CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

SEPT. - OCT., 1946

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

[PRINTED IN U.S.A.]

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Vol. 24 | SEPTEMBER-OCTOBER 1946 | Nos. 9, 10

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Joint Fact-Finding Committee Hears Report of G. Donald Kennedy on A Ten-Year Highway Program

A COMPREHENSIVE study of California's highway engineering problems, embodying a 10-year program for effecting necessary road and street improvements, has been completed by an independent engineering staff which carried on the project for the Joint Fact-Finding Committee on Highways, Streets and Bridges.

As directed by the 1945 Legislature, an investigation was made of the highway transportation system—State highways, county roads and city streets—to determine the cost and extent of improvements needed to bring existing facilities up to standards adequate to serve present and future requirements of the State.

The facts and recommendations contained in the engineering report, together with separate studies made currently on highway finance and taxation, will be reported to the Legislature in January to provide the factual basis for a sound, long-range policy of highway development.

KENNEDY MAKES REPORT

The engineering study was conducted by G. Donald Kennedy, Vice President of the Automotive Safety Foundation, Washington, D. C. Mr. Kennedy's services were made available by his organization with the understanding that the engineering report would not include recommendations on future highway fiscal policy.

Mr. Kennedy made a formal presentation of the report to the committee at a meeting held October 16th in the Senate chamber of the Capitol. By means of enlarged maps, charts and other graphic devices he reviewed the scope of the study and summarized the more important findings.

In attendance with the committee were members of its advisory council, made up of representatives of highway user groups, civic organizations and public officials interested in highway problems.

COMMITTEE MEMBERS

Senate members of the committee in addition to the chairman are George J. Hatfield, Newman; Ben Hulse; El Centro; James J. McBride, Ventura; Thomas McCormack, Rio Vista; Jerrold L. Seawell, Roseville; and Jack B. Tenney, Los Angeles.

G. Donald Kennedy, Engineering Consultant for the Joint Fact-Finding Committee on Highways, Streets and Bridges

Assembly members are Charles W. Stream, Chula Vista, Vice Chairman; Michael J. Burns, Eureka; C. Don Field, Glendale; Gerald P. Haggerty, San Francisco; Charles W. Lyon, Beverly Hills; Bernard A. Sheridan, Oakland; and Frank J. Waters, Los Angeles.

Leading up to the final objective of the study—determination of the cost of an economically justifiable and balanced program of highway improvement covering a 10-year period—Mr. Kennedy explained that the following steps had been taken:

An inventory was made of existing facilities and the amount and character of travel upon them.

Future highway needs were forecast in the light of the State's development and consequent traffic increases.

A proposed reclassification of roads and streets into systems was made according to service rendered, for purposes of jurisdiction, financing, administration, standards of improvement and maintenance.

A study was made to determine design standards which are the minimum to provide facilities for safe and efficient movement of the expected volume and character of travel.

Estimates of present and future needs submitted by the State, counties and cities were compiled and adjusted, with allowances for fluctuations of the price index.

The final step in formulating a sound, well balanced improvement plan was to evaluate the estimates of need, as presented and adjusted, together with engineering facts developed by the study.

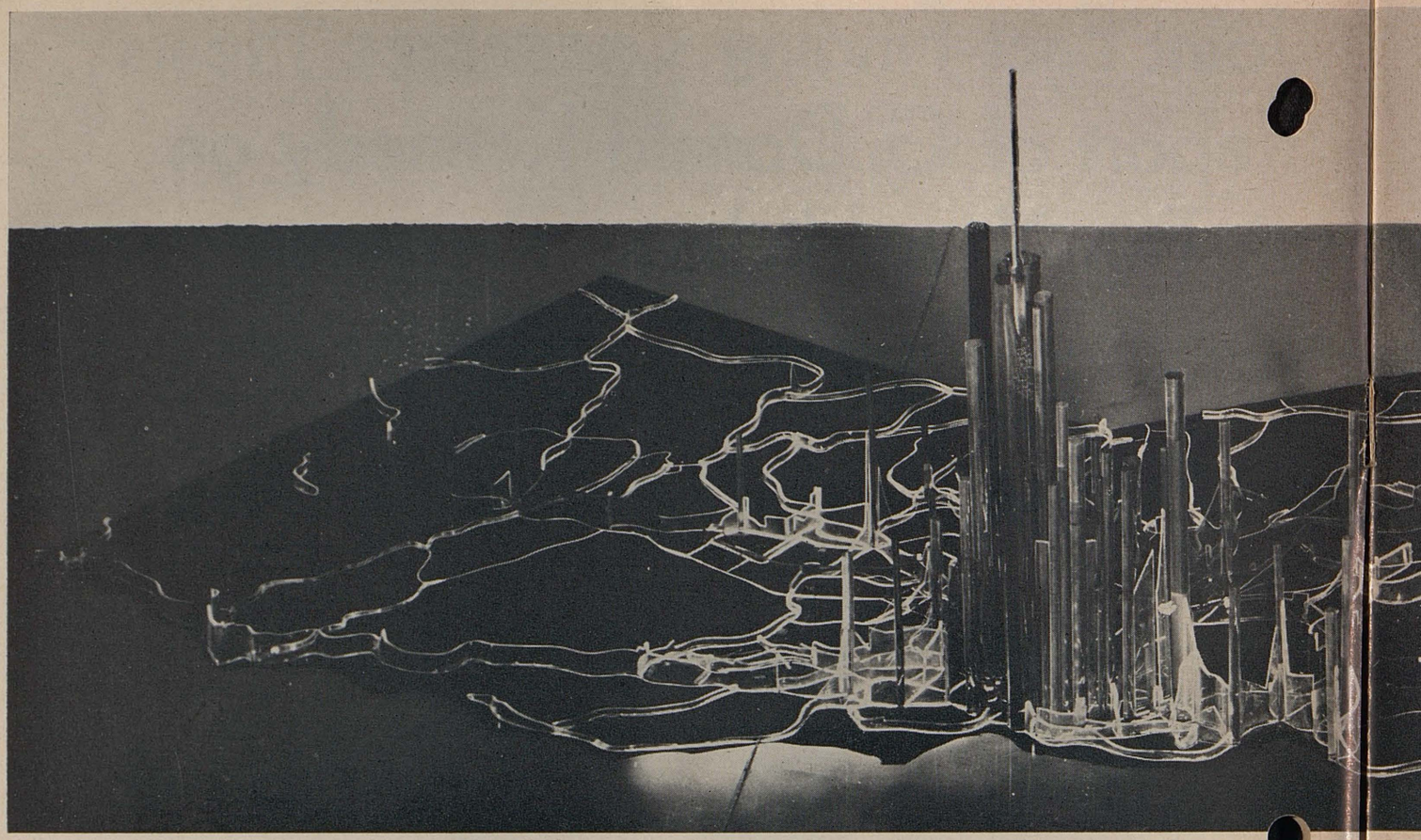
TEN-YEAR PROGRAM

It was considered advisable to plan a 10-year program, as requested by the Legislature. Some of the improvements recommended in the 10-year program will be accomplished during the interim period, within the limits of revenue available. It would not be feasible to supersede plans already made for the next two or three years, although such plans might well be accelerated.

The underlying principle applied in recommending the balanced program was that improvements should first be made where the greatest return on the highway investment would result. This return is measured in terms of safety, economy of vehicle operating cost, saving of time and convenience of movement over roads and streets.

RETURN ON INVESTMENT

The best assurance that return on the investment will be greatest is to provide facilities based on nationally adopted standards as minimums and as related to California's anticipated vol-



TRAFFIC FLOW ON THE CALIFORNIA STATE HIGHWAY SYSTEM. The average num[illegible] of ve[illegible]hicle average citizen. Traffic data are essential, however, to engineers in planning, designing, building and operating a proper high[illegible]way wide variations in traffic flow are clear. The tall cylinders mark the cities and each vertical plane represents a State high[illegible]way, average traffic of 250 vehicles a day and the highest point is 70,000 a day at the San Francisco-Oakland Bay Bridge. Volumes vary

ume and character of travel. These standards represent the experience and judgment of the best highway engineering talent in the Nation. They assure highways that will render safe, efficient service at a cost that is economically justifiable.

The 10-year program was presented in the form of annual expenditures for construction, maintenance, administration and other costs shown separately for the State Highway System, County Road System and City Street System.

The final preliminary step to drafting the program was to compile and analyze estimates submitted by the State, counties and cities of the cost of making highway and street improvements which they consider necessary to meet present and future requirements.

Recognizing the magnitude of the task, the committee arranged in advance of the study to gather the required information.

Estimates of cost were requested from the State Division of Highways covering the State system. County information was obtained by means of questionnaires distributed by the County Supervisors Association of California, and the League of California Cities cooperated in a similar manner in gathering data on municipal estimates of cost. The Los Angeles Metropolitan Parkway Engineering Committee provided information for the study of the special problem in its area. All of these original requests for information were supplemented by individual city and county presentations to the committee at hearings held throughout the State.

CALIFORNIA HIGHWAY PROBLEMS

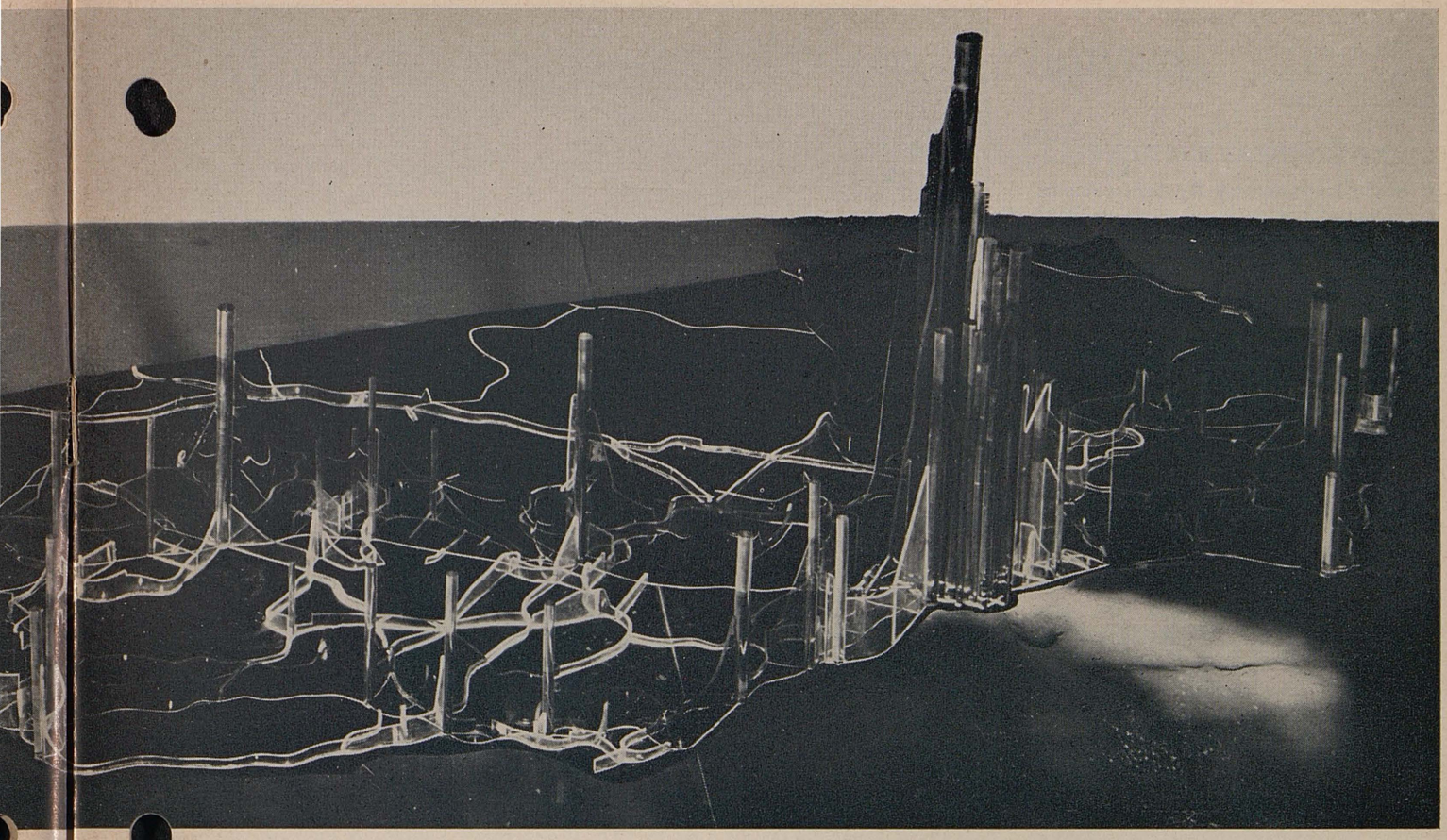
The study began by tracing the historical development of highway transportation in California. Mr. Kennedy pointed out that California highway problems reflect certain distinctive characteristics of the State—its rapid growth, leading position in number and utilization of motor vehicles, the travel habits of its people, its size and geographical position, and extremes of topography and climate.

An appraisal of the highway plant indicated it was deficient when World War II started, progress could not be maintained during the emergency period, and facilities now are inadequate to meet future needs.

Population, mileage of road systems, motor vehicle registration, vehicle miles of travel and accident records were examined as indices by which to measure more exactly the progress of highway development.

From 1912 through 1945 the State invested approximately one and one-fourth billion dollars in highways, of which nearly $832 million was spent by the Division of Highways and the remainder apportioned to the counties. Since 1934, State expenditures in cities averaged $7.9 million per y[illegible]

From 1920 through 1945 the co[illegible] ties spent $632 million for road pur-



of vehicles using each route of the State Highway System each day combines to a table of figures having little meaning for the er highway system. By expressing the traffic variations in terms of the thin vertical planes of the plastic model photographed here, the te highway, with the height proportional to the volume of traffic in each section. Lowest points on the planes correspond to an olumes vary widely between highways and on different sections of the same highway and increase sharply near the cities.

poses received from Federal funds, State-collected highway user taxes, and general taxes.

In the same period the cities expended $417 million for street purposes received from Federal funds, State-collected highway user taxes, and general taxes.

FEDERAL AID FUNDS

A study was made of the importance of Federal Aid funds in highway development, here and in other States, showing that since 1917 the Federal Government has expended more than $298 million for highway purposes in California. It was noted that the current three-year program involves the spending in this State of $9 million annually for Federal primary highways, $5 million for secondary highways, and $8 million for improvements on Federal aid routes within cities.

An examination of the factors affecting California's future development led to the prediction that highways must be planned to handle the traffic that will result from a population of 11,100,000 in 1960.

The report traced the rapid growth of California since statehood, noted that the population increased nearly two million during the war period, and concluded that on the basis of all available data the rate of growth established from 1920 to 1940 may be expected to continue.

POPULATION GROWTH

It now appears certain, Mr. Kennedy said, that the State will retain a high proportion of its wartime growth, which was more than three times as great as that experienced by any other State. The population passed the nine million mark early this year. In-migration continues at a substantial rate, the birth rate is increasing, and the death rate declining. These facts, together with the State's war-stimulated industrial growth and other favorable economic factors, led to the following population predictions for the next two census enumeration periods:

1950	9,600,000
1960	11,100,000

The prediction was made that California, which now has 3,340,000 motor vehicles registered, would have 5,250,000 in 1960.

With 1946 travel estimated at 32 billion vehicle miles, the prediction for 1960 was 45.8 billion.

Consumption of gasoline, now slightly less than two billion gallons a year, was estimated at 2.68 billion gallons in 1950 and 3.16 billion gallons in 1960.

One of the most important recommendations in the report called for reclassification of the network of roads and streets existing in California for the purpose of providing for the most efficient engineering and administration of the systems.

PLAN OF RECLASSIFICATION

The master plan of reclassification would result in the following approximate mileages:

STATE HIGHWAY SYSTEM

State Expressway System—An integrated network of modern, high design, limited access routes connecting the major centers of population, with extensions into the cities

Rural	2,050 miles
Metropolitan	780
Urban	110
Total State Expressway System	2,940 miles

State Trunkline System—Principal State routes not included in Expressway System

Rural	8,034 miles
Urban	511
Total State Trunkline System	8,545 miles

COUNTY ROAD SYSTEM

County primary system	20,000 miles
Other county roads	45,737
Total county roads	65,737 miles

CITY STREET SYSTEM

Streets of major importance	3,774 miles
Other city streets	14,554
Total city streets	18,328 miles

This reclassification would involve the transfer from the State Highway System to county and city jurisdiction of approximately 2,467 miles of highways of predominantly local interest. It would abolish the present distinction between primary and secondary State highways.

In recommending the designation of a network of principal State highways as the State Expressway System, Mr. Kennedy explained that highest priority of improvement would thereby be possible to provide fast, safe, efficient service between the State's principal cities and to relieve congestion in and around the metropolitan centers.

Design standards set for the Interstate System were recommended as minimums for the State Expressway System, with other nationally accepted design standards to be used in improving the remaining systems.

Throughout the report the part played by modern engineering in building safety into highways was emphasized as an important step in reducing California's currently high traffic death rate.

Legislative and administrative action to help solve the parking problems that exist in every California community were recommended. Development of modern highways leading into cities, the report pointed out, will not result in maximum benefits unless parking facilities are adequate to handle the increased traffic. It was declared to be the responsibility of local government to take the initiative in solving parking problems and to encourge private enterprise to operate off-street lots and garages.

In arranging with Mr. Kennedy to conduct the fact-finding study of the highway transportation system, the committee took into consideration his high professional standing and 20 years of experience in the fields of highway engineering and administration. He resigned as Michigan State Highway Commissioner in 1942 to join the Automotive Safety Foundation as Vice President. He is a former President of the American Association of State Highway Officials, and served as chairman of the postwar construction committee of the American Society of Civil Engineers.

On several occasions Mr. Kennedy has acted as consultant and prepared reports for governmental agencies and congressional committees on problems of highway development. He was Vice Chairman of the National Interregional Highway Committee appointed in 1941 by President Roosevelt. In 1943 he conducted a fact-finding survey of the national highway situation for a Special Senate Committee on Post-War Economic Policy and Planning, and prepared a report entitled "The Role of the Federal Government in Highway Development."

In assembling his staff for the California study, Mr. Kennedy obtained the services of two engineers of wide

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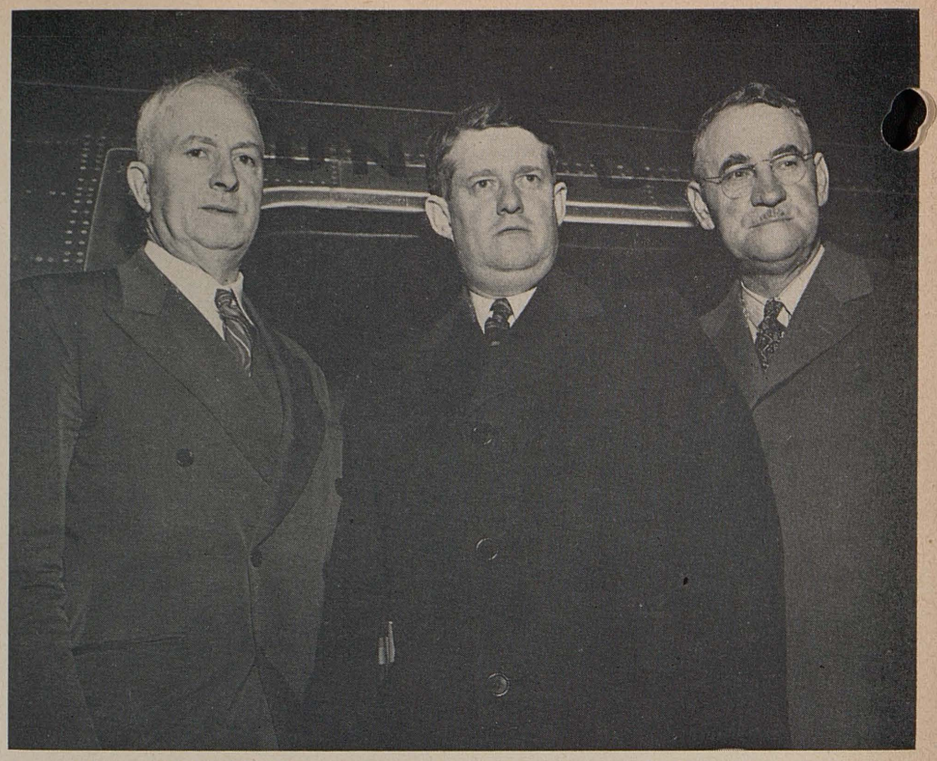

Assemblyman Michael J. Burns of Eureka (left), Chairman of the Assembly Interim Committee on Transportation and Commerce and also a member of the Joint Fact-Finding Committee on Highways, Streets and Bridges; Senator Randolph Collier of Yreka (center), Chairman of the Joint Fact-Finding Committee on Highways, Streets and Bridges; and State Highway Engineer George T. McCoy (right), member of the Advisory Council of the Joint Fact-Finding Committee on Highways, Streets and Bridges, shown departing for the President's Highway Safety Conference in Washington, D.

