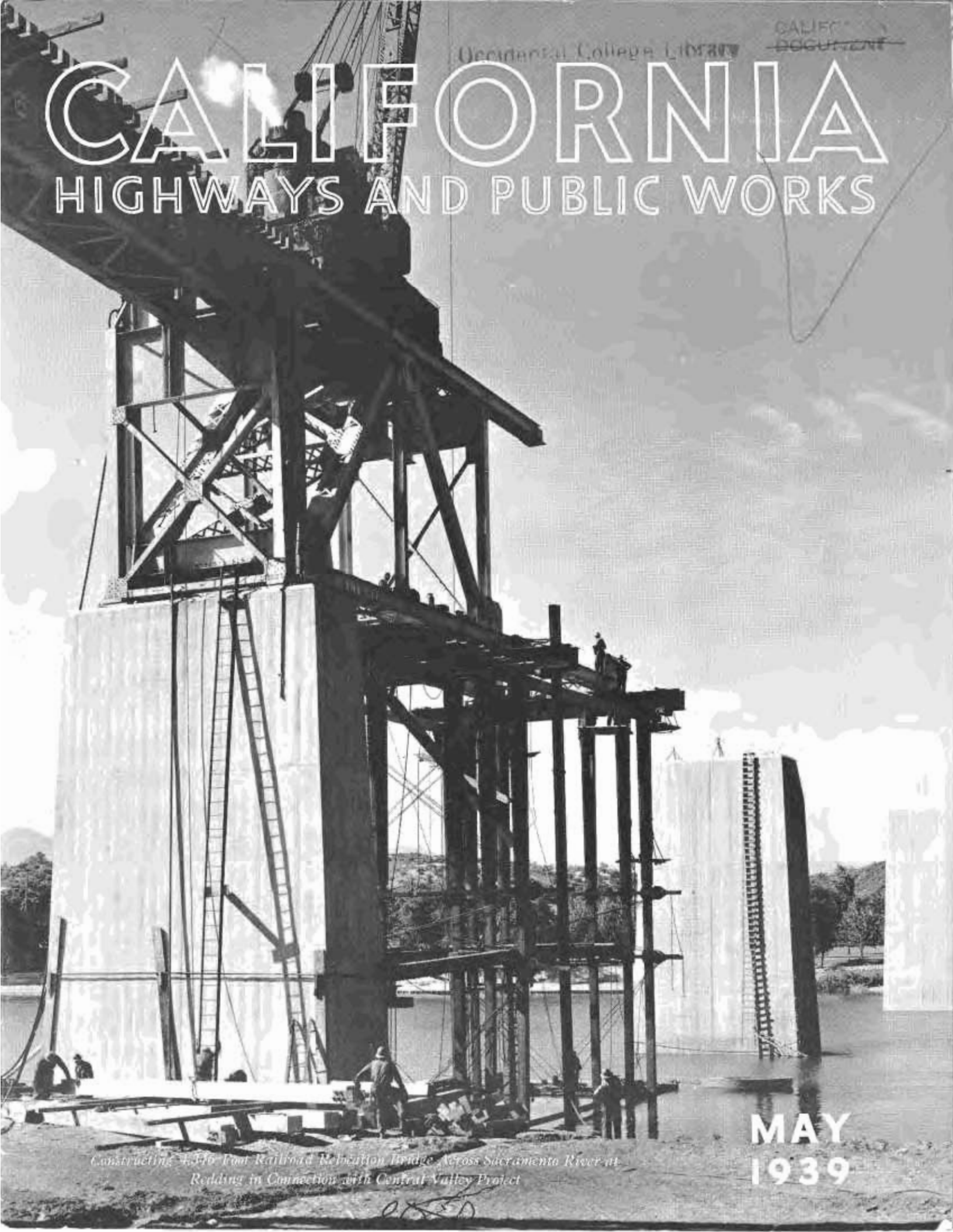


CALIFORNIA

HIGHWAYS AND PUBLIC WORKS



Constructing 4,116-foot Railroad Relocation Bridge Across Sacramento River at Redding in Connection with Central Valley Project

MAY
1939

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

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Water Authority Approves Proposed Legislation for Central Valley Project

UNDER the leadership of Governor Culbert L. Olson the Water Project Authority of the State of California is actively engaged in the consideration of policies and a program to be formulated for the operation of the Central Valley Project by the State, particularly with respect to the disposal and distribution of water and electric power to be made available therefrom. Negotiations are in progress with the Federal Government which is now constructing the main storage and conveyance units of the project under congressional authorization and appropriations, and State legislation has been prepared and introduced at the present session of the Legislature to effect the desired objectives.

The Water Project Authority is the agency created by the Central Valley Project Act of 1933 to administer the Central Valley Project on behalf of the State. Its present membership comprises Frank W. Clark, Director of Public Works, chairman; Phil S. Gibson, Director of Finance; Charles G. Johnson, State Treasurer; Harry B. Riley, State Controller and Earl Warren, Attorney General.

The Executive Officer is Edward Hyatt, State Engineer and Chief of Division of Water Resources of the Department of Public Works. A. D. Edmonston, Deputy State Engineer, is acting secretary. The technical and legal work of the Authority is conducted by the staff of the Division of Water Resources.

INITIATED BY GOVERNOR OLSON

Negotiations with the Federal Government concerning the policies and program for the operation of the Central Valley Project were initiated by Governor Olson in a letter to the Secretary of Interior on February 15, 1939, in which was submitted a proposal that the State through the Water Project Authority enter into a contract with the United States pro-

Water First Says Project Authority

The Water Project Authority adopted the following resolution defining the policy of the board:

WHEREAS, It is the intent of the Central Valley Project Act of 1933 that the Central Valley Project shall be operated primarily for the furnishing of water for the various purposes therein set forth, and secondarily for the generation of electric power; and

WHEREAS, It is necessary that electric power from the project shall carry a major portion of the cost thereof in order that the project may be a sound and economic undertaking;

NOW THEREFORE, BE IT RESOLVED, By the Water Project Authority of the State of California that the works of the Central Valley Project shall be managed and operated, the electric power from the project generated, distributed and disposed of to obtain the maximum revenue therefrom consistent with a reasonable price for electric power and the primary requirements for water, and the revenues from the project applied, to the end that the cost of water to the ultimate consumer shall be fair and reasonable,

BE IT FURTHER RESOLVED, That the Acting Secretary of the Authority is hereby directed to transmit copies of this resolution to the Governor of the State of California and to members of the Legislature.

viding for the Authority to operate and maintain the project upon completion; to repay the reimbursable costs of the project to the United States by revenues from the sale of water and electric power to public and private agencies; to construct with Federal financial assistance an auxiliary steam-electric plant at Antioch and necessary transmission and distribution facilities required for economic disposal of electric power; to direct and assist in the organization of public districts to contract with the Authority for the purchase of water and power; and to assist in the preparation and enactment of necessary enabling legislation to carry out the proposed program.

The Secretary of Interior now has the proposal under consideration. Although the policies and program are yet to be agreed upon with the Federal Government, the Secretary of Interior and the Commissioner of the U. S. Bureau of Reclamation have expressed a desire to cooperate with the State in the operation of the project and disposal of water and power therefrom.

The project will make available on the average over two million acre-feet annually of new water supplies for industrial, municipal and irrigation purposes for use in the Sacramento and San Joaquin valleys, and from one billion to one billion and one-half kilowatt hours of electric energy for use in the market of northern and central California.

The carrying charges of the project including repayment of reimbursable funds advanced by the Federal Government for construction will be met from revenues received from the sale of water and electric power. Provision for disposal and distribution of water and power is essential to the full realization of these revenues.

The project being constructed by the Federal Government makes no provision for the facilities required



FRANK W. CLARK, Director of Public Works, Chairman of Water Authority



PHIL S. GIBSON, Director of Finance, Member of Authority



CHAS. G. JOHNSON, State Treasurer, Member of Authority

for disposal and distribution of water and electric power. These facilities must be provided and be ready for operation when the main units of the project are completed. Furthermore, areas which are to obtain water and electric power from the project, if not already in appropriate districts or State agencies, must be organized into economic units, and must acquire or construct local distribution facilities and make ready for the purchase and use of water and electric power.

Since the Federal Government is not providing for disposal and distribution of water and electric power, it devolves upon the State and the local areas which are to receive the water and power to take the necessary steps to provide the required facilities and organize these agencies. It has been and is still the duty and responsibility of the Water Project Authority in accordance with the Central Valley Project Act of 1933 to see to it that the Central Valley Project is constructed and operated in accordance with its purposes and objectives so that the people served may receive maximum benefits.

Facilities for distribution of water and power and organization of proper agencies in connection therewith are essential to the project and the realization of the purposes and objectives sought. Extensive studies and investigations, engineering, legal, economic and financial, will be required to prepare plans and formulate a program with respect to disposal and distribution of water and power and these should be completed so as to be ready upon the completion of the project now anticipated in 1943.

For the purpose of putting the State in a position to effectively participate in, cooperate with and assist the Federal Government and the people which the project will serve in the realization of the objectives of the project and maximum benefits therefrom, legislation has been introduced and is now pending at the present session of the State Legislature.

PROPOSED LEGISLATION

One of the bills which is deemed of great importance is S. B. No. 1259 which amends the Central Valley Project Act of 1933 in several particulars. The need for these amendments arises from the fact that the existing act does not meet changes



EARL WARREN, Attorney General, Member of Authority



HARRY B. RILEY, Controller, Member of Authority



EDWARD HYATT, State Engineer, Executive Officer of Authority



Progress of excavation at Shasta Dam site is shown in this picture of work on the east side of river. Photo by U. S. Bureau of Reclamation

brought about since 1933 by the approval and adoption of the project as a Federal Reclamation undertaking. The objectives of the proposed amendments to the act are as follows:

1. To remove the present restriction upon the power to issue bonds, which requires that the amount of bonds authorized shall be reduced by such amount as the State or Federal government may "contribute" to the construction of the project, and thus make it possible for the Authority to sell bonds for necessary purposes; and to provide more stringent regulations for the issuance of bonds and safeguarding of funds to improve the marketability of the bonds.

2. To make certain the power of the Authority to extend aid to State agencies in making provision for the use and distribution of water and power.

3. To make certain the power of the Authority to "acquire" the Central Valley Project in whole or in part.

4. To make clear that the Authority may exercise its powers irrespective of the fact that the project

is constructed in whole or in part by the Federal Government.

Another bill of great importance to the project is S. B. No. 246 which authorizes and directs the Division of Water Resources of the State Department of Public Works "to prosecute efforts, on behalf of the Water Project Authority of the State of California, in aid of the construction of the Central Valley Project, including the preparation and formulation of surveys, plans, estimates, and other work, of whatsoever character, which may be required, including cooperation with agencies of the Federal Government," and appropriates \$250,000 for these purposes. The passage of this bill with the appropriation provided therein is considered particularly essential in order that the necessary studies and investigations may be made and plans and program prepared.

The Water Project Authority has unanimously approved these bills and is urging the adoption of both by the

State Legislature in the interest of the project and the people it will serve. It is considered that this legislation is vital to assure that the project will function successfully upon completion in accordance with its purposes and objectives.

The Authority also adopted a resolution declaring its policy with respect to the management and operation of the Central Valley Project (see first page) and another resolution approving Senate Bill No. 339 providing for the organization of mutual electric companies to operate in rural territories.

In addition to the foregoing activities, the Water Project Authority by contract with the Bureau of Reclamation is actively assisting and cooperating with the Bureau on certain important features of the project. Present activities are confined chiefly to investigations, surveys, studies and the preparation of numerous reports relating to the character, extent, lo-

cation, ownership, value and validity of water rights on the San Joaquin River between Friant Dam site and the mouth of the Merced River.

The purpose of these is to supply necessary information to the Bureau of Reclamation as prerequisite to negotiations for acquisition of water rights or the furnishing of substitute supplies in lieu thereof. Plans are also being prepared where necessary for the furnishing of such substitute water supplies. In addition, surveys are being made and maps prepared of topography, soils, ground water supplies, and ownerships covering the lands bordering the San Joaquin River between the mouth of the Merced and the delta.

THIRTY CONTRACTS UNDER WAY

Under the impetus of unusually favorable weather conditions during the past winter and spring months, construction work on the Central Valley Project has steadily forged ahead. Work is progressing under thirty major contracts awarded by the U. S. Bureau of Reclamation, which is in charge of the construction of the project as a Federal Reclamation

undertaking.

