tight locations in which it is not possible to do this except at a great cost. In such cases alternatives to avoid the obstruction by providing a large radius should be investigated and if found not possible a curve of radius less than the absolute minimum may be adopted. However, in such cases it may not be possible to attain the designed speed under conditions conducive to low friction.

Superelevation

As mentioned earlier, the centrifugal force is counteracted by friction and superelevation. Different authorities recommend different percentages of the centrifugal force that should be counteracted by superelevation. Fully counteracting centrifugal force by superelevation is objectionable because it results in all but the very flat curves being superelevated to the maximum limit of 0·067. Also, as 90 per cent of the vehicles travel at less than the average speed i. e., the design speed of the road, fully counteracting the centrifugal force developed at three-fourths of the design speed would serve a substantial percentage of vehicle using the road.

Slow moving vehicles would be aided by this method of superelevation without inconvenience to fast moving vehicles. When the numerical value of the centrifugal force per unit of weight of a vehicle moving slowly round a flat curve is less than the value of the superelevation slope, frictional resistance is required to prevent the vehicle sliding down the incline. If the assumed design speed for designing

superelevation is decreased the required friction is reduced or eliminated. This is a desirable feature as most vehicles would travel at speeds less than the assumed design speed. Fast moving vehicles would not be subjected to danger because sharp curves would be superelevated to the practical maximum in any case.

With the superelevation limited to that required for fully counteracting the centrifugal force developed at three-fourths the design speed, we have

$$e = \frac{(0{\cdot}75\ V)^2}{15\ R} = \frac{3\ V^2}{80\ R} \quad \ldots\ldots\ldots (5)$$

and this value is recommended subject to a maximum of 1 in 15. Values of superelevation for various design speeds and radii can be read from Plate I.

Where the radius of curvature is such that superelevation obtained by equation (5) is less than the camber on a straight portion of a road, superelevation may be dispensed with. In such cases the centrifugal-ratio developed would be very small and, even if superelevation is not provided, the frictional resistance, which will be well within the permissible value, will be sufficient to counteract the centrifugal force.

When R is greater than $\frac{3\ V^2}{80\ e}$,

where e is equal to the camber usually given to different kinds of surfaces, superelevation need not to provided.

Limiting radii beyond which no superelevation is essential for different surfaces, cambers and speed are given in Plate I, Table 3.

When no superelevation is necessary and the normal camber is continued on flat curves, the outer-half of the road should have a negative superelevation equal to the camber. Such a negative superelevation should in extreme cases be 1 in 36 or ·03. Frictional resistance can easily take care of this.

(To be Continued)

—o—

THE ARMY HERO

GRANDPA : *"Yep, I put nigh on to 300 men out of action once when I was in the army."*

Sonny : *"I didn't know you were such a hero. You never showed me your medals!"*

Grandpa : *"No medals. It just happened, I was camp cook for a week."*

There is so much good *in the worst of us,*
And so much bad in the best of us,
That it hardly behoves any of us,
To talk about the rest of us.
– Unknown.

TABLE 2

	Flat or Rolling country			Hilly or mountainous country		
	Min. Radius in ft.			Min. Radius in ft.		
Design Speed M.P.H.	Ruling	Absolute		Design Speed M.P.H.	Ruling	Absolute
50	1000	800		30	400	300
40	800	500		25	300	200
30	500	300		20	200	150
20	300	150		15	150	100

STANDARDS FOR MINIMUM RADII IN CURVES
(RULING AND ABSOLUTE)

TABLE 3

Design Speed M.P.H.	Radius in feet beyond which no superelevation is necessary for different types of surfaces				
	Water bound macadam	Block top	CAMBER 1 IN. 60		CEMENT CONCRETE
	36		48		72
15	300		400		600
20	550		700		1000
25	850		1100		1700
30	1200		1600		2450
40	2150		2900		4300
50	3400		4500		6750
60	4850		6500		7900

LIMITING RADII BEYOND WHICH NO SUPERELEVATION IS NECESSARY FOR DIFFERENT SURFACE, CAMBERS & SPEEDS

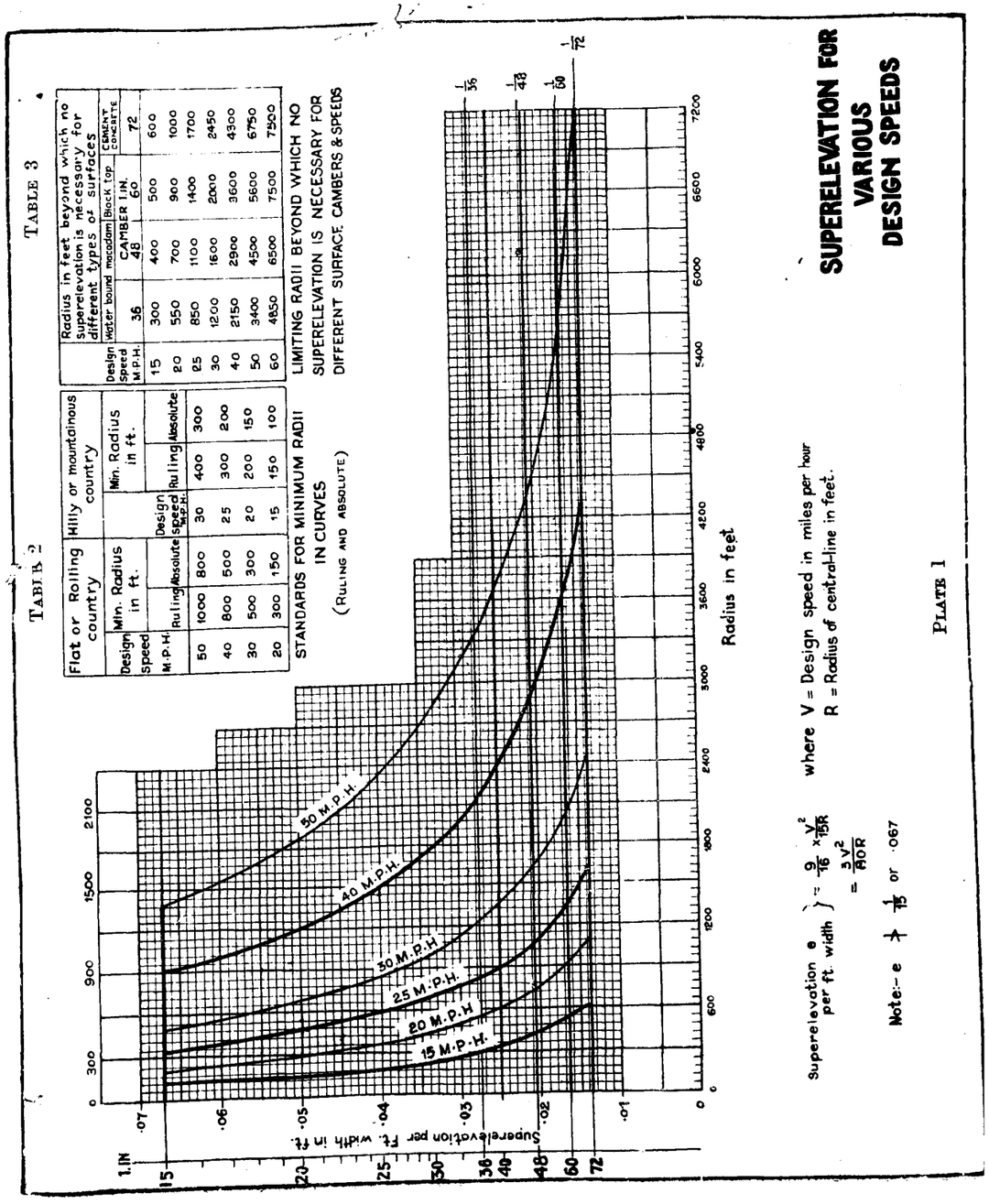


PLATE 1

HERE AND THERE

1. WHERE SELF-HELP IS AT A DISCOUNT

VILLAGERS in Tatanagar, who decided to help Government by helping themselves, have been asked to "show cause why they should not be restrained."