American Association of State Highway Officials Will Hold Annual Meeting In Los Angeles December 17-20

CONFRONTED with problems more serious than any with which it has heretofore had to cope, the American Association of State Highway Officials is preparing for the most important meeting in its history. Its members will hold their thirty-second annual convention in Los Angeles, December 17-20.

During the war, highway construction lagged far behind actual needs in every State in the Union, particularly those on the Atlantic and Pacific Coasts. With the coming of peace, highway officials found themselves facing a multitude of problems ranging from reconstruction of neglected roads to the building of new highways and freeways to care for steadily increasing traffic.

Heavily congested urban areas and [illegible]ral communities alike have pressing [illegible]hway needs and how to take care of them will occupy a large portion of the time of the association members at their 1946 meeting.

Committees appointed by George T. McCoy, State Highway Engineer of California, and general chairman, already are deep in convention arrangements. An extensive program of entertainment for the delegates and their wives and families is being mapped.

This is the third time that the American Association of State Highway Officials has chosen California for its meeting place. It met in San Francisco in 1924 and again in 1936. As in the past, the Los Angeles meeting will be highlighted by the attendance of Commissioner of Public Roads Thomas H. MacDonald and his staff between whom and the association there has been close cooperation since 1914 in building the splendid National system of highways of which this country now boasts.

Committees named by General Chairman McCoy are as follows:

Honorary Chairman—C. H. Purcell, [illegible]ector of Public Works, and Chairman, Highway Commission, California.

Governor Warren Looks Forward to A. A. S. H. O. Meeting

CALIFORNIA looks forward with pleasure to again welcoming the American Association of State Highway Officials. Ten years ago the Association honored our State by holding its twenty-second annual meeting in San Francisco. This year it returns to meet in Los Angeles December 17-20.

Delegates who attended the San Francisco meeting will find great changes have occurred in our State during the intervening years. During the war our population was increased by 2,000,000, and we assumed third position in population among the States of the Nation. Changes have been made in our entire economy and in all our highway needs.

Throughout the war, our State Government gave priority to the victory effort. In doing so, we obviously were forced to delay many important highway improvements, but even during the period when all construction except for war purposes was at a minimum, we were planning for the day when construction would be resumed. We realized that if we were to proceed with public works programs promptly following the war, plans for them would have to be prepared well in advance. And so we pursued a policy wherever possible of having highway surveys completed, rights of way purchased and construction plans finished ahead of authorized construction.

As a result of this policy, we have underway today the largest highway program ever initiated in a single year by our Department of Public Works. But we recognize this program, large as it is, as only the beginning. Our unprecedented growth and our development needs will make highway planning and construction one of our most important activities for many years to come.

General Chairman—G. T. McCoy, State Highway Engineer, California.

Convention Manager — Frank C. Balfour, Chief Right of Way Agent, California.

Program Committee—G. T. McCoy, Chairman; Dr. L. I. Hewes, Chief, Western Headquarters Public Roads Administration; Clarence B. Shain, Director of Highways, Washington; Robert A. Allen, State Highway Engineer, Nevada; R. H. Baldock, Chief Highway Engineer, Oregon; Hal H. Hale, Executive Secretary, American Association of State Highway Officials, Washington, D. C.

Advisory Committee—State Highway Commissioners Harrison R. Baker, Chairman, Pasadena; Homer P. Brown, Placerville; James Guthrie, San Bernardino; F. Walter Sandelin, Ukiah; C. Arnholt Smith, San Diego; Chester H. Warlow, Fresno.

Housing Committee—Lawrence P. Friel, Chairman, Right of Way Agent, District VII Office, Division of Highdays, Los Angeles; E. F. Wagner, J. W. Vickrey, Mrs. Asthore Clark, Secretary.

Transportation Committee—S. V. Cortelyou, Chairman, District Engineer, District VII, Division of Highways, Los Angeles; R. H. Stalnaker, T. H. Dennis, J. W. Vickrey, John K. Hess.

Entertainment Committee—Harold Norton, Chairman, Special Representative, Department of Public Works, California; F. W. Panhorst, R. M. Gillis, Fred J. Grumm, Clare P. Balfour, Edward F. King.

Women's Committee—Clare P. Balfour, Chairman; Mrs. C. H. Purcell, Mrs. G. T. McCoy, Mrs. Fred J. Grumm, Mrs. S. V. Cortelyou, Mrs. Jno. H. Skeggs, Mrs. Hodge L. Dolle, Mrs. Harold W. Leonard.

Women's Committee Aides—Harold Norton, Clyde Graham, W. L. Fahey, Neil C. Brown, Wm. L. Mills.

Women's Reception Committee—Mesdames C. H. Purcell, Chairman; G. T. McCoy, Vice Chairman; Fred J.

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Reduction of Fire Hazards Along California State Highways

By E. S. WHITAKER and H. N. BOSWORTH, Assistant Landscape Engineers

THE control of roadside growth to aid in the prevention of fires along portions of State highways of California has become an annual program of importance.

This work is not performed as a matter of roadside clean-up. Its justification is based on recognition of the need for a cooperative program for the protection of agricultural lands adjoining State highways from fires which may originate thereon.

These fires may be started through the carelessness of smokers, by hot carbon from the exhausts of motor vehicles, or from other accidental causes. The program is intended to minimize the number and spread of fires originating from traffic moving on the traveled way or parked on the shoulder area normally available for emergency use.

Burned firebreak on a cut slope from the gutter line up

FIRE HAZARD CONTROL

Fire hazard control work is undertaken along roadsides which adjoin pasture lands and grain fields where a fire originating on the highway would quickly get out of control. The density and type of traffic, as well as conditions peculiar to the locality, are deciding factors. This type of work—the programming of fire hazard control work—is necessarily limited as sufficient funds are not available to set up a program on a State-wide basis. No work is done along sections of highways where adjacent land is cultivated, irrigated, or in orchards. Neither is work undertaken where barriers such as rivers, irrigation ditches, or railroads serve as a firebreak.

The program was first initiated in 1926 when extensive fire losses to crops caused underwriters to consider increases in premium rates for this type of insurance. Development of equipment and start of a control program was undertaken early in 1927. In 1928 some 660 roadside miles were cleared or burned at an expense of $37,850 to the State. The program has gradually expanded to take in some 3,000 roadside miles and requires approximately $120,000 to finance the annual cost. This is in addition to work such as plowing firebreaks and burning work undertaken by owners of property adjoining the highways. For the years 1942 to 1945, inclusive, wartime restrictions on use of diesel oil limited the spraying and burning program.

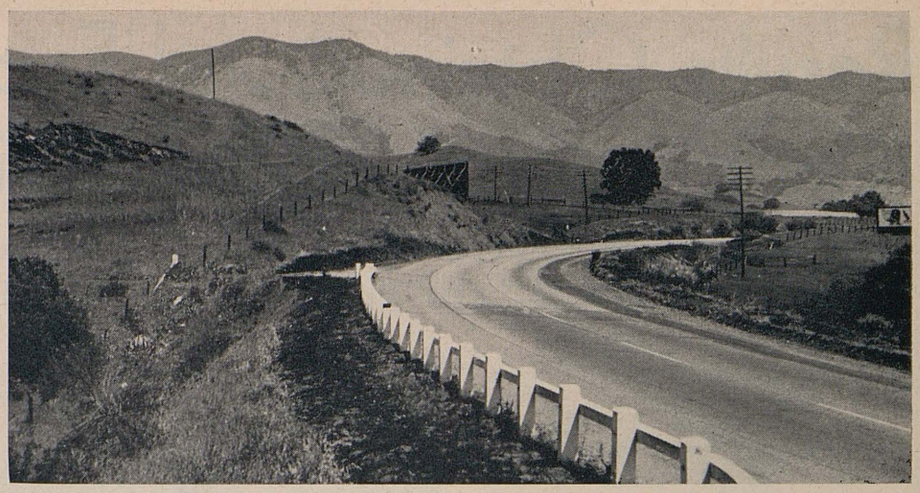
Burned firebreak on a fill slope from the top of the berm out and down

VARIOUS METHODS

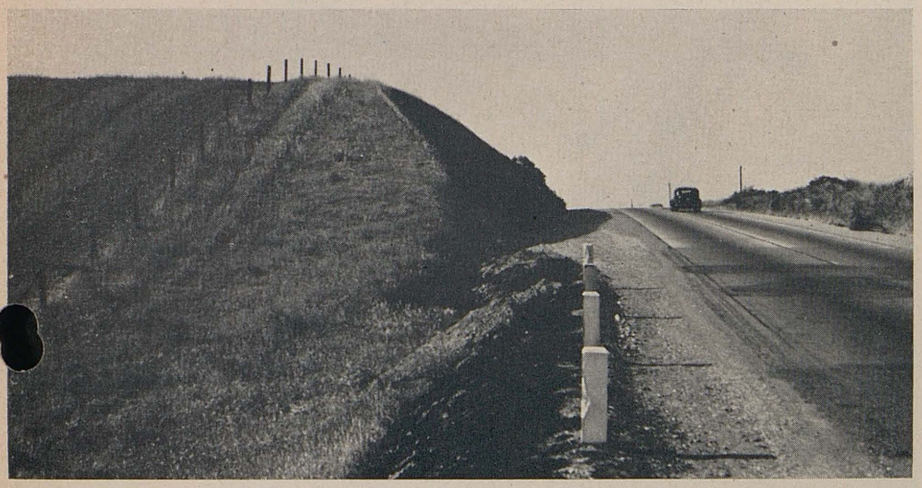
Methods of accomplishing the control include the killing of green grass with a diesel oil spray and a follow-up burning after the sprayed grass has become dead and dry, or the control of vegetation by mechanical means—that is, through the use of discing or blading equipment. During the war years, control was obtained as well as possible through discing and blading but due to the nature of the roadsides, there were many miles on which no control could be done. The return to the spray and burn work allows for a more complete control program.

The present practice provides for a control strip six feet wide when sprayed and burned, or the width of one operation if disced or bladed. The sprayed or bladed strip is placed on

or as close to the shoulder as growth demands in order to increase the width between the edge of the traveled way and the nearest roadside fire hazard. Fire incidence is reduced by controlling the hazard on the area nearest to the point of fire origination. In this location, it also eliminates the possibility of fire starting in the grass that was left between the traveled way and the control strip when placed next to the right-of-way line, as was the previous practice, and of burning along this growth to a point of possible escape to adjoining property. This type of fire occurrence did no particular damage so long as it was controlled by a firebreak between it and the private property; however, it placed an undue amount of work on the State Forestry Department as a result of the policy of that department to dispatch men and equipment for the suppresion of all fires reported in rural areas.



Firebreak behind guard rail



Firebreak on short area between cut and fill slopes in foothill section

BLADING ECONOMICAL CONTROL

Blading, which provides the most economical control, is done on valley, turnpike, and rolling foothill sections with the bladed width placed on the shoulder to control the hazard growing nearest the traveled way. Blading is also carried out on narrow shoulders to afford additional control to the spraying and burning done on cut and fill slopes.

Heavy duty discs are used on areas outside of the gutter line on turnpike or valley sections, or in rolling foothill sections. The disced width is placed outside of but as near to the gutter line as physical features permit for the same reasons noted regarding the sprayed and burned strip. Discing is not undertaken between the edge of the traveled way and the gutter line, it being desired to keep the soil stable in this area. Discing is carried out as near to the point of the cut slope as is reasonable. The sprayed strip along the bottom of the cut slope is extended either to meet the disced strip or is continued along the top of the fill slope, according to the nature of the roadside and the method of control determined advisable. In this manner, the danger of a fire escape at the transition areas is reduced to a minimum.

SOIL STABILITY MAINTAINED

Valley, turnpike, and rolling foothill sections may often be disced or bladed with little danger of solid erosion, whereas other areas that are fairly level require treatment by spraying and burning in order to maintain soil stability. Spraying and burning provides the maximum of protection when placed from the toe of cut slopes up on the slope and from the top edge of fill slopes out and down. In undulating country, a most effective fire hazard control job may frequently result from

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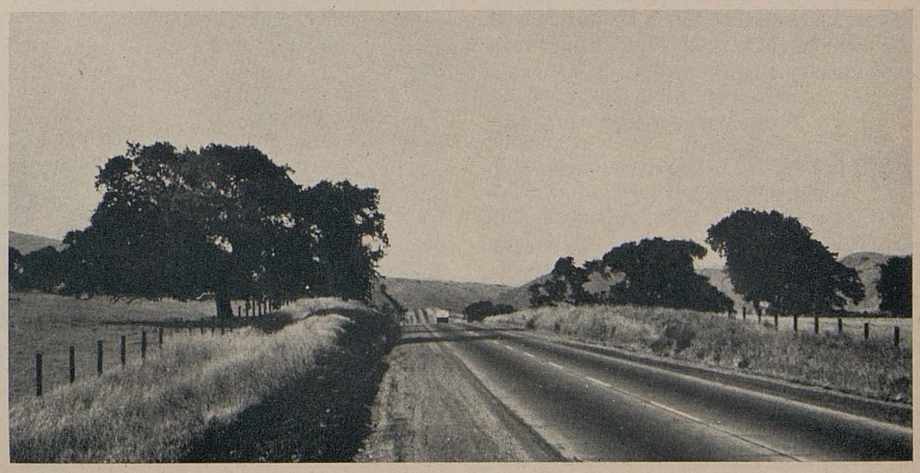
This firebreak was bladed next to right of way line as carried out in 1945



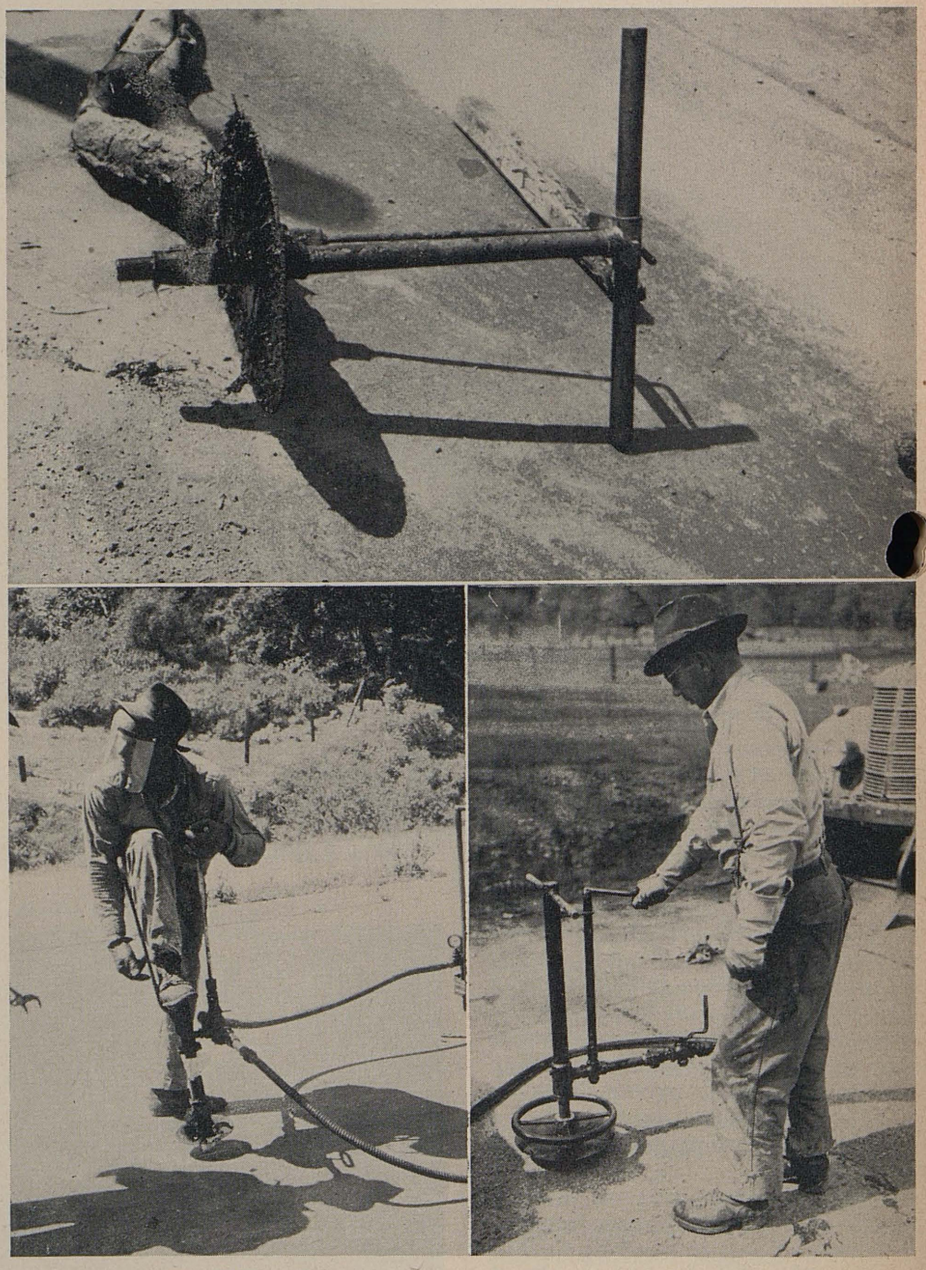
Results Obtained and Experiments Made in Asphalt Subsealing

By H. L. COOPER, Assistant Maintenance Engineer, and
W. R. SOVERING, Assistant Physical Testing Engineer

SINCE the article on "Asphalt Subsealing" appeared in the May-June issues of "California Highways and Public Works," improvements in the equipment, with more efficient methods of operation and more experienced crews, have increased the output and decreased the cost of this type of work to a marked degree.

Observations and experiments made since this work started in March, 1946, give promise that the use of hot liquid asphalt pumped under concrete pavements in order to reduce slab movement and eliminate the pumping condition and also seal the pavement from the bottom side will prove a sound and worthwhile procedure. One district reported that several days after pumping, an inspection showed that of 200 slabs which had previously pumped under traffic, only nine slabs showed any signs of pumping action and these to a lesser degree.

It has been possible to speed up the subsealing work by the use of two 900-gallon asphalt heating tanks which were converted from 1,040-gallon water tanks by Headquarters Shop. These tanks are complete with burners, oil pumps, and pressure hose and are capable of heating cold packaged asphalt to 450 degrees Fahrenheit and pumping directly under the pavement. These two tanks have been constantly in use in Districts IV, VII and X and the results obtained have been very satisfactory.



Three types of nozzles used in asphalt subsealing

INCREASED OUTPUT

After lengthy negotiations with several oil companies, arrangements were made to purchase hot 20-30 penetration asphalt in bulk from one bay area refinery. This was hauled directly to the job, with the result that considerable time has been saved (compared to heating the cold packaged asphalt) with a resultant decrease in cost for the work.

San Francisco and Stockton, Districts IV and X, have been able to take advantage of this service which has been reflected in increased output and decreased costs, as compared to the old method of heating cold asphalt in t small hand operated kettles to which the other districts have been limited.

For work in the City of Tracy, District X was able to obtain railroad tank car delivery of hot asphalt which resulted in the greatest production and lowest cost to date for this type of work. Some 5,200 holes were drilled and pumped on this project, which required 187 tons of asphalt. A daily average of 290 holes were filled at an average of 8.64 gallons of asphalt per hole and at an average of $1.60 each.

On another 3.9 mile section, 3,738 holes were pumped using 150 tons asphalt, or 9.4 gallons at an average cost of $1.62 per hole.

DISTRICT X DRILLS 15,900 HOLES

Since work started this year, District X has drilled and pumped 15,900 holes using 541 tons asphalt, or an average of 8.0 gallons asphalt and at a cost of $2.15 per hole.

District IV, by hauling hot asphalt directly from a bay area refinery, was able to average 188 holes per day on one job. Twelve gallons of asphalt were pumped per hole at a cost of $2.35 per hole.

