TRANSPORT-COMMUNICATIONS

MONTHLY REVIEW

MAY 1958—No. 133

INDIAN ROADS CONGRESS, NEW DELHI.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

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Transport - Communications Monthly Review is published on the 25th of each month by the **Indian Roads Congress, New Delhi.**

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

Subscriptions. Annual subscription including postage is Rs Fourteen. Single copy including postage is Re one and annas four.

To members of the Indian Roads Congress, Engineering personnel below the rank of an S. D. O. and Engineering students a special reduced subscription rate of Rs eight per annum is offered. Students are required to apply through the Principal of their College.

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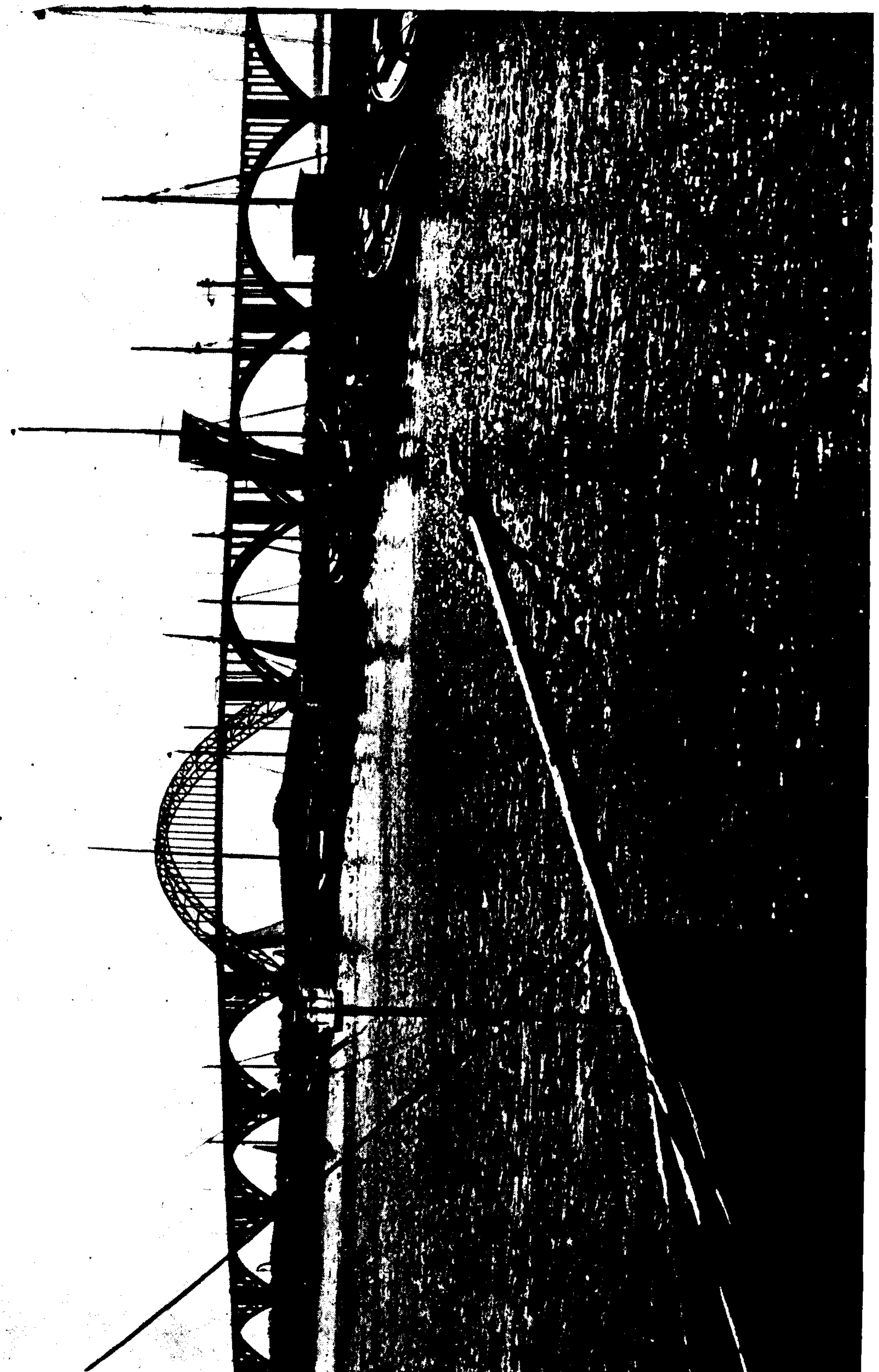

BRIDGE OF MON OVER THE SMALL ULVSUND BETWEEN ZEALAND AND MON DENMARK
THE BRIDGE IS 745 METRES IN LENGTH.

This and two earlier photos - by courtesy of Royal Danish Ministry of Foreign Affairs.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

MAY 1958

ROADSIDE DEVELOPMENT

WITH improvement of roads to carry fast expanding needs of road transport, development of the roadside is assuming importance hitherto not much realised. Roadside development comprises not only considerations of utility, safety, and economy-important as they are, but also the element of aesthetics which has come to receive increasing recognition in every field of human activity. Roads cannot be an exception particularly when long distance travel by road is becoming the order of the day. For this it is not enough if one can reach his destination somehow or the other ; the journey has also to be a pleasant one, relieved of fatigue and monotony.

In India, some of our old roads no doubt provide remarkable instances of planning and foresight, but we were so far used to think mainly of the 'roadway' and our meagre resources were mostly utilized in that direction. It is now seen that the 'roadside' cannot be neglected but has to be provided for and fortunately this can be done at not much extra cost along with the improvement of the road. The suggestion that provision should be made for roadside development in the road improvement schemes is, therefore, a pertinent one.

Roadside development covers a very wide field and although, in the first instance, it conjures up before the mind a picture of broad, smooth, and straight roads, shady avenues, green lawns and parks, pleasing sceneries, roadside utilities, and comfortable resting places—all these amenities depend on certain fundamental factors which make their provision possible. Land-width, road reserve or right-of-way, as it is called in different places, is one such factor and it is so much related to the development of the road that, whether it is case of widening the road, improving grades and curves, widening or improving narrow bridges and intersections, planting roadside trees, improving drainage or providing other facilities, no improvement can be effected unless sufficient road land width is available. Some of our roads have become outmoded for want of adequate road land and we find ourselves helpless to remedy the situation in the face of heavy ribbon development that has taken place. Even in rural areas, every village by the roadside presents the problem of a congested spot and unless the structures, which are now of a temporary nature, are forthwith removed and more land acquired, the problem can acquire serious proportions later on. Coupled with this is the problem of controlled access to highways, a consideration which is becoming more and more important with increare in fast moving traffic. Unless the traffic capacity of the road network is preserved, the new highway system will not be able to serve the needs of the future.

Coming to more pleasing features of the roadside, preservation and fostering of natural tree growth within the road reserve is probably the single item which contributes most to the amenities of road usage. In addition to providing shade, affording protection to the road surface and assisting in the prevention of roadside erosion, it is also a source of revenue to the department. The general considerations involved here are the selection of trees to suit local conditions, their plantation, nurture, preservation and maintenance. Right kind of trees have to be selected to suit the nature of soil, facilities for irrigation, climate, rainfall, etc. Local experience is a useful guide in this respect. Rearing of plants and shrubs is a slow and continuous process. They have either to be planted on the spot by means of direct sowing or cuttings, or reared in nurseries and transplanted on to the roadside. They require to be looked after through all the stages of growth against the depradations of street vandalism and stray animals. Proper care and maintenance of avenue trees is necessary to keep them in right shape and trim. All these operations are being carried out by the Public Works Departments since early days. Some of the roadside plantations are also being looked after by the Forest Department. In addition to the routine operations, there are considerations regarding selection, location and planting of trees and shrubs in relation to existing land forms and other features such as natural vegetation, buildings, etc., having due regard to the width of the carriageway, the speed of traffic and road alignment. These come under the purview of landscape architecture and specialists in this line have to be associated with the planning of highway projects from initial stages. In this connection we already have the valuable suggestion of Shri P. L. Varma in his Presidential Address to the 21st Session of the Indian Roads Congress that every highway engineer's office should have a properly trained landscape architect attached to it.

Coming to some of the features which can be unpleasant on the road, we shall refer only briefly to some of the more salient ones. Borrow pits, especially when they are not drained, are not only an eyesore but dangerous to health. Undergrowth of weeds and bushes at bridge sites detracts from their use as beauty spots. Roadside advertisements, if not properly placed, may be objectionable both from the point of view of safety and amenity. The Indian Roads Congress has already issued a policy in this respect. Mutilation of roadside frontages of buildings and other structures by undesirable posters and inscriptions is a veritable eyesore. Road signs have to be effective as regards their size, location, placement, day-and-night effectiveness, shape, legend, etc. Drainage arrangements have to be satisfactory. The berms should have proper slopes; turfing them will prevent erosion and create pleasing appearance. Commercial facilities like fuelling stations add greatly to the amenity of the roadside. The suggestion that small 'motels' should also be provided in important places deserves consideration.

Rest-houses have to provide accommodation and facilities not only for inspecting officials but also for bona-fide travellers. They have to be clean and comfortable.

There is also the consideration of roadside development in relation to tourism. Fortunately we have started to think of tourism as a trade. It already earns for us Rs 15.45 crores. There are immense possibilities ahead in this direction as few countries offer such rich and varied interests to tourists as India. Road communications to places of tourist interest should provide not merely access but make the journey enjoyable and one of unforgettable memories. Landscaping of roads and roadside monuments which are so rich in historical associations will contribute greatly to the development of tourism. Let here at least the traveller be made oblivious of the too familiar scenes on our roads—the red flag, the wheel barrow, the road roller and the vexatious experience of ROAD UNDER REPAIR.

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

FLOW CURVE: The Locus of points obtained from a Standard liquid limit test (mechanical method) and plotted on a graph representing water content as ordinates on an arithmetic scale and number of shocks as abscissa on a logarithmic scale.

FLOW INDEX: The slope of the flow curve.

THE IRISH OF IT

A man applying for a job was told by the manager that the firm was overstaffed. "Sure, you could start me," he replied. "The little bit of work I would do wouldn't be noticed."

—Irish News.

HIGHWAYS ARE EVERYBODY'S BUSINESS

By

FRED T. BENNETT, ENGINEER

Information and Statistics Division, Texas.

FOR uncounted centuries transportation —the movement of people and goods—has shaped man's destiny. Here in Texas and in America our pioneers pushed forward by water and trail, by wagon track, railroad, and highway to build a great nation.

Today we are pioneering again. We have started to construct a nationwide network of super highways that is revolutionary in concept. It will give a new freedom and a new speed to the movement of people and goods. It will stimulate business growth to an extent which staggers the imagination, and it will enrich the lives of every man, woman, and child in these United States.

This is the biggest public works program ever undertaken anywhere or at any time throughout the world. For the first time in highway history we are taking a long look into the future. We are designing and constructing a national highway system to handle the traffic volumes of twenty years from now, when more than 90 million motor vehicles are anticipated, as compared to today's figure of 65 million.

We shall criss-cross the nation with 41,000 miles of inter-state expressways. They will be divided highways of four to eight lanes, except in the lightly travelled stretches ; but even in those, a minimum right-of-way area of 150 feet is to be secured for a double-track highway when traffic warrants. Over-passes and clover-leafs will eliminate intersections. It will actually be possible to drive coast to coast without encountering a stop sign.

