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HIGHWAYS CAN BE MADE SAFER

(Extracted from "SAE Journal"—May, 1952.)

SOME highways are safer than others. What makes them safer? How safe can a highway be? For example, the accident rate on the Merritt Parkway—to which traffic is diverted from U. S. 1—is little more than one-third as high as it is on U. S. 1. The Parkway is, of course, restricted to passenger vehicles but records on expressways in Connecticut where trucks and buses also are handled indicate comparable safety. What makes these highways safer?

What Makes Parkways and Expressways Safer

Of foremost importance in parkway and expressway construction is the control of access from abutting properties. Vehicles enter and leave only at constructed access roads. Right-of-way purchases are made to take away an owner's right to enter the new parkway. With access to the facility controlled, one of the greatest sources of accidents on major highways is controlled.

Another important safety element on parkways and expressways is the physical separation of opposing traffic movements by a median divider. The possibility of head-on collisions, with their generally fatal result, is greatly reduced.

The elimination of conflict with crossing traffic at intersecting roads is another safety feature. Bridges are built to carry crossing traffic over or under the roadway. Pavements of ample width, accelerating lanes for entering traffic, consistent and generally flat curves and grades, and shoulder space for emergency parking are other safety-promoting characteristics. Of importance, too, is the prohibition of pedestrian use of these facilities.

Thus, it is easy to appreciate why highways and expressways are safer. It is important, however, to appreciate fully and to preserve all of the hazard-reducing elements. Analysis of accident data has demonstrated that relaxation of standards is directly reflected in increased accidents. Two examples are provided by the Merritt Parkway.

Initially, so-called "cross-overs" were constructed in the median divider. But it soon became apparent that many of the accidents on the Parkway were occurring because of the vehicle conflict at these cross-overs. It was further determined that there was no absolute need for the cross-overs because motorists could make all manoeuvres by using access ramps and bridge crossings. The cross-overs were closed and one source of accidents eliminated.

On the Merritt Parkway grass shoulders are provided for emergency parking. The shoulders are well maintained, the curb at the pavement edge is easily mounted, and frequent signs direct motorists to park off the pavement. However, many motorists apparently are loathe to drive over the curb onto the grass.

A few years ago, all accidents on the Merritt Parkway which resulted in fatalities were analyzed. One-third were found to result from accidents involving vehicles parked on the pavement. Bear in mind that the Merritt Parkway quite properly has a world-wide reputation for safety. But it appears that its record might be even better if it had hard-surfaced shoulders. Plans have been initiated to reconstruct the shoulders and, presumably when funds are available, the Parkway will get hard-surfaced shoulders and potentially more safety.

Safety Can Be Built Into Other Roads

How about roads that can't be rebuilt as parkways and expressways because traffic volume is insufficient to justify such action? **Pavements on these new highways may be wider, shoulders more stable, curves flatter, and sight distances longer**, but there will not be striking differences between the new and the old as is true when expressways are built. Safety values, also, of these new roads are not so readily apparent. However, they are there.

In 1940, Connecticut initiated the most vital step in accident analysis procedure from the standpoint of the influence of the highway on accidents. This step involved the determination for each reported accident of the precise location of its occurrence.

With these accident records, it is possible to determine the number of accidents in a particular period of time on every section of state highway.

For design purposes and for evaluating the adequacy of existing highways, roads are grouped according to the magnitude of the traffic they serve. The average rate of accident occurrence for all existing highways within traffic groups has been established. And, within each group, accident rates have been established for a select mileage of recently constructed "standard meeting" highways.

In every traffic group, the highways built to high standards have a lower accident rate than the average for all highways in the group. Bear in mind that all other factors affecting safety can be presumed to be the same. The same drivers in the same motor vehicles use both types of highways. Enforcement is no different, nor are signs and markings. The only difference is in the character of the road.

Table 1 shows a comparison between the accident rates, for the period 1945-48, on existing rural state highways and on standard-meeting highways. The probable number of accidents that could have been eliminated if all roads met standards is also shown. Altogether, 7770 accidents (37 per cent of the total number of rural state highway accidents) can be charged to deficiencies in rural state highways.

Table 1

Comparison of Accident Rates on Rural State Highways to Standard-Meeting Highways

(Accident Rate = Accidents per 100 Million Vehicle Miles) (1945–1948)

Design Traffic Volume Groups (20 Years Hence)	Accident Rate on all Rural State Highways	Accident Rate on Standard-Meeting Highways	Probable Savings in Accident Rate by Improving All Rural Highways to Standard	Probable Number of Accidents that could have been eliminated by Improving all Rural Highways to Standard
Under 750 Daily	288	200	88	160
750 to 1450 Daily	330	183	147	1110
1500 to 2950 Daily	356	233	123	1380
3000 Daily to 510 Hourly in Major Direction	365	299	66	590
520 to 790 Hourly in Major Direction	353	274	79	1010
800 to 1450 Hourly in Major Direction	301	121	180	2090
2300 and over Hourly in Major Direction	248	Assume 120	128	1330
Total				7770

There are not enough urban standard-meeting highways in different traffic volume groups to give statistically stable values for all groups. It appears, however, that an even higher percentage of accidents could be eliminated in urban areas by modern highways.

Planned Improvement

It will be appreciated that an entire state highway system cannot be reconstructed in short order. However, if programs are aimed at the high accident rate sections, the maximum in added safety within a specific program size will be obtained.

For example, in one traffic volume group there are 530 miles of rural state highways. There are 22 miles on which no accidents have occurred and, at the other extreme, 5 miles of road on which 150 accidents have occurred. There are 17 miles with an accident rate higher than 900 per 100 million vehicle miles of travel, whereas the average rate for the standard-meeting highways is 233. Here, then, is the tip-off on how safety can be built into a highway system with the greatest dispatch.

We are beginning to know what modernizing our highways can mean in added safety. A real approach to the problem of isolating specific features of the road in relation to their influence on the safety of travel has yet to be made. Furthermore, there are, without question, certain potentialities for further safety in the structure of highways. Studies being made in Connecticut will gradually disclose them and establish, as well, just how safe a highway can be.

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THE LESSONS OF WAR AND PEACE ARE THE SAME

In Peace

"I have come to the conclusion that one thing to which we must give topmost priority is roads — roads of all kinds, not only very up-to-date bitumenized or cement roads, but roads of any kind, to open out vast areas of this country which are closed up today and which you cannot reach unless you walk or ride.....I give roads first priority."

Jawaharlal Nehru.

"Among the social services, I put communications first since I do not see how it is possible to effect any great improvement in health and education in the villages of India unless they can be reached surely and quickly at all times."

Lord Wavell.

In War

"The more experience I have had of both peace and war, the more I appreciate its general truth. After some years in high military command, I am inclined to put forward as a parallel dictum that "War is Transportation." Certainly it is the ruling factor in military operations; and no campaign has better illustrated this than that on the North-East frontier of India and in the north of Burma."

Lord Wavell.

PROPHECY *

(Extracted from "The Structural Engineer." Dec., 1951.)

IT is natural to be cautious in adopting new ideas or materials, but such caution should be based on reason and not simply bias. Prophets are so often confounded and objectors change to merely nuisances. I am led to make this somewhat sententious comment by a number of statements by such objectors which I have come across in my search for material for this address. The following are examples :

Just prior to the opening of the Exhibition of 1851, it was said of the Crystal Palace "A gigantic building of glass and iron could not be made stable. There would be a stupendous disaster. The first gale that blew would reduce it to a shapeless wreck." Or again, "Even if the glass case managed to resist the gales, the heat engendered by the sun when it poured its rays upon the glass would be so terrific that no human being could hope to withstand it, consequently if they escaped the avalanche of glass they would be roasted to death inside it."

Even a group of eminent engineers proved to their own satisfaction that the structure was unsound, yet it stood for nearly 90 years.

In an introduction to a text-book on Iron published in 1872, the author stated that "It is questionable whether the substitution of iron for wood, bricks and stone is not being carried too far, and whether the new perishable substance is not frequently adopted for the sake of cheapness or facility of construction in cases where the more durable but less tractable material, stone, would be more appropriate, more noble and more worthy of the profession."

Such attitudes of mind are still with us. I need only remind you as an example applicable to the present Exhibition, of the fear of standing immediately under the Skylon! * * *

I have now completed my brief review. Much of what I have said will be well-known to some of you, but not I hope to all, particularly the younger members. If this historical study brings about some spirit of humility and acts as an inspiration to even a few, then I shall feel well repaid. May I suggest that the conclusions to be drawn are :—

1. There has not been a great change in the types or form of construction, but rather an increase in the number of materials at our disposal and improvements in techniques.

2. That engineers should beware of thinking they have the final answer to any problem, but rather to keep an open mind.

3. That each individual member should avoid, as far as lies in his power, specialising in one branch of structures, or one material, at too early an age—in short, to endeavour to become an engineer rather than a mere designer of structural elements.