Existing contracts covering construction and the furnishing of materials and equipment involve expenditures in excess of \$47,000,000. More than thirty construction firms from sixteen states are engaged on work under these contracts. In addition, several hundred firms from thirty-three states are or have been participating in the furnishing of materials and supplies.

Federal funds made available for the project to date total \$44,600,000 including an additional appropriation of \$10,000,000 made in the Interior Department Appropriation Bill by the present Congress. Actual expenditures on the project are now running at a rate of about \$2,000,000 a month and over \$13,000,000 has been spent thus far.

CONSTRUCTION PROGRESS

About 2400 persons are now engaged in work on the project, including the personnel of the Bureau and employees of the contractors.

The scene of major construction activities is in the vicinity of Redding in Shasta County. Twelve miles

north of Redding on the upper Sacramento River, the chief storage unit of the project—Shasta Dam—is being constructed. This will be the second largest concrete dam in the world, rising 500 feet above present low water stream level. It will create a reservoir with a storage capacity of 4,500,000 acre-feet. A hydroelectric plant will be constructed at the base of the dam with an ultimate installed capacity of 375,000 kva (kilovolt-amperes) in five units, four of which will be installed initially.

The contract for the construction of Shasta Dam and power plant was awarded to Pacific Contractors, Inc., on July 2, 1938, and construction work was started by the contractor on September 8, 1938. Work under the contract is now 21 per cent complete. Excavation is proceeding on both abutments and in the central spillway section and over two-thirds of the total excavation work—2,000,000 cubic yards of earth and rock—has been completed. A temporary river diversion channel has been cut along the east bank of the river.

A by-pass tunnel through the right abutment, 1820 feet in length, to be

This view of Shasta Dam excavation work shows Sacramento River and Southern Pacific tracks which will be relocated.

Photo by U. S. Bureau of Reclamation



used as a temporary route for the Southern Pacific Railroad, is now over 90 per cent complete. It is expected that the railroad will be routed through this tunnel in July and thus permit construction on the dam to proceed without interruption to rail traffic pending the completion of a permanent railroad relocation around the reservoir.

BUILDING RAILROAD RELOCATION

A major piece of supplemental construction work is involved in the building of 30 miles of new railroad to replace 37 miles of the present line of the Southern Pacific Railroad (Shasta Route) in the Sacramento River Canyon, which will have to be abandoned because a large portion thereof will be submerged by the reservoir when the dam is completed. Construction work is now actively under way under contracts awarded covering over 20 miles of road bed grading including four of the twelve tunnels and three of the eight bridges. The grading work under way is now about 25 per cent complete.

One of the main railroad bridges crossing the Sacramento River at Redding is already nearing completion with the substructure 100 per cent complete and the superstructure about 20 per cent complete. Bids have been received for four additional miles of grading and two more bridges, and contracts for these will be awarded shortly.

Three of the railroad bridges remain to be advertised for bids. One of these will be a combination highway and railroad bridge crossing the Pit River Canyon, which, when completed, will be the highest double deck bridge ever built, rising about 470 feet above present stream level and with an overall length of 3300 feet.

In addition to the railroad relocation, fifteen miles of the State highway (U. S. 99) will also have to be relocated around the reservoir. An initial two and one-half mile section of new highway is now being constructed.

Another important activity in connection with the Shasta Dam development is the clearing of the reservoir site which is now actively under way

(Continued on page 23)

Upper picture shows workmen installing steel reinforcement bars on sides and bottom of Contra Costa Canal. Center is photograph of concrete lining machine and finishing racks used on canal and lower picture shows completed section of canal near Antioch.

Photos by U. S. Bureau of Reclamation





Preservation of roadside trees in 29-foot separation strip marks transformation of this section of U. S. 99 north of Modesto from a 2-lane into a 4-lane divided highway.

Four Lane Divided Unit Finished

By C. J. TEMBY, District Office Engineer

THE improvement of another section of California State Highway has provided increased safety for the traveling public. Four miles of the Golden State Highway, Route 4, U.S. Route 99, through Stanislaus County between Modesto and Salida have been constructed to provide a divided four-lane highway. This was accomplished by the construction of a new 23-foot portland cement concrete pavement parallel to and east of the original 20-foot width of pavement.

This section of highway traverses a portion of the Modesto Irrigation District adjacent to the city of Modesto. This area is highly productive and intensely farmed. The transportation of this farm produce, together with through-valley hauling, is reflected in the number of trucks using this highway, which totaled 1915 for the 16-hour count in July, 1938.

The combined traffic on this improved section has increased from a

total of 6042 vehicles per 16-hour count in July, 1932, to a total of 10,935 for a similar count in 1938. A 1-hour count on February 17, 1939, indicates that the volume of traffic represented by the 1938 count is being maintained.

The construction features included the widening to a minimum paved width of 50 feet with portland cement concrete base and plant-mixed surfacing, MC type, the portion of the project within the city of Modesto, and extending about 500 feet northerly to a traffic island where the divided highway separates. From this point to the pavement island at Salida, the newly constructed easterly lane of pavement is a 23-foot width of portland cement concrete. Plant-mix surfacing was used to make the connection to the existing 20-foot width of pavement at Salida, the north end of the project.

The grade of the new pavement deviates from that of the west lane in

being more uniform, although slightly rolling, with a maximum grade under 1 per cent. The greatest variation between elevations of opposite points on the east and west lanes is about 2.2 feet.

The width of the area between the pavement lanes on the divided highway averages about 29 feet; this distance permits the utilization of lines of well-grown trees which bordered the former undivided highway, thus forming a natural separation of aesthetic value.

Irrigation structures include three reinforced concrete bridges, 45, 33, and 45 feet in length. Another bridge crossing an irrigation canal in the city of Modesto was widened to 50 feet by the city, thereby eliminating the last obstruction to a minimum pavement width of 50 feet into the business district. Drainage for the dividing strips, or areas between pave-

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At top—Looking north from Modesto on U. S. 99 showing divisional island at transition from 4-lane undivided to four-lane divided highway. Center—Guard rail construction in separation prevents cross-over traffic except at designated points. Bottom—End of transition segment showing separation strip and trees that bordered roadside of old pavement on right with newly added pavement lanes on left.

Hinged Swing Spans Feature Unique Design of Big Creek Arch Bridge

By H. E. Kuphal, Associate Bridge Engineer

THE completion of a reinforced concrete arch bridge across Big Creek, 40 miles south of Carmel, constituted the last link in a series of structures, inseparable elements of Coast Highway Route 56, between Monterey and San Simeon. Its construction introduced unusual problems in bridge design.

At the site of the crossing Big Creek meanders along the bottom of a deep "U" shaped canyon. Foundation exploration indicated that the steep, sloped canyon walls consisted of a badly fractured shale formation and that underlying the stream were beds of clay, sand and gravel of reasonable bearing value for the bridge foundations. The highway alignment at this location is immediately adjacent to the sea coast and approximately 90 feet above the bed of the stream.

In selecting a structure most suit-

able for this site foundation conditions were of course an important consideration, as was also the locale with its heavy fogs, rains and salt spray laden winds. In fact, the latter consideration ruled against a type of construction suitable for an inland site. Full consideration of these factors lead to the adoption of the reinforced concrete arch as the most suitable type for this location.

The arch structure comprises two main arch spans 177 feet 6 inches long across the canyon, and two tied half arches of 81-foot 6-inch span with 34-foot 6-inch swing spans which vault the canyon walls to the abutments at highway grade. The structure from abutment to abutment has a total overall length of 587 feet and provides a clear roadway width of 24 feet.

A unique feature of this structure involves the function of the swing

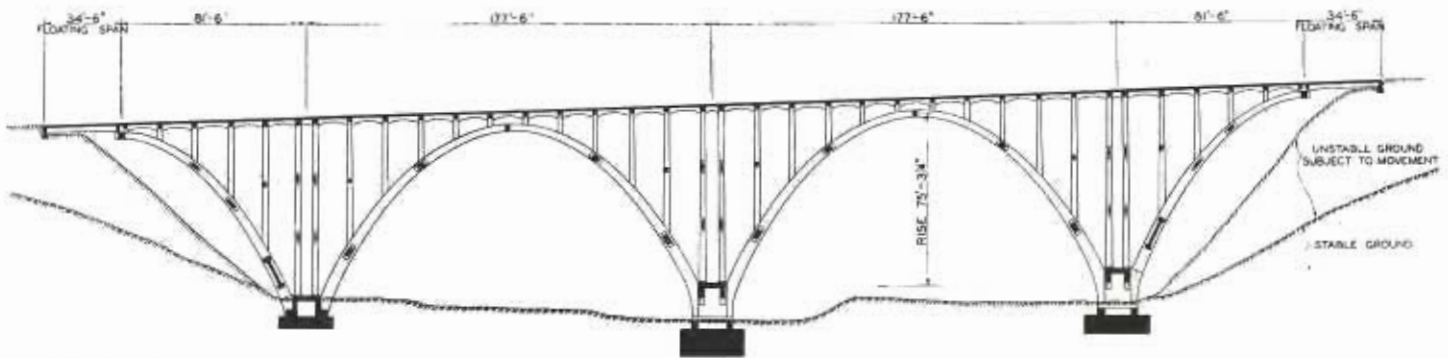
spans which are hinged to the half arches. Foundation conditions at the bridge ends indicated that the design should anticipate settlement of the end abutments. This condition, should it occur, may be readily overcome by virtue of the hinges which permit jacking the swing spans back to grade without detriment to the half arches. In effect any settlement at the abutments is localized and the correction effected with the minimum of expenditure.

The half-arch spans supporting the ends of the swing spans are hinged at the lower end and held in position by means of a steel eyebar tie extending from crown to crown of the half arches. Hinging of the half arches at their bases was indicated to eliminate stresses which would be induced by elongation and contraction of the eyebar tie from temperature change.

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Reinforced concrete arch bridge on San Simeon-Monterey Coast Highway at Big Creek Canyon carrying highway 90 feet above bed of stream.





Big Creek Arch Bridge is a striking feature of one of the most scenic spots on the rugged coast line. Center—Sketch shows location of floating spans at both ends of the bridge. At bottom—Side view of the structure looking seaward from the floor of the wide, deep canyon.



Swing Spans Feature Arch

(Continued from page 8)

As a part of the construction sequence the eyebar ties were erected complete in place and, when under conditions of full dead load, were stressed by means of toggles located at the center pier. This operation released the falsework supporting the half arches and secured the half arches in the designed position against dead load deflection.

Each toggle was operated by a 125-ton hydraulic jack which in a measure indicates the magnitude of the dead load involved. After transfer of the dead load of the half arches to the eyebar ties, the ties were concreted for their full length in the girders of the deck floor system.

At each side of each pier an open joint provided in the deck structure exposed the ties to the action of the elements. For protection at these points the eyebars were wrapped with asphalt impregnated burlap and the whole encased in a copper sleeve.

The three 80-foot columns between the arches were designed as cantilevers fixed at the bottom and proportioned to resist equally any unbalanced live load acting on the half arches in combination with the temperature stress. The column bases were founded on spread footings designed for a maximum bearing load of 5 tons per square foot.

Design of the arch rib, that is, the selection of the curve or shape of the rib as seen in elevation is of prime importance. For certain conditions of loading and span length a rib of circular shape will prove satisfactory. However, where span length is great and loading conditions extreme the designer must resort to a more complex form of curve if the rib is to economically perform its function of delivering the applied dead and live loads to the supporting piers.

The Design Department, after study and investigation, has developed and adopted a curve for long span arch ribs which has the shape of a modified ellipse. This curve or shape which is made up of elliptical segments was used in the design of the main area ribs for the Big Creek structure.

The live loading used in the design comprised either the standard H-15

Plans Advanced for International Pacific Highway

Added impetus to the International Pacific Highway which will eventually link Fairbanks, Alaska, with Buenos Aires, Argentina, was given when highway experts of the United States, Central and South America met at the Third Pan American Highway Congress at Santiago, Chile, recently.

Financial experts at the congress estimated that \$78,308,000 would construct the highway from Mexico City to Panama. This figure was based upon latest technical information applied to surveys initiated by the Pan American Highway Confederation and made jointly by the U. S. Bureau of Public Roads and engineers of Guatemala, Honduras, Nicaragua, Costa Rica and Panama. Engineers of Mexico and El Salvador determined costs for their countries.