Do not be misled by the word "inter-state." These broad arteries will also go into and through our large cities, as well as around them, wiping out today's king-sized traffic jams and speeding up traffic on city streets.

From present indications, about 60 per cent of the Inter-state System in Texas will be built entirely on new location, thus creating countless opportunities for business. Moreover, a prime purpose of the highway program is to support and encourage business development.

In the main, the proposed new highways will improve many types of business —in particular, the motels, restaurants, and gas stations. More people will be travelling ; they will have to find places to eat, sleep, and service their automobiles. There will be no commercial facilities on the inter-state route, but signs will alert the motorist when he approaches connecting roads leading to these facilities and the cities and towns he might want to visit.

An essential feature of these expressways is controlled access. The law prohibits the build-up of roadside businesses with a direct entrance onto the inter-state highways, for this would defeat their whole purpose ; namely, the safe and swift flow of traffic.

The more anyone studies the program and the case histories of numerous communities already in the area of current trunk lines, the more convinced he becomes that the benefits for all dispel any previous fear he might have harbored.

Competent surveys reveal that most of the through traffic forced to wend its way through our cities does not stop; but it does cause congestion, which discourages potential customers and deprives

establishments in the business district of business they would otherwise enjoy.

The production, distribution, and acquisition of those things required for carrying out this huge highway program will mean a vast expansion of payrolls and purchasing power: and its effect should be felt even by the smallest of business men. It can be translated into terms of new homes, new furnishings, new cars, more recreation and travel, and the countless refinements that Americans are making a part of their everyday lives.

The highway construction and improvement to be effected by the present program should save nationally about 550,000,000 dollars annually in vehicle operation costs alone. The experts estimate that adequate highways will save at least 2 cents per mile in travel expense. Thus, the motorist who drives 10,000 miles per year will save 200 dollars. This is not all clear profit, however, because these highways are being constructed by pay-as-you-go financing : and the added Federal taxes on gasoline and tires will cost the motorist about 8 dollars per year, which will leave him a net profit of 192 dollars annually in operating cost savings.

There are also other benefits that will be enjoyed by the highway user. For example, construction of the Inter-state System to modern standards is expected to save 4,000 lives per year and to greatly reduce the number of persons injured and property damaged. Although a dollar value cannot be put on lives saved and the injury and suffering that will be prevented, it is expected that these new highways will result in an annual saving of at least 725,000,000 dollars in accident costs alone. When this occurs, it is reasonable to expect that automobile collision and public liability and property damage insurance premium rates will fall.

It is estimated that savings of 825,000,000 dollars annually will be realized by commercial vehicles in the saving of time as a result of the new highway construction. It is difficult to evaluate in terms of money what time is worth in non-commercial vehicle operations. However, the saving in time to all of us in driving to and from work, for recreation purposes, and for carrying on our daily activities has real value.

An example of measurable savings resulting from improved highways was recently proved by a large trucking company in New York, which reported that by using the New York Throughway it had achieved a safety record so good that its insurance cost was cut by 50,000 dollars per year. On the old road it travelled prior to construction of the New York Throughway, the trucking company could recap only 30 per cent of its tires, but with the Throughway in operation, it now recaps 75 per cent. Clutch and brake maintenance has been cut in half ; and because of better grades and easier curves of the Throughway, the trucking company can use lighter tractors and carry up to 1,500 pounds more pay load with less fuel consumption on every trip, all of which result in substantial reduction in operating costs.

The highway program offers a golden opportunity for cities and towns to co-ordinate urban rehabilitation and redevelopment with highway construction in eliminating blights and slums, and in halting the flight to the suburbs. Good roads, particulary expressways, bring the suburbanite residents to within shorter driving time of the down-town places of business and shopping center than it takes the city dweller to travel a much shorter but more congested route. This not only promotes the sub-division and development of new areas outside of the metropolitan centers and results in better and fuller utilization of land, but it preserves business and property values in the metropolitan central business district by making it more accessible. Expressways frequently open up new areas; and by minimizing the travel time between such areas and the metropolitan centers they transform otherwise low-value land into desirable residential, commercial, and industrial sites. Obviously, such extension of metropolitan limits results in greater land utilization and increases property value. This is particularly true in respect to land that is adjacent to, or in the vicinity of, the freeways. The modern highways that are already in operation and are a part of the new Inter-State System are providing faster, safer, and cheaper travel and shipping services and greater job opportunities. Everywhere they have been synonymous with industrial and residential growth. From the analysis of the data obtained in the Gulf Freeway study, it can be concluded that the influence of the Gulf Freeway has been largely responsible for the following:

1. Down-town commercial properties along the four-street system increased in value several times faster than similar properties in other parts of the city. More large commercial concerns have been established in this area since 1945 than in any similar area in the city. Similar properties a few blocks away from the facility have also been favourably affected by the freeway although on a smaller scale. The effect appears to be lessening slightly now that the freeway has been opened through this area for eight years.

2. Low-cost, run-down residences along the freeway have been replaced by small businesses, light industries, and multi-unit apartment buildings. The value of land along this portion of the freeway has increased considerably while similar properties in other parts of the city have had practically no change in value or use.

3. The value of vacant land within the study area along the Gulf Freeway has undergone a tremendous increase as compared to vacant land in other parts of the city. Those vacant tracts have been developed by light industries, shopping centers, new residential subdivisions, and multiunit apartment houses. Those tracts that remain vacant have either been purchased for development or are available at prices far in excess of their value prior to the construction of the freeway or the present value of vacant land in other parts of the city.

4. Restricted residential areas along the freeway have remained unchanged. There has been no change in land use, and property values have increased proportionately with similar properties in other parts of the city.

5. At the time the freeway was constructed through the integrated suburban center (Park Place), the value of land increased very rapidly as the displaced store owners re-established as near the facility and their previous sites as possible. Many new concerns moved in also. After the more desirable sites along the freeway had been taken, the activity slowed down and property values decreased slightly. However, a few blocks farther from the freeway there was an increase in activity and property values as new concerns started getting established on some of the thoroughfares leading to the freeway.

From the foregoing it can be concluded that the use and value of properties within the zones of influence of the Gulf freeway were affected by their position relative to the facility. The effect varied with the type of land use prior to the construction of the freeway and with proximity to the facility.

(From "Texas Highways" February, 1958.)

STORY TELLING

Husband (arriving home late): *"Can't you guess where I've been?."*

Wife: *"I can, but go on with your story"*.

STABILISED SOIL AS A BUILDING MATERIAL

By

E. W. Eller*

DUE primarily to the satisfactory physical and chemical properties of stabilised soil (a soil-cement or soil-lime mixture pressure moulded into bricks or blocks) its use for the construction of buildings of all types-houses, schools, hospitals, offices and factories—is growing apace. Experience over several years has amply demonstrated the intrinsic merits of stabilised soil, correctly processed, for this purpose. Moreover it has the great adavntage of marked economy and the writer is convinced that the overall picture of its widely extended application is very bright indeed.

The Union of South Africa can justly and proudly claim to be pioneers in this development, which has gone far beyond the realm of providing low cost housing for the 'under-privileged'. Indeed, homes ranging from country mansions to unpretentious but comfortable dwellings, from official buildings to farm-houses, bear eloquent and lasting testimony to the fundamental soundness of stabilised soil as a building material. And it is surely significant that to-day the method is in either experimental or full scale use in over 70 countries.

Stabilised soil is relatively cheap, but in the light of experience the writer contends that correctly processed soil-cement produces an excellent quality of walling and can be regarded as second only to quarried stone or face brick.

It is interesting to consider briefly the characteristics of soil-cement as a building medium in relation to other media. The data relate to materials and conditions in South Africa, but the modifications necessary to translate them to other countries can only be slight and the general conclusions are unimpaired.

Consider first its compression strength, i.e. the resistance offered by the material to a crushing load. In these terms ordinary 'country quality' burnt brick will withstand a loading of 200-600 lb/sq. in., good quality 800-1,000 lb first class quality around 1,500 lb and cement blocks 600-1,000 lb. By comparison soil-cement will withstand a loading of anything between 1,250 and 2,350 lb/sq. in.

Water resistance can be measured by the maximum amount of moisture which can be absorbed by the material before becoming saturated, and this may be expressed on a weight percentage basis. Tests demonstrate the validity of the following figures for the materials concerned: burnt brick, 14-30 per cent; face brick, 8 per cent; cement blocks, 12-14 per cent; soil-cement 6-9 per cent in general, though for a few 'border-line' soils the figure may be 10-12 per cent.

Burnt brick, face brick and soil-cement have substantially the same insulation qualities, in which respect cement blocks are definitely inferior.

Then we come to regularity of form a matter which affects appearance, speed of brick laying and cost of mortar. Made in a properly designed machine, soil-cement bricks are actually superior to face brick. They are, within a tolerence of ± 1/32 in., true to size in every dimension.

Weathering tests undertaken by responsible authorities in many parts of the world have shown soil-cement to be at least equal to best quality brick. In brief, cement-soil produced under the appropriate pressure conditions is essentially 'stabilised'.

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The Firm with which the writer is associated have since their inception specialised solely in the design and construction of soil-cement high-compression brick and block making machines and in soil-cement building practice. These machines can be operated by unskilled labour and the whole process requires a minimum of supervision.

The production of stabilised soil bricks or blocks is a simple procedure. The dry soil is screened through ¼ in. mesh, an amount of cement or lime, depending on the composition of the soil, is added and the whole well mixed. The 'ready-for-use' mix is then prepared by adding the requisite quantity of water. This mix is poured into the mould of the machine and pressure is applied manually through a toggle and cam system, a downward pull of 90 lb producing a compressive force of over 40,000 lb. Such a force compresses a standard size brick at 1,000 lb/sq. in.

The semi-dry hard bricks can be stacked 6 to 10 high on the day of moulding. Curing time for soil-cement is 6 to 10 days and for soil-lime 4 to 6 weeks. Air drying is all that is needed. Costs of production will naturally vary from country to country and area to area, but the cost of 1000 soil-cement bricks in any situation can be calculated from the following basic data.

For 1,000 bricks the materials needed are 70-80 cu. ft. of soil, 60-100 gallons of water and 3½-7½ cu. ft. of cement according to the type of soil (5½ cu. ft. of cement, the proportion for a 1 : 12 mix, may be taken as a fair working average).

The labour required for the preparation of the mix, including digging of soil, sieving, mixing-in of cement and water, and assuming no mechanical aids, amounts to 6 to 10 man-hours. The labour needed on a suitable high compression machine for brick making is 6 to 8 man-hours and for removing and stacking bricks (depending on local conditions and methods employed) 6 to 10 man-hours, a total of 18 to 28 man-hours.

Under operating conditions in South Africa it has been shown that, assuming the cost of a wall built in average quality soil-cement to be unity, then the cost of the same wall built in average quality burnt brick from a brick yard not more than 12 miles away would be twice as much and the cost of the same wall in country districts with bricks conveyed by rail and road over three times as much. These relative costs would probably apply in countries other than South Africa.

Summing-up, soil-cement is to-day providing housing for the masses in many under-developed countries. Practically throughout South Africa and in much of the rest of Africa it is providing luxury homes, industrial offices, stores, workshops, staff quarters, farm soils, reservoirs and walling of every conceivable type.