4. To realise that structural engineering is a form of applied economics, and that there is an urgent need for the conservation of all materials and a saving of labour.

5. That every job we do has a social significance.

6. Appreciate that we are not more ingenious than our predecessors of 1851. Rather we have greater opportunities and better tools. **They appear to have been light of heart and sure of themselves—we not so**. What we most require is the opportunity to apply new knowledge, use new materials, and develop new techniques, without restraint or restrictions—but they are conditions somewhat outside our ability to bring about.

* From the Presidential address by Walter C. Andrews, OBE, MICE., M.I. Struct, E., at a General Meeting of the Institution of Structural Engineers, London, held on Thursday, October 11th, 1951.

WE NEED THE COURAGE TO DEMAND MORE FUNDS

(Extracted from "Better Roads"—April, 1952.)

THE problem of a choice of design standards is basically one of highway economics. Studies indicate that the annual monetary benefits to road users realized by the improvement of heavy-traffic primary highways far exceed the annual cost of amortization of investment, operation and maintenance. It is thus good business to increase the fees and taxes charged against road users to provide these greatly needed facilites; in fact, careful examination will often disclose that realization of the monetary benefits to road users now will much more than support the service on borrowed money to be repaid through increased fees and taxes in the years to come.

It would appear that highway authorities have been at fault in not bringing this situation to the attention of the members of state legislatures and pressing for the additional funds needed to keep vital main state highways improved to meet the demands of modern traffic. Unfortunately, many of the groups in the highway transportation industry, through a mistaken conception of their own interests, have constantly fought against gasoline and other road-user taxes. They fail to realize that in the long pull the prosperity of their own businesses depends on the existence of well-maintained highways, constructed to design standards adequate to meet modern traffic conditions, and that failure to provide the funds necessary to accomplish this objective not only will retard the development of the economy of the country, but will likewise ultimately result in a drastic decline in their own businesses.

Many authorities have lacked the courage to present these matters to the legislatures and the fortitude to withstand the pressures of special-interest groups; thus through expediency they have improved roads to standards far below present traffic needs. In the meantime the federal government has invaded the field of gasoline taxation, and is now taking more than 800,000,000 dollars annually from this source. If the states had levied higher gasoline taxes, perhaps this would not have occurred. Leaders of the American Association of State Highway Officials recently testified before the road committees of Congress, and recommended an annual authorization of federal funds in the next road bill of not less than 800,000,000 dollars. This compares to a 2,000,000,000 dollars annual take of the federal government from the road user.

The devaluation of the dollar resulting from the inflation since the war has particularly aggravated the situation. The highway dollar is now worth about half as much as it was in 1940. Fees and taxes levied on road users for the use of highways have not increased nearly in proportion to the decline in the purchasing power of the dollar. New automobiles and trucks now cost more than twice as much as they did in 1940, yet highway taxes have risen only slightly. Why, in the face of prevailing conditions, should road taxes not be increased? Road authorities must have more of the cheaper dollars if the job is to be done.

Highway standards, of course, must be commensurate with traffic. Economics will not justify high standards on low-traffic roads; but if the defeatist attitude be assumed that modernization of the primary highway system must be postponed, an effective blow will be

(Continued on page 17)

BRIDGING INDIA'S RIVERS

THE TALDANGA BRIDGE

THE Taldanga bridge takes N. H. 5 (Calcutta-Madras Highway) across the Taldanga canal which traverses the town of Cuttack. The construction of the bridge was taken up in May 1950 while the Kathjuri and the Kuakhai bridges were being built, as without bridging the canal these two bridges* could not be used effectively to connect Cuttack and Bhubaneshwar, the old and new capitals of Orissa.

The Taldanga Canal takes off from the Mahanadi near Cuttack and is an irrigation-cum-navigation canal.

The selection of site presented no problems in this case as the bridge was to be on an artificial channel.

Numerous Alternative Designs

Numerous alternative designs were examined in detail before deciding upon the design finally adopted. A design for a bow-string girder bridge of 100 ft span with masonry arch spans in the approach was got out in the Central Roads Organization. The firm of contractors who were building the Kathjuri bridge within less than a mile from the Taldanga bridge site was asked to quote. As the quotation was considered high the firm was asked to submit revised quotations for alternative designs. These were :—

(1) R. C. bow-string girder design

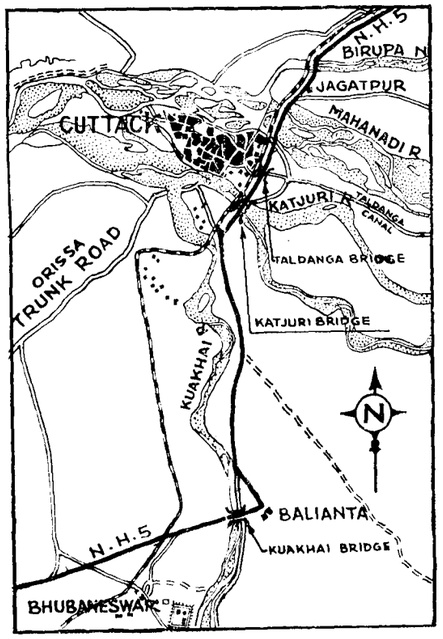
The Taldanga Bridge. The railway bridge upstream can be seen in the background.

* Articles on these bridges have appeared in our issues for March and May 1952.

(2) Uniformly thick R. C. solid slab (103 ft main span) with 40 ft cantilevers.

(3) R. C. solid slab of varying thickness (103 ft main span) with 40 ft cantilevers.

(4) R. C. T-beam and slab (106 ft main span) and 38½ ft cantilevers.



Out of these, alternative No. 3 was considered the best on technical grounds, but some changes were considered to be necessary. The design which emerged finally consisted of—

(1) Main R. C. solid slab of varying thickness of 103 ft span between bearings;

(2) Two cantilever spans of 47 ft each of R. C. solid slab of varying thickness;

(3) Two suspended spans of 3 ft each between the cantilever spans and piers;

(4) A semi-circular masonry arch span of 29 ft 6 in. and three segmental masonry arch spans of 20 ft each in the approach.

The main dimensions and other particulars of the bridge are :—

Overall length including abutments, 317 ft; spans, as described above; shaft height of main piers, 29 ft; batter in piers, 1 in 24; carriageway, 24 ft; total width of superstructure, 26 ft 6 in.; thickness of slab at bearings, 7 ft; at the centre, 2 ft 9 in.; at the ends of cantilevers, 2 ft 11 in.:

Live load, Indian Roads Congress Class AA on the carriageway.

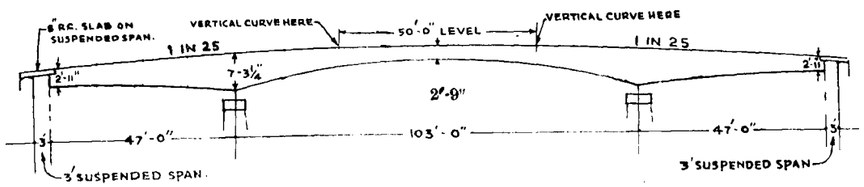
Foundations: open, on sandy soil; average pressure intensity on the foundation, 1.5 tons per sq. ft.

Discharge in the canal, 1100 cusecs; velocity, 3 ft per second.

Costs

The total cost of the bridge was Rs 365,000. As the quotation was on a lumpsum basis the break-up of this amount is given only approximately:

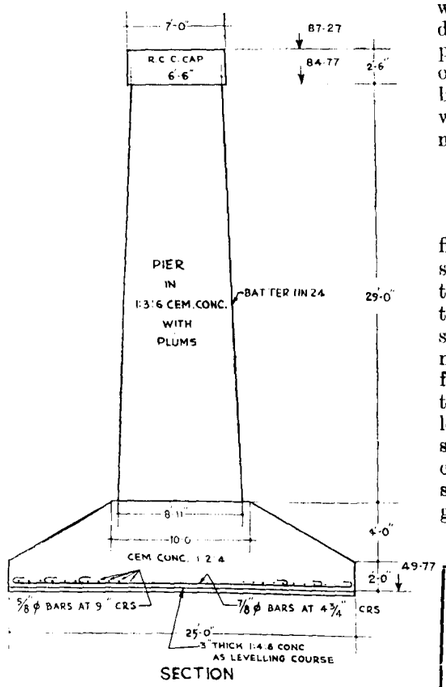
Cost per running foot, Rs 1152; per square foot of carriageway, Rs 48; per square foot of entire elevation, Rs 41; and per cubic foot of bridge, Rs 1/9/-.



The approximate cost per running foot of the concrete portion would appear to be Rs 1360/- and of the masonry portion Rs 800 -.

