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this date.*

# CALIFORNIA HIGHWAY BULLETIN



PUBLISHED BY THE CALIFORNIA <sup>Department of Engineering</sup> HIGHWAY COMMISSION

DEPARTMENT OF ENGINEERING, STATE OF CALIFORNIA

VOLUME III

JANUARY 1, 1915

NUMBER 1



ON THE COAST ROUTE OF CALIFORNIA STATE HIGHWAY

# CALIFORNIA HIGHWAY BULLETIN

## CALIFORNIA HIGHWAY COMMISSION

FORUM BUILDING, SACRAMENTO

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JANUARY 1, 1915

Published by the California Highway Commission for free distribution  
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### State Highway Progress

In this number of the Highway Bulletin a summary is presented of the status of work on the State Highway. The Highway Bulletin, in fact, is designed to offer a public report of progress in the construction provided in the State Highways Act.

When permanent highway building is under consideration it must be remembered that new and more exacting traffic requirements are to be met, that the roads must represent a service not dreamed of even ten years ago, and that safety and permanence, the two great considerations, call for more preliminary care than appears to the traveler on the finished highway. Some consideration also may be given to the backward financial conditions which have not made disposal of low-rate bonds an easy matter, even for the State of California.

Queries come constantly to the California Highway Commission and its representatives regarding the character or amount of work on the State Highway, and it is intended to present a full answer to these in this number of the Highway Bulletin. If additional information is desired it will be furnished gladly upon application to the Commission.

### Temporary Roads

One of the problems in highway construction is to find an acceptable method to take care of the traffic while the highway improvement is under way. Parallel roads, available by short detours, are found infrequently, and ordinarily some sort of a temporary road must be provided. This provision is not always difficult in the summer, but when the rains come the difficulty increases many fold. Construction must proceed at as rapid a rate as possible, while travel must be impeded to the smallest feasible extent; the old road and its bridges must be torn up and rebuilt, and yet it is not expedient to spend much money on the by-road for use less than a year.

In some cases, as in the so-called "Tejon route," the State Highway cuts through directly and does not interfere with the old traveled route. On other mountain roads the old road and the new conflict at points where it is difficult or perhaps impossible to provide any other, and a detour over an entirely different road is unavoidable. In the Great Valley and on other level sections the question of by-passes is more easily settled.

At best, however, the temporary road is far from satisfactory, and causes the traveler inconvenience. Against its roughness and added mileage should be placed the fact that the inconvenience of a few months is in order to give for all time in future a model road which will save in comfort and expense on a single trip more than enough to offset the disadvantages. Although the temporary road may not show it to the casual observation of the traveler special efforts are made by the supervisors and the Highway Commission to provide as good a road as possible without going to an extravagant outlay. As construction progresses signs designating the "best temporary route" are placed at turns, and caution notices are provided in accordance with road conditions. The automobile organizations render valuable assistance in this regard by route directions and in sign placing. The signing problem is a difficult one, for directions apparently clear to one person may be misunderstood by another, and frequently the driver with a "speed bug" pays no attention at all until an accident occurs.

Travelers through the state over routes where much construction is under way may save time and some trouble by securing information as to route conditions from one of the automobile associations, whose officers are always ready to answer inquiries, or at any of the offices of the California Highway Commission, a list of which is given elsewhere in this number of the Highway Bulletin. The automobile clubs publish

weekly bulletins giving definite information as to road conditions on the principal routes. A little forethought in making inquiries may save the motorist mileage.

During 1915 it will be the policy of the California Highway Commission to make special efforts in cooperation with county supervisors to maintain all temporary routes, especially between San Francisco and Los Angeles and San Diego wherever needed, in better-than-ordinary condition to meet the unusually large traffic of the exposition year. Where the grading must be left for the settling rains of one or two winters before placing the pavement, as will be the case on both the valley and coast routes between San Francisco and Los Angeles, the temporary surfacing will be firm and safe, and the traveler will have all the advantages of easy grades and safe curves. The roads between the two expositions, if not entirely paved, will be open and safe and greatly improved over the roads of 1913.

### Mountain Roadways

Perhaps in no part of the work of the California Highway Commission is the advantage of modern road making better shown than in the construction of the mountain sections of the State Highway. The old roads, in most cases, were outgrowths of trails, and grades in excess of twenty per cent were not uncommon, while sharp curves and narrow widths demonstrated that they were made before automobiles came on the market. Of late years many county authorities have made commendable progress in the mountain counties, but the expense of building a modern mountain road is greater than any county is justified in expending locally and is properly a state charge. This is particularly true in the mountains, for the development accruing from the best types of highways almost always extends from one county to another or is of special benefit to through traffic.

The state can, and should, construct a better type of road than a county can build—and this is in no way a disparagement of the work of county supervisors, who are inevitably called upon to expend more money than they have available. Their work is to meet local needs, while the state should undertake construction with an eye toward facilitating through traffic as well as local travel. Consequently the California Highway Commission has planned mountain roads, as the State Highways Act directs, on the "most direct and practical" routes for the through travel, while at the same time connecting the county seats with the remainder of the state. On the trunk lines of the State Highway the maximum grade will be 6 per cent, a trotting grade for a team with light rig, except for a comparatively few short pitches of  $6\frac{1}{2}$  or 7 per cent. The trunk routes will be paved in the mountains, and will be so safeguarded that the most timid drivers may enjoy mountain touring. On the laterals, where the traffic is much lighter, the expense of a 7 per cent maximum or of paving is not justified.

In addition to their appeal to the tourist or intending settler—which alone will bring millions of dollars into California—the mountain roads of the State Highway will bring into closer touch with the cities and seaports a number of sections now almost isolated geographically. In Modoc, Lassen, Plumas and Sierra counties, for example, California has a veritable empire needing only good roads to attract attention to its possibilities. Counties even nearer to the capital, like Nevada, Placer and Calaveras, will rank with the richest horticultural counties in the state when supplied with adequate communications to tidewater. With good roads Mono and Inyo counties will appeal annually to thousands of tourists. All the mountainous counties of the state, whether well known or seldom visited, will offer attractions in scenery, in ranching or stock raising and in fishing or hunting heretofore little appreciated for lack of good roads.

In its studies of possible routes for the main trunk roads of the State Highway the Commissioners and the Highway Engineer traveled by automobile 6,800 miles, and in studying the mountain lateral problems during the past summer they went over an additional 2,100 miles, making practically 9,000 miles traversed in order to work out the preliminaries for the construction of the 3,000 miles of road comprehended in the State Highway system.

The value of an "engineered road" is shown in the State Highway connection between Southern California and the San Joaquin Valley, on which, in addition to provision of a maximum grade of 6 per cent and the avoidance of sandy stretches, sharp curves and other "bad going," actually effects a saving of forty-five miles over the shortest old route.

Thousands of persons interested in road improvement will visit California in 1915, and there are few phases of highway building which will not be available for inspection in the State Highway system.

## PROTECTING THE PUBLIC

## Safeguards Provided to Meet Financial and Moral Responsibilities in Connection with State Highway Contracts

By CHARLES F. STERN,  
Member California Highway Commission.

In its financial relations with its contractors, the Highway Commission differs but little from any large employer of labor under the contract system. The credit and financial responsibility of the state are just as separate from the credit and financial responsibility of the contractor as in any private or corporate contract. Yet, there is a certain moral responsibility involved; to an extent, the reputation and the credit of the state are placed in the hands of the contractor to whom a contract for a section of State Highway is let. To this moral responsibility the Highway Commission is keenly alive. No one wants the State Highway to contain an ounce of material or an hour of labor for which the seller has not been paid. This applies both to the contractor and to those who furnish him with supplies, material or labor.

The contractor is presumed to know his business. The contract which he takes is on his own bid, at his own price, and on specifications which definitely define every element that enters into the work. Notwithstanding this, the Commission takes extraordinary pains to aid the contractor in the successful completion of his work, precautions that are not taken to protect a contractor or the public in either private or corporate construction.

The materials for the work—rock, sand, cement, etc.—are furnished by the state. This saves the contractor a considerable investment and incidentally places the work within reach of the resources of a large number of contractors. The Commission pays for its work in a way most unusual. "Progress estimates," or estimates of the work done, are made every thirty days, and in places where it is necessary, oftener, and the money due for such work is promptly paid. This materially lessens the contractor's investment in labor and supplies, and correspondingly eases the burden of the work. The state places at the disposal of the contractor the highest type of engineering advice and assistance.

On the part of those who supply the contractor with hay or grain, groceries, powder, or labor, or any other commodity, the matter is more

complicated. There is no question but that a contractor on the State Highway finds it much easier to get credit locally than he would were he working for a railroad, for example. "It is State Highway work, the state is good for it," seems to be the general impression.

Now, as a matter of fact, the creditor of a Highway contractor has no recourse to the state other than the ordinary legal procedure which would obtain in any private or corporate work. Even labor itself is not a preferred creditor under the law. For sentimental reasons, too, the local dealer is proud to furnish supplies for the Highway work—proud to have a hand in this great constructive enterprise.

The Highway Commission goes to extreme lengths in its effort to protect these claims. Two bonds are required of the contractor who enters upon a Highway contract for the full amount of his bid. Before a contract is let, a searching examination is made into the reputation, ability, and financial responsibility of the contractor. The Highway Commission does not propose to have its work in the hands of any contractor whose record and resources are not sufficient to warrant the presumption that he can carry out his contract with satisfaction to the state and to the public. As the work progresses, 15 per cent is deducted from each progress estimate, constituting a "retention fund," which is not released until the job has finally been completed and accepted by the state. This is to protect any claims that may arise against the contractor.

These precautions in themselves would seem sufficient, but the Highway Commission goes yet further. Article XI of the contract entered into between the state and the contractor reads as follows:

"Said contractor further agrees that he will pay all bills for labor, material and supplies contracted for by him on account of the work herein contemplated, when same become due and payable, and that he will furnish to the California Highway Commission on the fifteenth of each month, a sworn statement of all unpaid indebtedness contracted for on account of the work herein contemplated, together with the dates of such bills and the names and addresses of such creditors.

The Department of Engineering, through the California Highway Commission, at its option and at any time by written notice to the Contractor, upon the failure of Contractor to furnish such statement, or upon proof that the contracted indebtedness is not being met when due, may declare this contract terminated, and may itself proceed to complete the work herein specified, or engage any other person or persons to do the same.



Motor Car Clearance on Minimum Improved Width of State Highway

Moreover, said State of California, by and through the Department of Engineering or other appropriate state officer or officers, may at its option and at any time retain out of any amounts due said Contractor sums sufficient to cover any such unpaid claims, provided that sworn statements of said claims shall have been filed in the office of the Department of Engineering or in the office of any other state officer or officers; and, furthermore, said State of California, by and through the Department of Engineering or other appropriate state officer or officers, may at its option and at any time pay any such unpaid claims out of the amounts so retained. The Department of Engineering may also, with the written consent of the Contractor, use any moneys in the possession of the State of California belonging to the said Contractor for the purpose of paying for both labor and materials for the work.

In the event that the party of the first part declares this contract terminated, as provided by this article or by Article VII herein, the Department of Engineering, through the California Highway Commission, reserves the further right to take possession of and use any materials or equipment of any nature whatsoever belonging to or used by said Contractor on the work herein contemplated, the Department of Engineering assuming responsibility for the final relinquishment of such equipment at the conclusion of the work or sooner at its option, in as good condition as when it was taken over by said department, reasonable wear and tear excepted; and the Department of Engineering, through the California Highway Commission, agrees to pay for the use of said equipment or material a reasonable compensation, to be mutually agreeable to the Commission and the Contractor, or, in the event of their failure to reach such agreement, then such compensation as may be determined upon by the Advisory Board of the Department of Engineering of California."

The intent and significance of this article are too plain to require elucidation. By virtue of this provision the Commission keeps definite tab on the financial obligations of the contractor, with the intent that when it becomes apparent that the contractor is becoming involved, that the state shall intervene to protect the creditors of the contractor before their claims aggregate an amount in excess of the retention fund. This provision will prevent a recurrence of former failures on the part of contractors wherein claims for labor, material, and supplies were unpaid for many months, awaiting the tardy action of the bonding company, and were then subject to compromise.

It is inevitable that from time to time contractors will fail. This is the hazard of all business. The Highway Commission surrounds its relations with its contractors and their bondsmen with such conditions as to protect to the fullest extent the creditors of the contractor. And in the event of the failure of the contractor, every effort is made to see that claims for labor, material and supplies are liquidated promptly and in full from the retention fund if it be large enough; if not, then by the prompt action of the creditors' bondsmen. The Highway Commission does not look with favor upon any bonding security which can not be depended upon for prompt cooperation and definite action to this end.

In recent instances wherein contractors have failed, their contracts have been immediately transferred to other parties nominated either by the state or the bondsmen, and all claims have been settled in full with a celerity impossible under any less drastic or far seeing arrangement.

The interest and support of the people at large in the highway work is a matter of pride and is to be encouraged to the utmost. The moral responsibility of the state must be, and will be, fully shouldered, regardless of the legal nonresponsibility behind which a private or corporate enterprise is willing to hide.

From time to time a contractor falls by the wayside. The percentage on this work is small—a half dozen in one hundred seven jobs handled. When this happens, every resource of the state is brought to bear to protect the innocent creditor. But the man who sells his labor or the dealer who sells supplies must bear in mind that his business is done with the contractor and not with the state; that the interests of the state, representing the whole people, must be protected as well as the interests of the small proportion who chance to be creditors; that the law itself knows no favorites. Indiscriminate credit exacts its own penalties, here or elsewhere.

## Studying Mountain Laterals

In advance of the preparation of plans for State Highway construction the Highway Commissioners and the Highway Engineer made a series of studies of the main lines prescribed in the State Highways Act, traveling six thousand eight hundred miles by automobile between Siskiyou and Del Norte counties on the north and San Diego County on the south. These studies were only on probable routes for the principal

lines through the great valley and along the coast, comprehending what are sometimes referred to as the "trunk roads" of the State Highway system.

As each county was visited an approximation was made of the probable total mileage of State Highway in the county and information was secured from supervisors, county surveyors and others interested, which served as the basis, in conjunction with additional data collected at the office in Sacramento, for a rough apportionment, county by county, of the \$18,000,000 provided for State Highway construction. From this skeleton plan was worked out the working scheme for building the State Highway. The visits to the various counties, which were made while awaiting the first sales of bonds, also proved valuable to the Commissioners in giving them first-hand information about the country through which the State Highway must be built.

Similar studies of the lateral lines which will be built to connect the county seats not on the principal routes were undertaken by the Commissioners during the past summer. These lines may be considered the second great phase of the State Highway work, the building of the system through the valleys and along the coast being the first. Since the latter was well under way this year the Commissioners took up the former, initiating that work by a series of personal studies similar to those made on the main lines in 1911. In August and September they traveled more than two thousand miles in Placer, Nevada, Sierra, Plumas, Lassen, Modoc, Shasta, Tehama, Butte, Yuba, Amador, Alpine, Calaveras, Tuolumne, Mariposa, Madera, Mono, Inyo and Kern counties to obtain an idea of the best method for tying those counties to the main lines.

Starting from Sacramento, the possible routes between the Sacramento Valley main route and Auburn were traversed and routes to connect Nevada City via Grass Valley with the main route by three suggested laterals—the direct route to Auburn, the Colfax route and the Smartsville old toll road to Marysville—were traveled in considering the Nevada County tie-up. The possibility of a "Y" for Nevada City and Downieville with the two roads coming together in Brown's Valley and connecting at Marysville was considered, as well as a more southerly connection for Downieville. The Commissioners went from Downieville to Quincy and traveled over the various routes suggested for the Plumas County tie-up. They next visited Susanville and Alturas and traveled over connections for Modoc and Lassen counties by way of Redding and Red Bluff. On the return, the tie-up for Oroville was studied. A trip was next made to Markleeville in Alpine County to consider the probable tie-up for that county seat.

As soon as business matters in the headquarters office at Sacramento were disposed of, the Commissioners continued their studies of lateral routes by traveling from Sacramento to Jackson and over the routes to and from San Joaquin Valley points and the mountain county seats, Jackson, San Andreas, Sonora and Mariposa. The probable connection for Mono and Inyo counties was then studied, the Commissioners going from Sonora over the Sonora Pass to Bridgeport and then traveling along the route through Mono Lake, Bishop, Big Pine, Independence, Lone Pine and Mojave. On the way an inspection was made of the Tioga Pass route at the Mono Lake end.

At the meeting on September 22, the following instruction was voted by the Highway Commission:

"Voted, That the Highway Engineer be and he is hereby instructed to cause to be made through the several Division Engineers and their assistants such reconnaissances and studies of the lateral state highways connecting the county seats with the trunk lines as may be necessary in anticipation of the construction surveys."

Such reconnaissances were made or are being prosecuted as fast as the regular work of the Division Engineer will permit. They have been carried out for Inyo and Mono counties and in Mariposa, Tuolumne, Placer, Nevada, Sierra and Butte counties, and preliminary work has also been done in Amador and Calaveras counties.

## Cautionary Signs

(See illustration on page 15.)

A serious problem connected with Highway construction is the handling of traffic when it is found necessary to close the old road during construction. In a well settled community there are usually sufficient roads to provide detours of comparatively short length, but in many sections, and particularly in the mountains, temporary roads must be furnished while the concrete is being laid and cured. Efforts are made by signs and lanterns to direct the traffic as fully as possible to avoid unnecessary travel while the road may be closed. In addition to cautionary signs at the end of the work, "Best Temporary Route" signs are placed along the temporary roads. These are frequently torn down, however, by school children and others who do not realize their value to the traveler, and it is not always possible to maintain an ideal system of signs on temporary roads.



Completed Roads on California State Highway

## THE LATERAL ROAD PROBLEM

### Secondary Demand of Highway Act is for Connecting County Seats Not Directly on Principal Routes

The primary demand of the California Highway Act is for trunk line construction; for two roughly parallel lines, one through the coast counties and the other through the great interior valleys, the Sacramento and the San Joaquin, "serving county seats and connecting centers of population by the most direct and practical routes." In the skeleton system of highways outlined by the act, these constitute the backbone.

The secondary demand of the act is for lateral road construction; to connect with the highway those county seats which are not directly served by either trunk line.

The trunk lines will constitute the great arteries of road traffic into which will flow the local traffic of every section, as well as the through traffic of the entire Pacific coast. The lateral roads, by location and



California Meeting Oregon: Commissioners and Officials of Two States and Counties at the Boundary Line.

In 1911, when the California Highway Commission was considering probable routes for the main roads of the State Highway, a visit was made to Siskiyou County where officials of that county accompanied the Highway Commissioners to the California-Oregon boundary line and there conferred with representatives of Jackson County, Oregon, regarding the interstate highway connection. As a result, the Oregon road will come over the Siskiyou Mountains with a maximum grade of six per cent, joining the California State Highway at the point shown in the illustration.

purpose, are feeders only for the trunk lines. In importance, use, and logical sequence they constitute the subordinate part of the highway scheme.

A glance at the highway map will show that the coast trunk line serves all of the county seats of the coast counties, practically speaking; that the trunk line through the valleys serves all of the county seats of the valley counties, practically speaking. The problem of lateral roads is a problem by itself, in a location by itself. It is the problem of tying the eastern tier of counties, the mountain counties, to the valley trunk line. It consists almost entirely of mountain roads through sections largely undeveloped and sparsely settled, and connecting centers of population—county seats—of no great numerical importance. These facts find their logical expression in the attitude of the Highway Commission toward the mountain laterals; as to time of construction, and character of construction.

More highway was built this year in California than was ever attempted in a single year in any other state. And yet, the roads can not all be built in a season—the money is not available, contractors are

not available, right of way questions take time; and there is a limit to the capacity of any organization, however efficient, beyond which speed is obtained only at the cost of efficiency and economy.

Therefore, trunk lines first.

We are now ready to take up the lateral roads as a comprehensive, distinct road problem. The Highway Commission and its engineers in charge in each division have finished two thousand miles, traveling by automobile, through these mountain counties, studying their location, needs and desires at first hand. These county seats, for the most part, lie to the east of the Sierras. Their connecting roads to the valley cross elevations of from 4,500 to 7,500 feet, and are snow blocked for months on end. The problem is to build laterals to these points which will utilize the lowest passes through the mountains and be useable through the winter months. Following the inspection by the Commission, the engineering force will study every detail of this problem, examine every possible or suggested route, in order that the needs, the wishes, and the rights of these communities under the law may be met. That actual work upon the mountain laterals has not been begun does not indicate that the mountain counties have been forgotten, or will be neglected. The spring of 1915 will see this portion of the highway scheme under active headway.

