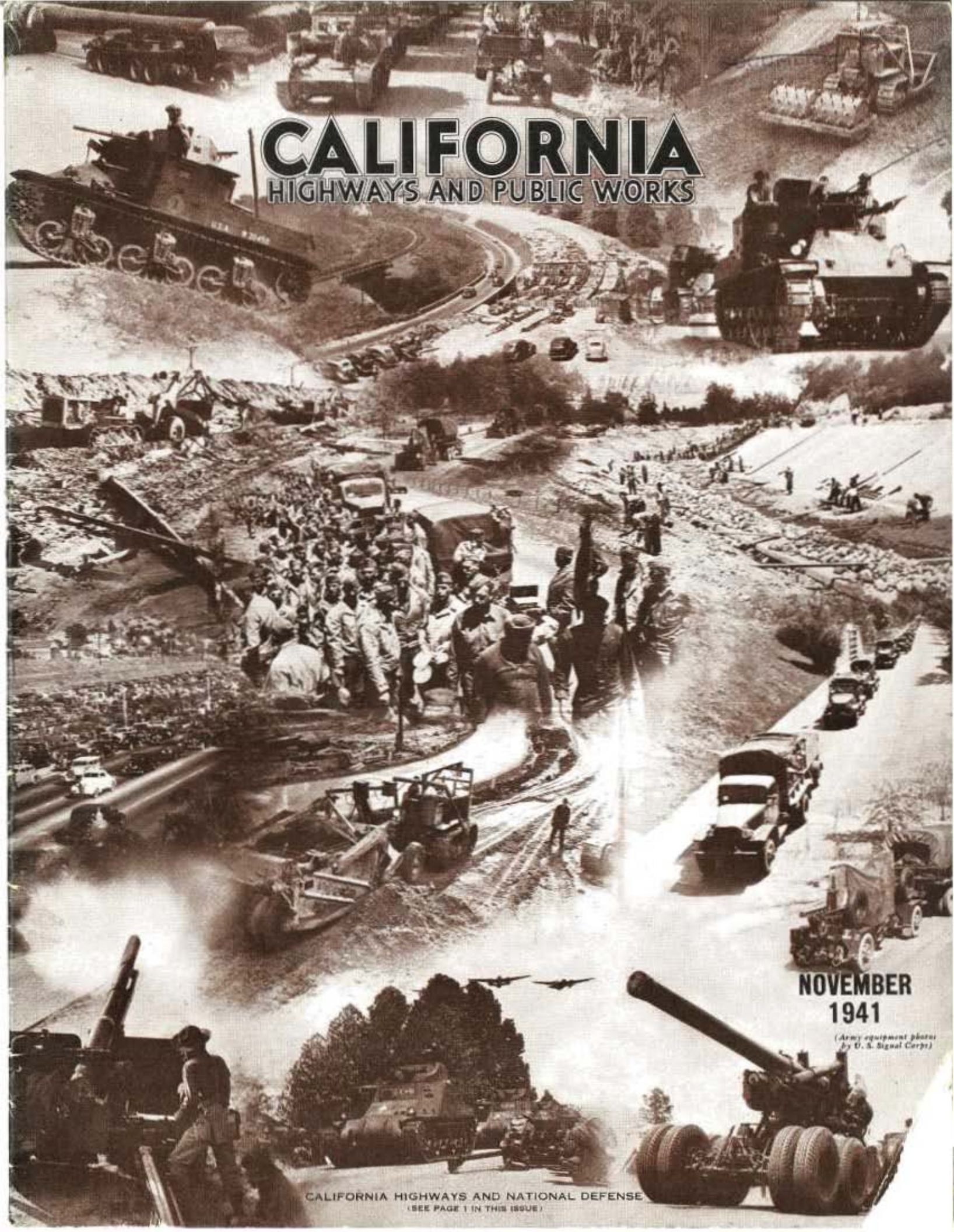

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

NOVEMBER
1941

(Army equipment photos by U. S. Signal Corps)

CALIFORNIA HIGHWAYS AND NATIONAL DEFENSE

(SEE PAGE 1 IN THIS ISSUE)

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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National Defense Demands Compel Some Revisions and Postponements of Projects in State Highway Budget

By FRANK W. CLARK, Director of Public Works

NORMAL development of the California State Highway System must be curtailed in order to meet urgent demands of the Army and Navy for defense roads.

Revision of our highway budget for the 93d and 94th fiscal years is the only way in which the National defense requirements of the Federal Government can be met.

Major projects in the present biennial budget amounting to between four and five million dollars may have to be revised or deferred.

As this magazine goes to press the exact locations of these deferments and reductions are being determined by the California Highway Commission and the Department of Public Works. The specific details will be published in the December issue.

DEFENSE PROGRAM EFFECTS

In so far as possible, we seek to reduce the length of projects rather than eliminate them but it may be necessary to strike from the budget entirely certain contemplated improvements.

For the past six or eight months, we in the Department of Public Works have been increasingly aware of the impact of the National Defense Program on our activities. Most everyone is more or less familiar with the effect of the defense program on our private lives and businesses, but I do not believe that the average individual, or the motoring public in general, yet fully realizes just how serious the matter is from the highway standpoint.

In September, October and November of last year the California State Highway Commission in consultation with the Director of the Department of Public Works and engineers of the Division of Highways adopted our highway budget for the 93d and 94th fiscal years.

FRANK W. CLARK

This budget appropriated approximately $37,000,000 for major project construction on the California State Highway System. This figure included $7,600,000 of Federal aid funds that we estimated would be available for expenditure by the State on the Federal Aid System.

BUDGET BALANCE NEEDS

That $37,000,000 budget was the result of a great deal of work and most careful consideration on the part of both the State Highway Engineer and the Director of Public Works and the State Highway Commission.

In accordance with the wishes of the Governor, the commission sought to determine the projects most necessary from the standpoint of the greatest good for the entire State. It sought to balance the needs of the ordinary traveling public and the shipper of freight on the highways.

It concerned itself with heavily traveled urban and interurban routes and with lightly traveled secondary and recreational highways. It attempted to make its allocations with a view to the sound future development of the highway system. At the same time it tried to keep a reasonable balance of highway expenditures between the various geographical sections of the State.

In its deliberations the commission had before it the recommendations of each of the 11 district engineers covering what they considered to be the most necessary improvements in their districts. These recommendations had in turn been passed upon by the State Highway Engineer C. H. Purcell and his central office staff and by the director's office.

REPRESENTS SOUND PROGRAM

The budget released to the public in January of this year was the result. It represented a sound construction program for the next two years. It is a program that has been widely publicized and has received the approbation or disapproval, as the case may be, of a great many interested groups.

We are now confronted with a situation requiring that we seriously reconsider that program, not only from the standpoint of the necessity of some of the projects in the light of present-day circumstances, but, and more important, from the standpoint of the actual feasibility of their construction.

I hope that in the months ahead the public throughout California will understand what confronts the administration and the need for action on our part.

COSTS NOW HIGHER

There are a number of reasons for this condition. In the first place, it must be remembered that the engineers' estimates on which the budget allocations were based were prepared prior to the meetings of the Highway Commission last autumn. That means that the actual engineering figures on the estimated cost of construction of any particular project were compiled at least 12 months and in some cases 14 or 15 months ago.

Estimates prepared in our office indicate that current construction costs are approximately 20 per cent higher than they were a year ago and the possibilities are that this rise will continue. Higher wages for both skilled and unskilled labor are felt not only in the labor used on the work itself but in the increased cost of the materials.

More important still is the uncertainty of obtaining many materials and the difficulty many contractors experience in attempting to replace equipment, both tending to increase bid prices submitted for highway construction.

DEFENSE FACILITIES EXPANDED

Finally, California with its thousands of miles of coast line, temperate climate, and large aircraft industries is a concentration point for Army, Navy, and Marine camps, training stations, air fields and the like and the rapid expansion of these facilities has resulted in an unprecedented amount of construction activity in this area.

This increase in construction has tended to decrease the supply of available skilled labor and to decrease the field of available bidders which in turn has had a marked effect in raising the bid prices submitted.

The defense program, however, makes itself felt in the Department of Public Works in other ways than in increased construction costs. During the past several months, all construction agencies, public and private alike, have experienced increasingly great difficulty in obtaining certain critical materials.

At the time of the establishment of the Office of Production Management, certain engineers of the Division of Highways were assigned to the task of studying this problem and cooperating with the Federal Government in the matter of obtaining proper priority designations for the several classes of highway construction.

GOVERNOR CONTACTED WASHINGTON

Both Governor Olson and I have communicated directly with Washington on numerous occasions regarding this matter, and in August, the Governor sent to Washington as his personal representative on this matter Deputy Director of Finance John Welsh in an effort to aid the Division of Highways, Division of Architecture and other interested State agencies in obtaining the required priorities.

The most critical commodity from the standpoint of highway construction up to the present has been steel, for most of our structural steel in California is shipped from eastern mills and due to the scarcity of maritime shipping to the west coast, consignments for the past six or eight months have of necessity come by rail.

RAIL FACILITIES CONGESTED

There has been a tremendous increase in railroad business and the rail facilities of the country are badly congested, so much so in fact that shipments of structural steel to this area have been coming in very slowly. Thus, while we have, as an administrative matter succeeded in obtaining relatively high priorities for most of our highway jobs, those priorities alone have not been enough to assure the prompt arrival of the steel on the job and both the State and its contractors have been and still are experiencing difficulty in obtaining deliveries of steel.

THREE MONTHS DELAY

The North Sacramento Viaduct for instance, which is a vital defense link between Sacramento and the Army Air Depot at McClellan Field and Mather Field, is now several weeks behind schedule because of a lack of reinforcing bars, even though this project carries a priority rating of A-1-E, equal to that of the air depot itself.

To give other examples the Azusa Underpass, east of Los Angeles, was delayed approximately three months because the structural steel necessary for its completion was rolled by eastern mills and lay there that length of time in an eastern port awaiting shipment to the Pacific Coast.

Similar delays have been experienced in the construction of structures across Eureka Slough in Humboldt County and the south fork of Putah Creek on the Sacramento-San Francisco highway, and in the case of various grade separation structures on the Figueroa Street extension of the Arroyo Seco Parkway in Los Angeles.

In addition to these difficulties already encountered, we are now advised that a recent ruling of the Supply Priorities and Allocations Board will confine allocations of strategic materials to improvements to the established strategic highway network and access roads.

IMPROVEMENTS MUST WAIT

Should this be the case and such a ruling actually put into operation, the State's construction program will for all practical purposes be limited to defense projects, and our normal highway development will necessarily be limited to approximately 6,000 miles of State highways and to the established access roads. Stated differently, approximately 8,000 miles of State highways scattered throughout every county in California will have to let their improvements wait.

Our situation is further aggravated because of the access road problem. We have in California an enormous number of military, Navy, and Marine establishments. The program of access roads to these establishments includes approximately $40,000,000 in highway and bridge projects. Since a great majority of these projects are off the State highway system, their construction by State funds is impossible under State law.

Nevertheless, the California Division of Highways has so far expended about $1,200,000 of regularly allocated Federal aid and Feeder funds for surveys and preparations of plans for requested access roads. This work on the access road program has, of course, interfered with our normal operations. State highway personnel has had to be assigned to it at a time when because of the draft, the expansion of the Reserve Corps, and the high salaries offered by various industrial plants, it has been most difficult to keep an engineering organization intact.

SOME ROADS OVERBURDENED

However, our troubles and the troubles of the Californians interested in the highway system do not even end there. Defense activities in Califor-

Photo by U. S. Signal Corps

Two and a half ton army trucks hauling 155 millimeter guns through woods on a dirt access road

nia such as the construction of the large military cantonments at Fort Ord, Fort Roberts, Camp San Luis Obispo, and elsewhere have changed the character and volume of travel on State highways to an almost unbelievable extent.

Near Lompoc, for example, the Federal Government is now constructing a camp for an armored division. This cantonment will be served by our State Highway Routes 56 and 149, both of which have always been assumed to be secondary highways carrying a relatively small number of vehicles and a relatively light type of traffic.

Construction of facilities to house a full armored division and the subsequent establishment of that division on such a road places a greater burden on that road in a period of six months than it was designed to carry in six years.

This same condition exists in other localities in the State where highways designed for relatively light rural and farm-to-market traffic have suddenly become main arteries over which thousands of tons of construction materials, foodstuffs and implements of war are moved every month.

MAINTENANCE PROBLEM COMPLICATED

The extent to which this particular phase of the problem will affect our maintenance work no one can tell at this time. Should we have an unusually heavy winter it is conceivable that the demands on our maintenance forces might become so great that substantial sums would have to be diverted from construction in order to even keep these roads open, as obviously there is no time to complete reconstruction to higher standards before the winter rains set in.

In this connection, a large proportion of the new traffic burden being Federal in nature does not support highway improvement through contribution to the gas tax and motor vehicle fees. This necessarily shifts a great responsibility to our supporting State traffic.

It must therefore be realized that in the last analysis we do not have absolute discretion as to the expenditure of our funds. Section 18 of the Federal Highway Act clearly states that the Federal Government may limit the use of all Federal aid funds to projects in the strategic network.

When it is considered that these Federal funds have been budgeted for this biennium, and that there has been budgeted an equal amount of State funds to match them, it is not difficult to visualize the result should the Federal Government require the expenditure of all Federal aid funds on certain strategic highways.

We would not only be required to change our budget to the extent of the Federal aid funds but would also be required to shift an equal amount of State money, or lose the Federal funds altogether.

FEDERAL AID LOSS POSSIBLE

This condition has not yet arisen, and we are attempting to forestall it to the best of our ability by budgeting our Federal moneys as far as possible on strategic highways, but it is a possibility that does exist and one that should be borne in mind by all of us.

Obviously, some adjustment of our existing highway budget will be necessary. How great an adjustment, can not be predicted at this time because many varying factors such as the fact that we are realizing an

(Continued on page 13)

Designing Foundation Courses for Highway Pavements and Surfaces

The following article is a paper prepared and read by Mr. Fred J. Grumm before the Public Works Officers Department of the League of California Cities in Sacramento, October 15, concerning adequate subgrades for highways.

By FRED J. GRUMM, Engineer of Surveys and Plans

IT SEEMS almost unnecessary to begin this discussion with the obvious truism that the integrity and serviceability of any structure is dependent on its foundation. I realize fully such a statement contains nothing new or startling and that all of you subscribe to its inherent truth. Nevertheless, few truths have been so universally acknowledged in theory and so frequently ignored in practice by road or highway engineers, especially with respect to the foundations of their pavements and surfacings.

The reasons underlying this apparent disregard of one of the accepted and fundamental tenets of our engineering faith are not so easily stated. Many factors are involved ranging from economic considerations to blind optimism and ignorance of the really complex and infinitely variable material which we so casually designate as plain earth or "dirt."

KNOWLEDGE RECENTLY GAINED

It is rather astonishing to record the fact that a major part of our present extensive and specialized knowledge of "soil science," from the standpoint of its peculiar characteristics as an engineering material, has been acquired during the last 10 years. Strange, is it not, that man's oldest and most commonly utilized building material should have retained so much of its mystery for so many years.

It is not inferred by the above, that we have stripped Mother Nature of all her secrets, for there are many acute problems still crying for a solution. I do believe, however, that we are now in a position to utilize the recently gained knowledge of the soil technician to avoid those obvious pitfalls which produce results that are too frequently evident to the discerning eye as they are reflected in the present condition and service record of our streets and highways.

It is rarely practical, or, at least, economically feasible, to found our streets and highways upon bedrock, else the problem would be infinitely simplified. On the contrary, due to the vagaries of Mother Nature, the engineer is usually faced with the necessity of providing some means or method of spreading imposed concentrated loads over a sufficiently large area so that the resulting unit pressures applied to the underlying subgrade or subsoils are reduced to a value within the supporting capabilities of the material.

STABILIZATION TEST PROJECTS

The required result may be obtained in many ways. For instance, the pavement design itself may be of a type having considerable structural or "beam" strength, thus reducing the unit stresses transmitted to the subgrade to the required limiting values. The native supporting material, in such cases, must be of a type not susceptible to large volume change by the addition or subtraction of water, such as is characteristic of heavy clays or adobes which also have very low supporting values, when wet.

