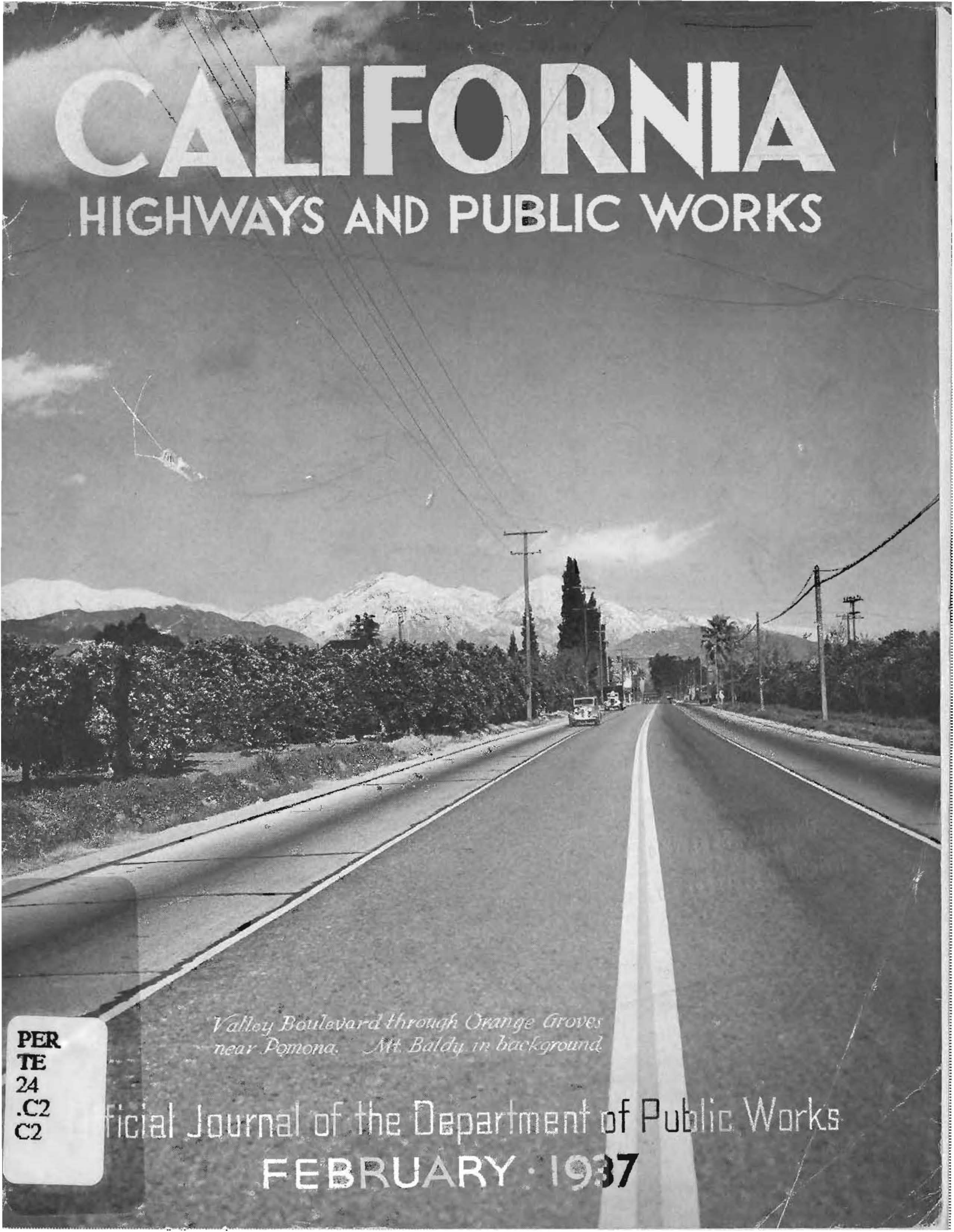


CALIFORNIA

HIGHWAYS AND PUBLIC WORKS



*Valley Boulevard through Orange Groves
near Pomona. Mt. Baldy in background*

Official Journal of the Department of Public Works

FEBRUARY 1937

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

EARL LEE KELLY, Director

C. H. PURCELL, State Highway Engineer

JOHN W. HOWE, Editor

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2,350 Miles of Highway Improved; 82 Bridges, Grade Separations Built in 1936

By GEORGE T. McCOY, Assistant State Highway Engineer

DURING the calendar year of 1936 construction and maintenance activities of the California Division of Highways reached a total of \$40,190,200. Of this amount \$29,929,900 is the cost of construction work put under way during the year and financed from State and Federal funds.

Of this total for construction \$18,363,900 represents the amount which was allotted from money derived from State revenues and \$11,566,000 is the amount on which Federal reimbursement will be made.

These figures show that the construction program placed under way during 1936 was made largely possible by Federal contributions from funds provided by Congress for the Works Progress Administration and regular Federal aid for State highway construction authorized for the fiscal years ending June 30, 1936 and 1937, under the Hayden-Cartwright Act.

Approximately 39 per cent of the entire construction program was financed by these Federal funds.

ORIGIN OF FUNDS

Segregation of the amounts and percentages making up the total for contracts to the various funds is shown in the following tabulation:

Funds	Amount
Regular Federal Aid (1936 and 1937)-----	\$6,788,000
Emergency Relief Appropriation—	
(WPA) -----	4,778,000
State Highway -- -- --	18,363,900
Total -----	\$29,929,900

In the foregoing tabulations the State highway funds include expendi-

tures from revenues to the Division of Highways from the gasoline tax and motor vehicle fees for construction, minor improvements, betterments, and contracts financed from one-fourth cent funds allocated to cities.

The total amount of construction and maintenance put under way between January 1 and December 31, 1936, and represented by the \$40,190,200, may be segregated to the various classifications of work as follows:

Construction -----	\$29,929,900
Minor Improvements ---	1,136,600
Betterments -----	1,804,000
Maintenance -----	7,319,700
Total -----	\$40,190,200

2350 MILES IMPROVEMENT

Progress of construction activities on the State highway system as gauged by the \$29,929,900 of construction undertaken during the year for a total of 2350 miles of highway graded, surfaced, or oiled and 82 bridges and grade separations constructed is shown by the following tabulation giving types of improvement, mileage for each type and amount of money required for the work.

Type	Miles	Amount
Pavement -----	214	\$7,709,600
Bituminous treated crushed rock surface -----	357	8,294,900
Untreated crushed rock surface ---	83	1,236,100
Graded roadbed --	170	4,434,400
Oiled roadbed and shoulders and seal coat ---	1526	1,720,300
Bridges and grade separations -----(82)		3,325,100

Type	Miles	Amount
Miscellaneous construction -----		3,209,500
Totals -----	2350	\$29,929,900

On January 1, 1937, the Division of Highways entered the last quarter of the current biennium with only about fifteen budgeted projects, amounting to some \$2,700,000, remaining to be placed under way before the beginning of the new biennium on July 1st. This favorable condition places the Division of Highways in position to begin work in preparing the plans and specifications on major projects, estimated to cost \$27,576,900, included in the proposed budget for the 89th and 90th fiscal years as soon as the State Legislature adopts the budget.

This amount of \$27,576,900 for major project construction will be made possible by \$9,500,000 in regular Federal aid apportioned to California for the biennium and \$18,076,900 in funds from State revenue. These Federal funds were appropriated by Congress under the act of June 16, 1936, which amended the Federal Aid Highway Act.

FEEDER ROAD FUNDS

In addition to these funds California is to receive under authority of this act approximately \$1,900,000 for secondary feeder roads and \$3,744,000 for elimination of hazards at railroad grade crossings. However, until Federal rules and regulations governing expenditure of the \$5,644,000 have been received the amount can not be included in the budget.

Construction placed under way during 1936 included, as some of the

(Continued on page 9)

Four Grade Crossing Projects Completed in Los Angeles

By DON WARREN, Senior Bridge Engineer

FOUR grade separation projects recently completed in Los Angeles are at Mission Road, Soto Street and Valley Boulevard, Soto Street between Pico Street and Washington Boulevard, and at Firestone Boulevard.

These projects have all been financed from funds set aside by the Federal Government to be used on grade separation projects. On these projects the State acted as an agent for the Federal Government, contracting and supervising the construction.

The projects were intended to relieve labor and carried the condition that, as far as practical, labor was to come from the relief rolls and that labor be confined to one hundred thirty hours per month. It also stipulated that railroad work could be done by the railroad forces.

CARRIES FOUR R. R. TRACKS

The largest of these projects is the Mission Road Grade Separation, which carries four lanes of Pacific Electric tracks over the junction of Mission Road with Huntington Drive North, Huntington Drive South and Soto Street. This project was built at a cost of \$434,000. At this point the traffic count of 1932 showed 43,000 vehicles, and the railroad record of 1935 gives 560 Pacific Electric trains daily.

This structure is built on the location of the old trail which was followed by the padres from the Mission San Gabriel to the settlement of Los Angeles. The evolution in vehicular traffic from the ox-cart days was evidenced by the old bridge structures and culverts uncovered during the construction of the foundations.

The project is 2600 feet long, which includes the railroad approach fills. The main structure, which is 490 feet long, contains 5800 cubic yards of concrete and 875,000 pounds of structural steel. The approach fills provide for a maximum of 1.70 per cent railroad grade.

TRAFFIC WAS CONTINUOUS

The project was planned so that stage construction provided for continuous flow of railroad traffic. The first construction was the placing of retaining walls to confine the railroad fill north of the crossing and also south of it along Soto Street. Then while cast-in-place piles were being driven for the east side of the structure through soft fill material, the railroad forces deposited and compacted the east half of the railroad approach fill.

At the completion of these approaches the supporting members of the main structure were in place and the railroad cranes, moving over the newly constructed approach fill, placed the structural steel girders and beams which span the highway.

EAST HALF BUILT FIRST

During this stage of construction the Pacific Electric trains were confined to the two westerly tracks. On completion of the easterly half of the structure the trains were routed over the structure, the westerly tracks removed, and the westerly half of the project constructed in a manner similar to that of the easterly one.

As an aid to the motoring public the main piers are illuminated with sodium vapor lights, and traffic stripes are provided to confine the flow of traffic to the four roadways under the structure.

ROUTE TO RACE TRACK

It is over this feeder road that a large percentage of the race track enthusiasts find their way to the Santa Anita Race Track, and it is through this structure that the throngs will pass on New Year's Day to attend the Pasadena Tournament of Roses and football game.

Another grade separation is at Soto Street and Valley Boulevard where the through traffic along Soto Street is carried over both the main line track of the Southern Pacific Rail-

road and Valley Boulevard. This overhead structure eliminated a sag in grade as well as the hazards inherent in a blind street intersection combined with a grade crossing of a main line track.

This project is 2200 feet long, and has gentle approaches. To prevent the flow of traffic from Valley Boulevard over the Southern Pacific tracks, Soto Street was deadended at this point. However, provision has been made for the flow of traffic north from Valley Boulevard to Soto Street.

TRAFFIC ISLAND CONSTRUCTED

To minimize traffic friction on this approach, a well lighted traffic island has been placed at the junction of this approach with Soto Street.

This Feeder Road project was completed October 31, 1936, at a total cost of \$235,000.

This structure, paralleling the Pacific Electric Railroad Separation over Valley Boulevard, fits pleasingly into the natural surroundings. The roadway, which is protected with an ornate metal handrailing, is supported on steel girders and the graceful substructure makes this overhead one of the most pleasing and outstanding grade separation structures in Los Angeles.

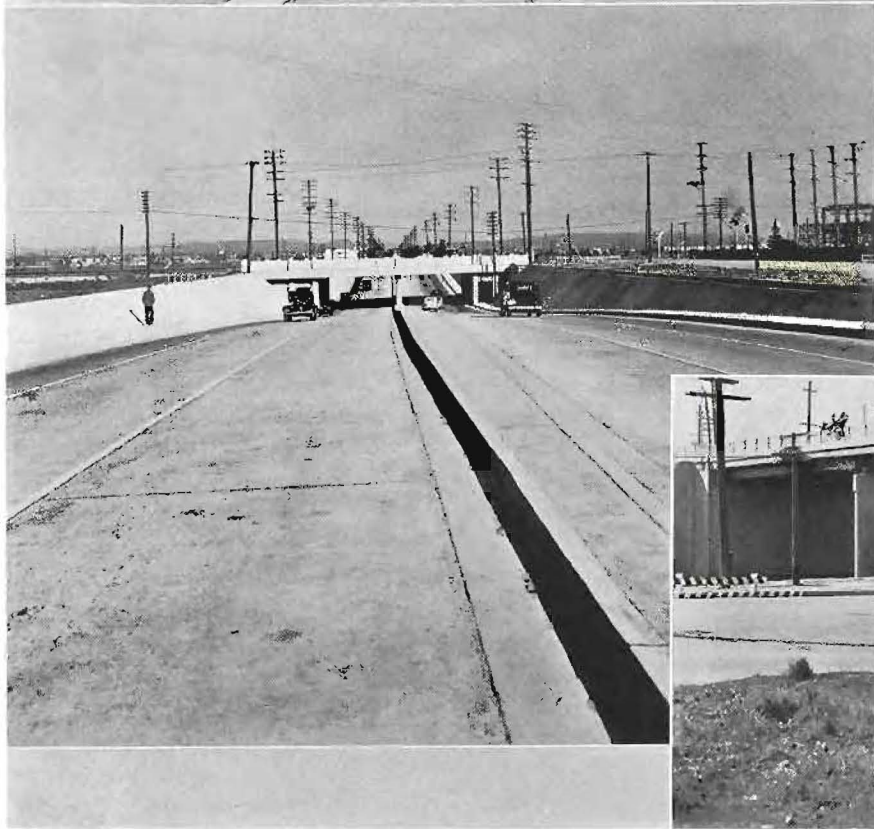
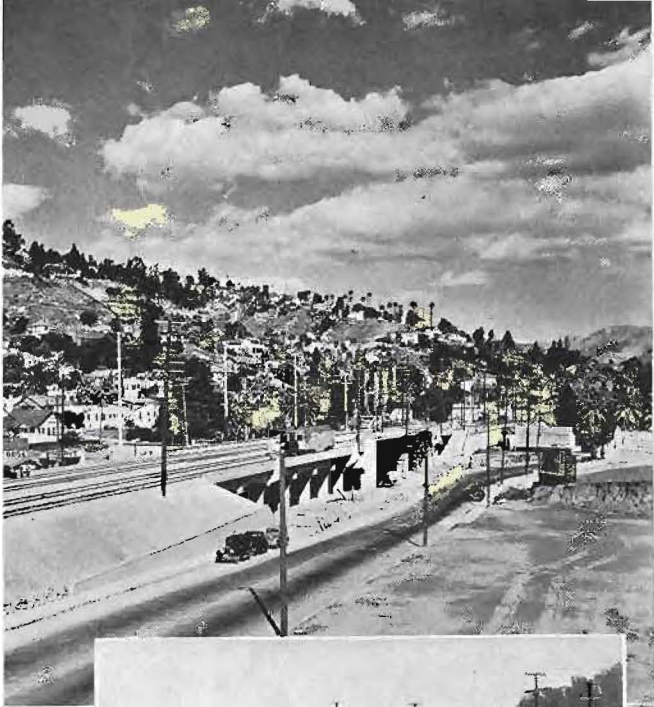
Another grade separation on Soto Street is between Pico Street and Washington Boulevard where the heavy vehicular traffic along Soto Street has been carried under two structures which support the Omaha to Los Angeles main line and the Pasadena tracks of the Union Pacific Railroad.

AUTO TRAFFIC DETOURED

This subway provides for a clear width of fifty-six feet of roadway with five foot sidewalks along either side. The sides of the subway cut are paved with concrete.