A plan is now under way to complete the international highway from Mexico City to the Guatemalan border, a distance of slightly more than 1000 miles. Mexican engineers estimate the cost at \$22,709,000.

The cost of completing the remaining section through Central America was estimated by the committee as follows: Guatemala, \$13,803,000; El Salvador, \$4,293,000; Honduras, \$4,375,000; Nicaragua, \$8,418,000; Costa Rica, \$12,427,000; and Panama, \$12,283,000. The international highway finance committee requested the Central American governments to examine the cost figures and submit their observations before February 1, 1940.

live loading, which consists of one 15-ton truck followed and preceded by 12.5-ton trucks at specified intervals, or one 40-ton shovel, the governing load being that which produced the maximum stress. Maximum design unit stresses for concrete and rein-

(Continued on page 28)

25,000 Miles of 4-Lane Highways Need in 25 Years

IN A PAPER presented at the 18th annual meeting of the Highway Research Board in Washington, D. C., on the sectional layout of multiple-lane highways, Wilbur H. Simonson, Senior Landscape Architect, U. S. Bureau of Public Roads, shows that 95 per cent of the State highway mileage in this country is of the primary two-lane type in which the trends in construction indicate a progressive widening of roadbed surfaces and shoulders, the flattening of crowns and of slopes of shoulders and gutters, as well as the flattening and rounding of cut and fill slopes and increasing right-of-way widths. These trends include a growing emphasis placed on the landscape development of highways.

The remaining 5 per cent of important improved highway mileage is of the multiple-lane type, which may be either undivided or divided in sectional layout. The undivided highway types of three-lane and of four or more lanes are compared with the divided highway type of four or more lanes.

"Three representative construction periods are used: 1932, 1934 and 1936. The projected trends into 1938 and the 1940's furnish a composite picture of current tendencies in the sectional lay-out of tomorrow's multiple-lane highways.

"According to the annual report of the American Association of State Highway Officials, as of July 1, 1937," says Mr. Simonson, "there were at that time 4704 miles of three-lane, 3082 miles of four-lane, and 221 miles of six-lane pavement. In other words, we had a total of about 8007 miles of multiple-lane highways in the United States in 1937.

"Of the 3303 miles of four- and six-lane widths, only 604 miles were divided so that traffic in opposing directions was separated by a raised parkway or median strip. Since the above report was prepared, some additional mileages of multiple-lane highway types have of course been constructed but exact figures are not yet available.

(Continued on page 28)

Sixty-eight Grade Separation Projects Aggregate \$11,000,000

F. W. PANHORST, Bridge Engineer

THE Federal Emergency Relief Appropriation Act of 1935 provided about seven and one-half million dollars to the State of California for elimination of hazards at railroad grade crossings.

This appropriation was followed in 1937 by an allocation of about one-half that amount under the Federal Aid Grade Crossing Appropriation for 1938-1939. Thus, in four years we have had about eleven million dollars of Federal funds for this purpose, and it appears that a brief report of the results accomplished to date would be of interest. For the background of this work an interesting article by Mr. G. T. McCoy, Assistant State Highway Engineer, appeared in the October, 1935, issue of the CALIFORNIA HIGHWAYS AND PUBLIC WORKS.

GRADE SEPARATION PROGRAMS

Briefly the history of the grade separation programs to date is as follows:

In June, 1935, the United States Congress appropriated \$200,000,000 to be expended for the stated purpose of eliminating hazards at grade crossings. The money was allotted to the various States on the basis of railroad mileage within the State, population of the State, and Federal Aid highway mileage. In addition to eliminating the hazards, one of the primary purposes of the appropriation was to furnish employment. Thirty-nine projects were programmed in California, as outlined in Mr. McCoy's article, but ultimately a total of forty-six projects which included two track removal projects and fifty actual separation structures were constructed from the 1935 appropriation.

For the fiscal years of 1938-1939 the total appropriation was \$100,000,000, giving about \$3,700,000 to California. From these funds twenty-one projects were programmed in this State and at least one additional crossing will be separated with

the savings. In the first two programs, sixty-five projects have been completed or are now under construction. Only two programmed projects remain to be advertised.

For the fiscal years 1940-41, an amount of \$50,000,000 was appropriated from which California's share will be about \$1,800,000. This last allotment has not yet been programmed, but at the present time extensive studies are being made to select the most desirable projects and to provide the greatest value for the money invested.

LOOKING BACK ON PROGRAMS

As stated, thirty-nine separations were programmed and forty-six were built under Works Progress Administration funds. Twenty-one projects were programmed and twenty-two are to be built under the second appropriation of Federal Aid grade crossing funds. The total cost of these sixty-eight projects will amount to over \$11,000,000.



Before and after views of dangerous grade crossing on Firestone Boulevard in Los Angeles. Overhead structure carries railroad tracks.



Busy railroad grade intersection with U. S. 99 that formerly caused accidents and delays at entrance to Salinas and wide underpass now that accommodates traffic of two converging arterials.

It was specified in making these appropriations that the elimination of hazards at grade crossings was desired but that the funds should be so expended as to employ as many people as possible throughout the country and to distribute the funds among the railroads. The appropriations were made at a time when unemployment was at its highest and the business of the railroads had reached a very low ebb. The problem was to select projects where the greatest amount of labor could be secured from relief rolls and crossings where the hazards were greatest to both

highway and railroad traffic.

There are 6000 grade crossings on the rural highway system in California and over 6000 more are within the corporate limits of cities. It was necessary to immediately classify these crossings in order of their importance and consider the practicability of constructing grade separations at that time.

The question of practicability involved determining if the crossing was on its final location and if other funds could be obtained to build the necessary highway leading up to it. It also was necessary to find out if the

usual high cost of right of way and property damage at important grade crossings could be financed.

No Federal funds could be expended for purchasing rights of way, paying property damage, or taking care of general right of way considerations such as approach road or street connections. A study of the twelve thousand odd grade crossings showed that the important ones where separations seemed practicable could be narrowed down to a few hundred.

It was further required by the Federal Government that 25 per cent of the allotment of funds be expended



Where U. S. 99 formerly crossed the railroad tracks at Wilson Way in Stockton, motorists now pass safely through a divided 4-lane underpass.



Railroad grade crossing on "S" curve at Livingston on U. S. 99 and underpass with 4-lane divided highway that eliminated it.

off of State highways—that is, on county feeder roads or city streets. In setting up a program covering this 25 per cent, which amounted to nearly two million dollars, it was necessary to confer with city and county officials and other civic bodies as well as the railroads, in order to arrive at the most desirable crossings to be separated and arrange for the purchase of the necessary right of way by the body having jurisdiction.

It was specifically required that the funds should be divided among the railroads on the basis of their main line mileage operated in the State and this requirement was a mat-

ter of no small moment. The Great Northern Railway, a Class I road, operates approximately one hundred miles of road through the most sparsely settled portion of the State.

Under the regulations, this mileage made it necessary to construct one grade separation project, on this line, although no crossing in that area could compare in traffic to hundreds of crossings in other locations.

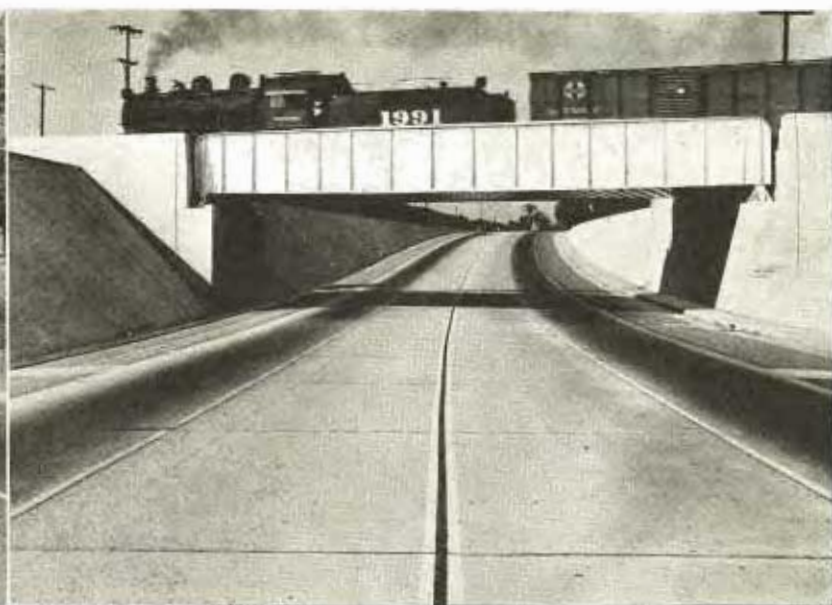
The Union Pacific operates only in Southern California, and the Western Pacific only in Northern California, while the Southern Pacific and the Santa Fe operate over the greater part of the State. Grade separation

projects at important crossings are individually expensive, and the problem of distributing a relatively small number of projects over these various railroads and throughout the State so as to affect the general unemployment situation was a difficult one and caused the postponement of many important projects in thickly settled areas in order to build other projects of somewhat less importance on other railroads and in other areas throughout the State.

From the standpoint of highway construction projects, a grade separation contract is probably the most difficult of any to get under way—not



Another grade crossing on an "S" curve at Delano on U. S. 99 in Kern County and 4-lane subway that replaced it.



View of old grade crossing on curve of San Gabriel Boulevard in Los Angeles and new highway subway beneath railroad.

from a design standpoint but because of the numbers of people and agencies involved and approvals which must be secured.

In all cases on projects within city limits it is necessary to secure the cooperation of the city to establish street grades not only on the routes being separated but on connecting streets. The city sewer and water pipe lines are usually involved, and public utilities and facilities require adjustments.

Since it is also necessary in most cases to construct the separations under railroad traffic, the railroad engineers necessarily take an active interest and all structure plans and construction schedules were subject to their approval.

Within the highway organization itself it was necessary for the Bridge Department to work closely with the districts and with the Surveys and Plans Department. The Bureau of Public Roads, also, considered all problems in connection with the project such as the selection by relative importance, the design, and all stages of construction and the auditing of final bills.

In addition to normal problems there was the necessity of getting the contracts under way at the earliest possible date in order to satisfy one of the primary purposes of the allocation—relief of the unemployment situation.

The net result was that within the calendar year of 1935 California had

advertised thirty-three contracts in the amount of \$5,542,000.

UNEMPLOYMENT RELIEF

The grade separation programs in California have contributed much to unemployment relief both directly on the job and in the production of materials. In units of work the following totals are measures of results:

Excavation	---1,900,000	cubic yards
Concrete	----- 220,600	cubic yards
Steel	-----21,130	tons

The projects have been distributed in twenty-one counties and sixteen cities.

The average cost of grade separation projects in California has been approximately \$200,000. Contractors estimating their costs figure from 30 to 40 per cent direct labor charges. Under the Federal regulations, practically all of this employment on the first program was local. In addition to the direct labor charges on the job, comes labor involved in producing cement and concrete aggregates, mining and refining the iron ore, rolling the structural shapes and reinforcing steel, logging and milling operations in connection with the lumber, and the shipping of all these materials to the job. There is no difficulty in showing that through these operations at least 95 per cent of the grade separation funds are eventually paid to labor. Statisticians have carried the matter still further and shown that the turnover of these

dollars through the consumers and producers extends to three or four times the original investment—that is, for every man employed directly in grade separation construction three or four men are employed indirectly on resulting activities.

PROGRESS DUE TO COOPERATION

The progress which has been made in handling the \$11,000,000 of grade separation work during the two programs in the last four years, has been entirely due to the fact that the State has received the very finest of cooperation from all parties involved. The cities and counties, realizing the opportunity and the difficulties involved, quickly and efficiently disposed of problems left to them in the way of securing rights of way, establishing grades, and removing interfering facilities.

The railroads have in all cases responded in a whole-hearted fashion and have directed their entire resources to the accomplishment of the common purpose.

The public utilities, such as the telephone, gas, and electric companies, have been equally cooperative.

A tabulated list of the grade separation projects appears on the adjoining page.