The relation of the lateral to the trunk line expresses itself also in character of construction. The standards of trunk line construction have been set high—no grade in excess of seven per cent, no curves with shorter radii than fifty feet, a twenty-one-foot roadbed, and with ideal alignment, etc. The type of construction has been fixed—the concrete base, permanent type. The lateral roads, however, warrant a much more flexible policy. Some of them, as the Oroville lateral and the Hanford-Visalia lateral, will carry sufficient traffic to warrant trunk line type of construction. On the purely mountain laterals such construction would be folly. No one wants, expects, or needs city streets through the Sierras. An accurate study, therefore, of this problem, will demonstrate the necessity of varying types of construction to meet varying situations. Grades steeper than on the main routes, narrower roadbeds, surfacing of native materials, and similar reasonable economies will be necessary in handling this lateral problem without a prohibitive cost; and at the same time the resulting roads will be godsend to communities where twenty-five per cent grades and narrow, dangerous roads without benefit of sound engineering are to-day the rule.

It will be the policy of the Commission to apply sound engineering to this problem first, that these laterals may be permanently placed where they belong; to expend the apportionment for these roads where it should be spent, eliminating excessive grades, dangerous curves, etc.; to take under maintenance the entire mileage and, where the cost of a perfect road can not be met with the available funds, to lay the foundation for a perfect road and out of our maintenance fund gradually perfect such roads by the addition of guard rails, culverts, retaining walls, surfacing, etc. By such a system the mountain counties will be opened up by roads that lend themselves to safe and economical traffic, and the mountain counties will become a part of California practically the whole year round.

It is a unique compliment to these counties that the Commission has been forced to ask them not to purchase highway bonds until the money can be used. They needed no urging to buy, they were ready and anxious.

And in the meantime, the lateral road problem is being whipped into shape for definite activity next season.

## State Highway Materials

At this period of the construction of the California Highway system, it is of considerable interest to note the quantities of material being delivered to the contractors engaged in State Highway construction. During September, 50,700 barrels of cement were delivered on the work from the various cement mills throughout the state, and 63,200 tons of sand and gravel were delivered by rail during the same period. The transportation of this material required over sixteen hundred cars. In addition to these shipments, approximately one hundred cars were used for the delivery of road oil, reinforcing steel, lumber, contractors' equipment and machinery of all kinds; and, during this time, not an instance of serious delay to the work occurred, notwithstanding the fact that there was a noticeable car shortage throughout the entire month, due principally, no doubt, to the heavy movements of grain, fruit and other farm products. This means that an average of sixty-eight cars of material were daily purchased and moved—and moved during a period of car shortage—without an instance of delay to the work.

## Rights of Way\*

By AUSTIN B. FLETCHER  
State Highway Engineer of California.

Adequate "rights of way" of "locations" are of prime importance in any highway system and too little attention has been given to this feature of highway work hitherto.

In the mad haste to get the roads built so that the automobile enthusiasts may use them "while they are yet alive," we are prone to forget that the highway location is the one really permanent feature of the road work.

The time to secure proper locations for the roads, and widths sufficient to serve all purposes for long years to come, is *now*. If we wait until some future day to correct improper locations, and to secure suitable widths of rights of way when we have more leisure, we will have wasted much money in pavements constructed and the land needed will cost much more and will be more difficult to acquire.

It goes without saying that all land owners are more complacent in giving up portions of their property to the public before the improvements are begun than at any time afterward.

In some of the older states the people came long before "sectionalization" by the government was thought of but in the middle west and on the Pacific coast, most of the land was divided years ago "checkerboard" fashion by the government surveyors.

The highways in the older states were laid out, or in most cases, simply grew where the travel wanted to go, but in the flat prairie land of the west, and even in the Pacific coast valleys, the roads were often, if not generally, laid out straddling the section lines, the center of the right of way being usually coincident with the section line. This plan had the merit of lessening the area of land deducted for road purposes from the holding of an owner by making his adjoining neighbor provide one half of the land required for the roadway.

This method of road location often proves to be an embarrassment to the present-day road builder since this time-honored rectilinear scheme does not fit the present needs. Centers of population often times have not occurred in conformity to such a plan; often the railroads have determined the location of the towns. In such cases it is desirable, considering the volume of "through travel" in motor cars and trucks, to construct the roads in the most direct lines possible. This often entails rights of way running diagonally across the sections, "cuts up" land holdings and makes trouble generally for the right-of-way department.

But when the rectilinear plan has been carried still farther and the land owners, to conserve particularly good areas for agricultural purposes, have had in times past enough influence to cause the county authorities to discontinue or vacate portions of ways along the section lines and have introduced right angled turns into the half or even quarter section lines, then the engineer has a task worthy of his mettle to secure a proper location for his improved road.

And if the road be in an orange grove section, his joy is indeed complete.

The writer knows of a main paved road in one of the California counties which has at least ten right angled turns in it in a distance of about 20 miles and this road passes through no town or city and is practically level. In planning their new highway system several years ago, that county gave up as hopeless the task of securing a direct route in the locality referred to, so for many years to come all through travel over those 20 miles of beautifully paved highway must be subjected to the dangerous right angled turns and to the unnecessarily increased length.

There is reason in cities and other centers of population for ways laid out in rectilinear fashion. In the open country, there is no excuse for planning a new highway system along such lines. Land should be condemned if the owners will not donate it.

There should be as direct a line between important centers as the topographical conditions will permit.

Assuming that the best alignment for the highway has been adopted, taking into consideration the factors of topography, climate and traffic needs, present and prospective, the next question confronting the highway engineer is the width of right of way.

It is certainly desirable that in any highway system the right of way be of uniform width, but as a practical matter each link in the system must be considered by itself. Near the centers of population it is obvious that the pavement and the rights of way must be wider than in remote rural communities, sparsely settled.

It is the writer's opinion, however, that for a minimum width of right of way 50 feet is none too much and that wherever possible, a

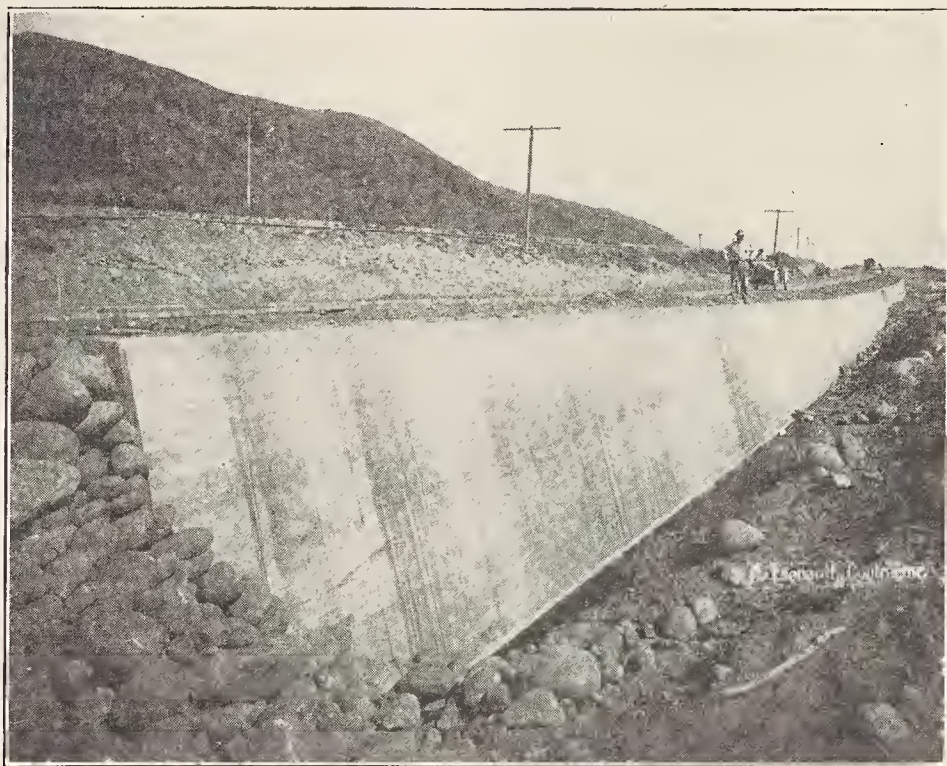
width of 60 feet is the least that should be secured, even in sparsely settled localities.

It is inevitable that street railway, electric light and power, gas, telephone, and telegraph companies will at some time clamor for locations in the highway, and although too little attention has thus far been paid to the matter, tree planting and other landscape treatment of our country highways will have to be provided for.

In many of the older sections of the country right of way problems are not serious affairs. Ways have been established there, well defined and traveled, for many years, and right of way improvements consist chiefly in rectifying the side lines of locations where abutting land owners have encroached successfully under the "open adverse possession" statutes which apply in some of the states.

But in many localities, the acquisition of necessary easements of way becomes as important a factor in the plan and progress of highway work as the road work itself.

In the more sparsely settled communities, roads have been built following lines of least resistance, in the valleys the "sectionalized" land lines, and in the hills wherever the ranchers could best spare it. Accordingly, when modern road building methods are invoked, it becomes necessary to alter meandering and precipitous roads by



Seawall on Rincon Route Protecting State Highway from Damage by Waves

Work is proceeding rapidly on the Rincon route, as the sea level sections of the State Highway between Santa Barbara and Ventura are termed. The attacks of the sea are being prevented in dangerous places by concrete sea walls to protect the highway pavement. The Rincon route will supplant the old Casitas pass, where several lives have been lost owing to the danger of the mountain road.

straightening, widening, and improving the gradients. The needed rights of way for these purposes must be acquired.

This feature of the work is particularly annoying to the highway engineer. His desire is to press forward the best line in the best way in the best time. When he is confronted by a hostile, reluctant or indifferent land owner, the engineer usually loses his patience.

It is not alone in cases of new rights of way that there is litigation, but frequently old surveys do not exactly coincide with existing ways, many of which in course of usage have become winding and irregular, and consequently additional land has to be acquired to widen, straighten or alter them.

Owners often build fences or cultivate up to the used portion of the ways and resist the shifting of the lines and delay the progress of the work. In many cases much time is lost where owners who have allowed people to pass and repass in vehicles without objection for years, assert adverse claims and work must be delayed to avoid complications.

One has also the experience of attempting to use dedicated rights of way shown on plats recorded in times past but which have been entirely unused or allowed to fall into disuse, and then being confronted by claimants, with their attorneys, who contest the rights of the public therein.

\*Read at Fourth American Road Congress, Atlanta, Ga., November 9-14, 1914.

There are many unavoidable delays in obtaining rights of way, arising outside of the disputed rights of way mentioned. Even when the owners intend to be liberal they exact a great deal of information before signing the deeds of easement. The records have to be searched to ascertain the true owners of the lands affected; owners must be notified or corresponded with; draftsmen are asked to furnish sketches to many owners defining the rights of way desired; visits to the lands must be made and surveys inspected; minor adjustments of lines and fences must be settled upon; vacation proceedings arranged and prepared, abandoning the old roads or portions of roads over property so as to leave no incumbrance on the same when the new road is located and built; co-owners must consult among themselves before executing deeds of easement; ownerships involved in probate proceedings or title litigation must be searched and a good title to the roads acquired out of the confusion, and there are other details ad infinitum.

These many difficulties have led, in the writer's western experience in highway work, to the employment of the subtle right-of-way man, who needs be a psychologist as well as a philosopher. His chief duty consists in attempting to wheedle the often-times contrary land owners into signing the needed conveyances and to convince them, usually, that their duty to the public lies in giving their property gratis. Such an employee becomes a very important member of the organization. His troubles are many.

In addition to the "right-of-way man" and his assistants in the California work, the help and advice of an attorney learned in eminent domain practice has been had who devotes all of his time to the highway work and whose principal activities are in right of way matters. The writer takes this opportunity of acknowledging the assistance of Mr. Charles C. Carleton, attorney to the California Highway Commission, in the preparation of this paper.

In many jurisdictions, if the deeds can not be acquired by diplomatic methods, war must be declared in the courts, and the highway board must desist from its efforts to promptly furnish the community with necessary thoroughfares until the courts finally determine that the litigious land owners' holdings may be entered upon.

There is a great lack of uniformity in the different states in the methods of paying or securing the payment of damages in taking property for public highway purposes. Such methods are of course regulated entirely by the constitutions and statutes of the respective commonwealths.

In some states it is not necessary for the authorities to pay for private property taken for public use in advance of the actual taking of possession. The property owner has been provided with a method of making his claim and with a tribunal constituted so that he may enforce his claim and obtain his damages therein.

In such jurisdictions, highway work may speedily progress and the laying out of routes followed by immediate construction. The property owner, if he is dissatisfied with the original offer of payment or the award made to him by the public authorities, may pursue his remedy in the appropriate court even though his land has already been occupied by the public.

The public has the advantage of celerity in the progress of its enterprise; the land owner is protected by ultimate and adequate compensation for his injuries, and in one state, at least, he may wait until after the State Highway is completed before he must file his petition for jury trial, it then being evident to all interested parties just what damage has been done, not only by reason of the land taken but by the road construction as well.

But some states are so unfortunate as to be harassed in their public work by constitutions and statutes expressly requiring prepayment before entry upon the land required for public use.

The writer has had to do with highway activities in two states which have operated under each of these methods, the one having the right to take land necessary for public use in advance of satisfying the owner; the other requiring that if the owner is not pleased with the offer made to him by the public authorities, he may stand back on his property with a shotgun and compel public officers to initiate proceedings in the court and remain off his property until after judgment has been obtained and the assessed damages paid into court for his use and benefit.

In the first mentioned commonwealth, the welfare and progress of the people as a whole are superior to the notions and eccentricities of an individual land owner.

In the other state, the recalcitrant land owner may oppose and delay the vital needs of a city, county or state, as the case may be, and his immediate rights predominate over the requirements of the community at large.

No rights of way, in states having regulations similar to the latter, can arbitrarily be taken by the people before the same, after a vast amount of red tape, have been acquired by donation, purchase or con-

demnation; that is, a taking can not be made and compensation and damages adjusted afterwards.

Consequently obstinate land owners are able to "hold up" the community at large until it either pays the demands or contests the question of compensation and damages in trials, the latter usually requiring considerable time, particularly in the case of the belligerent or indifferent land owners residing in other states or foreign countries when long publications of summons are necessary before the suits may be commenced. The western states appear to be particularly oppressed by such roundabout methods of entering upon private property and installing improvements for the benefit and welfare of millions of people.

For illustration, under such a system a large western land owner owning an area equal in size to an entire eastern state may be luxuriously traveling abroad. A county has voted and issued bonds for a large amount to construct important highways. Before the great ranch can be entered upon, except for surveys, a correspondence must ensue between the public authorities and the land magnate. The owner declines to sign a conveyance and the people are compelled to commence proceedings in eminent domain against the absent owner. Before a trial can be had, summons must be published for sixty days, and then follow the tedious court proceedings.

It usually happens that pugnacious land owners demand some exorbitant sum. The court may upon trial only allow a small percentage of their original claim but during the pendency of the action an important artery of travel may be debarred.

Such a system is absolutely hostile to progress; the people should be greater than the individual.

The writer submits that at this time, when modern highway construction is becoming so active throughout the nation, it is apparent that there should be simplification in the constitutions and statutes relating to the subject of eminent domain, and that this Congress may render invaluable service in assisting to bring about so desirable a result.

Too much attention can be given to the title technicalities of right of way activities. It has been an almost universal practice for public boards performing road work to obtain at great expense exhaustive abstracts of title to ascertain land ownerships.

The writer has had under his supervision the acquisition of hundreds of miles of highway right of way in California where the securing of rights of way could not be made much more difficult, complex or annoying, yet the purchase of expensive abstracts of title has been dispensed with. Out of hundreds of ownerships affected, not one serious complication has resulted from the following plan:

When the field parties are making the original surveys, the chiefs of party usually inquire from the occupants of the land surveyed who the owners or those interested in the property may be. This gives a clue to the ownership. Thereafter, one of the staff visits the proper county offices and ascertains from the assessment rolls or the records who purport to be the owners. Deeds or agreements are then prepared, containing the proper descriptions, and it is very rare, indeed, that any objection has been made to the accuracy of the instrument submitted.

By thus performing its own title searches, even though they may not have always been the most exact from a title lawyer's standpoint, the authorities have saved thousands of dollars and have never had an injunction or ejection proceeding instituted against them by objecting land owners.

By taking a few remote chances of complaints, work, which would otherwise be hopelessly harassed and delayed in the performance of a highway project, may proceed.

Furthermore, in most states, title may be obtained two ways by user or implied dedication by the passage of time. It has been the custom in California where the present traveled roads are wide enough for use and properly located, to place the monuments and build the pavements and assert jurisdiction thereover, the theory being that if the owner objects, the authority's title being fundamentally weak, the state can "condemn" as rapidly as the alleged owner can "oust."

The so-called state highways in the several states may be divided into at least two classes with regard to the control by the state of the roads after they are built, namely, those which are maintained by the state and over which the state assumes complete charge from property line to property line with the possible exception of the policing of the way, and those sometimes called state-aid roads where the commonwealth has little or nothing to do with the maintenance of the roads and the burden is placed by law upon some subdivision of the state, usually the county.

The writer has had to do only with the class of state highways first mentioned and he believes that the state ought to have as complete control as possible over its highways, state or otherwise. Such control, however, places a considerable burden upon the authority which administers the law.





Building Mountain Roads on California State Highway

## BUILDING CALIFORNIA'S HIGHWAYS

### Characteristics and Types of Roads in Systems Being Constructed under the Bond Issue of \$18,000,000.

The following excerpts are from an article contributed by A. B. Fletcher, Highway Engineer, California Highway Commission, to a highway number issued by the Engineering Record, of New York, furnishing a summary of the building of the State Highway of California:

"California has been constructing a system of State Highways under a bond issue of \$18,000,000 since the spring of 1912. The State Highways Act which controls the operations, defines roughly the roads to be built, although considerable latitude is permitted in fixing the exact locations. To comply with the law about 3,000 miles of road must be constructed. About 1,800 miles may be called trunk roads and the remainder laterals, or roads connecting county seats with the trunk roads.

"The trunk roads are sufficiently important to require paving to make them adequate at all times of the year. The laterals may, in general, be surfaced with gravels or other relatively inexpensive materials found near at hand.

"Early in the work it was determined that the roads built should have the following principal characteristics: (1) A right of way not less than 60 feet in width, where it is reasonably possible, and as direct between objective points as is consistently possible. (2) Gradients not exceeding 7 per cent, even in the mountainous parts of the state. (3) Curves as open as possible and in no case of less than 50 feet in radius. (4) As many culverts of sufficient capacity as are needed to take care of surface and underground water. (5) A traveled way, under ordinary conditions, not less than 21 feet in width, and in the mountains not less than 16 feet wide, with the center paved or surfaced so as to be hard and smooth under all climatic conditions at all times of the year, the width of surfacing to be in general 15 feet. (6) Smoothly graded road-sides, reserved for future tree planting.

"It is obvious that an appropriation of \$18,000,000 for the construction of 3,000 miles of modern highways, or at an average rate of \$6,000 per mile, is a very close if not an impossible figure. Even the engineering and administration expenses must be paid out of the \$18,000,000.

"It was necessary, therefore, to eliminate all possible expenses and substantial savings were effected by requesting the counties to provide rights of way for the State Highways without cost to the state; requesting the counties to construct along the routes all bridges having spans in excess of 20 feet; omitting from the system all streets in incorporated cities and towns and placing the burden of their improvements upon the corporations; securing extraordinary reductions in freight charges on road materials used in State Highway work; making contracts with supply men for materials in large quantities at reduced rates, and supplying such materials to the contractors.

"The savings due to the elimination of the expenses above outlined amount to several million dollars, for in a most generous manner the requests of the state to the counties, incorporated cities and towns and the railroads were favorably received and granted almost invariably.

"In California, as in Massachusetts, the state controls the entire width of its highways from location line to location line in all matters except policing. Thus no street railways may be constructed or power lines or telegraph or telephone lines placed except under a permit from the department of engineering, nor may the roads be dug up for water pipes or sewers without its consent. It is necessary for this reason, if for no other, that the records of the highways be made very carefully and accurately, and extraordinary pains have been taken with the surveys and plans so that there may be no doubt in the future as to the rights of way. In addition, substantial concrete monuments are set at all angle points on both sides of the right of way, and at all beginnings and endings of curves and on long tangents in sufficient number to fix the lines. These features add much to the engineering cost of the project, but it is believed that the expense is amply justified.

"Before beginning operations, the principle was well established in the minds of those in control of the project that the paving of the trunk line highways should be so planned and constructed as to fit the traffic needs. In other words, it would be futile to adopt a rigid standard for the pavement and install it in all localities, regardless of the local conditions. Money would inevitably be wasted under such a policy, either because of unnecessarily high first cost or, if the pavement proved to be inadequate, enormous maintenance charges.

"The problem was reduced to a choice of three types of pavement possible under the conditions obtaining in California: (1) oil macadam pavement (penetration method); (2) concrete roadway with a relatively

thin bituminous wearing surface; (3) concrete roadway with a thick bituminous top of asphaltic concrete.

"It was recognized that the water-bound macadam roads would not serve on the main lines of travel because of the preponderance of motor traffic.