During construction the vehicular traffic was detoured around the project

(Continued on page 12)



Four grade separations in the Los Angeles Metropolitan area are shown in this group. At top, left, 2600 foot structure across intersection of Mission Road, Huntington Drive and Soto Street where traffic count showed daily movement of 43,000 vehicles and 560 trains. Inset shows old grade crossing. At top, right, structure carrying 600 interurban trains over Firestone Boulevard that shows a daily movement of 20,000 autos. Inset is view of old grade crossing. At bottom, left, structure carrying Santa Fe railroad tracks over four-lane, divided roadway of Atlantic Boulevard. At right, a 2200 foot structure at intersection of Valley Boulevard where through vehicular traffic on Soto Street is carried over both the main line Southern Pacific tracks and Valley Boulevard traffic.

Vacaville By-Pass on U. S. 40 Under Construction

By R. E. PIERCE, District Engineer

THE Vacaville By-Pass, another unit in the plan for shortening and improving State Highway (U. S. 40) between San Francisco, the bay area and Sacramento, is now approaching completion.

This unit, approximately 2½ miles in length, starts at the easterly end of the recently completed Orchard Line Change, southwest of Vacaville, and keeping south of the built up section of the town runs by very direct alignment to the present road about one-half mile east of Vacaville.

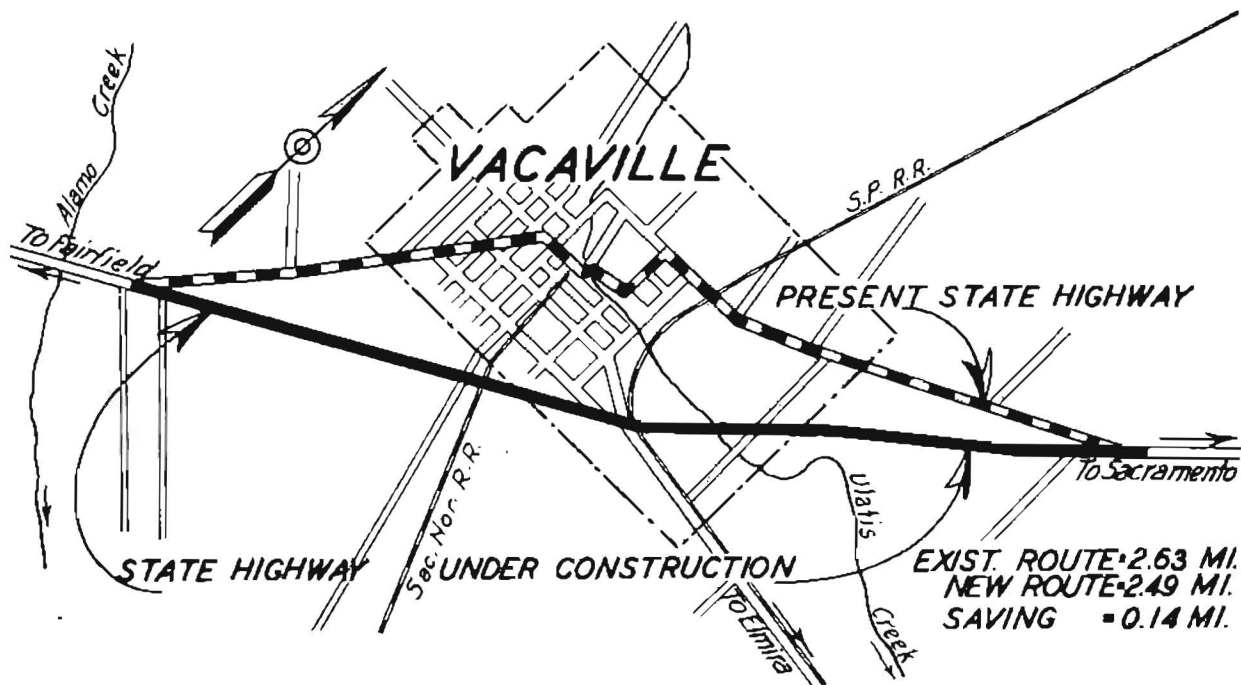
sists in general of constructing a graded roadbed 36 feet wide, placing a layer of selected material over the graded roadbed which has previously been treated by a bituminous roadbed seal and placing a Portland cement class "B" concrete pavement twenty feet wide and 0.55 foot thick, increasing to 0.75 foot at the outside edge from a point two feet inside each edge.

The pavement is to be laid in ten foot strips, which are tied together by tie bolt assemblies.

of the Bay Bridge. The much lighter concrete, it being about two-thirds the weight of ordinary concrete, made these piles much easier to handle and also took only two-thirds as long to drive, as compared with the other piles.

Also in spite of less crushing strength, as shown by laboratory tests, there was absolutely no sign of failure in either of the test piles, while considerable spalling took place in some of the regular piles.

This By-Pass is the fifth project of



This improvement eliminates entirely the narrow, crooked, congested streets of Vacaville, and will be a great help in expediting through traffic, as well as giving the local people a freer use of their streets with greater safety. Both the high school and grammar school are on the existing route through the town and the removal of the through traffic will remove the hazard to children who are forced to cross this street.

The contract now under way con-

A reinforced concrete bridge, with concrete pile bents, has been constructed over Ulatis Creek. This bridge has one 23-foot span at each end and a 30-foot span in the center, and is of the reinforced continuous slab type.

It has a 34-foot roadway with three-foot sidewalks on either side.

Two piles were constructed using a special light weight aggregate. This is a burned clay, the same material used in the paving of the upper deck

importance in the series on this important road which has been completed to date.

The following are listed in order of completion, showing saving in distance:

Cordelia Cut-off	0.4 miles
Cordelia-Fairfield Cut-off	0.75 miles
Orchard Line Change	0.75 miles
American Canyon Cut-off	6.00 miles
Vacaville By-Pass	0.14 miles
	<hr/>
	8.24 miles

(Continued on page 12)



Scenes on the Vacaville realignment project, an improvement to a unit of State highway (U. S. 40) between Sacramento and San Francisco, by-passing the narrow and crooked streets of a congested section of the city of Vacaville. At top, new bridge and end of completed pavement where existing highway enters city on a curve. New alignment, rough graded, extends in direct line to connection with highway one-half mile east of city. Center, left, narrow bridge and street passing two schoolhouses, and at right, short radius "S" curves, schoolhouse in background. At bottom, a large cut on the new alignment.

Olympic Boulevard Developing as Major Los Angeles Arterial

By S. V. CORTELYOU, District Engineer

A CRITICAL traffic situation faces the motor vehicle operators in the metropolitan area of which the city of Los Angeles is the center. According to the 1930 United States Census, the population of Los Angeles City was 1,240,575, and of Los Angeles County 1,891,964; the latter figure being one-third the total population of the State. Of the 2,132,350 motor vehicles (automobiles and trucks only) registered in the State for 1935, Los Angeles County had 867,866, or 40.7 per cent of the total vehicle registration in the State.

Naturally, with the large number of motor vehicles in Los Angeles County at present, which number is increasing steadily, the problem of providing relatively safe, convenient and unobstructed ways for the flow of this traffic is constantly becoming more difficult and more expensive to solve. Probably the greatest mileage of vehicular traffic develops in traveling to and from the down-town business area for those persons who work in the city and those persons who come

in to transact business or enjoy the various theaters and other amusements.

TRAFFIC LOAD INCREASING

The population and the motor vehicle registration are increasing at a more rapid rate than the facilities that the city, county and State have been able to plan and construct to take care of this increasing traffic load. It is, therefore, essential that the general public become conscious of this situation so that they will authorize their public authorities (city, county, State and Federal) to plan for the more important major traffic arteries to help carry this load.

The development by Los Angeles City and the State Division of Highways of the Ramona Boulevard-Garvey Avenue route leading from Los Angeles easterly is a step in the right direction and is intensively used.

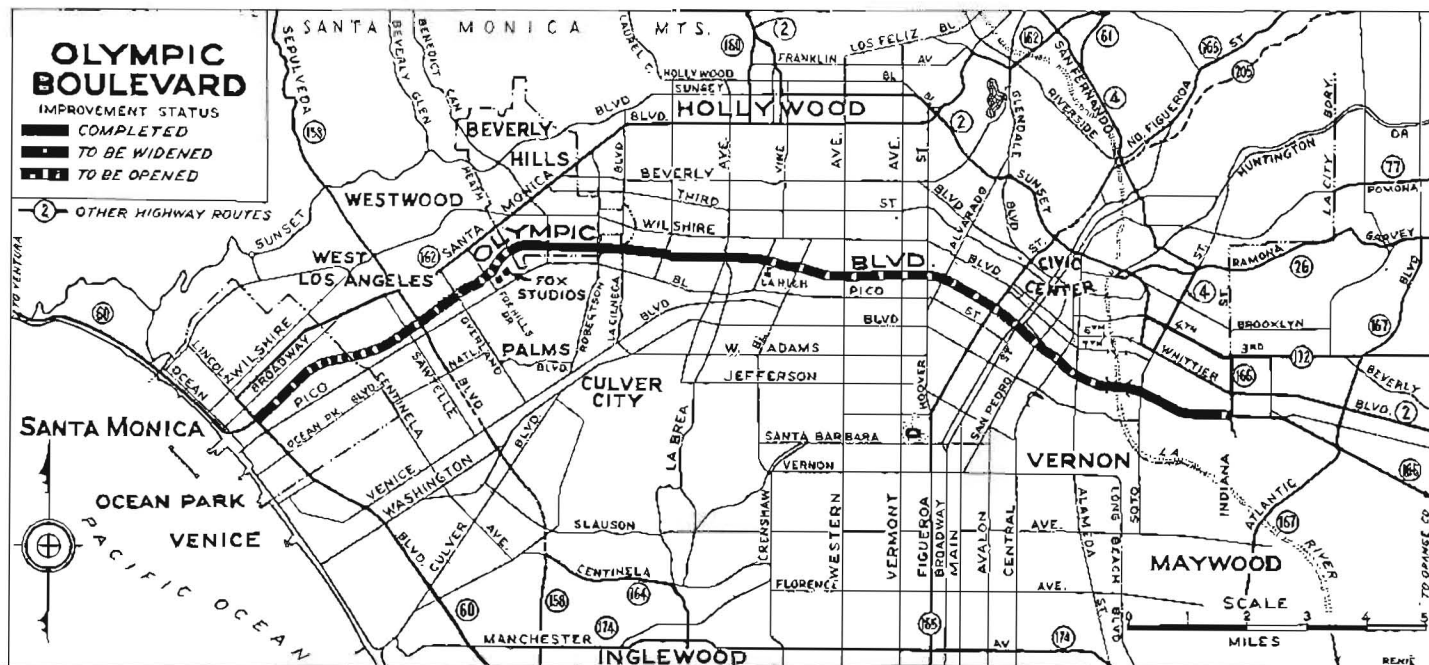
Another artery which takes advantage of natural topographic conditions will be the Arroyo Seco Parkway, State Highway Route 205, with

its connection to Figueroa Street, Route 165. The latter street has been developed particularly from Sunset Boulevard northerly by Los Angeles City, with a viaduct over the Los Angeles River and the Union Pacific tracks now under construction by State contract. Figueroa Street leads from the ocean through the center of Los Angeles to the mountains, and will be one of the major north and south traffic arteries.

OFFICIALLY NAMED OLYMPIC

One of the most important east and west traffic boulevards, if not the most important, will be Olympic Boulevard, State Highway Route 173, running from Route 60 at Santa Monica, as indicated on the accompanying map, easterly on what is now known officially as Olympic Boulevard, to the east city limits of Los Angeles.

This street name was officially given by the city councils of Los Angeles and Santa Monica to State Highway Route 173, which follows streets formerly known as Pennsylvania Avenue



Aerial view showing the route of Olympic Boulevard, the new East-West arterial, from Los Angeles to the sea at Santa Monica.

A—This portion is the proposed line through the Westwood Hills golf course and the property of the Twentieth Century-Fox Film Company, the latter right of way recently donated by the company.

B—Is the Louisiana Avenue link.

C—A mile of recently dedicated, opened and partially completed roadway.

D—The Pennsylvania Avenue link through Santa Monica.



Spence Aerial Photo

Courtesy Los Angeles Times

in Santa Monica, connecting with the extension of Louisiana Avenue and Tenth Street in Los Angeles, with an angling connection with Ninth Street east of San Pedro Street in Los Angeles, and thence following the old Ninth Street route to the east city limits of Los Angeles at Indiana Street. At this point it joins State Highway Route 166, generally known as the Anaheim-Telegraph Road.

STARTED FIFTEEN YEARS AGO

The development of this traffic artery was started by a group of far-seeing, public-spirited citizens about 15 years ago. This group, now known as the Olympic Boulevard Improvement Association, has taken a very active and helpful attitude in cooperating with public authorities and property owners to forward the acquisition of rights of way and construction of the road.

The Los Angeles City Engineering Department, under City Engineer Lloyd Aldrich, and under his predecessors, has done a large amount of work, not only in studies of the proper routings, but in making de-

tailed plans for acquisition of rights of way and construction of the street. A number of official efforts were made to have rights of way acquired and various portions of the route constructed under assessment district proceedings, the last proceedings having been vigorously protested by the people in the proposed assessment district, and were abandoned by the city council on February 23, 1933.

These proceedings had been carried out to a point where the necessary rights of way for the Tenth Street opening and widening proceedings were carried through court, and an interlocutory judgment was entered in the sum of \$12,215,175.90, plus incidental expenses estimated at \$175,000, covering the portion of Olympic Boulevard from Lucerne Boulevard to Indiana Street.

MUCH PROPERTY DONATED

It was felt by the people that the assessments for the opening, widening and improvement of this street would be excessive and should not be borne by an assessment district, but should be paid from public funds.

Considerable progress has been made since the abandonment of the old assessment district proceedings, and great credit should be given to the Olympic Boulevard Improvement Association, under the able leadership of Mr. James C. Dolan, its president, and to Dr. J. Dryden Davenport, president of the Louisiana Street Property Owners Association, who has personally secured donations of many important pieces of right of way.

Olympic Boulevard was made a State highway route by the State Legislature in 1933. Since this time the State Division of Highways has been cooperating with the city, working to eliminate the jogs and poor alignment which tend to prevent the use of the route by the public.

By examination of the accompanying map it will be seen that from Heath Avenue, the west city limits of Beverly Hills, to Rimpau Avenue near the Los Angeles High School, the street has been fully developed, being paved full width, approximately 74 feet between curbs.

The right of way has been secured



Completed portion of Olympic Boulevard in Los Angeles showing high class character of real estate development along the new arterial from the city to the sea at Santa Monica.

for the diagonal connection from Lucerne Boulevard to Bronson Avenue, and construction work is now progressing under a contract which has been let by the city of Los Angeles for the improvement from Rimpau Avenue to Bronson Avenue.

Before the award of this contract a very important step was taken by city authorities to guarantee the most efficient use of this boulevard. At the request of the State Division of Highways, and upon recommendation of the city board of public utilities, the city council refused to give a long-time extension to the Los Angeles Railway for the street car line which followed the Olympic Boulevard route generally from Hoover Street westerly to Victoria Avenue.

The street car company applied for a franchise to construct their tracks in the new right of way of the diagonal cutoff from Lucerne to Bronson. If this had been granted by the city authorities, the traffic carrying capac-

ity of the street would have been very materially reduced and the hazard to pedestrians and motorists both would have been greatly increased, inasmuch as all of the street car passengers would have to walk from the curb to the safety zones in the center of the street, crossing lines of automobile traffic. The safety zones themselves and the impaired use of the area occupied by the tracks would decrease the ability of the street to carry automobile traffic.