According to the President of the Tatanagar Gram Panchayat Committee, the villagers who received no response to their repeated appeals to Government to repair the dangerously bad roads in the district, decided to do the job themselves.

Assisted by the local factory workers and students the villagers took out their picks and shovels and got to work. They had scarcely got half way before they were asked by the Khasmahal Officer to "show cause why they should not be restrained" P. T. I.

(From the "Times of India," dated 24-5-52)

---

2. MODERN TRAFFIC CONTROL

HELICOPTERS are being used for mail delivery and sea and mountain rescue. Generals have inspected the front lines from them in manoeuvres and in war. Helicopters have picked up urgent hospital cases from remote places and dropped food over disaster areas.

Now, they are also to help regulating traffic in the Paris region. Not yet over the Place de la Concorde, that hopelessly confused turmoil of automobiles on one of the world's largest and most crowded open squares, over which even the best helicopter traffic policeman would probably not know what rule to apply: but at the outskirts of the city, where jams and accidents always occur in great numbers when big sports events attract tens of thousands of cars to stadiums and race courses. The helicopters will be equipped with red and green lights and two-way wireless, and their policeman-pilots will retain the traditional long, white gloves which serve them as beacons. There is only one drawback to the project: Parisians, being what they are, once the traffic helicopter hovers a few feet over them will probably stop and stare and shout jokes at the policeman overhead, and the jams will be more numerous than ever—although certainly more amusing.

A German has worked out another ultra-modern device for the use of traffic control: the "electronic rays"—to help reduce the many automobile accidents occurring on the country's 20,000 unprotected railway crossings. He proposes a law requiring all locomotives to be equipped with electronic transmitters and all automobiles with receivers tuned to the same wavelength. At a certain distance from each railway crossing the locomotive's transmitter would automatically light up red danger signals on the instrument boards of all motor-cars in the vicinity.

[Extracted from the "HINDUSTAN TIMES," New Delhi, dated the 25th May 1952.]

Transport-Communications
MONTHLY REVIEW

INDEX

January, 1951 to December, 1951.

(Issue Nos 45 to 56)

Published by

The Secretary, Indian Roads Congress,
Jamnagar House, Shahjahan Road,
NEW DELHI—2

INDIAN ROADS CONGRESS

Index to Transport-Communications Monthly Review Volume Nos. 45 to 56 (January 1951 to December 1951)

INDEX

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

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

Regd. No M-5653

3. RAILWAY OF TOMORROW?

THE great invention of George Stephenson is out of date: 127 years after his railway first made history on the famous track from Stockton to Darlington, a group of sixty experts in Cologne have been given the order to revolutionize it; and the direction of this revolution is clearly indicated by the fact that only half of those top-ranking German technicians are railway engineers while the others are experts in aero-dynamics.

The railway of today may look different enough from that of Stephenson's day. But to the technical mind it has not really changed during a century-and-a-quarter. It is still so closely earth-bound that it cuts across and holds up other traffic. It still runs top-heavily on two rails, so that its delicate balance cuts down the speed of trains far below the capacity of the locomotives which modern engineering art is able to build; so that locomotives and cars have to be much heavier than might otherwise be necessary, causing an incredibly costly wear and tear of rails, wheels and rolling stock and a great waste of energy in starting, slowing down and stopping trains, while still denying them a really smooth running.

All these disadvantages of old-fashioned rail-roading are being cut out in the miniature experiment with the train of the future which, according to the German weekly, 'Der Spiegel', is under way on a 1-$\frac{1}{4}$-mile track across a heath near the Rhine city of Cologne.

The railway of tomorrow is to run on a continuous ferro-concrete "bridge" over cities, towns and villages, forests, fields and roads, high wherever necessary, low wherever possible, but never straight on the ground. Over the bridge spans runs only one single rail, or rather an 18-inch "running rod" of steel. The train is balanced on this "running rod" by "hugging" it closely with its small wheels: the locomotives, carriages and freight cars, as light as possible, are virtually built around the "running rod", carrying most of their load on their deeply overhanging sides. The first trials have proved that these trains, driven by Diesel or electric locomotives, can easily reach a speed of 180 miles per hour (which would enable them to cover a distance, say, from New Delhi to Bombay in about 4 hours). They could reach their top speed, slow down from it, and even come to a stop in a fraction of the time and at a fraction of the energy cost it takes conventional trains. The wear and tear of "track" and rolling stock would be reduced enormously. The trains would travel with a smoothness unachievable by present day railways, and the cost of moving passengers and especially mass cargo would be lower than now, and very much lower than it could ever be by air transport.

What puts the new method of rail-roading very much into the future for most nations is the high initial cost of construction which would be a particular disadvantage where railway systems are already in existence and would have to be scrapped. This is why neither the originator of the idea (a Swiss professor at the famous Technological Institute of Zurich) nor the German experts who have built the miniature model near Cologne can reasonably hope to see the new railway built on a large scale in their own countries. But the Swedish-born American businessman who finances the research project, in the expectation of introducing it in the United States or in "new" countries which are not yet tied down to the old-fashioned style of railway construction, may well prove as realistic and practical as Stephenson, despite all doubting critics, did over a century ago.

(Extracted from the "Hindustan Times" of the 1st June, 1952.)

4. IRAQ HIGHWAY DEVELOPMENT PLANS

THE International Bank Mission to Iraq has approved the Iraqi highway plan, the proposals for which were submitted in 1950 by an inter-departmental committee. The cost of the development programme is estimated at I. D. 168 million (£168 million) over a four year period. The plan provides for the construction and improvement of thirty-seven main service roads totalling some 3,500 kilometres (2,175 miles). The International Bank Mission recommended, in addition, the building or improvement of some 8,000 kilometeres (4,971 miles) of secondary or feeder roads and suggested that the road programme, in particular, be co-ordinated with the development of new agricultural areas.

(From I. R. F. Bulletin No. 7/8, April, 1952).

---

5. ENGINEERING EDUCATION

* * *

ONLY Oxford and Cambridge persisted in giving an all-embracing course to a high level, in the firm belief, as Professor Inglis said in 1931, that such graduates "possess a versatility and balance of mind which enable them to strike out with equal facility along any line they may subsequently be called upon to pursue. Premature specialisation cramps the imagination and is destructive of the length and breadth of mental vision." One is forced to the conclusion, however, that as the syllabus grows only the ablest men can carry a large number of subjects to a high level simultaneously, and the alternatives are a lowering of standards or specialization.