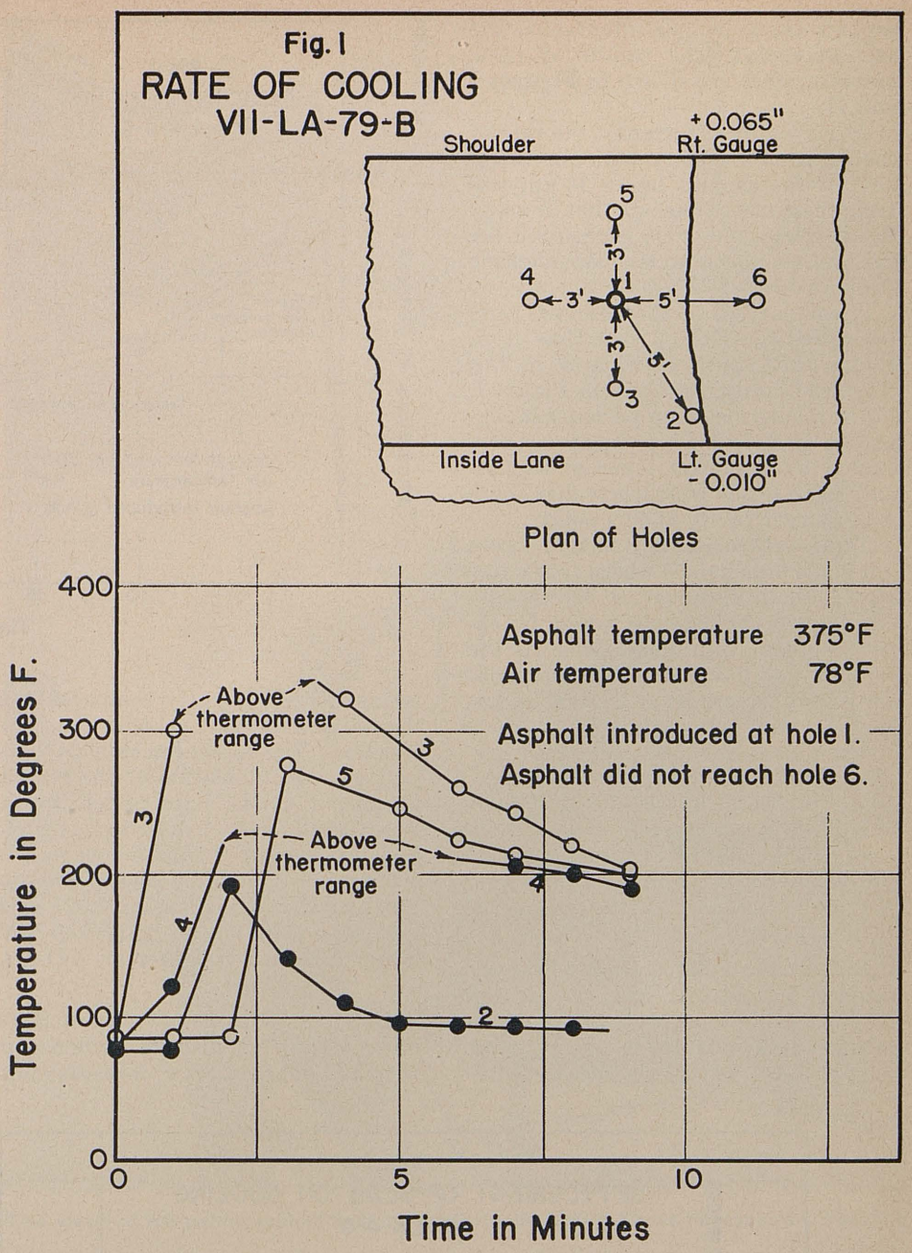
This seasons subsealing work has been completed in Districts II, III, V, VI and XI where the hand-operated asphalt heating kettles of 165 to 400 gallon capacities were used. The equipment used and conditions encountered were reflected in the variation in unit cost of the work which averaged from $2.60 to $4.00 per hole.

Work is still underway in Districts IV, VII and X.

Observations, Measurements and Experiments. In order to improve the asphalt subsealing procedure and to standardize equipment for this work certain observations, measurements and experiments were made in several districts with the help of the Headquarters Laboratory.

Measurements of the temperature of asphalt after injection beneath the pavement and the movement of the concrete slabs, both during subsealing and under loaded trucks, were made to secure information on the following.

1. The rate of cooling of the injected asphalt (which will affect the distance of travel or flow beneath the slab.)
2. The deflection of broken and unbroken slabs under heavily loaded trucks.
3. The magnitude of lift given each slab by the asphalt.
4. The distance to which the asphalt can be forced beneath the pavement.



5. The deflection of slabs both before and after injecting the asphalt.

The measurements of lift and deflection of the slab were made with an Ames dial registering to .001 inch, mounted on a metal support. The support was placed on an adjacent slab or on the shoulder with the dial resting on the slab to be measured. The Ames dial must be handled very carefully to prevent contamination with dust or oil and as the work progressed it was deemed advisable to construct a support which included a suitable protection case for the dial. The support (shown in accompanying photo) was made with a case that completely enclosed the dial but could also be dismantled easily for cleaning. This eliminated the possibility of a sudden blow-out of asphalt making the dial unfit for further use.

Rate of Cooling of the Asphalt. In order to measure the temperature of the asphalt after injection, holes were drilled in the concrete at various distances from the point of injection. Short sections of three-eighths inch pipe were set in jackhammer holes with plaster-of-paris. A small cork was then used to hold Weston or dial type thermometer in place in the pipe. Temperatures were recorded at one minute intervals during injection of

asphalt and at longer intervals as the asphalt cooled. The results of these measurements are shown in **Figures I and II.**

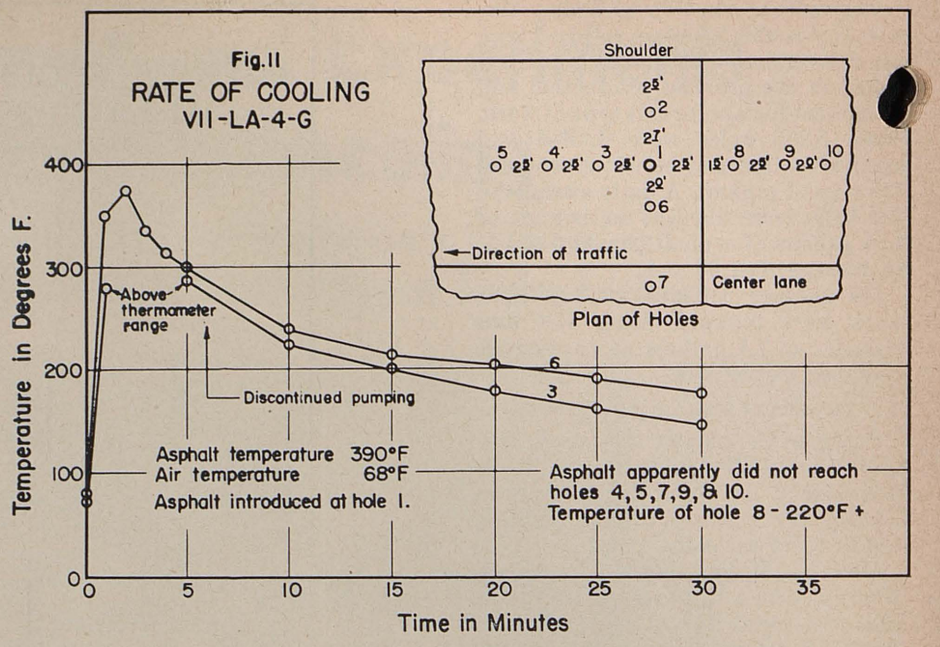
As shown by the graphs, the rate of cooling varies greatly with the thickness of the asphalt layer. It appears from these measurements that in many cases at least one hour is required for the asphalt to cool to normal subgrade temperature.

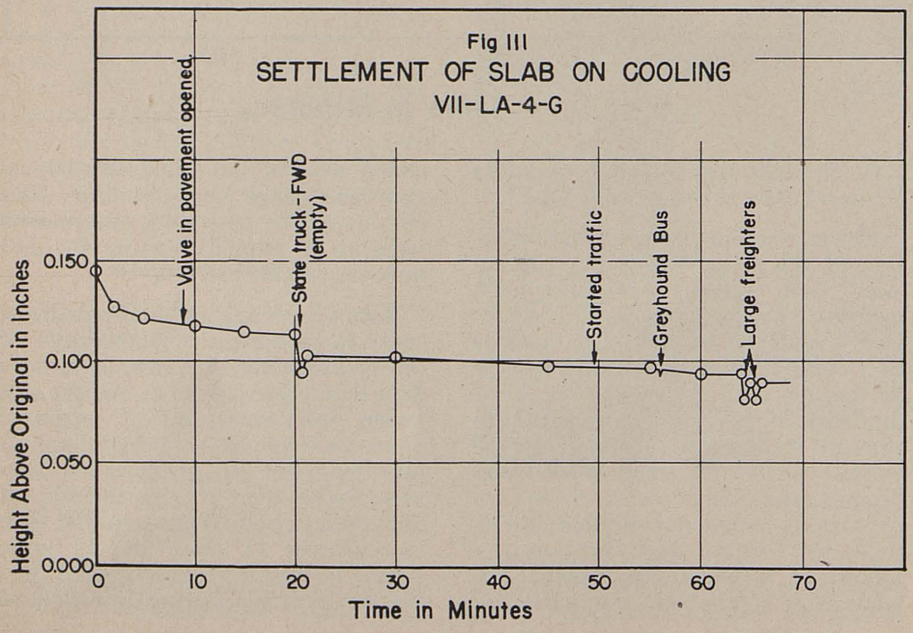
A comparison of the observed temperatures for Hole 2 and Hole 3 on Route 79B, south of Saugus in Los Angeles County, as shown in **Figure I,** shows a longer cooling period was registered at Hole 3. This was apparently caused by a thicker layer of asphalt and leads to the conclusion that there was a larger cavity at this point.

Temperature measurements were not made under slabs where free water was present. However, a more rapid chilling of the asphalt would be expected under these conditions. As the asphalt was pumped under the slabs, water was forced out at the cracks, but as the pumping continued this same water was sucked back under the pavement. This leads to the conclusion that when free water is present the asphalt is chilled in a relatively limited area around the point of injection, causing the slab to be raised on a localized support which creates a partial vacuum at the unsupported corners.

Deflection of Slabs Under Heavily Loaded Trucks. At several locations measurements were made of the movement of slab ends under loaded transport trucks. These several measurements are not directly comparable as the weight of the vehicles was not constant. The measurements do however give an indication of the normal movement of the slabs under typical commercial loads. A deflection of 0.015 inch was measured on a 20-foot slab on VII-LA-79-B under a loaded two-ton truck, and a deflection of 0.025 inch was measured on an unbroken slab under a loaded freighter on VII-LA-4-G (Ridge Route).

On U. S. 50, in the vicinity of Mossdale, there was definite evidence of rocking slabs. A few measurements were made where the end of a 25-foot slab raised from 0.003 inch to 0.005 inch as the loaded truck wheels came in contact with the opposite end. The end of a broken slab moved upward 0.20 inch and downward 0.015 inch registering several complete cycles above and below the normal elevation as the various wheels of a loaded freight passed over.





INTERESTING MEASUREMENTS

An interesting series of deflection measurements were made between Vallejo and the Napa Wye, on U. S. 40, on pavement constructed in 1944. Measurements made at 7.00 a.m. on July 16, 1946 showed that one end of the slab was moved approximately .003 inch upward as the front wheels of loaded trucks came onto the opposite end of the slab. As the truck progressed along the slab and the rear wheels came on the end being measured a downward movement of approximately 0.025 inch was noted. These measurements confirm profilograph records and indicate that the 15-foot slabs were curled upward and were rocking on the subgrade. Measurements made on these same slabs between 12.30 p.m. and 2.00 p.m., on the same day, after the heat of the sun had expanded the surface of the slab, showed no upward movement and a downward deflection under loaded trucks of only 0.004 inch.

The Magnitude of Lift Given Each Slab by the Asphalt. In the first sealing work no attempt was made to raise the slab, the object being to force

only sufficient asphalt under the slab to fill cavities and in addition provide a membrane that would seal off the subgrade and prevent further loss of subgrade material through the cracks in the concrete pavement.

The slabs should in all cases be given a lift of from 0.05 inch to 0.1 inch to assure that contraction of the asphalt on cooling will not leave the slab unsupported. A typical example of slab settlement is shown in **Figure III.**

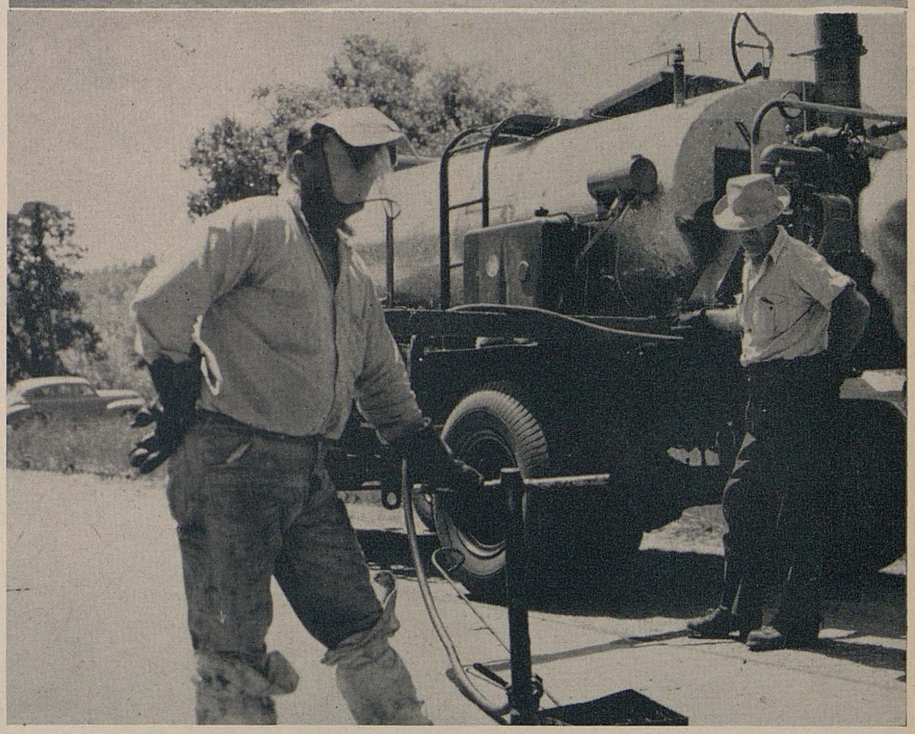
It is not possible by this method to raise slabs which are completely in contact with the subgrade. With the 40 pounds per square inch pressure normally used, it is necessary for the asphalt to spread over an area of approximately three square feet before sufficient hydraulic pressure is exerted to lift a 20- by 11-foot slab.

Distance to Which the Asphalt Can be Forced Beneath Pavement. Temperature measurements and observation of asphalt pumping operations indicate that the asphalt can be forced into any cavity which may exist beneath the pavement. Several cases were noted in which the asphalt forced its way beneath the adjacent bituminous shoulder and came to the surface 12 feet from the point of injection. (Even greater distances have been reported.) As noted above, however, the spread of the asphalt may be restricted by the presence of free water beneath the pavement slab. Additional temperature measurements should be made for a complete study of results obtained where free water is present. The distance to which the asphalt can be forced is determined by the temperature of the asphalt at injection and the size of the void beneath the pavement.

The most satisfactory asphalt injection temperature seems to be from 375 degrees to 425 degrees Fahrenheit.

Deflection of Slabs Before and After Injecting Asphalt. Deflection measurements under a loaded truck were made north of Redding on U. S. 99 on slabs before subsealing with asphalt and again after sealing using an identical load. The second measurements were made the next morning after an elapsed time of 24 hours and showed an average reduction in slab deflection of 60 per cent. The results of these measurements are shown in **Table I.**

Extrusions of Asphalt. During 1944 and 1945 asphalt having a penetration of 40-50 and 30-40 was used. It was found that some extrusions took place due to the fact the asphalt apparently was too soft.



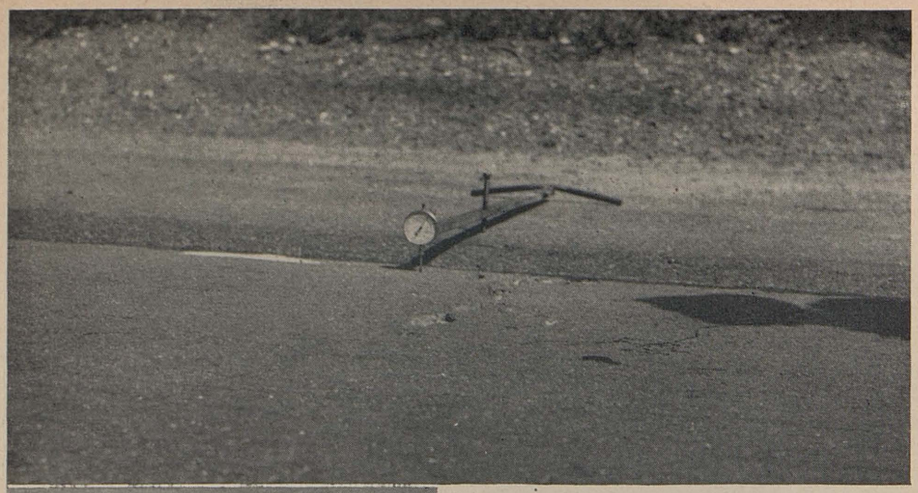
Two views of 900-gallon asphalt tank built by Headquarters Shops for asphalt subsealing

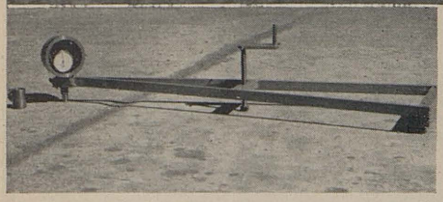
TABLE I

DEFLECTION OF SLABS BEFORE AND AFTER SUBSEALING
II-SHA-3-B

Deflection Before Subsealing				Deflection After Subsealing	
	Loaded Truck *			Loaded Truck	
Slab+ No.	Front Wheel	Rear Wheel	Amount of Slab lift produced by Asphalt	Front Wheel	Rear Wheel
1	.016″	.039″	.233″	.000″	.015″
2	.030″	.060″	.110″	.009″	.015″
3	.015″	.027″	.125″	.009″	.019″
4	.050″	.064″	.010″	.009″	.019″
5	.015″	.030″	.077″	.002″	.009″
6	.005″	.023″	.243″	.001″	.008″
7	.014″	.027″	.220″	.004″	.011″
8	.026″	.047″	.330″	.003″	.012″
9	.011″	.030″	Adjacent Slab Raised	.006″	.016″

* Total gross load of truck 20,600 pounds.
\+ Numbers arbitrarily assigned for these measurements only.





Ames dial used to record pavement raise in asphalt jacking (upper), and for measuring deflection of slabs (lower)

This year asphalt of 20-30 penetration was used in all subsealing work to partially overcome this difficulty. However, in many cases, especially in parts of the State where air temperatures are high, small extrusions still take place where the drill holes have not been filled with cement grout or with wooden plugs. Possibly a slightly lower penetration asphalt should be used in the future for this type of work.

Conclusions

1. The asphalt, after being injected, will cool to subgrade temperature in from 15 minutes to one hour, depending on the thickness of the asphalt layer.

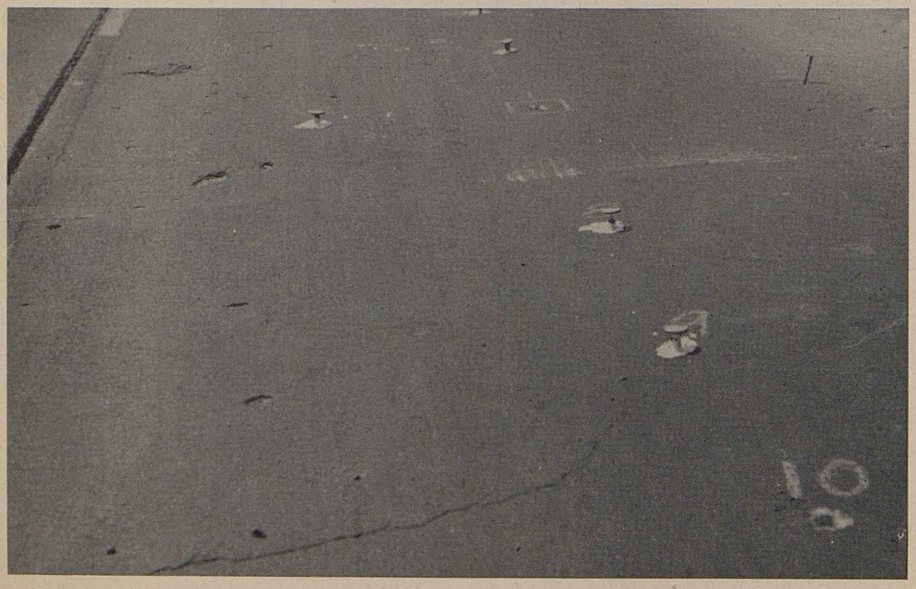
2. Free water under the pavement may chill the asphalt too quickly to permit satisfactory distribution. Additional temperature measurements should be made to secure more data on this phase.