ASSOCIATION FOUGHT TRACKS

The Olympic Boulevard Association carried on an energetic campaign to guarantee the removal of the street car tracks and the installation of a bus service. A temporary extension of the Los Angeles Railway Company's franchise was made for three years, as this was the period estimated by the city which would be required for the acquisition of rights of way and the construction of the street

between Hoover Street and Bronson Avenue. The Los Angeles Railway Company officials have indicated that they are in full accord with the program of installing bus service at or before the end of the three year extension of their franchise.

The city is busily engaged in acquiring the right of way to eliminate the jog from Hoover easterly, and has already opened the street for the first block east of Hoover Street. The city is also appraising property and negotiating for the right of way to eliminate the jog at Figueroa Street.

FILM COMPANY DONATES

A very important development occurred recently when, after a conference between Dr. J. Dryden Davenport, president of the Louisiana Avenue (Tenth Street) Property Owners Association, Mr. James C. Dolan, president of the Olympic Boulevard

(Continued on page 20)

Olympic Boulevard pavement was stopped at Fox Film company property pending acquisition of Right of Way which the company recently donated to the State. Larger sound stage building in background.



Many Large Highway Projects Completed During 1936

(Continued from page 1)

larger projects on heavily traveled routes, the following work:

On the Coast Route between San Francisco and Los Angeles ten major contracts provided for reconstruction, paving and surfacing on 46 miles of highway aggregating \$1,786,500 in cost. These contracts included such important improvements as grading and surfacing on the Conejo grade in Los Angeles and Ventura Counties, paving between Bradley and 6 miles south of San Ardo in Monterey County, widening and paving the 10 miles south of San Jose to Coyote and the new wide pavement between San Mateo and Redwood City on the Peninsula.

COAST ROAD IMPROVEMENTS

In San Diego County four contracts amounting to a total of \$1,035,500 provided for reconstruction of 15.6 miles of the main highway from Los Angeles to San Diego between Del Mar and Encinitas, Oceanside to the Las Flores underpass, a bridge across the Santa Margarita River and on Main Street in the city of San Diego.

In the San Joaquin Valley on the Los Angeles-Sacramento highway six contracts totaling \$829,400 were awarded for reconstruction projects on 45.6 miles of this heavily traveled arterial. Two of these contracts provided for widening and paving from Belmont Circle to Herndon north of Fresno and a third was for paving 11.7 miles south of Bakersfield.

Probably the largest single project undertaken during the year was the construction in Marin County of the Waldo approach to the Golden Gate Bridge. This northerly approach to the world's longest span suspension bridge connects with the Redwood Highway at Waldo Point just north of Sausalito. The work is being performed under two contracts, one for the grading and surfacing of 2.8 miles of highway and the other for the construction of a 1000-foot concrete lined tunnel. The total cost of the project is \$1,716,322.

NILES REALIGNMENT PROJECT

Another large project in the Bay area was located on the Oakland-San Jose route at Niles in Alameda County. Work under this contract

involved the realignment of the highway, construction of six grade separations with the tracks of Southern Pacific Railroad and Western Pacific Railway and a bridge across Alameda Creek. This improvement is estimated to cost over \$600,000.

In Los Angeles County the State has awarded contracts amounting to more than \$900,000 for construction and improvement of 8.8 miles of Sepulveda Boulevard, the largest section being that between San Fernando and Brand Boulevard.

Over \$300,000 was expended for improving and widening the Foothill Boulevard, chiefly on the 8 miles between Azusa and Claremont. During the year further work on the construction of the Rosemead-Cerritos Avenue project which connects Pasadena with Long Beach, included about 9 miles of pavement and surfacing, one bridge and one grade separation amounting in cost to over \$400,000.

TEN JOBS COVER FIFTY MILES

Nearly \$1,000,000 in contracts were placed under way on State Highway 26 which connects Los Angeles with El Centro. While no one of the contracts was very large the 10 major ones provided for improvement to nearly 50 miles of highway in Los Angeles, San Bernardino, Riverside and Imperial counties.

In desert sections of California the State highway across Death Valley was improved to the extent of about \$225,000 and 21.1 miles graded and surfaced.

Construction on the East Shore Highway in Berkeley has provided some 5.8 miles for the northerly approach to the San Francisco-Oakland Bay Bridge. Three contracts awarded in 1936 for this work amounted to \$350,000.

LAST BAYSHORE SECTIONS

About \$385,000 provided for the last sections in the construction of the Bay Shore Highway between San Francisco and San Jose and resurfacing of the heavy fill section between Redwood City and San Mateo.

On the Sacramento-Truckee route three contracts were awarded east and west of Donner Summit covering a distance of about 9 miles and cost-

ing \$434,500. This work provided a much needed improvement of this section of U. S. 40 across the high Sierras where snow plows are kept continually in operation during storms.

Reconstruction of the Walnut Creek-Oakland road has provided a modern highway in Contra Costa County which will connect with the low level Broadway tunnel now under construction in the Berkeley Hills. Two contracts for grading and surfacing this road from the easterly tunnel entrance to Walnut Creek amounted to \$675,000.

Under the conditions governing the expenditure of Works Progress funds stipulation was made that a certain percentage of the Federal funds should be expended for improvement to Federal roads not on the State Highway System. During 1936 the Division of Highways awarded nine contracts for such work amounting to \$1,516,180 and providing for construction of 45.4 miles of county roads and 3 grade separations. The work was well distributed over the State, involving construction in San Diego, San Bernardino, Imperial, Los Angeles, Santa Clara, Alameda, Sacramento and Mendocino counties.

1,617 Miles of Gotham Roads Need Widening

New York State, possessing the most people, the most motor vehicles and the busiest roads, faces a road construction problem perhaps unequaled by any State.

A large task is confronted in highway widening alone, reports E. C. Lawton, assistant commissioner of construction, division of highways.

"By 1940, 1,617 miles of the State system should be widened to three lanes and 929 miles to four lanes," says Mr. Lawton. "When it is considered that there are only 770 miles of three-lane pavement and 229 miles of four-lane pavement in the State, the magnitude of the problem which confronts the Department of Public Works can be realized."

Beggar—Excuse me, sir; you gave me a counterfeit bill.
Gentleman—Keep it for your honesty.

Construction History of San Francisco Bay Bridge

By CHARLES E. ANDREW, Bridge Engineer

(Excerpts from Address at Convention of American Association of State Highway Officials)

DURING the past four years San Francisco has enjoyed the unique position of having within its borders the construction of the world's two largest bridges. These two great projects have had a very profound influence during the recent depression, not only locally, but nationally. As a matter of fact, San Francisco and the bay district have, on account of these projects, felt the depression less than any other part of the nation.

To date eighty millions of dollars have been spent, fifty-two millions of which have been expended on the San Francisco-Oakland Bay Bridge and twenty-eight millions on the Golden Gate Bridge. Approximately 10,000,000 man-hours of labor have been used locally and nearly an equal amount elsewhere in cement mills, steel mills, fabricating shops, etc., on the construction of the Bay Bridge.

Inasmuch as this is probably the first so-called major bridge and certainly the largest bridge that has been wholly designed and constructed by any State highway department, the general plan of organization will be of interest to you as State highway officials.

BRIDGE AUTHORITY CREATED

The laws governing and authorizing the San Francisco-Oakland Bay Bridge are primarily somewhat general, as they permit the construction of self-liquidating bridges anywhere in the State.

They create a body known as the Toll Bridge Authority, consisting of the Governor, Lieutenant Governor, Director of Public Works, Director of Finance and chairman of the Highway Commission. The Toll Bridge Authority is a fiscal body, directing where bridges shall be built under the act, issuing and selling bonds secured only by tolls, fixing rates of tolls, and finally redeeming bonds.

The Chief Engineer of the Toll Bridge Authority is the State Highway Engineer.

Under the law the designing, constructing, maintaining and operating are responsibilities of the Department of Public Works, of which the Highway Division is a part. After completion, the bridge becomes a part of



C. E. ANDREW

the highway system. The San Francisco-Oakland Bay Bridge is a project under this general law. Should it be found advisable or for the public good, other bridges, if self-liquidating, can be built in a similar manner and setup.

As organization history, all of the original studies of foundation condi-

tions, bridge location, design studies, estimates and financial considerations were made and assembled by the State Bridge Department in Sacramento during the latter part of 1928, 1929 and 1930, and constituted the body of the Hoover-Young Report, through which the permit from the Army Engineers was granted to build the structure. Estimates of cost of seventy-seven millions for the completed bridge made in 1929 are within a very small percentage of the actual final cost.

Late in 1931, a design office was established in San Francisco to make detailed design plans. The general organization then established was a chief engineer who was also the State Highway Engineer, a bridge engineer in general charge of design and construction, a design engineer in direct charge of design, and four resident engineers in direct charge of construction; also, an engineer in charge of triangulation and surveys and a right of way department.

Detail design plans for foundations were completed late in 1932 and bids received in March, 1933. Work was under way by June 1, 1933. Since that time contracts have been let and completed in scheduled sequence with such precision that practically no time has been lost because one contractor lagged behind the others.

FEDERAL COOPERATION

I consider that this project has enjoyed the finest possible cooperation with the Federal government and all its agencies. Our problems might easily have become difficult and involved, but we have always found that frank discussion and honesty of purpose will always receive fair consideration and just conclusions from all the Federal agencies with which we were required to deal.

Our financial problems were, of course, intricate, involving as they did

intensive traffic and income studies and requiring long and more or less tedious reports. Here again our relations with the Reconstruction Finance Corporation were most pleasant. We have found that they "must be shown," but when shown they are eminently fair and excellent business men. We have always given them our financial problems in an open, frank, and complete manner and have received the finest possible treatment in return. They have shown implicit faith in our designs, construction, and expenditure of funds. They have offered no interference and have been extremely prompt in decisions.

Likewise our relations with the Bureau of Public Roads have been most pleasant and in fullest cooperation. They, too, have shown faith in our designs and construction and we have not broken faith with them.

New Bridge Precedent

It is probably presumptuous to say that there is anything really new in engineering in these days of great engineering projects such as dams, bridges, power plants, etc.

I do, however, feel safe in saying that even though there is nothing new, at least we have gone beyond precedent in many phases of bridge building which may have been done on a smaller scale heretofore. These unprecedented things not only apply to engineering, but also to contractor's operations. I could not here recount all the exceptional phases of this project, neither can I go into great detail.

There are, however, several outstanding features which I shall mention later in some detail with pictures and if questions are asked in further detail I shall be glad to attempt to answer them.

Romance in Foundations

The romance of bridge building is, I believe, quite considerably confined to foundations. Superstructures, of course, require great skill and study, but for the most part are capable of, and confined to, mathematical computation and strength of materials. Generally speaking, they are finite in character.

On the other hand, each foundation is a problem in itself. Each foot of the way to rock or other suitable material may develop some new problem or situation which can not be predetermined.

In the locating and designing of the piers for this structure some \$250,000 were spent in prospecting foundation material. Not only was the foundation material carefully studied, but great care was taken in determining the character of material through which the caissons were sunk to reach final foundation. Data so obtained were invaluable both to the designer and the contractor. The great care taken in these foundation surveys resulted in almost an exact check in final construction and we may without doubt attribute our success very largely to this advance information.

Piers in Deep Water

Piers have been sunk in two cases to over 240 feet below water, and in several other cases well over 180 feet on this project. In the East Bay, rock was at such great depth that it could not be reached and we were forced to rely on sandy clay for foundations. Intensive study was made of these materials and the result has been that no settlement has been observed worthy of note.

Much has been written of the details of the Bay Bridge foundations, and no doubt most of you are familiar with them, so I will not attempt to enter such a large subject here. Suffice it to say that I believe the methods used and the results obtained here will stand as an outstanding achievement, and lend encouragement to engineers and contractors in attempting greater depths if the future demands.

Another World's Greatest

Among the list of world's greatest things accomplished on the Bay Bridge is the Yerba Buena Island tunnel. Yerba Buena Island is geologically made up of very badly shattered shale and sandstone. The tunnel excavation required a bore approximately 80 feet wide by 80 feet high. The method of excavating constituted primarily two side wall headings and a crown heading. Rock was then stroyed out in alternate sections of about 20 feet from the side headings to the crown headings. Temporary roof support was effected by 16-inch steel H-beams, 3-foot centers, bent to the arch of the roof. Placing of concrete lining followed very closely this excavation. In all cases the concrete lining was placed tight against the rockface. No backfilling was used except pressure grout. For the first time the concrete in the lining was placed by means of concrete pumps and vibrated into place with mechanical vibrators. We believe this method far superior to the former use of cement guns.

After the lining was complete, the upper deck road was placed and the upper tunnel section lined with tile.

No Cave-ins Occurred

In spite of the extremely broken and faulted character of the rock and due to the constant vigilance of both engineers and contractors, no cave-ins of any consequence occurred.

For the first time in major bridge design and construction the twin suspension type of superstructure with central live load anchorage has been used.

The long backstay in San Francisco injected some considerable question of deflection when combined with the long side spans necessary. Connection of the cables to the central anchorage in order to transfer unbalanced live load to the structure was new in bridge design.

In the East Bay we have the longest cantilever span in the United States, a 1400-foot span. Due to its great clearance height, rough uncertain water, and great weight, the suspended span could not be lifted, but was cantilevered out 700 feet from each tower.

In order to tie the structure together as much as possible longitudinally against earthquake influence, portions of the bridge up to 5,000 feet in length were constructed without expansion joints. This fact has required expansion joint design twice as long as ever before. In high-speed electric rail tracks this becomes a major problem.

As to contractor's problems, many are novel and outstanding.

First, the foundation contractor's problems, which are extensively covered in former publications. Suffice it to say that the outstanding success which they enjoyed was due to new and excellent equipment,

high-class supervision and personnel, and last but not least, a very close cooperation with and attention to engineers. All of them made satisfactory profits and would like to do the job over again.

In superstructure erection several new methods and devices were developed, among them the use of hammerhead cranes to erect the suspension towers, which proved to be a rapid and efficient method.

A new type of catwalk was used, the novelty being the use of wire mesh instead of plank for the walkways. A great reduction in wind resistance was effected as well as an efficient and rapid erection with less weight.

Double Spinning-Wheel

Cable spinning was largely conventional except the use of a double spinning wheel was perfected which greatly increased performance.

The erection of stiffening trusses was also new. Instead of the conventional method of erecting member by member, two panel sections were erected in a yard on railroad ways, loaded on barges, and towed to the bridge where they were hoisted into place by hoisting girders supported by the cables. The motive power consisted of hoists on the adjacent piers. Lifts up to 205 tons were made in this manner direct from barges in the bay below. As many as four sections were erected in a day.

All steel was shipped unpainted and sand-blasted in the yards before shipment to the site, the first red-lead coat being applied. After erection three additional coats were given.

Remarkable Painting Record

One of the most remarkable records made on the job is that of the painting contractor. His progress was such that within four weeks after the floor paving was finished, all surface, except a small amount of sidewalk and part of the lower floor system, was finished.

Over 125 painters were employed. The painting contractor's performance will stand as a record for a long time. It is of interest to note that the complete painting job on the San Francisco-Oakland Bay Bridge involves an expenditure of nearly \$1,700,000. Worthy of further note are some of the treatments and methods applied to concrete forming and placement. In no other bridge has the use of mechanical vibration of concrete been so exclusively used. Practically all of the 1,000,000 cubic yards have been mechanically vibrated. By the use of vibration we were able to reduce the water cement ratio to a minimum and at the same time obtain a sufficiently dense concrete with high strength and a minimum shrinkage. In this connection we have had no trouble in obtaining 4000-pound concrete consistently with five and five and one-half sacks of cement per cubic yard. Extensive use has been made of plywood panels for form work and by its use in connection with mechanical vibration concrete finishing was reduced to a minimum.

The placing of concrete floors on the structure was in itself a major contract and constituted the equivalent of approximately 18 miles of 20-foot pavement. The lower deck is 6½ inches thick and 31 feet in width.