The writer feels that, as knowledge of the merits of soil-cement as a building material spreads, development of its application to structures of all types will take place rapidly.

[*From "Machinery Lloyd March 1, 1958."*]

LESSON OF SCIENCE

To travel hopefully is a better thing than to arrive.

—R. L. STEVENSON.

CONCRETE ROAD CONSTRUCTION ABROAD

By

N. R. SRINIVASAN †

(*Contd. from April 1958 T.C.M.R.*)

CONSTRUCTION METHODS

Germany

The soils in Germany vary from cohesionless sands to plastic silty clays and clays. German engineers usually avoided peat-bog area, but in the few unavoidable short sections over such areas, they superimposed the fill material and displaced the muck soil with dynamite charges. When high embankments had to be built on yielding sub-soils, the completion of the earthwork was so planned as to permit the major portion of settlement to take place before the concrete pavement was placed.

Frost damage was given important consideration. Wherever possible, soils susceptible to frost action were replaced. Concrete slabs were also placed at sufficient height above the ground water level. The Germans always used a layer of cohesionless sand between the slab and the subgrade. In fills too, it was used whenever possible even if it meant transporting the material from long distances. The sands were compacted with 'frog' rammers ½ to 1 ton in weight.[21]

The pavement slabs were of uniform depth of 8 in. to 10 in. The concrete contained aggregates supplied in a number of separated sizes. The maximum size was limited to about 1 in. A minimum flexural strength of 540 p.s.i. and a compressive strength of 4700 p.s.i. at 28 days were specified.[21] The water added was the minimum, usually between 0.35 to 0.5 W/C.

The heavy road-laying machinery travels on rails fixed to the previously laid concrete shoulder strip. Proportioning is done in a central weigh-batching plant. The mixers also travel on rails. Some of their viber-finishers could be employed both as tampers and vibrators. The vibrating frequencies could be as high as 3600 per minute. Usually these machines give several passes till the desired finish is obtained. The curing is done under sunshades, mounted on light wooden frames and carried on rails. Transverse dummy joints and central longitudinal joints are cut in concrete by a carborundum wheel. While reinforcement was not popular in the past, its value has, of late, been realised and it is often used. Dowels were usually used for load transfer. Expansion joints were spaced 40 ft-60 ft for reinforced sections.[21] Often there was a systematic increase in the joint spacing from slab to slab, in increments of 3 ft or so, with periodic return to the first spacing, obviously with a view to avoiding rhythmic vibrations in cars travelling at constant speed.

Belgium

The practices adopted in Belgium and Holland are much akin to the German methods. In Belgium the sub-base treatment varies with the foundation condition. Often 8 in. of graded crushed stones are placed before concrete is laid. In cuttings, this stone sub-base is placed over a layer of sand, sometimes 1 ft thick. Rapid hardening cements giving a concrete of crushing strength of 8500 p.s.i. at 56 days are used.[14] The mix is rich, of the order of 1 : 1 : 4. Reinforcement is not used much in Belgium.

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† Central Road Research Institute, New Delhi.

As in Germany rails are fixed to the banketts, previously placed. There is no travelling mixer along the rails as in Germany. Mixing is done in a central mixing plant and the concrete is transported in lorries and tipped into the trough of the spreading machine. It is said that no trouble of segregation was noted, perhaps due to the dry mix used. Very powerful vibration finishers are used as in Germany, for compaction and surface finish. The one notable feature about the Belgium way of construction is the type of joint cutters for making transverse joints. This has a blade equal to the width of the slab and half-an-hour after placing concrete, it is sunk into the concrete and vibrated within, till a clean joint is cut. The blade is then withdrawn and the joint filling material is introduced.

The use of tents for shade curing is prevalent in Belgium also.

Holland

The construction practice in Holland is akin to that of Belgium. Preference is given to rapid hardening Portland cement and blast furnace slag cement. The soils in Western Holland are very soft. Some of these cannot even stand the weight of cattle. Often the soils have to be removed to great depths, refilled with granular material and allowed to stand for at least one year for most of the settlement to take place.

Mention has already been made of the practice of constructing 'thresholds' or sills under the expansion joints over the whole width of the pavement. With these sills, trouble due to pumping is almost unknown. They also serve for load transfer.

England

Mechanised construction in England began just a few years before the last war, but with the war intervening and leaving the country with a variety of problems, not much of concrete road construction has taken place till now. However, lots of experimental work has been undertaken on such problems as slab thickness, length of plain and reinforced slabs, joint spacing, prestressed pavements, etc. A good amount of research work has been done on concrete laying machinery and on the riding quality of surfaces. It should be remembered in this connection that the main objection to concrete road construction in England is the comparatively poorer riding quality of the concrete surface. Hence great attention is paid to the causes and remedies. It has been found that uniformity of spreading is a very important factor in getting evenness of finished surface. Improvements in the existing spreading machines were said to be needed.[22] Also the practice of fixing the rail to the formwork itself was deprecated since due to the large vibrations and the heavy weights of the passing machinery, the forms may sink affecting the surface characteristics of the roads. The care of proper alignment and fixing of formwork was particularly stressed.[22] Quality control in concrete production and the weather conditions during construction were also found to be important factors affecting the road performance. It was found that most cracks developed in the experimental road were at the places where work was stopped due to break-down of machinery or similar causes.[22]

Research on the vibrating machinery has revealed that a low frequency (about 1500 V.P.M.) and high amplitude vibration machine gives better performance than a high frequency, low amplitude one.[23, 24] Housing Estate roads were often consructed with hand operated screeds. In compacting the concrete using these screeds, it was found that the practice of dragging the screed along the form gives unsatisfactory compaction. It has been suggested that the screed should be lifted and placed over the uncompacted concrete as the screed moves forward.[25] Mechanical contrivances to effect this has been incorporated in some of these screeds and this saves the strain of frequent lifting and placing of the screed by the labourers operating it.

Regarding output using fully mechanised construction it is considered that under the present conditions, an 8″ thick slab, 24 ft wide and 450 ft long a day, which is equivalent to 250 yards of concrete, is a reasonable output. In larger works, this output could be doubled.

Among new techniques, the rolled concrete construction is being increasingly used in England in recent years due to the ease of construction and economy involved. It is usually of lean concrete of the proportion of 1 : 15 or so[26] and serves as a base to a coated macadam carpet. The lean concrete from the mixer can be laid direct on the subgrade and compacted with vibratory rollers.

U. S. A.

The practice in U. S. varies somewhat markedly from that of the continent. American cements of today are finer than those of some 20 years back. With greater emphasis on fine grinding the Americans consider the coarser German cements inferior, though already doubts are expressed by some regarding the durability of fine cements. Such cements giving high early strength may have very little reserve strength in later ages.[27]

Regarding the subgrade preparation, the American specification requires that the top 6 in. of soil below sub-base profile be carefully scarified and recompacted to 90-95 per cent Proctor density.[28] The sub-base may be of gravel or selected granular material 6 in. - 12 in. thick, depending on the bearing value and quality of subgrade.

The concrete used was far wetter than on the continent. Consequently the vibrators used were not as powerful as those on the continent. Spreading and finishing were done by a variety of methods. Finishing was often done by longitudinal finishing beams 10 ft or 20 ft long, parallel to the axis of the road, which moves from side to side as the machine passes by. The riding quality was good. An output of 650 cubic yards of concrete was normal. Air entraining agents were used to give greater resistance to frost action and scaling. High tensile steel fabric reinforcement is used sometimes in one length near the top.

The tendency on the part of some of the States to omit expansion joints has already been mentioned. Already 9 States have omitted their provision and 3 States do not insist on this in their specifications.[13] There is also an increasing use of concrete saws for forming dummy contraction joints. These saws were used in Germany even before the war and besides U. S., many other European countries including England are either using or are experimenting with the use of these saws. The main advantages derived from sawing of joints are:

(1) Better riding quality of the road;

(2) Facilitating concreting, without any interruption;

(3) Ensuring better quality of concrete adjacent to the joints;

(4) Saving in filler material since the amount of material required to fill a sawn joint is less than the requirement of the manually made joint; and

(5) Straight and neat appearance of these narrow grooves cut by the saw.

These saws use circular blades revolving at a high speed for cutting. A typical machine has a four cylinder air cooled petrol engine developing 25 B.H.P. at 2400 R.P.M. A water pump is fitted to the machine to deliver a jet to the blade while cutting. Arrangements to adjust the depth of cut and for guiding the saw along a straight line marked on the concrete surface exist.

The three common types of blades employed are the Diamond, the wire reinforced silicon carbide and the steel centre silicon carbide ones. Of these the first is the most expensive costing in U. K. about Rs 900/- while the other two cost about Rs 50/- and Rs 35/- respectively. The choice of the blade mainly depends upon the type of aggregate and despite the higher initial cost, the diamond blade seems to be more economical when cutting concrete with granite and other hard aggregates after 48 hours of hardening.[29] There is a great variation in the cost data for cutting joints even within the same country; but it appears that at present cutting joints is a costly work and those

(*Continued on page 17*)

1952-54 SERIES OF TESTS AT THE ROAD TEST TRACK, MAJERHAT, CALCUTTA

Introduction: Experiments described below were conducted at the Road Test Track, Majerhat, Calcutta, during the period 1952–54. The scheme was financed by the Government of India on the advice of the Indian Roads Congress.

Scope: The object of the experiments was to test the relative performance of the stabilised soil base courses of varying thicknesses covered with the same type and thickness of intermediate and wearing coats, under adverse moisture conditions, so that the minimum thickness of such a base required for the test load might be determined.

Specifications: The specifications were based on the tests carried out on the West Bengal Roads & Buildings Research Institute, The layout of the test sections is shown in Fig. on page 25.