On the other hand, if a flexible pavement or surfacing is the determined design, the supporting subgrade will be subjected to much higher unit stresses under maximum legal wheel loads, inasmuch as pavements or surfacings of this type have no beam strength and show little, if any, greater load spreading characteristics than an equal thickness of well graded crushed rock or gravel. In such cases, good design will provide a "ballast" or base course of sufficient thickness and of high enough bearing value to withstand the high unit stresses to which it will be subjected. Native materials of a granular nature are often available within economical haul limits, having satisfactory quality for use as ballast courses in such cases.

It is, however, well to emphasize the importance of careful and thorough sampling and testing of such sources prior to their use to insure the availability of a sufficient quantity and quality for the intended work. Sedimentary deposits of such material in this State are seldom uniform and often contain deleterious deposits of clay which are difficult to detect by eye especially under the rapid methods of operation of modern construction equipment.

So-called "stabilization" of unsatisfactory native soils is sometimes economically justified, the most common stabilizing agents being Portland cement, bituminous materials or chemical admixtures. The State Division of Highways has constructed several test projects utilizing the first named of these admixtures and two or three using bituminous products. It is still too early in their service life to offer definite conclusions, but the well constructed soil-cement jobs show considerable promise, inasmuch as they bind together and develop considerable base strength. We have not attempted stabilization with chemical admixtures, as this method is more costly and of more doubtful utility as compared to the others at the present time.

A final method of improving the quality of an inferior soil, which we

Officials checking weight of large truck and trailer equipment on State Highway. Note portable scales in front of wheels

have used to advantage several times, is by the addition of a predetermined quantity of clean beach sand intimately mixed into the top 12 or 18 inches of a heavy and completely unsatisfactory clay loam. This method is rather costly due to the large percentage of sand usually required for best results, and the considerable processing involved, but is sometimes economically justified if the sand is easily and cheaply available.

Now that we have discussed the basic problem and some of the general and most common methods of solution, let us particularly examine into the necessity of foundation courses. When are they required? What should be their thickness and quality under the infinite variations of soil, climate and traffic conditions encountered in practical road and street construction?

First, let me say that in my opinion the present-day engineer who attempts to design a modern street or highway without a thorough and scientific study of the soils and materials involved is no longer worthy of his profession.

Under the best of conditions and in possession of all the facts which can be accumulated, the engineer seeking to design an economic, long lasting and thoroughly satisfactory road or street has a difficult enough task, without further complicating the problem through lack of information.

TRAINED PERSONNEL IMPERATIVE

Therefore, the first order of business is to determine what are the physical characteristics and the limits of the soil material of which, and upon which, we intend to build our facility. This is no job for an untrained man. Misinformation is often more dangerous than no information. Soil sampling procedure, as well as the actual test determinations demand trained and intelligent personnel, if we are to place full reliance upon the results.

There are several well developed methods of soil classification. In the California Division of Highways our laboratory has developed and perfected a test procedure which is as simple as any, and has the further advantage to commend it in that it does furnish some indication of the stability or bearing power as a soil both in the ideal state of optimum moisture and compaction as well as in the most unfavorable condition to which it may degrade by the accumulation of excess moisture.

The test consists essentially of penetrating a sample of the soil material, which has been previously compacted at its optimum moisture content under a load of 2,000 pounds per square inch, with a piston at a constant rate and noting the loads developed at certain specified penetrations. The specimen is then reconsolidated and soaked for a period of four days, to allow it take up as much moisture as it will.

The sample is confined in the mold during the soaking period by a porous disc and a 10-pound weight which represents the surcharge of the pavement. After soaking, the sample is again penetrated by the piston in the testing machine, and the loads again noted. The bearing value is expressed as a percentage of a standard granular sample of crushed well graded ideal material the loads and penetra-

tions of which are considered as 100 per cent. The penetrations at which the loads are observed are in increments of 0.1 of an inch.

Another important characteristic of the material is observed during the soaking test. Early studies of soil expansion by our Materials and Research Laboratory indicated that each particular type of soil material had a state of equilibrium with respect to density and moisture content for each condition of confinement.

EXPANSION TEST DESCRIBED

It was found that the moisture capacity of a soil varied inversely as the superimposed load. Since the expansion of a foundation material which may be expected to occur under a gradual accumulation of moisture is of concern to us, the expansion test is performed by measuring the height of the sample, prior to soaking, and again measuring it after the four-day soaking period under the superimposed load representing the pavement or surfacing. The increase in height is recorded in terms of the original height and the percentage of swell computed.

Experience has demonstrated that a soil which shows "bearing values," as defined above, of under 10 per cent in the compacted and soaked state, and having high expansion, as measured by the swell test, is an unsatisfactory material to use under any type of pavement.

During the last 40 years numerous rules and formulae have been advanced for relating the wheel load unit pressures exerted on the surface of a pavement or surfacing to corresponding unit pressures on the subgrade. Despite the continuous and intensive study given to this problem, no rule or formula has yet been advanced which will yield a rational solution under the infinitely variable conditions and materials encountered in nature.

Hence, the "bearing value" test developed in this State does not yield a mathematical or formalized solution. It does give us a practical tool to evaluate the character of the soils encountered and through close observation and correlation over a period of years, it has permitted us to establish certain fairly accurate limiting conditions for soils and traffic loads, and for paving and surfacing types.

Before proceeding further with the enumeration of what these limiting conditions are, an explanation of another important tool which the Design Department of the Division of Highways has recently developed to evaluate another very important phase of design problems would be of interest.

As with any other strictly utilitarian structure we are very intimately concerned with the loads which our pavement must support, not only from the standpoint of the maximum weight, but also with respect to the probable total number.

Because the failure of a road surface results in nothing more serious than discomfort and possibly inconvenience to the users thereof, it is the established custom, for economic reasons, to design the road surface with a much lower factor of safety than is usual in structures where life and limb are at stake. As a consequence, the principles of fatigue enter into the problem to a much greater extent than is the case with most structures. Hence, not only the magnitude of loads are involved, but also the probable repetitions thereof, especially those which may stress the pavement up to 50 per cent or more of its ultimate strength.

FATIGUE FACTOR INVOLVED

It has long been known that the destructive effects of repetitive wheel loads of increasing weight is much more severe than the flat increase in the load would indicate. In the case of rigid pavements this "fatigue effect" has been definitely established and evaluated, but in the case of flexible types its effects have not been determined with the same certainty. However, by careful study of service records and their correlation with traffic and load data accumulated by our Planning Survey, it is plainly evident this same fatigue factor is just as important with flexible types.

In view of the above, it becomes important to determine, if possible, what probable use of our facility will be made by commercial vehicles, especially those in the heavier weight groups having wheel loads of 4,500 pounds and over.

Thanks to the Planning Survey mentioned above, which since 1936 has been engaged, in cooperation with the Federal Government, in the accumulation of facts and figures on the highways of the State, for the information of the highway executive and designer, we are now able to estimate these data closely enough for our purpose. We accomplish it in this way.

First, from the annual traffic count records which we have been maintaining for many years, it is possible to estimate with reasonable accuracy the probable total traffic per day which will use our highway for the next 20 years. As these traffic counts have separated commercial vehicles from the passenger car type, it is also possible for us to forecast the number of each type.

LOADOMETER FACTS ESTABLISHED

The Planning Survey engineers in their study of State highway traffic, established loadometer or weighing stations at certain carefully selected points throughout the State, and for a period of time weighed representative groups of commercial vehicles, axle by axle.

Thus they established two facts of particular use to us for our present purpose: First, the representative axle weight distribution of the commercial vehicles using a particular section of highway; and second, the average number of axles of the average trucking unit. In other words, if we know the weight distribution, by axle loads, of the commercial increment of the traffic as well as the average number of axles per vehicle, from these data we can compute the total number of axles for each weight increment which will pass over our facility for any given period.

By applying proper "weighted" factors to each number and weight group of axle loads we can arrive at the probable repetitions of an equivalent 5,000-pound wheel load which our pavement or surfacing must be designed to withstand for the period of its assumed useful life. We use these "weighted" factors for the reason that it is necessary to determine some common denominator to which we reduce our axle load determinations, for purposes of comparison and correlation. In our practice it is in terms of 5,000-pound wheel loads, for our design analysis of probable stress in our higher type pavements convinces us that they will stand unlimited repetitions of wheel loads of less than 5,000 pounds.

For the purpose of giving you some idea of the magnitude of the truck use of our highways, our studies have indicated there are some heavily traveled sections in the southern part of the State, where a total of over 20,000,000 equivalent 5,000-pound wheel loads may be expected in a 10-year

(Continued on page 15)

Tentative Highway Design Standards

1. **HEAVY INDUSTRIAL TYPE** (10,000,000 equivalent wheel loads or over).

Outside traveling lanes to consist of 0.92′-0.67′-0.92′ portland cement concrete pavement, or 0.75′-0.50′-0.75′ lower cement content portland cement concrete base surfaced with asphalt concrete 0.25′ thick.

Inside or passing lanes to consist of 0.75′-0.58′-0.75′ portland cement concrete pavement, or 0.58′-0.42′-0.58′ lower cement content portland cement concrete base surfaced with asphalt concrete 0.25′ thick.

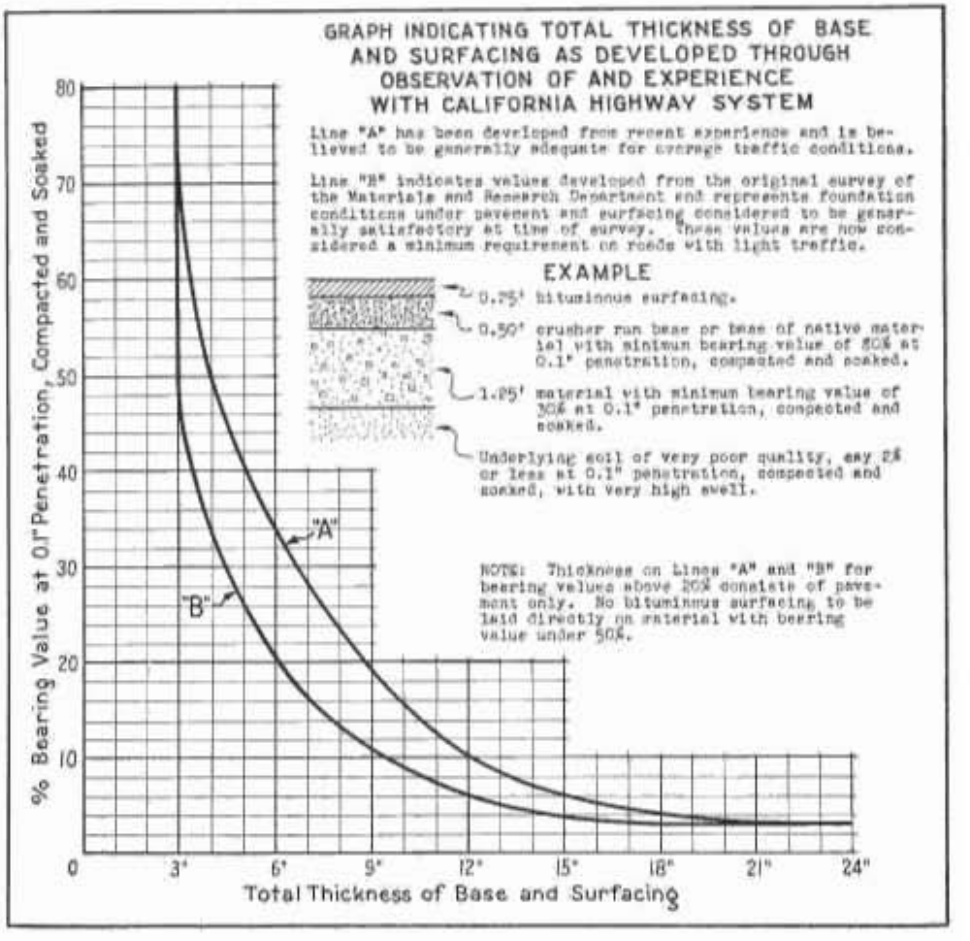
2. **MEDIUM INDUSTRIAL TYPE** (2,500,000 to 10,000,000 equivalent wheel loads).

All lanes to consist of 0.75′-0.58′-0.75′ portland cement concrete pavement, or 0.58′-0.42′-0.58′ lower cement content portland cement concrete base, or cement treated base varying in thickness from 0.50′ to 0.75′ in accordance with number of wheel loads and other conditions, with bituminous surfacing 0.25′ thick, or asphalt concrete pavement of adequate strength where subgrade is suitable and wheel load repetitions are under 5,000,000.

3. **LIGHT INDUSTRIAL TYPE** (less than 2,500,000 equivalent wheel loads).

Pavement to consist of 0.75′-0.60′-0.75′ asphalt concrete or some combination of local base materials surfaced with bituminous mixtures as the equivalent repetitions decrease below the top limit designated above, the design necessarily being subject to various local conditions of traffic and materials.

NOTE.—Figures 0.75′-0.58′-0.75′ indicate pavement slab 0.58′ thick, increasing to a thickness of 0.75′ in a distance of two feet at each edge of each lane.



Road VI-Ker-4-E

Loadometer Station L-52

Limits: South of Famoso

Average daily traffic (1940) 6629
Average daily commercial traffic 1940 1442
Est. average daily commercial traffic 1950 2884
Average= 2163

2163 X 365 X 10X*2.88 = 22,737,456 axle loads in 10 years

Wheel Load Groups

1. 4500 - 5500	10.71 % = 2,435,182	X 1 =	2,435,182	
2. 5500 - 6500	9.61 % = 2,185,070	X 2 =	4,370,140	
3. 6500 - 7500	11.96 % = 2,719,400	X 4 =	10,877,600	
4. 7500 - 8500	6.02 % = 1,368,795	X 8 =	10,950,360	Estimated equivalent 5000# wheel loads in 10 years
5. 8500 - 9500	3.40 % = 773,074	X 16 =	12,369,184	
6. 9500 and over	0.91 % = 206,911	X 32 =	6,621,152	

Total estimated equivalent 5000# wheel loads in 10 years 47,623,618

Design repetitions (traffic in one direction) 23,811,809

REMARKS: Loadometer station at junction of Routes 4 and 33 at Famoso.

* Average number of axles per vehicle.

Subgrades

Subgrade under portland cement concrete pavement or base to consist of a minimum depth of one foot of material with a minimum bearing value of 20% at 0.1″ penetration, compacted and soaked, and swell less than 3%.