(Continued on page 20)

Four Grade Crossing Projects Completed in Los Angeles

(Continued from page 2)

and the railroad traffic was provided for by stage construction.

The heavier girders for the railroad tracks weigh eighty-four tons each and rest on concrete abutments.

This feeder road project was opened for traffic on December 21, 1936, at a total cost of \$235,000.

The Firestone Boulevard Grade Separation provides for the carrying of the four high speed interurban tracks of the Pacific Electric Company over Firestone Boulevard.

Long gradual approaches carry these tracks to a steel structure which spans Firestone Boulevard.

Firestone Boulevard, a main trunk highway carrying traffic to the south, was estimated to carry 20,000 automobiles daily, and at this point the interruptions from train crossings were 600 daily.

During the construction of this project the Pacific Electric trains were confined to two "shoofly" tracks placed west of the structure. The construction required that retaining walls be built along Graham Avenue and Park Avenue, followed by the placing of the railroad approach fills and the pouring of the substructure for the spans across the boulevard.

The approach fill of 106,000 cubic yards was made by rail shipments from Long Beach. On completion of these fills the railroad cranes, working from the abutments, placed the structural steel girders and beams across the highway.

To provide for pedestrians a subway was constructed through the railroad fill and under the tracks at Eighty-fourth Street.

Three railroad stations, one at Eighty-fourth Street, one at Firestone Boulevard and one at Kent Station, were constructed for the convenience of local residents.

With the exception of a few hours when structural steel was being erected, traffic was permitted to pass through the project.

At a total cost of \$323,000 the project, including railroad work, was completed on February 6, 1937.

In addition to these four structures other grade separations have been built in the metropolitan area

Driver Crossed the Double Line: 1 Killed; 9 Hurt

(Editorial from Stockton Record)

Central California today has the grim lesson of what may happen when a motorist flouts the law governing the highway double line. In a crash at Paradise Cut involving three cars one man was killed and nine other persons were injured, several of them seriously. Had it not been for the cool head and skill of a bus driver, a motor stage would have been added to the pile-up of vehicles. From the evidence at hand, it all occurred because the man who was killed crossed the double line.

This type of highway marking is there for a definite purpose. In some places where the double line appears, the motorist can not always figure why it was put there. If he thinks no officer is in sight, he will take a chance by disregarding it. Sometimes he will get away with his infraction. But he is inviting tragedy by crossing the line.

The double lines were put on roads and highways under the direction of officials who know more about traffic hazards and danger spots than the average motorist. They were marked there to prevent such smash-ups as occurred last evening. When driving, see that YOU do not cross the double line!

of Los Angeles. These projects have been built entirely by funds authorized in the Grade Separation Program and were constructed under the direction of the Division of Highways.

These grade separations, which are located at some of the most dangerous crossings in the southland, are a great boon to the traveling public for they permanently eliminate hazard and interference and permit safe, free and uninterrupted flow of a great volume of highway and railroad traffic.

Advertising of Highways Held to be Good Business

IF MODERN highways are worth building they are worth advertising, in the opinion of Mississippi State highway authorities.

Advertising of attractive roads increases traffic on them with a consequent increase in purchases of gasoline and a corresponding rise in gasoline tax revenues. At least, that is the way Mississippi figures and it has appropriated \$100,000 to publicize its highway building program.

One Mississippi newspaper editorializes on the matter as follows:

Here's a business point of view. Mississippi is spending 42 millions on highways and \$100,000 on advertising. The more people who travel our highways the more gasoline will be bought and the more gasoline is sold the more taxes the State will collect to apply on the cost of these highways. It seems logical that \$100,000 be spent to encourage people to ride our 42 million dollars worth of highways.

VACAVILLE BY-PASS ON U. S. 40 UNDER CONSTRUCTION

(Continued from page 4)

Other possible changes will reduce the distance by another six miles, which if built, will make a total saving of 14 miles between Sacramento and the Bay Area.

This job is being done under contract by the firm of Fredricksen and Westbrook; the contract price is \$114,341. Considerable delay has been experienced due to rainy weather, but as soon as the subgrade dries out, rapid progress can be made.

Geo. Hubbard is the resident engineer for the State on the job.

GASOLINE TAX SHOWS INCREASE

California motorists used more gasoline in 1936 than ever before in the history of the State.

Increased use of motor vehicle transportation brought the revenue from December sales up to \$4,093,574.53, an increase of 20.02 per cent for the month to bring the annual total income from the 3-cent tax to a new record of \$48,286,080.92, it was announced by the State Board of Equalization which assesses the tax.

Significance of "Slow" Group of California Highway Signs

By F. M. CARTER, Assistant Maintenance Engineer

THIS, the second in a series of articles dealing with highway signs used by the Division of Highways to safeguard and expedite traffic on California State highways has to do with the "Slow" group of the warning type of signs.

This group of signs, all yellow in color with black letters or symbols, is designed only to indicate some physical condition of the highway or an operating hazard. For convenience warning signs are divided into two classes: namely, "Slow" and "Caution" types.

A "Slow" sign is used only where a permanent physical hazard exists, which is a part of the highway itself, always requiring a reduction in speed for safety. All signs of this type are diamond shape. Their message is of such importance that all in this class have this distinctive shape and are equipped with reflector buttons for the guidance of night traffic.

MOST IMPORTANT WARNING

The "Slow" sign is considered the most important in the warning series.

Experiments have been conducted to determine the quickest way to give the message to the motorist. It has been determined that this is best accomplished by using only a symbol, when possible, without unnecessary or distracting wording.

When wording is necessary on this type of sign, the message should be very short—one word is preferable.

The diamond shape is used exclusively for this type of warning and thus the shape aids in transmitting the message that reduced speed is advisable. Whenever a safe driver sees a diamond shaped yellow sign he takes his foot off the gas and slows down.

It is imperative that the diamond shaped "Slow" type signs be carefully positioned, and only after a thorough study of the location.

Learn the Sign Language Taught in These Articles

The proper signing of California highways is regarded as one of the most important functions of the Division of Highways in contributing to safety of life and vehicular traffic. In carrying out this aim the State has adopted the uniform sign system recommended by the American Association of State Highway Officials and adopted by the U. S. Bureau of Public Roads. A detailed description of the signs and the vital messages they bear will be found in a series of articles in these columns, of which this article is the second. Others will appear in later issues.

Uniformity of positioning is important because the wise motorist drives in accordance with the signs of this type. This warning sign is placed 400 feet in advance of the beginning of the curve, and on the right hand side of the road, so as not to be obscured by oncoming cars.

Two signs of different type and carrying a different message are not placed closer together than 100 feet if possible. Where a warning sign and a guide sign are needed at approximately the same location, the warning sign location precedes the guide sign.

On wide up-to-date highways where right of way for future widening is

already provided and the entire road-bed graded, some engineers have placed their signs at the extreme limit of the right of way. Signs placed so far from the traveled way not only fail to give the message to the motorist, but, because of the lack of message, or the motorist's attempt to read the signs, more hazard is introduced.

ALL ARE REFLECTORIZED

Because of increasing speeds and the ease of driving, night travel has made it necessary to reflectorize all signs of this type.

In order to obtain the best return reflection, all reflectorized signs are placed as near to the traveled way as is consistent with safety. The standard distance is eight feet from the edge of pavement.

Being reflectorized, these curve signs are positioned not at right angles, but slightly away from the direction of the highway so that the light falling on the background of the sign will not be reflected back to the motorist in a confusing glare. This positioning does not diminish the return reflection of the buttons in the symbol because of the wide angle of return reflection.

There are seven of this group of curve signs:

1. The right reverse curve.
2. The left reverse curve.
3. The right sharp angle curve.
4. The left sharp angle curve.
5. The right 45° angle curve.
6. The left 45° angle curve.
7. The tee intersection.

The symbol on the sign indicates the direction of the curve.

CURVE SIGN SIGNIFICANCE

A curve sign is used when safety requires a slackening of speed because of high degree of curvature, obstructed visibility, narrowing of pavement, lack of superelevation, or similar conditions. Such curve signs are positioned only at curves where the speed of approach can not be safely maintained on the curve itself.

The reverse or "S" curve sign (1 and 2) is positioned 400 feet in advance of two curves in the opposite direction with short tangent between them. The direction of the symbol in its first curve designates whether it is right or left.

(Continued on page 18)

California's Uniform Road Sign System Pro

"Slow" Warning Group



This sign indicates a left reverse curve and calls for a slackening in speed, possibly because of high degree of curvature.



For a 45 degree right angle turn this one is used, also on curves of less than 60 degrees.



For a right reverse curve this sign is used. It may also warn of obstructed visibility or narrowing of pavement.



At tee intersections this symbol is used and is one that should never be disregarded.



A sharp left angle curve is indicated by this sign. It is positioned in advance of curves of short radius.



The "Slow" sign is the most important in the warning series. When a safe driver sees this he takes his foot off the gas. It is not used alone, but followed by an explanatory sign.



Similarly this sign is used for a sharp right angle turn of 60 degrees or over.



Motorists approaching a subway see this sign. It is a warning that should be followed by cautious driving.



A 45 degree left angle curve calls for this sign. It is for curves of less than 60 degrees.



This sign warns of a grade ahead and the careful driver is prepared for a different speed and increased caution.

Guides Drivers An Infallible Guide to Safety

"Slow" Warning Group



This sign is placed in advance to mark the end of a road or blind street.



A one way bridge is a hazard and this sign should impel motorist to be sure no other car is on bridge before crossing. It is placed where roadway width is less than 16 feet.



A dip in a road ahead is indicated by this warning to avoid possibility of a dangerous jolting of the car.



This sign is a warning to slow down for a stop sign ahead. It is placed 400 feet in advance of the STOP sign.



Motorists should slow down when they see this sign. Danger lurks in narrow roads.



The careful driver will pay heed to this warning that soft highway shoulders and sand lie ahead and thus avoid a possible skid and overturned car.



Warning of a narrow bridge is important to motorists as increased attention to driving is imperative to avoid accidents.



This sign cautions a driver to slow down for a nonpaved road. Necessarily a slower speed is indicated.



Slower speed is advisable when this sign appears and caution in entering such a subway is advisable.



Different traffic conditions ahead may be expected when this sign shows up on a three or four lane highway and a cautious driver will not ignore it.

Federal and State Policies On Feeder Roads Discussed

By HARRY A. HOPKINS, Chairman California Highway Commission

IT WAS my pleasure during the twenty-second annual convention of the American Association of State Highway Officials in San Francisco to preside over the sessions of the Administrative Committee of that body.

At our group meetings we discussed many problems connected with highway administration and exchanged interesting and valuable ideas.

Various topics were assigned to authoritative speakers who presented their subjects, after which the committee members engaged in general discussion. It might be well to take up in chronological order the sundry matters considered.

Our new association president, Mr. T. H. Cutler of Kentucky, offered a paper on what States can do to publicize their work. He advised wider use of such agencies as magazines, the press, radio, photographic material, signs, exhibitions and motion pictures with attendant data on accidents and information in general, together with a closer contact with civic and other organizations.

PROTECT GAS TAX FUNDS

The conclusion reached by our group is that no State has reached the maximum amount of effort to publicize highway work that could be used as a model for other States to follow in making our citizens highway conscious. It was the consensus that every state should enlist the aid of the public in protecting gas tax funds from diversion and that to this end states should spend greater sums from the gas tax to carry on such educational propaganda.

On the question of whether states are ready to assume the economic problems involved in starting a program for divided highways, Commissioner M. D. Van Wagoner of Michigan read a very instructive paper, which will appear in a later issue, of California Highways and Public

Works in which he raises some interesting questions concerning this innovation.

All those attending the sessions of the committee feel that we are confronted with a condition that will call for greater development of divided highways. The conclusion of the committee was that we should accept as a policy the need for divided highways, but the extent of such development should be subject to consideration by the various states in handling their local problems. It was suggested a further survey be made to determine the attitude of the states with regard to divided highways.

W. W. Zass, Chief Highway Engineer of Arkansas, opened the discussion on "Should Greater Governmental Aid or Assistance be Given in the Construction and Maintenance of Highway Facilities?"

This subject is closely allied with that of the nationalization of federal roads and bridges later discussed by H. E. Tabler of Maryland and the committee's conclusions on the former topic could be applied to either of them.

COMMITTEE CONCLUSIONS

The conclusion reached was that federal assistance should be given to maintenance as well as construction on federal aid roads and while the thought was expressed that there was a danger in nationalization of federal roads and bridges, which would call for greater federal assistance, at the same time it is realized that operation of anything of this kind would cause many legislatures to take advantage of it to the extent that it might have a very apparent effect on the states in the operation of their own highway systems.

It was the consensus of opinion that the parity between construction and maintenance is negligible. Also that the Federal Government should give consideration to nationalization of federal aid roads and bridges, partic-

ularly in the public land states, and the participation on federal aid roads now on the basis of approximately fifty-fifty might properly be increased to two-thirds of the cost on the part of the Federal Government.

The question of future federal and state policies in the construction of feeder or local roads was taken up by the general session of the convention and discussion of it in our group meeting was led by T. S. O'Connell of Arizona.

QUESTIONNAIRE CONSIDERED

A questionnaire on this issue was sent to all the states and the sentiment of the committee on the different items involved was substantially as follows:

As to whether or not it would be desirable during the program already authorized to attempt the designation in each state of a system of secondary or feeder roads on which future expenditures for this class of improvement would be confined until the system had been brought to satisfactory completion, the thought prevailed that since the results of the planning survey are not yet definitely known it would be more satisfactory to submit programs of projects covering the expenditure of funds authorized for a two-year period looking to the designation of a system of secondary roads if federal funds continue to be appropriated, the projects selected for construction in this two-year program to be such as will fit into this future system.

It was felt that the states should control the expenditure of funds regardless of how the funds are matched whether by state or other authority.

The thought prevailed that it is desirable to attempt to secure a distribution of the benefits of these secondary road funds to not less than 50 per cent of the counties within a state.

It was conceded by those present that considerable latitude should be given to permit the states to allow the



The Administrative Committee of the American Association of State Highway Officials is pictured in session at the recent annual convention in San Francisco. Chairman Harry A. Hopkins is seen standing at the right addressing the committee.

counties to match funds expended within the county since the state laws, which vary in each of the states, will in the end determine who matches these funds.

It was the thought of the delegates present that the closest cooperation should exist between state highway departments and county authorities relative to the formulating of programs, but it was felt that any such suggestion might well be left to the judgment of the various state highway departments and that no mention should be made of this matter in the regulations.

It was felt that the matter of using county engineering organizations should be left to the discretion of the states to work out.

It was also our belief that those states which cannot legally expend money on roads not included in a definitely established state highway system be permitted to expend the secondary funds on that part of the state system not included in the federal aid system provided that in the opinion of the Bureau of Public Roads a reasonable portion of the total mileage of roads within the state is included in the state highway system.

Mr. A. W. Brandt of New York led the discussion on the proper formula for dividing the cost of railroad crossing eliminations and continuing grade crossing work and the question of to what extent policies should be adopted on types of construction.

The general opinion was that it would not warrant anyone in providing a formula that would be a measure and a guide covering the cost of railroad grade crossing eliminations. Because there was a difference of opinion between the fair proportion of cost allocated to the railroads and the public which differed from a 50-50 basis to as far as the public assuming all of the cost, the conclusion reached was a recommendation that a committee be appointed from the American Association of State Highway Officials to confer with railroad organizations interested in this activity. The position of the Administrative Committee was that it did not possess sufficient research data to arrive at a conclusion.

In the discussion on this very interesting subject, the committee was favored with the observations of Mr. R. E. Dougherty of the American Railroad Crossing Association and Mr. J.

C. Brennan, vice president of the New York Central Railroad.

What improvements, if any, can be made in relief legislation in respect to highway construction?