3. The asphalt may be forced into any void beneath the pavement except when free water is present.

4. A lift of 0.05 inch to 0.10 inch should be given to all slabs and lifts up to one-half inch may be given if slabs are low.

5. The deflection of slabs under loads are materially reduced by asphalt subsealing.

Test holes with thermometer inserted to determine flow of asphalt under pavement



Doughnuts Have Holes Too

THE DIARIES of resident engineers on construction projects are usually quite informative as to what is being accomplished and how. On a current project, where rocking slabs of concrete, in an existing pavement, were removed and replaced with other material, a resident engineer's diary contains the following: "Two men and truck maintaining holes in pavement."

Thereby begins what may expand into a far reaching encroachment by the construction engineers on the prerogatives of the maintenance department.

The district maintenance engineer and his assistants, when asked to recommend the best way to maintain holes in a pavement, stood on their constitutional rights and refused to talk.

Highway Transportation Leads Nation By 3 to 1 In Total Passenger Miles

HIGHWAY transportation in the United States has credited to it a world's record of over three times as many passenger miles as all other forms of transportation combined, according to a tally recently published by a well-known firm of engineer consultants in New York.

Forms of transportation surveyed included steam and electric railways, domestic air lines, inland waterways including Great Lakes traffic, as well as all forms of highway transportation.

In 1945 highway transportation alone accounted for the astronomical total of 491,995,000,000 passenger-miles. Of this total passenger cars piled up 429,100,000,000 passenger-miles and buses accounted for 62,895,000,000 passenger-miles; this latter figure was exceeded only by the railroads with a total of 91,000,000,000 revenue passenger-miles. Also noted in the survey was the fact that truck transport accounted for an estimated total of 48,800,000,000 ton-miles of freight moved.

Over the past 25 years private automobiles have increased from about 60,000,000,000 passenger-miles to the 1945 figure of 429,100,000,000 passenger-miles. Buses since 1923 have increased from 4,000,000,000 passenger-miles to 62,895,000,000 passenger-miles.

Fourteen Miles of Three Flags Highway Has Been Resurfaced

By LUIS ARAMAYO, Resident Engineer

RESURFACING of a 14-mile section of the Three Flags Highway, on State Route 73, between Viewland and Secret Valley has been completed.

The initial stage construction in 1936 included grading, drainage, and a base of imported borrow, with penetration oiling. In 1941 a light road-mix was placed. The resurface consists of a gravel base cushion course over a portion of the existing highway across Mud Lake, and covering this and the remainder of the section with two inches of plant-mixed surfacing and a Class "A" seal coat.

Of historical interest is the fact that the highway follows the route of the old wagon road built in 1869 across Mud Lake, near the site of the burning by the Piute Indians, in 1862, of the Mud Flat Station enroute to the old Humboldt Mines.

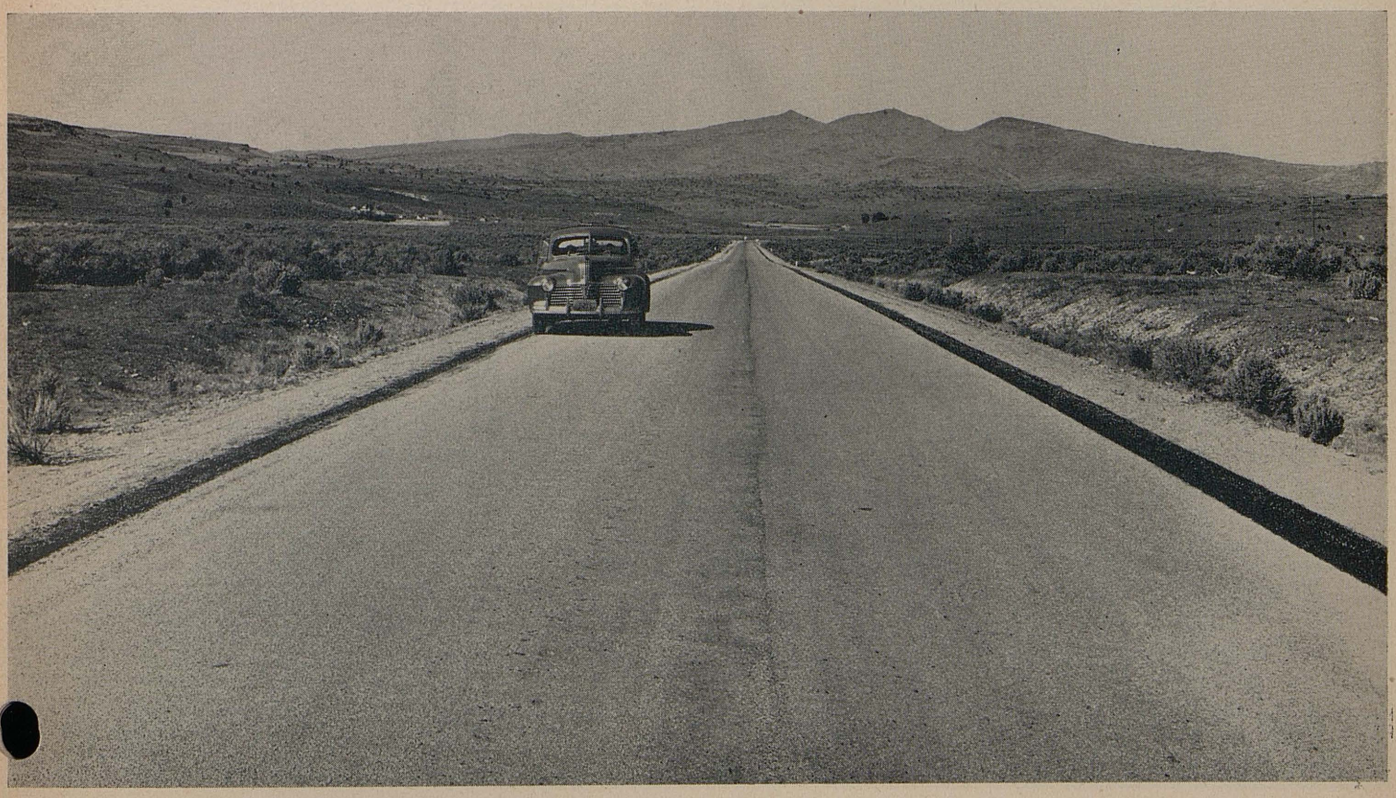
This portion of the highway is located in Lassen County, which is situated in the Cascade Range at the northern end of the Sierra Nevadas. Lassen is one of the larger California counties and was created in 1864 from parts of Plumas and Shasta Counties. The county is mountainous throughout, with a minimum elevation of nearly 4,000 feet, high plateaus, and numerous peaks that exceed 7,000 feet in altitude.

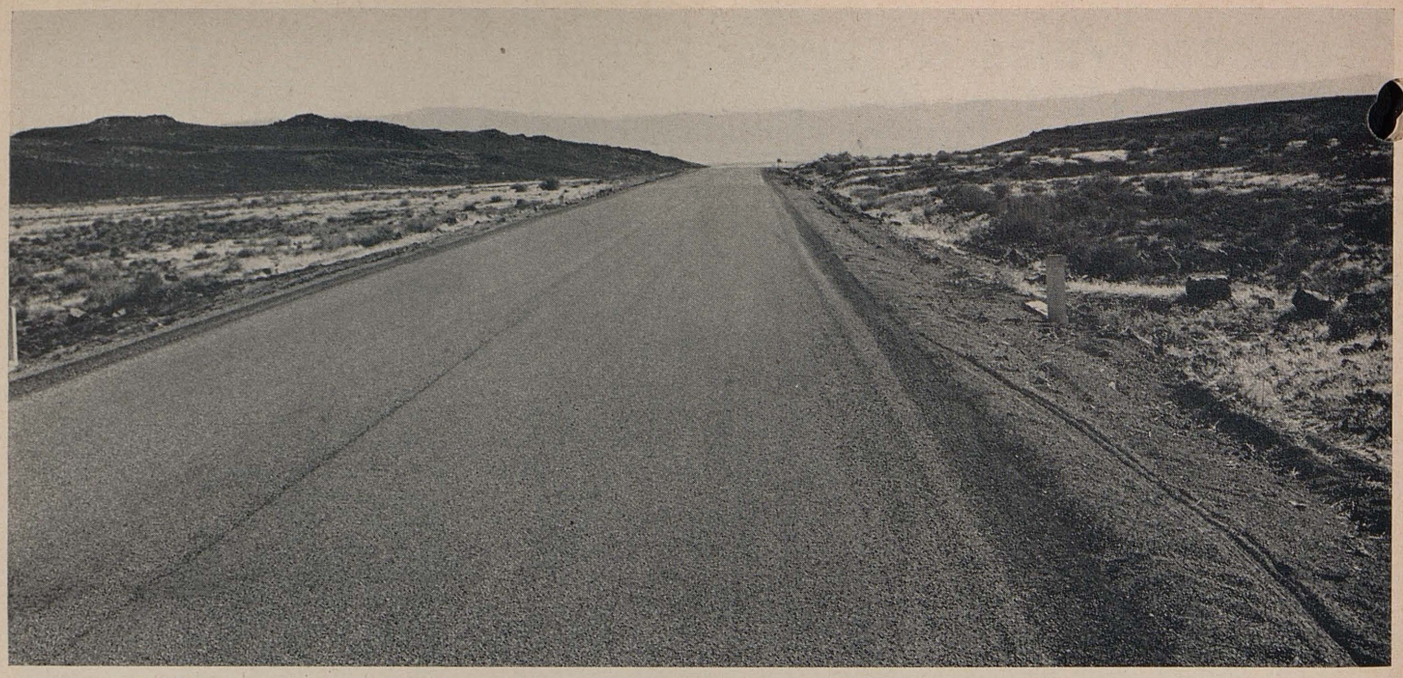
GEOLOGICAL FEATURES

Complex geological activities associated with the formation of the Sierra Nevada and Cascade Ranges and the formation and dessication of ancient Lake Lahonaton produced the present physiographic features of this area. The present formations are mainly of lacustrine or semilacustrine nature consisting of old lake bottoms and terraces. On the north the valley is bounded by the low barren hills of the lava plateau, which extends into Northern California and Oregon.

The two-mile strip across Mud Lake consists of a fill approximately five feet high which has, in the past, given considerable trouble by developing longitudinal cracks and fissures extending the depth of the fill and, in many instances, several hundred feet in length. This is caused by drying up of the lake bottom during the summer months. Several attempts were made to correct this by raising the grade of the fill, with no permanent success. On the project just completed a cushion course 0.33 feet thick of imported gravel base has been placed on top of the existing pavement for the purpose of dissipating any stresses that may originate in the future, thus preventing them from damaging the newly laid plant-mixed surfacing.

North end of 9.6-mile tangent looking toward Secret Valley. Secret Valley Maintenance Station in left background





Near Viewland, looking south. Dry bed of Honey Lake, remnant of ancient Lake Lahonatan in dim background

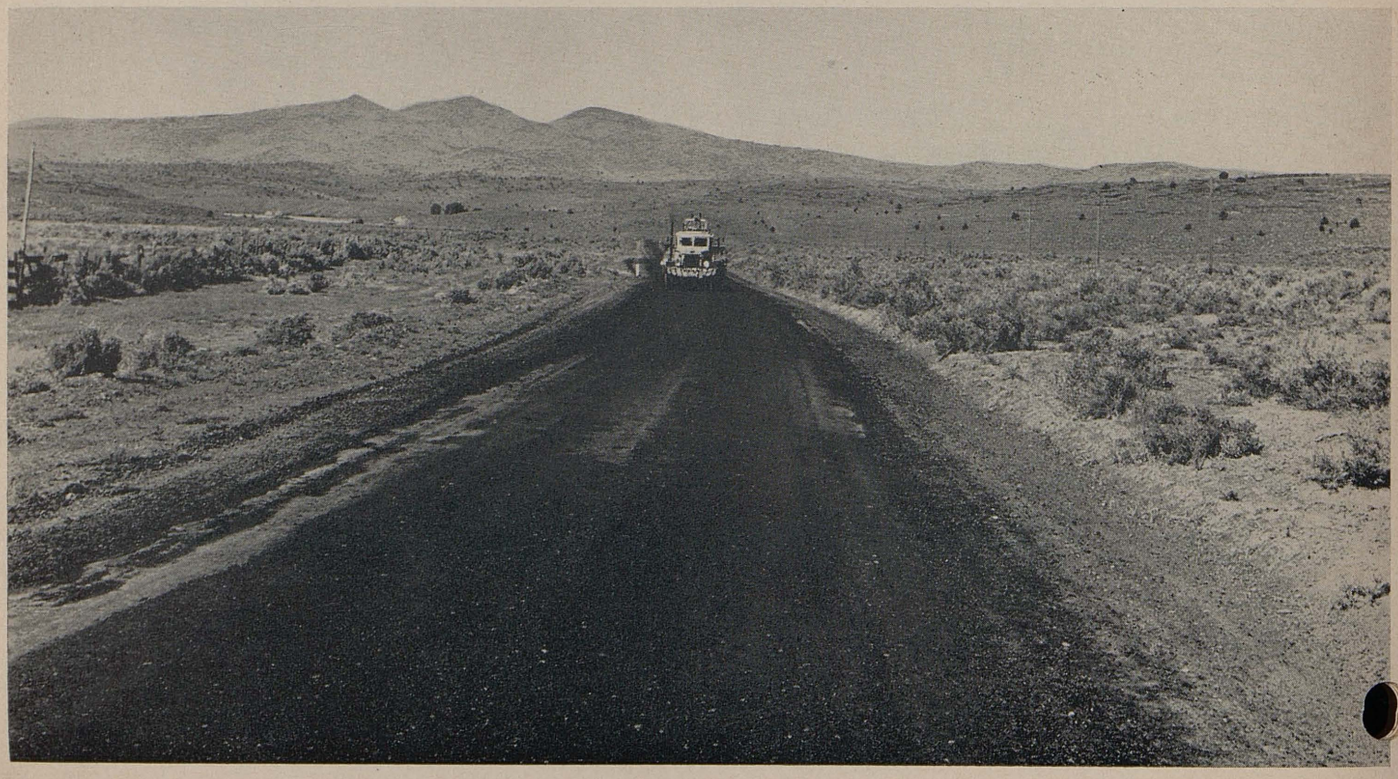
WATER PHENOMENA

Parts of the existing subgrade, particularly on the summit near Viewland, were greatly deteriorated and had to be removed and replaced with imported borrow. It is interesting to note that this subgrade material, approximately 12 inches thick and clayish in nature, laying between the old oiled earth surface, which was rather well preserved, and the existing pavement, was found to be completely saturated with water with no visible or apparent seepage of water anywhere.

The work was done during one of the hottest summer seasons experienced in this part of the desert, and the material beneath the old surface was relatively dry. Whether the existing subgrade material is hygroscopic is a matter of conjecture.

(Continued on page 32)

Oiled earth road beyond long tangent. Portion of 17-mile bottleneck, Secret Valley to Ravendale



North Sacramento Freeway Project Construction Is Well Advanced

By ARTHUR L. ELLIOTT, Associate Bridge Engineer

THE North Sacramento Freeway project, by-passing the heavy Route 3 (US 40 and 99E) traffic around the increasingly congested business district of North Sacramento, is now one-third complete.

Starting near the east end of the North Sacramento Viaduct, the new alignment runs 4.1 miles with only two changes of direction to return to the present traveled highway near the Municipal Golf Course about one-half mile east of the Ben Ali Underpass.

The new highway is a full freeway, four lanes with a 30-foot division strip. Access is allowed at only seven locations in this length. Intersecting streets which are not to be closed are taken either over or under the freeway with partially developed, modified clover-leaf type connections being provided.

Owing to the fact that the land adjacent to most of the freeway is relatively undeveloped, only the two opposite corners of the normally four-section clover-leaf are being provided in this contract. The right of way has been obtained for the remaining two quadrants however, so that the full intersection may be completed when the traffic warrants.

EIGHT STRUCTURES

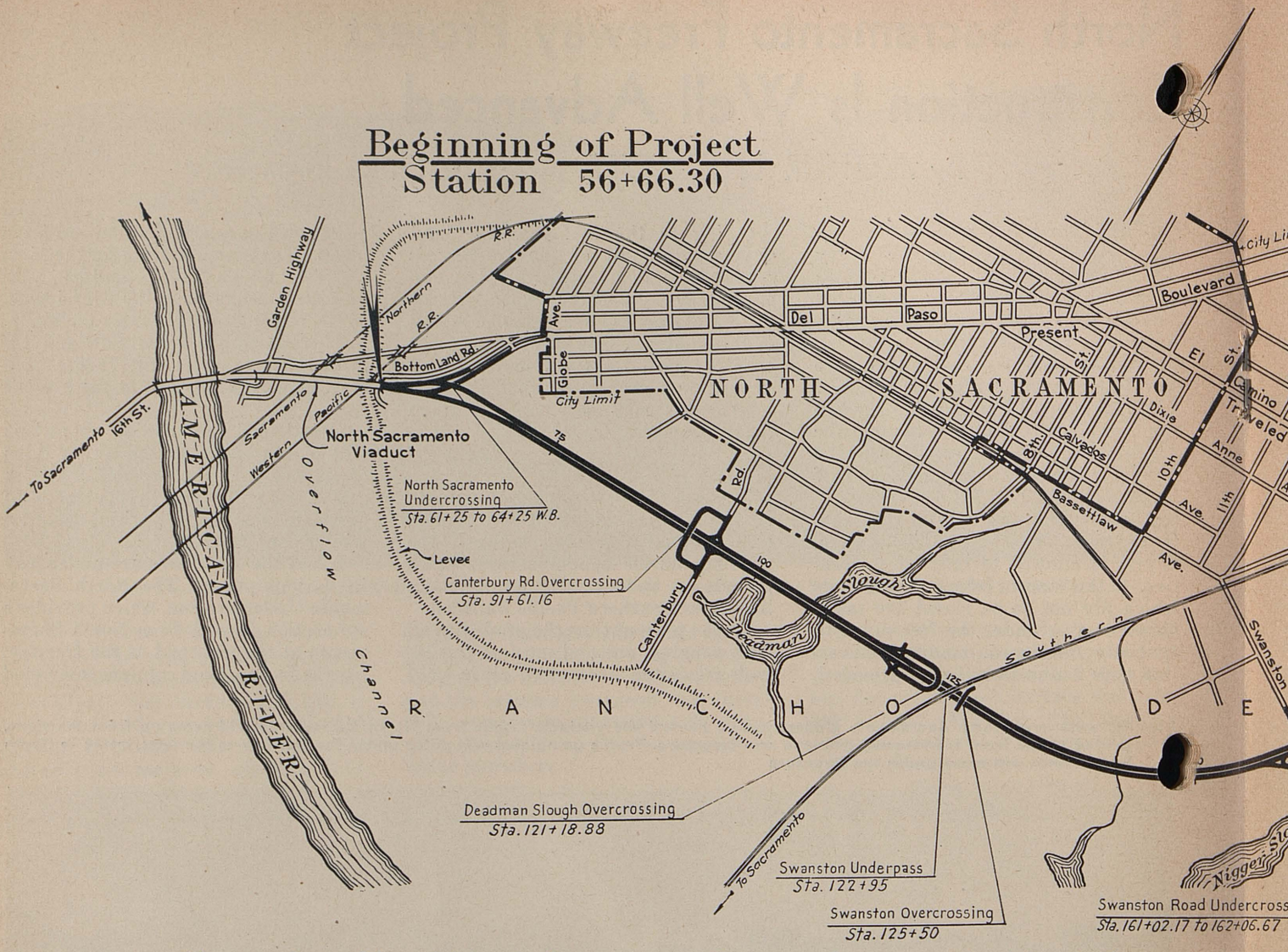
The cost of the construction portion of the project is about $1,800,000, nearly equally divided between the grading and the eight structures which include an underpass under the main line of the Southern Pacific Railroad.