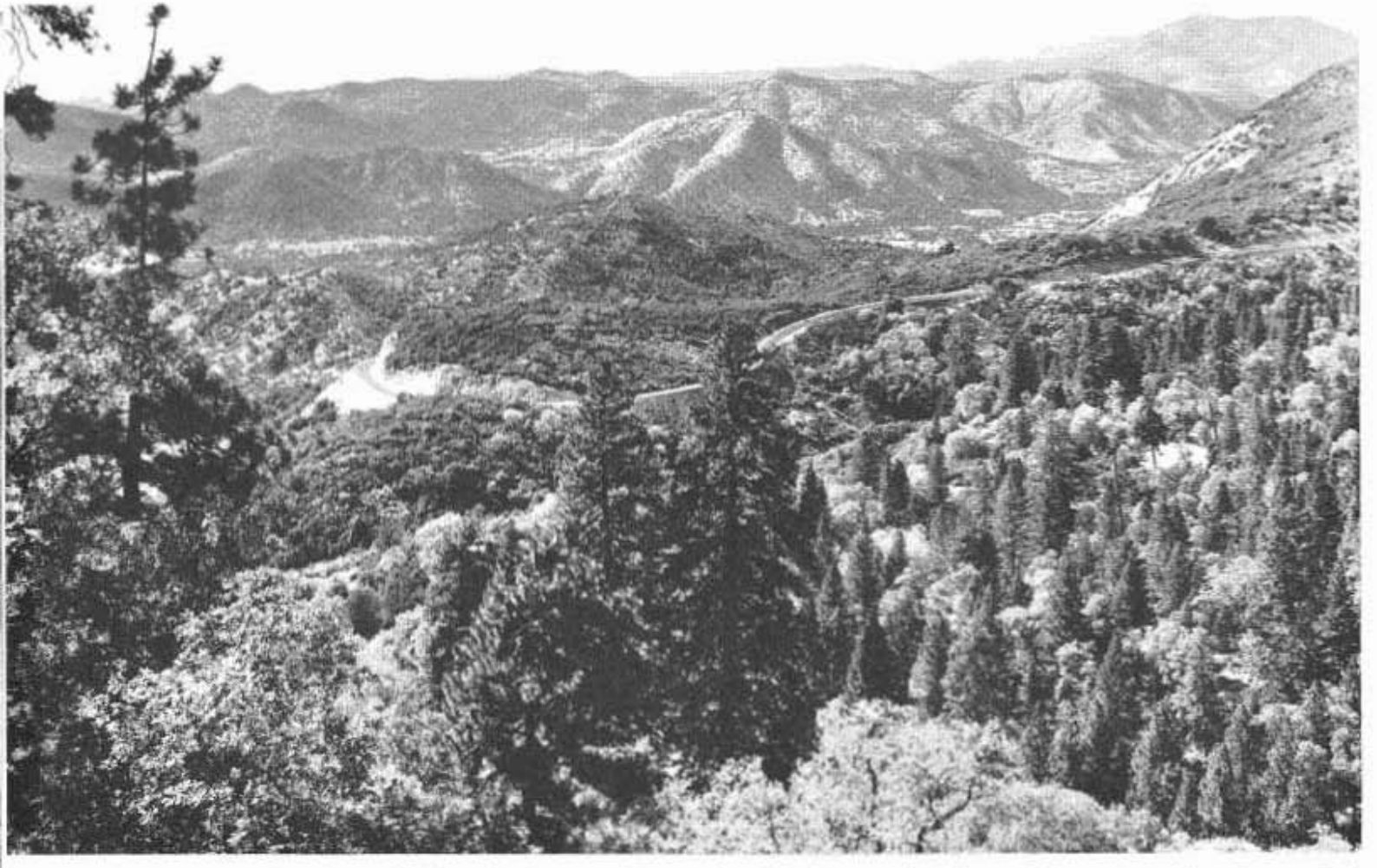
Subgrade under cement treated base to consist of a minimum depth of one foot of material with a minimum bearing value of 20% at all penetrations, compacted and soaked, and swell less than 3%.

Subgrade under other combinations of surfacing as discussed in accompanying article.

Expansion Joints

Usual expansion joints in portland cement concrete pavement consist of ¾″ redwood boards with dowels at 120′ intervals, with weakened plane joints without dowels at 15′ intervals.

Usual expansion joints in portland cement concrete base consist of ½″ redwood boards with dowels at 500′ intervals with weakened plane joints without dowels at 20′ intervals.



Panorama from Kings Canyon Highway showing new alignment, in middle foreground, of Squaw Valley route to Kings Canyon Park

New Modern Highway Unit Completed on Approach Road to Kings River Canyon

By E. T. SCOTT, District Engineer

IN ORDER to provide more modern highway facilities from Fresno to General Grant Grove section of the Kings Canyon National Park, the Public Roads Administration, the Division of Highways, and Fresno County have jointly constructed a new approach highway which is some 5 miles shorter than the old route by way of Dunlap and Pinehurst.

The Public Roads Administration constructed for the U. S. Forest Service some 12 miles of the route upon new alignment from the westerly boundary of Sequoia National Forest to a connection with the old road near Big Stump Lodge about a mile south of the General Grant Grove.

The Division of Highways has now completed a 3.1-mile connection with this new forest road between White Deer Road, just westerly of Dunlap, and the Forest Boundary. Fresno County improved 0.3 of a mile of the White Deer Road between the existing highway and the State construction so that the route is now completely modernized.

At a recent meeting the State Highway Commission voted on motion of Commissioner Iener W. Nielsen of Fresno, to keep the route open this winter providing the Forest Service extends the road beyond Cedar Grove, in the canyon, as originally planned.

The new alignment, grade and surfacing are up to modern mountain highway standards and are a marked improvement over the old route, making for a much more enjoyable trip to either the General Grant Grove or farther on up the scenic and rugged Kings River Canyon.

On the 3-mile section constructed by the Division of Highways, the maximum grade is 6 per cent while some of the grades on the old Dunlap-Pinehurst route were as high as 10 per cent. The alignment of the new route does not have the sharp curvature which exists on the old road as the minimum standard of curvature on the State's portion is a 700-foot radius and on the Forest section 300 feet. The maximum grade on the Forest section conforms to that used on the State's portion—6 per cent.

The work performed by the State consisted of constructing a graded roadbed 26 feet wide covered for its

full width with selected material. The contract for grading, constructing drainage structures and placing the selected material was awarded by the Director of Public Works on May 8, 1940, and all work was completed on this contract on February 21, 1941.

On June 20, 1941, a second contract was awarded for applying a bituminous surface treatment to the selected material placed the year before. This work was completed on August 28, 1941.

The cost to the State for the construction amounted to $142,261 for the grading contract and $12,683 for applying the bituminous surface treatment, making a total of $154,944 for the improvement. The work was financed with State and Federal Aid Funds.

HEWN FROM SOLID ROCK

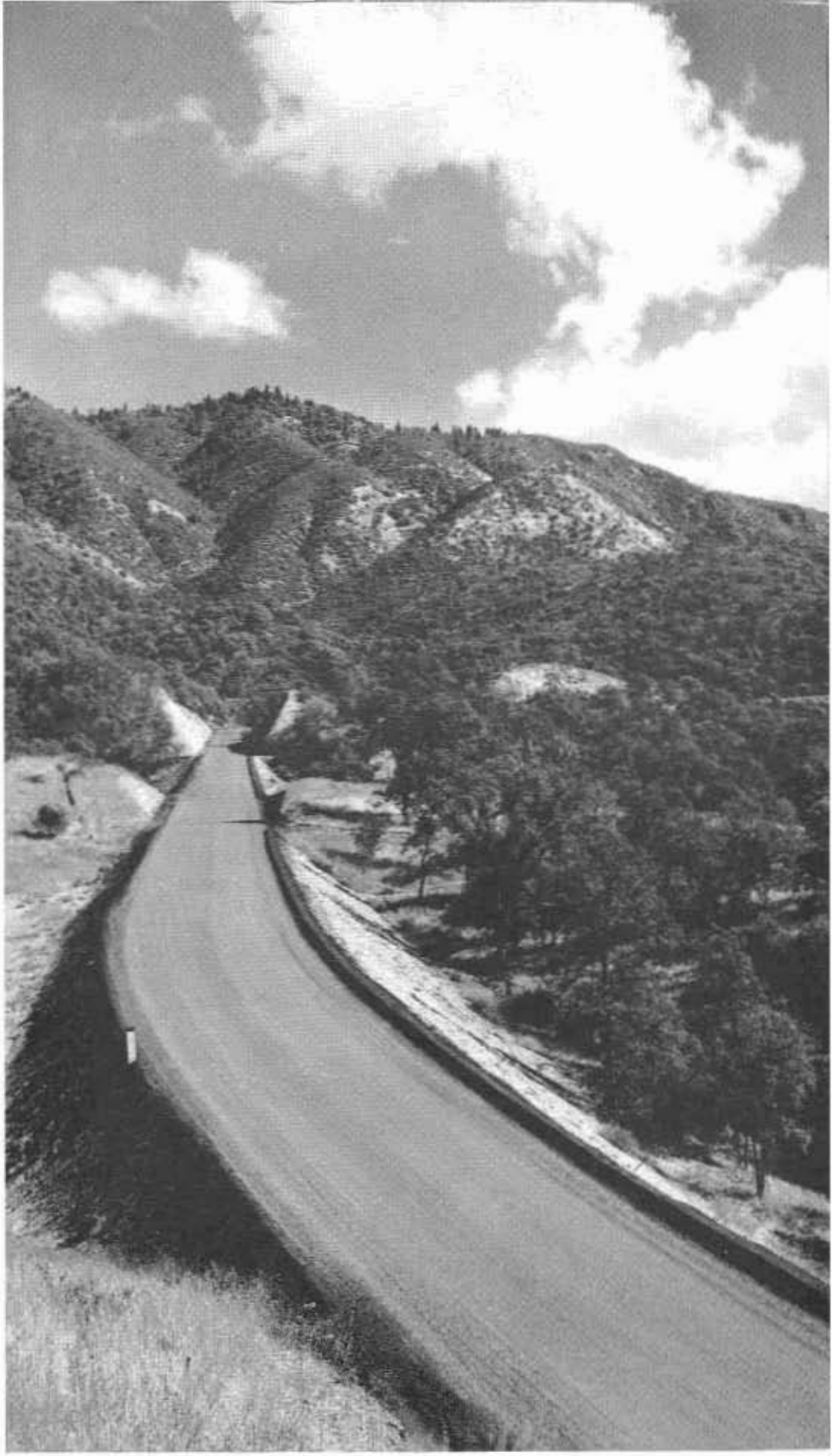
The completion of this highway to the General Grant Grove makes the rugged grandeur of the scenic Kings River Canyon Highway more available to Fresno and the San Joaquin Valley. From the northerly boundary of the General Grant Grove this road stretches into one of the most primitive areas yet touched by a modern highway.

The Kings River highway was hewn from the solid rock masses of this section of the High Sierra by 10 years of labor on the part of the Division of Highways. This construction involved the building of about 24.5 miles of road and its cost amounted to nearly $2,300,000.

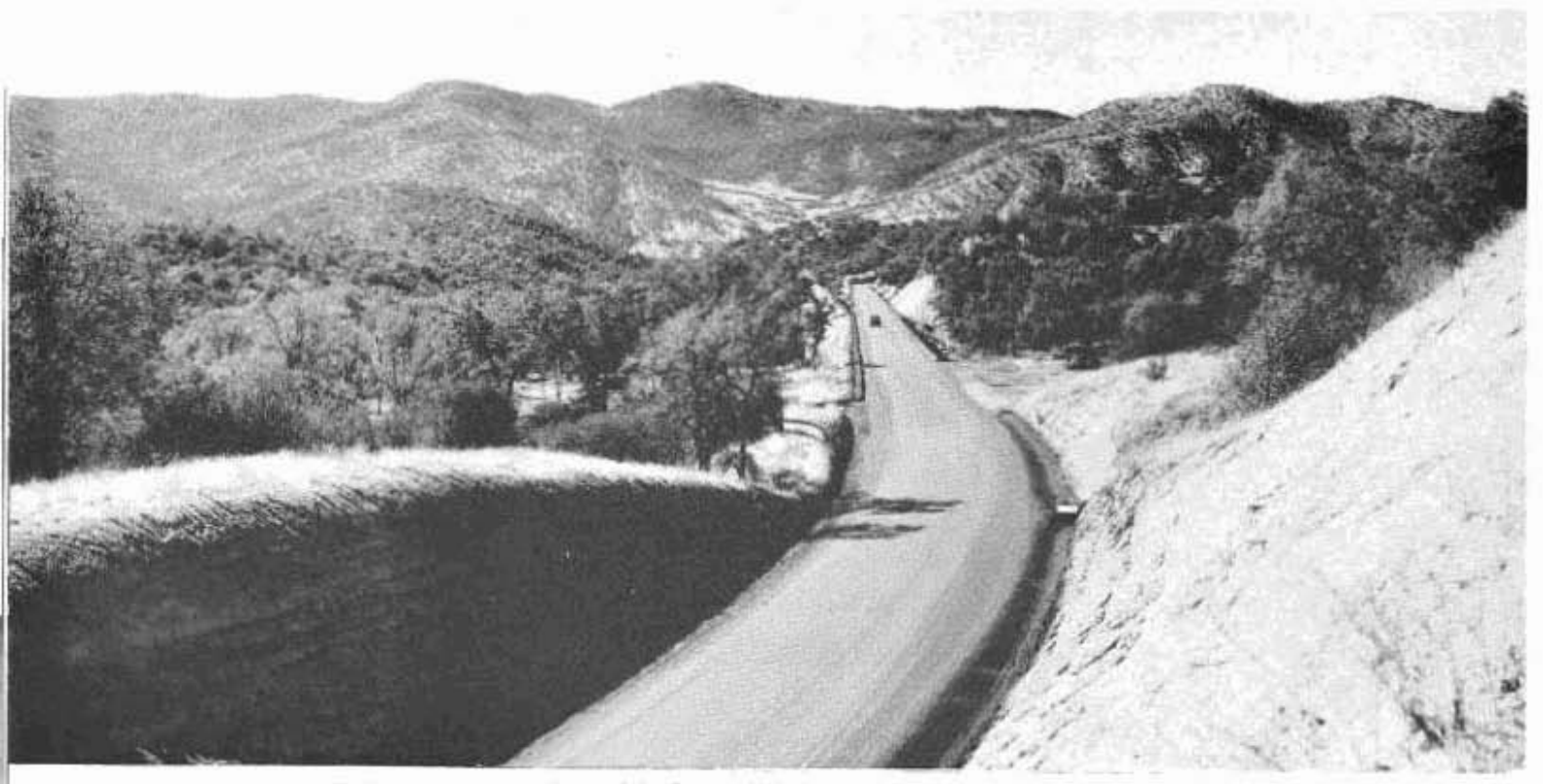
With the completion of the approach road construction during the past two years, motorists may now travel with ease and comfort as far as Cedar Grove on the South Fork of Kings River and new joys await the California travelers who glory in the State's mighty Sierra along the entire trip.

Dropping deep into the canyon from heights among the clouds overlooking the expanse of the San Joaquin Valley to the west and High Sierra to the east, the Kings River Canyon Highway offers panoramic views of mountain grandeur not easily to be forgotten, such as views of mountain massives, peaks of sheet granite rising to dizzy heights, pinnacles and deep canyons, and all on a tremendous scale.

The highway into the canyon proper extends from the northerly boundary of General Grant National Park



New unit on recently completed realignment of State Highway section between Squaw Valley and Dunlap on Kings River Canyon Highway



Modern type mountain road in Squaw Valley area has 26-foot bituminous surfaced roadway

through Indian Basin, dropping down to Lookout Point, where a gorgeous panoramic view unfolds, and thence winds on down grade to Yucca Point. Here an inspiring view is to be had of the river named by the Spaniards in 1805, El Rio de los Santos Reys (River of the Holy Kings). From here one can see the confluence of the Middle Fork and the South Fork of the Kings River, both extending miles back into steep walled gorges, scoured by glaciers in ancient times.

Winding down hill on gentle grades and easy curves the highway is carved in the granite of the canyon wall of the South Fork of Kings River. The river is finally reached at Windy Cliff, about 18 miles distant from General Grant Park.

Here the rock formation suddenly changes. A great limestone dike rises almost vertically to a height of 1,500 feet above the river, exquisite mountain sculpture. Nor are these natural carvings limited to the surface of the limestone formations.

Near Windy Cliff is to be found the entrance to Boyden Cave, a cavern extending several hundred feet into the great dyke. Galleries and grottoes carved in the limestone, ornamented with statuary of weird design; groups of stalactites and stalagmites, increase in numbers as one walks further into the cavern. Strong currents of air are felt apparently from crevices not yet explored, perhaps from an outside opening somewhere.

From the foot of the trail leading to Boyden Cave a large parking area has been provided for automobiles. At this point a bridge takes the high-

(Continued on page 25)

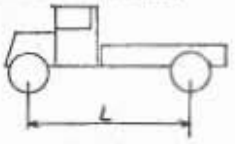
Heavy black line shows recently completed section of realigned State Highway on more direct route shortening distance by 5 miles

How Weight Laws Effective Jan. 1, 1942 Apply to Various Types of Vehicles

By STEWART MITCHELL, Assistant Bridge Engineer

THE changes made in the gross weight provisions of the Vehicle Code at the last session of the Legislature were described in the October issue of this magazine. The reasons for the change and the history of the studies and discussions leading to a much needed revision of the old law were also described.

In this issue the application of the revised weight regulations to various types of vehicles in common use on California highways is shown with the differences between the old and new laws described in detail.