Special Features

The original designs provided for brickwork foundations and piers. As good bricks were not available in the locality, the two main piers of the concrete spans were made of 1 : 3 : 6 cement concrete with plums on 1 : 2 : 4 reinforced concrete bases. The other piers and abutments were built of brickwork in cement. All piers were made with semi-circular ends.



A length of 50 ft at the middle of the main span was kept level. From here the formation sloped away in both directions at 1 in 25 so as to keep down the height of the embankment. The height of the bridge at the centre of the main span was determined by considerations of the minimum clearance (25 ft) specified for navigation.

Vertical curves have been provided at all changes of gradient on the bridge. This was found particularly necessary as the wearing surface is of cement concrete. The vertical curves have been designed for a vehicle speed of 25 m. p. h.

The 3-ft suspended spans were introduced at a late stage because calculations showed that the end of a cantilever span would sag by about 4 inches under a design load and unless some suitable provisions were made a vehicle passing over the bridge at such a time would bump against the edge of the abutment wall. The suspended spans provided a means of adjustment.

Tests

The bridge has been tested twice. The first test demonstrated amply that the structure was strong enough to withstand the load for which it was designed. The test did not, however, provide satisfactory scientific data as the bridge structure was not allowed to regain its original form, as far as possible, after the removal of each test load and before imposing another load system. As this was the longest solid slab span in the country it was considered desirable to test it again more systematically so as to obtain data for guidance in future designs.

A correction

In the article on the Kuakhai bridge in our May issue the following corrections may be made at page 7 in the paragraph on " costs " :

for Rs 13,04,000 read Rs 1,34,000 ;

for Rs 1768/- read Rs 1368/-.

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SPECIAL ARTICLE NO. 7.

HORIZONTAL AND TRANSITION CURVES FOR HIGHWAYS

[*Continued from page 18, July 1952.*]

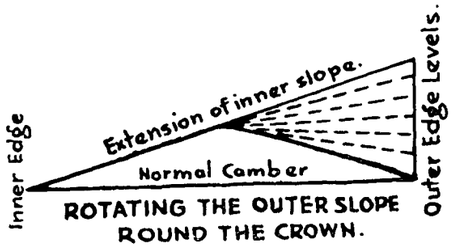
How to Super-elevate ?

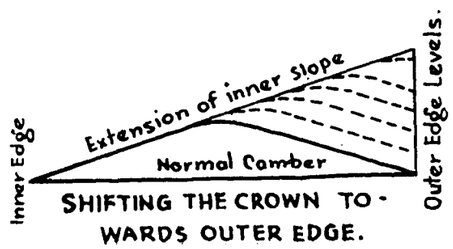
THE superelevation is built into a road in two stages. In the first stage the camber is neutralised gradually till the road has one straight line slope from the inner to the outer edge. In the second stage, the straight line slope is gradually increased till the designed superelevation is attained.

The change from a cambered section to a straignt line cross slope is effected by progressively decreasing the inclination of the outer slope tangential to the curved crown until it reaches the horizontal and then progressively increasing it until it coincides with the inclination of the inner slope (See Figure). This method is open to the objection that difficulties with surface drainage are introduced unless the road has a good longitudinal fall. It has however, the following advantages—

(1) The outer half of the curve can be brought to level before the start of the curve so that at no point in the curve will the surface have a negative superelevation.

(2) It does not call for the use of special templates and points of elevation of the outer edge can be easily calculated.





Another method known as the diagonal crown method which consists in progressively shifting the crown toward the outer edge and along the extension of the inner slope until the crown is completely run off the width of the pavement. Adoption of this method necessitates the starting of the shift after the start of the curve and is not recommended.

After the profile of the pavement has been brought to a straight line slope, the designed superelevation could be obtained either by—

(1) progressively revolving the slope about the centre line, thus simultaneously depressing the inner edge and elevating the outer edge ; or

(2) progressively revolving the slope about the inner edge raising both the centre and the outer edge simultaneously.

Method (1) maintains the grade of the centre line without inducing bumps in the longitudinal section and therefore is preferable. Method (2) is suitable for flat

locations to prevent drainage difficulties, in cuts and in approaches to bridges on trestles.

The above recommendations regarding radii of curvature and superelevation apply to roads in open country. In built up areas, the amount of superelevation that can be provided must be governed by considerations of " access " and drainage. Also the travel speed in built-up areas will be considerably less on account of the restrictions imposed by sight distances, intersections, changing street widths, mixed traffic, standing vehicles, etc.

In the field the superelevation is applied to a curve so that the maximum designed value is attained at the start of the circular curve (or at the end of the transition in case of fully transitioned curves) by gradually increasing the superelevation from an amount equal to the camber at the start of the curve. Small vertical curves not exceeding 10 ft in length may be introduced at the changes in the grade necessitated by the method. Usually camber is eliminated in a distance of about 20 feet.

It is obvious that the superelevation, where provided, should not be less than the camber appropriate to the type of surface, namely—

(i) Concrete pavement	1 in 72
(ii) Black top surface	1 in 60
(iii) Water bound macadam	1 in 36 to 1 in 48.

Widening of Pavement on Curves.

When a vehicle with a rigid body and a definite wheel base moves on a curve its rear wheels do not move in the same path as that of its front wheels. Hence when the inner front wheel is on the inner edge of pavement, the corresponding rear wheel will be off the pavement.

Drivers do not keep as close to the edge of the road on curves as on straights. When passing or overtaking vehicles on curves, the psychological tendency of the drivers is to keep greater clearance between vehicles than on straights.

For these and for other important reasons* it is necessary that on curves the pavement should be made wider than the normal carriageway in the straight. This additional width helps to secure increased vision distance for drivers on the outer half of the curve.

Calculations show that for each traffic lane of pavement an extra width of $l^2/2R$ is required where l is the wheel base of the vehicle and R is the radius of the curve. Assuming a wheel base of 20 ft for commercial vehicles, the formula reduces to $\frac{200}{R}$ as the extra width for each traffic lane. This widening is termed "**mechanical widening**"

Pavements must be widened much more than thus calculated to provide for manoeuverability of steering at high speeds and also to provide for the overhang. An empirical formula that is recommended to allow for this factor is $\frac{V}{\sqrt{R}}$ where V is the design speed in m.p.h. and R is the radius of the curve in feet. This extra width denoted by $\frac{V}{\sqrt{R}}$ is termed "**psychological widening**".

Therefore, the widening that is to be provided is given by the formula

$$W_e = n\left(\frac{200}{R} + \frac{V}{\sqrt{R}}\right)$$

where W_e = extra widening in feet.

n = number of traffic lanes.

V = design speed in m.p.h.

R = Radius of the curve in feet.

The extra widths recommended for one and two lane pavements are given in Table 4.

* For these reasons see the original Paper in I.R.C. Journal, Volume XI-3.

Table No. 4

Extra Width of Pavements

Radius of curve in feet	Upto 200	201 to 500	501 to 1000	1001 to 1500	Above 1500
Extra width in feet	4	3	2	1	nil

Notes:

(1) This Table is for one-lane (12 ft) and two-lane (22 ft) pavements.

(2) For pavements wider than the standard widths indicated in (1) above, reduce figures in the Table by the excess over the standard width. Negative values to be ignored.

(3) For pavements narrower than the standard width, increase the figures in Table by the width of pavement short of the standard width.

(4) Widening to be equally distributed on the inner and outer sides except that, in the case of short curves in hill roads with radius of curve less than 200 ft the widening may be on the inside only.

(5) For pavement widths in excess of two lanes the formula mentioned above should be used and rounded off to the nearest foot.

For two-lane pavements the maximum extra width is limited to 4 ft, as with any further increase a two-lane pavement will tend to be used as a three-lane pavement with consequent traffic hazards.

The widening will start at the beginning or tangent point of the transition curve and progressively increase at a uniform rate until the maximum designed widening is reached at the beginning of the circular curve. The same widening will continue throughout the circular portion.

Transition Curve

The change of a vehicle in motion from a straight path to curve of finite radius or vice versa subjects the vehicle suddenly to a centrifugal force causing a jerk and sway with consequent discomfort to the occupants. The methods of minimising the effects of the sudden application of this force are—

(1) Reducing the speed of the vehicle before entering the curve and gradually raising it after the vehicle has swung into the curve;

(2) Taking a path other than that along the central line of the curve with greater radius;

(3) Combination of (1) and (2);

(4) Designing the curve alignment with the radius of curvature gradually changing from infinity to the designed radius.

Methods (1) to (3) require a prior knowledge of the existence of the curve. Discomfort is not entirely eliminated by the adoption of these methods. Method (4) permits a gradual development of the centrifugal force so that the same speed can be maintained on the curve as on the straight. If the curve is properly designed, no discomfort will be experienced by the occupants of the vehicle. A uniform rate of change of centrifugal acceleration can be secured by designing **a curve of suitable length with a radius of curvature changing gradually from infinity to the designed radius.** By the use of such a curve, which is called **a transition curve,** it is possible to obtain compensation against the centrifugal force by gradually increasing the superelevation of the road surface.