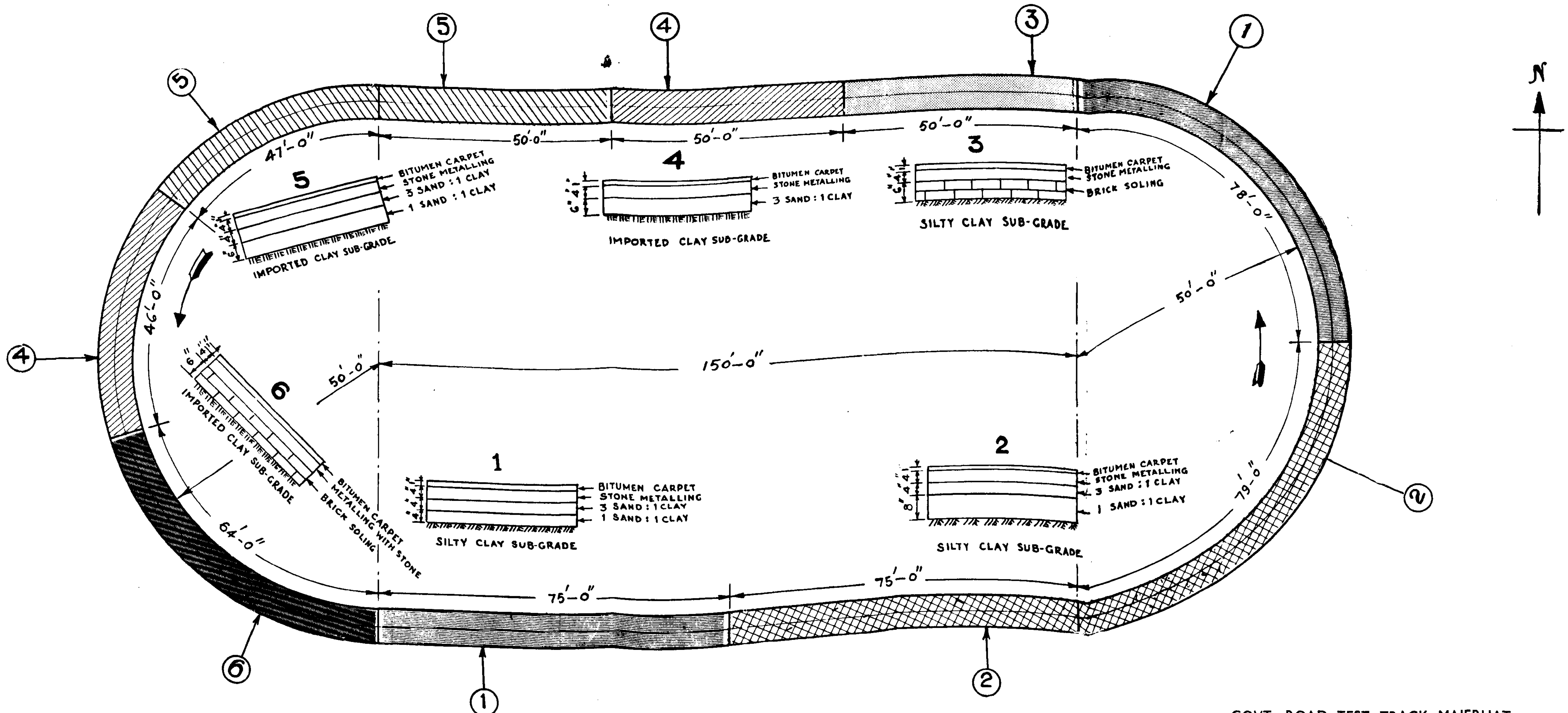
Field Tests: During construction some field bearing tests were also conducted for different layers under saturated conditions, with the help of the North Dakota Cone Penetrometer. The results were found to agree with those obtained in the Laboratory. During construction, the stabilized surface was allowed to dry for about 3 days after laying the base course, and a thin layer of ½ in. thick course Bazakar Sand was spread over all the sections (except test section No. 3) to save the softer base course from drainage during consolidation of the W. B. M. Coat over it.

Test Operation and Observations: The test was started on the 22nd June, 1953 when the sub-soil water was 9 ft 1 in. below the test road sections. The condition of the road surface was rather dry. Each 2-in. steel-tyred test cart attached to the power tractor weighed 2,000 lbs (gross weight), while each pneumatic tyred test cart weighed 3,000 lbs (gross weight). These were attached separately to a trailer-tractor.

The carts were drawn round the track at a speed of 3 miles per hour for about 2 weeks, during which period they completed 1,000 trips for initial ironing out of the surface. Thereafter, the load on the steel-tyred test cart was increased to 4,000 lbs (gross load) i.e., 1,000 lbs per inch width of the tyre and on each pneumatic-tyred cart the load was increased to 6,000 lbs (gross load). The test was continued for about a week when it was observed that the tar carpet had got deformed and there were slight upheavels on both the sides of the track. It was decided to suspend the test temporarily till the sub-soil water had risen within 2 to 3 ft from the road level. During this period the upheavels were smoothened out by drawing loaded pneumatic-tyred carts (6,000 lbs). Also, a seal coat over all the test sections was applied. The test was again started on the 25th September, 1953 when the sub-soil water was about 2 ft below the test road sections.

From 12-10-53 to 1-12-53, the test had to be closed again, temporarily, for repairing the affected tracks and defective electricity system. After the necessary repairs had been carried out the traffic was resumed again and the test was continued upto 10-12-53. On the 8th January, 1954 the members of the Test Track Committee of the Indian Roads Congress met to discuss the results of the tests. After inspecting the test sections they decided that the test should be continued further and recommended as follows:

(i) ridges and humps on the road surface should be removed and a dense carpet applied; the test should be continued with the



GOVT. ROAD TEST TRACK MAJERHAT
LAYOUT PLAN FOR
1952 SERIES OF TESTS

SCALE:—15 FEET = 1 INCH.

water table maintained at 1 ft 6 in. below road level for at least one month ;

(ii) arrangements should be made to carry out the plate bearing test on the base courses ;

(iii) observations should be made, at intervals, to note the development of deformation in the different layers till destruction.

As per decision of the Committee all the damaged portions of the test sections were repaired and arrangements were made to raise the water level artificially by sinking a tube-well and drawing water from it. Also, the plate bearing test was carried out.

From the 7th August 1954, to the 18th October 1954, the test was continued under adverse moisture conditions. The water level varied from 9 inches to 1 ft 6 in. below the road. During this period damaged portions of the carpet had to be repaired for smooth running of the test carts. To observe deformation of the base and the sub-base courses trenches were dug out in each of the test sections.

Conclusion: The Members of the Test Track Committee of the Indian Roads Congress inspected the trenches and concluded that: (i) the stabilised base did not fail under the test conditions, and (ii) two layers of bricksoling could be compared favourably with the 7-in. thick stabilised soil base.

(*Continued from page 13*)

who adopt it do so despite this for the other benefits obtained.

Concluding Remarks

Even though our present method of concrete road construction is devoid of much mechanisation, there is likely to be a gradual change, first with the introduction of small scale machinery and later with full scale mechanised construction in certain major road works. The experiences of other countries where full scale mechanisation is already in vogue should be of use in choosing the method suited to our conditions.

Acknowledgments

The note was prepared as a result of the information collected during the Author's study in England under the Colombo plan. The note is published with the kind permission of the Director, Central Road Research Institute, Delhi.

REFERENCES

21. F. H. Jackson and H. Allen—"Concrete Pavements in German Autobahn", Public Roads; Vol. 25(4) 1948, pp. 65-79.

22. "Riding Qualities of Concrete Roads," Road and Road Construction, Vol. 31, 1953 ; p. 233.

23. R.H.H. Kirham & A. C. Whiffin—The "Compaction of Concrete Slab by Surface Vibration—First Series of Experiments," Magazine of Concrete Research No. 8. 1951, pp. 79-91.

24. W. H. Glanville—"Survey of Road Research at home and Abroad", Contractor's Record and Public Works Engineer Vol. 5 (3), 1953, pp. 39-55.

25. R. H. H. Kirkham and M. G. White—"Methods of Improving the Riding quality of Concrete Roads laid with hand Operated Vibrating Finishers"—Roads and Road Construction, Vol. 30 (359), pp. 317-21, 1952.

26. "Use of Lean Concrete in Estate Road Construction," Highways and Bridges Vol. 19 (980) ,1953, p. 4.

27. Dr. Bogue—Private Communication.

28. "Specifications for Concrete Pavement Construction"—A. S. S. H. O. 1950.

29. L. S. Blake & L. O. Southen—"Sawn Joints in Concrete Roads and Airfields Pavements," The Surveyor, Vol. 115, 3338, p. 153, 1956.

DISCUSSIONS AND CONCLUSIONS OF THE XITH ITALIAN ROADS CONGRESS—MAY 1957

THE topic on the agenda was the determination of the criteria for the establishment of standards for the design, construction and modernisation of roads in relation to the traffic.

Eighteen authors had submitted individual reports on this question and these reports were considered and discussed.

MM. Ariano, Jelmoni and Berti were asked to undertake the drafting of the general report, a summary of which is given below.

Criteria to be followed in the Planning of Roads

The principal factors to be taken into consideration when planning a road, whether the plans concern the construction of a new road or the improvement, with a view to its modernisation, of a road already in existence, are: the soil and the movement of the vehicular traffic.

The first factor must be regarded from two aspects: the physical aspect (morphological, hydrographical, and geognostical); and the second factor from three aspects, that is to say, safety, regularity and economy.

Although it does not seem possible to lay down detailed standards of general applicability for the drawing up of the plans, suitable for every case and for every situation, it is possible, however, to formulate certain basic rules which the designer should follow as a frame work for the technical criteria forming the data for his work, without however, his personal responsibility for the plans being affected by such rules.

These rules mainly relate to the design of the lay-out, both in line and level, which must satisfy the requirements of the basic purpose of the road, while at the same time being adapted to the terrain in the most suitable and natural manner: that is to say, it must follow the orographical characteristics without disturbing the flow of water or the system of natural static equilibrium, and without interfering too much with the aesthetic and panoramic values of the site.

The general plan of the scheme must likewise be drawn up in accordance with the intended economic and social utility of the road. This utility must be considered in the light of the whole of the benefits that the road is able to provide: as a general rule, the overall benefits should not be less than the total expenditure which would be required for the construction and the maintenance of the road and the operation of the transport taken as a whole.

However, it is frequently advisable to make allowance for gradual improvement by planning the new road as a structure that can readily be extended, in successive stages, as the traffic increases both in quality and in quantity.

The technical characteristics of the gradient and the curvature of a road are not independent of one another: they must harmonise in order to confer on the lay-out, throughout its entire length, a three-dimensional aspect that is rational and in accordance with the design.

Similarly, the widths of the carriageway and of the verges and other adjuncts of the road, the length of clear visibility, any crossings and junctions must be planned in order to constitute an harmonious whole.

The technical planning of a scheme for a new road or for the modernisation of an existing road, must begin by a study of

the ground: a study in the most comprehensive meaning of the term, that is to say, a knowledge of the ground in its most intimate details, which can only be revealed by a geotechnical investigation. The topographical survey must be thorough and accurate.

With a view to ensuring harmonious relationships between those responsible for the supervision of the work and the contractors undertaking the construction of the road, a careful and thorough study of the specifications for the work is essential; these specifications must be clear and detailed and as precise as possible; the responsibilities of the contractor must be distinctly stated and the regulations governing the work must be indicated in a manner that is quite clear and devoid of any risk of ambiguity; the same observations apply to the contract prices, in which allowance should be made for the actual costs borne by the contractor.

The three-dimensional aspect of the road must, in accordance with what we have just said, satisfy the purposes for which the road has been designed, but must also be adapted to suit the topography and the nature of the terrain on which the road is to be constructed.

A succession of straight sections connected by wide and easy transition curves, and a series of properly connected gradients, would appear to summarise, in the most general terms, the basic characteristics of any road plan.

In this connection, it is only necessary to recall that the general aspect of the lay-out, either in plan or in level, can be judged as satisfactory from a consideration of the following points:

—The possibility of adapting the road to the terrain in the most satisfactory manner by reducing the cuttings and embankments and hence the amount of earth movement;

—The avoidance as far as possible of any disturbance of the natural equilibrium of the ground when this exhibits a static formation lacking in stability;

—The finding of the most suitable means of introducing the road into the landscape, while disturbing as little as possible the appearance of the surroundings in which the road is located;

—The possibility of designing a lay-out which is less monotonous for road users while at the same time keeping the driver's attention alert and improving the attractiveness of the road by a succession of panoramic views;

—Preventing fatigue of the engines and other working parts of vehicle;

—Reducing the discomfort and danger due to dazzle from headlamps during the hours of darkness.

Gradients

In selecting gradients consideration must be given to the question of the running of the engines. When passing from a flatter to a steeper gradient, it is essential that the transition curve should have sufficient length to enable the operation of the gear-change, should this be necessary, to be made quite easily.