Some universities are questioning the value of formal experiments in the laboratory and are introducing small investigations and projects in the final year as a means of encouraging initiative and a methodical approach to new problems. Similarly, alarm at the inability of students to think and write logically has led, in one case, to formal instruction in the presentation of technical information and in others to the use of discussion groups or to practice in the writing of essays and long reports.

Efforts are also being made to encourage undergraduates to achieve a more general education, not by the pathetic step of adding a smattering of classical culture which should have been acquired at school, but by showing the relationship of engineering to other sciences and arts. This development may represent the beginnings of a new attempt to strike a balance between belles-letters, mathematics and experimental philosophy, which was attempted so long ago as 1807 by Belfast Academy and which was referred to by the Principal of Owen's College in 1873 when he said of university education, "The subject matter of the studies selected is, in fact. of less importance than the discipline imparted".

"But a selection must be made which will draw out and strengthen the powers of the mind and afford a broad basis on which to build a subsequent professional career. The common groundwork must therefore include (a) Letters—to cultivate taste and judgment and to give style in speech and writing; (b) Mathematics—to discipline the reasoning faculty and to give the habit of concentrated thought: (c) Some branch of physical study to develop the powers of observation and inductive reasoning and to impart the method of this study, thus enabling a student to provide himself with pleasure and facility, a knowledge proper to his calling."

(From "Concrete & Constructional Engineering" July 1951, Vol. XLVI, No. 7.)

[*Elsewhere in this issue we have published an article on the "Education of the Highway Engineer"—Ed.*]

6. NEW ROADS FOR LANCASHIRE

THE British Road Federation recently published a booklet "New Roads for Lancashire" issued in conjunction with the Manchester Exhibtion. In this brochure it is pointed out that the urgently required road plan for the county would eventually pay for itself through savings of upto 40 per cent in fuel and lubricant costs, 15 per cent in tyre costs and 10 per cent in vehicle repair and maintenance costs, quite apart from economies resulting from time saved and accident reduction. The cost of the project, when contrasted with the revenue derived from motor taxation and with the sums currently being spent on capital investment projects, cannot by any means be considered excessive.

(From I. R. F. Bulletin No. 7/8, April, 1952.)

---

7. SIGN WITH A SMILE

A neat turn of the King's English resulted in the following amusing signs:

A warning sign at a construction project near Housten, Tex., warns: "Slow, construction. Hell ain't half full."

On highway 66 at Stateville (111.) Prison: "State Penitentiary—No Trespassing."

In a Wichita (Kan.) park: "May it be said of these flowers that they died with their roots on."

On the rear of a midget automobile parked daily near the Portland, Me., police headquarters: "Hit Someone Your Own Size."

(From the Highway Magazine, April, 1952)

---

8. SAVING IN FUEL CONSUMPTION

RESULTS of comparison runs in city traffic and in the open country have demonstrated how test drivers cut automobile gasoline consumption by as much as 50 per cent.

In a series of tests conducted by Chrysler Corporation engineers to determine fuel economy, it was found that by timing their city driving to the flow of traffic and the setting of traffic lights, test drivers cut gasoline consumption in half, and similarly by reducing open country driving from 70 to 50 miles an hour 25 percent in savings were achieved.

(From 'The Highway Magazine', April, 1952).

---

9. SWEDISH ROAD BUDGET

THE road budget for 1952-53 has been fixed at Kr. 579 million (£ 40,000,000), an increase of some 60 per cent on the previous year. Some Kr. 500 million (£35,000,000) will be forthcoming from vehicle and fuel taxes.

(From I. R. F. Bulletin No. 7/8, April 1952.)

---

10. ENGINEERS—PLANNERS AND DOERS

ENGINEERS divide into two general classes those who like to plan, and those who like to get things done in the field. Although this statement is obviously over simplified, these two basic qualities can be observed with differing ratios in every technical man. The planner is loathe to reach final conclusions, while the doer is inclined to snap-judgment in the interest of expediting the work to be done. In a frontier civilization the doer takes precedence because of the pressing need for his accomplishments, but in a stabilized economy the planner gradually takes over.

The first group–the planners–are not happy unless striving for the complete answer to the assigned problem. Starting with a set of physical conditions they will develop solutions using all possible combinations. Then, they will select other criteria and repeat the study to check the new answer against the first. This step will bring to mind other variations of the original premise and a really earnest planner is pleased to carry forward this process and refine his previous refinement until his boss, or some higher authority demands a decision.

On the other hand, the doers are driven by a corresponding urge to get the job under way, and are only happy when the dirt starts to fly, even though they know it may be necessary to improvise or even revise as work progresses. They have the firm conviction that a project completed, even though only 95 per cent perfect, is more useful than one still in the study stage. If charged with an occasional failure, this group should also be credited with tremendous accomplishments.

(From "Western Construction" Vol. 27, No. 2, Feb., 1952).

11. ROAD DEVELOPMENT IN UTTAR PRADESH

THE 100 mile long strategically important hill road connecting Tanakpur with Pithoragarh and the road to Kailash has been completed. Construction covered some three years and the cost amounted to approximately Rs 6 million (£ 450,000) instead of the originally estimated Rs 8.8 million (£ 660,000).

Before the construction of this road great difficulty was experienced with regard to communications, the only means of transport being mules and sheep. Prior to the construction of the road the travelling time between Tanakpur and Pithoragarh took some four days ; this has now been reduced to one day.

The road has already benefited the local communities since during food scarcity conditions last year as many as fifty vehicles loaded with supplies travelled the road daily. Transport charges for goods along this route have decreased from some Rs 9 per maund (80 lbs) to approximately Rs 3 per maund on truck transport. It has been estimated that the annual saving on transport on this route totals some Rs 800 thousand to Rs 1 million (£60,000 to £75,000).

(From I. R. F. Bulletin No. 7/8, April, 1952).

SIN

"William," said the teacher, "can you tell me what we must do before we can expect forgiveness of sin?"

"Yes, Sir," replied the boy. "We must sin."

INDIA WORKS AWAY ON ITS "HOOVER DAM"

(Abridged from "Engineering News Record"—March 27, 1952.)

BHAKRA-Nangal is India's greatest single hydro and irrigation project. It is planned to service 3.6 million acres of farm land, and to produce power from 517,200 kw. of turbines in its three initial power plants.

Situated in the northwest corner of the country in the Punjab area, Bhakra-Nangal takes its name from its two dams. Bhakra, the storage dam located in a gorge where the Sutlej River breaks out of the last foothills of the Himalaya Mountains, will be 680 ft high, 1,600 ft long and contain 5.12 million cu. yd. of concrete. It would thus be the third largest concrete dam in the world and nearly as big as second-place Shasta Dam. A straight gravity type dam with an overflow spillway, Bhakra is similar to, and about half the size of Grand Coulee Dam. It is, however, more often likened to Hoover Dam in somewhat the same way that the Damodar Valley scheme is referred to as India's TVA.

Bhakra's height, only 46 ft short of Hoover's and in excess of all other dams, is one reason for this comparison. Its two 50-ft (finished-diameter) diversion tunnels, the same size as the four at Boulder and in the same relative position —through either abutment—is another.