TWO-AXLE TRACTOR OR TRUCK

Gross Weight=700(L+40) when L is less than 11.4 ft.

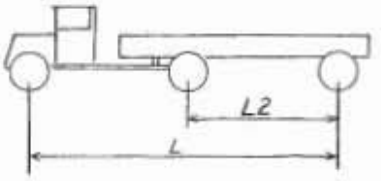
Under the old law, this type of vehicle is permitted a gross load of 26,000 pounds.

Under the new law the gross weight of the vehicle is practically governed by the maximum axle load. If both axles are loaded to 18,000 pounds, it is necessary for L to be at least 11.4 feet in accordance with Section 705 (b) (700(L+40)). However, because of loading and steering conditions, the load on the front axle seldom exceeds about 8,000 pounds and a total gross load of 18,000+8,000 or 26,000 pounds is permissible for any practicable value of L. (Note that the other provisions of the section do not place any additional limiting value and need not be considered in this particular case.)

Present owners of ordinary commercial vehicles of this type need only to be sure the gross load of the rear axle does not exceed 18,000 pounds and that neither wheel load exceeds 9,500 pounds.

Under the old law this type of vehicle combination is permitted a gross load of 43,000 pounds.

The permissible gross load of the tractor under the new law has been covered. The permissible gross load on the rear axle of the tractor and the

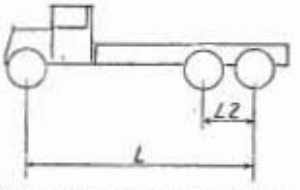


TWO-AXLE TRACTOR AND ONE-AXLE SEMI-TRAILER. 2S1

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) when L is greater than 25 ft.
Two Rear Axles=700(L2+40) when L2 is less than 11.4 ft.

semi-trailer axle together can not exceed the maximum axle loads, and to get this load of 36,000 pounds it will be necessary for L2 to be at least 11.4 feet as already pointed out. If these axles are not this far apart the gross load on them will be reduced to the amount given by the formula 700 (L+40) as given in Section 705 (b).

Hence, present owners of ordinary commercial vehicles of this type, in addition to seeing that the axle and wheel loads do not exceed the maximum, must check the gross load of the rear axle of the tractor and that of the semi-trailer added together and see that it does not exceed that permitted by the formula 700(L+40) for the actual length L2.



THREE-AXLE TRACTOR OR TRUCK

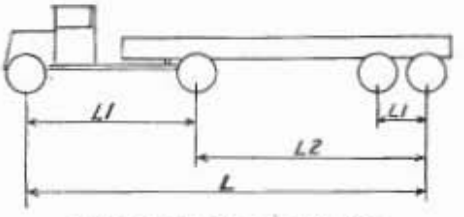
Gross Weight:
Vehicle =700(L+40) when L is less than 14 ft.
=800(L+40) when L is greater than 14 ft.
Dual Axles=700(L2+40)

Under the old law this type of vehicle is permitted a gross load of 34,000 pounds.

Under the new law, the gross weight permitted on the ordinary vehicle of this type is limited to a large extent by practical considerations. As in the case of the two-axle vehicle, the maximum front axle load is usually about 8,000 pounds. The allowable load of the dual axles is governed by the formula 700(L+40) of Section 705 (b) and in a common case where L2 is 3' 9", the allowable gross load on these two axles is 30,600 pounds—neither, of course, to exceed 18,000 pounds. Such a vehicle, with a gross load of 38,600 pounds would have to have an overall wheel base L of 15.2 feet if built after January 1, 1942, in accordance with the formula 700(L+40) of Section 705 (b). Existing vehicles can operate under this load until January 1, 1952, if this distance is 14 feet in accordance with Section 705 (d).

Present owners of ordinary commercial vehicles of this type are primarily concerned with the allowable load of the dual axles which will vary slightly with the customary small difference in distance between the axles. If they conform to this restriction it is only necessary to see that the wheel base is 14 feet or over, but if it is less the gross load of the vehicle must be checked by the formula 700(L+40) for the actual length L.

Under the old law this type of vehicle combination is permitted a gross load of 52,000 pounds.

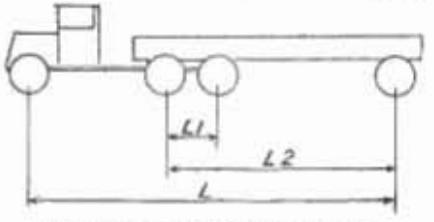


TWO-AXLE TRACTOR AND TWO-AXLE SEMI-TRAILER. 2S2

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) when L is greater than 25 ft.
Each Vehicle=700(L1+40) when L1 is less than 11.4 ft.
Last 3 Axles=700(L2+40) when L2 is less than 14 ft.
=800(L2+40) when L2 is between 14 and 18 ft.

The permissible gross load of the tractor and of dual axles, under the new law, has already been discussed. Adding together the maximum permissible load of the rear tractor axle (18,000 pounds) and a common maximum load of the dual axles of the semi-trailer of about 30,600, the total is 48,600 pounds. However, this total load is not allowed unless the distance L2 is 18 feet or more so that the pro-

visions of Sections 705 (b) or 705 (d) will not apply. A load of 43,000 pounds is permissible on these axles under the old law and for this amount to be legal it is necessary that L2 be 14 feet or greater so that the provisions of Section 705(b) will not apply.

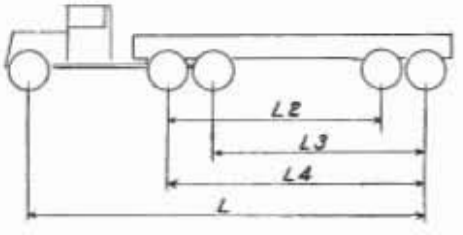


THREE-AXLE TRACTOR AND ONE-AXLE SEMI-TRAILER. 3S1

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) when L is greater than 25 ft.
Dual Axles =700(L1+40)
Last 3 Axles=700(L2+40) when L2 is less than 14 ft.
=800(L2+40) when L2 is between 14 and 18 ft.

Under old law this type of vehicle is permitted a gross of 51,000 pounds.

The preceding paragraph referring to the permissible load on existing 2S2 vehicles also applies to this vehicle type.



THREE-AXLE TRACTOR AND TWO-AXLE SEMI-TRAILER. 3S2

Gross Weight:
Combination=800(L+40) when L is less than 25 ft.
=850(L+40) but not over 68,000 lbs. when L is between 25 and 45 ft.
Dual Axles =700(L+40)
Axles 2, 3 and 4=800(L2+40) when L2 is between 14 and 18 ft.
Axles 3, 4 and 5=800(L3+40) when L3 is between 14 and 18 ft.
Last 4 Axles=700(L4+40) when L4 is less than 14 ft.
=800(L4+40) when L4 is between 14 and 18 ft.

Under the old law this vehicle is allowed a gross of 60,000 pounds.

Under the new law the load allowed on this vehicle type is dependent first on the distance L4 and secondly on the total wheel base of the combination L.

The determination of the permissible load on present owned vehicles of this type is as follows:

If L2 or L3 (whichever is the least) are 18 feet or greater, only two axles will fall within the 18 foot limit and Section 705 (b) will only affect each set of dual axles. Each set of duals then will be allowed about 30,600 pounds as previously discussed and the total load on the combination will be limited by the total wheel base, L, in the formula W=850(L+40) of Section 705 (c).

If L2 or L3 is between 14 and 18 feet and L4 is 18 feet or greater, the total load on axles 2, 3 and 4 can not exceed the amount given by the formula of Section 705 (d), (W=800 (L+40) where L=L2) nor can the total load on axles 3, 4 and 5 exceed the amount given by the same formula where L=L3. Also the total load on the combination is restricted by the formula W=850(L+40) where L is the total wheel base of the combination.

If L4 is between 14 and 18 feet, the total load of the last four axles of the combination will be determined by the formula W=800(L+40) where L=L4. In the rare instance where L4 is less than 14 feet the load on these four axles must be determined by 700(L+40). In neither of the last instances will it normally be necessary to check the total wheel base against the formula of Section 705 (e).

Two-axle trailers are allowed a maximum load of 18,000 pounds on each axle or a total of 36,000 pounds provided their wheel base is at least 11.4 feet. Where less than this amount the load is limited by the formula of Section 705 (b): 700(L+40).

The existing three-axle trailer is limited by the formula 700(L+40) applied to the dual axles and also applied to the three axles of the vehicle when its wheel base is less than 14 feet. When the wheel base exceeds 14 feet, the total on the trailer is determined by the formula 800 (L+40) in accordance with Sections 705 (a) or 705 (d).

Existing truck and trailer combinations will generally be controlled

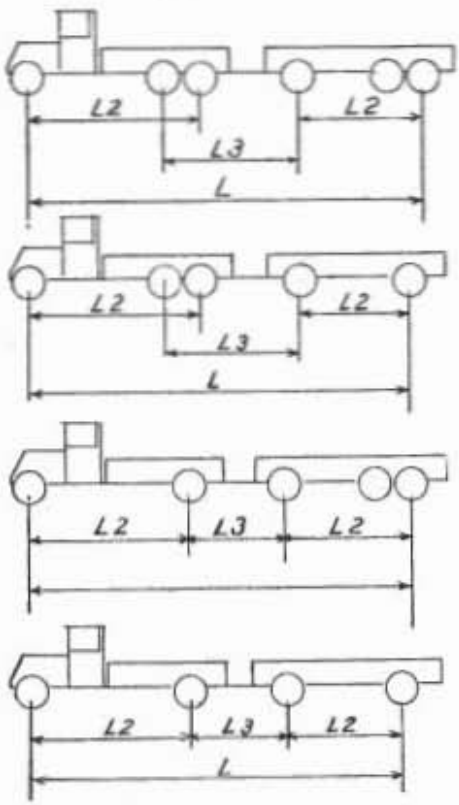
ALLOWABLE GROSS LOAD ON ANY GROUP OF TWO OR MORE AXLES BASED ON DISTANCE BETWEEN FIRST AND LAST AXLES OF THE GROUP FOR VEHICLES FIRST REGISTERED BEFORE JANUARY 1, 1942.

DISTANCE IN FEET	ALLOWABLE LOAD IN POUNDS	FORMULA
3.5	30,450	W = 700 (L + 40)
3.75	30,625	
4.0	30,800	
4.25	30,975	
4.5	31,150	
5.0	31,500	
6	32,200	
7	32,900	
8	33,600	
9	34,300	
10	35,000	
11	35,700	
12	36,400	
13	37,100	
14	43,200	W = 800 (L + 40)
15	44,000	
16	44,800	
17	45,600	
18	46,400	
19	47,200	
20	48,000	
21	48,800	
22	49,600	
23	50,400	
24	51,200	
25	55,250	W = 850 (L + 40)
26	56,100	
27	56,950	
28	57,800	
29	58,650	
30	59,500	
31	60,350	
32	61,200	
33	62,050	
34	62,900	
35	63,750	
36	64,600	
37	65,450	
38	66,300	
39	67,150	
40	68,000	
45	68,000	W = 800 (L + 40)
46	68,800	
47	69,600	
48	70,400	
49	71,200	
50	72,000	
51	72,800	
52	73,600	
53	74,400	
54	75,200	
55	76,000	

ALLOWABLE GROSS LOAD ON ANY GROUP OF TWO OR MORE AXLES BASED ON DISTANCE BETWEEN FIRST AND LAST AXLES OF THE GROUP FOR VEHICLES FIRST REGISTERED AFTER JANUARY 1, 1942.

DISTANCE IN FEET	ALLOWABLE LOAD IN POUNDS	FORMULA
3.5	30,450	W = 700 (L + 40)
3.75	30,625	
4.0	30,800	
4.25	30,975	
4.5	31,150	
5.0	31,500	
6	32,200	
7	32,900	
8	33,600	
9	34,300	
10	35,000	
11	35,700	
12	36,400	
13	37,100	
14	37,800	
15	38,500	
16	39,200	
17	39,900	
18	40,600	
19	47,200	W = 800 (L + 40)
20	48,000	
21	48,800	
22	49,600	
23	50,400	
24	51,200	
25	52,000	
26	52,800	
27	53,600	
28	54,400	
29	55,200	
30	56,000	
31	56,800	
32	57,600	
33	58,400	
34	59,200	
35	60,000	
36	60,800	
37	61,600	
38	62,400	
39	63,200	
40	64,000	
41	64,800	
42	65,600	
43	66,400	
44	67,200	
45	68,000	
46	68,800	
47	69,600	
48	70,400	
49	71,200	
50	72,000	
51	72,800	
52	73,600	
53	74,400	
54	75,200	
55	76,000	

by the restrictions of Section 705 (c), as applied to their combined wheel base L. They are allowed a total load 850(L+40) up to a maximum of 68,000 pounds for vehicle combinations with a total wheel base of 40 to 45 feet. If the total wheel base exceeds 45 feet, the gross load is governed by the formula 800(L+40) of Section 705 (a).



TRUCK AND TRAILER COMBINATIONS

Gross Weight:

Combination: =850(L+40) but not over 68,000 lbs. when L is less than 45 ft.
=800(L+40) when L is greater than 45 ft.

Each Veh. =700(L2+40) when L2 is less than 14 ft.
=800(L2+40) when L2 is greater than 14 ft.

Dual Axles=700(L+40)

Center 2 or 3 Axles=700(L3+40) when L3 is less than 14 ft.
=800(L3+40) when L3 is between 14 and 18 ft.

THREE-AXLE TRUCK AND THREE-AXLE TRAILER
Under old law allowed 68,000 lbs.

THREE-AXLE TRUCK AND TWO-AXLE TRAILER
Under old law allowed 60,000 lbs.

TWO-AXLE TRUCK AND THREE-AXLE TRAILER
Under old law allowed 60,000 lbs.

TWO-AXLE TRUCK AND TWO-AXLE TRAILER
Under old law allowed 52,000 lbs.

In addition to these restrictions based on the total wheel base, the center concentrations of present truck trailer combinations must conform to Sections 705 (b) or 705 (d). The load on these center concentrations (L3 on the above sketches), shall not exceed 700(L+40) when L3 is less than 14 feet, nor 800(L+40) when L3 is between 14 and 18 feet.

State-owned Toll Bridges Continue to Show Large Traffic Increases in October

TRAFFIC on the three State-owned toll bridges continued at a high level throughout the month of October.

The daily average on the San Francisco-Oakland Bay Bridge was 56,464 vehicles, representing an increase of almost 23 per cent over the record of October, 1940. The heaviest single day's traffic occurred on Saturday, October 11th, when 69,210 vehicles crossed the bridge.

On the Carquinez Bridge the traffic was 13,783 vehicles per day, indicating a gain of 53 per cent over the same month of last year.

The Antioch Bridge, with a daily average of 888 vehicles, showed an increase of 37 per cent over the record of October, 1940.

The vehicular traffic for October, 1941, on the San Francisco-Oakland Bay Bridge and the Carquinez and Antioch bridges is tabulated below:

	San Francisco-Oakland Bay Bridge	Carquinez Bridge	Antioch Bridge
Passenger autos and auto trailers	1,564,584	383,419	19,601
Motorcycles and tricars	5,248	1,086	64
Buses	46,429	5,973	190
Trucks and truck trailers	91,124	36,533	7,618
Others	42,994	250	64
Total vehicles	1,750,379	427,261	27,537

Highway Fund Bill Waits President's Signature

As this issue goes to press word has been received from Washington that the $220,000,000 federal highway appropriation bill has been approved by congress and awaits the president's signature.

California is certain to receive more than $1,000,000 for strategic highways alone, said State Highway Engineer Purcell, and a substantial amount for access roads.

The bill would provide $50,000,000 for strategic network highway projects which would be allocated on a matching basis with the federal government paying 75 per cent of costs; $150,000,000 for military access roads with no matching funds required; $10,000,000 for flight strips with no matching funds needed, and $10,000,000 for plans and surveys to be allocated to the states on a fifty fifty matching basis.

The State has between $25,000,000 and $30,000,000 worth of access road projects surveyed and ready for contracting. These will be submitted to the federal government as soon as the appropriations measure becomes final.