At the present time the grade has all been roughed out and most of the 16-inch minimum blanket of river sand being used as select material has been placed. The typical section for the freeway calls for an RC-3 bituminous surface treatment of the top four inches of the select material under the eight-inch uniform thickness Portland cement concrete pavement. This surface treatment is being done at the present time.

It is hoped that paving operations will be started before the winter rains commence with the possibility that a dry winter will enable the contractor to complete most of the paving without a winter shut-down.

All of the structures are under way in various stages. The North Sacramento Undercrossing, which provides a connection to and from North Sacramento at the west end of the freeway, has the footings and columns completed

Looking west over North Sacramento Undercrossing toward the viaduct. Traffic from North Sacramento will come up from the right, joining traffic from the freeway over the new structure. Traffic going east will enter under the freeway to the left; traffic to North Sacramento will cross under the structure



Plan and profile of North Sacramento Freeway between the North Sacramento V

and the girder forms are being erected rapidly. This structure is being pushed during this season because as a detour for west-bound traffic, the old State Highway across the bottom land replaced by the viaduct in 1942, is being used.

ROAD MAY BE CLOSED

It is possible that this old road may be closed by flood waters as early as December first. By that time it is expected that all connections in this area will be paved and the undercrossing sufficiently completed so that traffic in both directions will again be on the Viaduct and up out of flood danger.

Of the eight structures, six are of the concrete hollow box girder type, one is variable thickness slab construction, and the railroad structure is steel plate girders on steel columns. All of the structures have steel railings.

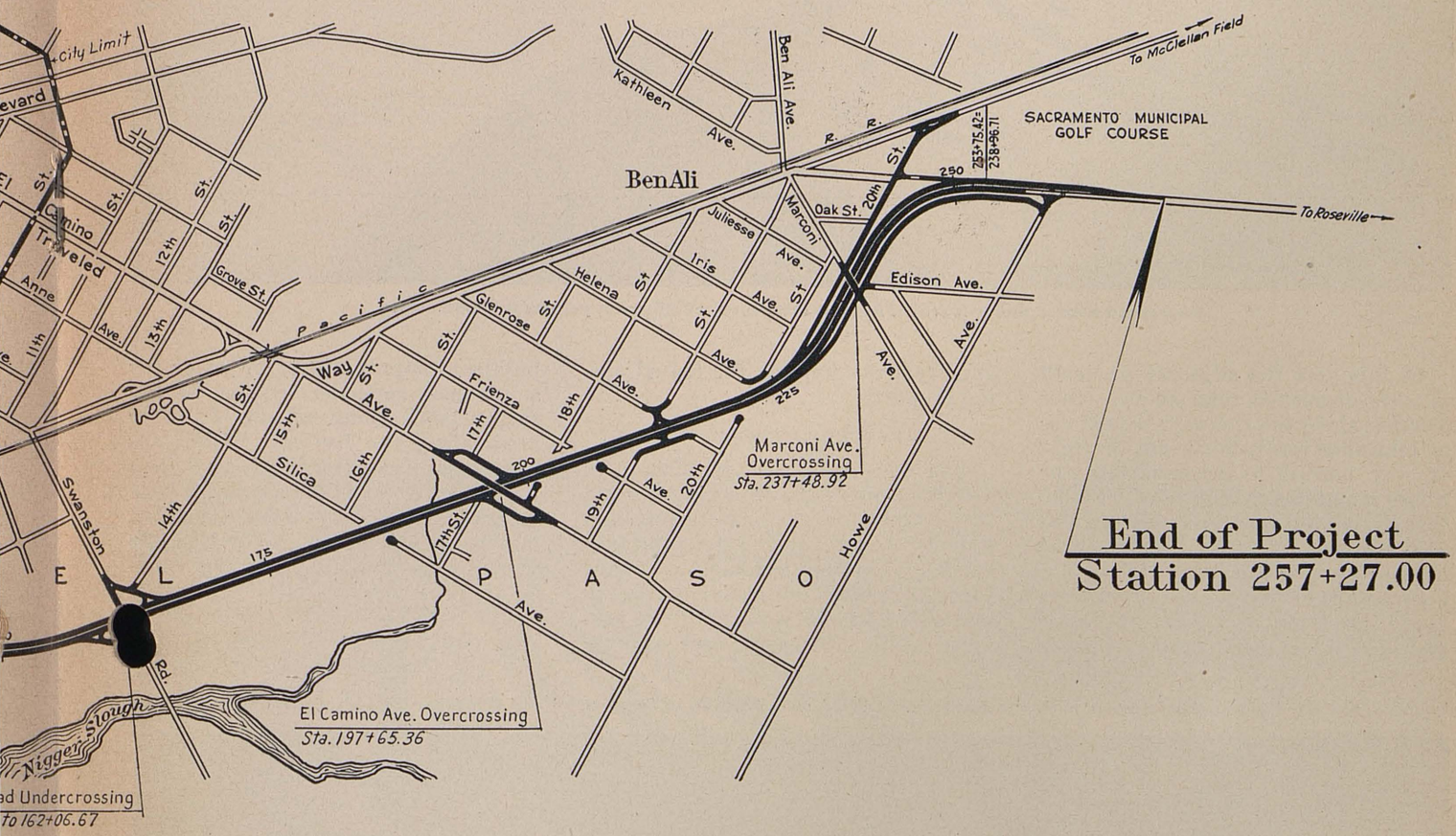
The separation structure at Canterbury Road over the freeway is virtually complete except for the railing and end posts. A portion of the approach fills has been placed and has still to be surfaced. The arrangement of this structure is a case where the bridge was offset parallel to the existing cross-street and new right of way obtained. The existing street will be used for inlet and outlet from the freeway. In addition, in the parallel position, the bridge is intended to line up with a main street in a projected subdivision of the undeveloped land south of the freeway.

The direction-change and access structure near Deadman Slough is having the last deck pours made, leaving it complete except for the curb and railing.

SHORTAGE OF STEEL

The Swanston Underpass under the Southern Pacific tracks necessitated one of the two major excavations on the project. This excavation, over which three structures are being built, is complete except for the removal of the railroad shoo-fly fill. These three structures adjacent to the railroad are all on pile foundations. The footings and abutments of the Underpass structure are completed but further construction is stymied waiting for structural steel.

Postponed rolling dates at the steel mills in the East caused the first dela and then the shipment of steel by wat to the West Coast had the further mis-



ento Viaduct and one-half mile east of Ben Ali. Project is one-third completed

fortune of getting caught at sea during the maritime strike, causing several weeks additional delay. This delay is vital to many parts of the work in this area because, until the railroad can be restored to its permanent alignment on the new structure, the shoo-fly fill, on which the trains are now operating, blocks the freeway section, dividing it into two parts and holding up grading and paving operations on about 4,000 feet of the freeway.

SWANSTON OVERCROSSING

The Swanston Overcrossing structure, to provide a cross-over to the undeveloped property between the freeway and the American River, is also [illegible]plete except for the curbs and [illegible]ing. Limited approaches have yet to be provided.

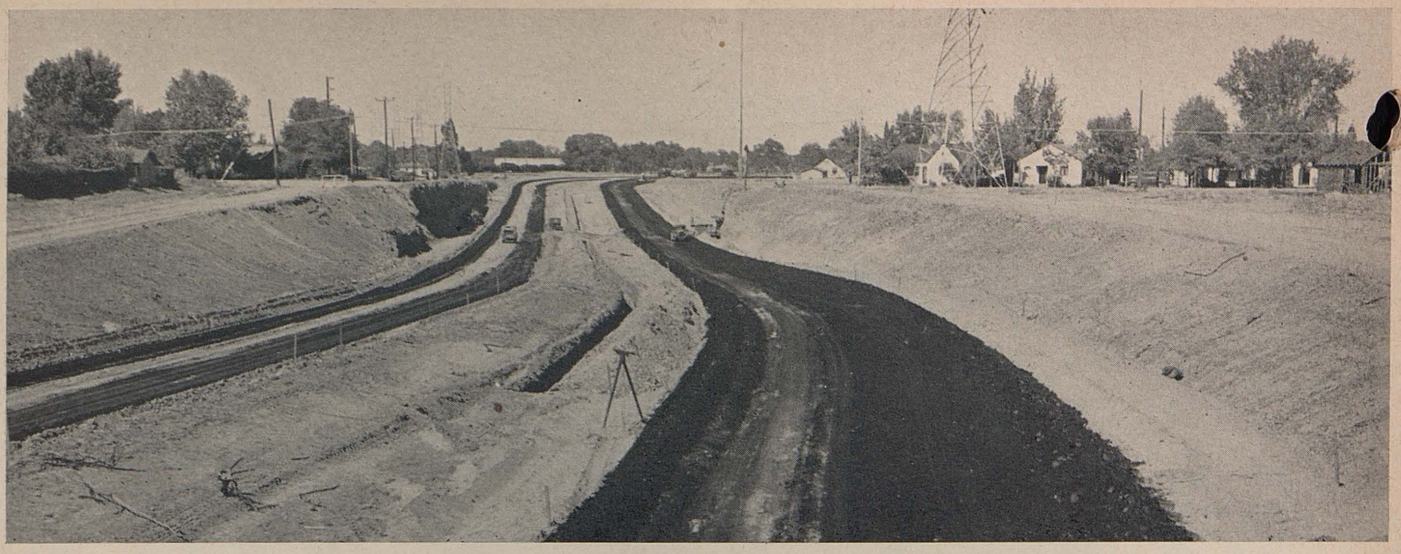
The Swanston Road Undercrossing structure has only the approach fills and the footings completed. This bridge, 109 feet wide to accommodate speed change lanes, in fact wider than it is long, will be uniform depth slab construction carrying both lanes of the freeway with the outer lanes and the center dividing strip over Swanston Road.

The El Camino Avenue Overcrossing structure provides a separation with connections for El Camino Avenue. The approach fills and the main footings have been placed.

At Nineteenth Street and Glenrose Avenue side access but no cross-over is provided. The two streets are joined in loop connections on each side outside the right of way, and side access provided to these loops. Twentieth Street and Helena Avenue, which would otherwise be dead-end streets, are looped together outside the right of way to eliminate the cul-de-sac.

MARCONI AVENUE OVERCROSSING

At the Marconi Avenue Overcrossing the freeway dips into a long depressed section to go under Marconi Avenue and a portion of Edison Avenue. This is the largest single excavation on the project and material from this cut was distributed over much of the job. Having completed the excavation and subgrading, the sand borrow has been placed and given the bituminous surface treatment through this area. Excavation for the footings of the retaining walls which line the freeway through this depressed section, is now under way.



Depressed section under Marconi Avenue structure, which is not yet under construction

In this area the adjacent property is more developed than at any other location along the freeway. By the use of retaining walls, the width of right of way needed to accommodate the slopes is materially reduced. Construction economies were also achieved and abutting property was accommodated by constructing the outer highway at average ground level above the elevation of the freeway. This arrangement provides much more ready access to and from the freeway for the adjoining property.

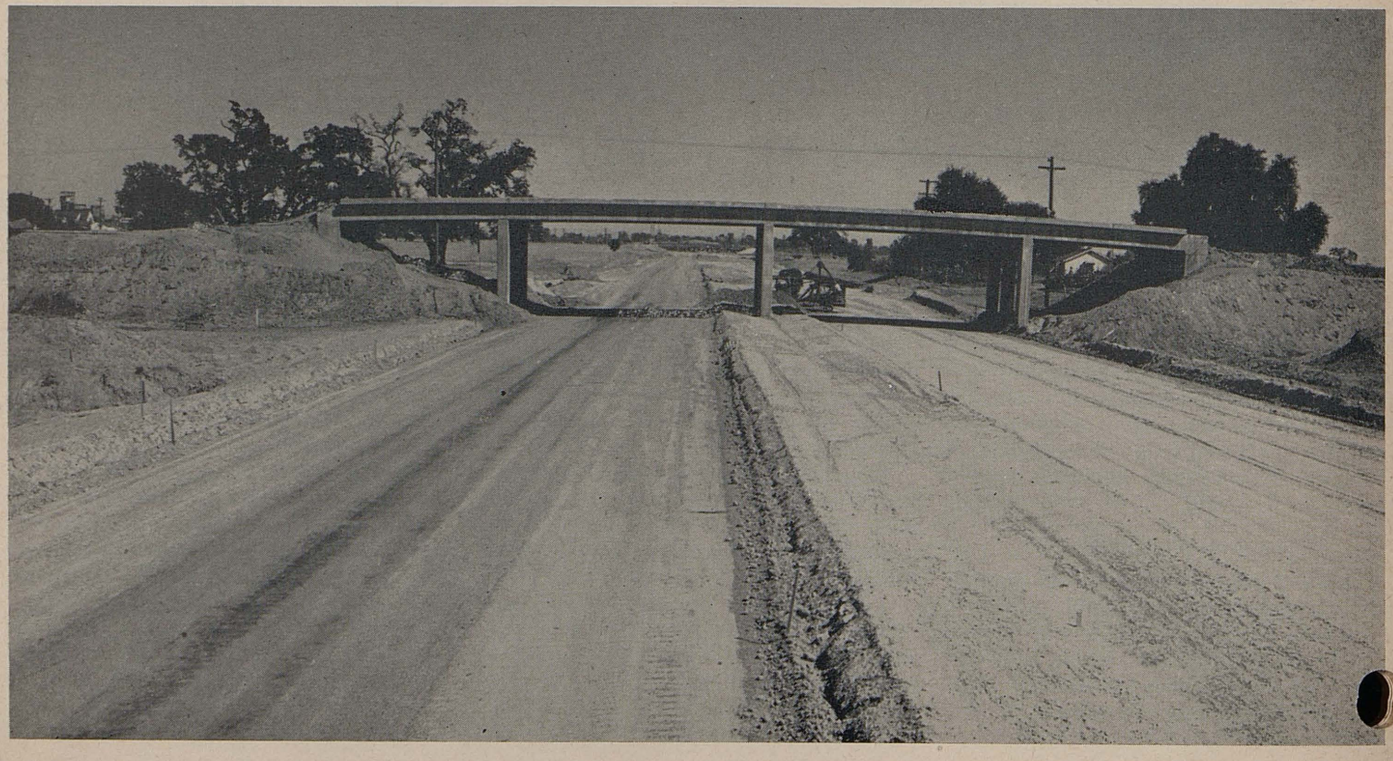
FUTURE LANDSCAPING

One feature of the two structures over the depressed sections, in addition to the pairs of large pumps provided to remove run-off water, will be the provision of deep-well pumping plants for future irrigation of roadside landscaping. These 10-inch wells are to be provided with 200-gallon per minute pumps to supply plenty of water for a planned sprinkler system in the future landscaping scheme. In other areas along the freeway, topsoil has been stockpiled and will be placed upon the slopes. Areas in the center division strip where the cuts have been less than one foot below natural ground will be scarified to facilitate future landscaping.

The division strip on the project in general uncurbed although in acc

(Continued on page 31)

Looking eastward along the freeway with the Canterbury Road overcrossing in foreground and Deadman Slough structure in distance

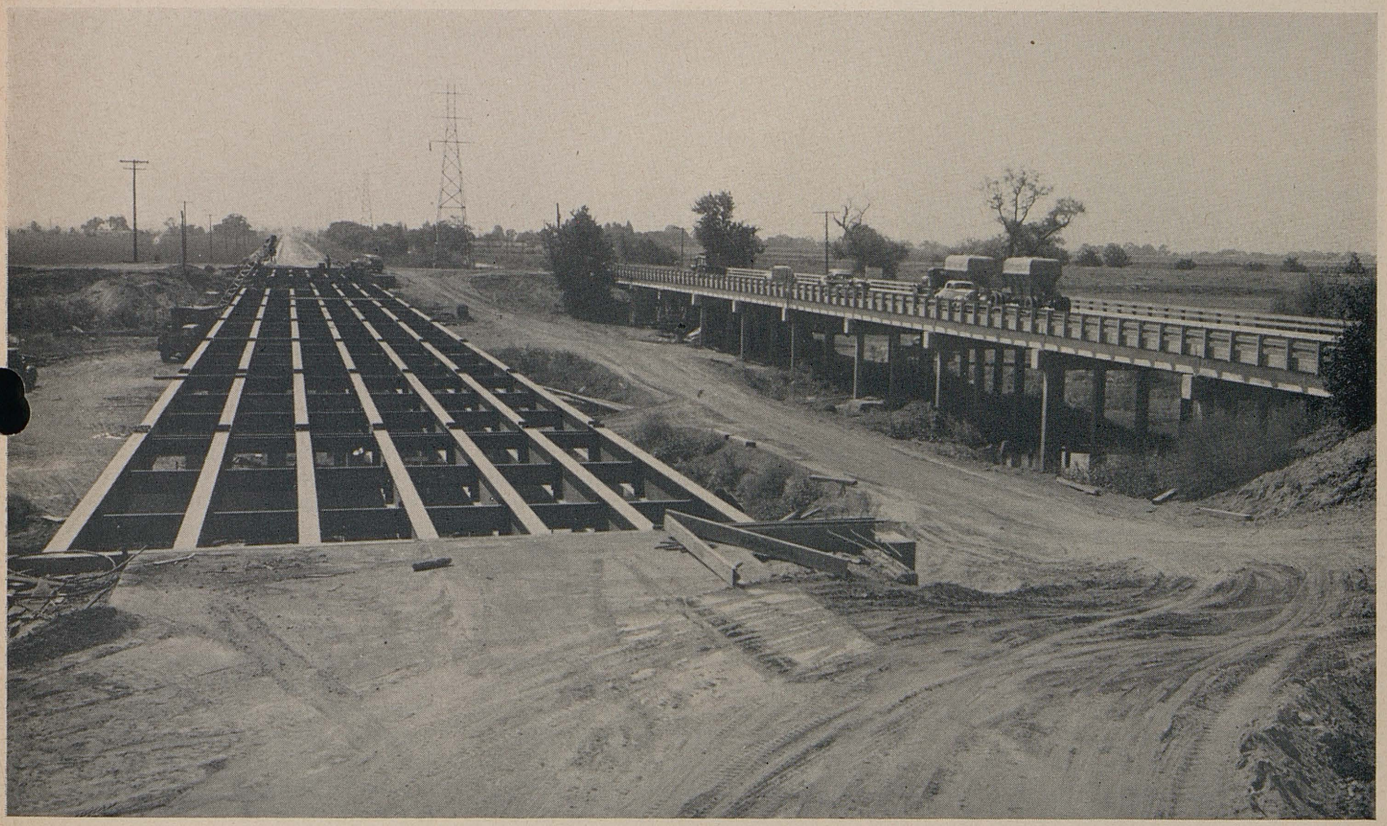


Limited Access Postwar Project in District X Nearing Completion

By MARC C. FOSGATE, District Construction Engineer

ANOTHER postwar project in District X, Division of Highways, which is nearing completion, will be of particular interest to the travelers on this route who were required to detour when the highway was submerged by San Joaquin River floods. This improvement is located in San Joaquin County between the Grant Line Road intersection with the U. S. Route 50 east of Tracy and the Mossdale intersection of U. S. Route 50 with California State Highway Sign Route 120, a distance of about 3.8 miles.

The road carries most of the traffic originating in the Bay region with a destination in San Joaquin Valley or traveling the inland routes south, and may also be considered a farm-to-market road in that it carries products from the San Joaquin Valley as far south as Bakersfield and into the Bay area. The route traverses the Altamont Pass which is the most important artery between the Pacheco Pass in Merced County and the Sacramento River. The present average daily traffic is 8,400, and reaches a peak of over 12,000.