And a third reason is perhaps the fact that John L. Savage, the designer of Hoover Dam, was also the chief consultant in the design of Bhakra.

A view of the Sutlej showing the suspension bridge

(Photo by courtesy Dr. E. Zipkes Director, Central Road Research, Institute, New Delhi)

There have been no concrete dams in the country heretofore, and the nearest approach to Bhakra's size is Mettur in the south of India, a cyclopean masonry structure one-fifth as large.

Nangal Dam, located 8 miles downstream from Bhakra, is a low (95 ft) structure, 1,029 ft long in the form of masonry-faced concrete piers and steel gates. Its purpose is to control and divert the daily discharge from Bhakra into a large (12,500 cuse.) canal, known as the Nangal Hydel (for hydroelectric) Channel, on which two power plants are being built and a third is projected to utilize a total drop of 250 ft. This 38-mile channel will also feed the 100-mile, 12,500-cus. Bhakra Canal, main artery of the new irrigation system, as well as the existing Sirhind irrigation canal before rejoining the Sutlej near the town of Rupar. Main irrigation canals and branches, is is said, will total 538 miles, while the distribution canals and branches will add another 2,400 miles to the irrigation system.

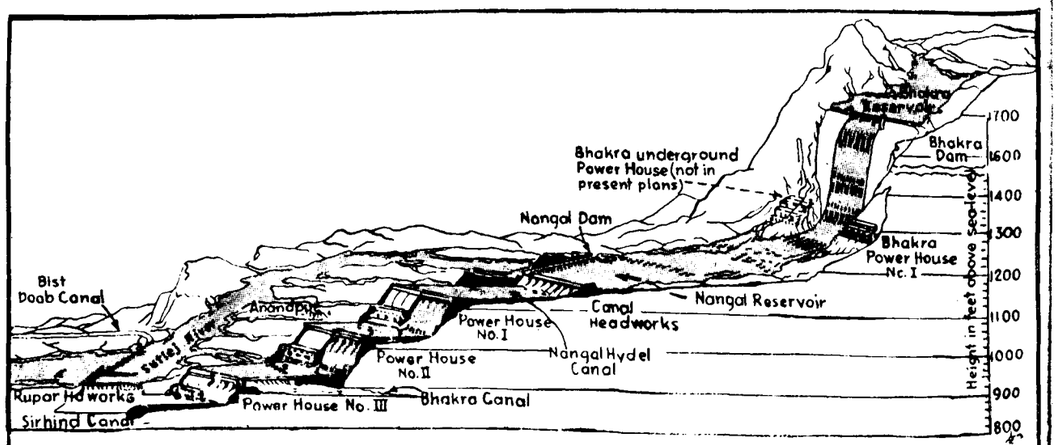


Fig. 1—Major Elements of the Bhakra-Nangal Development Project.

Present Operations—Up to now, construction operations on the project have been entirely preparatory in so far as Bhakra Dam is concerned. These have included the building of access roads and a 40-mile rail line from the nearest railhead at Rupar, development of housing colonies for the workmen, driving the diversion tunnels (now about two-thirds complete) and some abutment scaling. Elsewhere on the project, Nangal Dam has been brought to virtual completion, and power canal excavation is under way as is work on the two canal powerhouses.

Compared to normal Indian Dam building practice, the Bhakra-Nangal project is destined to require revolutionary steps in mechanization. So far, however, by American standards, the steps are being haltingly taken, although on the Nangal Dam work a crushing and screening plant was used, and concrete was mixed in a small central plant, hauled on an industrial railway and hoisted into the forms by a crawler crane. A few shovels and trucks have been used on the diversion tunnel excavation, but even on these huge bores, requiring 511,000 cu. yd. of excavation, a surprising amount of hand labour is still employed.

Entrance to a tunnel.

(Photos by courtesy Dr. E. Zipkes, Director, Central Road Research Institute, New Delhi.)

Work in progress at the mouth of a tunnel.

Bhakra Dam—Main Features

Only the left bank power house shown in Fig. 1. is included in present planning. Four 93,333 KVA vertical-shaft generators driven by 115,000 H. P. Francis-type turbines are contemplated. The right bank power house is foreseen as of underground type equipped with eight units of the same size. Should it ever be built, it is projected as a tunnelled-opening in the cliff, with such remarkable diamensions as a 500-ft length, an 80-ft width, and a 140-ft height.

The reservoir will have a 7·4 million-ac ft capacity, of which 5·7 million will be live storage.

Foundations. The material on which the dam will be founded consists of beds of hard sandstone in which intrusions of clay-stone appear. The strata are inclined 70 to 80 deg. from the horizontal, dipping from upstream to downstream, which is counted upon to reduce both hydraulic uplift and sliding.

Foundation preparation as now planned involves stripping the stream bed and abutments to depths of nearly 100 ft to remove weathered and shattered material. Total excavation is estimated at 3 million cu. yd. Clay seams will then be removed, refilled with concrete, and the entire foundation area pressure-grouted.

Tunnelling:—The general plan of tunnel excavation being followed is to enlarge from an 8 x 10-ft pioneer bore, holed through early as a part of the foundation exploration. Driving is from both ends of the half-mile long tunnels. Air drills are used, but much excavation is done by hand. Material is hauled out by trucks, generally loaded by hand.

The Bhakra tunnels would present a difficult construction problem for an experienced, well-equipped contractor.

NANGAL DAM AND CANAL

In contrast to slow progress on the Bhakra Dam and the power features of the project, some of the irrigation facilities are relatively far along. As soon as the steel gates can be installed in the twenty-six 30-ft-wide bays of Nangal Dam it will be ready for use. The canal headworks, also a low dam with eight 24-ft-wide openings located adjacent and approximately at right angles to one end of Nangal Dam, are complete.

Work in progress inside one of the tunnels.

Canal excavation and the building of some 40 siphons and aqueducts to carry intersected streams across the canal are also under way. Since this latter work can follow Indian practice of using manual labour, it is progressing continuously, if slowly. Much of the alignment is through hilly country where large cuts and fills are required. Some of the embankments attain heights of 75 ft, and must be constructed on earthdam principles.

The normal section of the canal itself is 21 ft deep, 92 ft wide at the bottom and nearly 140 ft at the water surface.

Excavation work is also under way at the sites of the two canal power plants located 13 and 19 miles below the headworks. Each of these plants will be equipped with two 24,000 kw. generators, which can operate on the water impounded daily in the 24,000 ac. ft Nangal reservoir. In effect, they will be run-of-river plants until Bhakra Dam is complete. After that a third generator is planned for each plant.

A project to merit praise—Even though the Bhakra-Nangal project is not advancing as fast as it might, it is one in which Indian engineers can take pride. To undertake a piece of work so far beyond their experience required courage of a high order. Their designs and hydraulic model studies have been thorough and well founded. Bhakra's spillway arrangements are ingenious and in keeping with the hydrologic history of the river. Extensive use of precast concrete blocks to face the Nangal Dam piers and thus eliminate formwork or masonry facing saved money and speeded the work. Fabricating on the job of the 50-ft diameter frames for the tunnel lining jumbo was another operation of note.