"The brick pavement was not seriously considered as available because of the great cost of that type under California conditions. There are few, if any, suitable paving bricks made on the Pacific slope within a reasonable haul by rail and eastern brick would be enormously expensive.

"The asphaltic concrete pavement (Warrenite and its variants) unsupported by a cement concrete base was not considered so satisfactory as with the cement base and because there is little, if any, difference in cost in California between the 'black base' and the cement base.

"At the beginning of the work it was thought that for the major part of the paving the oil-macadam type would have to be adopted in all cases where the traffic was moderate in volume. Oil macadam, as it is called in the vernacular of the West, is substantially what is referred to in the East as macadam, penetration method.

"The going price for Portland cement was high and the price was closely controlled by the manufacturers. Two contracts, aggregating about 20 miles, were let for oil macadam pavements and the roads were built satisfactorily. The chances for failure in this kind of work, however, are many. It is difficult to secure suitable broken stone for this kind of work in many localities. The local gravels will not serve unless they are passed through a stone crusher and then they are often ill adapted to the work. It is difficult to control the quantity of asphaltic oil used and, all in all, the oil-macadam road in California, at the present writing, is not looked upon with much favor generally.

"To establish a market for Portland cement for highway work, the manufacturers after much parleying, agreed to reduce the price then obtained and established a maximum mill price, which they agreed to protect during the life of the State Highway work, thus permitting a much more general use of that commodity. Thereafter most of the highways were planned with a cement concrete base and a bituminous top, thick or thin as the character of the traffic seemed to dictate.

"In most cases where the traffic is moderate in volume—500 to 600 vehicles per day, at least one half of the vehicles being business or pleasure motors, with a fair sprinkling of wagons carrying from five to eight tons of produce—the concrete base with a bituminous top from one half to three eighths inch thick is being constructed. Indeed, although the writer decries the use of the expression, this kind of pavement has been called the standard type of the California State Highways.

"In general, where the subgrade is firm and hard and likely to stay so, or where the subgrade can be made to conform to such requirements, the concrete base is but four inches in thickness. There seemed to be ample precedent in the mind of the writer for a base so thin as four inches in certain eastern construction of which he had knowledge, and certainly if such a base is sufficient in the frost-bitten East, there would be little doubt of its adequacy in sun-kissed California. The experience of more than two years has proved the suitability of the four-inch concrete base under the conditions mentioned. There have been no failures even under extreme traffic. The writer does not wish to be understood as favoring a base so thin except under ideal conditions of subgrade with a total absence of frost conditions. The concrete must be honestly made and laid and reasonably rich in cement.

"In the California work the concrete closely approximates a 1:2:4 mixture and it is carefully inspected in all stages. The materials are usually purchased by the state and delivered to the contractors. The cement is invariably handled in this way. When the concrete must be laid over adobe or other bad material the base is thickened to five or six inches.

"Another somewhat unusual feature in the California work is the omission of expansion joints. All of the concrete base is covered with a wearing surface of asphalt, thick or thin. It is notorious that all concrete pavements crack, whether because of contraction, expansion or absorption of moisture. Many learned members of the profession are still seeking the reasons, for they are probably diverse, in an endeavor to minimize the cracking. It is equally notorious that concrete pavements will crack in a most perverse manner, and they do not always open solely at the artificial joints. The bituminous covering, in California, seems to fill such cracks as develop, and there has been but little if any trouble from such cracks.

"There have been cases, however, in the hot central valley, with mid-summer temperatures at 110 degrees Fahrenheit or more, where the concrete has buckled. The writer is familiar with one section about ten miles long which has sixteen buckles, due, beyond doubt to the expansion of concrete. It is possible that a few joints in that ten-mile stretch, filled with asphaltic material would have prevented the buckling. Such cases, however, are few and far between in the California

work and by no means suggest the need of a radical change in policy as to the non-installation of expansion joints.

"There has been much said in California concerning the thin bituminous wearing surfaces which the state has employed so generally. The state is fortunate in having within its borders a vast supply of oil with an asphaltic base. This oil, or most of it, is so heavy in its natural state as it is pumped from the ground, that it is better adapted for making asphalt and fuel oil than it is for manufacturing kerosene and gasoline. The California asphalts, as now made, have become well and favorably known all over the United States. It is because of the excellence of the asphaltic oil which has been secured that the thin top has been so successful on the State Highways.

"The oil is purchased by the state in large quantity after competitive bidding on carefully prepared specifications. It is tested from time to time as the storage tank is filled, and it is known before shipment to the work that the oil is satisfactory. For the thin top work, an oil carrying about 90 per cent of bitumen is now considered the best adapted for covering the concrete, but under certain conditions, oils in excess of 95 per cent have been used successfully.

"There is no essential difference between this coating and the bituminous carpets which have been used for eight years or more in protecting macadam roads from the ravages of automobiles. It seems likely, however, that because of the excellent oil in California the coating will have a longer life than the bituminous carpets applied in the East.

### Savings From Good Roads

Orange County in Southern California has supplemented the State Highway by the construction of 107 miles of paved roadway. When Sonoma County decided to consider a system of highway improvement, the secretary of the Sonoma County Good Roads Club wrote to Col. S. H. Finley, a leading tax payer of Orange County and County Highway Engineer, regarding the saving effected by good roads in that county. Colonel Finley said in reply:

"Assuming that your bonds bear 5½ per cent interest and extend over a period of thirty-two years payable \$50,000 each year, your payments will average \$91,250 per year for bonds and interest. How will you pay this? I will answer that you can do it in several ways and be richer after the debt is wiped out.

"1. The assessed valuation of non-operative property in your county last year was \$37,000,000. The value of all this property will be increased by at least ten per cent by the construction of 163 miles of good roads. Assuming that your tax rate is \$1.70, this increase will yield you about \$60,000 annually without increasing your rate, or enough to pay the interest and one third of the bonds. Or, the immediate increase in valuation will be more than sufficient to pay the entire bond issue and interest for thirty-two years.

"2. The saving on depreciation, repairs and fuel for automobiles will average at least \$110.00 each per year. Assuming that you have 2,000



Building the State Highway Through Northern California Forests

"The earliest work of this sort on the California State Highways was done near Fresno about twenty-three months ago. There is hardly any wear appreciable at this time on this surfacing and there is every indication now that the bituminous covering, in that locality at least, will have a life of at least four years with little or no expense for repairs.

"Near San Francisco and running southerly to San Jose, about fifty miles distant, the traffic is very great in volume and the paving has been made wider and the wearing surface thicker than is usual in the less populous regions, the paving varying from twenty to twenty-four feet in width.

"In some places, where this stretch had been previously macadamized, the old roadway was used as a base for the new road and the asphaltic top, about one and one half inches thick, was placed upon the old macadam after considerable labor and expense in smoothing and re-rolling. It was usually found, however, that the old macadam was so worn that it cost excessively to make it suitable and to receive the asphaltic top and it is probable that a cement concrete base would have been nearly as cheap and the results would certainly have been better.

"In general, where the traffic is heavy, a wearing surface of one and one half inches of asphaltic concrete has been placed over an adequate cement concrete base, the top and the base being united by a paint binder of asphalt and gasoline or distillate, applied hot to the cleaned concrete base.

"For the asphaltic top, Warrenite, Topeka mixture and sheet asphalt have all been used, apparently with excellent results."

motor vehicles of all kinds in the county, the savings to the owners of these will annually amount to \$220,000, or enough to pay off the entire bond issue with interest twice over.

"3. Assuming that you have 5,000 horses and mules in your county, the goods roads will save at least:

For shoes and harness annually, \$1.50 each.....	\$7,500
For each animal for feed, 50 cents per month.....	30,000
Increase useful life of each animal, 10 per cent.....	75,000
Wear and tear on wagons and carriages, 2,000 at \$5.00 each.....	10,000
<b>Total .....</b>	<b>\$122,500</b>

"This will be sufficient to pay the bonds and interest for thirty-two years and have an annual surplus of \$32,500 to expend on maintenance.

"4. United States census figures show that it cost Sonoma County \$180,000 per year more to haul over its present roads than it would over improved roads, and this item alone would more than meet the annual payments on bond and interest.

"5. The advertising feature alone would be worth enough to cover the \$40,000 average annual interest. Your neighboring counties will doubtless make permanent road improvement, and if you do not, the results will be that people touring through the state will be advised to go around Sonoma County. You can not afford to permit that.

"Our good road system in Orange County is nearing completion and, judging from its effects already evident, I am convinced that the above figures are not the result of an idle dream."

*(From California Highway Bulletin)*

## A California Concrete Road

By JAMES B. WOODSON

Division Engineer, Division VI, California Highway Commission.

A portion of the San Joaquin Valley artery of the State Highway which has been constructed and under traffic for a longer period than any other section, is a 9.55-mile piece extending northwesterly from the city of Fresno to the banks of the San Joaquin River.

The contract for the construction of this road was let in August, 1912, to the Worswick Street Paving Company of Fresno. The laying of concrete pavement was begun in October, 1912, and the completion of concrete was in April, 1913.

The system used in throwing open a section of pavement to traffic is that after the concrete has reached an age of 21 days, if a side road be conveniently handy to divert the travel away from the new operations, the concrete is cleaned off, a barricade placed at the diversion point and all types of vehicles are permitted thereon.

The pavement consists of a four (4) inch base of Portland cement concrete, 15 feet wide, covered for the most part with a one half ( $\frac{1}{2}$ ) inch wearing surface of asphaltic oil and broken stone screenings or coarse sand, and has a crown rise of  $2\frac{3}{4}$  inches. In addition, 3 foot shoulders widen the width of traveled roadway to 21 feet.

Recognizing the fact that a firm foundation is one of the first and most important principles of good engineering as applied to road construction, the contractor was required to plow or scarify the existing roadway and after pulverizing and cultivating the broken up portion, to thoroughly wet and roll to the greatest possible compactness.

In this way a subgrade was secured which showed no perceptible movement under a ten ton road roller.

In order to secure water for wetting the subgrade and concrete, wells were drilled at convenient points and connected with a 2-inch pipe line. Wherever irrigation canals or old wells were not available new wells were bored and the water pumped through the pipe line up to a distance of approximately one mile on each side of the pumping station. In this way sufficient water was secured for settling the subgrade, mixing and placing the concrete and keeping same wet for the required period of six days despite the prediction of outside parties that a concrete base for country roads in as warm a section as the San Joaquin Valley would not be practicable owing to the impossibility of economically handling the water question and of keeping the concrete moist until thoroughly cured.

The contract for grading was on a mileage basis though the present policy of this Commission is to prefer the yardage basis.

The contract price was \$900 per mile or 10.2 cents per square yard of concrete pavement.

After the roadway was graded and thoroughly watered and rolled, timber headers of 2-inch by 4-inch planks placed on edge and securely nailed inside of supporting stakes were placed along the outside for pavement forms. These headers conformed to the lines and grades of the edge of the finished pavement and the subgrade was then shaped to the finished grade of the bottom of the concrete by a wooden template, the bottom of the template conforming to and approximately 4 inches below the finished crown of the concrete. By "approximately" is meant that the subgrade was usually finished a little above the final grade, depending upon the nature of the material forming the foundation, and the final rolling and wetting compacted the dirt to the desired grade.

The grade was then kept clean and thoroughly wet immediately in advance of the concrete to insure obtaining a full 4 inch thickness and to prevent any of the water in the concrete being absorbed by a dry subgrade.

A 1:2 $\frac{1}{2}$ :5 mixture was used for the concrete, which when properly mixed with clean and well graded material has proven to be perfectly satisfactory. This requires on the basis of 45 per cent voids 1.3 barrels of cement to the cubic yard of concrete.

A Foote two third cubic yard mixer was used throughout, and the concrete was mixed with just enough water to be of a jelly-like consistency, care being taken not to have the mixture so wet that the mortar would flow away from the coarse aggregate, with a resultant "lean" mixture.

After being placed, the concrete was struck with a template riding on the header boards, and was followed up sufficiently close with wooden tampers and smoothed with a wooden float, there being sufficient roughness on the finished surface to insure cleavage of the oil wearing surface.

The construction of a 4-inch satisfactory pavement demands practically no leeway in any departure from the specifications. Coarse aggregate for concrete that runs a high percentage of materials passing a one inch screen requires an excess of sand to get the finish and

therefore makes a weaker mixture of concrete than the specified quantity of sand. Also too much material in the coarse aggregate passing a  $\frac{1}{4}$  inch screen again reduces the quality of the mixture due to the fact that sufficient tests can not be made rapidly enough to adjust the sand at the mixer.

The coarse aggregate on this contract was entirely of clean gravel from the Friant pit. The gravel was well graded from  $\frac{1}{4}$  inch up to 2 $\frac{1}{2}$  inches. The sand was also from the same source; great care being taken to eliminate the clay dirt that was mixed with the sand at the pit.

Frequent tests were made both in the Division office and by the resident engineers on the work to determine the amount of objectionable material in the aggregate. Material that tests over 6 per cent by weight in material passing a 100 mesh screen was considered not satisfactory. This part classified as silt.

The cracks appeared at fairly regular intervals of from 25 to 35 feet. However, no bad results have been occasioned by reason of these cracks, as the first concrete laid was open to traffic seven months before the oil surfacing was applied and on this section there was no perceptible breaking down or disintegrating of aggregate.

With the oil surfacing complete and the concrete now close on to two years old, it would be a comparatively hard matter to locate the cracks unless one were making a special search.

Concrete was run during 104 days or an average of 484 lineal feet per day of concrete run. On 24 days out of the 104, over 700 lineal feet were made, and on six days the daily progress was over 800 lineal feet. The highest run for any 8 hours was 857 lineal feet with the following crew:

1 Foreman	\$4 00
1 Engineer	3 50
1 Water tender	2 00
1 Chute man	2 40
4 Chute men at \$2.00	8 00
11 Wheelers and shovelers at \$2.00	22 00
1 Wheeler	2 25
2 Men handling planks at \$2.00	4 00
2 Men smoothing concrete at \$2.00	4 00
1 Man tamping	2 00
1 Man brooming	2 00
2 Men handling cement at \$2.00	4 00
1 Wagon spotter	2 00
1 Two-horse wagon and driver (handling boards)	4 50
1 Man helping (handling boards)	2 00
1 Concrete mixer, fuel, etc.	5 00
1 Pump and engineer	6 00

33 Men, total on concrete work----- \$79 65  
857 lineal feet = 158.7 cubic yards = \$0.503 per cubic yard or 5.6 cents per square yard of concrete 4 inches thick.

The total cost of this 9.55 miles of road, covering grading and concrete base, and including cost of cement, was \$49,359, making a price of \$5,168 per mile or \$0.587 per square yard of pavement.

In order to determine an adaptable wearing surface that could economically be applied, two types were placed on this section.

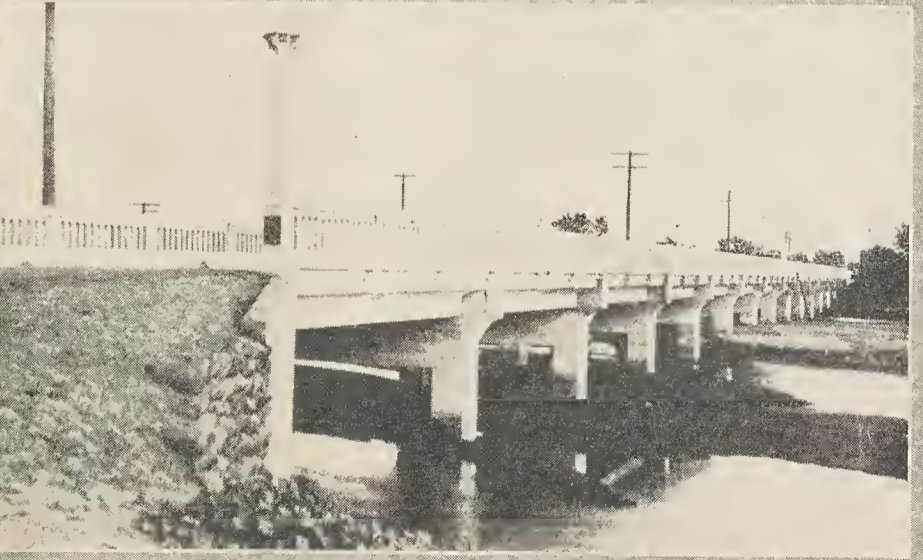
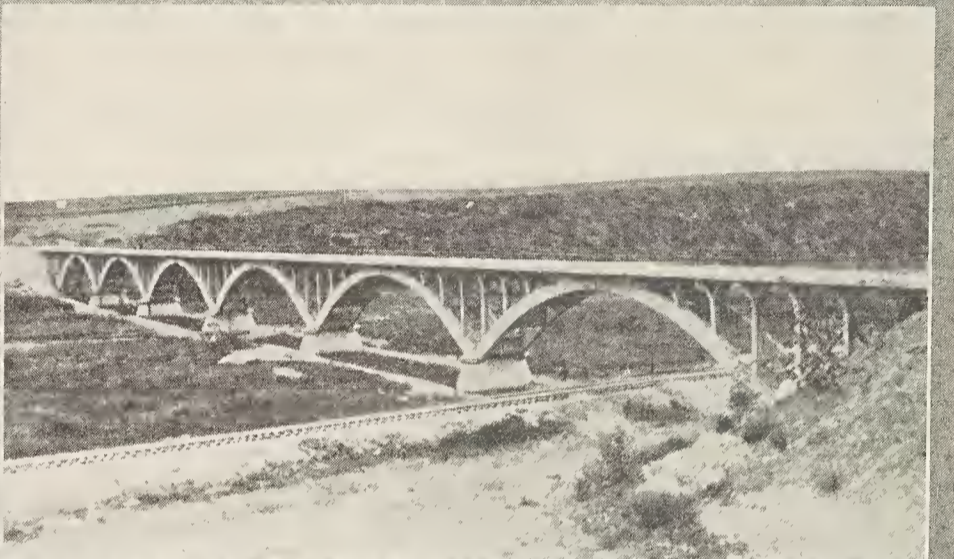
One was a mastic mixture consisting of a composition of approximately equal parts of asphaltic cement, 70 to 80 penetration, and powdered lime rock spread to a thickness of  $\frac{3}{8}$  inch, on top of which, after laying, was spread broken stone screenings or coarse sand as needed to absorb the excess of bitumen as it appeared on the surface or as the mixture softened under the heat of the sun.

The other surfacing consisted of an application of approximately  $\frac{1}{2}$  gallon per square yard of asphaltic oil spread at from 250 to 300 F. containing 90 per cent of 80 penetration asphalt, on top of which was spread sufficient sand or screenings to absorb the oil. Approximately 0.488 gallons of 90 per cent asphaltic oil per square yard and 260 tons of screenings per mile making 0.03 tons per square yard, making a final thickness of slightly less than  $\frac{1}{2}$  inch.

### SUMMARY OF COSTS.

	Total cost	Per mile	Per square yard of concrete
Grading	\$8,591 40	\$900 00	\$0 102
Concrete base (including cement)	49,358 92	5,168 48	0 587
Bituminous surfacing (including mastic)	7,730 19	809 44	0 092
Culverts, monuments, guard rail, etc.	820 32	809 44	0 009
Totals	\$66,500 83	\$6,963 82	\$0 790

In conclusion the writer wishes to state that it is now lacking a few days of being two years since the first portion of this road was thrown open to traffic; and with the exception of slight maintenance on oil surfacing and dirt shoulders, there has been no failure of any nature observed in the pavement.



Type of Bridges and Culverts on California State Highway

## Asphaltic Concrete

By A. E. LODER

Division Engineer, Division IV, California Highway Commission.

Asphaltic concrete is used to designate a concrete in which a bituminous substance serves as the cementing agent for the mineral aggregate of various sizes.

The word concrete in its earlier application to cement concrete implies a mixture in which the voids of a coarse aggregate are filled to a slight excess with a finer aggregate and the mass bonded with cement in such manner that the coarse pieces are in substantial contact. As the word concrete is now carelessly used in connection with bituminous materials, it is sometimes applied to a mixture in which the coarse material is a very small percentage of the fine, giving the effect of a fine aggregate with scattered pieces of coarse aggregate floating freely within it.

The three types of hot mixed asphaltic surface in most common use are Standard sheet asphalt, Topeka mixture, and asphalt concrete known under the proprietary names of "bitulithic" and "Warrenite."

In order to compare them more closely they will be discussed in order.

Sheet asphalt, commonly known as "standard surface," should be laid as closely as the available materials will permit to the grading known as the New York standard, with variations to meet climatic conditions and to provide for heavy traffic or for light traffic. The following tabulation gives in the first column the average grading from 68 tests covering the entire 5.4 miles of standard asphalt surface as laid one inch thick on Contract No. 1, and the second column gives the grading known as the New York standard for heavy traffic:

	Average 68 tests on Contract No. 1	New York standard heavy traffic
Penetration -----	90	-----
Bitumen -----	10.66 per cent	10.5 per cent
Passing 200 mesh -----	13.94 per cent	13.0 per cent
Passing 100 mesh -----	25.85 per cent	26.0 per cent
Passing 80 mesh -----		
Passing 50 mesh -----		
Passing 40 mesh -----	25.23 per cent	23.5 per cent
Passing 30 mesh -----	9.46 per cent	11.0 per cent
Passing 20 mesh -----	5.45 per cent	8.0 per cent
Passing 10 mesh -----	6.77 per cent	5.0 per cent
	2.64 per cent	3.0 per cent
	100.00 per cent	100.0 per cent

Comparison shows that Contract No. 1 was laid as near the standard grading for heavy traffic as possible to proportion.