The contractors are entitled to commendation in the way they took hold of the situation and marshalled their resources to accomplish the objectives of the program. In the millions of dollars worth of work, plans

(Continued on page 28)

Grade Separation Projects in the Works Progress and 1938-39 Federal Aid Grade Crossing Programs

County	Route	Project	Railroad
Monterey	2	Subway on Main Street in Salinas	S. P.
Kern	4 & 23	Subway on Golden State Highway at Famoso	S. P.
Tehama	3	Widening Subway south of Red Bluff	S. P.
Alameda	Feeder	Subway on San Leandro Street at 105th Street in Oakland	W. P. & S. P.
Sacramento	Feeder	Overhead on Jibboom Street in Sacramento, connecting with new "I" Street Bridge approach	S. P.
San Joaquin	5	Subway on Charter Way in Stockton	S. P. & W. P.
Sacramento	3	Widening Subway at 16th Street in Sacramento	S. P.
Santa Clara	Feeder	Subway on Lafayette Street connection to Bayshore Highway in Santa Clara	S. P.
Alameda	69	Overhead on East Bayshore Highway at El Cerrito Hill in Albany	S. P.
Santa Clara	Feeder	Subway on Almaden Road, San Jose	S. P.
Santa Barbara	Feeder	Rebuilding old Overhead on Los Positos Road in Santa Barbara	S. P.
Monterey	2	Subway on Coast Highway in Soledad	S. P.
San Joaquin	5	Subway on State Highway east of Tracy	S. P.
Riverside	26	Overhead on State Highway north of Indio	S. P.
Los Angeles	165	Bridge and Overhead on the Figueroa Street Extension in Los Angeles	S. P.
Los Angeles	Feeder	Overhead on Soto Street in Los Angeles	S. P.
Santa Clara	Feeder	Subway on Embarcadero Street, Palo Alto	S. P.
Alameda	5	2 Grade Separations on Revision of State Highway Alignment at Niles	W. P. & S. P.
San Francisco	Feeder	Reconstructing Subway on Army Street in San Francisco	S. P.
San Francisco	Feeder	Reconstructing and Widening Overhead on Williams Street in San Francisco	S. P.
Riverside	19	Reconstructing Overhead on new Alignment Jack Rabbit Trail west of Beaumont	S. P.
San Diego	2	Widening Overhead north of Del Mar	A. T. & S. F.
Contra Costa	Feeder	Reconstructing old Overhead near Maltby	A. T. & S. F.
Fresno	4	Overhead on Golden State Highway at Calwa, south of Fresno	A. T. & S. F.
Los Angeles	60	Overhead on Relocated State Highway Route via N and O Streets near Wilmington	A. T. & S. F.
Los Angeles	167	Subway on Atlantic Avenue near Hobart Station	A. T. & S. F.
San Bernardino	31	Subway on State Highway at Verdemon north of San Bernardino	A. T. & S. F.
Orange	171	Subway on State Highway at Northam Station, Buena Park	A. T. & S. F.
San Bernardino	58	Overhead on State Highway near Java	A. T. & S. F.
Los Angeles	174	Subway on Firestone Boulevard at Graham Station	P. E.
Los Angeles	Feeder	Raising tracks at Intersection of Mission Road and Huntington Drive in Los Angeles	P. E.
Los Angeles	Feeder	Subway under Main and Butte Street Line of Railroad on Soto Street in Los Angeles	U. P.
Alameda	105	Removal of Railroad track from 12th Street in Oakland	W. P.
Alameda	69	Washington Avenue Subway, south of San Leandro	W. P.
Alameda	105	Subway on Jackson Street in Hayward	W. P.
Alameda	Feeder	Rebuilding Subway on Mountain Boulevard in Oakland	S. N.
Alameda	Feeder	Subway on Broadway Terrace near Landvale Drive in Oakland	S. N.
Placer	37	Overpass on Realignment through Colfax	S. P.
Los Angeles	168	Subway on San Gabriel Boulevard at Riviera	A. T. & S. F.
Riverside	19	Overpass at Box Springs	A. T. & S. F.
San Bernardino	Feeder	Overpass on Palm Avenue	A. T. & S. F.
Lassen	28	Overpass at Nubieber	G. N.
San Diego	Feeder	Overpass at Solano Beach	A. T. & S. F.
San Diego	2	Overpass at San Onofre	A. T. & S. F.
San Joaquin	4	Subway on Wilson Way, Stockton	A. T. & S. F.
San Joaquin	4	Wilson Way Track Removal, Stockton	C. C. T. C.
Shasta	3	Reconstructing Subway south of Redding	S. P.
San Luis Obispo	2	Overhead on new alignment on Cuesta Grade	S. P.
Los Angeles	23	Overhead at Solamint	S. P.
Los Angeles	168	Subway under Rosemead Boulevard at Rudell Station	S. P.
Alameda	5	Replacing Overhead on old alignment at Greenville on Altamont Pass	W. P. & S. P.
Alameda	5	Replacing Overhead on old alignment at Redmond on Altamont Pass	S. P.
Contra Costa	14	Overhead at Pinole	A. T. & S. F.
Los Angeles	168	Subway at Chapman Station on Rosemead Boulevard	A. T. & S. F.
Los Angeles	168	Subway at Pico on San Gabriel Boulevard	A. T. & S. F.
Alameda	5	Underpass at Stone Cut on Altamont Pass	W. P.
Los Angeles	159	Subway at Hewitt Station on Lankershim Boulevard	S. P.
Merced	4	Subway in Livingston	S. P.
Riverside	187	Overhead west of Palm Springs Station	S. P.
Sacramento	Feeder	Subway at Air Depot, Walerga Station	S. P.
Plumas	83	Overpass and Bridge near Greenville	W. P.
Stanislaus	4	Overpass south of Turlock	S. P.
Contra Costa	106	Subway at Ohmer Station	S. N.
Alameda	Feeder	Overhead at University Avenue in Berkeley	S. P.
Santa Clara	Feeder	Subway at University Avenue in Palo Alto	S. P.
Kern	141	Overhead on Oak Street in Bakersfield	A. T. & S. F.
Los Angeles	77	Extension of existing Overhead west of Pomona	S. P. & U. P.

NOTE.—The location for an additional project completing the total of 68 has not been selected.



Relocation under construction on Ocean Shore highway north of Santa Cruz extending to Waddell Creek seen in middle ground.

New Link in Ocean Shore Road

By JNO. H. SKEGGS, District Engineer

FROM San Francisco to Santa Cruz, State Highway Route 56, Bear Sign Route 1, closely follows the ocean and is a part of the Coast Highway which will ultimately extend along the greater portion of the ocean front from Mexico to Washington.

There is at present under construction in District IV a segment of this highway in Santa Cruz County, located on a high, bare bench of Monterey shale. The portion under construction commences 11 miles north of the City of Santa Cruz and extends along a new alignment for a distance of 8.2 miles. The small unincorporated Town of Davenport, is at the southern terminus, and the northern terminus is Waddell Creek.

Northerly of Waddell Creek for a distance of over a mile Waddell Bluffs face the ocean. To construct a highway along these bluffs will challenge the ability and experience of the locating and construction forces when funds become available to reconstruct

the existing road, which leads a precarious existence menaced by the fury of the ocean on one side and slides and erosion from the bluffs on the other.

The high Monterey bench is easily eroded, and four large creeks with their head waters in the Ben Lomond mountains have trenched deeply through the shale, making it necessary to dip sharply into their valleys with the new location. The areas of the stream sheds are in general not of large extent, the longest not exceeding 10 miles in length; but the rainfall often exceeds 60 inches per year, producing heavy runoff.

The original trail was improved in 1852 by the County, and to avoid the saw tooth bluffs the road was located a considerable distance back from the coast, requiring the climbing of minor summits to regain the ocean front.

The State took over this highway for maintenance in 1933 under legislative action. When funds became available for reconstruction, surveys

showed that a large saving in mileage and in rise and fall could be had by skirting the ocean bluff.

The new highway will be 8.2 miles long, starting approximately one-half mile south of Davenport and extending to Waddell Bluffs. This is a saving over the old road of 2.1 miles in distance, with the elimination of 133 curves and 5030 degrees of curvature, and a reduction of 0.4% from the maximum grade as well as the saving of 300 feet in elevation.

There will only be minor stretches of 7% grade. The roadway surfacing will be 22 feet wide, consisting of a road mix with ROMC-3 binder for a depth compacted of 0.21 of a foot with D.G. material and 7 foot wide shoulders on each side, treated with a seal coat of screenings and 90-95 liquid asphalt.

Two of the large streams will be bridged with large reinforced concrete arch culverts, and the third stream, Scott Creek, will be taken

(Continued on page 22)



At top—Section of old narrow, winding highway on Coast north of Santa Cruz now being reconstructed. Project is 8.2 miles long, eliminating 133 curves and saving 2.1 miles in distance. Center—equipment at work widening grade. At bottom—Stretch of new roadbed along ocean bluffs showing straight, level alignment.

New State Highway Through Colfax Nearing Completion

By JOEL B. HODGES, District Office Engineer

PROGRESS reports show that the new State highway route through Colfax in Placer County will be completed late in June, making it available for the heavy summer traffic.

This project is another important improvement on U. S. 40 between Sacramento and Truckee. Its use will enable through traffic to avoid the existing main line crossing of the Southern Pacific Railroad and the abrupt turns and interference with local traffic in Colfax.

The new route, $1\frac{1}{2}$ miles in length, leaves the existing State highway ap-

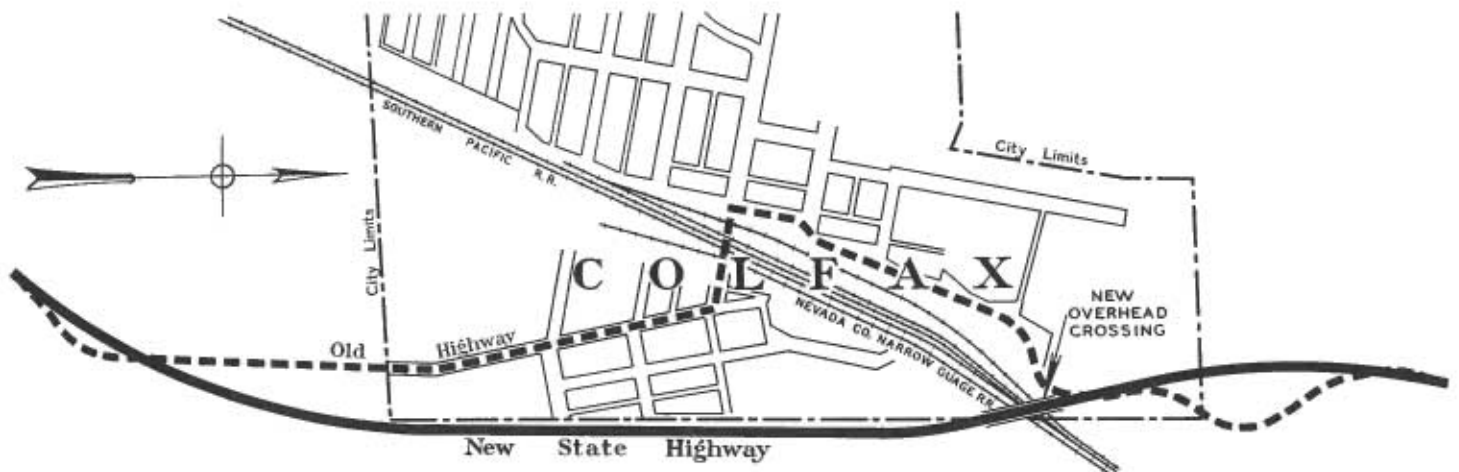
Funds have been included in the recommended budget for the next biennial budget to provide for an improved connection to the State highway approximately one-half mile north of the overhead. It is expected that this extension will be completed early this fall.

The construction on the present project was divided into two contracts, one for the grade separation structure and one for the road construction.

The construction periods on both contracts were so coordinated that the road construction will be completed

forced concrete abutment span. The total length of the structure will be 504.30 feet.

The north 88.59-foot span crosses over two Southern Pacific Railroad main line tracks and one switch track. The steel girders are supported by four concrete piers, each pier consisting of two slender concrete column bents with a deep diaphragm across the top. The piers and abutments are placed with a 41-degree skew to the center line of the roadway. The maximum height of the roadway above the ground is approximately 67 feet.



Sketch showing relocation of State Highway 37 (U. S. 40), at Colfax in Placer County.

proximately one-half mile south of Colfax and follows along the east side of Colfax to a connection with the existing State highway north of Colfax, effecting a saving in distance of 0.2 mile.