The engineers and labour supervisors can also take satisfaction in the amount of old U.S. Army surplus construction equipment that they have been able to repair and keep running. If they had the new equipment necessary, it is possible that the Bhakra-Nangal project would be nearer than it is to fulfilling its destiny of reducing India's dangerous deficit in both food and electrical power production.

—o—

ARDENT LOVE

A youngman was in love. He did not hesitate to make known in very profuse terms his affection for the young woman who had won his heart. In a letter to her he exhausted his supply of adjectives and figures of speech in an effort to declare his devotion. He said, "I could swim the ocean to be with you; I could endure the Arctic cold, or cross the burning sands of the Sahara, or climb the steepest mountains, if only I could be in your presence!"

After multiplying his endearing phrases at great length, he added, at the bottom of his letter this postscript: "I will be over on Wednesday evening if it does not rain."

—o—

TECHNICAL INFORMATION

1. SLAB SLIPPING METHOD MENDS HIGHWAY

(Extracted from 'Engineering News-Record' 10th April, 1952)

THE Connecticut State Highway Department has developed a successful plan for restoring concrete pavement slabs that have slipped sidewise and vertically from the original grade.

The first step in the procedure is to jack up the pavement slabs to within one inch of the original grade. The next step is to free the slab to be moved, as well as to make sure that the adjoining transverse

(Photo of the Hook)

joints are free. Material that may have been packed in the longitudinal joint during the slab's outward movement must also be removed.

After the slab has been freed on three sides, heavy moving equipment is set in place. (See diagram.) This heavy equipment consists of three 6½ tons winch trucks with 5/8-in. cable, three sets of three and two 12-in. sheave blocks, three sets of 12-in. snatch blocks, three sets of 2½-in. steel pins with welded braces, and three sets of heavy steel hooks.

Technique.—One hook is placed at a distance of 18 inches from the end of the slab to be moved and the other hook is placed across the pavement on the adjoining slab approximately 18 inches from the end which creates a slight diagonal pull against two blocks.

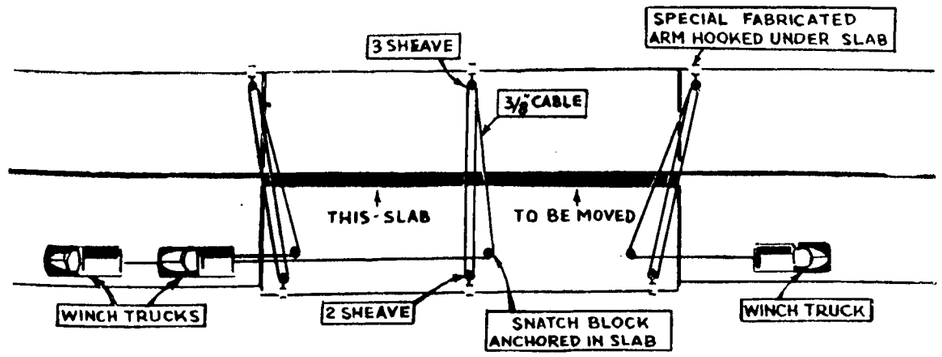
The same installation is used at the other end of the slab to be moved. A third set of hooks is placed midway of the slab at which location the pull is straight across the pavement.

One truck is positioned about 100 feet from one end of the slab and the other two trucks at the opposite end of the slab approximately 100 and 150 feet away respectively. The slack is then taken up on all three sets of hooks pulling the cable to a slight strain. When the strain is equal on all three pulling lines, all three trucks then commence pulling together. This causes the slab to move laterally back to its original position.

Quick Operation.—The longest delay to traffic during slab moving on Conn. Route 9 in the town of Haddam was not more than five minutes. These slabs are estimated to weigh 60 tons and in the particular replacement described, there was a 2½-in. wide longitudinal crack between the slabs of each direction lane.

Some experimental work has been undertaken to instal ties to keep slabs from separating at the longitudinal joint. Such separation occurs only on pavements

which were laid before it was customary to provide longitudinal ties. The experimental bracket was made up to conform to a plan devised by an employee of the State Highway Department.



These brackets were installed on the outside edge of the pavement directly across from each other, 10 ft apart and bolted to the concrete with a bolt embedded in lead wool. The tie material used under the pavement is standard fence cable and fittings which makes the tie bracket the only special equipment required. On the Haddam job, these ties were installed after the replacement of the slabs and department officials feel there will be no further slippage.

The method described here covers work where slippage is away from the centre line.

—o—

2. HERE'S A STEEL SAVING SCHEME PRECAST CONCRETE PILES WITHOUT STEEL

(Extracted from 'Engineering News-Record' – Jan. 10, 1952)

A new steel saving plan has just been tested on the West Coast. It involves casting, handling, and driving precast concrete piles, then removing the longitudinal reinforcing steel for re-use. Feasibility of this approach was demonstrated by tests on 40-ft long piles by Ben C. Gerwick, Inc., San Francisco heavy construction contractor.

The thinking behind these tests is this: In many foundations requiring piles, particularly building foundations, pile loading is axial with no significant bending stress. In such case, longitudinal steel may be needed in precast piles only to take handling and driving stresses. Accordingly, in the recent tests the longitudinal reinforcing steel was arranged so it can be removed after the pile is in its permanent position.

Longitudinal reinforcing consists of one or more threaded steel rods that fit loosely in sheet metal or paper tube sleeves cast in the concrete. The rods are anchored top and bottom with nuts and plate washers. After the concrete has attained required strength, the rods are tensioned to a specified unit stress to prestress the pile for handling and driving.

Test piles incorporating this unique idea were cast, successfully lifted and driven to refusal without any visible cracks or other evidence of distress. Rods

used in these tests were of mild steel. Normally, high strength steel would be used for its higher allowable working stress. This would permit greater prestress in the concrete pile.

One of the 18×18-in. test piles was lifted with a three-point pick-up that resulted in a calculated maximum moment with no allowance for impact of 92,000 in.-lb. The four 1-in. dia. rods were tensioned with a torque wrench to 20,000 psi resulting in a unit compressive stress in the concrete of 136.3 psi. Considering the concrete under prestress as a homogeneous section, the gross fibre stress in the concrete due to bending was 94.5 psi. Deducting the amount of prestress, when the pile was lifted as described the net stress on the tension side was therefore 41.8-psi. compression.

A second test pile was lifted with a single point pick-up 9 ft from the butt end. The calculated maximum moment under this loading, again with no allowance for impact, was 414,000 in.-lb. In this case the four 1-in. dia. rods were only tensioned to 12,000 psi. resulting in a unit compressive stress in the concrete of 82 psi. The gross fibre stress in the concrete from the lifting stress was 426 psi. The net stress in the concrete on the tension side for this severe loading was therefore 344-psi. tension.

The fact that no tension cracks developed demonstrates, in the opinion of the testing contractor, that concrete can, and often does, take appreciable tension without cracking. This test pile was poured with a six-sack mix, resulting in a 28-day strength of 3,500 to 4,500 psi.

This scheme for saving steel in precast concrete seems to have possibilities for wide application. The contractor reports no particular problems in manufacturing the piles, in tensioning the rods, handling or driving the piles, or in removing the rods.

An Impact-type wrench was used to loosen the nuts, and the rods were provided with square ends above the upper threads to facilitate unscrewing the rods from the lower nuts. The only steel that remain permanently in the pile are the lower nuts and plate washers and the stirrups and dowels if used. All other steel is salvaged.