National Defense Demands Will Curtail Development of Highways

(Continued from page 3)

increase in gas tax revenues, may alter conditions. This increase, however, is not as great by one half as is our increase in costs.

Taking into consideration these increased costs and considering our increased revenue, it is our best judgment that at the present time major projects in the existing budget amounting to between four and five million dollars, will have to be eliminated.

I hope the people of California will understand the conditions that exist. The Department of Public Works and Governor Olson will do everything within our power to meet the highway problems with which we are confronted with the least possible inconvenience to the people of California.

"They say that brunettes have sweeter dispositions than blondes."

"Well, my wife has been both and I can't see any difference."—Recorder.

Man (in locker)—Did you ever do any public speaking?

Chap (on stool)—Well, I proposed to a girl in the country over a party line.

San Rafael Viaduct and Two Major Projects Dedicated in Redwood Empire

RAIN in torrential quantities failed to dampen the spirits of Federal and State dignitaries and officials and citizens of counties of the Redwood Empire who participated in the dedication on November 2d of three major highway projects in Marin and Sonoma counties.

Ceremonies arranged by the Redwood Empire Association were held in the City of San Rafael to celebrate near completion of the $675,000 San Rafael viaduct, which breaks a serious traffic bottleneck in the heart of the city; at Petaluma to dedicate the new four-lane sections of highway south and north of Petaluma and at Sebastopol commemorating the opening of the new Luther Burbank Memorial Highway between Santa Rosa and Sebastopol.

Representatives of the Army and Navy and the U. S. Public Roads Administration joined with the California Highway Commission, officials of the State Department of Public Works, city and county officials of San Francisco, Marin, Sonoma and Mendocino and representatives of chambers of commerce of San Rafael, Petaluma, Santa Rosa, Sebastopol and San Francisco in the series of dedicatory ceremonies.

The celebration began on the southern end of the San Rafael viaduct at 10 a.m. with a program of speech making. The viaduct provides a four-lane divided highway over approximately five city blocks of residential and industrial property in San Rafael, providing five grade separations which will speed up traffic through the city and eliminate dangerous congestion. The structure occupies the channel of Irwin Creek, a stream which carries the runoff from practically all the streets in the eastern portion of San Rafael. It has a total of 67 spans, varying in length from 17 feet to 57 feet 6 inches. It is 2,207 feet 6 inches in length.

The viaduct structure itself cost $402,000; the roadway work, $153,000; and the Linden Lane underpass, which carries traffic beneath the viaduct, $120,000.

Director of Public Works Frank W. Clark represented Governor Culbert L. Olson and the Department of Public Works at all three dedications. Clifford Bartlett, Vice President of the Redwood Empire Association, acted as master of ceremonies.

Speakers at the San Rafael viaduct included Clark; T. Fred Bagshaw, chairman of the Marin Board of Supervisors; Mayor William S. Nock of San Rafael; Clyde Good, President San Rafael Chamber of Commerce; George Schleicher, President Marvelous Marin, Inc.; Senator Thomas F. Keating, San Rafael; Assemblyman Richard H. McCollister, Mill Valley; Senator Herbert Slater of Santa Rosa; Colonel M. F. Davis, Commanding Officer of Hamilton Field; Captain H. G. Taylor, 12th Naval District; Supervisor John M. Ratto, San Francisco; Supervisor Ed. Haehl, Mendocino; Chief Administrative Officer Thomas A. Brooks, of San Francisco, representing Mayor Angelo J. Rossi; M. Goldman, Past President of the Redwood Empire Association; Colonel John H. Skeggs, District Highway Engineer, San Francisco; Hugo Newhouse, representing the Golden Gate Bridge and Highway District; Highway Commissioners L. G. Hitchcock, Santa Rosa; Amerigo Bozzani, Los Angeles; and Larry Barrett, Chairman, San Francisco; Levant Brown, Senior Highway Engineer U. S. Public Roads Administration; C. H. Purcell, State Highway Engineer; and Director Samuel Gardiner, San Rafael Chamber of Commerce.

Following the program of speeches in San Rafael, the officials, invited guests and attending citizens journeyed by automobile caravan to Petaluma, where luncheon was served in the Petaluma Hotel under the auspices of the Petaluma Chamber of Commerce. The occasion was enlivened by musical renditions by the Petaluma Municipal Band.

With Vice President Bartlett of the Redwood Empire Association again acting as master of ceremonies, short talks were made by the speakers who took part in the San Rafael viaduct dedication and greetings to the visiting officials were extended by Chairman E. J. Guidotti and Supervisor George Kennedy, Sonoma Board of Supervisors; Jasper S. Woodson, Mayor of Petaluma; Ralph Belden, President Associated Chambers of Commerce of Sonoma County; and H. C. Hazlett, President of the Petaluma Chamber of Commerce. John Olmsted, Editor of the Argus-Courier of Petaluma, spoke on behalf of the press.

MRS. LUTHER BURBANK VISITED

Following the luncheon, the caravan proceeded to Santa Rosa, making a brief stop at the home of Mrs. Luther Burbank, widow of the world-renowned horticulturist. The inclement weather made it impossible for Mrs. Burbank to journey on to Sebastopol, as had been originally intended.

Open air ceremonies which had been scheduled to be held on the new sector of the Luther Burbank Memorial Highway, were abandoned on account of rain and a program of music and speech making was staged in the auditorium of the Sebastopol High School. Music was provided by the Santa Rosa Junior College Band and the Drum and Bugle corps, Sons of American Legion.

Addresses of welcome were made by Supervisor Kennedy, Mayor Robert Madison of Santa Rosa, Mayor A. P. Sweetman of Sebastopol; President Belden, Associated Chambers of Commerce of Sonoma County; Dr. Carl Sawyer, Vice President Santa Rosa Chamber of Commerce; Archie Butler, Sebastopol Chamber of Commerce; Senator Slater of Santa Rosa; and Assemblyman McCollister of Marin County.

BANQUET AT SAUSALITO

Speakers throughout the day paid high compliments to General Manager Clyde Edmondson, of the Redwood Empire Association, and members of

(Continued on page 21)

Official group at San Rafael Viaduct dedication: (L to R) Mayor W. S. Nock, Major W. C. White, U.S.A.; Col. M. F. Davis, U.S.A.; Public Works Director Frank W. Clark; Amerigo Bozzani, Highway Commissioner; Chairman Larry Barrett, Highway Commission; Col. L. W. White, U.S.A.; Capt. H. G. Taylor, U.S.N.; State Highway Engineer Purcell; L. G. Hitchcock, Highway Commissioner

Designing Foundation Courses for Highway Pavements and Surfaces

(Continued from page 6)

period. Obviously, nothing except an expensive and heavy industrial type of pavement can be expected to stand up under such punishment.

PAVEMENT TYPES REQUIRED

What type of foundation would be required for a pavement of this character? Based upon our present knowledge and information the following types of subgrade material are required for various types of pavement and surfacing.

PORTLAND CEMENT CONCRETE—At least a 12-inch depth of 20 per cent Bearing Value, minimum, at 0.1 inch, compacted and soaked. Swell less than 3 per cent.

ASPHALT CONCRETE—At least a 12-inch depth of 30 per cent Bearing Value, minimum, at all penetrations compacted and soaked. Swell less than 3 per cent.

BITUMINOUS SURFACINGS — Various depths, ranging from 6 inches to 24 inches, dependent on the underlying soils, the climate, and the traffic, of 30 per cent to 50 per cent Bearing Value, minimum, at 0.1 inch, compacted and soaked. Swell less than 3 per cent. The top 6 inches, in all cases to be of 80 per cent B. V. minimum, at 0.1 inch.

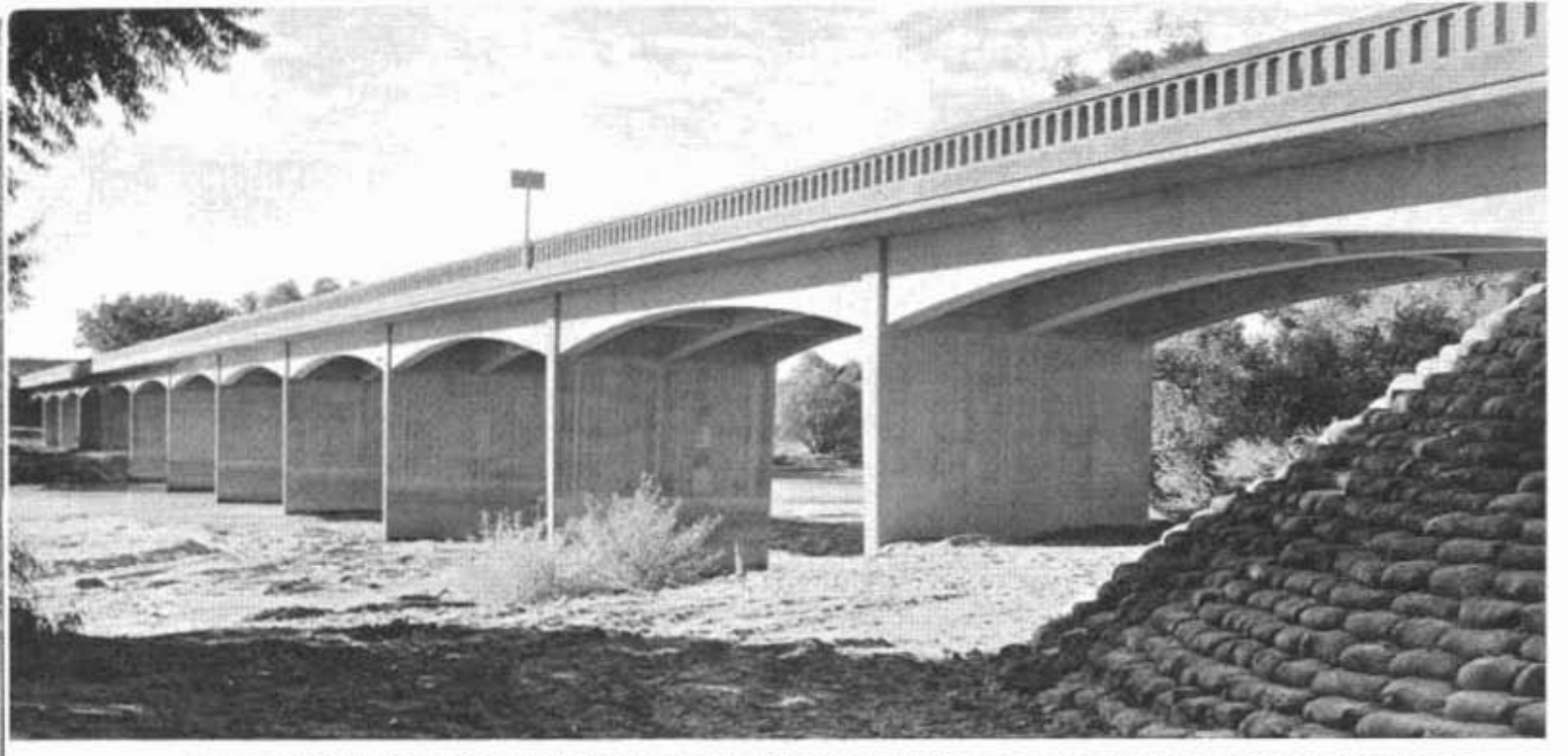
The B. V. or bearing values indicated refer to the California Division of Highways standard soil test determinations and have no relation to the actual supporting power of the material. The swell referred to is the expansion, under soaking, as determined by the California method. The thickness of blanket referred to means compacted thickness, over a definitely inferior soil of less than 10 per cent bearing value, having high swell.

There are some conditions where a lesser thickness of blanket or "ballast" course might do the job, but past experience indicates that good judgment will always profit by being conservative with respect to foundation courses, especially where they are to protect a considerable investment in pavement or surfacing. In a few cases, even greater thicknesses may be desirable or necessary.

It should be distinctly understood that the data above are admittedly empirical, but they have been determined from a considerable experience record in the Division of Highways. They are constantly being changed and modified by actual experience records and by tests and experimentation.

All of you are thoroughly cognizant, from sad personal experience, of the eternal and never-ending struggle to make one highway or street dollar do the work of two. Too often we have compromised with our foundation rather than with our surfacing or pavement with the result we have unhappy memories and a desire to forget—until next time.

(Continued on page 18)



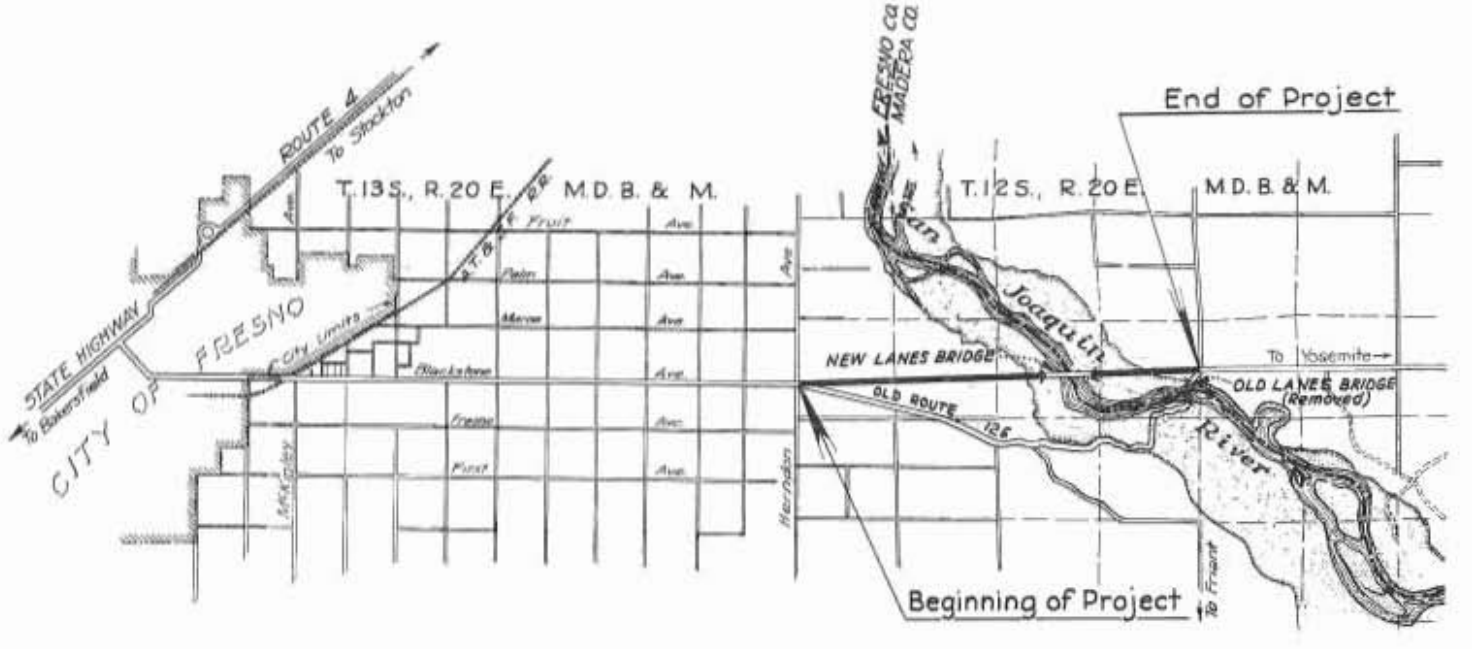
New Lanes Bridge across San Joaquin River on Fresno-Yosemite Highway is a 750-foot reinforced concrete structure