The discussion of this subject was opened by H. G. Shirley of Virginia.

The conclusion was that due to uncertainty of any action by Congress relative to the temporary or permanence of character of relief funds used directly in highway construction and the possibility of this kind of assistance being of short duration, the committee did not feel warranted in offering any conclusion except that should further funds be made available by Congress for this purpose it should be cleared through the U. S. Bureau of Public Roads and the various state highway departments.

Should the Federal Government appropriate additional funds for surveys and studies of additional international highway connections with Canada and Mexico.

The discussion on this subject was opened by L. V. Murrow of Washington. Our conclusions developed from this discussion are embodied in a resolution presented to the resolutions committee.

Normal Trend of Business on Bay Bridge Indicated

VIEWING a decided drop in San Francisco-Oakland Bay Bridge traffic during January as a trend toward future normalcy, Director of Public Works Earl Lee Kelly submitted to Governor Frank F. Merriam and the California Toll Bridge Authority a report showing that the number of passenger autos using the transbay structure last month was 93,340 less than in December and that the number of passengers carried dropped off 20,385 as compared with the December total.

The only increased business during January was registered by truck trailers and in freight tonnage. One hundred and sixty-eight more truck trailers crossed the bridge last month than during December and freight transported increased 1,592,428 pounds.

Total collections on the bridge last month amounted to \$447,146.17, a decrease of \$63,053.90 as compared with December revenues.

NORMAL TREND EXPECTED

While an average of 21,634 vehicles used the great span in December the average for January was 18,551.

"During November," said Director Kelly, "the bridge enjoyed what we called sightseeing traffic, making that month from the date of the opening of the bridge on November 12 to its close the banner month. Holiday traffic during December and the sustained novelty of bridge travel held traffic figures to a high level during that month. January shows a trend toward normal traffic. We expect that the lowered bridge fares will result in an increase in business during February, after which we should see a steady normal traffic trend."

Comparative figures on bridge operations submitted to Director Kelly by Chief Engineer C. H. Purcell and contained in the report to the Toll Bridge Authority, were as follows:

	Jan.	Dec.
Passenger autos (including ambulances, taxis commercial and light delivery automobiles)	550,106	643,446

Two Bridge Engineers Attain Higher Rank

TWO important changes in the executive personnel of the Bridge Department of the Department of Public Works have been announced by Director of Public Works Earl Lee Kelly.



F. W. PANHORST

Charles E. Andrew was elevated from the post of Bridge Engineer of the Division of Highways to that of Bridge Engineer in charge of the San Francisco-Oakland Bay Bridge, which he helped build.

He has been succeeded by F. W. Panhorst who, since September 1, 1931, when Mr. Andrew was transferred to duties in connection with the construction of the great San Francisco Bay span, acted as Bridge Engineer.

Born at Oregon, Illinois, Mr. Andrew graduated as a civil engineer from the University of Illinois in 1906, since which he has been identified with many important bridge projects in the West. For two years following his graduation he was assistant resident engineer on the Spokane, Portland & Seattle Railroad bridge across Willamette River at St. Johns, Oregon. He was city engineer of St. Johns from 1908 to 1913. He followed his profession in Oregon and Washington and in 1918 he was appointed bridge designer in the Portland office of the U. S. bureau of Pub-

lic Roads. From 1920 to 1927 he was Bridge Engineer for the Washington Department of Highways. Since 1927 he has been Bridge Engineer of the California Division of Highways. He was in charge of all preliminary studies and borings for the San Francisco-Oakland Bay Bridge and of the design and construction of the huge structure.

Graduating from the University of Illinois in 1915 with B.S. and C.E. degrees, Mr. Panhorst entered the employ of the Pennsylvania Railroad as a designer in the bridge department. After several years experience as a bridge designer for various railroads, the Anaconda Copper Mining Company and the U. S. Navy, Mr. Panhorst went to the State of Washington where for six years he engaged in bridge construction work.

In 1927, Mr. Panhorst came to California and entered the service of the Division of Highways as construction engineer of bridges. He stepped naturally into the shoes of Mr. Andrew in 1931 when the latter was called to San Francisco Bay Bridge.

"SLOW GROUP" OF CALIFORNIA HIGHWAY SIGNS

(Continued from page 13)

The curve sign with symbol of right angle turn (3 or 4) is positioned in advance of curves of short radius, the symbol showing direction of turn.

The policy in deciding the proper curve sign is determined as follows:

Curves whose deflection angle (the angle turned proceeding from the straight line of approach around the curve on to the straight line of departure) is sixty degrees or over are marked with right angle curve signs (3 or 4); curves of less than sixty degrees, are marked with the 45° curve sign (5 or 6).

The tee symbol (7) is placed in advance of intersections of roads where the highway being traveled ends in another highway running at right angles, defined as a "T" intersection.

	Jan.	Dec.
Auto trailers	545	813
Motorcycles	1,615	2,000
Tricars	402	405
Trucks	16,727	18,292
Truck trailers	1,458	1,290
Buses	4,230	4,405
Total vehicles	575,083	670,651
Extra passengers (including bus passengers)	93,119	113,504
Freight (lbs.)	34,394,571	32,802,143

"California Highways" Color Film Creates Big Demand for Showings

By EDWARD J. NERON, Deputy Director of Public Works

SINCE its premiere showing in Sacramento on October 6, four months ago, the all-color film, "California Highways," portraying pictorially the history of road building in this State from the days of the Franciscan friars to the present, has fully justified the time and money expended in its production by the Division of Highways.

Designed to inform the people of California of the continual development of their splendid system of State highways made possible by the gas taxes they gladly contribute, the film has been exhibited in many cities throughout the State and requests for its showing are constantly increasing.

Two films are being shown at the present time in the east and the Department of Public Works has been unable to accede to all the requests for it that have been received from other States.

Recently, "California Highways" was given a showing in Mexico City with the result that the Mexican government has decided to produce a similar film depicting the scenic and other attractions on the newly-completed national highway from Laredo, Texas, to the capital city of the southern republic.

Exhibition of the film at the annual convention of the American Association of State Highway Officials in San Francisco last December was acclaimed as one of the highlights of the meeting by the delegates in attendance.

OTHER STATES IMPRESSED

A number of highway officials of other States were so enthused by the beauty of the picture and its advertising potentialities that they announced their intention of emulating California and producing an all-color film of their own State highways.

When Governor Frank F. Merriam and Director of Public Works Earl Lee Kelly gave their approval to the proposal of the Division of Highways

that such a picture be made they did so with the thought in mind that the film would be a visual report to the payers of the gasoline tax that would graphically reveal to them how their money is being spent by the State on highways.

The film does just that. Its wide exhibition has borne out what Governor Merriam said of it at its premiere showing.

"This picture," the Governor said, "was worth while making because it will show Californians what becomes of the gas taxes they pay. It was worth while because this film will attract thousands of tourists to this State. It was worth while because many States already have asked that we loan them the picture for showing. Decidedly, it was worth while to produce this picture."

LOANED FOR EXHIBITIONS

In order that as many Californians as possible may be afforded an opportunity to view the film, the Department of Public Works has obtained four 35-millimeter copies of the film suitable for exhibition in theaters and several sets of 16-millimeter films which may be used by civic clubs, fraternal orders and similar organizations.

Theaters may have the film free for showing in their own standard projection machines. For the smaller size film the Division of Highways has portable projection machines which it sends with a trained operator to clubs, lodges, chambers of commerce and civic organizations desiring to view the picture.

"California Highways" is a film of especial charm. The picture consists of 355 separate scenes and its producers traveled over more than 11,000 miles of the State Highway System photographing in color mountain, valley and desert highways and their beautiful scenic attractions.

In cities and communities where the film has been exhibited the press

has been fulsome in its praise of the picture. Typical of newspaper commendation is the following editorial which appeared in the Appeal-Democrat of Marysville following a recent showing of "California Highways" in that city:

Views of an Editor

"THOSE who saw the colored motion picture of California highways at the State theater got more adequate conception than ever before of the scope and quality of roads that have transformed the trails of pioneer days into modern thoroughfares. Even the average person's experience in driving the roads fails to impress upon him the composite view of our highways as well as this film does, for the motion picture knows no limits of time and distance.

"As we watch the unwinding of this all-color film we not only obtain a new comprehension of the road program and its infinite demands upon engineering skill and public financing, but we thrill with pride at the scenic beauties of California. It is a long-established fact that no other State is so replete with natural beauty, but this screen panorama brings conviction anew.

"IT IS TO BE HOPED THAT THE PICTURE IS GIVEN WIDE CIRCULATION OUTSIDE CALIFORNIA. IT IS SUFFICIENTLY ATTRACTIVE TO BRING THE WORLD TO OUR DOORS, ALTHOUGH A GOODLY PORTION OF THE WORLD ALREADY COMES THIS WAY AS OPPORTUNITY OFFERS.

Worth Investment

"Does the thought also obtrude that the interlacing system of concrete ribbons depicted on the screen has cost California a tremendous amount of money? What if it does? The result has been worth the investment. The highways we have built and are building, fine as they are, do not exceed the demands of modern transportation.

"And what if this investment had not been made, or had been held to a parsimonious minimum? Certainly we would not get the pleasure from driving which we do, and many of the most delightful regions would have remained isolated and inaccessible. But beyond that, we could not have attracted the millions of automobile tourists if we had nothing to offer them when they arrive.

"It is well to have such a picture as this to remind us of what fine roads mean to California. Frequently in the past efforts have been made to raid the funds with which these roads are built, and such attempts are by no means ended. When they recur it is well to realize that highways are one of our best investments and to be on guard against every suggestion of diversion. Governor Merriam and Public Works Director Kelly have done a fine thing in providing this film and the chamber of commerce and State theater are to be commended for arranging such an early showing here. California has never sent out a more eloquent exponent of its attractions."

Film Corporation Donates Valuable Right-of-Way

(Continued from page 8)

Improvement Association, City Engineer Lloyd Aldrich, and a legal representative of the Twentieth Century Fox Film Corporation, public announcement was made that the officials of this film corporation had donated a 100-foot right of way through the studio property along the alignment selected by City Engineer Aldrich and approved by the State. The studio officials also cooperated with the Janss Investment Corporation, and donated the right of way through the golf grounds between Heath Avenue and the studio grounds.

The city engineer in making his location through the studio grounds took advantage of a natural draw running along the north side of the new Will Rogers Memorial sound stage. By proper planting of trees and shrubbery along the sides of this canyon after the road is built, any noises developing along the traffic artery will be screened and dissipated so as not to interfere with work in the studio.

Dr. Davenport also reported the securing by donation of the 100-foot right of way from Granville Avenue in Los Angeles to Nebraska Avenue in Santa Monica, a distance of approximately one mile.

With this fine spirit of cooperation existing between the officials of the cities of Los Angeles and Santa Monica, the county of Los Angeles and the State of California, the public-spirited property owners and the energetic officials of the improvement associations above mentioned, it is hoped that continuous progress can be made on this important major traffic artery following a State highway route, No. 173, through the city, until the dream of a completed highway can be realized.

The total length of the Olympic Boulevard project from the east city limits of Los Angeles to Lincoln Boulevard in Santa Monica is 18.6 miles, of which 2.1 miles is in the city of Santa Monica, 1.6 miles in the city of Beverly Hills and 14.9 miles in the city of Los Angeles.

This mileage is distributed through

Construction History of San Francisco Bay Bridge

(Continued from page 11)

Normal hard rock concrete was used. The upper deck is 6 inches thick and 58 feet wide. For the upper deck light weight concrete was used to reduce dead load. A locally manufactured product known as Gravelite was used, approximately 30 per cent of the sand content being normal hard rock sand. Concrete weighing approximately 100 pounds per cubic foot was obtained with an average strength of 3,000 pounds per square inch. In order to guard against traffic abrasion, a hard sand mortar top was used about one-quarter of an inch thick. All pavements were laid by means of a mechanical vibrating screed on a strike-off machine.

The average day's run was 225 cubic yards in place, with maximum day's of 350 cubic yards. The Hunt Process of curing was used.

Tile traffic lane markers were set as the concrete was laid in all light-weight concrete. These markers consist of 4½ x 4½-inch tile set flush with the pavement surface. A tile having less than one-half of 1 per cent absorption was specified to guard against discoloration by road oils.

In the way of research considerable work has been done. Early in the design of the bridge it was thought proper, and in some cases necessary, to make a considerable expenditure along this line. An expenditure of \$50,000 was approved by R. F. C. to investigate the question of riveted joints. Considerable data was available in small sections, but heretofore no full-size large joints had been investigated. The extremely large riveted members and long rivet grips necessary in the San Francisco-Oakland Bay Bridge seemed to justify such an investigation.

The large testing machines at the University of Illinois and of California made it possible. These tests have been in process for some time at both the University of Illinois and the University of California and some very interesting results are being obtained. Full reports will be made by both

the various cities as follows:

From Route 60, Lincoln Boulevard in Santa Monica to East City Limits Santa Monica—2.1 miles.

From East City Limits of Santa Monica to West City Limits of Beverly Hills (This area in the City Limits of Los Angeles)—3.5 miles.

From Heath Avenue, West City Limits of Beverly Hills, to the East City Limits of Beverly Hills near Robertson Boulevard—1.6 miles.

From East City Limits of Beverly Hills to East City Limits of Los Angeles at Indiana Street—11.4 miles.

Total length—18.6 miles.

of these institutions and I am sure they will be of great interest and use to bridge engineers in future bridge design.

Another problem which developed during construction was the question of long grip rivets. Inch and one-quarter rivets with grips up to eight inches were required and considerable concern was aroused as to whether or not these rivets were filling holes properly. To test this question several test blocks were made using grips of four and six inches including carbon and manganese rivets. In the first block riveters were allowed to use the equipment and method normally used. This block was then sawed along the rivet center line and rather unsatisfactory results were obtained.

Other test blocks were then made up, using heavier guns with various modifications of driving and "bucking up," also modifications of heat. Typical pictures of blocks will be shown later. The general result of the tests led to the decision that best results could be obtained by using heavier riveting guns and bucking up with combination riveting and bucking up tool. In the long grip rivets it was found necessary to heat rivets to a lemon color rather than the conventional cherry red. It is, of course, impossible to follow rules in detail in actual practice. The tests, however, were so obvious that riveting crews were impressed with the effectiveness of certain precautions and methods. We all know how riveting crews hate to cut out rivets and I am sure the tests had good effect. Some points were developed which might well be incorporated in future specifications.

In conclusion I can not say less than that our Director and our Chief need no commendation to you. Their ability and their personalities are known to all of you.

Our engineering and office organization from top to bottom deserve the highest commendation for the loyal service which they have performed. Chief engineers and bridge engineers can not build bridges without the men who actually do the work. Long hours have been worked and their best has been given. I am sure no better organization has ever been assembled.

Equal commendation is due to all contractors and their employees.

We still have to build the interurban terminals, yards, viaducts, bridge track and signal systems which will transport commuters across the bay. Eighteen months will be required and \$15,000,000 additional will be spent. We are certain that the second stage of construction will be as efficiently and successfully completed as the first.

Operation of the vehicular crossing has been in process since the twelfth of November. During the first week of operation 820,000 vehicles crossed the bridge, with a maximum of 78,000 in one day and an average for three consecutive days of 67,000.

Four Additional Grade Crossing Projects Provided

SAVINGS effected in Works Progress grade separation projects in California for which the Federal government appropriated \$7,318,141 involving 41 different undertakings have enabled the State Highway Commission to add four more grade crossing projects to its program, Director of Public Works Earl Lee Kelly has announced.

The additional grade separation work will cost \$306,000 and finding that this amount will be available out of the original total government allocation the Highway Commission at its December meeting submitted to the U. S. Bureau of Public Roads a supplemental program calling for four projects in San Diego, Los Angeles and San Joaquin counties.