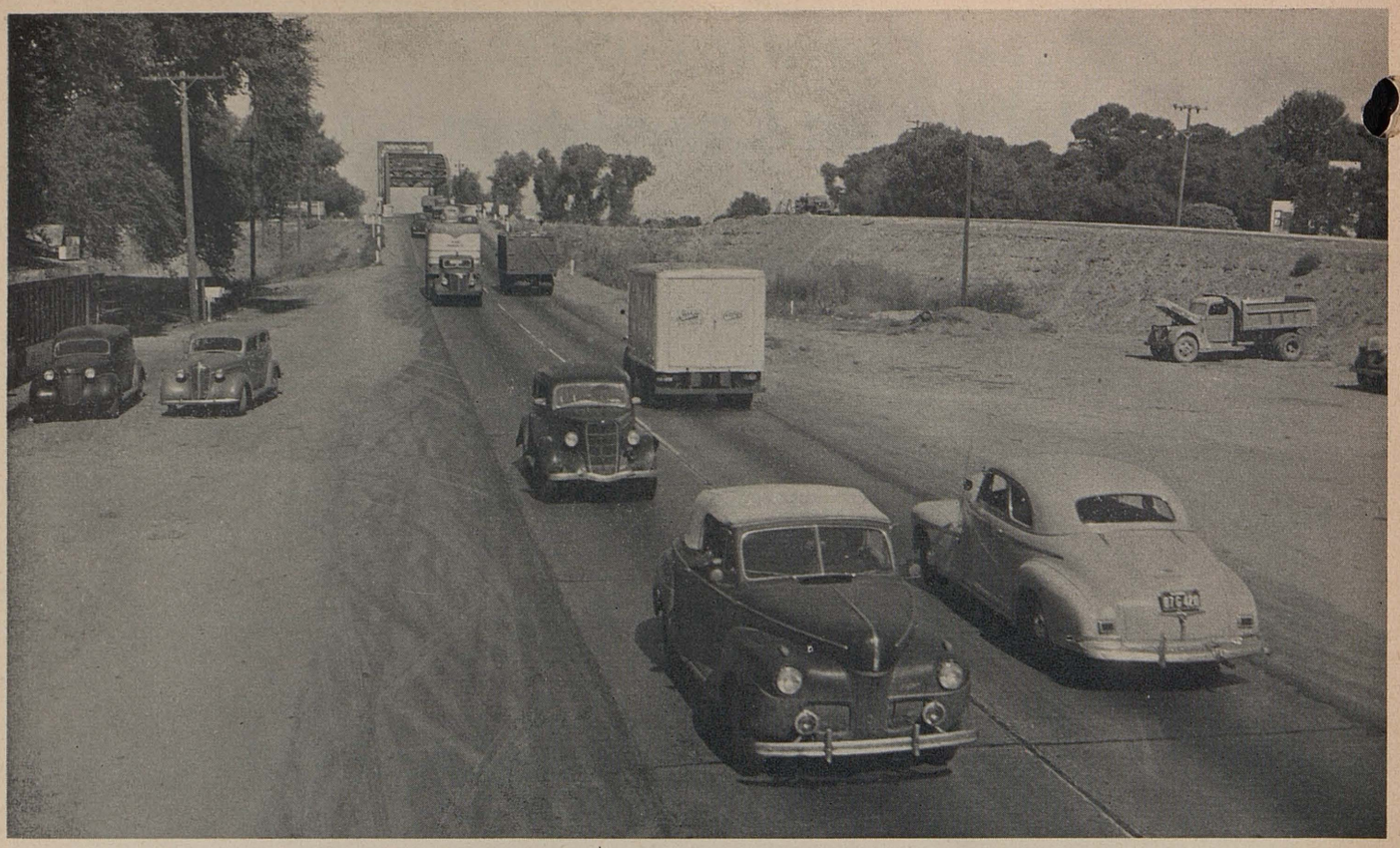
New bridge at Paradise overflow to replace present span on right is shown under construction

FLOODS CLOSE HIGHWAY

The section of road now being improved was closed to traffic on account of floods, for a total of 27 days from March 16th to March 26th, and from June 7th to June 24th in 1938. Between these dates, the traffic between Tracy and Stockton was detoured across Roberts Island to California State Highway Sign Route 4. The traffic between Tracy and Manteca was detoured through San Joaquin City and back to the highway on the Durham Ferry Road. During this period of time, it is estimated that an additional 2,000,000 car miles over lower type roads was expended by traffic.

The immediate improvement consists in general of the construction of an additional two lanes of Portland cement concrete pavement along the southwesterly side of the existing pavement which, with a separation strip, will provide a divided highway as a part of a limited freeway. The new pavement is designed at an elevation above anticipated high water.

Two bridges are included in the project, one crossing the Paradise Cut relief channel and the other, over the



This sort of congestion will be relieved by new highway shown on elevation at right. View is on east end of project with traffic approaching Mossdale Bridge. A second bridge will be built for east-bound traffic

San Joaquin River overflow channel. A new bridge over the San Joaquin River at the Mossdale intersection is planned but has not been advertised because of the shortage of materials, especially structural steel.

TO BUILD NEW BRIDGE

It is anticipated that this bridge will be constructed under two contracts, the first of which is to be advertised in the near future and will consist of the foundation construction and the second, for the super-structure, will be advertised as soon as it has been determined that the materials are available. A temporary connection southwest of the San Joaquin River will permit the use of the divided highway until the new bridge is constructed.

The Portland cement concrete pavement which is 8 inches in thickness and 23 feet wide is being constructed in two lanes, the right hand lane being 11 feet wide with the passing lane 12 feet in width. The two lanes are being tied together with tie bolt assemblies. There are no expansion joints but dummy joints to control contraction have been placed at 15-foot intervals. The pavement is laid over a 0.5-foot compacted thickness of untreated rock base. Plant-mixed surfacing laid on untreated rock base is used for the transition from four lanes to two lanes at each end of the project.

HANDY IMPORTED BORROW

Imported borrow for embankment construction was obtained from a draw in Paradise Cut, where sandy material was available. It was hauled to the road in Tournapulls. This borrow location was approximately at the center of the job and adjacent to the existing highway on the northwest side. This material was specified for embankment construction beneath an elevation 2½ feet below profile grade. Above this elevation, a higher quality borrow was required, the important specifications for which are minimum bearing value at 0.1-inch penetration after soaking, 20 per cent, expansion of not more than 1.0 per cent, and a plasticity index of not more than 6 per cent. This material was obtained from a location about 0.5 of a mile east of the northeast end of the project and was all transported in trucks across the San Joaquin River Bridge.

The untreated rock base was a commercial product supplied by the Pacific Coast Aggregates Company plant at River Rock. The mineral aggregate and concrete aggregate, also obtained from this plant were hauled to the roadbed or batching plant by trucks. The large size aggregate for the concrete pavement was obtained from the Elliott plant near Livermore and shipped by rail to the project. A Nobel full automatic batching plant was used for the Portland cement concrete pavement.

Also included in the current contract is the construction of a modern design highway intersection at the junction of U. S. Highway 50 and the California State Highway Sign Route 120 at the northeast end of the project, east of the San Joaquin River and south of the Mossdale railroad underpass.

The construction of the concrete pavement has been completed and it is anticipated that traffic can be routed over the new construction early in November.

The cost of this construction will be approximately $400,000. The contractor is the M.J.B. Construction Company of Stockton. The Resident Engineer is E. L. Craun.

Traffic on State Highways Shows 46.5 Per Cent Increase Over 1945

By G. T. McCOY, State Highway Engineer

THE annual state-wide traffic count taken on Sunday and Monday, July 14th and 15th, shows the very marked upturn in traffic which has occurred since the cessation of hostilities and the removal of restrictions on the use of motor vehicles. Comparison with the annual count of July, 1945, which was taken a month prior to the ending of gasoline rationing, reveals an increase of 46.5 per cent. This is likewise an increase of approximately 18 per cent over the previous high annual count of July, 1941.

These increases were general throughout the entire system. All routes without exception recorded gains; and while among the various route groups the Recreational group shows the largest percentage gain, this increase is only slightly greater than that of others. Since the wartime restrictions on the operation of commercial vehicles were much less drastic than those imposed upon passenger vehicles, the present increase in traffic is in very large measure accounted for by the greater use of passenger cars, commercial vehicle traffic showing only a nominal gain.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday, totals being shown for each hour. Traffic is segregated into the following vehicle classifications: California passenger cars, out-of-state passenger cars, buses, pickups, two-axle commercial units, three-axle units, four-axle units, five-axle units, and six-or-more-axle units.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded when determining comparison with the preceding year, only those stations that were identical during both years being taken into consideration.

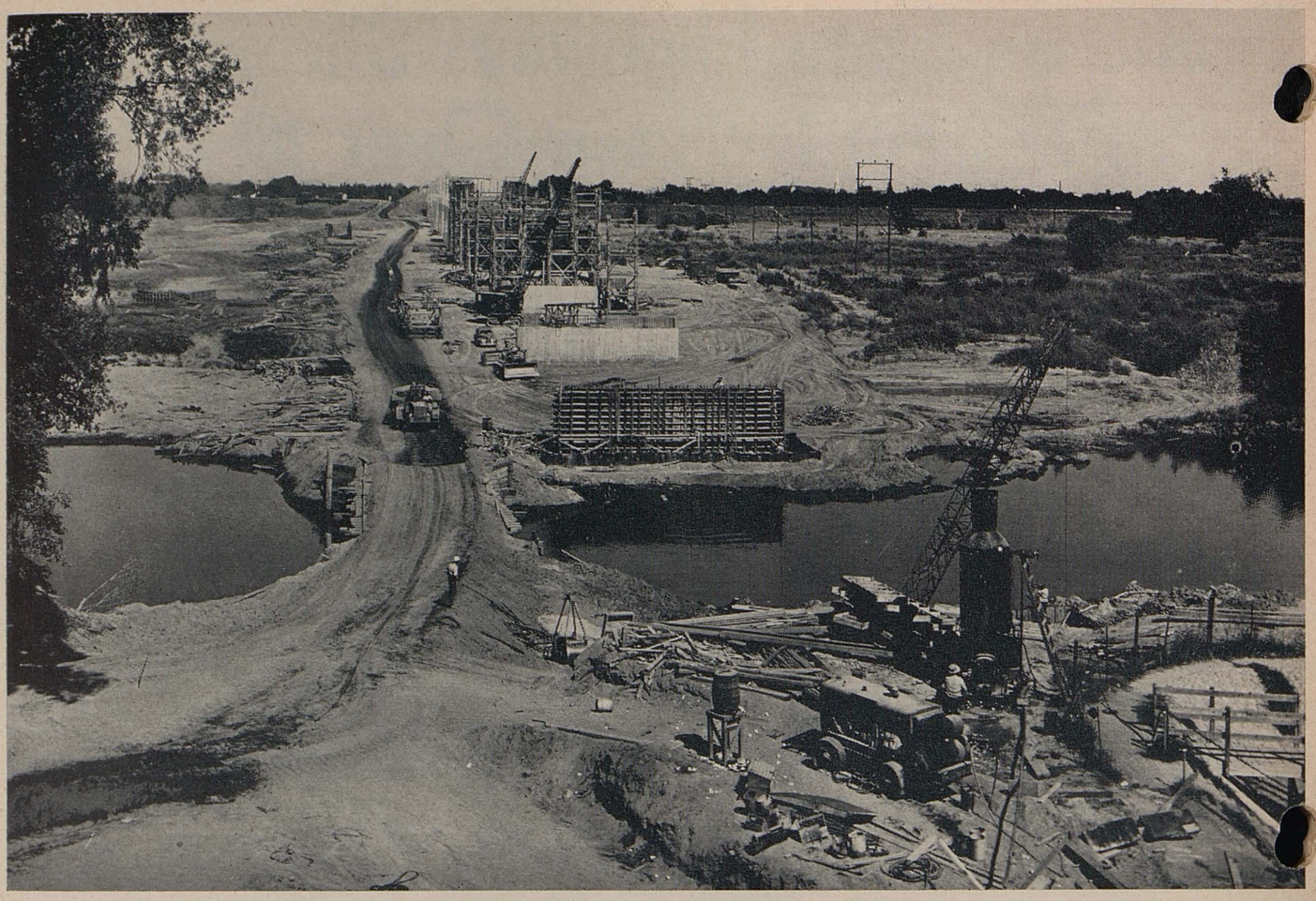
These comparisons for the various route groups are as follows:

PER CENT GAIN OR LOSS FOR 1946 COUNT AS COMPARED WITH 1945

	Sunday	Monday
All routes	+ 46.10	+ 46.55
Main north and south routes	+ 47.28	+ 50.00
Interstate Connections	+ 53.73	+ 45.76
Laterals between inland and coast	+ 41.82	+ 40.52
Recreational routes	+ 53.18	+ 51.74

The gain or loss of traffic volume for State Highway Routes 1 to 80, inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation.

Route	Termini	1946 Per cent gain or loss Sunday Gain	Sunday Loss	Monday Gain	Monday Loss
1.	Sausalito-Oregon Line	67.03		74.16	
2.	Mexico Line-San Francisco	26.99		42.34	
3.	Sacramento-Oregon Line	75.85		68.86	
4.	Los Angeles-Sacramento	69.51		48.56	
5.	Santa Cruz-Jc. Rt. 65 near Mokelumne Hill	48.52		37.74	
6.	Napa-Sacramento via Winters	49.54		55.76	
7.	Crockett-Red Bluff	71.74		72.57	
8.	Ignacio-Cordelia via Napa	57.51		56.94	
9.	Rt. 2 near Montalvo-San Bernardino	48.43		47.76	
10.	Rt. 2 at San Lucas-Sequoia National Park	53.76		37.72	
11.	Rt. 75 near Antioch-Nevada Line via Placerville	73.42		49.19	
12.	San Diego-El Centro	39.47		29.82	
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.	29.54		56.23	
14.	Albany-Martinez	43.33		51.86	
15.	Rt. 1 near Calpella-Rt. 37 near Cisco	70.57		61.18	
16.	Hopland-Lakeport	55.30		37.26	
17.	Rt. 3 at Roseville-Rt. 15, Nevada City	59.77		55.06	
18.	Rt. 4 at Merced-Yosemite National Park	124 03		121.60	
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont	35.01		36.11	
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary	74.04		71.08	
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy	87.80		73.39	
22.	Rt. 56, Castroville-Rt. 29 via Hollister	22 99		26.58	
23.	Rt. 4 at Tunnel Sta.-Rt. 11, Alpine Jc.	39.59		45.10	
24.	Rt. 4 near Lodi-Nevada State Line	63.18		51.92	
25.	Rt. 37 at Colfax-Rt. 83 near Sattley	72.35		92.16	
26.	Los Angeles-Mexico via San Bernardino	28.38		34 53	
27.	El Centro-Yuma	0.02		0.07	
28.	Redding-Nevada Line via Alturas	63.14		46.49	
29.	Peanut-Nevada Line near Purdy's	54.40		45.76	
31.	Colton-Nevada State Line	45.85		37.80	
32.	Rt. 56, Watsonville-Rt. 4 near Calita	62.61		63.42	
33.	Rt. 56 near Cambria-Rt. 4 near Famoso	32.22		28.75	
34.	Rt. 4 at Galt-Rt. 23 at Pickett's Jc.	60.51		52.06	
35.	Rt. 1 at Alton-Rt. 20 at Douglas City	64.09		72.07	
37.	Auburn-Truckee	83.86		104.14	
38.	Rt. 11 at Mays-Nevada Line via Truckee River	95 76		106.29	
39.	Rt. 38 at Tahoe City-Nevada State Line	80.34		73.36	
40.	Rt. 13 near Montezuma-Rt. 76 at Benton	89.06		127.78	
41.	Rt. 5 near Tracy-Kings River Canyon via Fresno	49.57		38.01	
42.	Redwood Park-Los Gatos	78.69		67.47	
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville	31.90		34.02	
44.	Boulder Creek-Redwood Park	69.01		23.14	
45.	Rt. 7, Willows-Rt. 3 near Biggs	50.57		20.21	
46.	Rt. 1 near Klamath-Rt. 3 near Bray	78.27		77.38	
47.	Rt. 7, Orland-Rt. 29 near Morgan	56.90		48.51	
48.	Rt. 1 N. of Cloverdale-Rt. 56 near Albion	46.59		62.77	
49.	Napa-Rt. 15 near Sweet Hollow Summit	49.70		44.23	
50.	Sacramento-Rt. 15 near Wilbur Springs	74.72		72.20	
51.	Rt. 8 at Shellville-Sebastopol	37.35		29.52	
52.	Alto-Tiburon	50.54		54.97	
53.	Rt. 7 at Fairfield-Rt. 4 near Lodi via Rio Vista	43.93		39.50	
54.	Rt. 11 at Perkins-Rt. 65 at Central House	120.43		47.45	
55.	Rt. 5 near Glenwood-San Francisco	102.15		139.25	
56.	Rt. 2 at Las Cruces-Rt. 1 near Fernbridge	56.96		44.31	
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield	49.50		31.83	
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mojave and Barstow	38.93		42.71	
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead	37.41		46.51	
60.	Rt. 2 at Serra-Rt. 2 at El Rio	46.28		46.40	
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan	58.22		38.80	
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake	48.69		26.35	
63.	Big Pine-Nevada State Line	0.05		42.18	
64.	Rt. 2 at San Juan Capistrano-Blythe	42.05		45.92	
65.	Rt. 18 near Mariposa-Auburn	62.19		71.74	
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale	109.51		33.75	
67.	Pajaro River-Rt. 2 near San Benito River Bridge	33.96		21.84	
68.	San Jose-San Francisco	51.31		52.43	
69.	Rt. 5 at Warm Springs-Rt. 1, San Rafael	35.94		45.61	
70.	Ukiah-Talmage	33.07		28.10	
71.	Crescent City-Oregon Line	158.48		166.74	
72.	Weed-Oregon Line	156.38		201.73	
73.	Rt. 29 near Johnstonville-Oregon Line	45.55		54.44	
74.	Napa Wye-Cordelia via Vallejo and Benicia	32.78		33.23	
75.	Oakland-Jc. Rt. 65 at Altaville	47.52		34 74	
76.	Rt. 125 at Shaw Ave.-Nevada State Line near Benton	38.76		52.10	
77.	San Diego-Los Angeles via Pomona	35.74		27.22	
78.	Rt. 12 near Descanso-Rt. 19 near Marsh Field	36.29		19.78	
79.	Rt. 2, Ventura-Rt. 4 at Castaic	59.61		29.78	
80.	Rt. 51, Rincon Creek-Rt. 2 near Zaca	54.66		53.66	



Pier construction for Feather River Bridge. Looking along the structure toward Marysville from the Yuba City levee. The summer flow of the Feather River, all but depleted by diversion for irrigation, is crossed by a temporary construction bridge in the foreground

Peach Bowl Laced by New Bridge

By RALPH W. HUTCHINSON, Associate Bridge Engineer

BETWEEN Marysville and Yuba City, in the Peach Bowl of America, the new bridge across the Feather River is nearing completion. All of the abutments and piers are in place and waiting for the arrival of the structural steel which has been delayed by the maritime strike.

The new bridge will divert through traffic from the 40-year-old bridge, five blocks downstream, which has long been inadequate for the traffic which was required to use it. In addition to the local traffic between the two interdependent communities of Marysville and Yuba City the bridge is a focal point for east and west traffic across the Sacramento Valley as well as for north and south traffic on the East Side Highway, U. S. 99E. By 1941 about 18,000 vehicles daily crossed the existing bridge on the 19-foot-wide "wagon road," as it was designated on the 1906 bridge plans.

OBSOLETE SPAN REPLACED

The replacement of the obsolete bridge has been under consideration over a period of years and was delayed by the war. Early studies made it apparent that any satisfactory solution of the problem required that traffic be removed from the main business streets of the two cities. Replacement of the existing bridge at the same location with a structure designed to modern standards was almost an impossibility due to the controlling features of levees, railroad tracks and highly developed business property adjacent to the site. On new alignment there was less restriction and the bridge could be built better, cheaper and with less disruption of the existing business life of the two cities. The old bridge could be left in place to continue to serve for the rest of its economical life.

Several years were required to bring together the various interested parties and agree upon a location. Design of the bridge was begun in 1941 and construction was scheduled to start in 1942. Actual construction was a war casualty. Construction of this bridge was considered so urgent that during the early part of the war plans were prepared for the construction of the

concrete piers, using salvaged railroad rails for reinforcing, so that the bridge could be completed with minimum delay as soon as structural steel became available. Before this plan could be contracted the shortage of labor and materials became so critical that the project was deferred and the Feather River Bridge became a postwar project with top priority.

FOUR-LANE DIVIDED HIGHWAY

As soon as materials and equipment became available a contract for the construction of the span was awarded. Work began in January of 1946. Work being done under the bridge contract consists of the Feather River Bridge, the Yuba City Overhead over the tracks of the Southern Pacific Railroad, the Sutter Street Undercrossing over Sutter Street in Yuba City and about 2,000 feet of approach fills. The extent of the contract is about 0.9 mile. The cost of work being done is $1,879,000. Additional contracts are underway for widening and improving connecting streets in Marysville and in Yuba City. When completed the entire project will provide a four-lane divided highway having limited access to side streets and adjacent property. Five-foot-wide sidewalks will be provided for pedestrians.

The major feature of this project is the bridge across the Feather River costing about $1,678,000. Of less magnitude are the Yuba City Overhead costing about $73,000 and the Sutter Street Overhead costing about $44,000.