The alignment and grades on the project conform to present-day high standards, the minimum curve radius being 3000 feet.

TWO CONTRACTS

Insufficient funds made it necessary to terminate the present construction with a temporary connection to the existing State highway immediately north of the overhead structure.

soon after the completion of the overhead.

OVERHEAD GRADE CROSSING

Bids on the overhead were opened on July 27, 1938, and a \$117,882 contract awarded to the Campbell Construction Company at Sacramento for the construction of the crossing which is over the Southern Pacific Railroad tracks and the Nevada County Narrow Gauge Railway tracks.

The new bridge will consist of two steel girders and a reinforced concrete deck, consisting of one 101.99-foot span, one 94-foot span, one 93.97-foot span, one 90-foot span, one 88.59-foot span and one 35.75-foot rein-

The new bridge is designed for a 26-foot roadway with a 2-foot 7-inch sidewalk along each side. A steel hand railing made up of square tubular sections will extend along the entire length on each side.

The road contract, on which work has recently been resumed after a winter shut-down, consists in general of constructing a graded roadbed 36 feet wide, placing selected material over the full width of the roadbed and surfacing with plant-mixed surfacing 22 feet wide by 0.25 of a foot thick on a crusher run base 23 feet wide by 0.4 of a foot thick. The min-

(Continued on page 27)



At top—grade crossing of tracks of Southern Pacific main line in city of Colfax, Placer County, where U. S. 40 makes numerous abrupt turns for through traffic. A relocation follows the east side of the city eliminating turns and carrying the highway over the railroad tracks on a steel and reinforced concrete bridge structure 504.30 feet long, shown in bottom picture under construction.

Aerial Motion Pictures as Aids to Traffic Engineers

By MILTON HARRIS, Associate Highway Engineer

THE collection and analysis of traffic patterns is one of the essential elements of highway engineering. Traffic patterns might be defined as the recurrence of certain driving habits indulged in by motorists. These behaviors are affected to more or less degree by various extrinsic conditions such as the highway structure, roadside development and other streams of traffic.

Ascertaining the relationship of these physical conditions to traffic patterns is a form of engineering analysis. Ascertaining the effect that changes in the physical conditions have on traffic flow is a form of engineering research, and applying a physical change to obtain a known traffic pattern is a form of engineering design. Summed up, they constitute the elements of traffic engineering.

STUDY OF DRIVING HABITS

The collection of data from which to derive traffic patterns is no different than sending out a survey crew for the purpose of collecting geographical facts upon which a location design may be founded. The traffic survey has for its purpose the collection of factual data from which traffic patterns may be derived and analyzed.

In these film pictures, engineers can study the movement of several cars and a truck past a traffic island at intersection of two arterials. Preparation and operation of the captive balloon with movie camera attached is shown in other pictures.

The isolation of malign driving habits is one of the principal objects of traffic engineering analysis, inasmuch as these types of behavior lead to accidents or to friction within the traffic stream. The isolation of these habits from those that are normal is often very difficult, but they are present in any traffic stream and a close study of the flow should make them apparent.

The visual study of traffic flow on the ground presents many difficulties. The continuous movement is distracting, combining as it does, all the multiplicity of movements inherent in any stream. The human eye can not pick out and retain the course of a single car without gathering other impressions that detract from the value of the study. It is necessary to stop the motion at any point and analyze its relation to surrounding elements.

Photography seems the ideal medium to accomplish this feat. A bird's-eye-view of traffic lends itself to study from an angle that encompasses all the elements having an influence on traffic. Milwaukee, Wisconsin, experimented with a still camera attached to a captive balloon for the purpose of making site plans of intersections. Their results seemed to be eminently satisfactory, although they were only able to take one picture each fifteen minutes. To study traffic movement a continuous set of pictures is necessary and with this thought in mind, a motion picture camera seemed to be the logical answer.

In its work of simplifying traffic





studies the Safety Department of the Division of Highways has recently completed an experimental test in which a 16-mm. motion picture camera was sent aloft attached to a captive balloon and actuated by ground control. The cooperation of the Goodyear Tire and Rubber Company and Bell and Howell Company, camera manufacturers, was obtained in devising and furnishing the necessary equipment.

A small motion picture camera equipped with a wide angle lens was mounted in an aluminum frame to which was attached a solenoid and plunger connected to the shutter release and actuated by a power supply on the ground. An 11-foot spherical balloon was filled with helium gas and the camera so mounted thereon that it swung free with its lens normal to the ground.

Two bronze guy wires, in addition to the main steel cable, which controlled the elevation of the balloon, were used not only for holding the bag in position over the road but also as transmission lines for the current that actuated the shutter release.

The balloon with its complement of camera and guys was sent aloft over a typical intersection in the vicinity of Los Angeles. It was anchored in such a manner that the lens framed a good portion of the intersection. The ground crew was disposed out of sight of the motorists. The traffic observer was in such a position that he could operate the camera by remote control whenever he desired to take a length of film depicting a movement he wished to record.

Close watch was maintained to note any change in normal driving habit due to the balloon floating above the pavement, but its height was such that it did not seem to be a source of interest to drivers and no perceptible change in the manner of driving was apparent.

The results appear to fully justify the experiment. It was feared that the swinging of the camera would blur the pictures, but they seem to be

clear enough for study and the intersection was well framed. The uses to which such paraphernalia might be put are numerous in traffic investigation, particularly in rural areas.

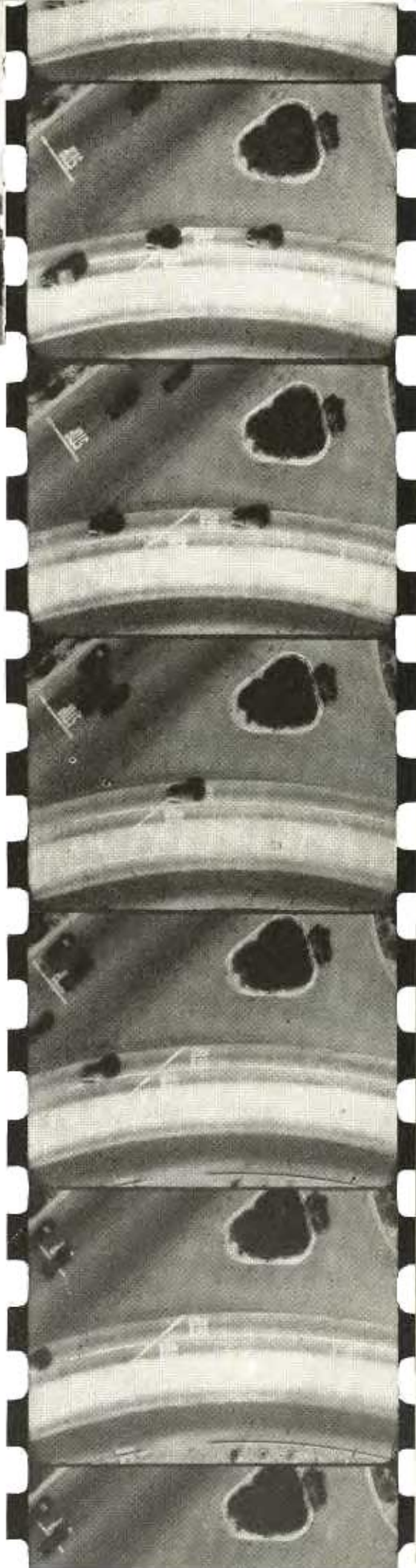
Density and speed checks are easily obtained if the camera speed is known and a ground control provided. For vehicle paths aerial photography is without doubt the most practical method so far devised. Three or four frames should be sufficient to plot the path of most any machine within the area covered by the lens. Types of vehicles are easily ascertained and traffic violations may be detected, especially when the film is viewed through a hand-operated "editor" where it can be stopped and studied at any desired point.

MOTORISTS NOT AFFECTED

Pedestrian interference is a large field for research and by means of aerial views may be readily broken down into behaviors for analysis. Site plans and location of objects that offer impediment to lines of sight are easily obtained from the air.

Many of these phases of investigation would be made concurrently from a study of the film. By varying the speed of the film, very efficient use can be made of the footage taken aloft. One hundred feet of 16 mm. film contains 4,000 individual frames and at a normal speed of 16 frames per second will run for 4 minutes, 10 seconds. By cutting the speed to 8 frames per second, twice the length of time will be consumed. By a simple mechanical arrangement individual frames may be "shot" at the operator's will, thus making a variety of frame speeds available to suit the needs of the survey.

Modernization of survey equipment and methods should engage the attention of all engineers. It seems quite fitting, therefore, that the most modern methods are so adaptable and should be made available for that most modern profession—the profession of traffic engineering.



Four Lane Divided Unit Finished

(Continued from page 6)

ment lanes, was found necessary and accomplished by installing 12-inch corrugated metal pipe culverts beneath cross-overs and for cross-drains as required.

Cross-overs were placed at county road intersections and at intervening locations for local traffic. The latter were placed a maximum distance apart of approximately 3300 feet. The cross-overs were limited to the minimum number considered necessary for the convenience of local residents on account of the hazard and interference with general traffic.

The portland cement concrete pavement designated Class "B" contained five sacks of cement per cubic yard. The maximum size aggregate used in the mix was 3½ inches. Aggregate was hauled from the contractor's batching plant in trucks, each containing two 1-cubic yard batches. Cement was added on the grade, being dumped from sacks into the hopper of a concrete mixer.

TRAFFIC ISLANDS INCLUDED

The concrete was placed on the subgrade between wood side forms, tamped with a mechanical strike-off screed and tamper, and finished with a mechanical finishing machine. After the concrete took an initial set, a 10-foot straightedge was used, and all high spots were removed with an 18-foot bump cutting float.

An average compression strength of 4088 pounds per square inch was obtained from 28-day tests of this concrete. Transverse and longitudinal pavement joints are being sealed with latex joint filler as developed by the Materials and Research Department of the Division of Highways.

Safeguards to traffic are noted in the construction of traffic islands at each end of the divided highway. These islands are each provided with amber electric light flashers set in portland cement concrete curbs in which a special recessed design reflects a white paint.

Two grade crossings with railroad spur tracks are each provided with two overhead illuminated RXR signs

An Appreciation

Carnegie Institution of Washington
MOUNT WILSON OBSERVATORY
Pasadena, California

Mr. S. V. Cortelyou,
District Engineer
Los Angeles, California

Dear Mr. Cortelyou:

About a dozen of us, employed by the Mount Wilson Observatory of the Carnegie Institution of Washington, are year-round residents on Mount Wilson, and the condition of the Angeles Crest Highway is, of course, a matter of great interest and importance to us.

All of us particularly appreciate the highly satisfactory service which has been rendered this year in connection with this road. Emergencies resulting from difficult weather conditions have been handled promptly and efficiently, and as a result the problem of safe transportation to and from Mount Wilson has never proved serious.

Will you be good enough to express our cordial appreciation to whatever department is most directly responsible for this very satisfactory service.

Very truly yours,

EARL F. KARR (signed)

5 by 8-foot in size, two reflectorized advanced warning signs, two wooden crossbuck signs and standard pavement marking. In addition to the usual pavement traffic striping and warning and directional signs, there were installed 4708 lineal feet of guard railing and 136 culvert markers and guide posts.

The major contract items included the following quantities.

Water.....	8,078 M gals.
Roadway excavation.....	9,932 cu. yds.
Structure excavation.....	1,449 cu. yds.
Imported borrow.....	39,305 cu. yds.
Untreated crushed gravel or stone surfacing.....	8,436 tons
Mineral aggregate(PMS)....	2,219 tons
Structure concrete.....	291 cu. yds.
Pavement concrete.....	14,171 cu. yds.
Reinforcing steel.....	112,428 lbs.

Fredericksen & Westbrook was the contractor for this project. The Resident Engineer was R. H. Lapp. A total of 54,421½ man hours for all classes of labor used on the contract is indicated from the contractor's pay rolls.

The approximate total cost of the construction is \$208,000. The project was financed from State highway construction and Federal Aid funds and the one-fourth cent gas tax allotment to the city of Modesto.

New Link in Ocean Shore Road

(Continued from page 16)

care of by a reinforced concrete bridge, 160 feet in length, resting on concrete piles. The fourth stream, which is Waddell Creek, will not be bridged until the section through the Waddell Bluff has been realigned.