Director Kelly said he had been notified by State Highway Engineer C. H. Purcell that District Engineer C. H. Sweetser of the Bureau of Public Roads, San Francisco, has given his approval to the additional projects.

The sum of \$195,000 will be spent to eliminate a grade crossing on San Gabriel Boulevard in Los Angeles at the point where the Union Pacific Railroad crosses the State highway at Pico. San Gabriel Boulevard is being developed into a main thoroughfare.

A major line change is being made in the State highway at San Onofre north of Oceanside in San Diego County and \$85,000 will be expended to construct a concrete overhead where the Atchison, Topeka & Santa Fe crosses the highway.

SOLANO BEACH PROJECT

A concrete overhead to carry the Atchison, Topeka & Santa Fe across the county road at Solano Beach north of San Diego will be constructed at a cost of \$20,000. The Solano Beach road connects with the State highway at the San Diego fair grounds.

The Central California Traction Company is removing its tracks on Wilson Way in the eastern section of Stockton and \$6,000 will be devoted to repaving and widening that thoroughfare after removal of the tracks is accomplished.

An Appreciation

John W. Howe,
Editor, California Highways
and Public Works,
Sacramento, California.

Dear Mr. Howe:

I subscribe for many magazines, but the one I read most promptly and most thoroughly is the one I receive free, "California Highways and Public Works."

It is really quite a thrill to me to follow by its wonderful pictures and informative articles the progress of California's marvelous State Highway System, and the other great public works which the Department of Public Works is carrying out.

I think the Department through you is doing quite a wonderful thing by the publication of this magazine which you so ably edit. By it, citizens and taxpayers not only have the facts and figures of Highway budgets and expenditures, but, outside of these important but dry statistics, are told in a most interesting way of the great feats of engineering and construction going on as just a part of the day's work throughout the State.

I hope this magazine is widely circulated for I know it must be greatly appreciated by all who receive it.

Very sincerely yours,

(Signed)

JAMES M. BURKE,
Visalia, California.

State Highway Commissioner Stanton Feted on Birthday

Attending a meeting of the California Highway Commission at Sacramento on February 4th Commissioner Philip A. Stanton of Anaheim was the recipient of many congratulations on his sixty-ninth birthday.

The headquarters staff of the Department of Public Works tendered

252,727 Tourist Autos Entered State Last Year

TWENTY-SEVEN foreign countries, four distant United States possessions and territories, and the forty-eight States of the Union were represented in the 252,727 non-resident cars that entered California in 1936.

This represents an increase of more than eighteen per cent over the 1935 total of 213,428, according to Director Ray Ingels of the Department of Motor Vehicles. The number of persons in the cars was given as 757,167 last year, an increase of twenty-three per cent over the 1935 total of 615,728.

Arizona headed the list with 19,345 cars, followed by Oregon with 17,300; Washington was third with 14,451, and Texas was fourth, when 12,551 automobiles entered from that State.

Delaware sent fewer cars than any other State—eighty-four—being surpassed by the Territory of Hawaii, 408, and the Republic of Panama, 116.

Canada led all foreign countries with 3,465. Mexico was second with 371. Two cars bearing Australian plates traveled half way round the world to reach California. Two also came from India.

Nonresident permits were issued to one or more visitors from each of the following distant points: Argentine, Austria, Chile, China, Costa Rica, Cuba, Czechoslovakia, Dutch West Indies, El Salvador, England, France, French Indo-China, Germany, Guam, Honduras, Jamaica, Philippines, Venezuela, and the West Indies.

him a birthday party at the Senator Hotel that night. A huge cake with twenty-one lighted candles adorned the banquet table and the guest of honor blew out the candles with all the gusto of a six-year-old.

Among those present at the dinner were Director of Public Works Earl Lee Kelly, Assistant Director Justus F. Craemer, Deputy Director Edward J. Neron, Harry A. Hopkins, chairman of the California Highway Commission; State Highway Engineer C. H. Purcell, Highway Commissioner H. R. Judah, and Julien D. Roussel, secretary of the Highway Commission.

Underpass Eliminates Dangerous Grade Crossing at Palo Alto

By IRWIN T. JOHNSON, Resident Engineer

THE new Embarcadero Road Underpass in Palo Alto was officially opened to the public recently by Harry A. Hopkins, Chairman of the California Highway Commission, at an impressive ceremony sponsored by the city of Palo Alto.

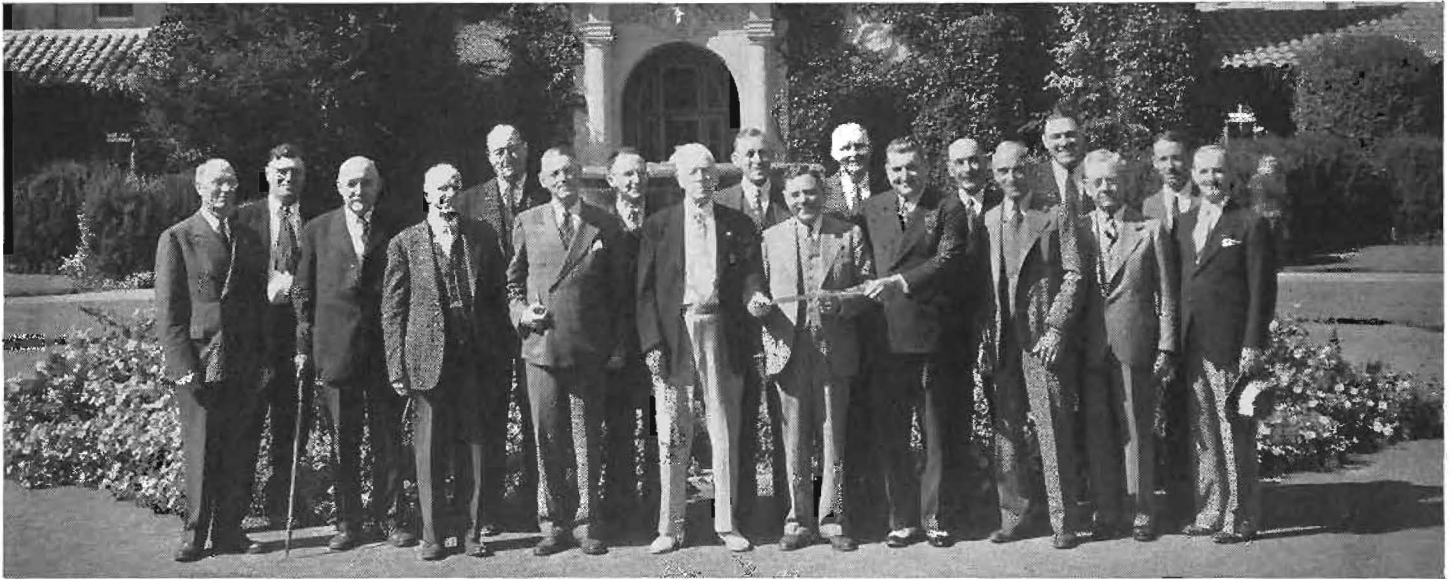
Mayor C. H. Judson acted as master of ceremonies, introducing the speakers who included Edward J. Neron, Deputy Director of Public

Works, E. Roth of Stanford University, predicted that its construction would stimulate traffic flow to Embarcadero Road which, in a relatively short time, would handle more traffic than University Avenue in Palo Alto; becoming more and more a principal entrance to the campus and serving future urban development on the campus property.

The Embarcadero Road Underpass is located on an important lateral

road. The situation confronting the department in its construction was complicated by the District High School adjacent to and west of the crossing, with over a thousand children using the crossing four times a day, and the location of the "Stadium" station of the railroad directly at the crossing.

Included in the work of construction are ramp facilities at each side of Embarcadero Road for handling railroad passengers during football games



Official group at dedication of Embarcadero Underpass at Palo Alto: Left to right, Andrew W. Hoy; F. S. Miller, Assistant City Engineer; Col. Chas. B. Wing; C. E. Ashworth, chairman Palo Alto Planning Commission; Prof. E. C. Thomas, member City Council; O. F. Campbell, chairman Board of Public Works; Prof. E. L. Grant, Board of Public Works; Mayor C. H. Judson; Col. Jno. H. Skeggs, District Engineer, State Division of Highways; Chairman Harry A. Hopkins, State Highway Commission; City Engineer J. F. Byxbee; Deputy Director Edward J. Neron, State Department of Public Works; G. G. Bertsche; G. D. Whittle, Bridge Engineer; L. H. Anderson, Deputy City Engineer; President D. A. Mendenhall, Chamber of Commerce; I. T. Johnson, Resident Engineer; Col. E. L. Hayden.

Works. An informal luncheon was served the guests at noon on the Stanford campus and the Palo Alto High School Band and several troops of Boy Scouts enlivened the proceedings conducted at the new structure.

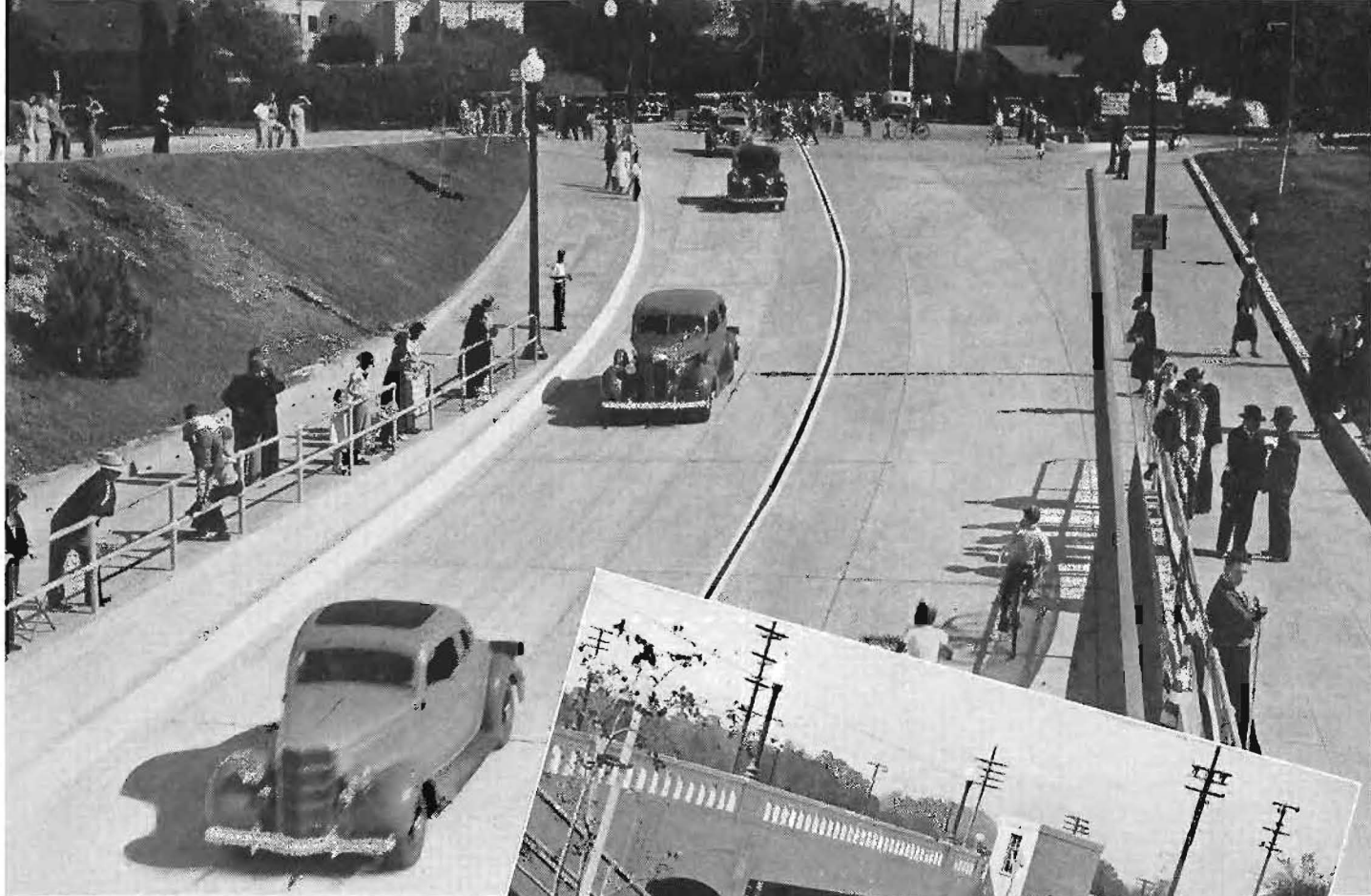
Mr. Hopkins graciously termed the Embarcadero Underpass the most thoroughly treated and architecturally pleasing of the new structures he had yet dedicated. Controller A.

between the El Camino Real and the Bayshore Highway, at the crossing of the double-track line of the Coast Division of the Southern Pacific Company. Construction of the separation was effected by the Division of Highways, Bridge Department, under the Grade Separation Program of the Federal Government, the entire cost of the work being borne by the United States Government.

without grade crossing; carrying Alma Street, paralleling the railroad, over the depressed roadway; revision of all underground utilities and sewers; and revisions to the existing streets and approaches.

The separation is constructed on an offset line through the depressed portion to take advantage of an existing city park and about an acre of the

(Continued on page 26)



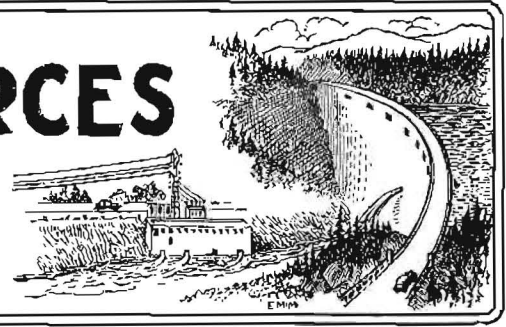
The Embarcadero Underpass at Palo Alto eliminates a dangerous traffic point formed by the intersection of the Southern Pacific main line tracks and the Embarcadero lateral connecting El Camino Real State Highway with the Bayshore Highway—a crossing daily used by a large number of high school pupils and Stanford students and by the large football crowds on game days to and from the adjoining Stadium Station. The underpass carries the Embarcadero roadway beneath the tracks of the railroad and the roadway of Alma Street both of which are accommodated on the structure above. The top picture shows the wide subway for the Embarcadero lateral swinging down to the underpass with pedestrian ramps on either side. Inset is a view of the structure that carries railroad and Alma Street over the subway. At bottom is the scene on dedication day showing the crowd at the speakers' stand and the high school band grouped on the steps.



DIVISION OF WATER RESOURCES

OFFICIAL REPORT
FOR THE MONTH OF
January, 1937

EDWARD HYATT, State Engineer



Verification by the U. S. Bureau of Reclamation of the investigations of engineers of the Department of Public Works upon which the latter based their recommendations in favor of the Kennett dam site for the Central Valley Project was highly gratifying to Director of Public Works Earl Lee Kelly and the Water Project Authority of the State of California.

John C. Page, Commissioner, U. S. Bureau of Reclamation, reported to Secretary of the Interior Harold L. Ickes, that the storage reservoir on the Sacramento River will be constructed at the Kennett dam site, provided that satisfactory arrangements can be made promptly with the Southern Pacific Railway Company for moving its tracks from the reservoir site.

"The Bureau of Reclamation engineers have found that the Kennett site is unquestionably a safe site for a dam of a height sufficient to provide the storage that will be necessary," Mr. Page said. "The exact height of the dam to be constructed has not been determined; however, this will not delay the start of construction. The dam will at least be of a height sufficient to provide 3,000,000 acre feet of storage."