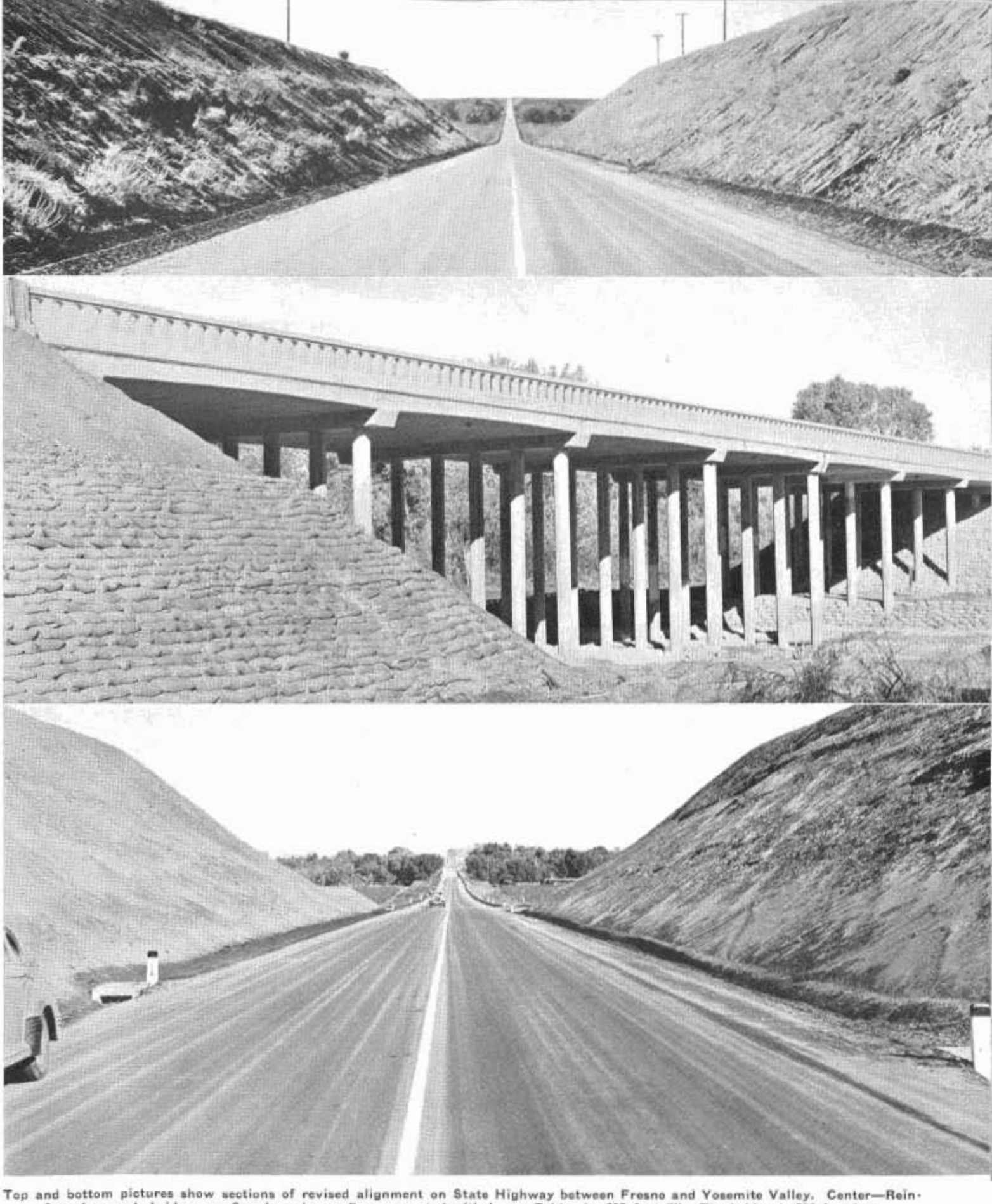
Two New Bridges Span San Joaquin River

SEVERAL hundred persons attended the dedication Sunday, October 12, 1941, of the new Lanes Bridge across the San Joaquin River. The new structure which spans the river is 750 feet long. In addition to this main bridge, there is a second structure 200 feet long across an overflow channel. The two bridges are connected by a 255-foot fill and are built on a revised alignment, which shortens the distance over the old State highway between Fresno and Yosemite Valley by eight-tenths of a mile.

Due to the destruction of one of the truss spans of the old Lanes Bridge by an illegal truck load, traffic between Fresno and Yosemite Valley was required to travel a county road through Friant, the distance by way of Friant to Yosemite being about 5½ miles greater than by State highway route.

The opening of the new section of State highway on Sunday had been well publicized and a great many motorists drove out to visit the realigned road and the bridges. Naturally the opening of this highway





Top and bottom pictures show sections of revised alignment on State Highway between Fresno and Yosemite Valley. Center—Reinforced concrete bridge over San Joaquin overflow connected with Lanes Bridge by 255-foot fill. The bridge is 200 feet long

unit, which completes the last link in the Fresno-Yosemite Highway improvement so far as new alignment is concerned, was a welcome event to the motorists.

The dedication ceremonies were presided over by Paul Staniford, chairman of the roads and resorts committee of the Fresno Chamber of Commerce. Superior Judge Ernest Klette of Fresno was the principal speaker and told some of the early history of highways and bridges in the San Joaquin Valley. He recalled the transportation conditions as they existed when he was a boy. At that time the San Joaquin River was crossed by fording the river during low water, or by means of ferryboats when the water was high.

Representatives of road committees of both Madera and Fresno Counties, together with county supervisors, representatives of chamber of commerce, as well as other county and State officials were introduced.

The history of the naming of the original Lanes Bridge was told by Arthur H. Drew, District Grand President of the Native Sons of the Golden West.

The formal opening of the new structure across the San Joaquin River, together with the new section of highway, was accomplished by the cutting of a ribbon by Barbara Nielsen, daughter of State Highway Commissioner Iener W. Nielsen. Miss Nielsen was assisted by Mildred Edwards.

The bridge across the San Joaquin River, and the overflow structure, were constructed by the Campbell Construction Company at a cost of $134,935.60. Both bridges are of reinforced concrete construction, the piers being supported by piles.

Fredrickson Brothers, contractors, constructed the highway approaches to the new bridges, from the intersection of Blackstone Avenue and Herndon Avenue northerly across the San Joaquin River to a point 1.6 miles north of the Fresno-Madera County line. The oiled surface of road-mix type was subcontracted by the Oilfields Trucking Company.

L. Tresidder was resident engineer for the Division of Highways on the road construction, while A. J. Stocks represented the Bridge Department as resident engineer on the construction of the bridges.

Sally (in car)—Does the moon affect the tide?

George—No, just the untied.

Barbara Nielsen (left), daughter of Highway Commissioner I. W. Nielsen (center), cuts ribbon at Lanes Bridge dedication, assisted by Mildred Edwards

Foundation Courses for Pavements and Surfaces

(Continued from page 15)

There is every reason to believe that your own particular conditions and service records will indicate some modifications, but I beg of you, base them upon facts. Know the actual physical characteristics of your soils, your traffic loads and volumes and you will then be in a position to make an intelligent modification, if such is indicated.

We are even now engaged in a comprehensive experiment involving the construction of several types of pavement upon a number of different character subgrades on a test track under carefully controlled conditions, for the purpose of further verifying and proving our design requirements. The results will probably not be complete until next year but will eventually be made available to all who are interested through our official publication.

In the previous discussion an attempt has been made to cover briefly certain essential information which we in the State Division of Highways believe is of vital importance preliminary to the design of either a foundation course, a pavement, or a surfacing, if a thoroughly satisfactory and economical result is to be secured.

Needless to say, there are still many roads and streets being designed and built upon no firmer foundation than the personal opinion and preferences of the responsible authority. Some of these will return a satisfactory period of service, but many others will fail and result in an economic loss which could have been avoided at a relatively small increase in the investment, by a more intelligent and thorough study of the conditions preliminary to the design.

(Continued on page 23)

$283,200,000 Needed to Modernize Rural State Highway System, Says Official Report

SERIOUS inadequacies in California's 12,621-mile rural State highway system are revealed in a report on "California Highway Needs" submitted to Governor Olson by Frank W. Clark, Director of Public Works.

The report, prepared by engineers of the Division of Highways, shows that 8,231 miles, or approximately 65 per cent, of the mileage in the rural State highway system is below present-day standards as to width, type of surface, alignment, sight distance or some combination of such deficiencies.

California's rural State highway system represents an investment of approximately $433,000,000 for construction alone. Although in miles it is less than one-ninth of the total highway, road and street mileage in the State, it carries more than 30 per cent of the total vehicle traffic in the State.

Three main purposes are outlined in the report, namely:

SCOPE OF REPORT

To show clearly the extent to which the rural State highway system of California has been improved up to the present time, and what this improvement has cost;

To demonstrate the extent of deficiency of the present facilities with relation to necessary and desirable standards, and special requirements to meet the needs of California motorists and visitors now and for the future;

To present a detailed estimate of minimum funds required to bring the rural State highway system up to desirable standards and show the alternative which must be faced.

The report states the following facts:

LARGE TRAFFIC INCREASE

Traffic on California's rural State highway system has increased 46 per cent from 1934 to 1940. A further increase in traffic of about 24 per cent is looked for by 1950.

Reconstruction of the inadequate mileage to standards desirable and necessary for the needs of California motorists now and for the future will cost an estimated $283,200,000.

Some 842 miles of roads which are adequate at present will become inadequate because of traffic increases by 1950. Reconstruction of this mileage will cost the State an estimated $46,000,000.

PAVEMENT REPLACEMENT

Because of surface deterioration about 10 per cent of the total mileage in the rural State highway system must be replaced annually. This replacement is estimated to cost $34,600,000 by 1950.

At least 100 miles of rural State highways within metropolitan districts (exclusive of State highways in cities) will require improvement as freeways to relieve traffic congestion. It is estimated these improvements will cost $25,000,000.

Elimination of railway grade crossings with high accident records are an urgent necessity. It is estimated this will cost approximately $27,000,000.

928 UNSAFE BRIDGES

At least 928 bridges out of 3,436 on the rural State highway system are inadequate or unsafe for modern traffic and must be replaced at an estimated cost of $26,700,000.

The total cost of improving the rural State highway system to standards adequate for 1950 traffic is estimated at $442,500,000.

The total estimated cost of modernizing the rural State highway system by 1950 is approximately $251,600,000 more than the total income which will be available for construction during the next 10 years. On this basis the Division of Highways faces an apparent annual deficit of $25,000,000.

WHAT MOTORISTS PAY

California motorists at present pay an average of only about $30 a year per registered motor vehicle. This is less than the motorists of 44 other States pay in road user taxes. Of the $30 less than $12 is for the use on the rural State highway system.

The California rural State highway system has been underfinanced for 20 years. This has made it necessary to limit the standard of improvements, particularly of road surfaces with consequent high maintenance costs.

Mileage added to the rural State highway system by legislative action in 1933 practically doubled the responsibility of the Division of Highways without any compensating increase in revenues.

MILEAGE DOUBLED IN 1933

More than 54 per cent of the total inadequate mileage in the rural State highway system consists of routes that were added to the system by legislative action from 1933 to 1939. Over 79 per cent of such mileage is deficient.

About 7,700 miles or 61 per cent of the rural State mileage is in mountainous or rugged country where it is difficult and expensive to provide adequate sight distance for passing or even safe stopping distance for present-day speeds.

Some 2,869 miles of the rural State highway system are surfaced with over-age pavement. Many miles of obsolete roads are still carrying traffic far beyond their safe capacity.

Lack of funds will prevent the Division of Highways from improving highways in the War Department's National defense network to standards required for military use.

The work of improving the rural State highway system to fit 1950 traffic can not be accomplished if the present level of highway financing is continued.

SOME POSSIBLE ALTERNATIVES

The report suggests several possible courses of action for financial relief. One is to add no roads to the system until funds are available for their adequate improvement. Another is to undertake no construction on highways carrying a low volume of traffic. A third suggestion is to initiate measures to increase State highway funds so the highway system may be improved to a standard adequate for existing and anticipated traffic.

Needed financing, the report suggests, might be accomplished by increasing taxes on vehicles, motor fuel, or increased Federal aid allotments.

(Continued on page 21)

Annual Convention American Association of State Highway Officials Held in Detroit

By AMERIGO BOZZANI, Member California Highway Commission

IN THE past 30 years I have attended a great number of National and State conventions, political, religious, business mens, and many fraternal orders, as delegate, executive committee member or spectator; but never before has a convention impressed me as did the convention of the National Association of State Highway Officials held at the Statler Hotel, Detroit, Michigan, from September 29th to October 3d, 1941.

Contrary to other conventions which are generally accompanied by a great fanfare, bands, drum corps, majorettes, or rival groups of men, striving to promote some candidate, or cause, that convention was very serious and dignified.

It was composed of over a thousand highly intelligent men, representing every State in the Union, who went there for the sole purpose of working out plans for improvement of highways and bridges, for faster but safer movement of traffic by intensive development of limited freeways and overhead motor ways to relieve traffic congestion and separate local from through vehicular traffic, by active collaboration with public authorities. In other words, to make America the safest place in the world for the 32 million vehicles which are now using our highways.

The arrangements for this successful convention, prepared by the committee headed by Governor Murray D. Van Wagoner, former Michigan Highway Commissioner, and Mr. Kennedy, were perfect in every detail. The auditorium itself had a real atmosphere of dignity. At the exact hour, the representatives of all the States in the Union, were in their designated places.

Immediately after the opening ceremonies, Governor Van Wagoner delivered an impressive welcoming address.

It was most remarkable to see all the committees at work between the various sessions of the convention. There was no rivalry among the members. Each was willing to give to the other the benefit of his findings, and freely exchanged opinions in the most harmonious atmosphere. I took my place as a student, for the reason that I did not belong to any committee, but I had the opportunity of going from one committee room to another, and learned a great deal. I inspected the many delicate instruments of the research department and laboratory and was extremely amazed to see the great progress in this line of endeavor.

Resolution Adopted by A. A. S. H. O. Convention

WHEREAS, The United States Senate has passed a bill authorizing the use of $20,000,000 for cooperating with the countries of Central America and Panama in constructing the Inter-American Highway; and

WHEREAS, The completion of such highway from the United States to Panama will facilitate international trade among all the countries and will add progressively to the measures necessary to the defense of the western hemisphere; therefore, be it

***Resolved:* That the American Association of State Highway Officials endorses the proposal to assist the Central American Republics and Panama and urges the Congress of the United States to act favorably on the pending legislation; and be it further**

***Resolved:* That the Secretary of the American Association of State Highway Officials shall send a copy of this resolution to each member of the Congress of the United States.**

The California delegation was one of the most outstanding, including State Highway Engineer, Charles H. Purcell, and Fred Grumm, engineer of Surveys and Plans, and I felt very proud of my State. The address delivered by Dr. L. I. Hewes, Chief of the Western Region of the Federal Bureau of Public Roads on the subject "HIGHWAY SOLVENCIES," was complete in every detail. I am making a recommendation to our Director of Public Works, Frank W. Clark to have copies printed, sending them to all the Assemblymen and Senators of our State in order to enlighten them on the subject. I am quite sure, after studying the report of Dr. Hewes, they will be very careful before taking any more roads into the State highway system.

The spotlight was thrown on the Arroyo Seco Parkway of Los Angeles for the reason that during the first eight months it demonstrated its safety value, and as a very sound economical investment. The 8.9 mile Arroyo Seco Freeway between Los Angeles and Pasadena completed within a year, cost about $560,000 per mile for a six-lane design. It is a good example of a solvent metropolitan freeway. Its daily average traffic for last August showed in excess of 25,000 vehicles.

Using the State-wide user revenue rate of $.00566 per vehicle-mile this freeway is earning $51,650 per mile annually or about 9.22 per cent on its initial cost because traffic is practically constant throughout the year. As soon as the last bottle-neck is eliminated from the Los Angeles River to Sunset Boulevard, the traffic will increase to over 35,000 per day, and give at that rate, a return on the investment of better than 12 per cent.

A great deal of praise was given to the engineers of the State of California, for this fine construction. Not only for its safety, but also for its beauty and the record time in which it was built.

This great project after 20 years of unsuccessful pioneering, was brought to a successful conclusion by the Administration of Governor Olson.

The report of Dr. Hewes, of the Federal Bureau of Public Roads, regarding the value of the construction of Freeways in the United States, which has already been conclusively proved, should be brought to the attention of our Legislators in order that the necessary funds would be provided for the construction of many more through the congested metropolitan areas, where most of the fatal accidents and others causing personal injuries occur, and many millions of dollars in property loss are sustained every year.

Another very important address, a copy of which should be sent to all our Legislators, was the one made by Robert B. Brooks, consulting engineer and member, Missouri State Highway Commission, St. Louis, Mo.