The most important feature of proportioning standard asphalt mixture is to secure the proper percentage of the finer sands passing the 80 and 100 mesh screen and then to use the correct amount of rock powder and bitumen. In fact this principle holds for any successful asphalt pavement.

The specifications for the so-called Topeka mixture which is now being laid on this division were prepared by using the standard sheet asphalt grading and scaling the proportions down to 75 per cent to admit 25 per cent of coarse aggregate or grit between the 10 mesh screen and  $\frac{1}{2}$  inch. This provides for a much more uniform and dense pavement than would be permitted under the original Topeka specifications. The former Topeka grading permits the use of either coarse or fine sand at the contractor's discretion.

The proprietary bitulithic or Warrenite pavement is more truly asphaltic concrete than the Topeka mixture. It was formerly known under the name "bitulithic," which was an asphalt concrete laid upon a crushed rock base which had been grouted with bituminous material. Later, a slight variation was put out under the name "Warrenite" to meet the requirements where a cheaper surface was required. The two terms are now used more or less interchangeably. Both may be laid with either a bituminous or a cement concrete base. For a time, two or three years ago, the proprietors permitted the use of gravel aggregate under the name of Warrenite. Recently they opposed the use of gravel aggregate under either brand. The only apparent difference now between bitulithic and Warrenite is the use of the term Warrenite when a relatively thin wearing surface is to be laid, in which the maximum size of rock is  $1\frac{1}{4}$  inches and the use of bitulithic when a thicker or more expensive surface is to be laid, in which case rock may be used up to  $1\frac{1}{2}$  inches. It is the general practice to limit the size of rock to one half the thickness of the wearing course.

The following grading is used for a bitulithic surface in the city of Los Angeles under Specification 99:

Passing $1\frac{1}{2}$ -inch mesh -----	10-15 per cent
Passing 1-inch mesh -----	26-35 per cent

Passing $\frac{1}{2}$ -inch mesh -----	12-20 per cent
Passing $\frac{3}{4}$ -inch mesh -----	8-12 per cent
Passing 10 mesh -----	24-32 per cent
Passing 200 mesh -----	4-7 per cent
Bitulithic waterproof cement -----	7-9 $\frac{1}{2}$ per cent

This calls for the use of from 56 to 82 per cent of coarse aggregate.

The following extract from a general specification for bitulithic embodies the claims of the promoter as to the merits of the pavement: "In the mixer bitulithic cement shall be added in sufficient quantities to coat all particles and fill such voids as remain unfilled by the proportionment of the mineral aggregate. The aggregate shall be so proportioned as to secure in the aggregate inherent stability, density, freedom from voids, and resistance to displacement, and a mixture which when combined with the bitulithic cement and compacted together, will form a bituminous street pavement structure containing mixed mineral ingredients of such grades as to give the structure inherent stability."

When laid strictly in accordance with the above specification, the pavement should give excellent results on a good foundation. However, like every other type of surfacing, poor work can be laid if not properly supervised. The "inherent stability" is secured more by the material passing the 80 mesh screen than by the rock.

When laying a Topeka surface, we require the asphalt plant to be so equipped that the rock powder, the hot asphaltic cement, the hot sand and the hot aggregate between 10 mesh and  $\frac{1}{2}$  inch can be weighed separately into each batch or box which totals from 900 to 1,000 pounds. A skilled inspector is required at the plant to take temperatures of each load and of the hot materials, and to see that the materials are properly combined. A skilled assistant is required where the prepared asphalt mixture known as "hot stuff" is delivered and incorporated into the pavement. The load must be dumped on the foundation sufficiently ahead of the spreading that it will all be shoveled over by the hot gang before it becomes a part of the surface. The mixture must be thoroughly raked out to the bottom and spread with uniform density and thickness, to reduce to a minimum the small undulations which appear after rolling.

The process of mixing and placing standard sheet asphalt is the same as for the Topeka, except that the coarse aggregate is omitted.

When sands impregnated with a natural bitumen such as the product known as "Santa Cruz bitumen" is used on either Topeka or Standard asphalt work, the process on the street remains the same, but the plant work is very different. A batch is made up by weighing and proportioning separately in wheelbarrows, the following ingredients:

- Rock powder;
- Coarse or soft bitumen;
- Fine or hard bitumen;
- A small amount of Antioch sand;
- And the coarse mineral aggregate if desired.

The cold ingredients are fed into a revolving cone-shaped drum known as a torpedo mixer. Heat is applied to the outside and the materials thoroughly mixed and cooked for about fifteen minutes, while passing to the discharge end.

The trouble with this process is that the output is limited and the work slow. It is difficult with such a plant to secure uniform temperatures. The continued cooking during the process of mixing gives the product some advantage over material prepared in the standard plant.

The Santa Cruz bitumen contains a natural asphaltic cement which is very tough and ductile and of higher penetration than the manufactured product. From our observations thus far it appears possible to construct an asphaltic surface with this natural bitumen which will equal and probably excel pavements containing the manufactured product. It has been used with indifferent results for many years, but only recently has it been treated and combined in a scientific manner, giving satisfaction. During the past season we have found it possible to secure more uniform grading from day to day than where the best available sands were used with manufactured asphalt.

The thickness of a hot mixed asphalt surface should not be less than  $1\frac{1}{2}$  inches. It was difficult to spread and rake Standard asphalt as thin as one inch; in fact it required the materials for an average of nearly  $1\frac{1}{4}$  inches. The hot mixture cooled so rapidly that it was difficult to properly place and roll it so thin. It should not be undertaken except during very warm weather, and then is of questionable economy. The thin surface requires the same expense for placing as if it were laid  $1\frac{1}{2}$  inches thick. When sheet asphalt has worn down to an average of one half inch it needs replacement. On such a basis it is readily seen that for fifty per cent more material, and possibly twenty per cent more labor, one hundred per cent more available wearing thickness can be had.

A paint binder composed of 80 penetration paving asphalt, dissolved in from one to one and one half times its volume of No. 1 engine dis-



Cautionary Signs Used in State Highway Construction

tillate, has been used successfully on all of the asphalt surface work laid upon concrete base in this division.

The asphalt is heated at the roadside in a portable kettle. A measured quantity is placed in a mixing pail at a safe distance from the fire and the distillate added. It is then poured on the concrete from buckets and swept ahead in a light wave with house brooms. The painted surface is immediately swept over a second time to remove excess paint from depressions. It should be applied only when concrete is thoroughly dry.

The paint should be so proportioned that after evaporation there will remain a thin film of asphaltic cement having a bright, glossy black surface and penetrating into the concrete for perhaps one thirty-second of an inch.

On Contract No. 1 where the paint was used on 5.4 miles, the cost per square yard as applied by force account was as follows:

0.095 gallons distillate at .085 per gallon, delivered on the job.....	\$0.0081
0.514 pounds asphaltic cement at \$9.76 per ton, delivered on the job.....	.0025
Labor at \$2.50 per day to \$3.00 per day of 8 hours.....	.0067
Plus 15 per cent on labor.....	.0010

Total cost per square yard..... \$0.0183

The paint binder gives such a positive bond that the concrete is torn away when the asphalt is removed. It prevents slipping of the surface. It waterproofs the under side of the asphalt and prevents it from being attacked by water, which is so often found to sweat through the concrete and appear in small drops in the under side of the asphalt. It also prevents water from entering between the asphalt and the concrete and seeping along between them down long grades, raising the asphalt away from the base.

On the one inch standard asphalt on Contract No. 1, the asphalt is so tightly bonded to the base that whenever the concrete cracks the asphalt surface is forced to crack immediately above it, instead of stretching over the crack, as it does where the binder is not used. This can not be held as a disadvantage since it is desirable to know where the cracks are located in order that they can be poured full of waterproofing asphalt from the surface.

Considerable waterbound macadam base was constructed for carrying asphalt surface during the past year. It is believed that good results have been obtained, but that it will not be economical or desirable to attempt further work of the same class. It had been expected that a considerable portion of the old macadam could be used, but it was found so thin that substantially a new macadam base became necessary. It was found best to compact the 5-inch concrete base in one course of large rock or in two courses with the larger rock at the surface. It was thoroughly bonded by rolling and screening until it appeared as hard and unyielding as concrete. Excess screenings were broomed out, leaving a clean surface of projecting pieces of angular rock. This gave a good mechanical bond which proved to be essential.

During the early part of the winter it was found on two jobs that rising ground water weakened the macadam base and permitted the asphalt surface to crack from the under side until it showed through to the surface in irregular concentric rings about the weak spot. Such trouble occurred in only a few minor places and was promptly repaired by the contractors, even though they had completed the work. However, the lesson to be gained from it is that concrete base is better than macadam base, or any type of flexible base, for carrying asphalt surfacing wherever there is a possibility of rising ground water.

Water-holding soils contain a large percentage of plastic clay. As

the water increases, the stability of the soil decreases, due to the lubrication, until the mass approaches the state of a liquid, offering little or no resistance to change in shape. When the pressure increases or concentrates at any point, the material flows until it reaches a state of equilibrium. Such material, whether partially or wholly saturated, would never be displaced by the heaviest loading were it possible to confine it and maintain the pressure uniformly on all sides.

Where rising ground water causes an unexpected soft spot under a completed pavement, a rigid cement concrete structure is better than a flexible pavement. The rigid slab floats or distributes the heavy concentrated load over a much wider area than the flexible surfacing. The unit pressure on a yielding subgrade resulting from a concentrated load applied to the pavement varies inversely as the square of the span over which the pavement is acting as a beam. This great reduction in the unit pressure and its uniform application over such a wide area when cement concrete is used, serves to confine saturated places, reducing the possibility of its displacement. If the soft spot is small, a rigid pavement will bridge the load to the hard material on either side.

The argument is often advanced that a flexible pavement like asphalt concrete is better than cement concrete over soft ground or new fills, because it will conform with any irregularity or subsidence without cracking. The writer's observation convinces him that such argument is the very reason why it is inferior to cement concrete for such conditions; but there is no objection to asphalt concrete base where drainage is adequate and uniformly good support is to be had. Concrete will conform with any general settlement, as on new fills, without unusual cracks, while it will bridge over and equalize the pressure where soft spots develop, thereby preventing an undulating surface with its unpleasant riding qualities.

## Rights of Way

(Continued from page 8.)

More is expected of a state organization, and rightly so, than of a county board. Its work must be done carefully and accurately. The surveys and plans of the state highways must be well made and no small part of the engineering costs is chargeable to the careful work needed in running out and establishing the right of way lines.

In trying to establish old right of way lines in anticipation of highway improvements, much difficulty is often experienced in finding any landmarks to indicate what the right of way really is, and the old surveys and plans often prove to be of little assistance. Often the roads to be taken over and built as state highways were laid out when the land was of little value and the surveys were carelessly made or the descriptions carelessly recorded. With the lapse of time buildings, trees, and other similar features, which formerly marked the location of the road, have entirely disappeared, and the traveled ways have shifted from place to place as the action of the elements or the whims of the travelers have directed. Fences, if they exist, have been so moved about that they in no way indicate the original line of the road.

In all state work with which the writer has had to do it has been the policy to fix the right of way lines on the ground by setting proper monuments into the soil to such a depth that they serve as markers for all time to come.

In planning a new system of highways, careful plans should be made and permanent monuments set. Future generations will surely appreciate such records and the additional cost of this kind of work should not forbid.

## California Highway Commission's Specifications for Road Oil

(a) The oil shall be a natural oil with an asphaltic base, treated to remove water or sediment or the residuum of such an oil from which the volatile material has been removed by distillation, and shall be satisfactory to the Engineer. It must not have been injured by overheating, and it must not be obtained by adding solid asphalt to lighter oils or distillates.

(b) In determining the quantity of oil delivered, the correction for expansion by heat shall be as follows: From the measured volume of oil received at any temperature above sixty (60) degrees Fahrenheit an amount equivalent to four tenths (0.4) of one (1) per cent for every ten (10) degrees above sixty (60) degrees Fahrenheit shall be subtracted as the correction for expansion by heat. For the purpose of measuring oil, a temperature of sixty (60) degrees Fahrenheit shall be deemed a normal temperature.

(c) Deduction will be made for water and sediment in exact proportion to the percentage of water and sediment found therein, and the oil shall not contain over two (2) per cent of such water and sediment.

(d) After being freed from water and sediment, the oil shall contain not less than ninety (90) per cent of asphalt, having at a temperature of seventy-seven (77) degrees Fahrenheit, a penetration of eighty (80) degrees District of Columbia standard. The percentage of asphalt shall be determined by heating twenty-five (25) grams of said oil or residuum in an evaporating oven at a temperature of four hundred (400) degrees Fahrenheit until it has reached the proper consistency, when the weight of the residuum shall be determined and the per cent calculated.

(e) The oil shall show an adhesive strength of not less than three hundred (300) seconds when tested at a temperature of seventy-seven (77) degrees Fahrenheit by the Osborne Adhesive Test Apparatus at the laboratory of the California Highway Commission. The oil shall show a specific viscosity of not more than one hundred (100) when tested with the Engler viscosimeter at a temperature of two hundred and twelve (212) degrees Fahrenheit.

(f) Residuum shall not contain in excess of two tenths (0.2) of one (1) per cent of organic matter insoluble in carbon tetrachloride at ordinary temperature, after the removal of the percentage of water and sediment.

### GENERAL REQUIREMENTS.

The asphaltic oil is to be stored in a tank or tanks held for the California Highway Commission. A representative of the California Highway Commission will take samples of this oil as the tank is being filled. The tank will be sealed and held until the tests are completed.

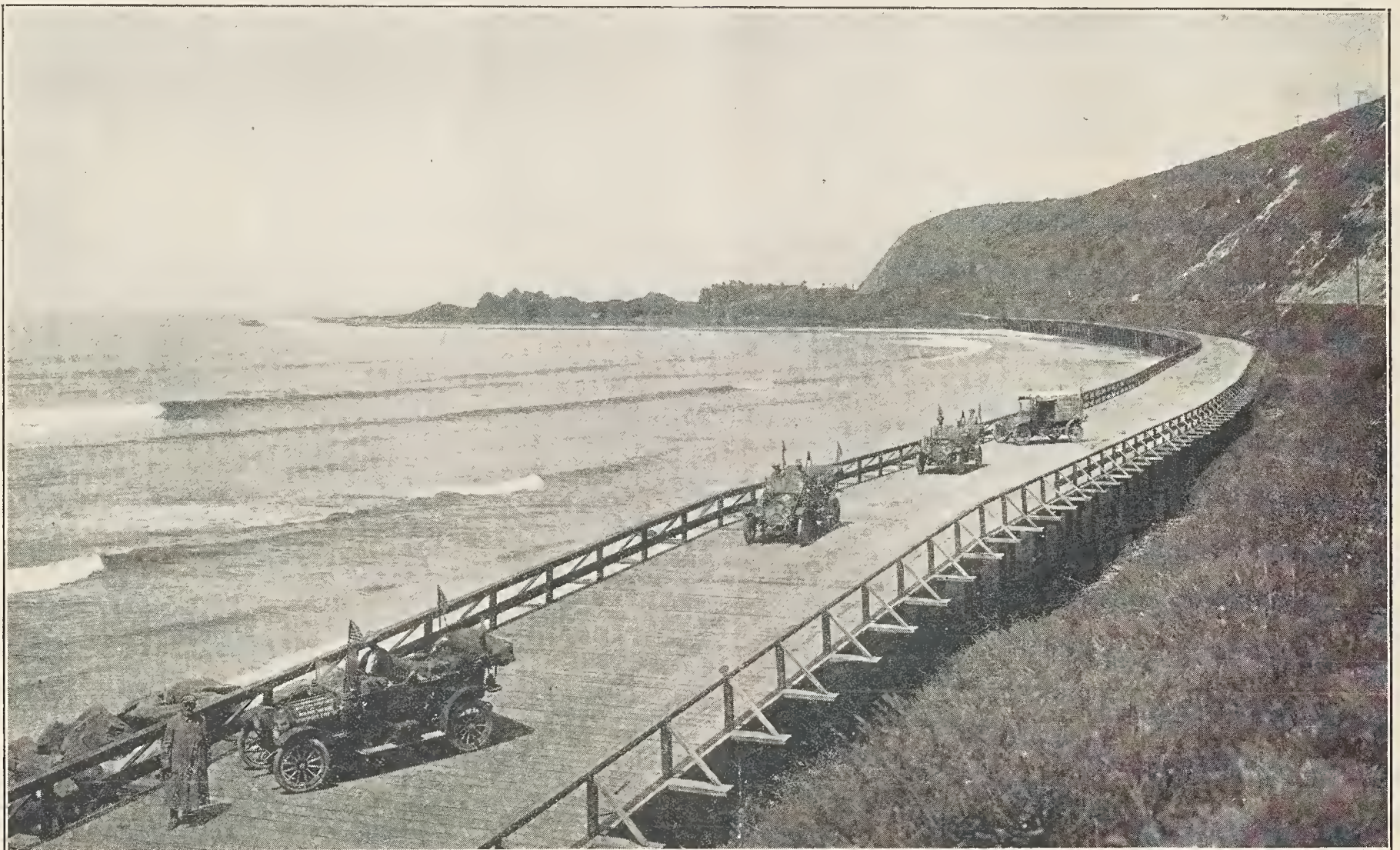
When the tests show the oil to satisfy the above specifications for oil, it can be drawn on, subject to the orders of the California Highway Commission.

The oil will be kept under seal and this seal broken and oil car loaded under the inspection of a representative of the California Highway Commission.

The asphaltic oil is to be shipped in tank cars of standard measurement loaded to gallonage capacity, such cars to be properly equipped with tight steam coils that do not permit any leakage of water or live steam into the oil. It is understood that the unit of measurement, the barrel, contains 42 United States gallons of 231 cubic inches each.

In general the improved width of the completed State Highway on the main routes where the concrete pavement is placed is 21 feet. Many travelers who ride over the concrete pavement before the surfacing and shoulders are placed regard the pavement as finished work and consider it too narrow. The rock shoulders placed on either side of the concrete make the improvement six feet wider than the concrete section of the road, giving ample clearance for passing vehicles at the maximum speed permitted by law.

The Highway Bulletin is designed to present a report of progress on California's State Highways, and, in connection therewith, matters allied with Highway construction and growing out of the progress of the work, and is sent free of charge to those interested in the State Highways. It is published only as occasion justifies, and the present number is the fourth to be issued since organization of the California Highway Commission. Nearly all the State Highway departments of the United States issue bulletins in magazine form, which is found the most desirable means of presenting the work to the public. That of the Iowa Commission reaches a monthly circulation of 20,000.



Trestle of Rincon Causeway Coast Route of State Highway



# RECORD OF PROGRESS OF THE STATE HIGHWAY

## State Highway Routes

The routing of the State Highway is not entirely optional, as certain mandates of the State Highway Act must be followed. The act makes the following provision as to routes: "The route or routes of said State Highways shall be selected by the department of engineering and said route shall be so selected and said highways so laid out and constructed or acquired as to constitute a continuous and connected State Highway system running north and south through the state traversing the Sacramento and San Joaquin valleys and along the Pacific coast by the most direct and practicable routes, connecting the county seats of the several counties through which it passes and joining the centers of population, together with such branch roads as may be necessary to connect therewith the several county seats lying east and west of such State Highway."

The routes already established for the State Highway are naturally related first to the system traversing the valleys and along the coast and joining the centers of population. These have all been designated, surveys practically completed and work well advanced, and the Highway Commission is now working on the problem of the best branch roads to connect the county seats not passed through on the main system.

The following figures include surveys only, and do not comprehend mileage through incorporated cities or improved highways in county systems, as in Sacramento, San Joaquin and Los Angeles counties, not yet taken over as part of the State Highway. Hence the mileage given represents State Highway surveys or construction, only, and not the total number of miles between the terminals indicated.

The surveys made to December 15, 1914, aggregate 2,062.84 miles. The work completed or under contract to the same date totals 1,036.3 miles. One hundred and fifty-four layouts have been finished, totaling 1,108.1 miles.

Routes already established and the counties through which they pass are as follows:

**ROUTE 1**, along the Pacific coast north of San Francisco Bay, through Marin, Sonoma, Mendocino, Humboldt, and Del Norte counties. Length, as surveyed, and with surveys ordered, 381.2 miles; completed or under contract, 111.6 miles.