The Yuba City Overhead carries the approach highway over the tracks of the Southern Pacific Railroad at the foot of the levee on the west side of the Feather River. It consists of a reinforced concrete barrel 118 feet long with wing walls. The barrel is 20 feet wide and 23 feet high over the tracks. There is about seven feet of highway fill over the barrel. The entire structure is supported by steel H piles.

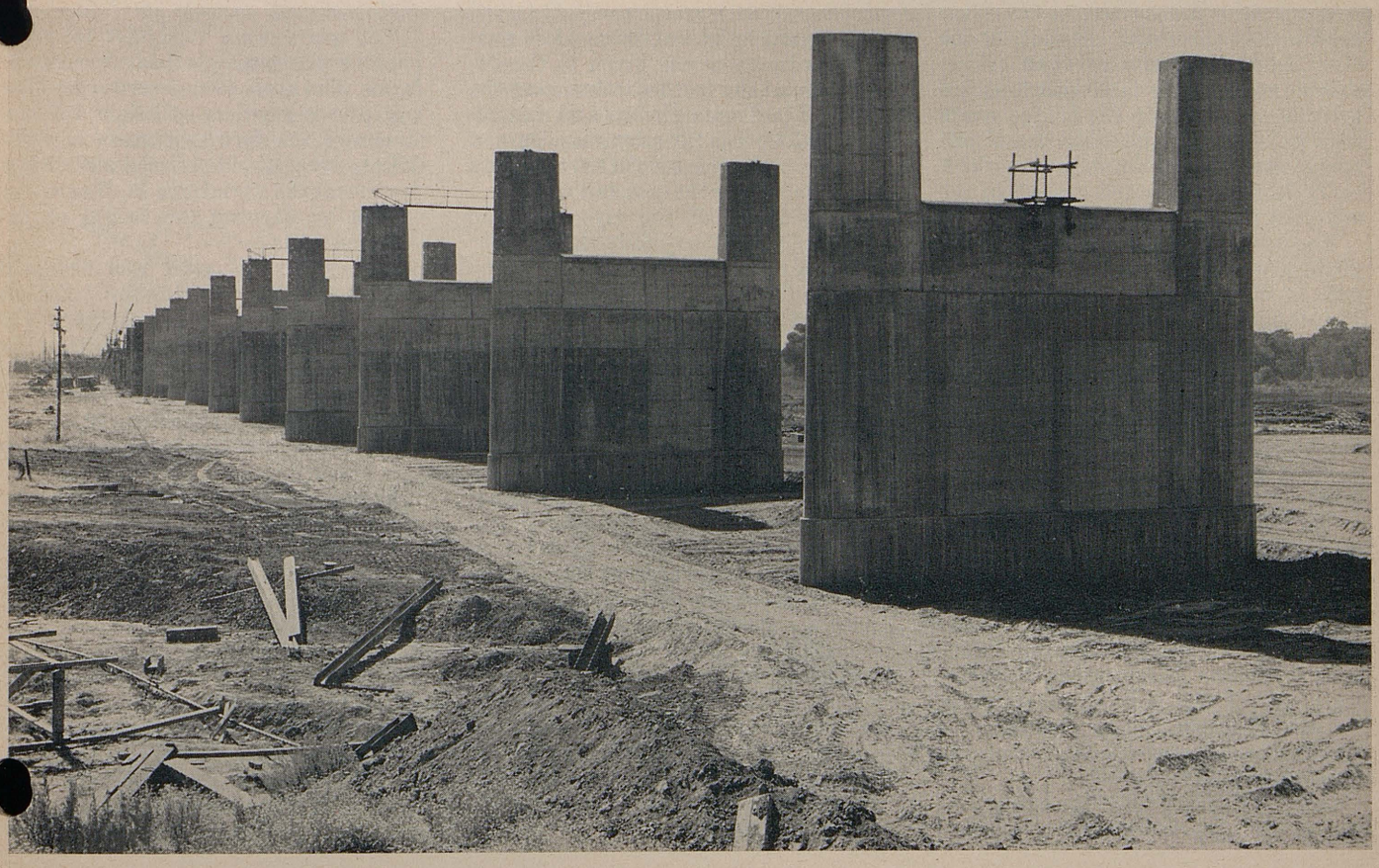
SUTTER STREET UNDERCROSSING

The Sutter Street Undercrossing carries the approach highway over Sutter Street in Yuba City. With connecting ramps it will provide convenient access directly into Yuba City from the highway. A 26-foot wide roadway and two 4-foot wide sidewalks are provided on Sutter Street. The structure is a flat slab reinforced concrete design. It has three spans, a 36-foot span over Sutter Street and two side spans, 24 feet long, connecting to the approach fills with small abutments and short wings. The deck slab is carried on concrete columns and below ground the entire structure is supported by steel H piles.

The Feather River, in the vicinity of Marysville, is confined by levees which are about 25 feet high at the bridge site. The bridge extends from levee to levee, a distance of 2,674 feet. The bridge also serves as a grade separation structure for it passes over the main line tracks of the Western Pacific Railroad which run along the top of the levee on the east side of the river. In order to provide the necessary clearance over the tracks the high point of the bridge is more than 60 feet above the river bed. The entire structure is on graceful vertical curves which connect to the approach fills. The fills have a maximum height of about 50 feet.

The bridge consists of 24 spans. Most of these are 115 feet long but longer spans up to 161 feet long are

Completed piers for Feather River Bridge. Looking toward Yuba City from the Marysville end. The first of 23 piers rise from the river bed ready for the structural steel girders



Compacting original ground prior to placing imported borrow on realigned approach to new Feather River Bridge. Scene is at Fifth and E Streets in Marysville

used across the main channel of the river while over the railroad tracks shorter spans down to 69 feet long are used in order to keep the bridge grade to a minimum. Alternate spans are anchor spans with cantilevers which carry 72-foot suspended girders in the adjacent spans.

The deck is carried on a pair of plate girders which are 10 feet deep over most of the bridge but are haunched to 12 feet 6 inches at the longer spans and tapered to 6 feet deep over the tracks. These are the largest highway plate girders used by the Bridge Department. The girders carry cantilevered floor beams at 23-foot intervals which support steel stringers and a concrete deck.

The bridge provides for two roadways 25 feet wide, separated by a four-foot dividing strip. There is a five-foot sidewalk on each side with a steel railing on the outside. The bridge is lighted by luminaries suspended from standards set in the railing along the sidewalk. All of this is in contrast to the narrow roadway, tight clearance to trusses and crooked approaches on the existing bridge route.

One of the features of the bridge are the concrete piers. Owing to the necessarily great height of these piers particular attention was given to the design. One of the factors influencing the choice of two main girders and a cantilevered deck was the advantage gained by shortening the length of the piers so as to minimize the cost and weight.

The violence of the river and the heavy drift carried during the larger floods prevented the use of open column bents or towers. Above high water the girders are supported on pylons of variable height. The junction between the pylons and the main pier shaft is on a vertical curve similar to that of the roadway. The main shafts are of cellular construction to reduce the weight and cost. The noses of the piers are streamlined by means of elliptical curves. The elliptical curves are compounded with a graceful curve extending the whole length of the shaft. Making the entire shaft on a curve reduced the possibility of a harsh transition between a curved nose and a straight shaft.

Eight of the piers near the east end are supported on spread footings founded on hardpan about 10 feet below the ground line. The remainder of the piers and the abutments are supported on steel H piles.

The piers were designed to make possible the multiple use of concrete forms. The same forms were reused for any pier regardless of height by constructing the forms in units or lifts. Offsets were provided in the pier design to conceal the variations in dimensions caused by varying the height of the battered units.

The structural steel was designed for economical production. Details were standardized and designed for ordinary shop fabrication. Except for minor variations, due to the vertical curvature, the same units were used throughout most of the structure.

In the design considerable attention was given to achieving a pleasing appearance. This was accomplished by careful proportioning of the required structural materials rather than by adding excess materials to create an architectural effect.

The structures on the project were designed by the Bridge Department and the approaches by the District Office, Division of Highways in Marysville. Construction is being handled by the Bridge Department. Harry Carter is the Resident Engineer. The contractor is J. H. Pomeroy Inc. of San Francisco.

U. S. 99E Project Through Marysville and Yuba City Is Extensive Undertaking

By P. C. SHERIDAN, Associate Highway Engineer

IN connection with the bridge now under construction across the Feather River, between Marysville and Yuba City, a separate contract is under way for construction of approaches in both cities.

The approach work is quite extensive, involving the grading and paving of about two miles of streets and immediate approaches.

The existing route through Marysville traverses "D" Street at Fifth Street, with curb to curb widths of 56 feet to 69 feet, allowing for two lanes of traffic and room for diagonal parking.

The approach to the existing bridge in Yuba City is on very poor alignment. There are reverse right angle turns to negotiate the overpass grade separation of the Sacramento Northern Railroad.

The 1946 traffic count taken on the Feather River Bridge between Marysville and Yuba City on Monday, July [illegible]th, for a 10-hour period, was 22,617 vehicles of which approximately 20 per cent were trucks. The peak hour count was 1,955 vehicles. At periods of heavy traffic volume there is much congestion.

The new location begins at the north end of the "D" Street Bridge at the southerly approach to Marysville, angles across to "E" Street by a new connection, traverses "E" Street and Tenth Street in Marysville, crosses the Feather River and extends by way of Sumner and Colusa Streets to the end of the project at the junction of Routes 3 and 15 near the north city limit of Yuba City.

Generally, four 12-foot lanes and, where necessary, 8-foot parking lanes are being provided. The opposing lanes are to be divided except from Second Street to Sixth Street in Marysville and from Plumas Street to the end of the project in Yuba City.

A grade separation with "off" and "on" ramps will be constructed to serve the southeastern portion of Yuba City by way of Sutter Street, and outer highways are being provided to connect the channelization at the Sutter Street Undercrossing with the existing streets from Sutter Street to Plumas Street.

Street intersections are being channelized at First Street, Tenth and E Streets in Marysville, at Plumas Street and at Live Oak Road in Yuba City.

A crossing of the Yuba City Branch of the S. P. is effected by an overhead.

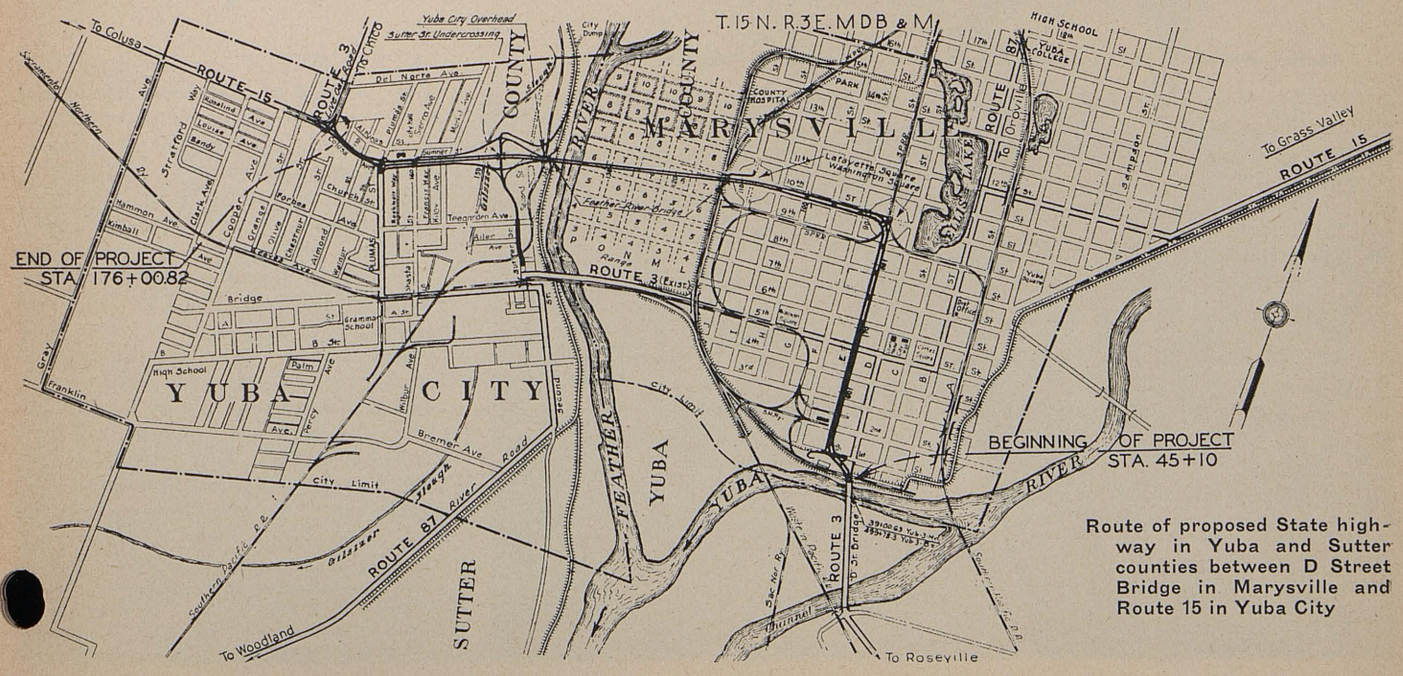
Sixteen inches of imported borrow is to be placed superimposed with cement treated base and asphalt concrete pavement.

The work is being done in sections. It is specified that no two adjacent sections shall be opened up at one time to minimize inconvenience to traffic. Not more than three consecutive cross streets are closed at one time.

Considerable adjustments to domestic water lines, communication systems, power lines, and storm and sanitary sewer lines were necessary to accommodate the improvement.

The plans were prepared as a post-war project and a contract was awarded to Lester L. Rice on June 22, 1946 at a construction cost of $680,000. Two hundred working days are allowed to complete the project which should make the improvement, with the new Feather River Bridge, available for public traffic early next summer.

The work is under the general supervision of C. H. Whitmore, District Engineer, District III, with F. D. Hillebrand as Resident Engineer.

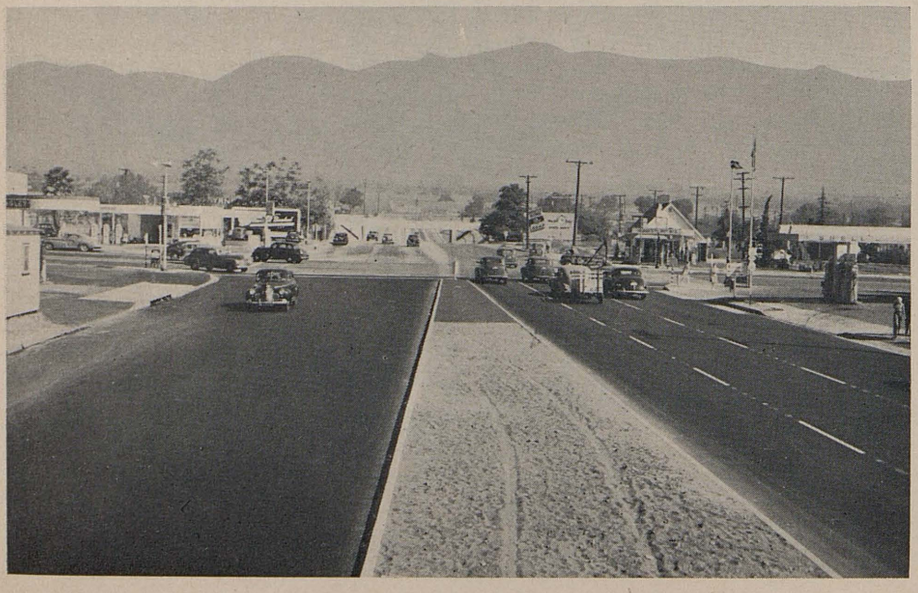


Route of proposed State highway in Yuba and Sutter counties between D Street Bridge in Marysville and Route 15 in Yuba City

Cement treated base on Rosemead Boulevard had been completed on roadway to the right and seal coat applied when this construction picture was taken

Rosemead Boulevard Job Completed

North end of project at El Dorado Street a few blocks east of Pasadena City limits



A RECENTLY completed one-mile section of Rosemead Boulevard easterly of Pasadena reflects the latest trends in the use of cement-treated soils and bases in highway design.

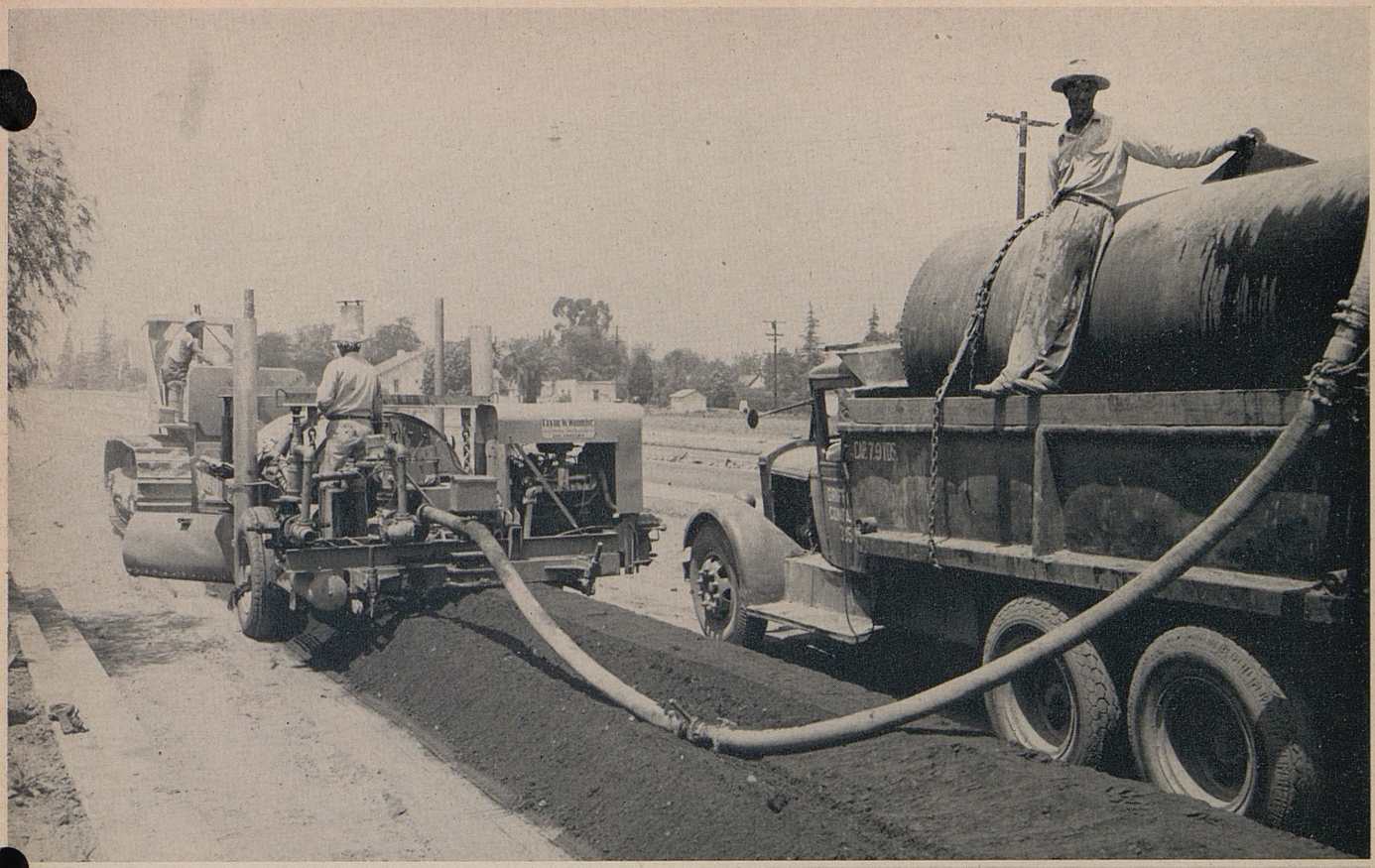
On this project two types of cement treatment were used.

First, four inches of native soil was treated in place by the road-mix method.

Second, four inches of imported material was treated with cement at a central mixing plant.

The final surface was four inches of asphaltic concrete. The total thickness, therefore, amounts to 12 inches. As the native soil has excellent supporting

Pictures on opposite page show, upper—Mixing cement treated subbase on Rosemead Boulevard. Lower—Close-up of equipment used in mixing cement treated subbase



qualities, a pavement structure of unusual strength was developed.