In conclusion, after reading many reports and hearing the many splendid addresses delivered at the convention, and visiting eight of the most outstanding industrial States in the East, and talking to hundreds of manufacturers, merchants, farmers, and thousands of plain citizens, I have become convinced more than ever that in the United States of America we are 20 years behind in highway construction to meet the requirements of modern transportation created by the automobile industry.

While I believe law enforcement and education are fine things, still I am convinced now, more than before, that the solution of our traffic problem lies in the hands of our engineers. The time has arrived when human life should be put before monetary value, and the United States should start to prepare now a master plan of a perfect system of transcontinental and super highways, the elimination of all dangerous railroad crossings, installation of divided and elevated clover-leaf curves, construction of freeways of the same type as the Arroyo Seco Parkway, wider use of high visibility, signs and signals. As Germany has built them for offensive purposes we should build them for National defense, saving the lives of a hundred thousand people, and the injury of millions and the property loss of billions.

California today is facing the gravest traffic problem of any State in the Union, due to the fact that we have about 12 per cent of the automobile circulation in the United States, and the necessity of a modern system of highways is very important, and every good California citizen should support the movement to increase the gas tax in line with other States in order to provide the funds to solve this great problem. When I say this, I advance only my personal opinion and not that of Governor Olson and his administration.

In other States which do not produce any gas or oil, but have a gasoline tax two, three, and four cents higher than California, the retail price is lower than in our State. California engineers with the money made available to them in the past years, have done a great job, and deserve to be highly complimented. But due to the tremendous increase of motor vehicles in number, weight, height, and width, this State is 30 years behind its necessary road facilities.

I am very happy to have attended this convention for the very important information I received and the statistics I gathered which will be very valuable to me in making my decisions as a member of the State Highway Commission when the time comes to give my opinion in matters pertaining to highways and traffic.

I want to compliment members of the engineering staff, and the legal staff of the State of California who attended the convention for their intelligent, hard work.

I want to thank our great Governor, Culbert L. Olson and our Director of Public Works, Frank W. Clark, for sending me to the convention, where I had the opportunity of acquiring valuable knowledge.

Resolution Adopted by A. A. S. H. O. Convention

WHEREAS, The desirability of building up a program of highway and street construction projects as a means of employing workers to be released from defense industries upon termination of the present National emergency, is recognized; now, therefore, be it

***Resolved:* That the American Association of State Highway Officials directs attention to the intimate familiarity with highway improvement needs possessed by the State Highway Departments and the Public Roads Administration, and the effective cooperative relations already existing between such agencies, and recommends to the Federal Works Administrator that the services of these established highway and functioning construction agencies be employed to the fullest possible extent in directing the listing and planning of highway and street improvement projects to be included in such a backlog of public works.**

Purcell Again Honored By A.A.S.H.O. Convention

At the conclusion of the twenty-seventh annual convention of the American Association of State Highway Officials in Detroit on October 2, delegates representing every state in the country elected G. Donald Kennedy, Michigan's highway commissioner, president.

State Highway Engineer C. H. Purcell of California, former president of the association was elected member of the Executive Committee.

San Rafael Viaduct

(Continued from page 14)

his staff, who had so perfectly arranged the three dedication programs.

On Saturday evening preceding the programs in Marin and Sonoma counties, the Highway Commissioners and State, Federal and county officials, were tendered a banquet at the Alta Mira Hotel in Sausalito, where they were guests of the Sausalito Chamber of Commerce.

$283,200,000 Needed to Modernize Rural Highways

(Continued from page 19)

Actual abandonment by the Division of Highways of roads of purely local importance is also suggested as a course which may become necessary.

The report points out that if the Division of Highways should be forced to defer construction, the highway system would become more and more inadequate because although improvements may be deferred through necessity, increases in traffic volume are inevitable.

Bridge at Orleans Decorated as Beauty Prize Winner of U.S.

CALIFORNIA State and county officials joined with Eureka and Redwood Empire Association representatives, Saturday, September 13, 1941, in dedicating the new Orleans bridge over the Klamath River at Orleans.

Feature of the program was presentation of a plaque by the American Institute of Steel Construction designating the suspension span as the most beautiful steel bridge of its class (costing less than $250,000) constructed in the United States and opened to traffic during 1940.

The plaque is a large, decorative bronze plate with letters in relief reading "American Institute of Steel Construction. Annual Award of Merit. Most Beautiful Steel Bridge, Class C, 1940." It is attached to one of the bridge towers.

With the unveiling of the plaque by Howard A. Schirmer, structural engineer of the Bethlehem Steel Company, San Francisco, representing A. I. S. C., the new State highway bridge was formally dedicated.

On behalf of the California Department of Public Works and the California Highway Commission, the plaque was accepted by F. W. Panhorst, bridge engineer for the Division of Highways.

An old fashioned barbecue with all the trimmings at noon preceded the colorful dedication ceremonies with Indians from the Klamath River reservation offering native dances, songs and entertainment.

Located on the world famous Klamath River approximately 100 miles east of Eureka on State Sign Route No. 96, amid a beautiful setting of forest-covered mountains and superb scenic splendor, the structure replaces an old obsolete suspension span with timber towers and 8-foot timber roadway. It is a modern 24-foot deck steel suspension bridge.

Designed by H. H. Gilbert of the Division of Highways, now a lieutenant commander in the U. S. Navy, the bridge was built under State contract by C. W. Caletti and Company of San Rafael. Construction began in November 1939 and was completed in September 1940.

(Continued on page 28)

At top—View of dedication ceremonies on beauty prize bridge across Klamath River at Orleans. Bottom—State Bridge Engineer F. W. Panhorst being presented with award by American Institute of Steel Construction. Note plaque on bridge tower upright

Divided Highway Unit Completed on U. S. 99 in Fresno Co.

By R. S. BADGER, District Construction Engineer

ANOTHER divided highway unit in the progressive improvement of the Golden State Highway, U. S. 99, through the San Joaquin Valley was completed September 2d in Fresno County by the Division of Highways.

The new unit covers a distance of 4.7 miles from the northerly limits of Selma into the southerly section of Fowler. It consists of an additional 23-foot asphalt concrete pavement paralelling and separated from the existing two-lane highway by a dividing strip varying in width from six to 26 feet.

OLD PAVEMENT USED

The inside lanes are 12 feet wide and the outside ones 11 feet, with concrete curbs on the dividing strip.

In this project the old pavement is utilized to carry the northbound traffic while the new construction carries southbound vehicles, along a slightly elevated and perfected grade line. The pavement is bordered by seven-foot nonskid shoulders which clearly outline the traveled way and further safeguard traffic when pavements are wet.

It is noteworthy that on this contract, as in other divided road projects, it was generally feasible to save and utilize the major portion of the existing tree plantings. However, near intersections, in order to minimize accidents through better sight conditions, low growing shrubs only were used.

EXISTING BRIDGE WIDENED

The contract for this project was awarded by Director of Public Works Frank W. Clark on March 10, 1941. The cost was $151,916.80 and included the widening of a two-span, reinforced concrete girder bridge across Fowler Switch Canal.

Bud Baccus was Superintendent for Contractors Piazza and Huntley of San Jose. F. W. Howard was resident engineer and F. B. England was assistant in direct charge.

Divided sector of U. S. 99 between Selma and Fowler. New south-bound traffic lane on right. Old highway on left

New divided road construction saves and utilizes on division strip trees that bordered roadside of old highway

This type of improvement is a continuation of other units built in that section of Fresno County in the past few years, the first beginning south of Kings River Bridge on U. S. 99 and extending to Kingsburg. The next, of similar construction, was built from a point just south of Selma via a by-pass route to the northerly edge of that community.

During the 18 months from January 1, 1940, to June 30, 1941, traffic accidents in the United States resulted in 51,700 deaths, while during the same period air raid casualties in Great Britain totaled 41,900.

Foundation Courses for Pavements and Surfaces

(Continued from page 18)

In the trying days ahead of us we will undoubtedly be called upon, more and more, as engineers worthy of our heritage, to obtain the greatest possible value from the taxpayer's dollar. This can only be accomplished by applying these sound, fundamental principles which are anchored on a firm foundation of fact; and a firm and adequate foundation is necessary, whether it be for a pavement, a surfacing, or a fact.

Publicly Owned Utilities of California Show Net Earnings Above All Costs

PUBLICLY owned electric utilities of seven cities and two irrigation districts operating in Northern California have been subjected to a careful analysis by the State Division of Water Resources for the Water Project Authority of California. The utilities studied are operated by Alameda, Biggs, Gridley, Lodi, Palo Alto, Redding and Roseville, and the Modesto and Turlock irrigation districts.

The results of these analyses contained in a report just completed show that all of the utilities were operated in 1939 with substantial net earnings over and above all costs. The report states "from the information available the earning position of all of these utilities has been favorable throughout the entire period of operation of these systems."

Other conclusions set forth in the summary analysis are:

POWER LARGEST COST

"Cost of power purchased wholesale from the Pacific Gas and Electric Company constitutes the largest item of operating expenses for the city-owned electric utilities, averaging 64 per cent of the total annual "out of pocket" operating costs.

"All the publicly operated electric utilities covered by this report are now dependent upon the Pacific Gas and Electric Company either for their entire electric power supply or for standby capacity or both.

"Of the seven city-owned electric utilities, four have no outstanding bonded debt and the remaining three have bonds outstanding amounting to from 2.3 to 12.1 per cent of book capital, which are being retired as they become due each year.

"Electric rates charged by the several publicly operated utilities are on the average similar to but with some higher and some lower than those prevailing for equivalent service in adjacent territory served by the Pacific Gas and Electric Company; and the character of electric service is comparable to that furnished by the private utility.

"The rates charged for electric energy by the publicly operated electric utilities do not reflect the cost of service but net earnings realized from revenues in excess of all "out of pocket" costs are transferred from the electric system accounts and used for other municipal or district expenses.

NET PROFIT OPERATIONS

"With one exception none of the publicly operated utilities covered by this report bear any expense for taxes, either State or Federal.

"The analyses indicate that all of the publicly owned utilities covered by this report could have paid State and Federal taxes comparable to the amount that would have been paid by similar privately owned electric utility systems in Northen California in 1939, in addition to all operating expenses and a full allowance for fixed charges of interest at 5 per cent, amortization and depreciation, and still have earned a net return ranging from 4 to 35 per cent of operating capital."

For the purpose of determining the over-all financial aspects of the operation of each of the nine publicly owned utilities, financial analyses were made reflecting not only the actual "out of pocket" costs shown in the official record for each utility, but including also full consideration of other fixed and operating expenses not reported by the utilities, either in part or whole. These analyses were made on two bases, one including an allowance for estimated State and Federal taxes and one without State and Federal taxes.

FINANCIAL ANALYSES MADE

In addition to "out of pocket" operating expenses as reported by each utility, the analyses include fixed charges comprising interest on estimated operative capital at an assumed rate of 5 per cent, amortization on a 3 per cent sinking fund basis predicated upon retirement of debt in 40 years, depreciation on a 3 per cent sinking fund basis predicated upon an average life of 25 years for distribution facilities.

On the basis of these data and with the assumption that the utilities had paid State and Federal taxes, the utilities would have made a net revenue in per cent of their estimated capital as follows:

	Per cent		Per cent
Alameda	4.60	Redding	35.05
Biggs	4.13	Roseville	13.77
Gridley	14.19	Modesto I. D.	4.64
Lodi	14.12	Turlock I. D.	7.04
Palo Alto	13.66		

Without State and Federal taxes, but based on the same assumptions otherwise, the utilities would have made a net return in per cent of estimated capital in 1939 of:

	Per cent		Per cent
Alameda	10.40	Redding	48.78
Biggs	13.01	Roseville	22.06
Gridley	20.88	Modesto I. D.	8.88
Lodi	21.96	Turlock I. D.	10.77
Palo Alto	20.34		

The book capital of the electric distributing systems of the seven cities serving power amounts to $2,788,017.27 against which there is a bonded indebtedness of $161,382.77. Modesto and Turlock irrigation districts which generate their own power have a total book capital of $8,319,159.92 against which there is an outstanding indebtedness of $3,528,000.

SERVE 46,281 CUSTOMERS

The 9 utilities serve a total of 46,281 customers, the survey shows. Power is purchased by the city utilities entirely from the Pacific Gas and Electric Company. A total of 71,394,925 kilowatt hours of power is purchased by the cities at a cost of $819,716.70. The Modesto and Turlock irrigation districts which generate their own power at Don Pedro Dam purchase only a small amount from the Pacific Gas and Electric Company. In 1939, the year of the survey, the two districts used 94,322,889 kilowatt hours of electricity at an estimated cost of $361,792.70.

The Turlock Irrigation District, by virtue of its larger share in the Don Pedro works, generates all of its power at the lowest cost per kilowatt hour. Power costs the Turlock Irrigation District 2.20 mills per kilowatt hour. The Modesto Irrigation District which obtains the major share of its power from the Don Pedro plant was next in line for low-cost power. The district paid 5.55 mills per kilowatt hour.

In 1939 the Turlock District sold the Pacific Gas and Electric Company 77,622,920 kilowatt hours for which it received $263,125.97. During the same year, however, Modesto District found it necessary to purchase at wholesale from the Pacific Gas and Electric Company, 6,363,210 kilowatt hours of electric energy. The cost of the purchased power for the year was $63,233.73.

VARIED POWER RATES

Among the cities, Biggs paid the highest rate for its electricity with a rate of 11.18 mills per kilowatt hour. Other cities range from 10.09 mills per kilowatt hour for Gridley, to a low of 7.79 mills per kilowatt hour for Redding.

The total income of the electric utilities in 1939 ranged from $9,000 in the City of Biggs to $687,000 in the City of Alameda and approximately $800,000 for each of the irrigation districts.

For the cities the annual revenue per customer ranged from $46.62 in the City of Biggs to $92.99 in the City of Redding. Average revenue per kilowatt will range from a minimum of 2 cents in the City of Lodi to a maximum of 4.5 cents in the City of Biggs.

Annual consumption of electric energy per customer for all classes of service in the seven cities ranged from 1,036 kilowatt hours annually in the City of Biggs to a maximum of 4,353 kilowatt hours in Redding. Considering all classes of retail customers, the Turlock Irrigation District showed the largest average unit revenue of any of the nine publicly operated public utilities. It also showed the largest customer use of electric energy—5,708 kilowatt hours annually per customer—including the electric energy used by the district for drainage purposes.

Average revenue per kilowatt hour for domestic service only in the seven cities ranged from a minimum of 2.052 cents in Redding to a maximum of 5.235 cents per kilowatt hour in Biggs. These two cities also showed the extremes in consumption of electric energy per customer. Consumption in Biggs amounted to only 711 kilowatt hours, while in Redding it was 2,801 kilowatt hours per customer. Greatest domestic consumption per customer was in the rural area of the Turlock Irrigation District, amounting to 2,910 kilowatt hours annually.

Investment per customer in electric distribution facilities of the publicly operated utilities as related to the annual revenue per customer was shown in the report to be in line with the customer investments and related revenues for privately owned electric utilities under similar situations and conditions in Northern California.

Investment per customer in the publicly operated Redding system amounts to $89.08 as compared to a customer investment in the privately owned system in Salinas of $90.88. Annual revenue per customer in Redding amounted to $92.99 as compared to $95.25 in Salinas. Among the larger communities Alameda has an investment of $115.75 per customer with an annual average revenue per customer of $50.88. For Stockton, which is served by a private utility, the investment per customer amounted to $113.39 with an average annual revenue of $72.90.

Shovel and trucks completing construction on Kings River Canyon unit

Highway Unit Completed on Kings Canyon Road

(Continued from page 10)

way across to the northerly side of the Kings River and thence it follows along the river past Boulder Creek and by Grizzly Creek, where a high waterfall and spray from that stream can be seen through the trees.

At Deer Cove the highway constructed by the State comes to an end, but the road does not end here. The Forest Service has built the highway from Deer Cove on upstream to Cedar Grove. Here a large area among the trees has been prepared with all conveniences and comforts for a fine picnicking and camping grounds.