**ROUTE 2**, along the coast south from San Francisco to San Diego, through San Mateo, Santa Clara, San Benito, Monterey, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange and San Diego counties. Length, exclusive of county highway in Los Angeles County, as surveyed 464.6 miles; completed or under construction, 302.3 miles.

**ROUTE 3**, through the Sacramento Valley, from Sacramento to the California-Oregon boundary line, through Sacramento, Placer, Yuba, Sutter, Butte, Tehama, Shasta and Siskiyou counties. Length, as surveyed, 277.6 miles; completed or under construction, 158.5 miles.

**ROUTE 4**, through the San Joaquin Valley, from Sacramento to Los Angeles, through Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Tulare, Kern and Los Angeles counties. Length, as surveyed, 270.8 miles; completed or under construction, 211.1 miles.

**ROUTE 5**, from the San Joaquin Valley system to Santa Cruz via Oakland and San Jose. Length as surveyed, 92.2 miles; completed or under construction, 55.7 miles.

**ROUTE 6**, from Sacramento across the Yolo by-pass to a connection with route 7 near Davis. Length, as surveyed, 14.5 miles; under contract, 3.1 miles.

**ROUTE 7**, from Tehama Junction to Benicia, connecting the county seats of Glenn, Colusa, Yolo and Solano counties. Length, as surveyed, 151.3 miles; under construction, 93.7 miles.

**ROUTE 8**, from a connection with Route 1 near Ignacio to a connection with Route 7 either at Benicia or Cordelia, via Napa, through Marin, Sonoma and Napa counties. Length, as surveyed, 26.2 miles; under construction, 4.5 miles.

**ROUTE 9**, connecting San Bernardino with the main highway system, through Los Angeles and San Bernardino counties. Length, as surveyed, 31.8 miles; completed or under construction, 17.9 miles.

**ROUTE 10**, connecting Hanford with the main route and running to Visalia. Length, as surveyed, 18.5 miles.

**ROUTE 11**, connecting Placerville with the main route at Sacramento. Length, as surveyed, 29.1 miles; completed or under construction, 18.7 miles.

**ROUTE 12**, connecting El Centro with the main system at San Diego and running through Imperial and San Diego counties. Length, as far as surveys are completed, 102.5 miles; under construction, 21.4 miles.

**ROUTE 13**, connecting Sonora with the main system in the San Joaquin Valley through Stanislaus and Tuolumne counties. Length, as surveyed, 49.5 miles; under construction, 10.9 miles.

**ROUTE 14**, in Contra Costa County. Length, as surveyed, 20.8 miles; under construction, 10.6 miles.

**ROUTE 15**, connecting Colusa with Route 7 at Williams. Length, 8.5 miles.

**ROUTE 16**, connecting Lakeport with Route 1 at Hopland. Reconnaissance made.

**ROUTE 17**, connecting Auburn with the main road in the Sacramento Valley. Length, as surveyed, 15.6 miles.

**ROUTE 18**, connecting Mariposa with the main system in the San Joaquin Valley at Merced. Surveys in progress. Approximate length, 33.9 miles.

**ROUTE 19**, connecting Riverside with the main system at Los Angeles. Length, as surveyed, 16.9 miles; completed or under construction, 16.3 miles.

**ROUTE 20**, connecting Weaverville with the main system at Redding. Length, as surveyed, 47.9 miles.

**ROUTE 21**, from Richvale to Oroville, in Butte County. Length, as surveyed, 8.7 miles.

## Progress of Construction

The following progress record gives the situation in each county of California as indicated, the percentage of work completed, mileage of the sections, status of surveys or other completed work, and awards and progress of construction:

Routes under way are located in the counties as follows, the figures in parentheses indicating the divisions: Alameda (Division IV), route 5; Alpine (III), Amador (III), Butte (III), 3 and 21; Calaveras (III), Colusa (III), 7 and 15; Contra Costa (IV), 14; Del Norte (I), 1; El Dorado (III), 11; Fresno (VI), 4; Glenn (III), 7; Humboldt (I), 1; Imperial (VII), 12; Inyo (VI); Kern (VI), 4; Kings (VI), 10; Lake (I), 16; Lassen (II); Los Angeles (VII), 2, 4 and 9; Madera (VI), 4; Marin (IV), 1; Mariposa (VI), 18; Mendocino (I), 1 and 16; Merced (VI), 4 and 18; Modoc (I); Mono (VI); Monterey (V), 2; Napa (IV); Nevada (III), 17; Orange (VII), 2; Placer (III), 3 and 17; Plumas (III); Riverside (VII), 19; Sacramento (III), 3, 4 and 11; San Benito (V), 2; San Bernardino (VII), 9 and 19; San Diego (VII), 2 and 12; San Francisco (IV), touched by 2 and within ferry reach of 1, 5, 7 and 14; San Joaquin (III), 4 and 5; San Luis Obispo (V), 2; San Mateo (IV), 2; Santa Barbara (V), 2; Santa Clara (IV), 2 and 5; Santa Cruz (IV), 5; Shasta (II), 3 and 20; Sierra (III); Siskiyou (II), 3; Solano (III), 7; Sonoma (IV), 1; Stanislaus (III), 4 and 13; Sutter (III), 3; Tehama (II), 3 and 7; Trinity (II), 20; Tulare (VI), 4 and 10; Tuolumne (III), 13; Ventura (VII), 2; Yolo (III), 6 and 7; Yuba (III), 3.

### ALAMEDA COUNTY.

#### Division IV, Route 5.

**SECTION A**, from the east boundary of the county to Livermore (IV—Ala.—5—A): length, 14.6 miles.

**A<sub>1</sub>**, laid out as State Highway July 7, 1914. Contract (No. 90) awarded Aug. 11, 1914, to Parrott Bros. Co. Length, 5 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$42,525; per mile, \$8,548. Amount of contract completed to Dec. 12, 1914, 40.4 per cent.

**A<sub>2</sub>**, laid out as State Highway Aug. 26, 1914. Contract (No. 108) awarded Oct. 6, 1914, to Palmer & McBryde. Length 5.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$65,190; per mile, \$11,090. Amount of contract completed to Dec. 12, 1914, 25.2 per cent. Surveys completed, and plans in progress for remainder of the section.

**SECTION B**, from Livermore to Hayward (IV—Ala.—5—B): Surveys completed. Plans in progress. Length 17.7 miles.

**SECTION C**, from Hayward to south boundary of the county (IV—Ala.—C): Surveys completed. Length 17.5 miles.

**C<sub>1</sub>**, from Hayward to Valle Vista school; laid out as State Highway March 25, 1914. Contract (No. 61) awarded April 22, 1914, to Tieslau Brothers. Length, 3.1 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$38,503; per mile, \$12,340. Amount of contract completed to Nov. 15, 1914, 96.2 per cent.

**C<sub>2</sub>**, laid out as State Highway March 25, 1914. Length, 4.4 miles. Pavement, oiled concrete 18 feet wide. Now being constructed by the state by day labor (No. D7).

**C<sub>3</sub>**, laid out as State Highway Dec. 8, 1914. Length, 1.83 miles. Pavement, oiled concrete 18 feet wide. To be constructed by the state by day labor (No. D7). Plans and estimates for the remainder of the section are in progress.

**SECTION D**, from Oakland to Hayward (IV—Ala.—5—D): Laid out as State Highway March 25, 1914. Contract (No. 62) awarded April 22, 1914, to Ransome-Crummey Co. Length, 5.1 miles. Pavement, asphalt on concrete and macadam, 24 feet wide. Probable total cost, \$56,955; per mile, \$11,256. Work completed.

### ALPINE COUNTY.

The Highway Commissioners have made a personal study of the possible routes to connect Markleville with the trunk line, and on Sept. 22, 1914, directed the Highway Engineer to order such reconnaissances to be made as are necessary in advance of the construction surveys.

### AMADOR COUNTY.

The Highway Commissioners have made a personal study of the possible routes to connect Jackson with the trunk line, and on Sept. 22, 1914, directed the Highway Engineer to order such reconnaissances to be made as are necessary in advance of the construction surveys.

### BUTTE COUNTY.

#### Division III, Route 3.

**SECTION A**, from the south county line to Biggs (III—But.—3—A): Surveys completed. Plans and estimates in progress. Length, 7.4 miles.

SECTION B, from Biggs to Nelson (III—But.—3-B): Surveys completed. Plans and estimates in progress. Length, 10.1 miles.

SECTION C, from Nelson to Chico (III—But.—3-C): Surveys, plans and estimates completed. Length, 12.5 miles.

SECTION D, from Chico to the north boundary (III—But.—3-D): Laid out as State Highway October 22, 1912. Bids received Nov. 18, 1912. Contract (No. 70) awarded June 9, 1914, to P. L. Burr. Length, 11.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$109,690; per mile, \$9,740. Amount of contract completed on Nov. 28, 1914, 44 per cent.

#### Route 21.

SECTION A, from Richvale to Oroville (III—But.—21-A): Surveys completed. Length, 8.7 miles.

### CALAVERAS COUNTY.

The Highway Commissioners have made a personal study of the possible routes connecting San Andreas with the trunk line, and on Sept. 22, 1914, voted to instruct the Highway Engineer to order such reconnaissances made as are necessary in advance of the construction surveys.

### COLUSA COUNTY.

#### Division III, Route 7.

SECTION A, from the south boundary to Berlin (III—Col.—7-A): Laid out as State Highway May 27, 1914. Contract (No. 80) awarded June 23, 1914, to C. L. Schaad. Length, 10.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,550; per mile, \$10,030. Amount of contract completed to Dec. 12, 1914, 45.9 per cent.

SECTION B, from Berlin to Colusa Junction (III—Col.—7-B): Laid out as State Highway July 21, 1914. Contract (No. 99) awarded Sept. 10, 1914, to C. L. Schaad. Length, 12.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$130,050; per mile, \$10,320. Amount of contract completed to Dec. 12, 1914, 16.6 per cent.

SECTION C, from Colusa Junction to the north boundary (III—Col.—7-C): Surveys completed. Plans in progress. Length, 10.7 miles.

#### Route 15.

SECTION A, from Williams to Colusa (III—Col.—15-A): Laid out as State Highway Oct. 6, 1914. Length, 8.4 miles. Pavements, oiled concrete, 15 feet wide. Contract (No. 117) awarded Dec. 22, 1914, to C. W. Cross. Probable total cost, \$97,190; per mile, \$11,570.

### CONTRA COSTA COUNTY.

#### Division IV, Route 14.

SECTION A, from the south boundary to Pinole (IV—C.C.—14-A): Length, 7.9 miles. Surveys completed.

A<sub>1</sub>, laid out as State Highway July 7, 1914. Contract (No. 91) awarded Aug. 11, 1914, to James H. Falconer. Length, 3.6 miles. Road to be graded 21 feet wide. Probable total cost, \$15,970; per mile, \$4,450. Contract completed.

Plans in progress for remainder of the section.

SECTION B, from Pinole to Martinez (IV—C.C.—14-B). Length, 12.9 miles.

B<sub>1</sub>, laid out as State Highway Aug. 11, 1914. Contract (No. 103) awarded Sept. 22, 1914, to Bates, Borland & Ayer. Length, 7 miles. Road to be graded 21 feet wide. Probable total cost, \$47,350; per mile, \$6,770. Amount of contract completed to Nov. 15, 1914, 26.6 per cent.

Surveys, plans and estimates completed for remainder of the section.

### DEL NORTE COUNTY.

#### Division I, Route 1.

SECTIONS A and B, from south boundary of Del Norte County to Crescent City (I—D.N.—1-A): Surveys ordered. Length, 31.7 miles.

### EL DORADO COUNTY.

#### Division III, Route 11.

SECTION A, from the west boundary to Shingle Springs (III—E.D.—11-A): Surveys completed. Plans in progress. Length, 10.4 miles.

SECTION B, from Shingle Springs to El Dorado (III—E.D.—11-B): Laid out as State Highway May 21, 1913. Bids received and rejected June 30, 1913. Now being constructed by the state with day labor (No. D2). Length, 5.3 miles. Pavement, waterbound macadam, 12 feet wide. Probable total cost, \$25,610; per mile, \$4,860. Work is 95 per cent completed.

SECTION C, from El Dorado to Placerville (III—E.D.—11-C): Laid out as State Highway, Jan. 21, 1914. Bids received and rejected March 30, 1914. Now being constructed by the state with day labor (No. D5). Length, 6.6 miles. Pavement, oiled concrete 12 feet wide. Probable total cost, \$61,220; per mile, \$9,320. Work is 96.4 per cent completed.

### FRESNO COUNTY.

#### Division VI, Route 4.

SECTION A, from the south boundary to Fowler (VI—Fre.—4-A): Laid out as State Highway Oct. 29, 1913. Contract (No. 48) awarded Nov. 21, 1913, to A. Teichert & Son. Length, 8.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$64,950; per mile, \$7,915. Amount of contract completed to Dec. 12, 1914, 93.3 per cent.

SECTION B, from Fowler to Fresno (VI—Fre.—4-B): Laid out as State Highway Oct. 29, 1913. Contract (No. 47) awarded Nov. 21, 1913, to A. Teichert & Son. Length, 8.0 miles. Pavement, oiled concrete, 20 feet wide. Probable total cost, \$67,335; per mile, \$8,420. Contract completed.

SECTION C, from Fresno to Fresno-Madera county line (VI—Fre.—4-C): Laid out as State Highway July 23, 1912. Contract (No. 8) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,546; per mile, \$7,065. Contract completed.

### GLENN COUNTY.

#### Division III, Route 7.

SECTION A, from the south boundary line to Willows (III—Gle.—7-A): Laid out as State Highway Aug. 11, 1914. Contract (No. 113) awarded Nov. 24, 1914, to C. W. Cross. Length, 8.6 miles. Pavement, oiled concrete 15 feet wide.

SECTION B, from Willows to Grapit (III—Gle.—7-B): Surveys completed. Plans in progress. Length, 10.0 miles.

SECTION C, from Grapit to the north boundary line (III—Gle.—7-C): Laid out as State Highway April 22, 1914. Contract (No. 77) awarded June 9, 1914, to P. H. Hoare. Length, 6.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$60,550; per mile, \$8,640. Amount of contract completed to Nov. 28, 1914, 98.8 per cent.

### HUMBOLDT COUNTY.

#### Division I, Route 1.

SECTION A, from the south boundary to Garberville (I—Hum.—1-A): Survey completed. Length, 10.3 miles.

A<sub>1</sub>, laid out as State Highway, Sept. 24, 1913. Contract (No. 44) awarded Oct. 29, 1913, to Fairbanks & Baechtel. Length, 5.5 miles. Road to be graded 18 feet wide. Probable total cost, \$56,360; per mile, \$10,270. Contract completed.

A<sub>2</sub>, laid out as State Highway March 25, 1914. Contract (No. 60) awarded April 22, 1914, to Berry, Mackie & Co. Length, 4.6 miles. Road to be graded 18 feet wide. Probable total cost, \$52,535; per mile, \$11,470. Contract completed.

SECTION B, from Garberville to Miranda (I—Hum.—1-B): Surveys, plans and estimates completed. Length, 15.7 miles.

SECTION C, from Miranda to Dyerville (I—Hum.—1-C): Laid out as State Highway July 7, 1914. Contract (No. 93) awarded Aug. 11, 1914, to Fairbanks & Baechtel. Length, 13.8 miles. Road to be graded 18 feet wide. Probable total cost, \$163,860; per mile, \$11,900. Amount of contract completed to Dec. 12, 1914, 15.8 per cent.

SECTION D, from Dyerville to opposite Elinor (I—Hum.—1-D): Length, 11.3 miles.

D<sub>1</sub>, laid out as State Highway May 27, 1914. Contract (No. 71) awarded June 9, 1914, to Smith & Connors. Length, 7.5 miles. Road to be graded 18 feet wide. Probable total cost, \$87,850; per mile, \$11,730. Work practically completed.

D<sub>2</sub>, laid out as State Highway July 7, 1914. Contract (No. 104) awarded Oct. 6, 1914, to William Crowley and T. E. Cloney. Length, 3.7 miles. Road to be graded 18 feet wide. Probable total cost, \$38,880; per mile, \$10,500. Amount of contract completed to Dec. 12, 1914, 8.6 per cent.

SECTION E, from opposite Elinor to Rio Dell (I—Hum.—1-E): Surveys completed. Plans in progress. Length, 10 miles.

SECTION F, from Rio Dell to Fortuna (I—Hum.—1-F): Surveys completed. Plans in progress. Length, 8 miles.

SECTION G, from Fortuna to Eureka (I—Hum.—1-G): Length, 18 miles.

G<sub>1</sub>, laid out as State Highway Aug. 26, 1914. Contract (No. 105) awarded Oct. 6, 1914, to Elsemore & Jacobs. Length, 4.3 miles. Road to be graded 24 feet wide. Probable total cost, \$21,825; per mile, \$5,075. Amount of contract completed to Dec. 12, 1914, 34.4 per cent.

Surveys completed and plans in progress for remainder of the section.

SECTION H, from Eureka to Arcata (I—Hum.—1-H): Surveys completed. Length, 12 miles.

SECTION I, from Arcata to Trinidad. Surveys in progress. Length, 15.4 miles.

SECTION J, from Trinidad to Orick. Length, 23.5 miles. Surveys in progress.

SECTION K, from Orick to the county line. Length, 16 miles.

### IMPERIAL COUNTY.

#### Division VII, Route 12.

SECTION A, from the foot of Myers Canyon to Coyote Wells (VII—Imp.—12-A): Laid out as State Highway July 7, 1914. Contract (No. 107) awarded Oct. 6, 1914, to J. W. Calback. Length, 6 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$96,110; per mile, \$15,970. Amount of contract completed to Dec. 12, 1914, 10 per cent.

SECTION B, from Coyote Wells to Dixieland (VII—Imp.—12-B): Laid out as State Highway Oct. 6, 1914. Contract (No. 116) awarded Dec. 8, 1914, to Rice & Dutcher. Length, 11.7 miles. Probable total cost, \$118,250; per mile, \$10,070.

SECTION C, from Dixieland to El Centro (VII—Imp.—12-C): Surveys completed. Plans in progress. Length 12.3 miles.

SECTION D, from the west county line of Imperial County to the foot of Myers Canyon (VII—Imp.—12-D): Surveys ordered. Approximate length 5.5 miles.

### INYO COUNTY.

The Highway Commissioners have made a personal study of the possible routes connecting Independence with the trunk line and on Sept. 22, 1914, voted to instruct the Highway Engineer to order such reconnaissances to be made as are necessary in advance of the construction surveys.

### KERN COUNTY.

#### Division VI, Route 4.

SECTION A, from the south boundary to Grapevine Creek (VI—Ker.—4-A): Laid out as State Highway July 21, 1914. Contract (No. 106) awarded Oct. 6, 1914, to A. C. McLean Construction Company. Length, 10.7 miles. Road to be graded 21 feet wide. Probable total cost, \$74,050; per mile, \$6,940. Amount of contract completed to Dec. 12, 1914, 5.4 per cent.

SECTION B, from Grapevine Creek to Sections 5 and 6, T. 32 S., R. 28 E., M. D. B. and M. (VI—Ker.—4-B): Laid out as State Highway June 23, 1914. Contract (No. 96) awarded Aug. 26, 1914, to Lynn S. Atkinson. Length, 17.3 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$242,595; per mile, \$14,030. Amount of contract completed to Dec. 12, 1914, 11.1 per cent.

SECTION C, from Sections 5 and 6, T. 32 S., R. 28 E., M. D. B. and M. to Bakersfield (VI—Ker.—4-C): Laid out as State Highway May 27, 1914. Contract (No. 67) awarded May 27, 1914, to John D. Marsh. Length, 13.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$139,840; per mile, \$10,770. Amount of contract completed to Dec. 12, 1914, 30.6 per cent.

SECTION D, from Bakersfield to Lerdo (VI—Ker.—4-D): Laid out as State Highway Jan. 21, 1914. Contract (No. 50) awarded Feb. 26, 1914, to Geo. S. Benson & Sons. Length, 10.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$71,210; per mile, \$7,025. Contract completed.

SECTION E, from Lerdo to Famosa (VI—Ker.—4-E): Laid out as State Highway Jan. 21, 1914. Contract (No. 51) awarded Feb. 26, 1914, to Geo. S. Benson & Sons. Length 8.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$56,720; per mile, \$6,340. Amount of contract completed to Dec. 12, 1914, 42 per cent.

SECTION F, from Famosa to the north boundary of Kern County (VI—Ker.—4-F): Laid out as State Highway March 12, 1914. Contract (No. 63) awarded April 22, 1914, to Lynn S. Atkinson. Length, 12.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,340; per mile, \$8,710. Amount of contract completed to Dec. 12, 1914, 98 per cent.

KINGS COUNTY.

Division VI, Route 10.

SECTION A, between Hanford and the east boundary of Kings County (VI—Kin.—10—A): Surveys, plans and estimates complete. Length, 9.28 miles.

LAKE COUNTY.

Division I, Route 16.