Considerable truck farming and dairying is in progress along this entire route, this coast route being naturally the only road available for people living on the western slopes of the Santa Cruz and the Ben Lomond country. There is a comparatively small amount of dense fog.

The ultimate distance from Santa Cruz to San Francisco, via the Coast Road, will be approximately the same as other inland routes, with the added features of no cross traffic and the absence of long sustained grades. This improvement, along with others, eventually should be a great boon to truck transportation, also recreational purposes, and even for through traffic service a new, fast and scenic highway is in the making.

The progress to date has been very good, due to the unusual amount of rainfall during the past winter. It has been possible to work a continuous two 8-hour shifts, without any interruption with the equipment even during the rain, due to the Monterey shale and sand formation.

This is the third section of the Ocean Shore Highway to be improved since 1936; the first section being a 3-mile section just out of the City of San Francisco, and the second section being the San Pedro relocation, between Farallone City and Rockaway Beach, a distance of 6 miles.

It is expected that another difficult section will be constructed during the next biennium in the neighborhood of Tunitas Creek.

The project is being built on a cooperative basis from Federal, State, and Joint Highway District No. 9 funds. Joint Highway District No. 9 comprises the counties of San Francisco, San Mateo and Santa Cruz. The directors of the District are members of the Boards of Supervisors of the respective counties; John M. Ratto

(Continued on page 25)

Legislation for Central Valley Project Proposed

(Continued from page 5)

with two companies of Civilian Conservation Corps youths engaged thereon. An area of 23,500 acres will be cleared of brush and timber. Usable timber is being salvaged, but most of the forest cover is in brush and small trees which are being cut, piled and burned.

Several important contracts for material and equipment have also been awarded. These include a contract with the General Electric Company for the furnishing of four electric generators rated at 75,000 kva each and a contract with Allis Chalmers Company for the furnishing of four hydroelectric turbines each with a rated capacity of 103,000 horsepower. Bids will be opened on June 1st in Sacramento for the furnishing of 2,800,000 tons of sand and 7,600,000 tons of gravel to be used as aggregates for the concrete to be placed in the dam and power plant. In addition bids have recently been opened in Washington, D. C., for the furnishing of cement for Shasta Dam in various amounts up to 5,800,000 barrels.

It is now expected that the first concrete will be poured in Shasta Dam in March, 1940. In the meantime, the excavation work on the dam will be largely completed and materials will be provided and equipment installed for the manufacture and placing of concrete of which 5,600,000 cubic yards will be required for the dam and power plant.

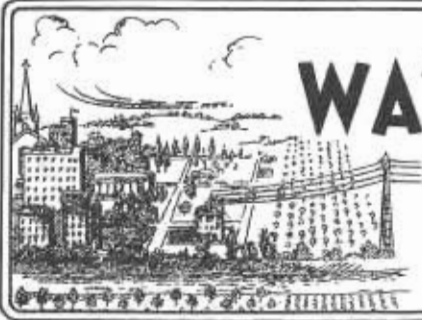
BUILDING CONTRA COSTA CANAL

The second scene of construction activity is in Contra Costa County, where work is under way on the Contra Costa Canal. Construction work—the first undertaken on the project—was started on this canal in October, 1937. The first four miles, which is an unlined earth canal, has already been completed and an additional sixteen miles is now being built under two contracts which, when completed, will bring the finished section of this canal to the vicinity of Pittsburg. Four pumping plants are also

(Continued on page 26)



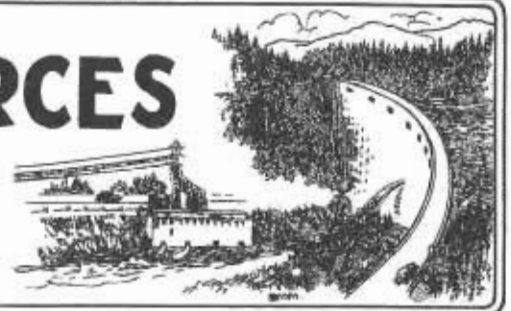
Photo by U. S. Bureau of Reclamation
Through this by-pass tunnel, main line railroad traffic now crossing site of Shasta Dam will be routed early this Summer.



DIVISION OF WATER RESOURCES

OFFICIAL REPORT
FOR THE MONTH OF
April, 1939

EDWARD HYATT, State Engineer



THE Division of Water Resources, representing the Water Project Authority of the State of California, has continued the preparation of data and reports provided for in an agreement between the United States and the Authority. In connection with this work, field surveys are being made for the preparation of topographic maps of the lands along the San Joaquin River between Friant and the Gravelly Ford Canal, and between the mouth of the Merced River and the San Joaquin Delta. Also, in connection with the studies of the water rights of the lands bordering the San Joaquin River, soil survey maps are being prepared of the areas along the river between the same points.

Work also continued on the preparation of data for reports on the acquisition of, and a plan of exchange for, waters of the San Joaquin River claimed by properties east of the river in Merced County and south of the river in Fresno County.

DISTRICTS SECURITIES COMMISSION

Considerable work was done in the commission office upon the formulation of a financing plan for submission to the bondholders of Montague Water Conservation District. The board of directors of the district at the request of the commission submitted data upon the estimated ability of the district to pay and it is hoped that a proposal may soon be placed before the bondholders for their consideration.

Hearings in the U. S. District Courts upon the petitions of several irrigation districts for confirmation of their refunding plans have recently been held or are scheduled for the near future. Some plans which have been confirmed by the courts have been taken to the Circuit Court of Appeals.

SPECIAL INVESTIGATIONS

Investigations and the preparation of reports on work for which applications have been made for allotments from the State Emergency Fund for the restoration of prop-

erty, levees, flood control works, county roads and bridges damaged by the floods of the 1937-38 winter season, were continued and seven reports and recommendations were submitted to the Director of Finance pursuant to his instructions. Nine allocations were made by the Director of Finance for flood damage repair work during the month. The total amount of outstanding allocations at the end of the month was \$4,501,300. The Division of Water Resources has performed or is performing considerable of the work for which these allocations were made and the remainder is being done by the applicants under 132 contracts entered into with the Department of Public Works. These contracts cover work which will cost \$3,373,700, much of which has already been completed.

SUPERVISION OF DAMS

Application was filed on March 23, 1939, for approval of the Last Chance Weir in Kings County, owned by the Last Chance Water Ditch Company, Hanford, California.

Application was filed on April 3, 1939, for approval of plans and specifications for the construction of the Kimball Creek Dam in Napa County, owned by the City of Calistoga, Calistoga, California.

Bids have been called for work on the Long Valley Dam in Mono County and construction will start in the very near future. Construction work is progressing on Palos Verdes Reservoir in Los Angeles County.

FLOOD CONTROL AND RECLAMATION

Routine maintenance work has been carried on during this period. There has been a total lack of flood water during the winter and the usual winter and spring activities were not necessary. Irrigation has commenced in the Sutter By-pass and adjoining area. An unusually large area of rice will be planted and preparation is being made for irrigation flooding of the bean lands in the by-pass preparatory to planting.

With the aid of WPA labor, the channels of the Butte Slough By-pass and Knights Landing Ridge Drainage Cut are being cleared. An average of 65 men has been engaged in this work. The truck and storage shed at the Sutter yard is nearing completion, all labor being furnished by WPA.

Emergency Levee Repair

All construction work under this project has been completed, the last unit being the dike near the head of Edgar Slough, in which

two irrigation conduits were constructed with funds provided by local interests. The completion report on this project is now being prepared.

Relief Labor Work

Under WPA Project No. 10612, sponsored by this department, approximately 953 men are now assigned. A total of 66,702 man-hours of labor have been applied from March 26th to April 22d, inclusive, an average of 3,739 man-hours per working day. This is equivalent to a continuous working force of 467 men working eight hours per day.

Emergency Flood Damage Repair

The repair of the damaged units of the Sacramento River Flood Control Project has been carried on by the division by force account during this period. Of the \$150,000 available, approximately \$114,000 has been expended to date.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

Field work has commenced and at present consists of visiting all points of diversion and return flow to insure that records of pumping operations and return flow stations will be kept during the coming season. Discharge measurements are being made at all of the larger plants which are at present in operation. On account of the abnormally dry season, the majority of diversion plants are in full operation. The rice planting program is well under way and in many sections completed. In view of the impending water shortage, it is apparent that the irrigators are all endeavoring to soak up the ground while water is yet available.

The annual mimeographed report of this office is virtually completed and it should be available for distribution some time in May. The stream flow into the delta is rapidly decreasing, the flow of the Sacramento River at Verona having fallen from 11,000 cubic feet per second on April 14th to 8000 cubic feet per second on April 21st. The flow of the San Joaquin River at Vernalis is likewise rapidly decreasing and on April 22d was 2400 cubic feet per second.

You have heard, of course, about the English bulldog that went for a tramp every day.

Dora's N. Y. cousin is worried about the campaign to do away with noises. She's been studying for three years to be one and was to get her diploma at the hospital next June.

Highway Bids and Awards for the Month of April, 1939

ALAMEDA COUNTY—A reinforced concrete girder bridge, Arroyo de la Laguna, at Sunol, consisting of six spans with total length of 310 feet and about 0.25 mile of roadway to be graded and surfaced with plant-mixed surfacing and penetration oil treatment applied to shoulders. District IV, Route 107, Section A. Eaton & Smith, San Francisco, \$46,839; Earl W. Heple, San Jose, \$47,680; M. J. Ruddy, Modesto, \$48,451; E. T. Lesure, Oakland, \$48,526; C. W. Caletti & Co., San Rafael, \$49,976; MacDonald & Kahn Co., Ltd., San Francisco, \$51,928; Heafey-Moore Co. Fredrickson & Watson Const. Co., Oakland, \$52,322; Lindgren & Swinerton, Inc., Oakland, \$52,871; A. Soda & Son, Oakland, \$55,000; R. G. Clifford, San Francisco, \$55,990. Contract awarded to Caputo & Keeble, San Jose, \$44,760.

LOS ANGELES COUNTY—On Arroyo Seco Parkway across Arroyo Seco Channel near Hough Street, a reinforced concrete box girder bridge having a total length of approximately 432 feet composed of a main center span and four approach spans. District VII, Route 205, Section S. Pas. John Strona, Pomona, \$138,615; J. S. Metzger & Son, Los Angeles, \$143,875; J. E. Haddock, Ltd., Pasadena, \$153,396; Bates and Rogers Contracting Corporation, Oakland, \$154,481; Carlo Bongiovanni, Los Angeles, \$157,899; Andy Sordall & R. R. Bishop, Long Beach, \$159,924; Chas. J. Dorfman, Los Angeles, \$162,780; Byerts & Dunn, Los Angeles, \$163,295; United Concrete Pipe Corp., Los Angeles, \$166,606; Heuser & Garnett, Glendale, \$169,322; Mitty Bros. Construction Co., Los Angeles, \$172,821; C. O. Sparks and Mundo Engineering Co., Los Angeles, \$176,222; A. T. Cassell-Fred E. Potts Co., Los Angeles, \$205,157; Gibbons & Reed, Burbank, \$218,711. Contract awarded to Contracting Engineers Co., Los Angeles, \$134,727.

LOS ANGELES COUNTY—West of Pomona, two reinforced concrete girder overhead crossings to be constructed and approaches, about 0.7 mile in length, to be graded and paved with Portland cement concrete and plant-mixed surfacing. District VII, Route 77, Section B. C. O. Sparks & Mundo Engineering Co., Los Angeles, \$181,094; United Concrete Pipe Corp., Los Angeles, \$182,325; J. E. Haddock, Ltd., Pasadena, \$182,401; Claude Fisher Co., Ltd., Los Angeles, \$182,562; The Contracting Engineers Co. & S. Edmondson & Sons, Los Angeles, \$184,199; Daley Corp., San Diego, \$188,594; J. S. Metzger & Son, Los Angeles, \$188,887; Gibbons & Reed Co., Burbank, \$191,676; Griffith Co., Los Angeles, \$192,834; Basich Bros., Torrance, \$204,695; Chas. J. Dorfman, Los Angeles, \$210,157; Matich Bros., Elsinore, \$218,311. Contract awarded to John Strona, Pomona, \$171,466.75.