The highway along the river presents a scenic contrast to views from Lookout Point—winding gently along shaded aisles of a forest of dense growth, then breaking out into flowery meadows. In a rock-walled canyon, are groves of Oak, Incense Cedar, Laurel and Ponderosa Pine. And always towering above the woods, are polished domes and spires of granite, reaching upward while below, the restless mountain torrent is swirling down the gorge, its flow checked by deep silent pools, and hindered by long rapids and numerous cascades. This is the South Fork of the Kings River.

New Method for Fixing No-passing Zone Limits–Uses 2 Autos With Trailing Wheels

By BLAIR GETTES, Assistant Traffic Engineer

IN A RESURVEY of no-passing zones by the Traffic and Safety Department of the Division of Highways the use of a new method for determining the zone limits has been successfully employed in Highway District IV.

The element of chance and error in establishing the beginning and end of the double stripes on highway hills and curves has been eliminated by specially designed equipment attached to the rear end of an automobile. Heretofore, these limit points have been located from available engineering data by a man on foot who could not accurately determine vertical curvatures and sight distances.

In District IV, ways and means of fixing limits which would be accurate, rapid and economical have been under consideration for some time, particularly because of the many points of restricted sight distance throughout the district and the very few installations in existence.

TWO AUTOMOBILES USED

In adopting a new method, it was necessary to cover the field rapidly to complete the work in advance of the regular repainting of center stripes, so that the laying of yellow stripe could progress in an orderly fashion and the amount of paint required be minimized.

In experimental tests, two cars were used to travel along the road and mark the limits of no-passing zones. Every physical condition existing at each location was studied, including the combination of horizontal and vertical curvature, which might affect the limits of a zone; structures, trees or cut banks which might have a bearing on sight distance, and any other combination of circumstances that could cause a difference in driver reaction.

Speed checks were taken at representative points on each route and section where there was an apparent need for the zone. These checks were so spaced as to provide a good average for each area where geographical and topographical conditions were consistent for a reasonable distance on either side of the checked points.

TRAILING WHEEL DESIGNED

After reaching the decision on methods to be employed, it was necessary to work out the details of maintaining a predetermined distance between the two cars. A trailing wheel that measured in feet rather than miles and which could be readily mounted on the rear bumper of any car, was designed and the experiment was ready for trial. One wheel was required for each car.

The next problem was communication between the two cars. The most satisfactory method would be via short wave radio telephone, but the difficulty of obtaining the necessary equipment and licenses on short notice dictated other methods. A public address unit was installed in the trunk of the leading car and a frame built to support the trunk door at a height that provided vision through the rear window with no screening of the speakers.

This method was used for the first few days but proved unsatisfactory due to noises from other traffic on the road that drowned out the system. A red spot lamp was installed in the rear window of the lead car connected to a button on the steering wheel and this was used for the balance of the work, with the public address system used to direct traffic which attempted to travel between the cars.

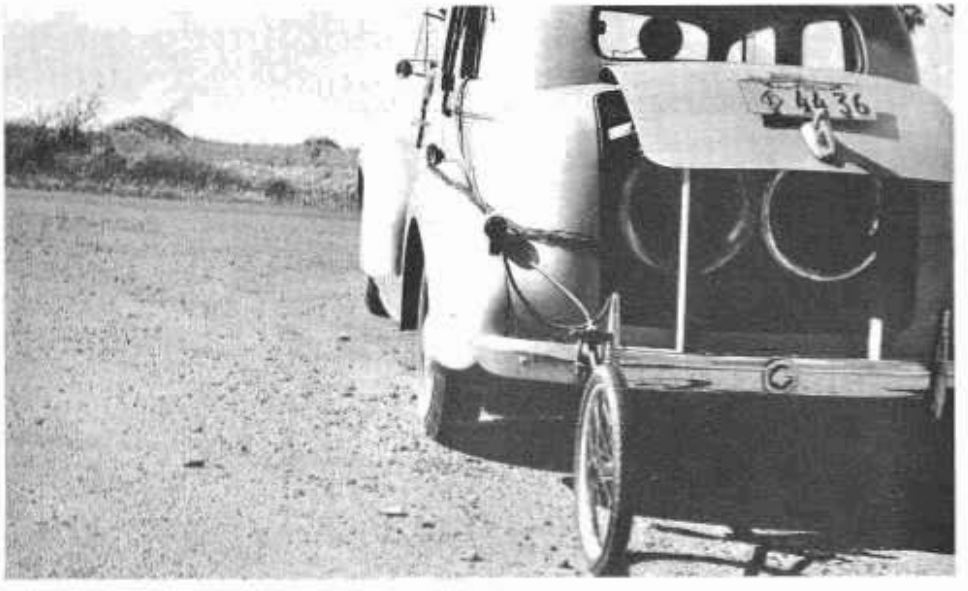
Automobile with flag precedes car with stripe marking equipment

THREE MEN IN CREW

Personnel consisted of three men, one in the leading car and two in the trailing car. The actual marking was first done by the second man in the rear car with paint brushes mounted on 4-foot lengths of bamboo and two small cans of paint, one white the other yellow, mounted on

the running board. However, the drip from the brushes whipped by the wind made a mess of the rear fender which was difficult to remove after the day's run and a change was made to oil cans with 6-inch spouts.

The marker in the rear car sat in the front seat and opened the door slightly, leaned down and squirted a small amount of paint on the pavement near the edge. It is intended for future work to mount two pump oil cans on the rear bumper with flexible tube and piano wire controls so that one man in the rear car can handle the entire job.



Second car has loud speaker under trunk door to warn intercepting traffic

The actual procedure of locating zones consisted of starting approximately 2,500 feet in advance of the first point of restriction, where the equipment was mounted and a determination made from the previously taken speed checks as to the sight distance required for the speed of travel on that section. A speed of travel would then be agreed upon—20, 25, or 30 MPH depending on the alignment and expected frequency of the points of restriction.

CHECKS BY SPOTLIGHT

The lead car pulled ahead the required distance and set to zero on the footmeter. The cars being the required distance apart the starting signal was given and both cars moved out accelerating as rapidly as comfortable to the agreed speed.

Check flashes were given with the spotlight at each 100 feet for the first 500 feet and each 500 feet thereafter until the end of the section was reached whereupon the rear car closed up on the front car and a check was made to be sure that wheel bounce or some weaving in the driving had not changed the relationship of the two instruments particularly at the higher speeds.

In practically all instances the difference was so minor that it could be disregarded. In two cases, however, the surface was rough and the disparity was sufficient to warrant a re-run at lower speeds.

After reaching the end of a section or a series of restricted locations the same procedure was followed in the opposite direction and all points marked in like manner.

CONSOLIDATION OF MARKINGS

The next step was to consolidate the markings on the pavement and place a visual indication for the striping crew to follow. After running the section in both directions the trailing car started back and placed an arrow on either side of the existing single line at the beginning of the restriction in the colors to be painted in the respective positions, then at the points of change from one side to the other and finally at the end. The lead car during this time proceeded to the nearest culvert marker and starting from that known point logged the consolidated markings for a permanent record and for a check sheet for the striping crew.

Due to the magnitude of the work only the routes of reasonably heavy travel were marked. The light traveled routes will be run during the season when striping is not in progress and the zones will be marked next spring when repainting begins.

To facilitate rapid painting of the zones, the paint striping outfit was revised by adding a tank on the truck for yellow paint and by the addition of quick change valves on the striper to allow for changing color of one or more lines on the move.

STUDIES BEING CONTINUED

After experiment it was found more rapid to paint the single line throughout an entire section skipping the "No-passing Zones" and then to change the guns on the striper and paint the zones on the return trip. This was primarily because of the method employed in California where a single stripe is 4 inches in width and the double stripe is 9 inches in width consisting of three 3-inch lines, the center line consisting of black lacquer to provide an extreme contrast for additional visibility.

Studies are now being conducted where the zones have been installed to determine what degree of observance is being realized and to ascertain if the zones fit the conditions of traffic on the various routes. Should local usage indicate revisions at any point, these will be made and when they are repainted next spring they will be beaded for increased visibility.

It was not considered economical to bead on the first painting primarily because the major portion of the lines would be on unpainted pavement subject to excessive wear whereas the repainting will be over the existing paint that will provide a good base for a long lifed line.

This method of determining limits of "No-passing Zones" was developed to cover a large area in a short period with limited personnel. The only equipment purchased were the footmeters, all other equipment being furnished by the writer for use in demonstrating the feasibility of the plan.

Visitor—"Does your baby brother talk yet?"

Johnny—"He doesn't have to. He gets everything he wants by just yelling."—California Cultivator.

First Boy—"My father is very brave. On a hunting trip in Africa he killed five lions and an elephant single handed."

Second Boy—"That's not so much. My dad is really brave. He bought a coupe when mother wanted a sedan."

Bids and Awards for October, 1941

ALAMEDA COUNTY—A through steel truss bridge with timber deck to be constructed across Arroyo de la Laguna, 3.2 miles north of Sunol. District IV, Route 107, Section B. L. D. Tonn, Lodi, $17,675; F. Fredenburg and G. Moriconi, South San Francisco, $17,780; A. Frederick Anderson, Oakland, $22,000. Contract awarded to Kiss Crane Service, Berkeley, $13,263.

COLUSA AND SUTTER COUNTIES—The decks of two bridges across the Sacramento River and First Street at Meridian to be redecked. District III, Route 15, Sections B,A. Parish Bros., Sacramento, $28,758; P. F. Bender, North Sacramento, $29,802; L. D. Tonn, Lodi, $31,057; Kiss Crane Service, Berkeley, $33,399; Lee J. Immel, Berkeley, $37,311. Contract awarded to C. C. Gildersleeve, Berkeley, $28,607.

CONTRA COSTA COUNTY—Between San Pablo Creek and Carquinez Bridge, about 3.5 miles, existing pavement to be widened with portland cement concrete and with asphalt concrete on portland cement concrete base, and borders to be constructed of crusher run base with armor coat to be applied. District IV, Route 14, Sections A, B. Louis Biasotti & Son, Stockton, $110,882; N. M. Ball Sons, Berkeley, $114,449. Contract awarded to Lee J. Immel, Berkeley, $109,121.

HUMBOLDT COUNTY—Between 3.0 miles and 3.3 miles north of Garberville about 0.25 mile to be graded. District I, Route 1, Section B. Parish Bros., Sacramento, $58,298; J. L. Conner & Sons, Crescent City, $63,447; Piombo Bros. & Co., San Francisco, $65,905; Poulos & McEwen, Sacramento, $66,504; Kiss Crane Service, Berkeley, $67,889; Claude C. Wood, Lodi, $69,922. Contract awarded to John Burman & Sons, Eureka, $56,805.

KERN COUNTY—Between 0.6 mile west of Bakersfield and Bakersfield about 0.4 mile to be graded and surfaced with plant-mixed surfacing on cement treated base. District VI, Route 58, Section L. Bakersfield. Louis Biasotti & Son, Stockton, $42,596; Griffith Co., Los Angeles, $43,912; Piazza and Huntley, San Jose, $46,241; J. E. Haddock, Ltd., Pasadena, $49,444. Contract awarded to George von KleinSmid, Bakersfield, $39,461.

LOS ANGELES COUNTY—On Rosemead Boulevard, between Las Tunas Drive and Longden Avenue, about 0.7 mile to be graded and paved with portland cement concrete. District VII, Route 168, Section C. Vido Kovacevich, South Gate, $49,866; Griffith Co., Los Angeles, $51,709; Oswald Bros., Los Angeles, $58,374. Contract awarded to J. E. Haddock, Ltd., Pasadena, $43,814.

LOS ANGELES COUNTY—At Figueroa St. in the City of Los Angeles, the steel portion of the superstructure of a bridge across Los Angeles River and over Riverside Drive and the tracks of the Southern Pacific Railroad to be constructed. District VII, Route 165. Contract awarded to Bethlehem Steel Co., Los Angeles, $268,804.

SANTA BARBARA COUNTY—Across Alamo Pintado Creek, about 4 miles east of Buellton, a timber bridge to be constructed. District V, Route 149, Section D. Dan Caputo, San Jose, $15,547; Combs Bros., Bakersfield, $16,155. Contract awarded to E. G. Perham, Los Angeles, $11,370.

SANTA CRUZ COUNTY—Between Watsonville and Rob Roy Junction, about 7.8 miles to be graded and surfaced with crusher run base. District IV, Routes 32, 56. Section Watsonville, B.D. A. Teichert & Son, Inc., Sacramento, $337,295; N. M. Ball Sons, Berkeley, $353,599; J. A. Casson, Hayward, $410,442; J. E. Haddock, Ltd., Pasadena, $464,038. Contract awarded to Parish Bros., Sacramento, $334,809.

SHASTA COUNTY—Between Bass Hill and Crespos, about 14 miles to be surfaced with plant-mixed surfacing on crusher run base and over existing surface, and about 0.3 mile to be paved with portland cement concrete. District II, Route 3, Sections B. C. Fredericksen & Westbrook, Sacramento, $346,005; Macco Construction Co., Clearwater, $381,780. Contract awarded to A. Teichert & Son, Inc., Sacramento, $320,330.

YOLO COUNTY—Between 2.5 miles east of Yolo Causeway and Washington Underpass, about 1.0 mile to be graded and paved with portland cement concrete. District III, Route 6, Section C. Parish Bros., Sacramento, $66,931. Contract awarded to A. Teichert & Son, Inc., Sacramento, $66,905.

Plan to Dedicate Pan-American Highway October 12, 1942

Washington, D. C.—(By Highway Information Service)—Travel by automobile from Argentina to Canada after October 12, 1942, was presaged by the Fourth Pan-American Highway Congress, held in Mexico City, September 15-24. A resolution passed by this conclave recommended that this date, which commemorates the 450th anniversary of the discovery of America, be set for the official dedication of the hemispheric highway.

Representatives of the North, South and Central American nations united their efforts to advance and coordinate the development of rural and urban highway construction throughout the Western Hemisphere. In addition to the official delegates designated by the various governments, representatives of numerous public institutions and highway officials and engineers attended as associate delegates.

Unification of traffic regulations in all countries served by the Pan-American Highway, including governmental examinations for driver licenses, was recommended by the congress.

Lima, Peru, was designated as the locale for the next meeting of the congress, which will be held in 1943.

Held concurrently with the highway congress was the Second Inter-American Travel Congress for the promotion of travel among the American republics.

Bridge at Orleans Prize Winner of U. S.

(Continued from page 22)

The suspended span is 360 feet long and there are 135 feet of reinforced concrete girder spans on the west and 170 feet on the east. Although traffic on this highway is comparatively light, it is subject to occasional very heavy loads of machinery, lumber, etc., so it was considered advisable to design it for the heaviest design loading used by the Highway Department.

Each of the main cables consists of four 3-inch 7/37 wire ropes arranged in an open group. These cables were designed for a dead load of 3,475 pounds per lineal foot of bridge and a uniform live load of 45 pounds per square foot of roadway. They were prestressed for one hour at 200 tons, then measured and marked at 100 tons, which load corresponded to approximately the dead load stress in the cables.

The bridge has a reinforced concrete slab floor on longitudinal steel stringers. The floor beams are framed into a 30-inch, 108-pound wide flanged stiffening girder. These girders were fabricated as chords of the dead load camber curve and were fully spliced at 36-foot lengths.

The steel towers contribute a great deal to the appearance of the structure and consist of two columns braced by elliptically shaped cross braces forming an arch over the roadway. The hinges at the tower bases rest on welded structural steel shoes.

Taking part in the dedication were: E. R. Green, district highway engineer; I. O. Jahlstrum, bridge construction engineer; C. C. Winter, resident engineer on the project; W. T. Norris, district engineer for the steel institute; Cario W. Caletti of San Rafael, contractor; Lieut. Commander Harold H. Gilbert of Burlingame, designer of the span; Senator Irwin T. Quinn; Assemblyman M. J. Burns; Supervisors George Cole, Len Yocom, Fred Anderson, George Lindley and Lloyd Brown; Vice President George Cloney of the Redwood Empire Association, Clyde Edmondson, manager of the association and Lantz Smith, secretary of the Eureka Chamber of Commerce.

What you don't owe won't hurt you.

State of California

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Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

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