SECTION A, from the west boundary of Lake County to Lakeport (I—Lak.—16—A): Reconnoissance made.

LASSEN COUNTY.

The Highway Commissioners have made personal studies of the various routes to be considered in connecting Susanville with the trunk line, and on Sept. 22, 1914, voted to direct the Highway Engineer to order such reconnoissances made by the Division Engineer of Division II as may be necessary in advance of the construction surveys.

LOS ANGELES COUNTY.

Division VII, Route 2.

SECTION A, from County Highway No. 3 to Rancho El Encino (VII—L. A.—2—A): Laid out as State Highway Sept. 25, 1912. Contract (No. 17) awarded Oct. 22, 1912, to Rogers Brothers Co. Length, 6.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$55,127; per mile, \$8,353. Contract completed.

SECTION B, from Rancho El Encino to Calabasas (VII—L. A.—2—B): Laid out as State Highway Feb. 4, 1913. Contract (No. 21) awarded March 4, 1913, to John D. Marsh. Length, 10.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$81,690; per mile, \$8,063. Contract completed.

SECTION C, from Calabasas to the Los Angeles-Ventura county line (VII—L. A.—2—C): Laid out as State Highway April 23, 1913. Contract (No. 33) awarded May 21, 1913, to Gillette, Montgomery & Tracy. Length, 11.3 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$133,290; per mile, \$11,820. Work practically completed.

Remainder in Los Angeles County outside Los Angeles is county highway.

Route 4.

SECTION A, from Saugus to Castaic schoolhouse (VII—L. A.—4—A): Surveys completed. Plans in progress. Length, 8.8 miles.

SECTION B, from Castaic schoolhouse to top of the ridge (VII—L. A.—4—B): Laid out as State Highway Aug. 11, 1914. Contract (No. 101) awarded Sept. 22, 1914, to Mahoney Brothers. Length, 12.8 miles. Road to be graded 21 feet wide. Probable total cost, \$134,860; per mile, \$10,500. Amount of contract completed to Dec. 12, 1914, 13.6 per cent.

SECTION C, from top of the ridge to Liebre Mountain (VII—L. A.—4—C): Laid out as State Highway Nov. 24, 1914. Contract (No. 120) awarded Dec. 22, 1914, to Lee Moor Contracting Co. Length, 14.5 miles. Road to be graded 21 feet wide. Probable total cost, \$303,572.46; per mile, \$20,900.

SECTION D, from Liebre Mountain to the Los Angeles-Kern County line (VII—L. A.—4—D): Laid out as State Highway May 27, 1914. Contract (No. 78) awarded June 9, 1914, to Lee Moor. Length, 12.6 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$201,140; per mile, \$15,940. Amount of contract completed to Dec. 12, 1914, 45.9 per cent.

Route 9.

SECTION A, from San Fernando road to La Canada (VII—L. A.—9—A): Surveys completed. Plans in progress. Length 13.9 miles.

SECTION B, from La Canada to Pasadena (VII—L. A.—9—B): Surveys in progress.

Route 19.

The portion of this route between Los Angeles and Riverside which is in Los Angeles County was constructed by that county and is still county highway.

MADERA COUNTY.

Division VI, Route 4.

SECTION A, from the south boundary of Madera County to the city of Madera (VI—Mad.—4—A): Laid out as State Highway July 23, 1912. Contract (No. 9) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$64,405; per mile, \$6,473. Contract completed.

SECTION B, from Madera to Califa (VI—Mad.—4—B): Laid out as a State Highway May 21, 1912. Contract (No. 3) awarded July 23, 1912, to the Ransome-Crummey Co. Length, 9.9 miles. Pavement, oiled macadam, 15 feet wide. Probable total cost, \$68,890; per mile, \$6,952. Contract completed.

SECTION C, from Califa to the north boundary of Madera County (VI—Mad.—4—C): Laid out as State Highway July 23, 1912. Contract (No. 10) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length 6.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$46,100; per mile, \$6,750. Contract completed.

MARIN COUNTY.

Division IV, Route 1.

SECTION A, from the north boundary of Marin County to the west boundary of San Rafael (IV—Mrn.—1—A): Surveys completed. Plans and estimates in progress. Length, 16.8 miles.

SECTION B, from the west boundary of San Rafael to the ferry slip at Sausalito (IV—Mrn.—1—B): Length, 7.2 miles.

B<sup>1</sup>, laid out as State Highway May 27, 1914. Contract (No. 65) awarded May 27, 1914, to O'Brien Brothers. Length, 6 miles. Road to be graded and part surfaced with gravel. Probable total cost, \$66,380; per mile, \$11,060. Contract completed.

Route 8.

SECTION A, from a junction with Route 1 three-fourths mile north of Ignacio to the east boundary of the county (IV—Mrn.—8—A): Surveys completed. Plans in progress. Length, 3.7 miles.

MARIPOSA COUNTY.

Division VI, Route 18.

SECTION A, from the southwestern county boundary to a point one mile southeast of Cathay postoffice (VI—Mar.—18—A): Length, 9.5 miles. Surveys in progress.

SECTION B, from a point one mile southeast of Cathay postoffice to Mariposa (VI—Mar.—18—B): Preliminary survey completed. Approximate length, 9.5 miles.

MENDOCINO COUNTY.

Division I, Route 1.

SECTION A, from the south boundary of Mendocino County to Hopland (I—Men.—1—A): Laid out as State Highway May 21, 1912. Contract (No. 2) awarded July 23, 1912, to the General Contracting Corporation. Length, 13.2 miles. Road graded 18 feet wide, but not paved. Probable total cost, \$69,448; per mile, \$5,314. Contract completed.

SECTION B, from Hopland to Ukiah (I—Men.—1—B): Laid out as State Highway July 7, 1914. Contract (No. 87) awarded Aug. 11, 1914, to Hard Bros. Length, 12.5 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$107,490; per mile, \$9,420. Amount of contract completed to Dec. 12, 1914, 16.8 per cent.

SECTION C, from Ukiah to Forsythe Creek (I—Men.—1—C): Laid out as State Highway Feb. 4, 1913. Contract (No. 24) awarded March 26, 1913, to D. L. Sawyers and Chas. Whited. Length, 7.6 miles. Road to be waterbound macadam and gravel, 15 feet wide. Probable total cost, \$55,650; per mile, \$7,290. Contract completed.

SECTION D, from Forsythe Creek to Ridgewood (I—Men.—1—D): Surveys completed. Length, 7.9 miles.

D<sub>1</sub> laid out as State Highway Sept. 24, 1913. Length, 7.8 miles. Road to be graded 18 feet wide, but not paved. No. D<sub>4</sub>, 1.25 miles of this layout, graded by the state by day labor; work completed. Probable total cost, \$8,800; per mile, \$7,100.

D<sub>2</sub>, laid out as State Highway Sept. 24, 1913. Contract (No. 57) awarded April 22, 1914, to Hard Brothers. Length, 6.6 miles. Road to be graded 18 feet wide. Probable total cost, \$57,800; per mile, \$8,825. Amount of contract completed to Dec. 12, 1914, 97.2 per cent.

SECTION E, from Ridgewood to Willits (I—Men.—1—E): Laid out as State Highway Oct. 22, 1912. Contract (No. 20) awarded Feb. 4, 1913, to Fairbanks & Baechtel. Length, 6.9 miles. Road graded 18 feet wide. Probable total cost, \$38,855; per mile, \$5,630. Contract completed.

SECTION F, from Willits to Arnold (I—Men.—1—F): Surveys and plans completed. Length, 8.5 miles.

SECTION G, from Arnold to Sherwood-Laytonville Junction (I—Men.—1—G): Surveys and plans completed. Length, 10.4 miles.

SECTION H, from Sherwood-Laytonville Junction to Rattlesnake Summit (I—Men.—1—H): Surveys and plans completed. Length, 14.2 miles.

SECTION I, from Rattlesnake Summit to Little Dan Valley (I—Men.—1—I): Surveys and plans completed. Length 13.6 miles.

SECTION J, from Little Dan Valley to Low Gap (I—Men.—1—J): Surveys completed. Plans in progress. Length, 10.5 miles.

SECTION K, from Low Gap, to the north boundary of Mendocino County (I—Men.—1—K): Surveys completed. Length, 13 miles.

Route 16.

SECTION A, from Hopland to east boundary of Mendocino County (I—Men.—16—A): Reconnoissance made.

MERCED COUNTY.

Division VI, Route 4.

SECTION A, from the south boundary to the City of Merced (VI—Mer.—4—A): Laid out as State Highway Oct. 22, 1912. Contract (No. 69) awarded May 27, 1914, to Taylor & Berliner. Length, 14.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$115,040; per mile, \$8,110. Amount of contract completed to Dec. 12, 1914, 65.1 per cent.

Section B has been combined with Section A.

SECTION C, from Arena to Merced (VI—Mer.—4—C): Laid out as State Highway Aug. 27, 1912. Contract (No. 11) awarded Sept. 29, 1912, to the Worswick Street Paving Co. Length, 10.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$84,710; per mile, \$7,800. Contract completed.

SECTION D, from the north boundary of Merced County to Arena (VI—Mer.—4—D): Laid out as State Highway July 23, 1912. Contract (No. 6) awarded Aug. 27, 1912, to the Worswick Street Paving Company. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$74,780; per mile, \$7,780. Contract completed.

Route 18.

SECTION A, from the city limits of Merced to the easterly county line (VI—Mer.—18—A): Surveys completed. Plans in progress. Length, 14.9 miles.

MODOC COUNTY.

The Highway Commissioners have made personal studies of the possible routes to connect Alturas with the trunk line, and on Sept. 22, 1914, voted to instruct the Highway Engineer to order such reconnoissances to be made as are necessary in advance of the construction surveys.

MONO COUNTY.

The Highway Commissioners have made personal studies of the possible routes to connect Bridgeport with the trunk line, and on Sept. 22, 1914, voted to instruct the Highway Engineer to order such reconnoissances to be made as are necessary in advance of the construction surveys.

MONTEREY COUNTY.

Division V, Route 2.

SECTION A, from the northeast boundary of Monterey County to Salinas (V—Mon.—2—A): Length, 10.45 miles.

A<sub>1</sub>, laid out as State Highway Aug. 27, 1913. Contract (No. 41) awarded Oct. 29, 1913, to E. O. Burge. Length, 4.3 miles. Road to be graded 21 feet wide, not paved. Probable total cost, \$30,828; per mile, \$7,103. Contract completed.

Surveys, plans and estimates have been completed for the remainder of the section.

SECTION B, from Salinas to a point 1,800 feet south of Chualar (V—Mon.—2—B): Surveys, plans and estimates complete. Length, 10.3 miles.

SECTION C, from a point 1,800 feet south of Chualar to Camphora (V—Mon.—2—C): Surveys complete. Plans in progress. Length, 11.0 miles.

SECTION D, from Camphora to Greenfield (V—Mon.—2—D): Surveys completed. Plans in progress. Length, 12.2 miles.

SECTION E, from Greenfield to a point four miles north of King City (V—Mon.—2—E): Laid out as State Highway Oct. 22, 1912. Length, 7.3 miles. Pavement, oiled concrete, 15 feet wide.

SECTION F, from a point 4 miles north of King City to San Lucas (V—Mon.—2—F): Surveys completed. Length, 12.7 miles.

SECTION G, from San Lucas to San Ardo (V—Mon.—2—G): Surveys completed. Plans in progress. Length, 10.8 miles.

SECTION II, from San Ardo to a point  $1\frac{1}{2}$  miles north of Bradley (V—Mon.—2—H): Surveys, plans and estimates complete. Length, 11.0 miles.

SECTION I, from a point  $1\frac{1}{2}$  miles north of Bradley to the south boundary line of Monterey County (V—Mon.—2—I): Surveys completed. Plans in progress. Length, 10.4 miles.

#### NAPA COUNTY.

##### Division IV, Route 8.

SECTION A, from the western boundary of the county to Napa (IV—Nap.—8—A): Surveys and plans completed. Length, 6.5 miles.

A<sub>1</sub>, laid out as State Highway Sept. 22, 1914. Length, 4.5 miles. Pavement, oiled concrete 15 feet wide. Now being constructed by the state by day labor (No. D15). Amount of contract completed to Dec. 12, 1914, 57.4 per cent.

Plans and estimates for remainder of the section are in progress.

SECTION B, from Napa to the county line. Reconnaissance ordered.

#### NEVADA COUNTY.

The Highway Commissioners have made personal studies of the possible routes for connecting Nevada City via Grass Valley with the trunk line, and have directed the Highway Engineer to order the reconnaissances necessary in advance of the construction surveys. Such reconnaissances have been made on two of the possible routes.

#### ORANGE COUNTY.

##### Division VII, Route 2.

SECTION A, from the southern boundary to Galivan (VII—Ora.—2—A): Surveys completed. Length, 15.4 miles.

A<sub>1</sub>, laid out as State Highway Oct. 6, 1914. Now being constructed by the state by day labor (No. D19). Length, 3.6 miles. Road to be graded 21 feet wide.

A<sub>2</sub>, laid out as State Highway Oct. 6, 1914. Contract (No. 119) awarded Dec. 22, 1914, to the M. R. Construction Co., Inc. Length, 5.5 miles. Probable total cost, \$53,710; per mile, \$9,710.

SECTION B, from Galivan to Irvine (VII—Ora.—2—B): Laid out as State Highway July 7, 1914. Contract (No. 97) awarded Aug. 26, 1914, to B. R. Davison Contracting Co. Length, 9.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$94,350; per mile, \$10,070. Amount of contract completed to Nov. 15, 1914, 8.1 per cent.

SECTION C, from Irvine to Santa Ana (VII—Ora.—2—C): Laid out as State Highway July 21, 1914. Contract (No. 98) awarded September 10, 1914, to White & Gaskill. Length, 7.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$54,850; per mile, \$7,410. Amount of contract completed to Dec. 12, 1914, 8.9 per cent.

SECTION D, from Santa Ana to Anaheim (VII—Ora.—2—D): See Section F, following.

SECTION E, from Anaheim to Fullerton (VII—Ora.—2—E): See Section F, following.

SECTION F, from Fullerton to the Los Angeles County boundary (VII—Ora.—2—F): With Sections D and E, laid out as State Highway August 27, 1913. Contract (No. 40) awarded Oct. 29, 1913, to Conner Contracting Co. Length, 11.2 miles. Pavement, Sections D and E, asphalt on concrete; Section F, oiled concrete, 18 feet wide. Probable total cost, \$86,900; per mile, \$7,790. Work completed. Surfacing under separate contracts (Nos. D12, D20 and D23); work completed on Sections D and E.

#### PLACER COUNTY.

##### Division III, Route 3.

SECTION A, from the south boundary line to Lincoln (III—Pla.—3—A): Laid out as State Highway Aug. 27, 1912. Contract (No. 13) awarded September 25, 1912, to Burns, Clark & De Roza. Length, 9.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$83,600; per mile, \$8,430. Contract completed.

SECTION B, from Lincoln to the Placer-Yuba County line (III—Pla.—3—B): Surveys completed. Plans and estimates in progress. Length, 9.4 miles.

##### Route 17.

SECTION A, from Roseville to Penryn (III—Pla.—17—A): Surveys completed. Length, 9.1 miles.

SECTION B, from Penryn to Auburn (III—Pla.—17—B): Surveys completed. Length, 6.5 miles.

#### PLUMAS COUNTY.

The Highway Commissioners have made personal studies of possible routes connecting Quincy with the trunk line, and on Sept. 22, 1914, voted instructions to the Highway Engineer to order such reconnaissances as are necessary in advance of the construction surveys.

#### RIVERSIDE COUNTY.

##### Division VII, Route 19.

SECTION A, from the Riverside-San Bernardino County line to Riverside (VII—Riv.—19—A): Laid out as State Highway Sept. 24, 1913. Contract (No. 43) awarded Oct. 29, 1913, to the M. R. Company, Inc. Length, 10.3 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$59,175; per mile, \$6,340. Contract completed.

#### SACRAMENTO COUNTY.

##### Division III, Route 3.

SECTION A, from the Auburn road to the north boundary line of Sacramento County (III—Sac.—3—A): Laid out as State Highway Aug. 27, 1912. Contract (No. 12) awarded Sept. 25, 1912, to Burns, Clark & De Roza. Length, 1.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost \$15,057; per mile, \$8,183. Contract completed.

##### Route 4.

The portion of Route 4 in Sacramento County was constructed by the county and is still county highway.

##### Route 11.

SECTION A, from Folsom to the east boundary of the county (III—Sac.—11—A): Laid out as State Highway Aug. 11, 1914. Contract (No. 112) awarded Nov. 10, 1914, to A. W. and C. H. Gorrill. Length, 6.8 miles. Pavement, oiled concrete, 12 feet wide. Probable total cost, \$65,065; per mile, \$9,560.

#### SAN BENITO COUNTY.

##### Division V, Route 2.

SECTION A, from the north boundary to the southwest boundary of the county through San Juan Bautista (V—S. Bt.—2—A): Survey and plans completed. Length, 9.2 miles.

A<sub>1</sub>, laid out as State Highway Aug. 27, 1913. Contract (No. 42) awarded Oct. 29, 1913, to E. O. Burge. Length, 4.2 miles. Road graded 21 feet wide, not paved. Probable total cost, \$27,650; per mile, \$6,550. Contract completed.

A<sub>2</sub>, laid out as State Highway Aug. 27, 1913. Length, 4 miles. Pavement, oiled concrete, 15 feet wide. Bids received July 6, 1914, and rejected. Readvertised, and bids received Aug. 24, 1914, and rejected. Now being constructed by the state by day labor (No. D8). Amount completed to Dec. 12, 1914, 30.5 per cent.

#### SAN BERNARDINO COUNTY.

##### Division VII, Route 9.

SECTION A, from Upland to Citrus Avenue (VII—S. Bd.—9—A): Laid out as State Highway Oct. 29, 1913. Contract (No. 46) awarded Nov. 21, 1913, to Hudson-Johnson Construction Co. Length, 10.4 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$77,270; per mile, \$7,460. Work practically completed.

SECTION B, from Citrus Ave. to Rialto (VII—S. Bd.—9—B): Survey completed. Length, 4 miles. See Section C.

SECTION C, from Rialto to San Bernardino (VII—S. Bd.—9—C): Survey completed. Length, 1.8 miles. Sections B and C laid out as State Highway July 23, 1913. Contract (No. 38) awarded Aug. 11, 1913, to C. J. Flower. Length, 5.8 miles. Pavement, oiled concrete 18 feet wide. Probable total cost, \$45,925; per mile, \$7,880. Work completed.

SECTION D, from the San Bernardino-Los Angeles County line to Upland (VII—S. Bd.—9—D): Laid out as State Highway Jan. 21, 1914. Contract (No. 53) awarded Feb. 26, 1914, to Louis Ferrell. Length, 1.7 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$17,375; per mile, \$10,305. Contract completed.

##### Route 19.

SECTION A, from the San Bernardino-Los Angeles County line to Ontario (VII—S. Bd.—19—A): Survey completed. Length, 2 miles. See Section B.

SECTION B, from Ontario to the San Bernardino-Riverside County line (VII—S. Bd.—19—B): Survey completed. Length, 4.6 miles. Sections A and B laid out as State Highway June 25, 1913. Contract (No. 37) awarded as a whole July 23, 1913, to Bent & Pennebaker. Length, 6.6 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$52,840; per mile, \$7,995. Contract completed.

#### SAN DIEGO COUNTY.

##### Division VII, Route 2.

SECTION A, from the north city limits of San Diego to C Street, Encinitas (VII—S. D.—2—A): Laid out as State Highway July 23, 1912. Contract (No. 7) awarded Aug. 27, 1912, to M. L. Curtis & Co. Length, 8.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$69,157; per mile, \$8,213. Contract completed.

SECTION B, from C Street, Encinitas, to the south city limits of Oceanside (VII—S. D.—2—B): Laid out as State Highway, Oct. 22, 1912. Contract (No. 30) awarded May 21, 1913, to J. M. Montgomery. Length, 10.5 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$82,190; per mile, \$7,870. Work completed.

SECTION C, from the north city limits of Oceanside to the Santa Fe crossing 1 mile north of Las Flores station (VII—S. D.—2—C): Laid out as State Highway July 23, 1913. Contract (No. 39) awarded Sept. 24, 1913, to the C. L. Hyde Construction Co. Length, 8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,775; per mile, \$8,440. Work completed.

SECTION D, from the Santa Fe crossing 1 mile north of Las Flores station to the San Diego-Orange County line (VII—S. D.—2—D): Laid out as State Highway Feb. 26, 1914. Contract (No. 58) awarded April 22, 1914, to W. A. Perry. Length, 11.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,870; per mile, \$9,395. Amount of contract completed to Dec. 12, 1914, 53.7 per cent.

##### Route 12.

SECTION A, from East San Diego to La Mesa (VII—S. D.—12—A): Laid out as State Highway March 25, 1914. Contract (No. 59) awarded April 22, 1914, to C. L. Hyde Construction Co. Length, 2.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$18,590; per mile, \$9,460. Contract completed.