The gradients must be such as to enable the heaviest vehicles—for which a normal frequency should be assumed—to climb under economic running conditions, even when conditions may incline to be slippery, particularly when such vehicles pass along the road fairly, frequently; similarly, the slopes must also provide the necessary degree of safety for the descending traffic.

It must not be overlooked that although it is usually possible to widen a road if the carriageway, owing to an increase in the traffic, has become too narrow, and although it is similarly possible, to some extent, to alter curves that have become inadequate or dangerous, it is very difficult, and sometimes it is even impossible, to correct the slope of a gradient or of a series of gradients.

Gradients must also be suitably alternated on lengths of road having a small radius of curvature, while at the same time avoiding excessive splitting up of the longitudinal profile. This is particularly important in connection with bends in the road where the gradient should not exceed 2 or 3 p. 100, not only along the development of the curve, but also over a certain length before and after the bend.

On the other hand, in exceptional circumstances, an increase in the gradient may be tolerated—in cases where this is necessary for reasons connected with the topography—on short inclines which can be rushed, taking advantage of the impetus which has been acquired by the vehicles.

Local reverse slopes must be avoided, as a rule, but they cannot be entirely prohibited when their adoption would result in an improvement to the road, making it safer and more economical without any appreciable deteriment to the economy and regularity of the road traffic.

In such cases, the transition curves of the opposed gradients must have a radius of curvature which takes into consideration the maximum design speed, in order to ensure the necessary distance of free visibility at the summit, and so that the effects of vertical centrifugal force can be reduced throughout.

Curves

As far as the plan is concerned, however the lay-out should make it possible for a straight section of road of sufficient length to be located between two successive circular curves, particularly if they run in opposite directions.

According to circumstances, this straight section may be replaced, totally on in part, by transition curves with variable curvature.

It is more particularly for the lay-out of roads over which traffic is to travel at a relatively high speed that these transition curves should be employed, at least for bends of rather small radius, in order to ensure uniform conditions of safety and regularity in the speed of the vehicles over the entire length of the road.

The planning and lay-out of transition curves "clothoid" or "lemniscate curves" can be undertaken fairly easily by the use of specially prepared tables which are now quite well known.

The curves constitute the most troublesome points in determining the lay-out of a road in relation to the traffic; it is not sufficient for the designer to maintain certain minimum values for the radius in relation to the importance of the road or of the section of the road affected by the curve.

There are other factors which exert an influence; the minimum value of the radius which must be given to a circular curve must be related to the development of the straight sections of the road adjacent to the curve itself, to the value of the angle which these sections make with one another, to the presence or otherwise of transition curves between the circular curve and the continuous straight sections, and to the general sinuosity of the length of road in question, that is to say, the ratio between the straight sections and the curves.

In the case of roads on the sides of hills or mountains, where it is not possible to dispense with "hairpin bends", the radius of curvature of these bends can be reduced to between 12 and 15 metres in the case of secondary roads and to between 25 and 30 metres in the case of main roads.

However, for various reasons of a technical or economic nature, both as regards construction and traffic operation, it seems advisable to restrict the use of "hair-pin bends" exclusively to exceptional cases.

On those sections where there are "hair-pin bends", the longitudinal gradient of the road must not exceed 2 or 3 p. 100, as we have already pointed out; the carriageway must be suitably widened in order to enable the bend to accommodate large-sized vehicles.

Super-elevation

The super-elevation to be given to the carriageway along the curve must be calculated in relation to the design speed and the length of the radius. In order to allow for slow-moving vehicles this super-elevation must not, however, be exaggerated. On that account the maximum super-elevation permissible is 10 p. 100.

Similarly, the design speed of the road and the radius of the curve, as well as the dimensions of the largest vehicles, it is anticipated will use the road, must be taken into account in determining the widening of the road on the curves for the purpose of safeguarding the safety and regularity of the traffic, particularly as regards overtaking or passing.

The lay-out must be designed in such a manner as to be "comfortable" for the road user.

In this connection, it should be pointed out that very long straight sections, owing to their monotony, induce a feeling of tiredness in drivers which may become dangerous; the same sense of fatigue may also be produced by long stretches of road formed by a long succession of curves having geometrical characteristics that are almost identical.

In every case it seems necessary to recommend that a generous margin should be allowed when assessing the minimum distance of visibility, by the adoption, as the estimate of the reaction time, of a minimum of one second.

Widths

The dimensioning of the carriageway and the verges must always be determined in relation to the nature, the volume, the density and the speed of the traffic.

The width of the carriageway is established on the basis of the width of the "traffic lanes", that is to say, on the strips intended for each stream of vehicles, and the number of such lanes.

For roads of minor importance the carriageway may consist of a single traffic lane; points for vehicles to pass one another, an occurrence which is anticipated to be somewhat infrequent, could be replaced by making use of the verges when these are sufficiently wide and substantial, or by arranging for widenings at reasonable distances and readily visible from one another.

Consequently, it is possible to design roads of even 4 metres in width, whereby the cost is considerably reduced, particularly in mountainous areas and this, among other things, would make the construction of the roads more likely.

However, it is advisable that a solution of this kind should satisfy a real criterion of general economic validity, in the sense that such a solution should only be applied in cases where it is clearly evident that the road in question could never be called upon to bear heavier traffic.

It seems of interest to draw the attention of designers to the advantages presented by the verges. The verges must form a shoulder to the pavement of the carriageway, enable vehicles to park, afford an adequate safety margin for fast-moving traffic by inducing vehicles not to occupy a position near the centre of the carriageway, provide a site for signals and shelters, and for a path for the use of cyclists and pedestrians.

Consequently, in addition to an adequate width, the verges must now-a-days be strong enough to withstand heavy loads.

The width of the "Traffic lanes" was fixed at 3 metres in the circular letter from the Minister, M. Romita (this width had also been recommended in 1930 at the VIth International Road Congress), but this regulation proved, in actual practice, to be too inflexible, because on roads used by considerable numbers of lorries with trailers, or on which vehicles travelled at high speeds, it was found necessary to adhere to widths of the order of 3.5 to 3.75 m.

In many other cases, on the contrary, in order to promote economy in the costs of construction of the road (as well as the likelihood of the work being undertaken) it is possible to remain satisfied with a width of 2.50 to 2.70 metres, particularly if the road is in a mountainous area.

The number of "Traffic" lanes which should be comprised in the carriageway of a road depends solely on the volume and density of the traffic, on the relative proportions of fast-moving and slow-moving vehicles, and on the importance of the road as well as the purpose for which it is intended.

For a carriageway with three "traffic lanes", it is a sound rule to give the central "lane", which is intended for overtaking and along which vehicles consequently travel at much higher speeds, a slightly greater width than that of the side lanes. If, for example, the side lanes have a width of 3.50 metres the central lane might be 4.25 metres wide.

Carriageways with more than 3 "traffic lanes" appear to be unnecessary and must be avoided; if the volume of traffic requires 4 "lanes" it is preferable to arrange for two separate carriageways, divided by a central reserve.

Design Speed

One aspect of the plan which must not be overlooked is that the road must be introduced into the natural surroundings in the least arbitrary manner in order to avoid, as far as possible, any disturbance to the appearance of the landscape.

The lay-out must be designed and planned in such a way that it has a homogeneous character, so that an isolated vehicle is able to travel along the road up to a certain limit of speed, that may be termed the *design speed* of the road, at a uniform rate, with complete safety on the bends and under economic running conditions.

The criterion of the design speed appears to be the most rational as well as the most practical criterion for general application, owing to the fact that the limiting values to be attributed to all the technical characteristics of the road depend upon the value of the design speed.

The same criterion of design speed should likewise be followed in every scheme for modernisation, in order that such plans may be carried out in a thorough manner, either immediately or in successive stages, in order to take account of the limited financial resources available. In the latter case, the first stage should comprise the whole of the work planned to give the road the degree of safety necessitated by the contemplated design speed. A careful study of the points where accidents have occurred should prove extremely useful. In the successive stages, constructional work relating to homogeneous length of the road should be undertaken.

It may therefore be concluded that modernisation must, let us repeat, be comprehensive and involve all the inter-dependent characteristics of the road, in view of the fact that the improvement of a single one of them makes it essential to improve all the others.

(To be continued)

(From "Bulletin De L' Association Internationale Permanente Des Congress De La Route" No. 148.)

FRIPPERY

According to Mr. Robert F. Wagner, Mayor of New York and Chairman of the Metropolitan Regional Conference, one way to tackle the parking problem is to reduce the size of the American automobile which, he feels, has too many frills using up more parking area than necessary.

HERE AND THERE

1. SOIL CEMENT—ULTRASONIC TESTING OF HARDENING RATE

● THE methods adopted by the Road Research Laboratory for testing concrete by an ultrasonic pulse technique and reported in Technical Paper No. 34, has also been found efficacious for testing the hardening of soil cement.

Generally the soil contains varying proportions of organic matter and the greater the proportion the slower the hardening when the cement is mixed with the soil. The mixture is usually, in the case of roads, of the order of 1 part cement to 10 of soil and the soil used will preferably contain a good deal of sand.

It was found that the pulse velocity increased with the age of the specimen and that there was a relationship between the pulse velocity and the compressive strength. The change in pulse velocity is most sensitive to change in compressive strength when the soil cement is very weak. This is valuable as the pulse velocity can be used to detect the initial stages of hardening.

It is hoped by the R.R.L. to find what relationship may be revealed according to the percentage and type of organic content.

The research on the rate of hardening of soil-cement has reached a stage when it can safely be said that the non-destructive method is satisfactory thus saving the preparation of the large number of specimens required for the conventional methods employed.

(From "Highways and Bridges and Engineering Works," January 8, 1958).

2. VIADUCT INVESTIGATION ON LONDON-YORKSHIRE MOTORWAY HYDRAULIC RESEARCH SAVES 800,000 POUNDS

● AN estimated saving of 800,000 pounds has been made on the cost of a proposed viaduct. An investigation just completed by government scientists has substantially reduced the length of the viaduct, which will carry the London-Yorkshire motorway across the River Trent and its flood plain.

The investigation was made by the hydraulics Research Station D.S.I.R., at the request of the Ministry of Transport and Civil Aviation and their consulting engineers, Sir Owen Williams and Partners, and with the co-operation of the Trent River Board.

The crossing will be located near the village of Sawley (Notts.), some ten miles upstream of Nottingham and half a mile below the confluence of the Rivers Trent and Derwent.

A model of the rivers, representing approximately five square miles, was built to scales of 1/200 horizontally and 1/50 vertically. It covers 3,200 sq. ft. of floor space in the Main Hall of the Hydraulics Research Station at Wallingford, Berkshire, and incorporates about 5½ miles of the Trent and 1½ miles of the Derwent and their flood plains, all of which were accurately moulded in concrete. All bridges, culverts and embankments were inserted to scale and provision was made to supply, regulate and measure the flows in each river individually.

Model Tests

Tests were made to establish the number, span and disposition of flood arches. The most important of these tests were carried out at a flow of 35,000 cubic feet per second (cusecs)—the greatest flow recorded in recent years. This flood covered the valley to a mean depth of 3 ft over a width of 8,000 ft at the site of the motorway.

The criterion adopted for comparing the efficiency of the various viaduct designs was the afflux at a gauge point in the river a quarter of a mile upstream of the structure. (The afflux is the amount by which the water level would rise above its present level at this point as a result of building the viaduct.)