If called for in the structural design of the building, stirrups such as square wrapped spirals can be provided. Or some longitudinal steel could be cast permanently in the pile with other removable steel provided too.

—o—

3. CHROMIUM PLATING SUBSTITUTE

(From "The Indian & Eastern Engineer" March, 1952)

WORLD raw materials shortages have rendered the use of second-best substitute materials necessary in a number of applications, particularly where the substitute does not detract markedly from the efficiency of the product. In Britain, nickel may no longer be used for decorative chromium plating—a ban which affects many industries, notably those producing cars, motor-cycles and bicycles.

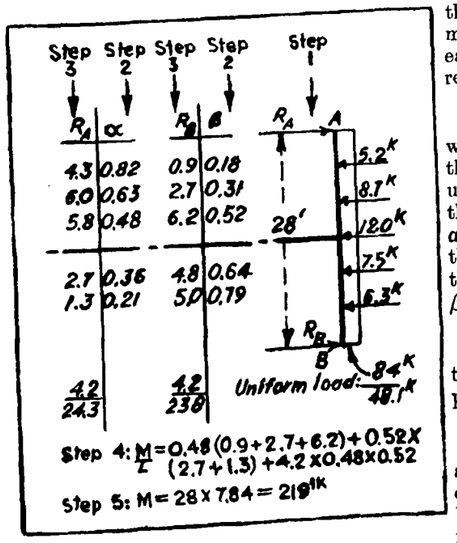
Details of a product known as Niklit, which is stated to be a useful substitute for decorative chrome, have recently been issued. Despite its name, Niklit contains no nickel and is readily obtainable from the makers, Metal Processes, Ltd., Kingsbury Road, Erdington, Birmingham, 24. This finish is applicable to brass and copper articles, or steel articles which have been coppered or brassed. Simple immersion in a warm chemical bath endows treated articles with an imitation white nickel finish which wears well and does not turn black. The Niklit finish is a change of the metal surface and therefore does not add to the dimensions or leave a deposit. A characteristic of the finish is that it reproduces the surface of the treated metal exactly: therefore, polishing operations should be completed before articles are dipped.

4. EASY WAY TO FIND MOMENTS

(From "Engineering News-Record" 10th January, 1952)

FOR beams carrying concentrated loads, here is a time-saving method for computing reactions and bending moments.

1. Sketch the beam vertically and indicate the loads horizontally, in kips, not necessarily to scale. Call one end of the beam A and the other B.



2. Determine the distances of each load from both ends of the span. Express these values as fractions of the beam length and enter on the diagram in line with the corresponding loads. Call the distances from the B end α-factors and from the A end β-factors.

3. Multiply each load by its α and β. Enter the product of the loads by the α-factors in a column marked R_A, reaction at A, and similarly, the product of the loads by the β-factors in a column marked R_B. The sum of the products in each column is the corresponding beam reaction. Check against total load.

4. Draw a horizontal line at the point where the moment is to be found. Note the α and β-factors for this point. Add up the values in the R_B column between the line and A and multiply by the α-factors at the line. Similarly add up the values in the R_A column between the line and B and multiply by the β-factor.

5. To obtain the bending moment at the point, add these products and multiply the resulting sum by the span length.

When the beam carries a uniform load also, add half this load to each reaction to obtain the total reaction. To obtain the bending moment at any point, add to the moment for the concentrated loads the product of half the total uniform load and both α and β-factors for the point.

—o—

FORGETFULNESS

Smith is a young lawyer clever in many respects, but very forgetful. He had been sent to a distant city to interview an important client, when the head of his firm received this telegram: "Have forgotten name of client. Please wire at once."

The reply he received was a masterpiece of sarcasm, irony or something. It ran: "Client's name Jenkins. Your name Smith."

BUDGETS AND ADMINISTRATION REPORTS

Government of Mysore Budget 1951-52

The following extracts pertaining to Civil Works Budget have been taken from the Government of Mysore Budget for the year 1951–52:

	(In Lakhs of Rupees)	
	Revised Estimates 1950–51	Budget Estimates 1951–52
I. Revenue (Civil Works)		
(i) Rents	1.15	1.15
(ii) Recoveries of expenditure	4.86	4.84
(iii) Transfer from Central Road Fund	—	6.00
(iv) Miscellaneous	2.11	11.95
(v) Deduct—Refunds	-.06	-.05
Total	8.06	23.89
II. Expenditure (Civil Works).		
(i) Original Works	37.63	14.85
(ii) Repairs	22.69	36.10
(iii) Establishment	11.13	13.78
(iv) Tools & Plant	4.95	9.45
(v) Grants-in-Aid	5.78	4.72
(vi) Suspense	—	8.00
(vii) High Price Allowance	3.31	—
(viii) Post-war Development Schemes	76.52	115.61
Total	162.01	202.51
III. Expenditure (Communications only)		
(i) Original Works	4.94	5.40
(ii) Repairs	17.44	27.44
(iii) Post-war Development Schemes		
(1) Original Works	13.48	19.98
(2) Repairs	15.00	18.00
Total	50.86	70.82
IV. Receipts from Roads.		
(i) Receipts under Motor Vehicles Acts	35.81	43.50
(ii) Sales Tax on Petrol and other Motor Spirit	18.00	17.85
Total	53.81	61.35

A BRIEF REVIEW OF THE MYSORE BUDGET
(With special reference to Civil Works)

THE total revenue receipts of Mysore State for the year 1951-52 are estimated at Rs 13,80.69 lakhs and revenue expenditure at Rs 14,18.23 lakhs leaving a deficit of Rs 37.54 lakhs. The revised estimates for 1950-51, however, indicate a surplus of Rs 16.58 lakhs with the revenue receipts amounting to Rs 13,58.84 lakhs and expenditure to Rs 13,42.26 lakhs.

Revenue expenditure on Civil Works for 1951-52 estimated at Rs 202.51 lakhs forms about 14% of the total State expenditure in the year, the corresponding percentage for the previous year being slightly less i.e, 12%. Revenue expenditure on communications (original works and repairs) in 1951-52 is estimated at Rs 70.82 lakhs out of which about Rs 38 lakhs is earmarked under Post-war Development Schemes. As a proportion of the total State expenditure, the expenditure on communications in two years 1951-52 (estimates) and 1950-51 (revised estimates) forms 5.0% and 3.8% respectively.