Types of Transition Curves

The three types of transition curve commonly adopted are:—

(1) Cubic parabola;

(2) Lemniscate;

(3) Spiral or Clothoid.

The Specifications and Standards Committee considered **the spiral** to be the most suitable curve for the following reasons:

(a) It best satisfies the requirements of transition in that the radius of

curvature is inversely proportional to the length traversed. Therefore, the rate of change of acceleration is uniform throughout the length of the curve.

(b) Its geometric properties make it suitable for setting out in restricted locations.

The **length of the transition** is determined either by :

(a) the rate of change of centrifugal acceleration and is given by the formula :

$$L_s = \frac{3{\cdot}16\ V^3}{C.R.},$$

where L_s = length of the transition curve (ft)

V = design speed (m.p.h.)

R = Radius of curve (ft),

and C = rate of change of centrifugal acceleration (f.p.s.). Values for C are 2·5 for speeds up to 20 m.p.h. and 1·5 for speeds above 60 m.p.h., and $= \frac{150}{40+V}$ for intermediate speeds.

(b) the rate of change of superelevation.

The greater of the two values should be adopted.

The Committee has fixed a rate of change of superelevation of 1 in 50 and 1 in 60 as suitable for plain and hilly country. The transition lengths recommended on the above basis are indicated in Tables 5 and 6.

Table 5.

Minimum standard transition lengths for various speeds and curve radii for plain or rolling country

Radius of curve R feet	Minimum Transition lengths in feet for speeds of m.p.h.			
	20	30	40	50
Above 2000	50	50	75	100
2000	50	50	75	150
1300	50	50	100	200
1100	50	50	100	250
1000	50	75	150	250
900	50	75	150	300
800	50	100	150	300
700	50	100	200	
600	50	150	200	
500	75	150	250	
300	100	150		

Note : For radii not given in the table, adopt the length for the next lower radius given.

Table 6.

Minimum standard transition lengths for various speeds and curve radii (for hilly tract)

Radius R feet	Minimum transition lengths in feet for speeds m.p.h.			
	15	20	25	30
Above 500	50	50	50	50
500	50	50	50	100
300	50	50	100	150
200	50	50	100	
150	100	100		
100	100			

—o—

HERE AND THERE

1. WOMEN WALKERS USE GREATER CARE THAN MEN

The supposedly weaker sex is favoured by four-to-one odds over the lordly male to walk to her destination without being struck by an automobile. In support of this statement the accident statistics for 1950 show the following :

Out of a total of 5,793 pedestrian deaths reported in 39 states, only 1,373 were women, for a ratio of slightly over four males for each female ; in 36 states reporting breakdowns on pedestrian injuries, of the total of 23,511 injuries only 7,931 were women, giving them a 3 to 1 advantage.

The better record of women pedestrians is attributed to several factors by the California State Automobile Association, follows :

" Women are naturally more cautious than men. They are also less active and don't stay out in the open, exposed to traffic, as long as the men. There are fewer alcoholic women than men, a very important factor, because alcohol is blamed for two out of five pedestrian deaths every year. Lastly fewer women are seen walking on the streets and highways at night which is when four out of five fatal pedestrian accidents happen."

(*From ' Highway Research Abstracts'- March 1952*).

2. DO BY-PASS ROADS HURT LOCAL BUSINESS ?

MERCHANTS doing business on the main street in North Sacramento, California, have good reason to applaud the building of a bypass around their community. Upon completion of bypass, traffic dropped 44 per cent. At the end of two years, sales volume of the 224 merchants along the bypassed street had increased 48.5 per cent compared to a county wide increase of 27 per cent. Largest increases were registered by grocery, drug, clothing, variety and hardware stores. Even service stations noted an increase of 38.5 per cent against a country-wide increase of only 15 per cent in the same period.

(*From ' Highway Research Abstracts', April 1952*)

3. ACCIDENTS CAUSED BY DOGS

THE British Minister of Transport was asked by Mr. Peter Freeman to what extent dogs were a contributory factor in causing accidents on the roads ; and whether he would take steps to minimise this danger. Mr. Maclay replied that 1.48 per cent of personal injury accidents in 1951 were attributed by the police to the presence of dogs in the carriageway. Dog owners were urged by propaganda, and an appeal on the back of dog licences, to keep their dogs under control. He did not see what further steps could usefully be taken.

(*From ' B.R.F. Monthly Bulletin ' May 1st, 1952.*)

4. ROAD VEHICLES DURING FLOODS

ONCE again the road transport industry demonstrated its versatility and value in disaster situations when earlier this year the Missouri River produced its worst floods ever. Last summer, in much the same area, it was road transport to the rescue when the Mississippi overflowed its banks and created havoc which even now is not fully repaired. This year's flood has been worse.

On both occasions, road vehicles demonstrated that they are the surviving form of transport in the event of disaster; for the kind of tasks required in the flood regions, the railways, despite their mass hauling capacity, simply lack the vital flexibility.

The wholesale evacuation of hundreds of square miles was undertaken both ahead of, and in, the floods. Special headquarters were established as vehicle centres, with relief organizations making their wants known so that vehicles left the centres with appointed tasks—evacauting families, hauling flood-protection materials, and removiug whatever property could be handled on short notice.

(From 'Motor Transport' June 14, 1952.)

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5. GOOD ROADS, A CONDITION FOR MARRIAGES

ONE Congress MLA said that roads in certain areas of his district, Partapgarh, were so bad that he had the utmost difficulty in persuading important persons, like Ministers, to visit them. Another said that girls and boys in the Bhinga area of Bahraich were faced with an acute marriage problem. Evidently few were prepared to overcome the difficulties of making a journey to this isolated region.

(Extracted from "The Statesman", July 20, 1952.)

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6. TRAFFIC SIGNAL AT CURVE

A STOP-AND-GO light installed near a dangerous curve on U.S. Route 11 near Natural Bridge, in western Virginia, is helping to reduce accidents. The safe speed for the curve has been established at not more than 25 m.p.h., but many motorists had attempted to drive it too fast; during the past 10 years, at least 12 persons died in accidents at the curve.

The special signal light installed at the curve normally shines red. As a driver approaches the curve, the car passes over a detector embedded in the highway. The contact flashes an impulse to the light, causing it to turn green after an interval, which is set so that a car moving at 25 m.p.h., or less gets a green signal without stopping. If the vehicle is moving faster than 25 m.p.h., it reaches the traffic light while it is still red, and there is a wait until the light turns green.

(From 'Better Roads'—April, 1952.)

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7. "TO ENRICH THE MEMORY"

THIS is a little item in which no names or places must be given. At a certain overseas office letters are occasionally received from native workers released from service on completion of a job, making tender enquiries as to when there will be any likelihood of the company re-employing them. We quote from one of them :—

"Here I seem alright, but I feel not so better as I was before in Mowlems. The difficulty is this that too many bosses and so the work turn out becoming less than expectation. The systems of the department works are too tedious and so the works becoming less progressive, i.e., if few nuts and bolts are required for a particular job in which no other works in continuation to that work cannot be attended as the nuts and bolts are not in place ; the same time it is available in stores, the sanction for to get from the store is very difficult because plenty of bosses should approve that. There is no matter if these bosses are available at the same site; but the difficulty is that one boss will be at..., one at...and one at...So it takes three days for the approval and the fourth day it is going for to collect the goods from the store. At last what is to say, a week after the nuts and bolts are fetched to the site. This a week delay for the ready stock, then what may be the delay if it is not in stock".

After lamenting that he was becoming more dull because "I am not liking this kind of idle works" and expressing the hope that his case for returning to us would be successful, he concluded:

"I am doing well and I hope the same I shall contact you always and so you may be able to enrich the memory."

(From London John, December, 1951)

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8. U. S. FREEWAY SURVEY RESULTS

ACCORDING to surveys carried out a little while ago on the 3.7 mile section of the Houston (Texas) Gulf Freeway, opened in October 1948, it has been estimated that this section has resulted in the annual saving of over $1\frac{3}{4}$ million vehicle hours and over $2\frac{1}{2}$ million dollars (£892,850). Since the surveys were carried out the traffic volume has increased by $133\frac{1}{3}$ per cent.

The Gulf Freeway has improved accessibility to the Houston Central business district, property values and business have become more stabilised, and land values have increased from 200 per cent to 500 per cent, whilst general development has been greatly accelerated.

The survey of the Shirley Highway, Virginia, has revealed that a 17 mile controlled-access divided highway has saved the trucking industry 311,000 hours and 2 million dollars (£714,280). Each ton of steel used to build the highway saves 83 truck and driver hours annually and 10 working days.

(From the I.R.F. Bulletin, May, 1952.)