The first design was a symmetrical viaduct. Tests showed that, 46 40-ft arches would be required to limit the afflux to 3 ins. at 35,000 cusecs (an equal number to the north and south of the river.)

Research on the model proved that the southern arches were much less effective than the northern arches and various arrangements were then tested to take advantage of low-lying pockets of ground to the North.

The Research Station was able to recommend that the most effective and yet economical design would be an asymmetrical arrangement which would span the regions of more active flow over the low-lying ground. For the same afflux (3 ins. at 35,000 cusecs) the number of 40-ft arches would be reduced to 23 (20 to the north and three to the south—(exactly half the number required with a symmetrical arrangement.

(From "Highways and Bridges and Engineering Works," January 8, 1958).

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3. HIGHWAY IMPROVEMENT IN BRUSSELS

● THE Increase in the population, the approaching 1958 International Exhibition and the proposed establishment of offices for international organisations in Brussels led in 1954 to a series of studies for the improvement of Traffic conditions. In 1955 a plan was adopted which has based on the modernization and development of the existing network and which would not entail the expropriation of land and the high costs of creating an urban parkway system. In 1956 and 1957 the roads leading into the city and the concentric traffic arteries (inner and outer belt systems and ring drive) were modernized. The tramway system was retained and service was improved.

Improvements in the inner belt boulevard system included construction of 4-lane underpasses and a 3-lane viaduct. A 4-lane tunnel was constructed under a narrow radial traffic artery.

The outer belt system was also modernized for a considerable part of its length.

Improvements of the Brussels ring drive included the betterment of existing roads and the construction of new parkway type sections.

The access roads to the Exhibition as well as large parking areas have been designed to handle the heavy traffic expected in 1958.

(From "De L' Institut Technique Du Batiment Et Des Travaux Publics," March-April, 1958.)

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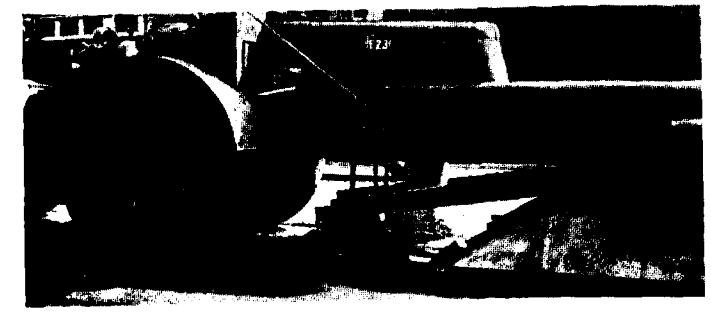
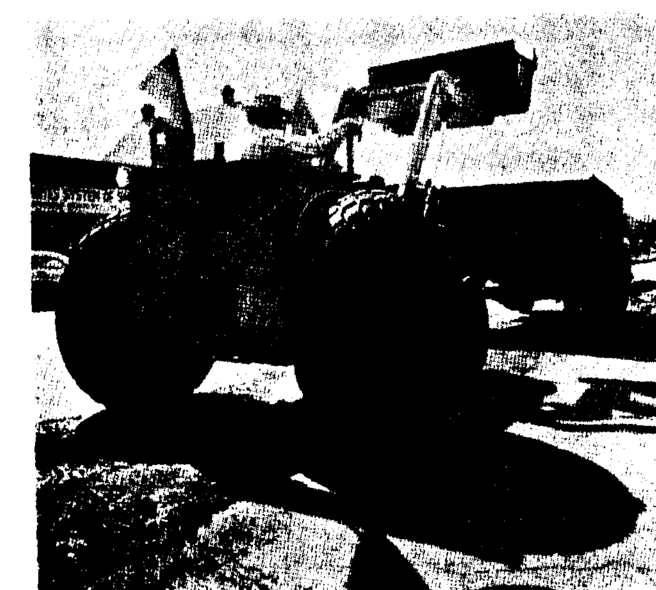
4. CHEAP AND TRAFFIC-SPARING WAY TO REPAIR STREETS

● BY turning to the use of heater-planers, St. Louis has reduced the cost of removing corrugated asphalt pavements from 1.10 dollars to 13 cents per sq. yd., according to Charles G. Gilmore, Superintendent of the street maintenance section of the city's department of streets.

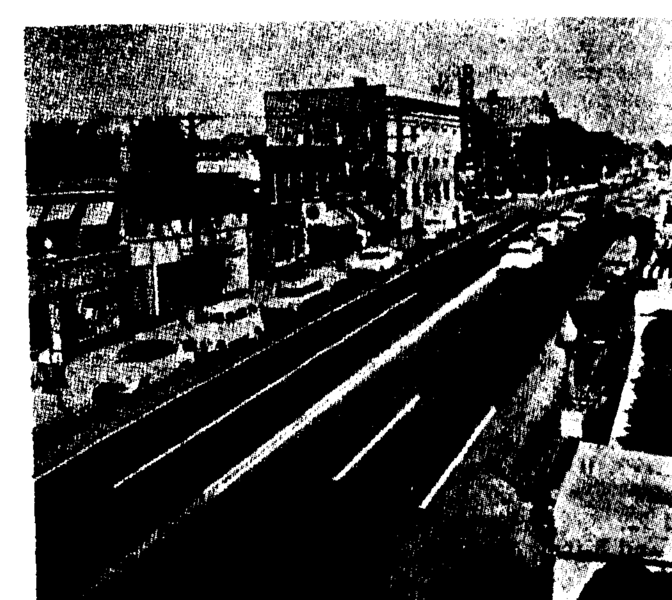
With a large percentage of its 1,100 miles of street and 500 miles of alley



Heater-planer scrapes out corrugated asphalt pavement in St. Louis streets



Forming windrow for tractor-shovel to deposit in truck



Leaving smooth surface (... patches) to take seal coat

paved in asphalt, St. Louis was hard-pressed to keep up with maintenance needs, with only three small surface heaters to remove the patches of deteriorated surface. Then in 1953 it purchased a mobile heater-planer unit, and another in 1955. With them, the city averages 250,000 sq. yd. of pavement removed each year, with minimum inconvenience to traffic.

The heater-planer quickly moves into position over the cracked and spalled stretch of pavement, shaves down the surface and leaves a windrow along the centre of the levelled section. A tractor-shovel deposits this windrow into dump trucks immediately following the heater-planer. Crew for these operations consists of one foreman, two truck drivers, two labourers plus the equipment operators.

In most cases, the heater-planer treatment is followed with an asphalt seal coat and 3/8 in. traprock. The heater-planers are used all year round, except for the most inclement weather.

The scraped material is used on unmade streets and alleys, and for plugging frost holes in all types of pavement.

(From "Engineering News–Record," March 13, 1958.)

5. ILLINOIS CONTINUOUSLY REINFORCED PAVEMENT CONCLUSIONS

● THE Information obtained from observations and study of the Illinois experimental pavement support the following conclusions:

1. Large numbers of transverse cracks develop in continuously reinforced pavements, their frequency being proportional to the amount of longitudinal steel.

2. Cracks are relatively wide spaced near the ends of a long continuously reinforced slab, their frequency increases at a fairly uniform rate to a maximum at a distance of 200 to 500 ft from the ends, from whence the frequency remains fairly constant over the long central portion.

3. A large number of transverse cracks occur very early, and thereafter the development of cracks is a function of age, the rate of development decreasing with time. It appears that transverse cracking in the Illinois pavement has reached an equilibrium at the end of ten years and that cracks can be expected to occur at a very slow rate in the future.

4. After 10 years the average crack intervals for the sections with 0.3, 0.5, 0.7 and 1.0 per cent longitudinal steel, respectively, are approximately 12, 8, 6, and 5 ft, considering the 7 and 8-in. pavements collectively. There is no significant difference between the thicknesses of pavement.

5. The width of cracks is an important factor in the performance of continuously reinforced pavement. Cracks must be narrow to minimize infiltration of soil and water and maintain effective aggregate interlock between crack interfaces.

6. Crack width is a function of the amount of longitudinal steel, the greater the percentage of steel the smaller the crack. It also increases with age.

7. At the age of 10 years the crack measured by focusing a measuring microscope on a point below the pavement surface, so as to reduce the effect of raveling, averages 0.034, 0.023, 0.016 and 0.009 in. for the 0.3, 0.5, 0.7, and 1.0 per cent sections, respectively, considering both 7-and 8-in. pavements collectively. There are no significant differences between the two thicknesses.

8. Cores drilled through representative cracks in each section indicate that the real width of the cracks is less than that measured by the microscope. On the basis of limited data, perhaps a reasonable approximation would be that the real width is about half of the measured width.

9. Raveling and spalling along the edges of the cracks is of no serious consequence, except at a few cracks in the 0.3 per cent sections which are excessively wide and where apparently the steel is broken. The cracks are not visible from a vehicle travelling at 30 mph.

10. Meandering longitudinal cracks will occur in a continuously reinforced pavement built without a controlled centre joint. While they may be of little significance structurally, they are likely to be considerably wider than the transverse cracks, will ravel more, and become unsightly.

11. Continuous reinforcement will reduce the tendency for pumping, judging from behaviour of the Illinois pavement. However, in view of the fact that some pavement pumping occurred, it appears that it would be wise to use a thin granular sub-base under this type of pavement as an added safety factor.

12. Construction joints are points of potential weakness and need provision for adequate load transfer. This can be accomplished by using at least No. 5 bars at a maximum of 6-in. centres or by providing auxiliary dowel bars when a lesser amount of reinforcing steel is used.

13. Sections of continuously reinforced pavement of the lengths used in this investigation and separated by wide expansion joints, will show a permanent increase in length with age. The cause of this growth is not readily apparent. Whether a similar increase would occur in sections several times that length is not known.

14. Continuously reinforced pavement can be built to a high standard of surface smoothness, and can be expected to possess good riding qualities throughout a long life.

15. A properly designed and constructed continuously reinforced pavement will require little maintenance and will compare favourably in this respect with pavement of conventional design.

16. It appears that on the basis of first cost, maintenance cost, service, life and salvage value, continuously reinforced pavements are economically sound.

(From: "Roads and Streets," March 1958.)

HOW LONG

The question is now rapidly becoming not whether we can afford new roads, but whether we can afford much longer to be without them.

Highway Times, February 1958.

WISHFUL THINKING

Over their coffee at the corner drug store, three stenos were considering what it would be like to be stranded with a man on a desert island.

"I'd want the man I was stranded with to be a good conversationalist," said the first.

The second said, "I'd rather mine were a good hunter and a talented cook."

The third thought a while and smiled, "I'd want to be with a damned good obstetrician."

CURRENT LITERATURE

ABSTRACTS

CODE OF PRACTICE FOR PRE-STRESSED CONCRETE.

PRESTRESSED Concrete is a comparatively recent development, and, in many respects, is markedly dissimilar to reinforced concrete construction. It is desirable, therefore, that prestressed concrete should be looked upon as a subject by itself, and be not approached merely as another form of reinforced concrete construction.

With a view to provide guidance for prestressed concrete work in the country, and to further develop this technique, while permitting justified latitude in the design and construction of prestressed concrete structure, the ISI has prepared a draft Indian Standard Code of Practice [Doc: BDC 2 (355)] for prestressed concrete, and has invited comments from the public before finalising the standard.