MARIPOSA COUNTY—Between Briceburg and El Portal, about 12 miles in length, to be surfaced with plant-mixed surfacing and shoulders to be constructed. District X, Route 18, Sections E, F, G. Mitty Bros. Construction Co., Los Angeles, \$66,277; J. A. Casson, Hayward, \$68,176; Piazza & Huntley, San Jose, \$68,331; Mountain Construction Co., Sacramento, \$73,858; Pacific States Construction Co., San Francisco, \$84,728; Marshall Hanrahan, Redwood City, \$92,615. Contract awarded to Griffith Co., Los Angeles, \$61,502.25.

MONTEREY COUNTY—About 0.3 mile south of Soledad, ten concrete bridge piers in the Salinas River to be demolished and disposed of. District V, Route 2, Section

D. John Fesler, Santa Maria, \$3,500; C. W. Caletti & Co., San Rafael, \$4,800; Frank Legg, San Francisco, \$6,512; A. A. Tieslau, Berkeley, \$3,470; Lord & Bishop, Sacramento, \$2,750; Granite Construction Co., Ltd., Watsonville, \$5,600; L. O. Seidel, Oakland, \$3,370. Contract awarded to Kiss Crane Service, Southgate, \$1,180.

RIVERSIDE COUNTY—Near Thermal, about 0.9 mile to be graded and roadmix surface treatment applied. District XI, Route 187, Section F. G. W. Ellis, North Hollywood, \$20,611; R. E. Hazard & Sons, San Diego, \$21,087; J. E. Haddock, Ltd., Pasadena, \$21,714; Parish Bros., Los Angeles, \$23,457; M. J. Ruddy, Modesto, \$23,646; Martin & Schmidt, Long Beach, \$24,027; General Construction Co., J. W. Johnson, Los Angeles, \$24,940; V. R. Dennis Construction Co., San Diego, \$25,853; H. H. Peterson, San Diego, \$26,141; R. L. Oakley, Pasadena, \$26,719; S. E. Edmondson & Sons, Los Angeles, \$27,117; Anderson & France, Visalia, \$27,686; C. R. Butterfield-Kennedy Co., San Pedro, \$27,999; C. G. Willis & Sons, Inc., & Chas. G. Willis, Los Angeles, \$28,026; S. M. Milovich, Montebello, \$28,925; B. G. Carroll, San Diego, \$29,154; J. S. Metzger & Son, Los Angeles, \$29,763; Griffith Co., Los Angeles, \$31,101; A. S. Vinnell Co., Alhambra, \$31,914; Valley Construction Co., San Jose, \$34,520. Contract awarded to Basich Bros., Torrance, \$17,742.30.

SAN BERNARDINO COUNTY—Approaches to Santa Ana River bridge east of Colton, about 0.3 mile to be graded and paved with Portland cement concrete. District VIII, Route 26, Section E. T. M. Page, Glendale, \$11,645; S. Edmondson & Sons, Los Angeles, \$12,241; J. E. Haddock, Ltd., Pasadena, \$13,240; Matich Bros., Elsinore, \$14,327; S. M. Milovich, Montebello, \$14,823; Claude Fisher Co., Ltd., Los Angeles, \$14,906; Griffith Co., Los Angeles, \$16,637; A. S. Vinnell Co., Alhambra, \$17,422. Contract awarded to Basich Bros., Torrance, \$11,176.05.

SAN BERNARDINO COUNTY—Between Barstow and one mile north, about 0.9 mile to be graded and surfaced with roadmix surfacing and a reinforced concrete bridge to be constructed. District VIII, Route 31, Section G. B. G. Carroll, San Diego, \$41,455; Parish Bros., Hollywood, \$41,698; Basich Bros., Torrance, \$41,801; R. M. Price, Huntington Park, \$41,937; J. A. Casson, Hayward, \$42,877; M. J. Ruddy, Modesto, \$43,382; J. E. Haddock, Ltd., Pasadena, \$43,852; S. A. Cummings, San Diego, \$45,742; Valley Construction Co., San Jose, \$46,416; C. R. Butterfield-Kennedy Co., San Pedro, \$46,991; Matich Bros., Elsinore, \$47,651; Byerts & Dunn, Los Angeles, \$48,517; Martin & Schmidt, Contractors, Long Beach, \$51,799; R. E. Campbell, Los Angeles, \$52,883. Contract awarded to A. S. Vinnell Co., Alhambra, \$41,255.

SAN DIEGO COUNTY—Application of diesel oil to 68.9 roadside miles of vegetation. Various locations. Square Oil Co., Los Angeles, \$1,300. Contract awarded to R. E. Hazard & Sons, San Diego, \$1,233.

SAN FRANCISCO COUNTY—Between Lake Street and Golden Gate Bridge approach in the City of San Francisco, construction of a viaduct consisting of reinforced concrete girder spans on reinforced concrete bents and retaining wall abutment. District IV, Route 56, Section SF. Clinton Construction Co. of California, San Francisco, \$67,359; Bates & Rogers Construction

Corp., Oakland, \$59,281; Eaton & Smith, San Francisco, \$59,660; E. T. Lesure, Oakland, \$55,484; Robert McCarthy, San Francisco, \$63,176. Contract awarded to Union Paving Co., San Francisco, \$54,441.10.

SANTA CLARA COUNTY—Near north-easterly city limits of San Jose, two bridges, one a reinforced concrete girder bridge across Coyote Creek, consisting of four 42-foot spans and two 14-foot cantilever spans on reinforced concrete piers on concrete piles and the other a reinforced concrete slab bridge across Silver Creek consisting of three 15-foot spans and two 3-foot 6-inch cantilever spans on cast-in-place concrete pile bents. District IV, Route 68, Section B & SJs. Earl W. Heple, San Jose, \$51,614; C. W. Caletti & Co., San Rafael, \$58,293; A. Teichert & Son, Inc., Sacramento, \$59,070; E. T. Lesure, Oakland, \$56,367; Lindgren & Swinerton, Inc., Oakland, \$59,705; Heafey-Moore Co. Fredrickson & Watson Construction Co., Oakland, \$60,660; Eaton & Smith, San Francisco, \$61,321; A. Soda & Son, Oakland, \$63,481; Bates & Rogers Construction Corp., Oakland, \$63,580; Barrett and Hilp, San Francisco, \$64,209; A. J. Raisch, San Jose, \$69,436. Contract awarded to Caputo and Keeble, San Jose, \$51,512.50.

TULARE COUNTY—Across Tule River at south city limits of Porterville, a reinforced concrete continuous slab bridge on reinforced concrete piers with concrete pile foundations to be constructed. District VI, Route 129, Section B. J. S. Metzger & Son, Los Angeles, \$35,100; R. G. Clifford, San Francisco, \$56,545; Earl W. Heple, San Jose, \$37,707; United Concrete Pipe Corp., Los Angeles, \$37,731; M. J. Ruddy, Modesto, \$38,619; Valley Construction Co., San Jose, \$38,889; A. Soda and Son, Oakland, \$39,482; S. A. Cummings, San Diego, \$39,747; R. R. Bishop, Long Beach, \$41,811; B. G. Carroll, San Diego, \$44,906; Case Construction Co., Inc., San Pedro, \$48,529. Contract awarded to Trehwitt-Shields & Fisher, Fresno, \$33,492.60.

NEW LINK IN OCEAN SHORE ROAD

(Continued from page 22)

representing San Francisco County, Alvin Hatch, San Mateo County, and George Ley, Santa Cruz County.

Excellent progress is being made on the construction of this highway, and it is expected that it will be opened to traffic before the contract date for completion, which is December 14, 1939.

"Pop," inquired little Clarence Lilywhite, "what am a millennium?"

"Sho," said the parent. "Doan' you know what a millennium am, chile? It's jes' about de same as a centennial, on'y it's got mo' legs."

Even a stout backbone won't get you anywhere if the knob at the end of it is made of the same material.



Placing excavated material in intermediate zone of upstream embankment section of Shasta Dam. Note bulldozer and sheepfoot roller at left.

Legislation for Central Valley Project Proposed

(Continued from page 23)

being constructed for this unit and the pumping machinery is ready for installation.

The Contra Costa Canal will have a total length of about 46 miles, extending from an arm of the delta near Knightsen to the vicinity of Martinez. With the exception of the first four miles, the canal section will be lined with a three-inch thickness of reinforced concrete. It will have a capacity varying from 350 second feet in the upper end to 256 second feet in the lower end. The remaining 26 miles of this canal are expected to be advertised for bids this year.

Construction work on the remaining units of the Central Valley Project has not as yet been started. These include the second storage unit of the project, Friant Dam and Reservoir on the San Joaquin River, the Friant-Kern and Madera canals, which will divert therefrom and convey water for use in the southern San Joaquin Valley from Madera County on the north to Kern County on the south, the San Joaquin Pumping System, and the Delta Cross Channel. Plans and specifications are being prepared for Friant Dam which will be 300 feet in height and create

a reservoir with a gross storage capacity of 520,000 acre-feet, 70,000 acre-feet of which will be reserved for flood control purposes.

In connection with the San Joaquin River development, substantial progress has been made on the necessary acquisition of water rights. Two contracts with the Miller and Lux interests, which now control a major portion of the present rights to San Joaquin River water, have been negotiated and approved and are ready for execution. One of these contracts provides for the purchase of the so-called grass land rights and the other for the exchange of San Joaquin River water, now used for irrigation of crops, for a substitute supply to be furnished by means of the San Joaquin Pumping System, which will divert the substitute supply from the delta. The recent approval of the "Exchange Contract" by the State Railroad Commission is the last step required preparatory to the execution of both of these contracts. Negotiations are progressing for the acquisition of numerous other water rights.

Other important negotiations still under way in connection with the Friant Dam unit comprise those with

the Madera and Fresno Irrigation districts for the acquisition of whatever rights or properties those districts may have in the Friant Dam and Reservoir sites. It is reported the negotiations are nearing completion with the Madera Irrigation District.

Walker R. Young, supervising engineer for the Bureau of Reclamation, states that additional construction work on the Central Valley Project now in prospect for early bidding includes Friant Dam, the upper sections of the Friant-Kern and Madera canals, the remainder of the Contra Costa Canal and more railroad and highway relocation around Shasta Reservoir, including the huge Pit River Bridge.

The bypass tunnel through which the Southern Pacific Railroad tracks will be diverted pending the completion of the railroad realignment at a higher elevation around the Shasta reservoir, was holed through on March 4.

The tunnel, which is 1,820 feet long, is being lined with concrete from 18 to 21 inches thick throughout its entire length and it is expected it will be completed and open to traffic sometime in July.

Western Families 'Own the Roads' Says Dr. Hewes

IN HIS address before the joint meeting of the annual conventions of the American Road Builders' Association, the Associated General Contractors of America, and the Western Association of State Highway Officials recently held in San Francisco, Dr. L. I. Hewes, Deputy Chief Engineer, U. S. Bureau of Public Roads, in discussing highway problems of today, said:

"In its position as a clearing house for the several state-wide highway planning surveys, the Bureau of Public Roads is obligated morally to make public as fast as possible general data that become visible when the highway planning surveys of the several States are combined.

"The bureau is doing such publicity work. Thus, in considering farm-to-market roads, it is seen that only 10 per cent of the total highway movement is served by county and local roads. Yet such movement requires 78 per cent of the total mileage. Similarly, local city streets serve generally only about 6 per cent of the total traffic."

"The increase in highway transportation in the western States in the last 18 years is apparent from a study of figures for motor vehicle registration and the gasoline tax dollar for the eleven western States between 1921 and 1938.

"In the year 1937 alone, the western road users paid in State license fees and gasoline taxes approximately \$152,256,000. * * *

OWN THE ROADS

"The 1938 western registrations indicate about 4.6 million vehicles. Family ownership of vehicles thus just about accounts for the total western population. So the western families, as such, actually may be said to own the roads.

"In the country as a whole, the ownership of family passenger cars is largely by people of very moderate incomes. Less than 5 per cent of the passenger cars are owned by people with incomes of \$5,000 per year or more. The Bureau of Foreign and Domestic Commerce in the United States Department of Commerce re-

Bay Bridge Traffic Shows Increase of 1700 Vehicles Daily Over March

APRIL TRAFFIC on the San Francisco-Oakland Bay Bridge piled up a daily average of 28,311 vehicles, it was revealed yesterday by State Department of Public Works Director Frank W. Clark in a report filed with Governor Culbert L. Olson.