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9. FOUR STATES ACT TO PROTECT HIGHWAY FUNDS

HIGHWAY users have renewed their efforts to secure approval of constitutional amendments prohibiting diversion of highway use taxes. Such proposals were recently introduced in the legislatures of Arizona, New Jersey and New York according to the National Highway Users Conference. Twenty-one states already have constitutional protection of revenues.

Highway users in Alabama and Georgia were successful last year in gaining legislative approval of resolutions for anti-diversion constitutional amendments. These amendments will be submitted to the voters in November.

(From "Roads and Streets," March, 1952.)

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10. CONVERSION FACTORS

Products:		Products	
Superior Kerosine	280 Gals to a ton	Furnace Oil	... 243 ,, ,, ,,
Inferior Kerosine ...	264 ,, ,, ,,	Light Diesel Oil	... 257 ,, ,, ,,
Motor Spirit ...	307 ,, ,, ,,	High Speed Diesel Oil	... 272 ,, ,, ,,
Aviation Spirit 100 O. N.	... 324 ,, ,, ,,	Jute Batching Oil	... 250 ,, ,, ,,
Aviation Spirit other Grades	... 316 ,, ,, ,,	Mineral Turpentine	... 283 ,, ,, ,,
		Solvent Oil	... 317 ,, ,, ,,
Aviation Turbine Fuel	... 282 ,, ,, ,,	Vaporizing Oil	... 272 ,, ,, ,,

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11. SET UP ROAD BOARD—ECONOMIST TELLS HIGHWAY ENGINEERS

A proposal to set up a new and independent Road Board, representing the interests of all highway users, including pedestrians, and with the responsibility of financing all highway construction, was made on Friday last at a London meeting of the Institution of Highway Engineers by Mr. G. J. Ponsonby, of the London School of Economics.

Mr. Ponsonby was speaking on the topical subject of "Highway Economics," and his remarks provoked such a vigorous discussion that the Chairman and President, Mr. C. J. Macdonald, found no little difficulty in closing the meeting.

In brief, the Road Board visualised by Mr. Ponsonby, would tax itself (the road users) and decide where and when the money should be spent. In fact, for quite a time the Road Board would wish to tax itself in order that the improvements to the roads could reduce operating costs. As more money was spent on highway reconstruction and maintenance, so transport operating costs would decline, but only to the point where, the road system having been considerably improved, further large expenditure did not give a sufficiently appropriate reduction in transport operation.

The Chancellor of the Exchequer, suggested the speaker, might still require his pound of flesh in the form of a percentage out of the pool. But he regarded his proposals as a framework or yardstick by which to assess the economics of highway finance, or, how much could be spent for a given or worthwhile return.

Mr. Ponsonby was concerned mostly with future costs which he divided into (a) occupation of land, (b) labour and materials and maintenance, and (c) interest and depreciation. He regarded past costs as historic costs which could be forgotten from an economic point of view.

By such means as he had suggested, he felt that the benefit of the machine age could be passed on the road user, by increasing his speed and reducing his costs. For example, a new road cut through a congested traffic area would doubtless attract more traffic, and perhaps while speed might not be much increased, throughput of traffic certainly would be.

(From: "Highways and Bridges", January 9, 1952.)

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12. VALUE OF INVESTMENT IN ROADS

IN his presidential address to the Institute of Transport last October Mr. A. B. B. Valentine, a member of the London Transport Executive, said:

"I believe it could be proved that the expenditure of say £ 10,000,000 on road improvements would produce a bigger and quicker dividend in the saving of man-hours, equipment and resources than an equal expenditure by almost any of the major industrial users of capital today. One well-known authority has expressed privately the conviction that such an investment on roads could be shown, if the facts were all properly marshalled and expressed, to yield a return in increased national productivity perhaps three times greater than the return for the same capital spent on oil, or steel, or even electricity, and about the same return for similar expenditure on coalmining.

(British Road Federation Bulletin, June 3rd, 1952.)

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(Continued from page 5)

struck against America's economic structure. Instead of saving money by temporary measures, such action will waste money, because inevitably the modern-standard road must be built. The keystone of any economy is transportation. The only way to gain wealth is to exchange goods and services; and to exchange them, they must be moved, which in America means largely by motor vehicle. It is high time that the question be looked squarely in the face, and steps be taken to gain the necessary revenues to modernize America's highways. We must put an end to the expedient of "dolling up" old roads instead of building to the standards that modern traffic demands, if America is to move forward and not slip backward. **It is axiomatic that good roads are paid for in one way or another, whether they are built or not.**

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COURTEOUS SARCASM

"Was I driving too fast, officer?"
"Oh, no. I stopped you "cause you were flying too low."

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STUDY OF TOP STATE HIGHWAY ORGANIZATION

(Extracted from "Better Roads," May, 1952)

Report of Highway Research Board classifies administrative types and analyzes principles underlying satisfactory performance. High-calibre personnel in key jobs seen as prime essential.

(This is the concluding section of "State Highway Administrative Bodies," a study of the committee on highway organization and administration of the department of economics, finance and administration of the Highway Research Board. The report, which is the result of studies carried on over a 5-year period, was prepared for the committee by the staff of the administrative-research section of the financial and administrative research branch of the Bureau of public Roads.)

State administration of highways, although existing in some form in colonial days, has developed largely since the beginning of the 20th century. This development has been diverse and at a different pace in various parts of the country. Modern state highway administration may properly be said to have had its beginning with the passage of the federal-aid highway act of 1916. Even at that time, about one-third of the states did not have highway departments complying with provisions of the federal-aid law.

State highway administrative organizations have changed considerably since their inception, and the variation and extent of such changes have differed in the various states. Some changes were the result of a state governmental reorganization movement that reached its climax in the 1930's. In other cases, purely political considerations were responsible; but some reforms were motivated by public dissatisfaction for one reason or another with existing administrative machinery. The resulting periodic adjustments and experimentation have produced the existing varied pattern of state highway administrative bodies.

Five Types

This diverse development has produced the five types of highway organization described and classified:

single executive;

single executive with advisory commission;

single executive and commission in coordinate capacities;

limited-control commission; and

administrative commission.

To the casual observer it may appear that there are only two basic types, the single-executive and the commission form, and that the classifications set up are only modifications of these basic types. On closer examination, however, it is evident that classification into two basic types does violence to distinctive and significant differences that exist among the several state highway administrative bodies. The types outlined in the study are the result of compromise with administrative theory, local political environment, and obvious experimentation with and adjustment of administrative machinery to make it more responsive to public will or to improve efficiency in operation.

With respect to the commission types, the legislatures have obviously attempted

with little success to place policy-determining and deliberative functions in the commission as a whole, while separating administrative operations and placing them in the hands of an executive officer. Compromises with principle and the difficulties of distinguishing between policy determination and administration have proved a stumbling-block, and the problem of walling off the separate areas has resisted solution thus far.

IT IS EVIDENT from the present balance of single-executive and commission types that the matter of superiority has not been finally resolved. On the one extreme are 14 states that have single executives without any board or commission, and on the other are 11 states that have the full administrative-commission type of control. In between are approximately one-half the states, in which the present type of administrative body obviously represents a compromise whereby an attempt was made to retain the advantages of a particular form while borrowing presumed beneficial characteristics from another.

Such experimentation will undoubtedly continue, and the issue of superiority of a particular type of administrative organization will never be resolved solely on an academic or theoretical basis. Rather, it seems likely that determination of the form of administrative body will be more dependent on the political atmosphere, tradition, state of highway development, success under the existing form and similar factors. Whatever the ultimate development, it is probable that future adjustments in highway administrative bodies will be materially affected by the current movement to reorganize state government. According to the Council of State Governments, 27 states have already established commissions that are making studies of the organization and operation of their state governments, and are seeking ways and means to improve them. These commissions are primarily investigating the advisability of adjusting and reorganizing state administrative departments to secure greater efficiency and sound administration.

Advisory Bodies

If there is any apparent tendency, it is in the direction of the use of commissions as purely policy-determining or advisory bodies. The combination of policy-making and administrative functions in the same body is contrary to our governmental tradition and lends itself to abuses. The "little Hoover" commissions that have thus far reported generally have recommended that where commissions are prescribed, they be limited to policy-making or advisory services, and serve as a device for obtaining citizen participation. However, recent administrative reorganizations in the highway field apparently have not adhered strictly to these conditions, in that the enabling legislation assigns some functions of an administrative character to the multi-member boards created.

Though rather common, the selection of members of commissions on a geographical basis is an undesirable practice and could well be eliminated. District representation, although having popular appeal and support, results in operations that on the whole are detrimental to state-wide interests.