The Code follows closely the revised Indian Standard (IS: 456-1957) Code of Practice for Plain and Reinforced Concrete for General Building Construction, and IS: 457-1957 Code of Practice for General Construction of Plain and Reinforced Concrete for Dams, which were issued recently.

The Present Code is based on considerations mainly applying to statically determinate structures. In the case of statically indeterminate structures the provision of the Code may be applied taking into account special conditions of the case.

This Code is expected to be followed by two specifications for high tensile steel wire and high tensile steel bars for prestressing purposes. Interested persons can get copies of the draft Code, on request, from the offices of ISI at New Delhi-1, Calcutta-1, Bombay-1, and Madras-6 and send their comments by 25th June 1958.

CONCRETE PAVEMENT TEST PROJECTS IN CONNECTICUT AND INDIANA–Bulletin No. 165, Highway Research Correlation Service, Highway Research Board of the National Academy of Sciences—National Research Council, 2101, Constitution, Washington, D.C.

THE first of the two reports in this bulletin gives the 23-year results of special tests and traffic on 8.35 miles of concrete pavement near Indianapolis, Indiana. Special design features incorporated in nine half-mile sections of pavement included different designs of joints and patterns of steel reinforcement. Seven other sections representative of the then standard design of concrete pavement in that state were interspersed among the specially designed test sections. The last pavement condition survey and detailed observations, made in 1954, supplied interesting data worthy of notice preceding the planned resurfacing and widening of the Highway.

The other report describes the design, construction, and four years of the life history of a concrete pavement test section in Connecticut. The test pavement, in the eastbound roadway of the Wilbur Cross Highway between Hartford and Tolland, was constructed in August 1952. Object of the test was to study the relative performance of different designs of dowelled transverse joints. Comparisons were made between expansion and contraction joints on the basis of measured changes in joint openings and the observed conditions of the pavement and the joint fillers. The special test section and some adjoining portions of the same highway were tested with a road roughness indicator. Joint faulting was classed as slight, but in some instances samples of dowels removed from the pavement showed pronounced rusting.

(Continued on page 31)

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

X. BRIDGES AND OTHER STRUCTURES

1. **The Vibration of Simple Span Highway Bridges**; J. M. BIGGS H. S. SUER, J. M. LOUW, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. 83, No. ST2*, March 1957, 1186/1-32.

2. **Analysis of Multiple Span Continuous Trusses**; BENJAMIN C. F. WEI, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. 83, No. ST2*, March 1957, 1187/1-21.

3. **Resistance to Westerning of Single Short Piles**: E. CZERNIAK, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. No. 83, No. ST2*, March 1957, 1188/1-25.

4. **Confirmation of Inelastic Stress Distribution in Concrete**: EIVIND HOGRESTAD, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. 83, No. ST2*, March 1957, 1189/1-17.

5. **Design of Flexible Steel Arches by Interaction Diagrams**; H. A. MIKLOFSKY, O. J. SOTILLO, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. 83, No. ST2*, March 1957, 1190/1-35.

6. **Prestressed Truss-Beams**; R. L. BARNETT, *Proceedings of the American Society of Civil Engineers, Journal of the Structural Division, Vol. 83, No. ST2*, March 1957, 1191/1-22.

7. **The St. Alban Bridge over the Rhein at Basel**; A. G. AEGESTER, *Schweizerische Bauseitung, Vol. 75, No. 28*, July 13, 1957, pp. 441-446 (in German.)

8. **Stressed Slabs have Draped Strands**; *Engineering News Record, Vol. 159, No. 1*, July 4, 1957, pp. 40-42.

9. **Design of Statically-Indeterminate Structures by the "Plastic-hinge" Method**; R. GARTNER, *Concrete & Constructional Engineering, Vol. LII, No. 5*, May 1957, pp. 161-174.

10. **The Use of high-Tensile Steel Reinforcement**; K. HAJNAL-KONYI, *Concrete and Constructional Engineering- Vol. LII, No. 6*, June 1957, pp. 197, 209, and *Vol. LII, No. 12*, December 1957, pp. 397-409.

11. **Estimating the Size of Rectangular Beams**; F. H. TURNER, *Concrete and Constructional Engineering, Vol. LII, No. 7*, July 1957, pp. 233-236.

12. **Design of Reinforced and Prestressed Bridges**; DR. RICCARDO MORANDI, *Concrete and Constructional Engineering, Vol. LII, No. 7*, July 1957, pp. 237-245.

13. **Prestressed Concrete Bridge for Heavy Loads**; E. A. L. KEITH, *Concrete and Constructional Engineering, Vol. LII, No. 7*, July 1957, pp. 247-251.

14. **Laterally Loaded Plates, Moment Distribution Around a Small Circular Hole**; RAYMOND HICKS, *Engineering, Vol. 184, No. 4770*, August 9, 1957, p. 175.

15. **Masonry Arch Bridges—a Study**; C. S. CHETTOE and W. HENDERSON, *Proceedings of the Institution of Civil Engineers, Vol. 7, Session 1956-57*, August 1957, pp. 723-774.

    The Surveyor, Vol. CXVI, No. 3396, May 25, 1957, pp. 571-572.

16. **Recent Highway Bridgeworks in Glamorgan with Particular Reference to Prestressed Conrete Design and Construction**; E. N. DAVIES, *Proceedings of the Institution of Civil Engineers, Vol. 7, Session 1956-57*, August 1957, pp. 897-900.

17. **Structural Use of Reinforced Concrete in Buildings-Revised Code of Practice C. P. 114: Summary of the Main Changes**, *The Surveyor, Vol. CXVI, No. 3406*, August 3, 1957, pp. 815–816.

18. **Concreted Tension Flange Saves Steel**; *Engineering News Record, Vol. 158, No. 23*, June 6, 1957, pp. 82-83.

19. **Alpine Road Tunnel Projects**; *The Engineer, Vol. 204, No. 5300*, August 23, 1957, pp. 279-280.

20. **The St. Alban Bridge over Rheine at Basel**; O. OBERHOLZER, *Schweizerishe Bauzeitung, Vol. 75, No. 33*, August 17, 1957, pp. 515-520 (In German).

21. **The Inelastic Analysis of Reinforced Concrete Slabs**; S. K. MALLICK and K. S. RANGASAMI, *The Indian Concrete Journal, Vol. 31, No. 9*, September 1957, pp. 287-292.

22. **Simplified Design of Balanced Cantilever Bridges**; N. C. BHARGAVA and SHITALA SHARAN, *The Indian Concrete Journal, Vol. 31, No. 9*, September, 1957, pp. 308-312 and *Vol. 31, No. 5*, May 1957.

23. **Application of Relaxation Methods to Engineering Problems**; Prof. R. M. ADVANI and ALAM SINGH, *Journal of the Institution of Engineers (India), Vol. 38 No. 1*, Part I, September 1957, pp. 27-64.

24. **Bridge Works on Federal Express Highways**; Dr. W. KLINGENBERG, *Der Bauingenieur, Vol. 32, No. 7*, July 1957, pp. 245-258 (In German).

25. **The Suspension Bridge over Seine at Tancarville**; K. H. SEEGERS, *Der Bauingenieur, Vol. 32, No. 7*, July 1957, pp. 275-276 (In German).

26. **The New Bridge Construction in Tersin**; WALTER KRISI, *Schiveizerische, Bauzeitung, Vol. 75, No. 38*, September 21, 1957, pp. 605-609 (In German).

27. **Composite Steel and Concrete Decks for Three Highways Bridges in the Fez Area**; M. GERBIER, *Travaux, Vol. 41, No. 275*, September 1957, pp. 453-470 (In French).

28. **Nomograms for the Design of Reinforced Concrete Sections Subjected to Simple Bending**; P. FAWIER, *Travaux, Vol. 41, No. 275*, September 1957, pp. 472-478 (In French).

29. **The Tancaville Road Bridge**; *Travaux, Vol. 41, No. 275*, September 1957, pp. 479-489 (In French).

30. **The Design and Construction of the Hindiya Bridge**; JOHN FRANCIS CAUSTON SWANSBOURNE, *The Institution of Civil Engineers, Proceedings, Vol. 8, Session 1956-57*, September 1957, pp. 2-16.

31. **Why are many California Bridges Prestressed?**; *Engineering News Record, Vol. 159, No. 3*, July 18, 1957, pp. 36-44.

32. **Girders Roll on to Piers from Pile Bends**; *Engineering News Record. Vol. 159, No. 3*, July 18, 1957, pp. 44-48.

33. **Genevreville Tunnel**; G. ONDOTTE and F. GUITAUT, *Travaux, Vol. 41, No. 278*, December 1957, pp. 589-598 (In French).

34. **Ghilam Timber Bridge, 500 Yard Girder Structure**; *Highways and Bridges and Engineering Works, Vol, XXV, No. 1219*, December 4, 1957, p. 3.

35. **Lifting Bridge over Swale at Isle of Sheppy**; *The Surveyor, Vol. CXVI, No. 3424*, December 7, 1957, p. 1260, and *Highways & Bridges and Engineering Works, Vol. XXV, No. 1220*, December 11, 1957, pp. 1 and 3.

36. **New Bridge over the River Allan at Bridge of Allan**; W. A. FAIRHURST, *The Journal of the Institution of Municipal Engineers, Vol. 84, No. 6*, December 1957, pp. 185-192.

(Continued from page 28)

SOIL DENSITY CONTROL METHODS—Bulletin No. 159, Highway Research Correlation Service, Highway Research Board of the National Academy of Sciences—National Research Council, 2101, Constitution, Washington, D.C.

SINCE the early 1930's when the relationship between soil moisture, density and compactive effort was discovered, an increasing interest has developed in the use of density as a measure of compaction.

Recently, efforts have been made by both engineers and contractors towards the preparation of specifications which call for compaction in terms of the quality of results rather than in terms of construction equipment and methods.

If compaction is to be measured and specified in terms of density, significance of density needs to be well understood, and specification requirements so stated that they will result in the quality of construction intended. Moreover, adequate and realistic density values must be specified and fast, accurate and practicable methods for measuring-in-place densities must be provided.

The four papers in this bulletin are significant contributions toward betterment of our knowledge of compaction, of methods of controlling compaction, and methods for measurement of soil density.

FOAMED ASPHALT IN BITUMINOUS PAVING MIXTURES—Highways and Bridges and Engineering Works, January 1, 1958.

RESEARCH studies made under the direction of Professor L.H. Csanyi, Head of the Bituminous Research Laboratory, Iowa State College, have not only shown that a bituminous binder can be efficiently and effectively foamed in sound forms, but that the use of a foamed binder in bituminous mixes and soil stabilisation work can offer many real advantages.

In a paper prepared for the Highways Research Board and forming part of Bulletin 160, Prof. Csanyi has given the conclusion derived by him.

INVESTIGATIONS ON THE DYNAMIC BEARING CAPACITY OF STRATIFIED SOILS; M. Davin, Engineer-in-Chief, Bridges & Roads, Ministere des Travaux Publics Et Des Transports, Annales Des Ponts Et Chaussees, March-April 1958.

THE "Stratified Soils", whose behaviour under loads which vary from time to time, is studied in this article, are assimilated to perfectly elastic media, indefinite in depth, limited on a horizontal plane and constituted by layers of uniform thickness, each of them homogeneous and isotropic, the lowest layer, of course, being of infinite thickness.