SECTION B, from La Mesa to El Cajon (VII—S. D.—12—B): Laid out as State Highway June 23, 1914. Contract (No. 94) awarded Aug. 26, 1914, to C. L. Hyde Construction Co. Length, 1.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$17,625; per mile, \$11,320. Amount of contract completed to Nov. 15, 1914, 94.6 per cent.

SECTION C, from El Cajon to Alpine (VII—S. D.—12—C): Surveys and plans completed. Length, 14.5 miles.

SECTION D, from Alpine to Pine Valley (VII—S. D.—12—D): Surveys completed. Plans in progress. Length, 16.7 miles.

SECTION E, from Pine Valley to Glencoe school (VII—S. D.—12—E): Surveys completed. Plans in progress. Length, 6.9 miles.

SECTION F, from Glencoe School to Tecate Divide (VII—S. D.—12—F): Surveys completed. Length, 11 miles.

SECTION G, from Tecate Divide to the east boundary of San Diego County (VII—S. D.—12—G): Surveys in progress. Length, 17 miles.

SECTION H, from the east city limits of San Diego to the old east city limits of East San Diego (VII—S. D.—12—H): Surveys and plans completed. Length, 3.5 miles.

#### SAN FRANCISCO COUNTY.

San Francisco is adjacent to Routes 1, 2, 5, 7, 8 and 14, which converge toward that city.

#### SAN JOAQUIN COUNTY.

##### Division III, Routes 4 and 5.

These were constructed by the county and are still county highways.

## SAN LUIS OBISPO COUNTY.

## Division V, Route 2.

SECTION A, from the north boundary of San Luis Obispo County to Paso Robles (V—S. L. O.—2—A): Laid out as State Highway Oct. 29, 1913. Contract (No. 56) awarded Feb. 26, 1914, to W. A. Dontanville. Pavement, oiled concrete, 15 feet wide. Length, 10.6 miles. Probable total cost, \$117,255; per mile, \$11,060. Amount of contract completed to Dec. 12, 1914, 55.2 per cent.

SECTION B, from Paso Robles to a point where Atascadero Creek crosses the Highway west of Atascadero Station (V—S. L. O.—2—B): Laid out as State Highway July 21, 1914. Length, 10 miles. Pavement, oiled concrete 15 feet wide. Bids received Aug. 21, 1914, and rejected. Bids received Oct. 5, 1914. Award pending.

SECTION C, from a point where Atascadero Creek crosses the Highway west of Atascadero Station to Santa Margarita (V—S. L. O.—2—C): Laid out as State Highway Oct. 29, 1913. Contract (No. 55) awarded Feb. 26, 1914, to W. A. Dontanville. Pavement, oiled concrete, 15 feet wide. Length, 8.4 miles. Probable total cost, \$81,630; per mile, \$9,780. Work practically completed.

SECTION D, from Santa Margarita to San Luis Obispo (V—S. L. O.—2—D): Surveys, plans and estimates completed. Length, 10 miles.

D<sub>1</sub>, laid out as State Highway Oct. 22, 1912. Bids received and rejected Nov. 18, 1912. Bids received and rejected June 30, 1913. Work now under construction (No. D3) by the state, using day labor. Length, 6.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$63,970; per mile, \$10,040. Work nearly completed.

D<sub>2</sub>, laid out as State Highway Aug. 26, 1914. Contract (No. 110) awarded Oct. 20, 1914, to Enoch J. Hunt. Length, 3.6 miles. Road to be graded 15 feet wide. Total probable cost, \$53,110; per mile, \$14,710. Amount of contract completed to Dec. 12, 1914, 8.5 per cent.

SECTION E, from San Luis Obispo to Arroyo Grande, via Pismo (V—S. L. O.—2—E): Laid out as State Highway June 20, 1914. Contract (No. 84) awarded July 7, 1914, to Rogers Bros. Co. Length, 13.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$168,235; per mile, \$12,540. Amount of contract completed to Dec. 12, 1914, 56.2 per cent.

SECTION F, from Arroyo Grande to the south boundary line of the county (V—S. L. O.—2—F): Surveys, plans and estimates completed. Length, 12.4 miles.

## SAN MATEO COUNTY.

## Division IV, Route 2.

SECTION A, from the north boundary of San Mateo County to San Mateo City (IV—S. M.—2—A): Length, 10.7 miles.

A<sub>1</sub>, from South San Francisco to Burlingame: Laid out as State Highway May 21, 1912. Contract (No. 1) awarded July 23, 1912, to F. R. Ritchie & Co. Length, 5.4 miles. Sheet asphalt, 24 feet wide, on concrete base. Probable total cost, \$93,004; per mile, \$17,223. Contract completed.

A<sub>2</sub>, from Burlingame to Hillsborough: Laid out as State Highway Oct. 22, 1912. Contract (No. 29) awarded April 23, 1913, to Clark & Henery Construction Co. Length, 0.2 mile. Road 24 feet wide. Asphaltic concrete on Portland cement concrete base. Probable cost, \$5,637; per mile, \$28,184. Contract completed.

A<sub>3</sub>, from the north boundary line of the county to the south line of Daly City: Laid out as State Highway March 26, 1913. Contract (No. 26) awarded April 23, 1913, to Flynn & Treacy. Length, 1.02 miles. Road 24 feet wide. Asphaltic concrete on Portland cement concrete base. Probable total cost, \$20,303; per mile, \$19,866. Contract completed.

A<sub>4</sub>, Cypress Lawn Cemetery to South San Francisco: Laid out as State Highway May 21, 1913. Contract (No. 34) awarded July 3, 1913, to Mahoney Brothers. Length, 2.1 miles. Road to be graded forty feet wide, for future pavement of 24 feet width. Probable total cost of grading, \$27,847; per mile, \$13,260. Contract completed.

A<sub>5</sub>, south line of Daly City to South San Francisco: Laid out as State Highway Feb. 26, 1914. Contract (No. 54) awarded Feb. 26, 1914, to Bates, Borland & Ayer. Length, 4 miles. Road to be asphalt surface on concrete base, 24 feet wide. Probable total cost, \$85,815; per mile, \$21,220. Contract completed.

SECTION B, from San Mateo City to the south boundary of the county (IV—S. M.—2—B): Surveys and plans completed. Length, 9.4 miles.

B<sub>1</sub>, Redwood City to south boundary of county: Laid out as State Highway Oct. 22, 1912. Contract (No. 22) awarded March 26, 1913, to S. P. Doyle. Length, 3.3 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$50,990; per mile, \$15,450. Contract completed.

B<sub>2</sub>, San Mateo to Beresford: Laid out as State Highway March 26, 1913. Contract (No. 27) awarded April 23, 1913, to Raisch Improvement Co. Length, 1.8 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$28,245; per mile, \$15,690. Contract completed.

B<sub>3</sub>, at San Francisquito Creek: Laid out as State Highway Jan. 21, 1914. Constructed by the state by day labor (No. D9). Asphalt on macadam, 20 feet wide. Length, 0.2 mile. Work completed.

## SANTA BARBARA COUNTY.

## Division V, Route 2.

SECTION A, from the north boundary of the county to a point 1 mile north of Bicknell (V—S. B.—2—A): Length, 10.6 miles.

A<sub>1</sub>, laid out as State Highway June 23, 1914. Contract (No. 95) awarded Aug. 26, 1914, to Arthur S. Bent Construction Co. Length, 6.5 miles. Pavement, asphalt on concrete, 15 feet wide. Probable total cost, \$92,820; per mile, \$14,330. Amount of contract completed to Dec. 12, 1914, 23.8 per cent.

A<sub>2</sub>, laid out as State Highway July 21, 1914. Length, 3.6 miles. Pavement, oiled concrete, 15 feet wide. Bids received Aug. 31, 1914, and rejected. Bids received Oct. 5, 1914; award pending.

SECTION B, from a point 1 mile north of Bicknell to Los Alamos (V—S. B.—2—B): Laid out as State Highway May 21, 1913. Contract (No. 36) awarded July 3, 1913, to Mayer & Lewis. Length, 11.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$125,810; per mile, \$10,585. Amount of contract completed to Dec. 12, 1914, 59 per cent.

SECTION C, from Los Alamos to Zaca Station (V—S. B.—2—C): Laid out as State Highway Aug. 26, 1914. Length, 8.7 miles. Pavement, oiled concrete, 15 feet wide. Bids received Oct. 5, 1914; award pending.

SECTION D, from Zaca Station to Gaviota Pass (V—S. B.—2—D): Surveys completed. Plans in progress. Length, 11.9 miles.

SECTION E, from Gaviota Pass to Alcatraz schoolhouse (V—S. B.—2—E): Surveys completed. Length, 8.3 miles.

E<sub>1</sub>, laid out as State Highway Aug. 11, 1914. Contract (No. 115) awarded Dec. 8, 1914, to J. W. Calback. Length, 4.9 miles. Pavement, oiled concrete, 15 feet wide. Total probable cost, \$94,220; per mile, \$19,220.

Plans in progress on remainder of the section.

SECTION F, from Alcatraz schoolhouse to El Capitan crossing (V—S. B.—2—F): Laid out as State Highway July 7, 1914. Contract (No. 92) awarded Aug. 11, 1914, to T. K. Beard. Length, 9.3 miles. Road to be graded, 21 feet wide. Probable total cost, \$94,220; per mile, \$10,120. Amount of contract completed to Dec. 12, 1914, 25.8 per cent.

SECTION G, from El Capitan crossing to Stony Creek (V—S. B.—2—G): Surveys completed. Plans completed. Length, 9.4 miles. See Section I.

SECTION H, from Carpinteria to the south boundary of Santa Barbara County (V—S. B.—2—H): Laid out as State Highway Oct. 29, 1913. Contract (No. 45) awarded Nov. 21, 1913, to Occidental Construction Co. Length, 2.4 miles. Grading, 15 feet wide. Probable total cost, \$17,340; per mile, \$7,380. Contract completed.

SECTION I, from Stony Creek to Glen Anne Canyon road (V—S. B.—2—I): Surveys, plans and estimates completed. Length, 0.8 mile.

SECTIONS G and I laid out as State Highway July 21, 1914. Contract (No. 109) awarded Oct. 6, 1914, to C. H. Hudson. Length, 10.2 miles. Road to be graded 21 to 24 feet wide. Probable total cost, \$89,815; per mile, \$8,800. Amount of contract completed to Nov. 28, 1914, 8.2 per cent.

SECTION J, Serena Gap, from county road to Serena station (V—S. B.—2—J): Laid out as State Highway Dec. 8, 1914. Length, 0.69 mile. Road to be graded 21 feet wide. Constructed by the state by day labor (No. D16); completed.

## SANTA CLARA COUNTY.

## Division IV, Route 2.

SECTION A, from the north boundary of Santa Clara County to San Jose (IV—S. Cl.—2—A): Surveys and plans complete. Length, 15.1 miles.

A<sub>1</sub>, Palo Alto to Stevens Creek bridge: Laid out as State Highway July 23, 1912. Contract (No. 14) awarded Oct. 22, 1912, to City Street Improvement Co. Length, 6.4 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$43,275; per mile, \$6,725. Work completed.

A<sub>2</sub>, Stevens Creek bridge to Saratoga-Lawrence road: Laid out as State Highway July 23, 1912. Contract (No. 15) awarded Oct. 22, 1912, to A. Teichert & Son. Length, 5.5 miles. Pavement, oiled concrete, 20 feet wide. Probable total cost, \$54,294; per mile, \$9,854. Contract completed.

A<sub>3</sub>, Saratoga-Lawrence road to Santa Clara: Laid out as State Highway April 23, 1913. Contract (No. 32) awarded May 21, 1913, to John Doyle. Length, 1.2 miles. Pavement, oiled concrete, 20 feet wide, with broken stone shoulders 5 feet wide. Probable total cost, \$15,168; per mile, \$13,190. Contract completed.

A<sub>4</sub>, from Santa Clara to San Jose (The Alameda): Laid out as State Highway July 7, 1914. Contract (No. 88) awarded Aug. 11, 1914, to Ransome-Crummey Co. Length, 1.9 miles. Pavement, 2 sections, asphalt on concrete, each 12 feet wide with car line between the sections. Probable total cost, \$41,970; per mile, \$21,745. Amount of contract completed to Nov. 15, 1914, 11.5 per cent.

A<sub>5</sub>, at San Francisquito Creek: Laid out as State Highway Jan. 21, 1914. Constructed by the state by day labor (No. D10). Length, 0.08 mile. Pavement, bituminous concrete, 20 feet wide. Work completed.

SECTION B, from San Jose to Morgan Hill (IV—S. Cl.—2—B): Survey and plans completed. Length, 17.3 miles.

B<sub>1</sub>, Edenvale to Morgan Hill: Laid out as State Highway Oct. 22, 1912. Contract (No. 23) awarded March 26, 1913, to Richard Keatinge & Sons. Length, 13 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$87,880; per mile, \$6,785. Contract completed, but not fully paid.

B<sub>2</sub>, San Jose to Edenvale: Laid out as State Highway March 26, 1913. Contract (No. 28) awarded April 23, 1913, to Richard Keatinge & Sons. Length, 4.3 miles. Pavement, oiled concrete, 15 to 20 feet wide. Probable total cost, \$32,400; per mile, \$7,450. Work completed, but not fully paid.

B<sub>3</sub>, San Jose to Mulia: Laid out as State Highway March 26, 1913. Contract (No. 64) awarded April 22, 1914, to John W. McDonald, Jr. Length, 1.8 miles. Asphalt surfacing on portion of Contract No. 28. Probable total cost, \$13,820; per mile, \$7,510. Contract completed.

B<sub>4</sub>, at Morgan Hill: Laid out as State Highway Sept. 22, 1914. To be constructed by the state by day labor (No. D21). Length, 0.4 mile. Pavement, oiled concrete, 15 feet wide.

SECTION C, from Morgan Hill to the south boundary of the county (IV—S. Cl.—2—C): Survey complete. Length, 13.9 miles.

C<sub>1</sub>, Morgan Hill to Gilroy: Laid out as State Highway May 21, 1913. Contract (No. 35) awarded July 3, 1913, to E. O. Burge. Length, 7.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$50,800; per mile, \$6,690. Work practically completed.

C<sub>2</sub>, Gilroy to Sargent: Laid out as State Highway May 27, 1914. Contract (No. 72) awarded June 9, 1914, to H. L. Peterson and A. J. Grier. Length, 6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,560; per mile, \$11,260. Contract practically completed.

C<sub>3</sub>, at Llagas Creek: Laid out as State Highway Jan. 21, 1914. Being constructed by the state by day labor (No. D18). Length, 0.26 miles. Pavement, oiled concrete, 15 feet wide.

## Route 5.

SECTION A, from the north boundary to San Jose (IV—S. Cl.—5—A): Laid out as State Highway July 7, 1914. Contract (No. 89) awarded Aug. 11, 1914, to John W. McDonald, Jr. Length, 6.8 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$73,095; per mile, \$10,770. Amount of contract completed to Dec. 12, 1914, 22.9 per cent.

SECTION B, from San Jose to the south boundary (IV—S. Cl.—5—B): Surveys completed. Length, 14.48 miles.

B<sub>1</sub>, laid out as State Highway Aug. 11, 1914. Contract (No. 102) awarded Sept. 22, 1914, to John A. Marshall. Length, 7.6 miles. Road to be graded 20 feet wide. Probable total cost, \$79,960; per mile, \$10,535. Amount of contract completed to Dec. 12, 1914, 1.9 per cent.

Plans and estimates in progress for the remainder of the section.

## SANTA CRUZ COUNTY.

## Division IV, Route 5.

SECTION A, from the north boundary of Santa Cruz County to the city of Santa Cruz (IV—S. Cr.—5—A): Survey complete. Length, 16.0 miles.

A<sub>1</sub>, from the north boundary of Santa Cruz County to Glenwood. Laid out as State Highway Jan. 21, 1914. Contract (No. 49) awarded Feb. 26, 1914, to

Martin S. Foss and John A. Marshall. Length, 5.7 miles. Road is to be graded 18 feet wide. Probable total cost, \$62,365; per mile, \$10,910. Work practically completed.

A<sub>2</sub>, from Glenwood to Santa Cruz; laid out as State Highway June 23, 1914. Contract (No. 83) awarded July 7, 1914, to Occidental Construction Company. Length, 10.3 miles. Road to be graded 21 feet wide. Probable total cost, \$62,500; per mile, \$6,050. Amount of contract completed to Dec. 12, 1914, 63.9 per cent.

#### SHASTA COUNTY.

##### Division II, Route 3.

SECTION A, from the south boundary of the county to Redding (II—Sha.—3—A): Surveys completed. Plans and estimates in progress. Length, 15.88 miles.

SECTION B, from Redding to Baird (II—Sha.—3—B): Surveys completed. Plans and estimates completed. Length, 18.95 miles.

SECTION C, from Baird to La Moine (II—Sha.—3—C): Surveys completed. Plans and estimates completed. Length, 23.94 miles.

SECTIONS B and C laid out as State Highway June 23, 1914. Contract (No. 85) awarded July 21, 1914, to Palmer & McBryde. Length, 16.2 miles. Road to be graded 16 feet wide. Probable total cost, \$185,000; per mile, \$11,415. Amount of contract completed to Dec. 12, 1914, 36.9 per cent.

SECTION D, from La Moine to the north boundary of the county (II—Sha.—3—D): Surveys completed. Length, 21.4 miles.

D<sub>1</sub>, from La Moine to Hazel Creek: Laid out as State Highway, April 22, 1914. Contract (No. 75) awarded June 9, 1914, to F. Rolandi. Length, 9.9 miles. Road to be graded 16 feet wide. Probable total cost, \$71,370; per mile, \$7,190. Amount of contract completed to Dec. 12, 1914, 74.5 per cent.

Plans and estimates on remaining portion of the section are partially complete.

##### Route 20.

SECTION A, from the west boundary of Shasta County to Stella (II—Sha.—20—A): Surveys in progress. Length, 14 miles.

SECTION B, from Stella to Redding (II—Sha.—20—B): Surveys in progress. Length, 12 miles.

#### SIERRA COUNTY.

The Highway Commissioners have made personal studies of the possible routes to connect Downieville with the other counties, and centers of population of the state, and on Sept. 22, 1914, voted to instruct the Highway Engineer to order such reconnaissances as may be necessary in advance of the construction surveys.

#### SISKIYOU COUNTY.

##### Division II, Route 3.

SECTION A, from the south boundary of the county to Weed (II—Sis.—3—A): Surveys completed. Length, 20.7 miles.

A<sub>1</sub>, laid out as State Highway Aug. 11, 1914. Contract (No. 100) awarded Sept. 22, 1914, to Toohey & Johnson. Length, 16.6 miles. Road to be graded 18 feet wide. Probable total cost, \$74,730; per mile, \$4,500. Amount of contract completed to Nov. 15, 1914, 6.4 per cent.

Plans and estimates on the remainder of the section are completed.

SECTION B, from Weed to Yreka (II—Sis.—3—B): Surveys completed. Plans and estimates in progress. Length, 28.46 miles.

SECTION C, from Yreka to the California-Oregon boundary line. (II—Sis.—3—C): Surveys completed. Length, 26.36 miles.

C<sub>1</sub>, from Hornbrook to the California-Oregon boundary line: Laid out as State Highway April 22, 1914. Contract (No. 66) awarded May 27, 1914, to W. H. Mason and F. T. Fradenburgh. Length, 8 miles. Road to be graded 18 feet wide. Probable total cost, \$35,750; per mile, \$4,450. Amount of contract completed to Nov. 28, 1914, 82.3 per cent.

C<sub>2</sub>, laid out as State Highway Nov. 10, 1914. Contract (No. 118) awarded to E. T. Johnson Dec. 22, 1914. Length, 16.9 miles. Road to be graded 18 and 21 feet wide. Probable total cost, \$108,470; per mile, \$6,410.

#### SOLANO COUNTY.

##### Division III, Route 7.

SECTION A, from Benicia to a point 2½ miles south of Cordelia (III—Sol.—7—A): Laid out as State Highway March 25, 1914. Contract (No. 79) awarded June 9, 1914, to Commary-Peterson Co., Inc. Length, 9.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$102,940; per mile, \$11,375. Amount of contract completed to Dec. 12, 1914, 25.3 per cent.

SECTION B, from a point 2½ miles south of Cordelia to Fairfield (III—Sol.—7—B): Laid out as State Highway Oct. 20, 1914. Contract (No. 114) awarded Nov. 24, 1914, to P. H. Hoare. Length, 8.1 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$77,630; per mile, \$9,630.

SECTION C, from Fairfield to Vacaville (III—Sol.—7—C): Laid out as State Highway May 27, 1914. Contract (No. 74) awarded June 9, 1914, to Commary-Peterson Co., Inc. Length, 8.8 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$89,870; per mile, \$10,215. Amount of contract completed to Nov. 28, 1914, 82.3 per cent.