IRRIGATION DISTRICTS

Following investigations conducted in the proposed Exeter and Lindmore irrigation districts, favorable reports were submitted to the Board of Supervisors of Tulare County, as to feasibility of the projects, and recommendations made that organization elections be approved at final hearings. The districts plan to secure their water supply from the Friant-Kern Canal of the Central Valley Project.

Owens Valley Irrigation District in Inyo County was dissolved by court order on December 24, 1936, in an uncontested action brought by the Attorney General. The district has been inactive since acquisition of the water supply by the city of Los Angeles.

Loans recently authorized by the Reconstruction Finance Corporation to California irrigation districts include: Carmichael, \$53,-

000, Citrus Heights, \$86,000, and Paradise, \$20,000.

Districts Securities Commission

The petition of La Mesa, Lemon Grove and Spring Valley Irrigation District for approval of a new bond issue in the amount of \$145,000 was granted. The proceeds will be used for repairs on the distribution system.

SACRAMENTO FLOOD CONTROL PROJECT

Construction has been commenced by the War Department on the first units of the Bear River system. This includes a drainage collecting system north of the Bear River and east of the Western Pacific Railroad, and the levee on the north side of the Bear River between Carlin bridge and Dry Creek.

Flood Measurements and Gages

All of the thirty-five recording water stage stations under charge of this office are now in operation and in good condition. Several of the stations have been remodeled and practically all of them have been repaired. Radio sending equipment is being installed in the stations at Colonia on the south fork of the American River, Rattlesnake Bridge on the north fork of the American River, Nicolaus on the Feather River and Ord's Ferry on the Sacramento River.

FLOOD CONTROL AND RECLAMATION

Sacramento Flood Control Project

A small crew in the Sutter area has been engaged in routine maintenance work on drainage canals, levees and structures. Following the light rains the roads on the levees have been bladed with equipment borrowed from Sutter County. The canals tributary to pumping plant No. 3 have been cleaned by a dragline excavator, and the machine is now engaged on cleaning ditches tributary to pumping plant No. 2. An approach has been constructed at pumping plant No. 3 and additional material has been placed on the Wadsworth Canal levee near the Franklin Road bridge.

The south levee of the Sacramento Bypass and the road on top, near the drainage plant of District 785, have been repaired. During the past several years there has been slipping of material at this point following heavy rains. Fifty tons of rock were placed on the road surface.

Relief Labor Work

Clearing of the flood channels of the Feather River north of Marysville has proceeded with a relief labor crew of sixty men. This may be increased during February 1st to approximately one hundred men.

Forty relief labor men have been engaged in clearing in the Tisdale By-pass, operating out of the State Relief Administration Camp No. 7 in Reclamation District No. 1500. It is expected that this crew will be increased to eighty men shortly.

Bank Protection Program

Progress in the construction of permanent bank protection works on the Sacramento River under the State-Federal cooperative program of June, 1932, has been satisfactory. The whole program is approximately 90 per cent complete.

SUPERVISION OF DAMS

Application for enlargement of the Danhauser Dam was approved on January 15, 1937. The increase in height is approximately 2 feet and the increase in storage capacity about 350 acre feet.

Construction work on the San Gabriel Number 1 Dam of the Los Angeles County Flood Control District is progressing as is the work of the Metropolitan Water District on the Cajaleo Dam.

Repair work on the Lake Hodges Dam has been completed.

Work on Grant Lake and Long Valley Dams of the City of Los Angeles has been discontinued because of climatic conditions. Work on the O'Shaughnessy Dam of the City of San Francisco has also been discontinued because of the weather.

Revised plans for the Gene Wash and Copper Basin dams of the Metropolitan Water District have been submitted and are under study.

The field work of the office has been somewhat curtailed during the past month because of weather conditions, although the usual maintenance and operation inspections have been made.

WATER RIGHTS

Supervision of Appropriation of Water

Twenty-five applications to appropriate water were received during December. 34 were denied and 21 were approved. During the month 20 permits were revoked, 5 were licensed and 1 license was revoked.

Two hundred and thirty reports were received during December from permittees and licensees. These reports are in process of study with a view to determining the proper course of action in each case.

Water Distribution

A financial statement for 1937 for each of the following water master districts has been prepared: Owl, Soldier, Emerson, Cedar, Deep and Mill Creek Water Master Districts (in Surprise Valley, Modoc County); New Pine, Davis, and Franklin Creek Water Master Districts (in Goose Lake Valley, Modoc County); South Fork of Pit River, Pine Creek, Hot Springs Valley and Big Valley Water Master Districts (in Modoc and Lassen Counties); Shasta River Water Master District (in Siskiyou County); Hat, Burney and Cow Creek Water Master Districts (in Shasta County).

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

During the past month the activities of this office have been confined to office work in making ready data to publish a report showing the amount of water diverted from and returned to streams in the Sacramento-San Joaquin territory. The report will also show the amount of land irrigated, the flow in the stream channels and the rate of advance and retreat of salinity in the delta.

There has been no sustained increase in the flow in valley streams. The flow of the Sacramento River at Sacramento is about 5000 second feet.

There has been a slight reduction of salinity in the delta. Sampling is being carried on at certain key stations throughout the delta.

California Cooperative Snow Surveys

During December the first extended storms of the season blanketed the Sierra with snow. Temperatures during the storm periods were low and snow fell at very low elevations. The record cold weather following these storms has maintained the snow line at low elevations.

In the office, work has continued on a compilation of precipitation and runoff data and the working up of the natural flows that occurred during the past season. The actual historical figures compare well with those estimated in the April snow survey bulletin. One or two of these have as yet not been worked up, but they will be completed as soon as necessary data is received.

Preliminary work is being done preparatory to issuing the first snow survey bulletin of the year, scheduled for release about February 10th.

Federal Cooperation—Topographic Mapping

Progress was made during December in the topographic mapping of Arenal Quadrangle in San Luis Obispo and Santa Barbara Counties and there was some office work on the Downieville Quadrangle in Plumas and Sierra Counties.

Advance sheets of Yreka, Burney and Mt. Emma Quadrangles are now available. The first two are Federal sheets and the last was done by the U. S. Geological Survey in cooperation with Los Angeles County. The Yreka Quadrangle covers an area in Siskiyou County and is published on a scale of 1:96,000 with contour intervals of 50 and 100 feet.

Kennett Project Will Safeguard All Water Users

ASSURANCES that the Water Project Authority of the State of California will zealously guard the interests of all owners of land and water rights in the San Joaquin Valley in the construction of the Central Valley Project were given by Director of Public Works Earl Lee Kelly to representatives of many property holders and irrigation districts affected by the project at a recent meeting of the authority.

"The Central Valley Project," Director Kelly said, "is progressing quite satisfactorily. Since the January session of the authority three important and very gratifying developments have occurred. The Federal government has determined that the Kennett dam site is the most suitable for the project, thus verifying the investigations of our own engineers on the subject; the Contra Costa conduit unit of the project has been advertised for bids, and Mr. John C. Page has been appointed Commissioner of the United States Bureau of Reclamation. All of us have occasion to rejoice that these steps have been taken."

000 with contour intervals of 50 and 100 feet. The Burney Quadrangle covers an area in Shasta County and is published on a scale of 1:96,000 with a contour interval of 100 feet. The Mt. Emma Quadrangle covers an area in Los Angeles County and is published on a scale of 1:24,000 with a contour interval of 25 feet.

CENTRAL VALLEY PROJECT

Comparative studies of the alternative sites for the large storage reservoir on the Sacramento River, which is the key to the Central Valley project, indicate that the Kennett site is superior from an economic standpoint to the others, that its foundation is secure, and that a larger amount of hydroelectric power can be developed there than at either Table Mountain or Baird.

Commissioner Page of the U. S. Bureau of Reclamation informed Secretary Ickes that bids were being invited for the construction of the first four mile section of the Contra Costa Canal and that they would be opened on March 1st.

"It is gratifying," Secretary Ickes said, "that the complex preliminary work on the great Central Valley project is now drawing to a close; with the way now apparently

NO WATER DIVERSION

Some of the representatives of water users in the upper San Joaquin Valley expressed fear that if Friant Dam is completed before Kennett, dam water stored there would be diverted to points south in Tulare, Kern, and Kings counties to the detriment of the upper valley landowners.

"The Water Project Authority," Mr. Kelly declared, "never will approve of any move to divert water from one section of the State to another where such diversion would be harmful to any owner of water and land rights. The interests of all present holders of such rights will be carefully guarded. Friant Dam is only one unit of the main project. Kennett Dam is another, the Contra Costa conduit is another.

"All are component parts of the general project and the Water Project Authority, in looking forward to the completion of the whole undertaking, is determined to safeguard all existing water rights and to see to it that no section of the State benefits at the expense of any other section."

cleared for the start of work in two divisions of the project. I anticipate construction to proceed rapidly."

WATER RESOURCES

South Coastal Basin Investigation

Good progress has been made in the field and office on the South Coastal Basin Investigation during the month of January.

Son Luis Rey River

Work upon the report covering the investigation and survey of San Luis Rey River in San Diego County for the purpose of securing data and preparing plans for flood control, rectification of river channels and conservation and utilization of the waters of the San Luis Rey made by the Division of Water Resources in cooperation with WPA, City of Oceanside, County of San Diego and Carlsbad Mutual Water Company has continued during the month.

"Do you mean to say, sir, that Jock McGregor is a Scotchman you can't accuse of being tight with his money?"

"Yes, he always leaves it home when he goes out to get tight."

Underpass Eliminates Dangerous Grade Crossing at Palo Alto

(Continued from page 22)

high school grounds, and saved a considerable property damage to the city. The pedestrian ramps are built on 15% grades and are each about 80 feet long and 10 feet wide. The depressed roadway has a width of 32.5 feet and vertical clearance of 14 feet. Sidewalks are built on each side, 10 feet wide, carried through the abutments 8 feet wide. Below these abutment walks are large chambers used to store surface water during storms.

One of the interesting features of the work was the method devised to handle storm runoff. The only available storm sewer for discharge was a 10-inch pipe, already used to about 60% of its capacity. In order to have handled storm water without storage a pipe twice this size would have been required.

STORAGE CHAMBERS PROVIDED

It was decided to build these storage chambers under the abutments to store the peak runoff, based on flood intensity records. These chambers can store 93,500 gallons of water before the subway is flooded, although it is planned to store only about 70,000 gallons maximum, leaving a 33% factor of safety. A complicated system of stilling wells and float switches to the small discharge pump operate to permit ordinary street drainage to use the storm sewer during a rain storm, storing water under the abutments at the same time, thus preventing any flooded streets. As the level of this ordinary sewer flow drops to negligible point, the pump operates against a check valve set in the storm sewer. Where storm water rises to a dangerously high level in the storage chambers, the pump starts regardless of the elevation of the sewer flow, pumping against the check with the full capacity of the sewer.

TRAFFIC PROBLEM SOLVED

Provisions are made for three railroad tracks at the crossing, furnished with wide concrete sidewalks and concrete railings. Station platform facilities are provided for about 1000

(Continued on page 23)

New Bumpograph Devised for Asphalt Concrete Pavement

By E. L. SEITZ, Resident Engineer

ASPHALT concrete pavement requires close and accurate straight-edging during construction in order to find and eliminate all bumps while the material is still in a workable condition. In order to facilitate the locating of irregularities, several types of devices more or less crude in construction, have been built in District VII, both by field assistants on the job and by the district shop.

Under the author's direction, there has recently been constructed a device he terms a "bumpograph" which has proven of considerable value in finding the high spots in this type of pavement.

The device consists essentially of a wooden frame hinged in the middle and supported by a bicycle wheel at each end, with two wheels at the middle hinge. One end of the frame extends well beyond the middle, acting as the primary arm of a compound lever. No springs or weights are required and the weight of the machine has been reduced to about 30 lbs. as against about 80 lbs. for former devices. The hinge permits the machine to be folded so that it can be transported by auto.

MARKING CRAYON IMPORTANT

Successful operation of the bumpograph depends greatly on maintaining the marking crayon at a fixed position in respect to the crayon holder. After trying out a number of devices, it was found that the worm feed proved most satisfactory. A rubber wheel about two inches in diameter is attached to the end of the crayon holder so that the tread of the wheel bears against the pavement surface when the crayon arm is lowered to marking position. Rotation of this wheel turns a feed screw through the medium of a spiral gear on the axle of the wheel and a worm gear on the feed screw, and a lug fixed to a nut on the screw extends through a vertical slot in the crayon

holder, so as to bear against the crayon and feed it downward through the holder.

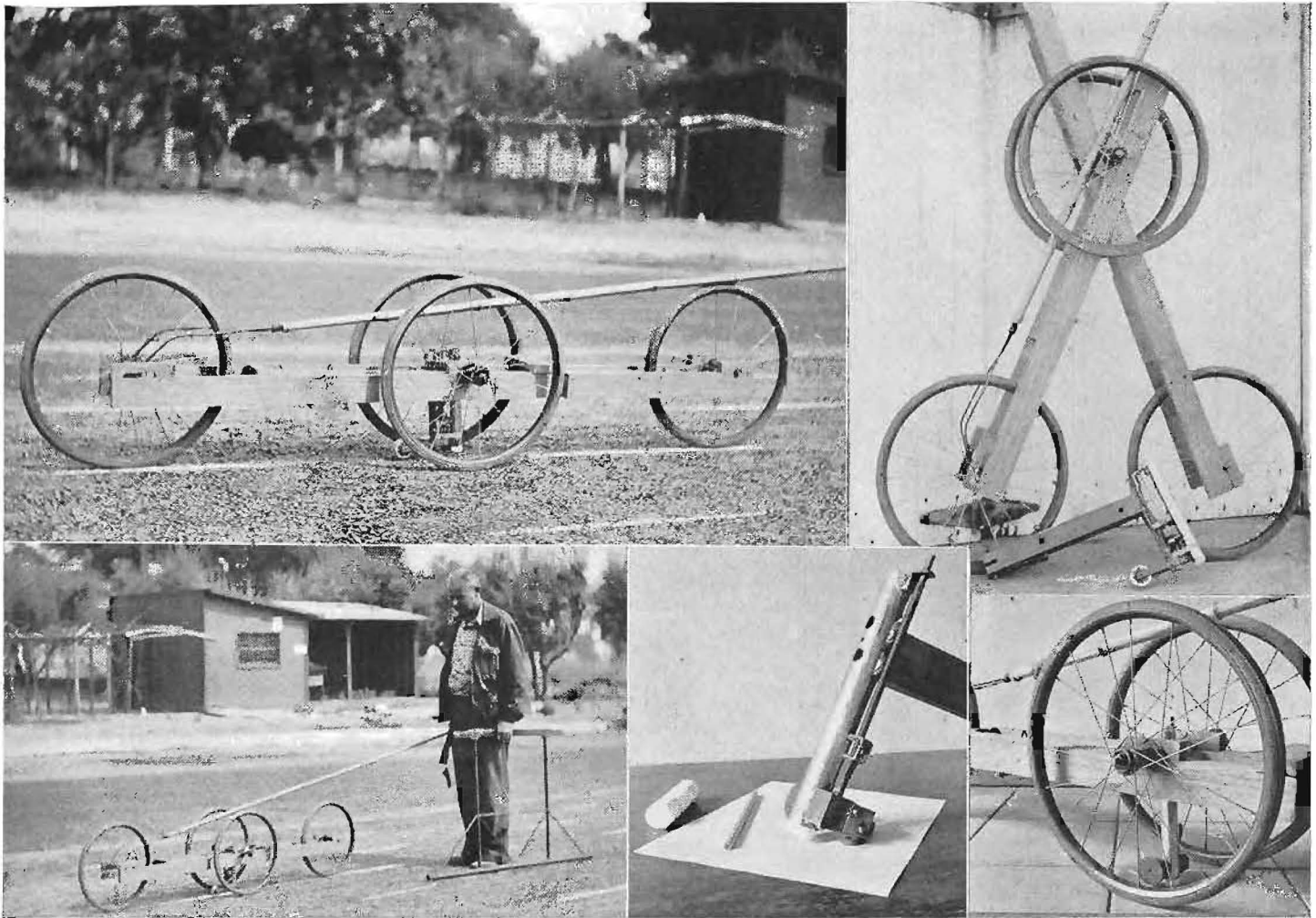
When the crayon has been fed down even with the tread of the wheel, it also bears on the pavement and tends to carry a part of the weight of the crayon arm and holder, and as the wheel is relieved of part of the weight there is insufficient traction to continue its rotation, and the crayon is fed only to that point even with the wheel. As the crayon wears away, the load is again transferred to the wheel and the crayon again fed downward. In this manner, the crayon is automatically kept at a fixed distance beyond the end of the holder and requires no attention except replacement.