—o—

List of Approved Works on National Highways

S. No.	Job No	Name of work	Amount Rs	Remarks
		BOMBAY		
1.	602 BM 8	Construction of the road from crossing of Kosamba-Zankhvav Railway line to Kharod-Bombay-Ahmedabad National Highway No. 8	4,64,200/-	
		UTTAR PRADESH		
2.	A-598 UP 2	Acquiring land for the bye-pass at Shikohabad on National Highway No. 2 (Miles 40-41 of Agra-Etawah-Fatehpur Road)	9,100/-	
		MADHYA PRADESH		
3.	600 CP 7	Widening the metal width of Jabalpur-Murtizapur Road (N.H. No. 7) from miles 11 to 67/7.	95,645/-	
		MADHYA BHARAT		
4.	597 MB 3	Upgrading the surface of Agra-Bombay National Highway No. 3 from Chambal to Gwalior	4,80,700/-	

S. No.	Job No.	Name of work	Amount Rs	Remarks
		HIMACHAL PRADESH		
5.	599 HP 22	Metalling and surfacing full width of the Hindustan-Tibet Road from mile 17/7 to 17 in Bazar at Theog (length about 0.87 miles)	16,400/-	
		SIKKIM		
6.	595 SK 31-A	Laying 1 in. premix carpet over miles 0-25 of the Rango-Gangtok section of National Highway No. 31-A	4,11,600/-	
7.	596 SK 31-A	Laying 1 in. premix carpet over miles 0-14 of the Tista-Rangpo section of National Highway No. 31-A	2,37,500/-	
		AJMER		
8.	594 AJM 8	Widening metal width from 9 ft to 12 ft in mile 15-20, 22, 24 to 27 and 29-32/4 of Ajmer-Beawar Road (N. H. No. 8)	1,43,700/-	

List of Books added to the Library of the Roads Organization during the month of May, 1952.

1. **Concrete Road Jointing Materials** by R. S. Millard and P. L. Critchell, (Reprinted from the Journal of the Society of Chemical Industry, 1950, 69.)
2. **A Non-destructive Method of Testing Concrete during Hardening** by R. Jones. (Reprinted from Concrete and Constructional Engineering, April, 1949.)
3. **Concepts of Safety in Structural Engineering, Paper No. 5786** by Alfred Glanvile Pugsley. (The Institution of Civil Engineers, Great George Street, Westminster, London, S.W.I.)
4. **The Design and Construction of Some Slipways upto 1,200 Tons—Paper No. 17** by G. Colin Grove, (The Institution of Civil Engineers, Great George Street, Westminster, London, S.W.I.)
5. **A Glossary of Petroleum Terms** Prepared by the Nomenclature Sub-Committee of Inst. of Petroleum. (The Institute of Petroleum, Manson House, 26, Portland Place, London, W.I., 1951.)
6. **Report on the Administration of Hyderabad State—(September 1948—March 1950)** (Government Press, Hyderabad.)
7. **The Coal Tar and its Derivatives, Le Goudron De Houille et des Derives** by Jean Beek. (Presses Universitaires de France, 108, Boulevard, Saint Germain, Paris, 1950.)
8. **Century of Reinforced Concrete, Cent Ans de Eton Arme** (Science and Industrie, 6 Avenue Pierreler de Serbie, Paris (XVIE) Supplement A La, Revue, Travaux, No. 194 B IS.)
9. **The Torsion of Aluminium Alloy Structural Members—Research Report No. 9** by M. E. G. Cullimdre and A. G. Pugsley. (The Aluminium Development Association, 33, Grosvenor Street, London, W. 1.)
10. **Surface Chemistry—An Introduction to its Principles and Applications** by A. E. Alexander. (Longmans Green & Co., Ltd., London)
11. **Rail and Road Statistics** by F. A. A. Menzler (Reprinted from the Journal of the Royal Statistical Society, Series A (General), Vol CXIII, Part III 1950).
12. **Goods Vehicle Operation Principles and Practice for Students and Executives** by C. S. Dunbar. (I-liffe & Sons Ltd., London.)
13. **The Inland Waterways of England** by L. T. C. Rolt. (George Allen and Unwin Ltd., Ruskin House, Museum Street, London.)
14. **Construction Cost Control**. (American Society of Civil Engineers, Construction Division, 1951.)
15. **Report by the Railway Board on Indian Railways for 1950-51. Vol. I.** (Manager of Publications, Delhi, 1952)
16. **Report by the Railway Board on Indian Railways for 1950-51, Vol. II—Statistics**. (Manager of Publications, Delhi, 1952)
17. **Economics of Transportation by M. L. Fair & E. W. Williams** (Harper & Brothers, Publishers, New York)
18. **Transition curve problems with the clothoid Curve**. (Le Problem Des Raccordements Par Un Arc De Clothoide) by Etienne Florina, (Societe Generale D'Imprimerie, 18 Rue de la Pelisserie, 18, Geneva).
19. **Handbook of Soil Mechanics Limited on Site Investigation and Geo-Technical Processes.** (Soil Mechanics Ltd., 123, Victoria Street, London, S. W. I.)
20. **Road Transport: The Inter-Related Problems of Flow and Safety.—Read at the 1st Meeting of the 61st Session, on Wednesday, 7th November 1951 by G. T. Bennett.** (Belfast Association of Engineers, London)

21. **An analysis of Statistically indeterminate Structure (Second Edition)** by C. D. Williams. (International Text Book Co., Scranton, Pennsylvania)

22. **First Report on Prestressed Concrete, Sept. 1951** (The Institution of Structural Engineers, 11, Upper Belgrave Street, London.)

23. **International Conference on Mechanics** (Colloque International de Mechanique) (Pallanza Lago Maggiore, 23-24 June 1950)—containing four papers :—

    (i) **The Dynamics of the buckling Process** by N. G. Hoff.

    (ii) **A classical error in the study of the effect of a moving load.** (Une error classique dans l'etude de L'effect D'une charge mobile) by F. H. Van Den Dungen.

    (iii) **Study of the phenomena of adjustment in pre-stressed concrete slabs** (Etude des phenomenes D'adaptation dans less dalles en beton arme precontraint) by F. S. Merlino.

    (iv) **Theoretical basis of a direct study of the stress conditions caused by non-compatible stresses.** (Fondements theoriques d'une etude directe des etats de contrainte proroques par une deformation non compatible) by Franco Levi. (Consiglo Nazionale Delle Ricerche, Roma)

24. **Fifty years of British Standards 1901-1951** (British Standards Institution, London, 1951)

25. **Statistics, Part I—Travancore** (The Superintendent, Government Press, Trivandrum, 1950)

26. **Statistics, Part II—Cochin** (The Superintendent, Government Press, Trivandrum, 1950)

27. **An Essay on National Income & Expenditure-in India** by B. Natarajan. (The Supdt., Govt. Press, Madras)

28. **The Comparative Cost of a Bridge in Prestressed and Reinforced Concrete—C.A.C.A. Liby., Translation No.** 19, Arthur Lammlien. (Cement and Concrete Association, 52, Grosvenor Gardens, London S.W.I.)

29. **Vacuum Concrete—C.A.C.A. Library Record.** (Cement and Concrete Association, 52 Grosvenor Gardens, London, S.W.I.)

30. **The Design and Placing of High Quality Concrete** by D. A. Stewart. (E. & F. N. Spon Ltd., 22, Henrietta Street, London, W. C. 2.)

31. **The Resistance of Piles to Penetration** by R. V. Allin. (E. & F. N. Spon Ltd., 22, Henrietta Street, London, W. C. 2.)

32. **Technological Applications of Statistics** by L. H. C. Tippett. (Williams and Norgate Ltd., London.)

33. **Basic Road Statistics Great Britain 1951.** (British Road Federation, 4-a, Bloomsbury Square, London, W.C. I., 1951.)

34. **The Midlands and the South-West New Roads.** (British Road Federation, 4-a, Bloomsbury Square, London, W.C.I.)