Burmister has studied their behaviour under the action of static loads in the case of two or three layers and on the basis of two different assumptions with regard to the bonding between two strata. The writer takes up this study again in connection with two strata when the load, concentrated on the surface of one stratum, varies sinusoidaly from time to time. He arrives at very complicated results as to which, however, he has ascertained that they comprise those of Burmister as a special case when the impulses of the sinusodal load tend towards 0.

He has also studied an extreme case, where the upper layer can be assimilated to a "paving slab" (very thin layer of sufficient relative rigidity, compared with that of the lower layer, for its effect to be anything but negligible).

He then makes a tentative study of the case where the soil is formed of very thin and very numerous strata, and at its extreme, tends to become a medium whose characteristics vary continuously as a function of the depth alone.

Finally, on a soil of a single or a double layer, he has studied the influence of a load which is displaced on the free surface by a uniform movement of translation.

RECENT ADDITIONS TO THE LIBRARY OF THE INDIAN ROADS CONGRESS

1. **Highway Research Board Special Report No. 17—" Road Sides Their Use and Protection "—1954 ;** Highway Research Board, 2101, Constitution Avenue, Washington 25 D. C.

2. **Highway Research Board Bibliography No. 17—" Effect of Water on Bitumen-Aggregates Mixtures ; 1954 ;** Highway Research Board, 2101, Constitution Avenue, Washington 25 D. C.

3. **Road Research Technical Paper No. 29—" The Use of Stabilized Soil for Road Construction in the U.S.A."—1954 ;** K. E. Clare, Road Research Laboratory, Harmondsworth, West Drayton, Middlesex, England.

4. **Road Research Technical Paper No. 32—Vehicle Head-Lighting Visibility and Glare-1954 ;** A. J. Harris, Road Research Laboratory, Harmondsworth, West Drayton, Middlesex, England.

5. **" A Simple Glare Meter ";** **V. J. Jehu, [Reprinted from Electronic Engineering, August 1954, 26(318), 359-60] ;** Road Research Laboratory, Harmondsworth, West Drayton, Middlesex, England.

6. **" The Indian Bullock-Cart: Its Pre-Historic and Vedic Ancestors "** P. K. Gode **(Reprinted from the Poona Orientalist, Vol. V, Nos. 2-3, pp. 144-151, 1940** Curator Bhandarkar, Oriental Research Institute, Poona.

7. **" The Future of the Bullock-Cart " B.V.Yagh, [Reprinted from the Silver Jubilee Volume of the Institution of Engineers (India), Bombay Centre] ;**

8. **Concrete Research Laboratory Annual Report 1951-Madras P.W.D. ;** Chepauk, Madras.

9. **" Agricultural Situation in India " June 1955 ;** Economic and Statistical Adviser, Ministry of Food and Agriculture, New Delhi.

10. **" Presidential Address Institution of Engineers (India) 35th Annual General Meeting, Hyderabad, February 20, 1955 ";** S. B. Joshi.

11. **" Expanded Metal in Resurfacing " Research Report No. 11, June 1955 ;** L. W. Crump and A. J. Bone, Massachusetts Institute of Technology, Department of Civil and Sanitary Engineering and Commonwealth of Massachusetts Department of Public Works, Joint Highway Research Project, Cambridge, Massachusetts.

12. **" Welded Wire Fabric in Bituminous Resurfacing Progress Report No. 1, Research Report No. 17, November 1955 ;** J. W. Horn, V. J. Roggeveen and A. J. Bone, Massachusetts Institute of Technology, Deptt. of Civil and Sanitary Engineering and Commonwealth of Massachusetts of Department of Public Works, Joint Highway Research Project, Cambridge, Massachusetts.

13. **" Lateral Stability of Bridge Arches Braced with Transverse Bars "—No. 84-1954, Transactions of the Royal Institute of Technology, Stockholm, Sweden ;** Kungl Tekniska, Hogskolans, Handlingar, Royal Institute of Technology, Stockholm, Sweden.

14. **" Further Investigations into Iterated Sine and Cosine Integrals and Their Amplitude Functions with Reference to Auteuna Theory No. 89-1955, Transactions of the Royal Institute of Technology ;** Erik Hallen Kungl, Tekniska, Hogskolans, Handlingar, Royal Institute of Technology, Stockholm, Sweden.

BUDGETS AND ADMINISTRATION REPORTS

GOVERNMENT OF UTTAR PRADESH BUDGET 1958-59

The following extracts relating to civil works have been taken from the Uttar Pradesh Government Budget for the year 1958-59.

Revenue (Civil Works)

Heads	In lakhs of Rupees Actuals	Revised Estimates 1957-58	Budget Estimates 1958-59
Rents of Buildings	3.15	2.40	2.40
Ferry receipts	23.45	19.90	19.90
Tolls on roads	0.85	0.40	0.40
Recoveries of expenditure	3.45	1.75	1.75
Miscellaneous	93.25	17.50	17.03
Tolls on bridges	—	4.50	8.00
Subventions from the Central Govt. for Budha Jayanti road works	0.17	2.74	1.51
Subventions from the Central Govt. for unemployment Relief Schemes for road projects	—	47.86	52.44
Subventions from the Govt. of India for Development Schemes included in the Second Five Year Plan	—	—	154.05
Deduct-refunds	-0.70	-0.75	-0.75
Total	123.62	96.30	256.73
Expenditure (Civil Works)			
Buildings			
Original works	29.85	25.45	20.25
Repairs	15.07	15.69	17.43
Communications			
Original Works	118.56	63.48	78.26
Repairs	277.04	274.19	293.83
Miscellaneous			
Original works	2.45	2.18	2.11
Repairs	6.16	2.88	3.08
Tools and Plants	5.67	4.26	3.29
Suspense	7.66	1.00	1.00
Capital outlay on Civil Works met from Subventions from the Govt. of India for Development Schemes included in the Second Five Year Plan	—	—	154.05
Establishment	13.46	23.00	22.27
Grants-in-aid	25.41	64.51	25.57
Deduct - Recoveries adjusted in the accounts in reduction of expenditure	-57.10	-41.37	-41.66
Total	428.91	435.27	579.48

Expenditure (Civil Works)

Heads	In lakhs of Rupees Actuals	Revised Estimates 1957-58	Budget Estimates 1958-59
Original Works			
Buildings	271.08	370·57	482.96
Communications	264.73	310.63	341.78
Miscellaneous	13.14	18.41	9.49
Tools and Plants	5.96	6.64	6.43
Suspense	26.13	3.00	3.00
Establishment	42.66	35.56	43.00
Deduct-recoveries adjusted in the account in reduction of expenditure	-80.56	-95.27	-202.78
Total	543.14	649.54	683.88
Revenue From Roads			
Receipts under the U. P. Motor Vehicles Taxation	141.43	128.00	130.00
Receipts under the Indian Motor Vehicles Act	—	10.00	10.30
Deduct-refunds	-1.04	-2.20	-2.30
Tax on sale of motor spirits	30.75	40.03	55.03
Total	171.14	175.83	193.03

GOVERNMENT OF UTTAR PRADESH CIVIL WORKS BUDGET 1958-59

(A brief review)

THE estimated revenue and expenditure figures for the year 1958-59 are Rs 10822.92 lakhs and Rs 11276.53 lakhs respectively. The anticipated deficit on the revenue account is therefore Rs 453.61 lakhs. The revised estimates for the year 1957-58 ended with a balanced budget, the revenue and expenditure both being Rs 10392.63 lakhs. In the year 1956-57 the actual revenue collection amounted to Rs 8995.97 lakhs, while the sum spent amounted to Rs 8983.98 lakhs. Thus the year 1956-57 ended with a revenue surplus of Rs 11.99 lakhs.

Revenue expenditure on civil works in 1958-59 is estimated at Rs 579.48 lakhs, which form 5.35 per cent of the total revenue for the year. The corresponding ratios for the years 1957-58 (revised) and 1956-57 (actuals) are 4.19 per cent and 4.77 per cent respectively.

The proportion of expenditure on communications (original works and repairs) to total revenue for 1958-59 estimate is 3.44 per cent while for 1957-58 (revised estimates) and for 1956-57 (actuals) the corresponding figures are 3.25 per cent and 4.40 per cent respectively.

The total outlay on civil works outside the revenue account for the year 1958-59 is Rs 683.88 lakhs out of which Rs 341.78 lakhs are proposed to be spent on communications alone.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

Sr. No.	Job No.	Name of work	Amount (Rs in lakhs)
		ASSAM	
1.	1875 AS 39	Reconstruction of the timber bridge No. 12/5 (Daigrong) on Numaligarh Dimapur Road National Highway No. 39 in Golaghat Sub-Division.	0.67
		BIHAR	
2.	1872 BR 21	Construction of a viaduct on the Southern approach at the crossing of Ganga bridge at Mokameh on National Highway No. 31.	2.66
		BOMBAY	
3.		Two works each costing less than 2 lakhs.	0.30
		JAMMU AND KASHMIR	
4.		Three works each costing less than 2 lakhs.	0.63
		KERALA	
5.	T. A. No. 103-KR 47	Improvements to National Highway No. 47 Main Central Road, miles 151/6 to 153/7.	1.74
		MADHYA PRADESH	
6.	1877 CP 43	Black topping of Raipur-Abbanapur section of National Highway No. 43, from mile 3 to 18.	2.00
7.	1878 CP 43	National Highway No. 43, Raipur Jagdalpur Vizayanagaram Road miles 49 to 66 fur. 1 to 4 Estimate regarding widening the formation width to 38 ft.	0.50
8.	1879 CP 43	National Highway No. 43 Raipur Jagdalpur Vizayanagaram Road miles 49 to 66 fur. 1 to 4 Estimate regarding reconditioning and black topping.	3.27

Sr. No.	Job No.	Name of work	Amount (Rs in lakhs)
		MADRAS	
9.	1868 MD 7	Constructing a bye-pass road at mile 294/4 to 301/1 of G.S.T. Road at Madurai National Highway No. 7	8.00
		MYSORE	
10.	1867 MY 4	Improving the curves at certain places on National Highway No. 4.	0.24
		PUNJAB	
11.		Two works each costing less than 2 lakhs.	1.05
		UTTAR PRADESH	
12.	1873 UP 2	Construction of approaches to the over-bridge at Bad to replace the existing level crossing in mile 778 of Bombay—Delhi Road, National Highway No. 2 in Mathura District.	2.46

PERSONAL AND MISCELLANEOUS

SHRI S. L. BAZAZ, Additional Consulting Engineer (Bridges) left for Berlin on the 3rd May 1958 to attend the Third International Congress of the F.I.P. (Federation Internationale de la Precontrainte). Shri Bazaz will also inspect some of the important bridges in Europe.

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SHRI S. R. MEHRA, Director, Central Road Research Institute, has gone as a member of the Indian Scientists' delegation to the U.S.S.R., for a period of three weeks. He left India on the 30th April 1958.

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SHRI S. N. CHIB, Director General in the Tourist Department and ex-officio Joint Secretary in the ministry of Transport and Communications left India on the 14th May 1958 on a tour of Europe.

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The Central India Centre of the Institution of Engineers (India) held a symposium on "How can the Institution be made more useful and effective" on the 14th May 1958. The discussion in which many members took part was interesting and brought forth useful suggestions.

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SHRI N. V. MODAK, Special Engineer, Bombay Municipal Corporatian, has been appointed Director, Central Public Health Engineering Research Institule with effect from April 8, 1958.