Continuity of Policy

Continuity of policy has not been achieved in a number of states largely because of the rapid turnover of administrative personnel resulting from vagaries of politics. Attempts by governors in the past to control state highway appointments have led to staggered terms for appointive officials. Although this device apparently has accomplished its purpose in a few instances, it has not prevented the turnover of personnel. Restraint on the governor's power of removal of appointive officials, together with staggered terms, supposedly assures that the composition of the highway body will change slowly despite changes in administration. This study shows that these devices have fallen short of the ideal, but it may be that enough continuity of policy has been achieved.

Restrictions on the governor's removal power exist in many state highway laws; but in view of the tendency of the state and federal courts to extend the governor's authority over appointive officials, most of them are superfluous. However, if legislative limitation of the executive power is deemed advisable, the specifi-

cations should include a fixed term for appointees, with removal only for certain causes, such as inefficiency, neglect of duty, or malfeasance in office, and with provision for a hearing. Experience in states with single executives appointed under laws embodying these provisions indicates a tenure much longer than in other states not having them.

Essentials of Administration.

ANY PLAN OF ADMINISTRATION OR reorganization should provide three essentials: delegation of authority, fixing of responsibility and accountability. It is an axiom of organization and management that any body or person held responsible for a particular function must be given authority equal to the responsibility in every respect. Lack of authority amounts to relieving the body or person of responsibility and accountability. Thus failure in any of these respects makes it difficult for the people to know whom to hold accountable. Experience has indicated that in any administrative system there should be no compromise with these sound principles. When such compromises are made, basically sound changes are often discredited, not because of inadequacy, but because of restrictions imposed on the system's freedom to operate.

Proper organization and methods are important to improved highway administration, but changes in them cannot produce desired results if the men appointed to administer are of *mediocre* calibre. **The most important requirement for top effective performance is the ability and integrity of the members of the top organization**. Appointees usually are laymen not professionally trained or experienced in the activities for which they are responsible. Additionally, appointees remain in office a relatively short time, and consequently rarely acquire the degree of expertness necessary to direct the function. Because appointments frequently are based on political support rather than merit, it is practically impossible to get men of recognized ability and capacity to accept the post.

Merit Alone Should Count.

If men were chosen on a proper basis, the chances would be greatly enhanced that they would remain long enough to permit the service to benefit from their expertness. Thus to assure appointments of the proper calibre, it is fundamental that governors be motivated by a desire to appoint only the best-qualified men available, and recognize that these positions are much too important to serve merely as havens for faithful party members. Although it is of utmost importance to select more competent personnel of recognized ability, capacity, integrity and vision, and with specific training and experience in administration, it is doubtful that such appointments could be assured through legislative specification.

For the most part, it would appear necessary to raise the general tone of highway administration through improvement of the calibre of the administrators and the personnel in the departmental service: for it is a truism that whatever the form of administrative body, the men who execute and administer nearly always spell the difference between good and bad management. **Government is usually what the people make it, and if the citizens have demanded good administration, they usually have it**. An alert and well-informed citizenry can insure good government: and it is the public that must ultimately decide whether a new form of organization is needed, or merely more careful and prudent selection of the men who will administer the highway function will suffice. It is no mere coincidence that in states where the calibre of the state service is of a high level, the form of administrative organization is seldom an issue.

ROADS IN THE PARLIAMENT

4th July, 1952.

Starred Question No. 1470 by

Shri A. M. Thomas

Roads in Travancore-Cochin

Will the Minister of Transport be pleased to state:

(a) Whether Government are aware of the condition of the roads in Travancore-Cochin as National Highways; and

(b) Whether any portion of the said road has been metalled, tarred or concreted and if so, how much?

Reply by

Shri Lal Bahadur Shastri

(a) Yes.

(b) $32\frac{1}{2}$ miles have black-top surface, $41\frac{1}{2}$ miles have cement-concreted surface, and about 170 miles have water bound macadam surface. There is no section of National Highways which is not provided with a hard crust.

9th July, 1952.

Unstarred Question No. 379 by

Shri Sanganna

Roads in Orissa

Will the Minister of Transport be pleased to state:

(a) Whether any proposals are under consideration of Government to take up construction of new roads or improvement to the existing roads in the scheduled areas of the state of the Orissa under the National Highways Development Programme; and

(b) If so, where and in what parts of the State?

Reply by

Shri Lal Bahadur Shastri

(a) Yes.

(b) National Highway No. 6 (Bombay-Calcutta Road) passing through Mayurbhunj is being developed as a fully bridged road. Also, some improvement works are being done on National Highway No. 5 (Calcutta-Madras Road) in Mayurbhunj and National Highway No. 43 (Raipur-Vizianagaram road) in Koraput area.

9th July, 1952.

Starred Question No. 1592

By Shri A. M. Thomas

Roads in Travancore-Cochin

(a) Will the Minister of Transport be pleased to State how many major bridges will have to be constructed in Travancore-Cochin under the National Highway Scheme?

(b) Where are they to be constructed?

(c) What is the total outlay that has been made?

(d) Has the construction of any bridge been embarked upon?

Reply by

Shri Lal Bahadur Shastri

(a) Two.

(b) One over the right arm of the Periyar river near Alwaye on N. H. No. 47 and the other over the backwaters at Aroor on the West Coast extension of this Highway.

(c) The five-year plan includes a provision of Rs 40 lakhs for the two bridges.

(d) Not yet.

9th July, 1952.

Starred Question No. 1610

By Shri Rishang Keishing:

Roads in Assam and Manipur

Will the Minister of Transport be pleased to state:—

(a) What schemes Government have made for the development of roads in Assam and Manipur under the Five-year Plan;

(b) How many motorable roads have been completed in the said areas since the achievement of independence; and

(c) the total amount spent so far by Government for the construction of roads in the said tribal areas?

Reply by

Shri Lal Bahadur Shastri

(a) Presumably the Hon'ble Member refers to the development of roads in Tribal Areas in Assam and Manipur.

Plans for development of roads in the Tribal Areas in these two States have not yet been finalised.;

(b) & (c) Information is being collected and will be laid on the table of the House in due course.

PROBLEMATICAL

A celebrated lawyer once said that the three most troublesome clients he ever had were a young woman who wanted to be married, a married woman who wanted to be divorced and an old maid who didn't know what she wanted.

A Hollywood child was asked if she had a mamma and papa.

"I should say I have," came the reply. "I have three papas by my first mamma and two mammas by my second papa."

Little Girl—Daddy, why do editors refer to themselves as "we"?

Daddy—So that the fellow who doesn't like what's printed will think there are too many for him to lick.

TECHNICAL INFORMATION

1. AGE-STRENGTH RELATIONSHIPS FOR CONCRETE

THE rate of strength development of concrete, particularly between the ages of 7 and 28 days, is of particular interest to anyone furnishing concrete on a strength specification. Such specifications are generally based on 28-day strength. The ability to tell ahead of time what strengths will be developed may enable the producer to adjust his proportions for greater economy, if he finds that the concrete has been overdesigned, or to bring the strength up and avoid costly adjustments, if he finds that the specified strength is not likely to be attained.

Unfortunately, there is no precise answer to the question of what the 28-day strength will be when the 7-day strength is known.

In spite of the variability of relationships between 7 and 28-day strengths, some general relationships can be established which will give at least an indication of probable strength development. An analysis of strength data from 13 different reasearch projects conducted at the research laboratory supported jointly by the National Sand and Gravel Association and the National Ready Mixed Concrete Association at the University of Maryland showed that no single formula could be used to provide a dependable prediction of 28-day strength from 7-day strength. It was found, however, that formulas could be used to bracket the expected strength within reasonable limits.

For these tests the formula giving minimum expected strength was

$$S_{28} = S_7 + 15\sqrt{S_7} \qquad \text{.....(1)}$$

and that giving maximum expected strength was

$$S_{28} = S_7 + 40\sqrt{S_7} \qquad \text{.....(2)}$$

This indicates, for example, that a concrete which produces a strength of 1,600 psi at 7 days may be expected to develop at least 2,200 psi, but almost certainly not more than 3,200 psi at 28 days.

The formula of this type found to give most accurate results for the average case was:

$$S_{28} = S_7 + 25\sqrt{S_7} \qquad \text{.....(3)}$$

Thus, on the average, the concrete which developed 1,600 psi at 7 days would be expected to produce about 2,600 psi at 28 days. Actually, in any individual case, the 28-day strength would probably be somewhat above or below this value.

It is believed that the relationships shown can be used to advantage in estimating potential 28-day strengths from the results of 7-day tests. They may also be of value in detecting abnormalities in testing techniques.

(From 'Highway Research Abstracts'— April, 1952).

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2. PIVOTING A BRIDGE INTO POSITION

A Novel Design Leads to 33% Saving

Early last year in California a new type of bridge was erected across a canyon 250 ft wide and 145 ft deep without the aid of false-work or high lines. By utilising inclined bents pivoted at top and bottom it was possible to assemble half of the bridge on each bank and then swing each half together to a junction near the centre of the crossing. This new type of bridge is the result of an effort on the part of the state's engineers to devise a cheaper bridge than any of the conventional types which would ordinarily be used for a crossing of this type.