35. **Influences on concrete and Reinforced Concrete (Einfuusse anf Beton und Stahlbeton by Adolf Klienlogel)** (Verlag von Wilhelm Ernst and Sohn, Berlin, 1950.)

36. **Air Compressors Control and Installation** by P. C. Bevis. (Sir Isaac Pitman & Sons, Ltd., London.)

37. **The Works Engineer-A Practical Manual on Building Plant Maintenance for the Works Manager & Works Engineer** by W. R. J. Griffiths. (Sir Isaac Pitman & Sons, Ltd., London.)

38. **Filing and Indexing** by O. W. S. Standingford. (Office Management Association, Ltd., Management House, 8, Hill Street, London, W.I.)

39. **Punched Cards—Their Applications to Science and Industry** by Robert S. Casey and James W. Perry. (Reinhold Publishing Coporation, 330, West Forty-Second Street, New York 18, U.S.A., 1951.)

40. **Social Surveys and Social Action** by Mark Abrams. (William Heine mann Ltd., London.)

41. **Principles of Private and Public Planning—A Study in Economic Sociology** by Wilhelm Keilhan. (George Allen and Unwin Ltd., London.)

42. **Social Aspects of a Town Development Plan-A study of the County Borough of Dudley.** (The University Press of Liverpool, 1951.)

43. **Memorandum on Safety Precautions recommended for Workers in Wells.** (The Institution of Civil Engineers, Great George Street, London, S.W.I.)

44. **Resistance Strain Gauges** by J. Yarnell (Offices of Electronic Engineering, 28, Essex Street, Stand, London, W.C.2.)

45. **The Preparation of Tarmacadam** (British Road Tar Association, 9, Harley Street, London, W. I.)

46. **Annales des Ponts et chaussees, 5 Rue Jules-Lefeburve, Paris.**

    a) **Annales Des, Ponts Et Chaussees—121 No. 1, Jany.-Feb., '51 containing an article "Deflection under dynamic Stresses and Oscillations in Bridges."**

    (b) **Annales Des. Ponts Et Chaussees—121 No. 2 Jany.-Feb. 1951 containing an article "Deflection under dynamic Stresses and Oscillations in bridges."**

47. **The Fundamental Principles of Reinforced Concrete Design** by W. T. Marshall. (Blackie & Sons, Ltd., London, 1951.)

48. **Britain Builds Abroad** by Editor Mark Joffe. (Constructional Steel Work Export Group.)

49. **1951 Agricultural Guide with Industrial Supplement.** (E. M. Allcock and Mohatta Ltd., 8, Lady Hardinge Road, P. B. No. 278, New Delhi, I.)

50. **Fundamentals of Reinforced Concrete** by K. F. Antia (The Concrete Association of India, 1, Queen's Road, Bombay, 1950.)

51. **Fixed Point Method for solving Rigid Frames applied to members of Constant and variable Moment of Inertia** by K. C. Roy. (Reprint from the Indian Concrete Journal.)

52. **Government of Assam—Detailed Estimates of revenue and expenditure for the year 1951-52 for the United Khasi-Jaintia Hills District.** (Assam Govt. Press, Shillong 1951.)

53. **Concrete Pipe Handbook** by Howard F. Peckworth. (American Concrete Pipe Association, 228 No. La Salle Street, Chicago 1, Illinois.)

54. **Experimental Single Course Eight Inch Macadam Base-State of Ohio Dept. of Highways Research Bulletin No. 3,** by T. J. Kauer and L. F. Schaeublin. (State of Ohio, Dept. of Highways, Columbus, 15.)

55. **Superintendent, Government Printing, Patna, 1951.**

    (a) **Government of Bihar Civil Estimates Budgets for the year 1951-52.**

    (b) **Government of Bihar Financial Statements for the year 1951-52.**

    (c) **Government of Bihar P. W. D. Budget for the year 1951-52.**

56. **Government Central Press, Bombay.**

    (a) **Government of Bombay Civil Budget Estimates for the year 1951-52.**

    (b) **Government of Bombay Budget Memorandum for 1951-52.**

    (c) **Government of Bombay Detailed Estimates and Explanatory Memorandum of the Post-War Reconstruction and Development Programme for the year 1951-52.**

57. **Government Printing, Madhya Pradesh, Nagpur, 1951.**

(a) **Government of Madhya Pradesh Development Estimates for the year 1951-52.**

(b) **Government of Madhya Pradesh Budget Estimates for the year 1951-52.** (Final)

(c) **Government of Madhya Pradesh P. W. D. Budget Estimates for the year 1951-52.**

58. **His Majesty's Stationery Office, London.**

(i) **Effect of Batching errors on the uniformity of concrete Road Note No. 3.**

(ii) **Design of Concrete Mixes—Road Note No. 4.**

(iii) **Types of Road Surfacing and Maintenance using Tar or Asphaltic Bitumen—Road Note No. 5.**

(iv) **Damage to roads caused by the Drought of 1947—Road Note No. 6.**

(v) **Filling and Sealing materials for joints in concrete Roads—Road Note No. 7.**

(vi) **Some cases of frost damage to roads—Road Note No. 8.**

(vii) **Recommendations for plastic White Line markings—Road Note No. 9.**

(viii) **A rapid method of analysis for Bituminous road materials—Road Note No. 10.**

(ix) **Binder Distributors for Surface Dressing—Road Note No. 11.**

(x) **Gritting Machines for Surface dressing—Road Note No. 12.**

(xi) **German Motor Roads, 1946—Road Research Technical Paper No 8.**

(xii) **Properties of Road Tars and Asphaltic Bitumens in relation to road Construction—Road Research Technical Paper No. 12.**

(xiii) **Soil Survey Procedure—Road Research Technical Paper No. 15.**

(xiv) **The Compaction of Soil—A Study of the Performance of Plant—Road Research Technical Paper No. 17.**

(xv) **Pavement Design for roads and airfields—Road Research Technical Paper No. 20.**

(xvi) **The Investigation of Road Foundation Failures—Road Research Technical Paper No. 21.**

(xvii) **Bituminous Roads in North America—Research and Construction—Road Research Technical Paper No. 22.**

59. **The Bridge over the Port Canal at Heilbronn—C. A. C. A. Library Translation No. 18.** by Albert Kaiser (Cement and Concrete Association, 52, Grosvenor Gardens, London, S. W. I.)

60. **Prestressed Concrete Manual—The Magnel-Blaton System.** (Stressed Concrete Design Ltd., Lynton House, 54 South Side, Clapham Common, London, S. W. 4.)

61. **Recommended Design for Metal Arc Welded Mild Steel Building Structures Beam and Column Connections.** (British Welding Research Association, 29, Park Crescent, London, W. I.)

62. **The Estimation of Extreme Flood Discharges by Statistical Methods—published in proceedings, Vol. 36, 1950.-by A. D. Benham.** (Ferguson and Osborn Ltd., General Printers, Lambton Quay, Wellington, New Zealand.)

63. **Garden Cities of Tomorrow, by Ebenezer Howard** (Faber and Faber Ltd., 24, Russel Square, London.)

64. **Stereoscopic photography—Its application to Science, Industry and Education by Arthur W. Judge.** (Chapman and Hall, Ltd., 37, Essex Street, London, W. C. 2, 1950.)

—o—