SECTION D, from Vacaville to a point ¾ mile northeast of Batavia (III—Sol.—7—D): Laid out as State Highway Aug. 11, 1914. Contract (No. 111) awarded Nov. 10, 1914, to P. L. Burr. Length, 8.2 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$80,690; per mile, \$9,875.

SECTION E, from a point ¾ mile northeast of Batavia to the north boundary of the county (III—Sol.—7—E): Surveys completed. Plans in progress. Length, 8.4 miles.

##### Route 8.

SECTION A, reconnaissance ordered.

#### SONOMA COUNTY.

##### Division IV, Route 1.

SECTION A, from the north boundary of the county to the south boundary of Healdsburg (IV—Son.—1—A): Length, 20.8 miles.

A<sub>1</sub>, from the north boundary to Cloverdale: Laid out as State Highway April 22, 1914. Contract (No. 68) awarded May 27, 1914, to Hard Brothers. Length, 4.45 miles. Road to be graded 21 feet wide. Probable total cost, \$43,355; per mile, \$9,740. Amount of contract completed to Dec. 12, 1914, 70.2 per cent.

Surveys completed and plans in progress for the remainder of the section.

SECTION B, from the south boundary of Healdsburg to the north boundary of Santa Rosa (IV—Son.—1—B): Laid out as State Highway Sept. 25, 1912. Contract (No. 16) awarded Oct. 22, 1912, to Richard Keating & Sons. Length, 13.7

miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,760; per mile, \$7,940. Work completed.

SECTION C, from the south boundary of Santa Rosa to the south boundary of Sonoma County (IV—Son.—1—C): Surveys completed. Plans in progress. Length, 18.7 miles.

##### Route 8.

SECTION A, from Petaluma Creek to Sonoma Creek (IV—Son.—8—A): Length, 11.6 miles. Surveys in progress.

SECTION B, from Sonoma Creek to the Napa County line (IV—Son.—8—B): Length, 4.4 miles. Surveys completed. Plans in progress.

#### STANISLAUS COUNTY.

##### Division III, Route 4.

SECTION A, from the south boundary of Stanislaus County to a point 1½ miles north of Ceres (III—Sta.—4—A): Laid out as State Highway July 23, 1912. Contract (No. 5) awarded Aug. 27, 1912, to E. O. Burge. Length, 12 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$89,429; per mile, \$7,428. Contract completed.

SECTION B, from a point 1½ miles north of Ceres to the north boundary of Stanislaus County (III—Sta.—4—B): Laid out as State Highway March 4, 1913. Contract (No. 25) awarded March 26, 1913, to Considine & Bates Co. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,795; per mile, \$7,080. Contract completed.

##### Route 13.

SECTION A, from Salida to Oakdale (III—Sta.—13—A): Surveys completed. Length, 14.4 miles.

SECTION B, from Oakdale to the northeast boundary of Stanislaus County (III—Sta.—13—B): Surveys completed. Length, 12.9 miles.

#### SUTTER COUNTY.

##### Division III, Route 3.

SECTION A, from Yuba City to the Sutter-Butte County line (III—Sut.—3—A): Laid out as State Highway Nov. 10, 1914. Bids received Dec. 14, 1914. Award pending. Pavement, oiled concrete, 15 feet wide.

#### TEHAMA COUNTY.

##### Division II, Route 3.

SECTION A, from the south boundary of Tehama County to Los Molinos (II—Teh.—3—A): Surveys, plans and estimates completed. Bids received July 6, 1914, for construction of Portland cement concrete, and rejected. Length, 10.6 miles.

SECTION B, from Tehama Junction to Red Bluff (II—Teh.—3—B): Surveys completed. Plans and estimates in progress. Length, 10.8 miles.

SECTION C, from Red Bluff to the north boundary of Tehama County (II—Teh.—3—C): Surveys, plans and estimates completed. Length, 14 miles.

##### Route 7.

SECTION A, from the south boundary of Tehama County to a point west of Tehama Junction (II—Teh.—7—A): Surveys completed. Length, 15.3 miles.

A<sub>1</sub>, from the south boundary to Corning: Laid out as State Highway April 22, 1914. Contract (No. 76) awarded June 9, 1914, to Jacinto, Burns & Da Roza. Length, 8.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$84,255; per mile, \$9,585. Amount of contract completed to Dec. 12, 1914, 81.3 per cent.

Plans and estimates on the remaining portion of the section are practically completed.

#### TRINITY COUNTY.

##### Division II, Route 20.

SECTION A, from Weaverville to the Trinity River (II—Tri.—20—A): Surveys in progress. Length, 13 miles.

SECTION B, from the Trinity River to the east boundary of Trinity County (II—Tri.—20—B): Survey ordered. Length, 11 miles.

#### TULARE COUNTY.

##### Division VI, Route 4.

SECTION A, from the south boundary of Tulare County to a point between Pixley and Tipton (VI—Tul.—4—A): Surveys completed and plans in progress. Length, 15.2 miles.

SECTION B, from a point between Pixley and Tipton to Tulare (VI—Tul.—4—B): Surveys completed and plans in progress. Length, 12.7 miles.

SECTION C, from Tulare to Goshen (VI—Tul.—4—C): Surveys completed. Plans and estimates partially completed. Length, 9.3 miles.

C<sub>1</sub>, laid out as State Highway April 22, 1914. Length, 4.3 miles.

No Section D.

SECTION E, from Goshen to the north boundary line of Tulare County (VI—Tul.—4—E): Laid out as State Highway Jan. 21, 1914. Length, 13.7 miles.

##### Route 10.

SECTION A, between Visalia and the west boundary of Tulare County (VI—Tul.—10—A): Surveys, plans and estimates completed. Length, 9.2 miles.

#### TUOLUMNE COUNTY.

##### Division III, Route 13.

SECTION A, from the southwest boundary of Tuolumne County to a point 2 miles north of Keystone (III—Tuo.—13—A): Laid out as State Highway Jan. 21, 1914. Bids received and rejected March 30, 1914. Being constructed by the state by day labor (No. D6). Length, 10.9 miles. Road to be graded 18 feet wide. Probable total cost, \$48,550; per mile, \$4,475. Amount of contract completed to Dec. 12, 1914, 82.2 per cent.

SECTION B, from a point two miles north of Keystone to Sonora (III—Tuo.—13—B): Surveys complete. Plans in progress. Length, 11.3 miles.

#### VENTURA COUNTY.

##### Division VII, Route 2.

SECTION A, from the Ventura-Los Angeles County line to Newbury Park (VII—Ven.—2—A): Laid out as State Highway March 26, 1913. Bids received and rejected, April 21, 1913. Bids received May 19, 1913. Contract (No. 31) awarded May 21, 1913, to Leigh G. Garnsey. Length, 7.3 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$71,525; per mile, \$9,740. Contract completed.

SECTION B, from Newbury Park to Springville (VII—Ven.—2—B): Laid out as State Highway June 23, 1914. Contract (No. 81) awarded July 7, 1914, to Leigh G. Garnsey. Length, 11.1 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$144,750; per mile, \$12,990. Amount of contract completed to Dec. 12, 1914, 35.8 per cent.

SECTION C, from Springville to Ventura (VII—Ven.—2—C): Surveys completed. Plans in progress. Length, 10.2 miles.

SECTIONS D and E, D from Ventura to Padre Juan Canyon, and E from Padre Juan Canyon to Sea Cliff (VII—Ven.—2—D and E): Laid out as State Highway Jan. 21, 1914. Contract (No. 52) awarded Feb. 26, 1914, to Carl Leonhardt. Length, 8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$109,645; per mile, \$13,670. Work practically completed.

SECTION F, from Sea Cliff to Rancho El Rincon (VII—Ven.—2—F): Laid out as State Highway Aug. 27, 1912. Length, 4.4 miles. This section includes a long timber trestle which was taken over by the state. See Section G.

SECTION G, from Rancho El Rincon to the Ventura-Santa Barbara county line (VII—Ven.—2—G): Laid out as State Highway March 25, 1914. Contract (No. 73) awarded for Sections F and G, June 9, 1914, to Modern Construction Co. Length, 5 miles. Pavement, 15 feet wide, oiled concrete, not including the trestle. Probable total cost, \$52,195; per mile, \$10,330. Amount of contract completed to Dec. 12, 1914, 66.4 per cent.

SECTION H, alternate route from foot of Conejo grade to Oxnard, length, 10.1 miles; and SECTION I, alternate route from Oxnard to El Rio. Length, 2.2 miles. Survey completed.

YOLO COUNTY.

Division III, Route 6.

SECTION A, from 2 miles west of Davis to Southern Pacific bridge 81A (III—Yol.—6—A): Surveys completed. Plans in progress. Length, 7.5 miles.

SECTION B, from Southern Pacific bridge 81A to West Sacramento levee (III—

Yol.—6—B): Laid out as State Highway April 22, 1914. Contract (No. 86) awarded July 21, 1914, to the Graff Construction Co. Probable total cost, \$392,810; per mile, \$127,120. Length, 3.1 miles. The road is wooden trestle for about 0.4 mile, and reinforced concrete trestle with draw-span for about 2.7 miles. Amount of contract completed to Nov. 28, 1914, 7.1 per cent.

SECTION C, from West Sacramento levee to the Sacramento River (III—Yol.—6—C): Surveys completed. Plans in progress. Length, 3.9 miles.

Route 7.

SECTION A, from the south boundary to Woodland (III—Yol.—7—A): Laid out as State Highway June 23, 1914. Contract (No. 82) awarded July 7, 1914, to M. Blumenkranz. Length, 11.8 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, \$102,290; per mile, \$8,710. Amount of contract completed to Dec. 12, 1914, 43.1 per cent.

SECTION B, from Woodland to Blacks (III—Yol.—7—B): Surveys completed. Plans in progress. Length, 11.0 miles.

SECTION C, from Blacks to the north boundary of Yolo County (III—Yol.—7—C): Surveys completed. Plans in progress. Length, 11 miles.

YUBA COUNTY.

Division III, Route 3.

SECTION A, from the south boundary line of Yuba County to Morrison's Crossing (III—Yub.—3—A): Laid out as State Highway July 21, 1914. Pavement, oiled concrete 15 feet wide. Length, 3.3 miles. Bids received Aug. 31, 1914, and rejected; further bids will be received.

SECTION B, from Morrison's Crossing to Marysville (III—Yub.—3—B): Laid out as State Highway May 21, 1912. Contract (No. 4) awarded July 23, 1912, to F. E. Frey. Length, 9.2 miles. Pavement, oiled macadam, 15 feet wide. Probable total cost, \$67,688; per mile, \$7,341. Contract completed.

TABLE OF CONTENTS

	Page		Page
Alameda County, progress in .....	17	Offices of Commission .....	24
Alpine County, study of route in .....	4, 17	On the Coast Route, <i>frontispiece</i> .....	1
Amador County, study of route in .....	4, 17	Orange County, progress in .....	20
Asphaltic Concrete .....	A. E. LODER—14	Placer County, progress in .....	20
Building California's State Highway .....	10	Plumas County, study of route in .....	4, 20
Building Mountain Roads, <i>illustration</i> .....	9	Principal Highway Routes, <i>with map</i> .....	24
Building State Highway through Forest, <i>illustration</i> .....	11	<i>Progress Record</i> .....	17-22
Butte County, progress in .....	17	Protecting the Public .....	CHAS. F. STERN—3
Calaveras County, study of route in .....	4, 18	Rincon Road Trestle, <i>illustration</i> .....	16
California Concrete Road, A .....	JAMES B. WOODSON—12	Rights of Way .....	AUSTIN B. FLETCHER—7
California Meeting Oregon, <i>illustrated</i> .....	6	Riverside County, progress in .....	20
Cautionary Signs .....	4	Road Oil Specifications .....	16
Cautionary Signs, <i>illustration</i> .....	15	Roads, lateral .....	4, 6
Colusa County, progress in .....	18	Routes, State Highway .....	17
Completed Roads, <i>illustration</i> .....	5	Sacramento County, progress in .....	20
Contra Costa County, progress in .....	18	Safeguards in Highway Contracts .....	3
Del Norte County, progress in .....	18	San Benito County, progress in .....	20
Division Engineers, list of .....	24	San Bernardino County, progress in .....	20
El Dorado County, progress in .....	18	San Diego County, progress in .....	20
Fresno County, progress in .....	18	San Francisco, State Highway routes touching .....	20
Glenn County, progress in .....	18	San Joaquin County, routes in .....	20
Heads of Departments, Highway Commission .....	24	San Luis Obispo County, progress in .....	21
Humboldt County, progress in .....	18	San Mateo County, progress in .....	21
Imperial County, progress in .....	18	Santa Barbara County, progress in .....	21
Inyo County, study of route in .....	4, 18	Santa Clara County, progress in .....	21
Kern County, progress in .....	18	Santa Cruz County, progress in .....	21
Kings County, progress in .....	19	Savings from Good Roads .....	11
Lake County, progress in .....	19	Seawall on Rincon Route, <i>illustration</i> .....	7
Lassen County, progress in .....	19	Shasta County, progress in .....	22
Lateral Road Problem, The .....	6	Sierra County, study of route in .....	4, 22
Los Angeles County, progress in .....	19	Siskiyou County, progress in .....	22
Madera County, progress in .....	19	Solano County, progress in .....	22
Map .....	24	Sonoma County, progress in .....	22
Marin County, progress in .....	19	Stanislaus County, progress in .....	22
Mariposa County, progress in .....	19	State Highway Progress .....	2, 17
Materials, State Highway .....	6	Studying Mountain Laterals .....	4
Mendocino County, progress in .....	19	Sutter County, progress in .....	22
Merced County, progress in .....	19	Tehama County, progress in .....	22
Modoc County, study of route in .....	4, 19	Temporary Roads .....	22
Mono County, study of route in .....	4, 19	Trinity County, progress in .....	22
Monterey County, progress in .....	19	Tulare County, progress in .....	22
Motor Car Clearance on State Highway, <i>illustration</i> .....	3	Tuolumne County, progress in .....	22
Mountain Road Construction, <i>illustration</i> .....	9	Types of Bridges and Culverts, <i>illustration</i> .....	13
Mountain Roadways .....	2	Ventura County, progress in .....	22
Napa County, progress in .....	20	Yolo County, progress in .....	23
Nevada County, reconnoissances made .....	20	Yuba County, progress in .....	23

STATE OF CALIFORNIA  
DEPARTMENT OF ENGINEERING  
CALIFORNIA HIGHWAY COMMISSION

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NEWELL D. DARLINGTON  
CHARLES F. STERN

Headquarters of the Commission: Forum Building, Sacramento.

AUSTIN B. FLETCHER, Highway Engineer.  
GEORGE R. WINSLOW, First Assistant Highway Engineer.  
LESTER H. GIBSON, Second Assistant Highway Engineer.

WILSON R. ELLIS, Secretary.  
CHARLES C. CARLETON, Attorney.  
H. L. WARREN, Purchasing Agent.  
JOHN H. SMALL, Chief Accountant.  
CLARENCE B. OSBORNE, Geologist.  
GEORGE B. HARRISON, Chief of Right of Way Department.

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DIVISION II. T. A. Bedford, Division Engineer; R. H. Stalnaker, Principal Assistant Engineer; H. S. Comly, Assistant Division Engineer; Dunsmuir.

DIVISION III. W. S. Caruthers, Division Engineer; T. E. Stanton, Jr., Assistant Division Engineer; S. S. Stahl, Assistant Division Engineer; Forum Building, Sacramento.

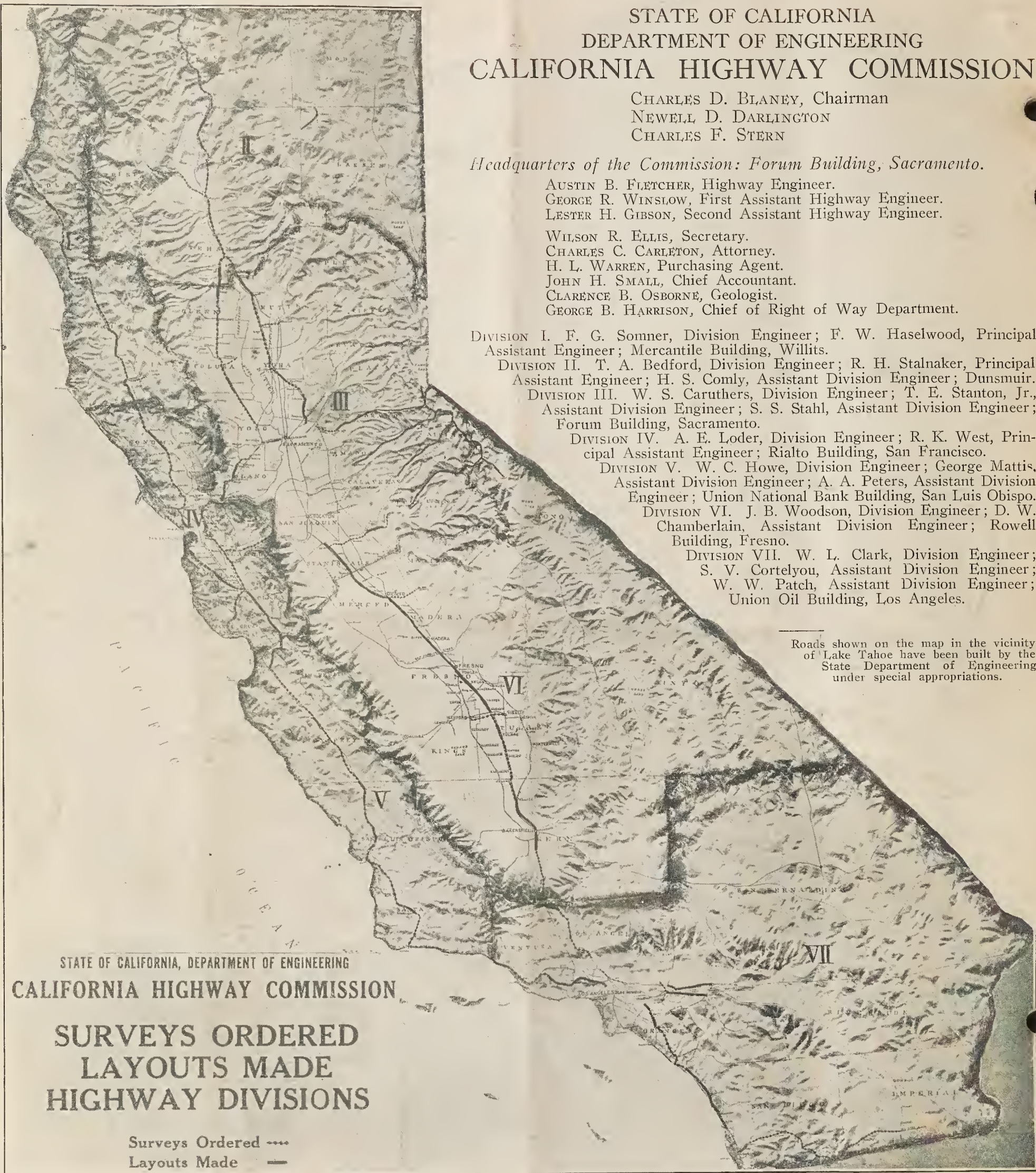
DIVISION IV. A. E. Loder, Division Engineer; R. K. West, Principal Assistant Engineer; Rialto Building, San Francisco.

DIVISION V. W. C. Howe, Division Engineer; George Mattis, Assistant Division Engineer; A. A. Peters, Assistant Division Engineer; Union National Bank Building, San Luis Obispo.

DIVISION VI. J. B. Woodson, Division Engineer; D. W. Chamberlain, Assistant Division Engineer; Rowell Building, Fresno.

DIVISION VII. W. L. Clark, Division Engineer; S. V. Cortelyou, Assistant Division Engineer; W. W. Patch, Assistant Division Engineer; Union Oil Building, Los Angeles.

Roads shown on the map in the vicinity of Lake Tahoe have been built by the State Department of Engineering under special appropriations.



STATE OF CALIFORNIA, DEPARTMENT OF ENGINEERING  
CALIFORNIA HIGHWAY COMMISSION

**SURVEYS ORDERED  
LAYOUTS MADE  
HIGHWAY DIVISIONS**

Surveys Ordered ----  
Layouts Made —

**Principal Highway Routes**

The map shows the main routes in the State Highway system, but does not indicate the laterals on which reconnaissances have been ordered, but which have not as yet been advanced to the point of location surveys or layouts. The details of these routes and the results accomplished are set forth in the Progress Record given in this number of the Highway Bulletin. The map is not as fully corrected as the

Progress Record, but it shows in a general way the routes through the Great Valley and along the coast, and, if taken in connection with the progress details, as arranged by counties, will give a good idea of the results to date in State Highway construction. The division into which the State has been arranged for State Highway work are indicated by the shaded lines. Apparent gaps in Sacramento, San Joaquin, Santa Barbara and Los Angeles counties indicate improved roads already constructed as parts of county systems.