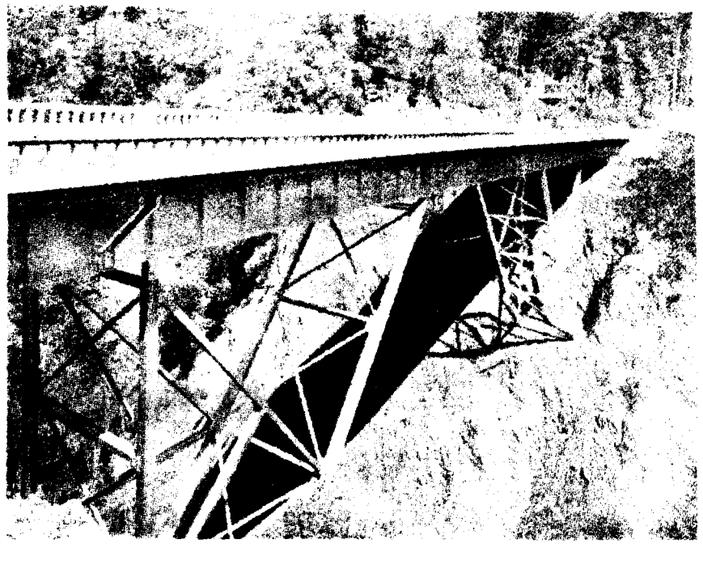
Arch Too Costly

Shortly after the end of the war, plans and specifications were prepared and bids advertised for a reinforced concrete arch bridge. Based upon previous experience, this appeared to be the most economical type of structure. The rock slopes of the gorge would furnish good foundations for an arch, and the span length was well within the economical range.

But only one bid was received, for an amount of 161,015 dollars, almost 21 dollars per sq. ft and far above the true value of the bridge. Rather than build a bridge at this high cost, the state's engineers decided to reject the bid and make further studies to work out a cheaper type of bridge.

The excessive price of the reinforced concrete arch was attributed to the high cost of labour and lumber for falsework, and to the additional cost of rigging a high line. **The problem then resolved itself into developing a new type of structure that would reduce or even eliminate the cost of these expensive construction procedures.**

Any of the other types of concrete bridges would have required the erection



* Abstracted from "World Construction"—July-August, 1951.

of falsework. A steel arch would have necessitated the use of a high line. A conventional truss or girder would have required either high expensive piers, extensive falsework or some type of counter weight to permit cantilever erection.

The present bridge was finally evolved and advertised for bidding, and the results of these bids more than justified the extra time spent on design. Eight contractors submitted bids, and the contract was awarded to the low bidder for 108,890 dollars, a saving of 33 per cent, though there had been a rapid increase in construction costs during the interval between the two advertising dates.

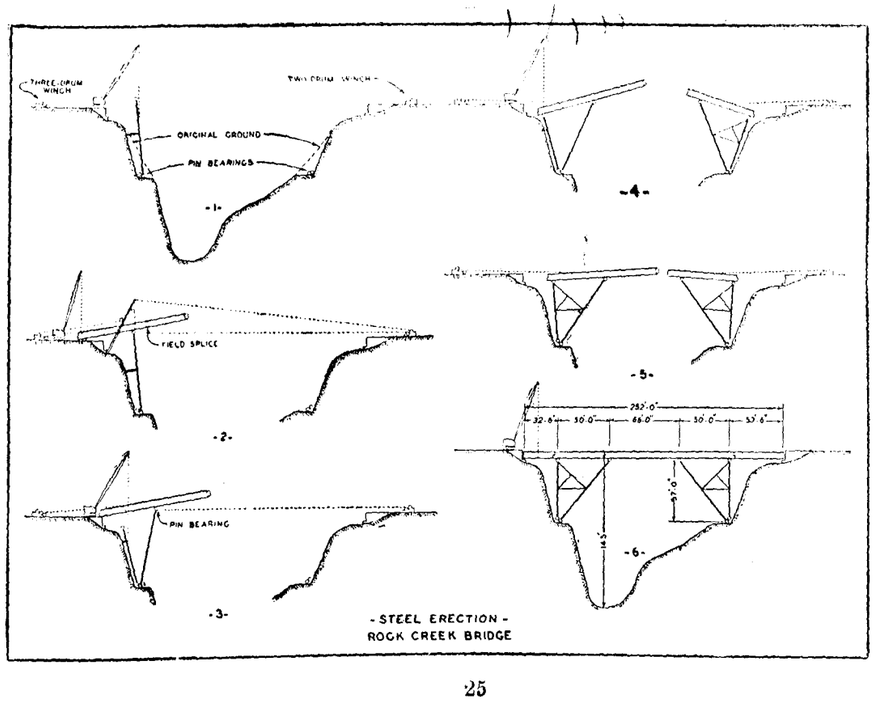
The Design

The new bridge is essentially a continuous-deck plate girder supported by steel bents. The two girders are 6 ft deep and are spaced at 18 ft 6 in. on centres. The bridge is 252 ft long with five spans of 32 ft 6 in. 50 ft, 66 ft, 50 ft and 53 ft 6 inches. The three central spans are continuous, but the two end spans are hinged. Bents are composed of wide-flange columns under each girder with T-beam and wide-flange bracing. All columns have pinned bearings at top and bottom. These bearings were required for the proposed method of steel erection (as described below) and also served to eliminate bending stresses in the relatively long and slender columns.

The bridge deck, a reinforced concrete slab 10 in. thick, gives a roadway width of 26 ft between concrete curbs.

Construction Procedure

The erection of steel was preceded by stripping of the rock slopes of the creek to form benches for column footings. The concrete abutments were constructed and all lower column bearings were then placed in position and carefully adjusted to line and grade. Winches were set up on the



ground back of each abutment. The accompanying drawings illustrate the various steps in the erection of the remainder of the bridge. Descriptions of each of the six steps of erection are outlined below:

1. The inclined bents were assembled on the ground back of the abutments, lowered to their bearings and temporarily braced against the bank with timber struts.

2. Girders were field-spliced on the ground and were then placed on the inclined bents.

3. Cross bracing was temporarily bolted in place between the girders, and the girders were pulled forward to the position shown. The vertical bents were then completely assembled, lowered to their bearings and braced against the bank.

4. The girders were lowered on the vertical bents. Bracing was placed between the vertical and inclined bents when the two halves of the bridge were in this position. The bracing could only be fastened loosely because of the relative movement that took place between the bents as the bridge was swung together.

Bridge Swung Together

5. The two halves of the bridge were then swung slowly together until a connection was made. Additional cables (not shown) were run from each winch to the opposite half of the bridge and were used to pull the two halves out beyond their balance points.

6. The girders and cross bracing for the end spans were then placed in position, and the structure was ready for final riveting.

The roadway is on a curved alignment for the full length of the bridge. The radius of this curve is 1,350 ft and superelevation is 8 per cent. The curved alignment caused but little complication in design or erection.

Unique Method

This is a unique method of bridge erection which will be useful when it becomes necessary to span deep, relatively narrow gorges. The maximum length of such a bridge is, of course, limited by the load capacities of readily available cranes.

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3. CAPACITY OF TRAFFIC CIRCLES

BECAUSE of the increase of motor traffic more attention has to be paid to the conditions of road and street crossings. One of the often propagated solutions for such crossings is a round-about (traffic circle).

Data regarding the capacity of a round-about are scarce. In the opinion of the writer it is possible to approximate this capacity by using the capacity data of weaving sections.

The capacity of a round-about is defined as half the sum of the traffic volume on the approach roads in both directions, when the round-about is fully loaded.

Certain mathematical relations to which the volumes of traffic flows on round-abouts must adhere are given.* It is apparent that the capacity of round-abouts depends largely on the way the incoming traffic flows are divided over the exit roads. For several hypothetical cases the capacity of a circular round-about with four approach roads is computed. It is apparent that the capacity of such a round-about ranges between 1,800 and 3,600 passenger vehicles per hour, while the traffic volumes on the most heavily loaded approaches range from 900 to 1,800 p.v. per hour for both directions together. A graph is given* for the relation between the radius and the capacity of a circular round-about with four approach roads. The radius of the connection between approach roads and round-about is of influence on the capacity. The capacity of a very large round-about can never be more than twice the capacity of a very small round-about.

The writer comes to the following conclusion: (1) The capacity of a round-about is largely determined by the way the incoming traffic on each approach road is divided over the exit-roads. (2) The traffic volume on the most heavily-loaded branch is by a fully loaded round-about somewhat lower than the maximum possible capacity of a two-lane road, and much smaller than the practical capacity of a four-lane road. (3) Increase of the radius of a circular round-about only slightly increases the capacity of the round-about: the capacity can never be more than twice the capacity of a very small round-about. (4) A smaller radius of the connections of approach roads and round-about increases the capacity. (5) To utilize fully its capacity a round-about, apart from the very small ones, should be designed with four traffic-lanes in the weaving sections.