The figure represents an increase of approximately 1700 vehicles per day over March and an increase of over 5,000 vehicles per day over the same period a year ago. April's daily average marks the third highest since the bridge opened, except for the first two weeks of November, 1936.

Total traffic for April was 849,317 vehicles, bringing the year's total to 3,172,113 and the total since the bridge opened to 22,233,202. Highest day of the month was Sunday, April 9, when 39,700 vehicles crossed the span.

April's revenues amounted to \$439,521.16.

Of last month's total 169,806 vehicles went to Treasure Island, Mr. Clark's report said. Traffic from San Francisco to Treasure Island totaled 89,917 vehicles and from the East Bay, 79,889.

Convenience of automobile travel to Treasure Island, Mr. Clark said, accounted for the heavy exposition traffic, which is exceeding original estimates.

April totals and comparative figures follow:

	April 1939	March 1939	Total 1939 to date	Total since opening
Passenger Autos and Auto Trailers	767,327	738,813	2,846,922	20,554,594
Motorcycles and Tricars	3,467	3,037	12,147	99,046
Buses	8,270	7,384	31,943	279,577
Trucks and Truck Trailers	44,790	47,138	182,411	942,310
Toll Vehicles	823,854	796,372	3,073,423	21,875,527
Passes	25,463	26,542	98,590	357,675
Total Vehicles	849,317	822,914	3,172,013	22,233,202
Extra Passengers	296,604	259,266	995,324	5,743,959
Freight Tons	54,830	59,981	244,478	1,155,608

cently found that more than half the family cars were owned by families with annual incomes of \$1,500 or less.

"We thus arrive at a rather astounding fact: namely, that since 1918 motorists, of whom nearly 96 per cent have less than \$5,000 incomes, have supplied the United States with its system of main highways. The details of family ownership are shown in the following tabulation:

OWNERSHIP OF FAMILY CARS BY ANNUAL INCOME GROUPS

Annual income bracket Dollars	Percentage of family pas- senger cars owned in each income bracket	Percentage of family car owners with income less than the maximum of each income bracket
Under 500	6.54	6.54
500-1,000	20.55	27.09
1,000-1,500	24.77	51.86
1,500-2,000	18.07	69.93
2,000-3,000	17.73	87.66
3,000-5,000	8.02	95.68
Over 5,000	4.32	100.00

Yet people still get thin worrying, excepting when they are worrying about being fat.

New State Highway Nearing Completion

(Continued from page 18)

eral aggregates for the crusher run base and plant-mixed surfacing were obtained by crushing material from a mine dump 1½ miles west of Colfax.

One of the features of the construction was the securing of 10,000 cubic yards of selected material from the roadway prism on the projected ultimate alignment. The contractor has arranged for the removal of this material by bulldozing and trapping the material in a bunker for loading into trucks instead of the more common method of loading with a shovel.

The contractors for the road construction are Piazza and Huntley of San Jose and the Resident Engineer is H. O. Ragan.

This is a Federal Aid project, and the total cost of the road construction is \$46,500.

Six Highway "Musts" Stated by MacDonald

IN CLOSING his address at the Dallas Convention of the American Association of State Highway Officials, Thos. H. MacDonald, Chief of the Bureau of Public Roads, stated that based on the highway planning surveys, we must have:

First, a reclassification of our highways;

Second, a provision for roads to serve all types of existing or developing traffic, and recognizing the fast, through traffic as distinct from local use;

Third, the beginning of special motor roads in congested areas leading from the hearts of the cities through metropolitan areas, designed to permit free flow of traffic separated from cross-traffic;

Fourth, the organization of a big mileage of local land-service roads to be brought rapidly to usable condition;

Fifth, the program of State and Federal-aid systems which lies between, on which work must continue with a constantly higher level of design standards for safe traffic service; and

Sixth, for these improvements, a radically new policy of land acquisition to be formulated and made effective in order to provide adequate space and to control unsightly and undesirable ribbon development.

These, he states, are partial details of a future program indicated by the data of the highway planning surveys, if these data are to be used intelligently in the immediate future.

Swing Spans Feature Arch

(Continued from page 10)

forcing steel were 1000 pounds per square inch and 18,000 pounds per square inch, respectively. An exceedingly high grade concrete was manufactured for the project; 28 day strengths ran as high as 6000 pounds per square inch.

The Contractor was C. O. Sparks and Mundo Engineering Company, and I. T. Johnson, Resident Engineer.

[Twenty-eight]

In Memoriam HOWARD SPENCER HAZEN

The Division of Architecture suffered a great loss April 13, 1939, in the death of Howard Spencer Hazen, who had served as senior architectural designer in the office of that division since 1926.

Mr. Hazen was born in LaSalle, Illinois, educated in the schools of that community, and graduated in Civil Engineering from the University of Illinois. Becoming interested in architecture, he pursued the study of this subject at the Massachusetts Institute of Technology in Boston and later at Harvard University.

His professional career covered a wide field of activity, first in Boston and later in Chicago.

In 1924, he came to Sacramento at the instance of James S. Dean of Dean & Dean, Architects, and was associated with that firm in the design of many important structures, including the Sacramento Memorial Auditorium, the Sacramento Junior College, and the Westminster Presbyterian Church.

In the office of the Division of Architecture he was responsible for the design of several complete State institutional groups, of which the San Diego State College, the Camarillo State Hospital, and the California Institution for Women are outstanding examples.

Always self-effacing, he was possessed of cultural attainments beyond the knowledge of any except those most intimately acquainted with him. Art, music, literature, and science shared in the use of his leisure moments without excluding the friendly human touch or the keen sense of humor so deeply appreciated by all who knew him. A great void exists where he once stood.

25,000 Miles of 4-Lane Highways Need in 25 Years

(Continued from page 10)

"Based on information gathered in the highway planning surveys, however, it is now apparent that 25,000 miles of new four-lane highways may have to be built in the next 25 years to accommodate the automobile traffic of the nation. This is an average of 1000 miles of new construction each year in addition to the existing mileage of the multiple-lane type now in use. Therefore, the sectional lay-out of multiple-lane highways is increasingly important."

Grade Separation Projects Total \$11,000,000

(Continued from page 14)

for which were in many cases much less complete than we would have desired, the contractors have cooperated to the end that we have secured very satisfactory jobs and the claims for additional compensation were reduced to a minimum.

The local district office of the Bureau of Public Roads was also an important factor in accomplishing the work under these programs. Their representatives were always available for consultation and furnished invaluable assistance in programming, designing, and constructing the grade separation projects.

Without such splendid cooperation all over California through the last four years, the State would have been hampered in getting this large program under way.

With the two earlier programs nearing completion, we are now in the process of formulating a program to utilize with the greatest possible benefit the allocation of about \$1,800,000 to be spent during the 1940-1941 Fiscal Years. It appears that with this money there will be added to the previous sixty-eight projects about ten additional separations.

AID TO UNIVERSITY

PURDUE UNIVERSITY

Engineering Experiment Station
Lafayette, Indiana

California Department of Public Works
P. O. Box 1499
Sacramento, California

Gentlemen:

We are very much interested in obtaining copies of "California Highways and Public Works" for use as references by our staff of the Joint Highway Research Project. We are doing research work on various highway problems under a cooperative agreement between Purdue University and the Indiana Highway Commission. As a result, we would appreciate being placed on the mailing list for the above mentioned publication.

Very truly yours,

(Signed)
K. B. Woods
Assistant Director

State of California

CULBERT L. OLSON, Governor

Department of Public Works

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

FRANK W. CLARK, Director of Public Works

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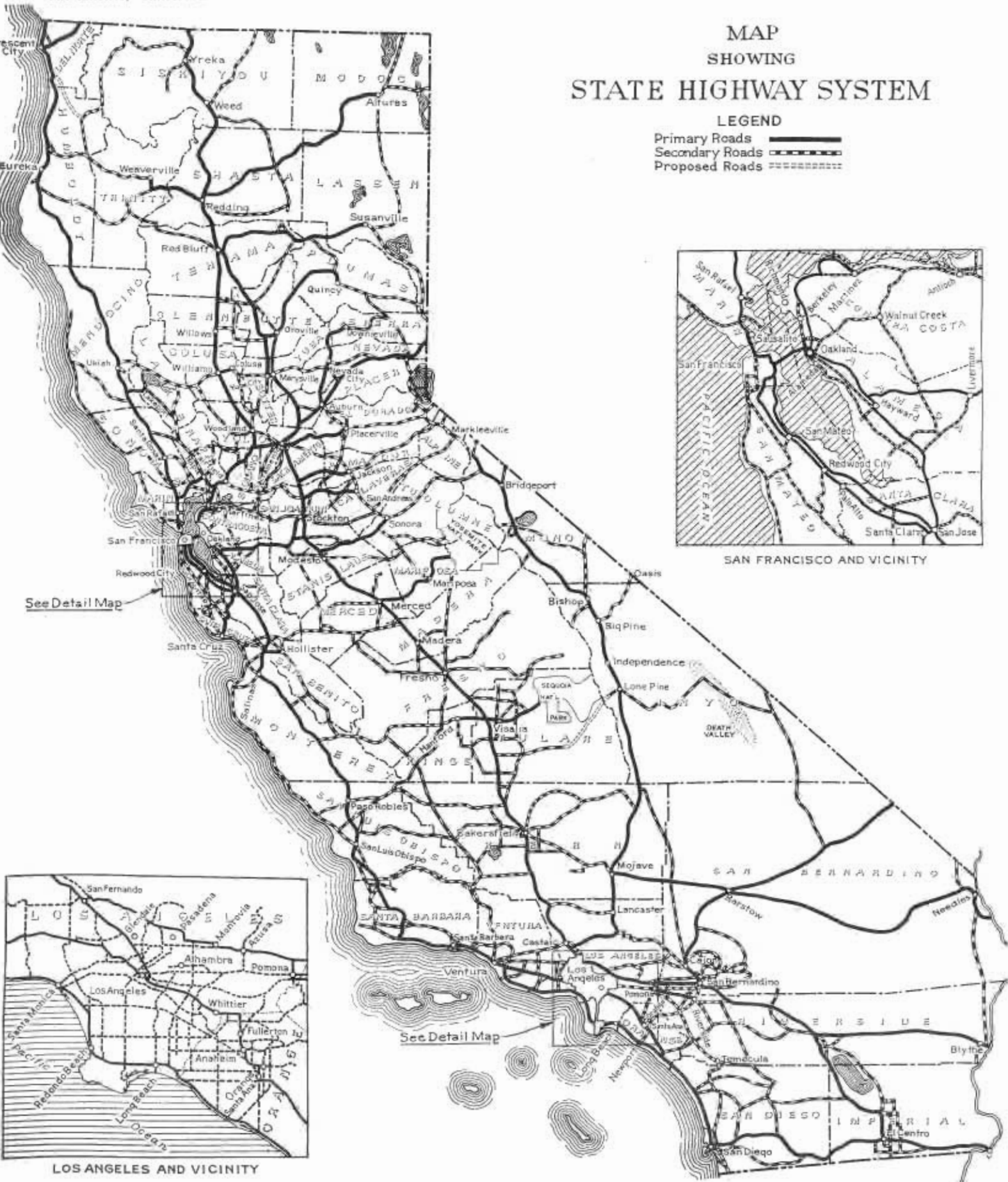
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STATE HIGHWAY SYSTEM

LEGEND
 Primary Roads —————
 Secondary Roads - - - - -
 Proposed Roads = = = = =

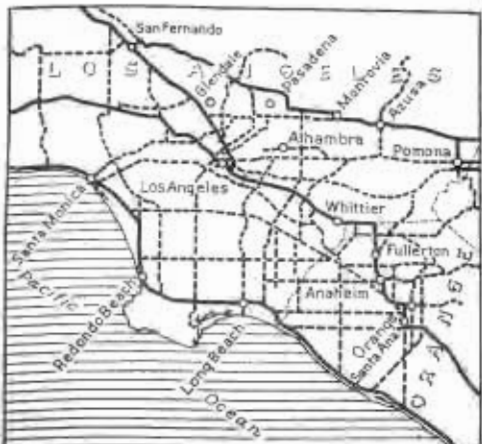


SAN FRANCISCO AND VICINITY



See Detail Map

See Detail Map



LOS ANGELES AND VICINITY