Railroad crayon, 1 inch diameter by 4 inches long, has been found best for marking bumps, leaving a heavy white mark which does not fade out from pavement heat.

BUMPS EASILY MARKED

The bumpograph is positive in action and sufficiently sensitive to mark bumps $\frac{1}{16}$ inch high over a length of 5 feet or less. By means of an adjusting screw on the marker arm, the height of the bump to be marked can be selected. The adjustment is generally made so that $\frac{1}{8}$ inch bumps will be marked, and this is best done by wheeling the bumpograph over a given section, measuring the bumps marked with a straight-edge and changing the adjusting screw until the desired height of the bump is marked.

Machines were first tried out with multiple marking arms, each arm being adjusted to mark bumps of different heights. By this means, the height of the bump was indicated by the number of marks. However, it has been found that when the bumpograph is sufficiently sensitive, the character of the marking will indicate not only the height of the bump but other characteristics as well.



"Bumpograph" devised by Resident Engineer E. L. Seitz consists of a wooden frame supported by a bicycle wheel at each end and two wheels at the middle hinge where marking device is located. At right, the machine folded for transportation. At bottom, Mr. Seitz operating the machine and carrying straight edge. At right, close-ups of marking device showing feed screw for crayon and device in position.

When the operator has learned to interpret the marks left by the bumpograph, much valuable information may be had.

Let us assume that the bumpograph has been adjusted to mark a minimum bump of $\frac{1}{8}$ inch and has been wheeled over a section of pavement on paths 2 feet to 3 feet apart for the full width of the pavement. If a short mark of 1 foot or less is made, possibly formed by a roller stop, one or two passes with the cross-roller will iron it out. Two or three foot marks showing $\frac{1}{8}$ inch to $\frac{1}{4}$ inch bumps indicate a change in load against one or both screeds of the spreading machine, and will require five or more roller passes. If marks are longer near one header, there will be a high spot in this header.

Occasionally, marks 10 feet or more long with $\frac{1}{8}$ inch deep bumps

are found, possibly formed by a machine stop, a cold load, or a high header. Rolling should then be started in the center and edged over a foot or more toward the end of the bumper, then go back to the center and edge over toward the other end. This will spread the bump both ways instead of crowding it to the center, and it may be necessary to repeat this operation several times to perform a good job. If the pavement is getting cold, it may be necessary to get another roller to iron out before the pavement sets up ahead.

To date this device has been used in several districts, but its development has reached a point where it may be advisable to distribute it to other districts. Only one machine is available and the mechanical construction is not entirely perfected.

The joints become loose and there appears to be some lost motion which might affect the accuracy of operation. However, it has proved of considerable value in constructing asphalt pavements wherever used.

Plan for Conservation Week

The Division of Highways of the Department of Public Works is cooperating with the California Conservation Council in plans for the observance of California Conservation Week, March 7 to 14.

The purpose of the Council is to promote an all-year educational program to arouse public interest in the conservation of the State's natural resources, improvement of roadsides and the preservation of natural landscapes, a work in which the Division of Highways, through its Roadside Development unit, is vitally interested.

Underpass Eliminates Dangerous Grade Crossing at Palo Alto

(Continued from page 26)

feet on each side of the tracks. Two flights of concrete stairs beside the separated street grades provide for full use of the separation for all pedestrian uses. An extensive landscaping plan was executed under the contract, together with an ornamental illuminating system throughout the project area.

Immediate effect was noted upon opening the separation, both for pedestrian and vehicular traffic. All normal pedestrian traffic to the high school and the university used the walks provided without direction or congestion, while vehicular traffic found the roadway adequate and convenient.

The crowds attending the football game on October 24th, last, estimated at some 50,000 persons and about 15,000 to 20,000 cars, used the separation in an orderly manner under the direction of the Palo Alto Police Department and the State Highway Patrol, while the railroad company handled all rail traffic at the stadium station with loud-speaker direction. A decided improvement was noted in dispersing the vehicular traffic from the stadium area to all bay district areas. The local traffic situation was returned to normal conditions in less than an hour.

MUCH EMPLOYMENT PROVIDED

The contract for the project was executed by Eaton and Smith of San Francisco, who are at present engaged in constructing the Niles Project described in a recent issue, of California Highways and Public Works. The principal items of construction cost were:

- 4,600 cu. yds. of ready mixed concrete
- 261,000 lbs. bar reinforcement
- 240,000 lbs. structural steel
- 60 MBM lumber
- 40,000 sq. ft. plywood
- 18,000 gals. gasoline
- \$2,500 electrical equipment
- \$1,000 plants and shrubs

Some 44,689 man hours of employment were provided by this work, totaling a payroll of \$38,687.39, by

In Memoriam

FRANCIS GEORGE DARLINGTON

District IV loses a valuable assistant from its ranks in the recent passing of Francis George Darlington, Associate Highway Engineer, at his home in the city of Palo Alto on January 7, 1937.

Mr. Darlington was born in Liverpool, England, on April 3, 1885, but while very young his parents moved to the United States to make this country their permanent home.

Frank, as he was known to all his friends, received his education in the public schools of Milwaukee, Wisconsin, and in the State University at Madison, but the San Francisco Bay region was his home from early manhood to the day of his passing.

Mr. Darlington filled various field and office positions from March, 1908, to October, 1918, in the City of San Francisco's Engineering Department, from which service he resigned to become a First Lieutenant in the U. S. Army Engineering Corps, where he served until January, 1919. In November, 1919, Mr. Darlington began his service with the Division of Highways in District IV, where he was employed for a time on field surveys until called to the office where his versatile talents and alertness proved a great value in assisting the Chief Draftsman in office work of the District organization.

During this seventeen years of State service, Frank Darlington accomplished a vast amount of work. His kindness, consideration and helpfulness to others were outstanding characteristics. Fidelity to principle and gentleness of spirit were predominant in his character.

His passing in the prime of his life was a shock to his many friends and leaves a profound sense of loss.

direct construction. Materials necessary to complete the work total approximately \$65,000 in cost, of which amount a large proportion went for production payroll. In addition to these amounts, the railroad was reimbursed for approximately \$20,000 of labor and material costs expended.

The entire project was designed and constructed by the Division of Highways, C. H. Purcell, State Highway Engineer, and F. W. Panhorst, Bridge Engineer. H. H. Gilbert designed the work, and the writer served in the capacity of construction engineer until the completion of the entire project.

Highway Bids and Contract Awards During January

HUMBOLDT COUNTY—Between Trinidad and McNeills Ranch, 2.3 miles to be graded and surfaced with road-mix surfacing. District I, Route 1, Section J. Hemstreet and Bell, Marysville, \$111,991.30; Fredrickson & Watson Const. Co. and Fredrickson Bros., Oakland, \$111,302.84; A. Teichert & Son, Inc., Sacramento, \$116,963; Mercer-Fraser Co., Eureka, \$117,803.50; Fredrickson & Westbrook, Lower Lake, \$119,934.80; Hanrahan Co., San Francisco, \$135,361.95; Harms Bros., Litchfield, \$136,826. Contract awarded to Poulos & McEwen, Sacramento, \$104,316.60.

IMPERIAL COUNTY—Between Sandia and Alamo River, 10.1 miles to be graded and surfaced with plant-mixed surfacing. District XI, Imperial County, Sections B, C, V. R. Dennis Const. Co., San Diego, \$99,001.70; Basich Bros., Torrance, \$98,337.40; Dimmitt & Taylor, Los Angeles, \$95,007.10; Oswald Bros., Los Angeles, \$84,637.75; B. G. Carroll, San Diego, \$94,566.30; R. E. Hazard & Sons, San Diego, \$88,640.75. Contract awarded to G. W. Ellis, North Hollywood, \$78,029.55.

IMPERIAL COUNTY—Between Calexico and 3.1 miles easterly, 3.1 miles to be graded and surfaced with gravel base and plant-mixed surfacing and two timber bridges to be constructed. District XI, Route 202, Section Cix.C. V. R. Dennis Construction Co., San Diego, \$89,047.35; Oswald Bros., Los Angeles, \$83,916.85. Contract awarded to R. E. Hazard & Sons, San Diego, \$79,968.70.

LOS ANGELES COUNTY—Between Azusa Avenue and San Gabriel River Bridge, 2.1 miles to be graded and surfaced with plant-mixed surfacing. District VII, Route 62, Section Azu, A. Geo. J. Beck Co., Los Angeles, \$12,728.50; Dimmitt & Taylor, Los Angeles, \$129,436; J. E. Haddock, Ltd., Pasadena, \$104,916.50; Oswald Bros., Los Angeles, \$110,930; Griffith Co., Los Angeles, \$129,210.50. Contract awarded to A. S. Vinnell Co., Los Angeles, \$98,545.50.

LOS ANGELES COUNTY—Between Playa Street and Washington Boulevard, 1.8 miles to be graded and paved with P. C. C. District VII, Route 158, Sections B, LA, C.L.C. Matich Bros., Elsinore, \$92,199; P. J. Akmadzich, Los Angeles, \$100,698.50; Geo. R. Curtis Paving Co., Los Angeles, \$103,462; Griffith Co., Los Angeles, \$99,998.20; C. O. Sparks & Mundo Engineering Co., Los Angeles, \$107,518; Oswald Bros., Los Angeles, \$95,758. Contract awarded to J. E. Haddock, Ltd., Pasadena, \$91,784.50.

ROAD PROGRAM MADE WORK

The highway program to relieve unemployment administered by the Bureau of Public Roads of the U. S. Department of Agriculture had resulted in the construction of 38,220 miles of road at the close of the last fiscal year, according to the annual report of the Bureau, just released. These roads cost \$636,622,561, of which \$571,276,033 was paid by the Federal government, says Thos. H. MacDonald, chief of the bureau.

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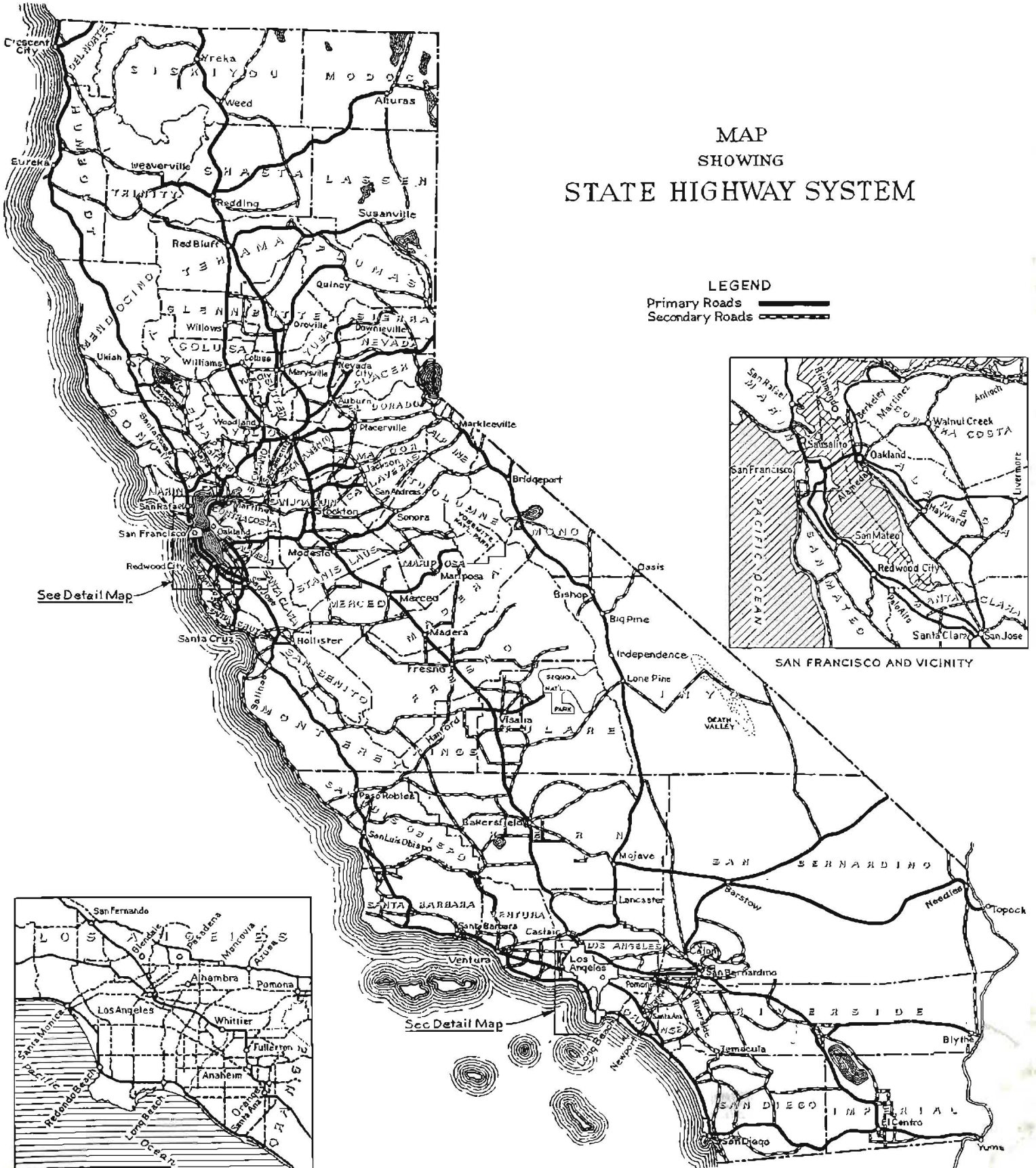
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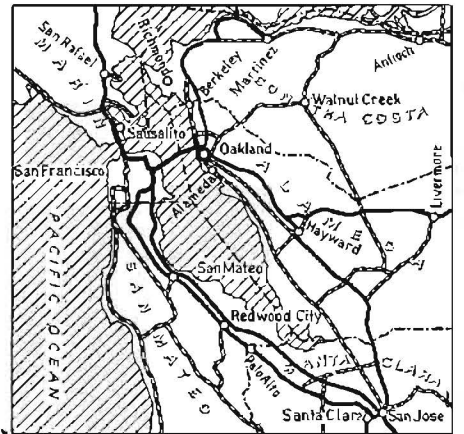
MAP SHOWING STATE HIGHWAY SYSTEM

LEGEND

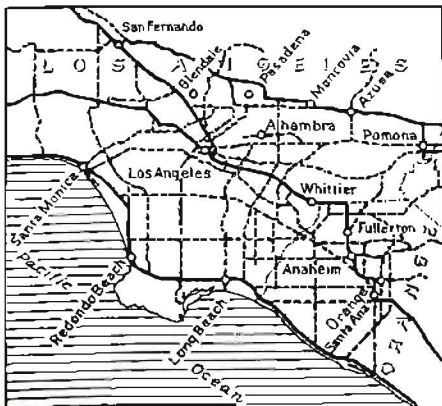
Primary Roads 
Secondary Roads 



See Detail Map



SAN FRANCISCO AND VICINITY



LOS ANGELES AND VICINITY

See Detail Map