From "Highway Research Abstracts". Feb. 1952

*Ir S. Volmuller; Wegen No 23, August, 1951

EXAGGERATION?

A woman driver pulled into a service station to complain that her car was using too much gas. The attendant pointed to the choke lever which protruded far from the dashboard. He asked "Do you know what that is for?"

"Oh, that!" replied the gal, airily. "I never use it, so I keep it pulled out to hang my handbag on."

A MIGHTY GOOD HAT

"That's a nice looking hat you got there, mister."

"Yes sir, and you might not believe it but that hat is 10 years old. I've worn it almost constantly, too. I dropped it in the river once, had it cleaned and blocked only once in the 10 years, and swapped it twice in a restaurant."

ADMINISTRATION REPORTS AND BUDGETS

THE TRAVANCORE COCHIN BUDGET 1951-52

THE budget for 1951-52 is the second after the integration of the federal revenues and expenditure of the State with those of the rest of India. At the instance of the Government of India, the budget estimates for 1951-52 have been prepared on the model of the budgets of Part A States. The revision of the scheme was with a view to maintaining a uniform system of accounts in all States but as it involved recasting many of the major and minor heads of revenue and expenditure, it has become difficult to compare most of the figures for 1951-52 with those of earlier years.

The estimated revenue and expenditure for 1951-52 amount to Rs 1487.22 lakhs and Rs 1491.33 lakhs respectively thereby indicating a deficit of Rs 4.11 lakhs. The revised estimates of revenue for 1950-51 was Rs 1432.33 lakhs and expenditure Rs 1405.48 lakhs which meant a surplus of Rs 26.85 lakhs.

The revenue and expenditure anticipated in 1951-52 on account of civil works are as follows :

Civil Works—Budget Estimates 1951-52

		Rs Lakhs.
Revenue.		
(1)	Rents	0.92
(2)	Transfer from Central Road Fund	2.00
(3)	Receipts from Water-Works and Drainage	6.39
(4)	Miscelleneous	41.48
	Deduct Refunds	-0.02
	Total Revenue	50.77
Expenditure		
Original Works	Buildings	30.10
	Communications	43.40
	Miscellaneous	2.98
Repairs		61.91
Establishment		53.14
Tools and Plant		2.92
Grants-in-Aid		1.73
Suspense		10.87
Deductions		-5.16
	Total Expenditure	201.89

The budgeted expenditure on Civil Works for 1951-52 appears much higher than the revised estimate of expenditure viz., Rs 164 lakhs under Public Works for 1950-51 but this is due to the amalgamation of Public Works and a few other heads of expenditure under the major head 'Civil Works' according to the revised scheme of preparing the budget.

Apart from the revenue expenditure, the capital outlay on Civil Works is as follows :—

Capital Outlay on Civil Works

Capital A/c of Civil Works outside the Revenue A/c

Heads of Account	Budget Estimate 1951-52 Rs Lakhs
(a) Original Works—Buildings	8.75
(b) Original Works—Communications	2.50
(c) Original Works—Miscellaneous (Water Supply Drainage etc.)	12.22
(d) Establishment	1.45
(e) Tools & Plant	Nil.
(f) Suspense	.13
Deduct receipts on Capital A/c.	-.13
Total	24.92

A few salient features of the budget in regard to Communications deserve attention. An amount of Rs 14.47 lakhs has been set apart for providing dustless surfaces to all District Roads. Steps have been already taken for the development of village roads and a provision of Rs 10 lakhs has been made for this purpose in the budget.

The responsibility of maintaining nationalised routes has been transferred to the Transport Department "on account of the savings under wear and tear of tyres and rolling stock which the Department will be able to secure by the outlay on roads". Maintenance expenditure of the order of Rs 10 lakhs is proposed to be debited to "Transport Working Expenses" instead of to Civil Works. This has reduced the net receipts from Transport to Rs 15 lakhs as against the revised estimate of Rs 20 lakhs for 1950-51.

The net receipts anticipated under Motor Vehicles Acts for 1951-52 is Rs 41.25 lakhs and expenditure Rs 5.25 lakhs.

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WHO'S INVINCIBLE ?

Wife : "Did you have a nice lodge meeting last night, dear?"

Husband : "No, it had to be postponed because the Grand Exalted Invincible Supreme Potentate's wife wouldn't let him out last night."

List of Approved Works on National Highways

S. No.	Job No.	Name of work	Amount Rs	Remarks
		BOMBAY		
1.	605 BM 8	Construction of the Kharod-Ankleshwar section of the Bombay-Ahmedabad National Highway No. 8 in Broach District (Length 7.2 miles) excluding culverts.	7,35,500/-	
2.	607 BM 8	Construction of the Broach-Wareria section of the Bombay-Ahemedabad National Highway No. 8 (Length 12.1 miles).	11,98,000/-	
3.	608 BM 8	Construction of the road from Kim junction to crossing of Kosamba-Zankhvav Railway line on the Bombay-Ahmedabad National Highway No. 8 (Length 4.7 miles).	6,34,400/-	
		WEST BENGAL		
4.	603 BG 31-A	Providing Premixed chipping carpet on Teesta Valley Road-National Highway No. 31-A (portion lying in West Bengal-Miles 14 to 30)	2,67,500/-	
		BIHAR		
5.	A 263 BR-31	Additional survey for the construction of a permanent bridge across the Mahananda river at Sonepurhat on National Highway No. 31.	1,100/-	
		MADHYA PRADESH		
6.	604 CP-6	Resectioning and black-top surfacing miles 40-51 of Great Eastern Road in Bhandara District National Highway No. 6.	2,50,482/-	
7.	606 CP 43	Improving Raipur-Abhanpur section of National Highway No. 43 (Length 15½ miles).	3,82,640/-	
		SIKKIM		
8.	609 SK 31-A	Construction of store godowns and Kitchen black at Melli in 3rd mile of the Teesta-Rangpo section of National Highway No. 31-A.	12,000/-	

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

1. **Theory of Perfectly Plastic Solids** by William Prager and Phillip G. Hodge. (Chapman & Hall Ltd., London, 1951).

2. **TACHEOMETRY — A Practical Treatise for Students and Surveyors** by F. A. Redmond. (The Technical Press Ltd., Gloucester Road, Kingston Hill, Surrey, London 1951).

3. **Elements of Highway Engineering** by S. C. Dutta (Pravash Chandra Datta, 44-T A Type, P.O. Indranagar, Jamshedpur, Bihar).

Ministry of Transport, Government of India :

4. **Report of the Ministry of Transport, Roads Organisation 1951-52 Part II-Road Development.** 2 Copies.

5. **Report of an Economic Survey of Certain rural areas in Delhi State with particular reference to road requirements-March 1952.** 2 copies.

6. **Speaker's Notes-1952, Road Development and Motor Taxation.** (British Road Federation, 4-a, Bloomsbury, London, W.C.I.)

7. **The Architecture of Bridges** by Elizabeth B. Mock. (The Museum of Modern Art, 11 West 53 Street, New York 19, N. Y.)

Building Road Congress, 1951, St. Onslow Gardens, London, S. W. 7.

8. **Building Research Congress, 1951-Paper presented in Division I.**

9. **Paper presented in Division 2.**

10. **Paper presented in Division 3.**

11. **Calcul des poutres continues Sous l' effect des charges roulantes (Design of continuous Beams for rolling loads) I-Toth.** (Centre Belgo-Luxembourgeois d'Information de l'Aciet, Bruxelles. 1951).

12. **The Motor Industry of Great Britain 1951** (The Society of Motor Manufacturers and Traders Ltd., Statistics Department, 148, Piccadilly, London, W. I.)

13. **Studies of some Methods of Avoiding the Expansion and Pattern Cracking Associated with the Alkali-Aggregate Reaction-Special Tech-Publication No. 99** by William Lerch (American Society of Testing Materials, Philadelphia, Pa. 1950)

14. **Road Curves for safe modern traffic and how to test them out. A Practical Treatise on Natural Transitions** by F. G. Royal Dawson. (E. & F. N. Spon Ltd., 57, Hay Market, London, S. W. I.).

15. **High Alumina Cement Building Research Digest No. 27-February 1951.** (His Majesty's Stationery Office, London).

16. **The Government of Part C States Act 1951-No. MLIX of 1951** (Manager of Publications, Delhi) 2 copies

17. **Statistical Year Book (consolidated Volume) for 1941-42 to 1944-45.** (The Superintendent, Govt. Printing, Hyderabad, Deccan).

18. **Solution of differential equations by recurrence relations** by C. W. Clenshaw and F. W. J. Olver (DSIR, U. K. National Physical Laboratory).

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