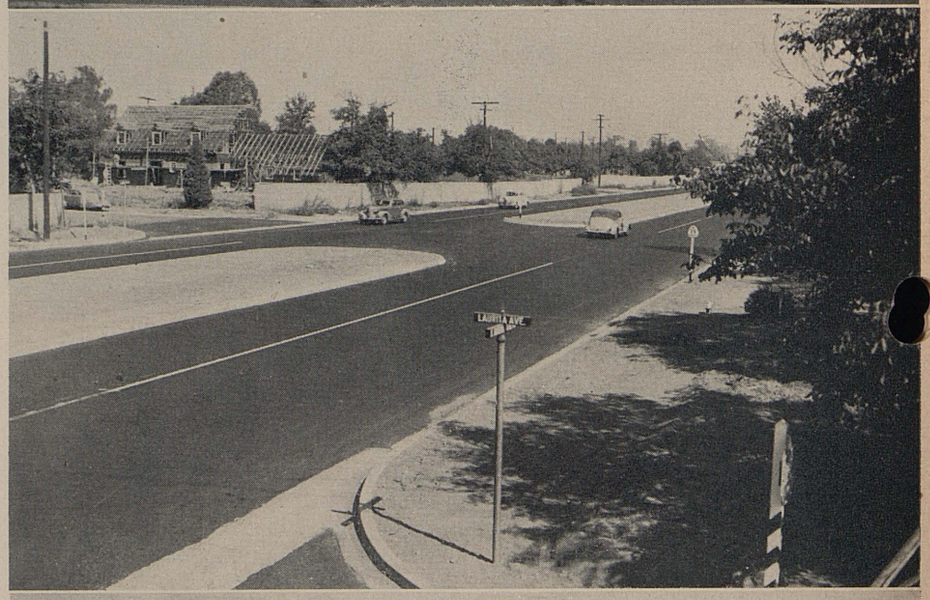
The subbase treatment was made with a traveling mixer which completed the operation in a single pass. The earth to be treated was first bladed into windrows upon which the cement was distributed in measured amounts, approximately 5⅓ per cent by weight. Water was added through the mixing machine. Immediately after completion of the mixing operation, the material was shaped to section with motor graders, and compacted with a 12-ton tandem roller and a 6-ton pneumatic-tired roller. An emulsion curing seal was applied upon completion of the rolling.

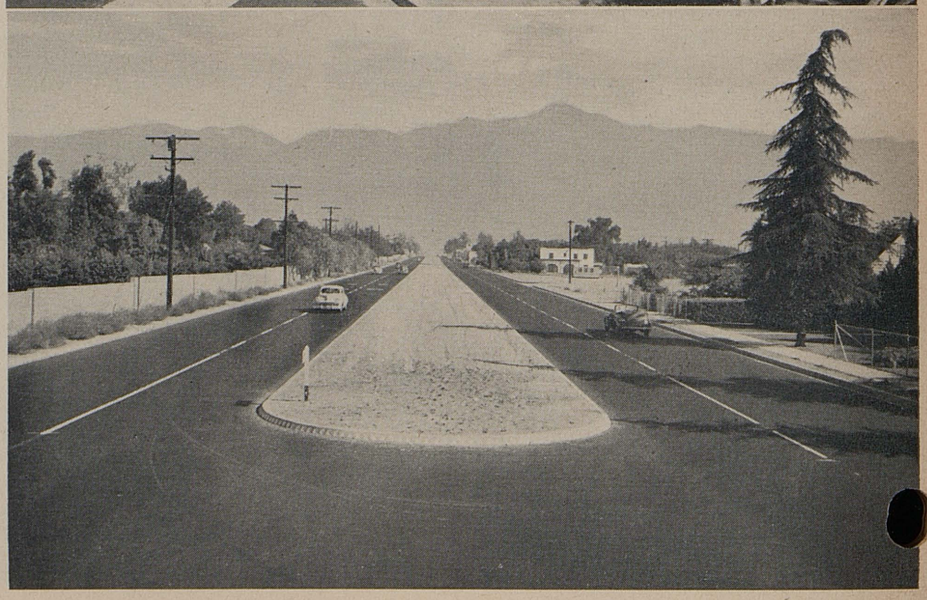
The imported material for the second course was mixed with cement and water in a central mixing plant, for which a standard asphaltic plant was used. The mixture was spread on the street with the conventional type asphalt machine.

Compaction was obtained with the same two rollers mentioned above; and also, the same type of curing seal was used. Six and one-half per cent cement was used in treating the imported base material. Compressive strength developed in the base, as indicated by test specimens, was unusually high for the small percentage of cement used.

Rosemead Boulevard is the local name for the northerly portion of Route 168, extending from Long Beach to Pasadena, with termini at the easterly edges of the two cities. It was originally located to by-pass all urban areas but war plants and housing projects and, now, the rapid expansion of the Los Angeles Metropolitan Area is changing the character of this route from a country highway to a city street. Traffic increase has been phenomenal.

This latest section to be improved, from Huntington Drive to Colorado Street, consists of two 32-foot paved roadways separated by a 28-foot median strip. At some later date when necessity demands, two additional 12-foot traffic lanes may be constructed by narrowing the center parkway.





Upper—View of completed project, looking north from center of Huntington Drive. Center—Openings in central parking strip are located for safety rather than convenience at side streets and are spaced at a minimum of 700 feet. Lower—Completed boulevard near center of project. Central dividing strip may be reduced from 28 feet to 4 feet to provide an additional 12-foot lane in each roadway when needed

Reduction of Fire Hazards Along California State Highways

(Continued from page 7)

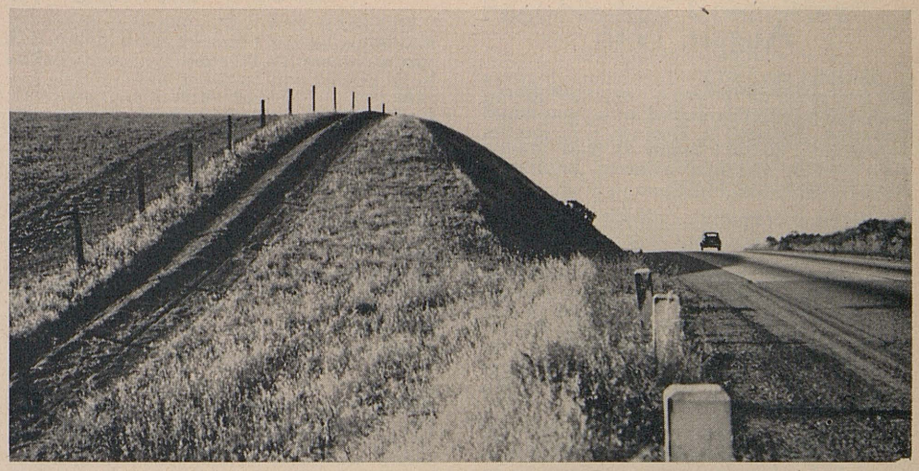
spraying and burning on cuts and fills and discing or blading on the wide flat spaces between.

The determining of the desired method of control is governed by the width of the shoulder and right of way, the location of the gutter line, the nature of the soil, and the profile of the treated roadside.

A new method of establishing a fire hazard control strip along the roadside, which is expected to greatly reduce costs over the conventional spray and burn system, has been given a trial this year. This method uses an inexpensive machine which consists essentially of a blower, powered by a small air-cooled engine, and a movable extended arm to which a burner head is attached. This machine is mounted on a two-wheel trailer which carries tanks for fuel oil which is used for heat. An intense flame is directed over a strip of grass as the machine is pulled along the roadside. This type of control is designed to be used on young green grass and weed growth. The searing action of the intense flame kills the plant tissues, and a second or follow-up burn removes the fire hazard. As with all other roadside burning operations, a water tank provided with high pressure pump should attend the work. It is anticipated that this machine, when somewhat improved, may prove especially valuable in mountainous areas where growth in the gutters and on cut and fill slopes on narrow winding right-of-way presents the greatest fire hazard.

Some work has been done in the past to eliminate roadside growth by chemical applications or with soil sterilizing agents. This has not proved successful for general roadside use due to the prohibitive cost of materials, the possible danger to livestock through poisoning, or because of unreliable soil reactions along any given roadside. Soil sterilization is practical, however, around guardrails, sight posts, bridge heads, structures, etc., and this practice is encouraged.

Many new chemicals have been produced in recent years which show promise as effective weed killers or soil sterilants. It is entirely possible that the present methods of roadside fire hazard control will become antiquated when these chemicals become commercially available and are within a price range which will justify their use as against present methods. A period of experimentation is always necessary in connection with such developments.



An improved control is provided by a burned firebreak placed from the gutter line up on cut slope

The benefits of the program from the public point of view are difficult to evaluate as the work is in the nature of insurance against loss. An uncontrolled fire leaves devastation behind, while a prevented fire leaves no record of fact. Until 1944, the occurrence of numerous fires was expected each season in a relatively small area of countryside south of King City, to cite one locality. These fires required the combined efforts of farmer-paid employees, railroad workers, and the men and equipment of the Division of Forestry for their control, which was only successful, perhaps, after some 2,000 to 25,000 acres of valuable grain, grazing, and watershed growth had been destroyed during each of several successive years.

In 1944, through the cooperation of the Southern Pacific Railroad, the State Division of Forestry, the State Division of Highways, and adjoining landowners, this menace was reduced by an estimated 100 fires and resulted in no serious loss to farmers. Although no appreciable loss had been suffered by farmers from fires originating on State highway right-of-way in this same area, the number of spot fires has been reduced by the roadside fire hazard control work from over 20 each year to fewer than five in 1944 and 1945.

This example is typical of what might be expected without the control which is now being exercised to protect certain types of agricultural lands adjoining State highways.

As is the nature of progress, it is not felt that perfection has been attained in roadside fire hazard control work. New methods, materials, and machines are continually being tested and given full consideration in an effort to improve the protection and to decrease the unit cost of this phase of highway maintenance work.

No More Copies of California Missions Available

CALIFORNIA Highways and Public Works has complied with so many requests for back issues of the magazine containing the articles on California Missions that the supply of these copies has been exhausted. It will be impossible to accede to any more such requests.

For the information of those readers desiring sets of the articles, the California Mission Trails Association, Ltd., will publish California Missions in brochure form with the same illustrations used in California Highways and Public Works. It is therefore suggested that those desiring the series of articles communicate with Mr. Ray Hewitt, General Manager, California Mission Trails Association, Ltd., 520 West Sixth Street, Los Angeles 14, California.

Highway Bids and Contract Awards for August and September, 1946

August, 1946

COLUSA COUNTY—In Williams between 293 feet south of "F" Street and "D" Street, about 0.3 mile to be repaired with plant-mixed surfacing. District III, Route 7. J. R. Reeves, Sacramento, $6,555; Lester L. Rice, Marysville, $6,974. Contract awarded to Harms Bros., Sacramento, $4,910.

CONTRA COSTA COUNTY—At San Pablo, between Wildcat Creek and San Pablo Creek, about 1 mile to be widened and paved with asphalt concrete on crusher run base, and traffic signal systems to be furnished and installed. District IV, Route 14, Section A. Lee J. Immel, San Pablo, $106,833.50; Independent Construction Co. Ltd., Oakland, $118,313; J. Henry Harris, Berkeley, $122,190.05. Contract awarded to J. R. Armstrong, El Cerrito, $101,210.50.

IMPERIAL COUNTY—Between Calexico and El Centro and in the city of El Centro, about 12.7 miles in length, portions to be graded, shoulders to be improved, and plant-mixed surfacing to be placed for the full length of the project. District XI, Routes 26,27, Sections J,E,Cn. Basich Bros. Construction Co. & Basich Bros., Alhambra, $246,214; Gunner Corp. & G. W. Ellis Construction Co., Pasadena, $257,772; Griffith Co., Los Angeles, $257,919.80; Arthur A. Johnson, Laguna Beach, $262,410.30; V. R. Dennis Construction Co., San Diego, $278,172.50; Peter Kiewit Sons Co., Arcadia, $288,475.40; Pacific Rock & Gravel Co., Monrovia, $348,611; J. E. Haddock Ltd., Pasadena, $365,718.70; R. E. Hazard Construction Co., San Diego, $364,367.50. Contract awarded to Tanner Construction Co., Phoenix, $244,795.30.

IMPERIAL COUNTY—At points near Winterhaven, eight timber bridges to be repaired, District XI, Route 27, Section B. E. G. Perham, Los Angeles, $29,909; Spencer Webb, Inglewood, $58,466. Contract awarded to Tanner Construction Co., Phoenix, $24,267.40.

KERN AND INYO COUNTIES—Between Mojave and Olancha, about 1.3 miles in net length, debris to be removed from existing roadbed, a portion to be graded and surfaced with roadmixed surfacing, and a seal coat to be applied to other portions and channels, dikes, and drainage structures to be constructed. District IX, Route 23, Sections B,C, E,G,H. Geo. E. Murray, Stockton, $46,164.60. Contract awarded to Brown & Doko, Pismo Beach, $45,914.

LOS ANGELES COUNTY—In the City of Los Angeles, on Arroyo Seco Parkway between College Street and Bernard Street, about 0.3 mile to be graded and paved with asphalt concrete, Portland cement concrete and plant-mixed surfacing. District VII, Route 165. Peter Kiewit Sons, Arcadia, $302,049.50; Charles T. Brown Co., San Fernando, $307,531.15. Contract awarded to J. E. Haddock Ltd., Pasadena, $285,710.20.

NAPA COUNTY—Four miles north of Vallejo at Station 410+75, a farm road undercrossing to be reconstructed. District X, Route 7, Section A. H. W. Ruby, Sacramento, $13,950; Kiss Crane Co., San Pablo, $15,120. Contract awarded to Minton & Kubon, San Francisco $12,258.

PLUMAS COUNTY—At various locations, furnishing and stockpiling plant-mixed surfacing. District II, Routes 21 & 83, Sections B,B,C. Frederickson & Watson Construction Co., Oakland, $4,863.80. Contract awarded to A. Teichert & Son, Inc., Sacramento, $4,770.30.

PLUMAS COUNTY—Between Route 83 near Almanor and Plumas-Lassen County line two miles west of Westwood, about 9.9 miles to be graded and surfaced with crusher run base and plant-mixed surfacing. District II, Route 523. Westbrook & Pope, Sacramento, $377,081.20; A. Teichert & Son, Inc., Sacramento, $490,944. Contract awarded to Frederickson & Watson Construction Company, Oakland, $367,267.32.

PLUMAS COUNTY—Across North Fork of Feather River at Chester. Sidewalk on bridge. District II, Route 29, Section A. O'Connor Bros., Red Bluff, $5,875; Kiss Crane Co., San Pablo, $6,525. Contract awarded to C. C. Gildersleeve, Willows, $4,716.

RIVERSIDE COUNTY—Between 1.3 miles north of Imperial County line and 0.5 mile south of San Bernardino County line, about 15.4 miles, portions to be repaired by placing road-mixed surfacing over the existing surfacing and portions to be repaired with imported base material and road-mixed surfacing. District XI, Route 146, Sections A,B,C, D,E. R. R. Hensler, Glendale, $65,352.50; Nevada Constructors, Inc., Reno, $87,037.10; Pacific Rock & Gravel Co., Monrovia, $107,460. Contract awarded to Arthur A. Johnson, Laguna Beach, $54,935.

SACRAMENTO COUNTY—In the city of North Sacramento on Del Paso Blvd. between Birch Avenue and El Camino Avenue, installing traffic signal system and constructing channelization facilities. District III, Route 3. Luppen & Hawley, Inc., Sacramento, $23,649. Contract awarded to R. Flatland, San Francisco, $18,668.

SAN DIEGO COUNTY—On Balboa Parkway at Sixth Street in the city of San Diego, a reinforced concrete undercrossing to be constructed. District XI, Route 77. E. S. & N. S. Johnson, Fullerton, $104,394; Carroll & Foster, San Diego, $105,565; Haddock Engrs., Ltd., Los Angeles, $105,852. Contract awarded to M. H. Golden Construction Co., San Diego, $98,197.70.

SAN DIEGO COUNTY—A reinforced concrete overcrossing over Balboa Parkway at Pasco Street in the city of San Diego to be constructed. District XI, Route 77. M. H. Golden Construction Co., San Diego, $82,791; Haddock Engineers, Ltd., Los Angeles, $89,655; Walter H. Barber, La Mesa, $94,931.82. Contract awarded to Carroll & Foster, San Diego, $79,508.

SAN MATEO COUNTY—On Whipple Road between Canada Road and Alameda de las Pulgas, about 2.9 miles to be graded. District IV. FAS 1052. Eaton & Smith, San Francisco, $215,039.54; N. M. Ball Sons, Berkeley, $225,414; Edward Keeble, San Jose, $232,924; Fredrickson Bros., Emeryville, $238,671.08; Guy F. Atkinson Co., South San Francisco, $244,265.20; Peter Sorensen, Redwood City, $259,699.94; Piombo Bros. & Co., San Francisco, $185,265.60.

SHASTA COUNTY—Between Schilling and Shasta, about 4.6 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District II, Route 20, Section B. H. Earl Parker & Clements & Co., Marysville, $515,558.30; Oilfields Trucking Co. & Phoenix Construction Co., Bakersfield, $535,388.50; E. W. Elliott Construction Co., San Francisco, $549,113.70; A. Teichert & Son, Inc., Sacramento, $598,053.10; Frederickson Bros., Emeryville, $627,731; Morrison Knudsen Co., Inc., Los Angeles, $653,012.71; L. G. Lynch, Danville, $688,501.50; Guy F. Atkinson Co., South San Francisco, $688,770.90; Stolte, Inc. & E. B. Bishop, Oakland, $705,690.30. Contract awarded to Harms Bros. & N. M. Ball Sons, Berkeley, $494,627.40.

September, 1946

KERN COUNTY—Between Route 143 and Cottonwood Creek, about 6.3 miles to be surfaced with roadmixed surfacing. District VI, Route 57, Section E. Oilfields Trucking Company and Phoenix Construction Co., Bakersfield, $24,607.50; Ted F. Baun, Fresno, $25,420; Griffith Company, Los Angeles, $26,889.50; Geo. E. France, Visalia, $28,875. Contract awarded to Rand Construction Co., Bakersfield, $24,372.50.

MENDOCINO COUNTY—At Red Bank Creek and Lost Creek between Boonville and Yorkville, about 0.4 mile to be graded and imported base material placed. District I, Route 48, Section A. J. Henry Harris, Berkeley, $37,828.25. Contract awarded to C. M. Syar, Vallejo, $29,966.70.

ORANGE COUNTY—About 18 miles north of Doheny Park, the existing bridge across North Arm of Newport Bay to be repaired. District VII, Route 60, Section B. Chas. A. Dutro Associates, Los Angeles, $33,059.40; Cox Bros. Construction Co., Stanton, $63,520. Contract awarded to Case Construction Co., San Pedro, $31,660.10.

PLACER COUNTY—Between Route 37 in Auburn and Wise Canal, about 1.7 miles to be graded and surfaced with crusher run base and plant-mixed surfacing. District III, Route 17, Section Aub., C. J. R. Reeves, Sacramento, $182,947.85; N. M. Ball Sons, Berkeley, $188,578.25; Elmer J. Warner, Stockton, $197,621.50; H. Earl Parker & Clements & Co., Marysville, $234,037.25. Contract awarded to Frederickson & Watson Construction Co., Oakland, $182,335.11.

PLACER AND EL DORADO COUNTIES—At North Fork of American River about 2 miles east of Auburn, a structural steel girder bridge to be constructed and about 0.26 mile of approaches to be graded and bituminous surface treatment applied thereto. District III, Route 65, Sections A,A. Harry J. Oser & Joe Garrick & Co., San Francisco, $254,540.50; Lord & Bishop, Sacramento, $269,872; Fredrickson & Watson Construction Co., Oakland, $318,348.05. Contract awarded to H. W. Ruby, Sacramento, $249,626.70.

RIVERSIDE COUNTY—At points near Indio, five timber bridges to be repaired. District XI, Route 64, Sections H,B. O'Rourke & Parker, Garvey, $29,732.20; Matich Bros., Colton, $32,960; Spencer Webb, Inglewood, $42,399. Contract awarded to E. G. Perham, Los Angeles, $22,026.10.

SAN BERNARDINO AND RIVERSIDE COUNTIES—Between one-half mile east of Ontario and Mira Loma, about 5.8 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and existing bridge structures and culverts to be widened. District VIII, Route 19, Sections B,A. Griffith Co., Los Angeles, $437,731; Geo. Herz & Co., San Bernardino, $449,827.65; N. M. Ball Sons, Los Angeles, $505,927.20; Matich Bros., Colton, $528,319.40; J. E. Haddock, Ltd., Pasadena, $592,676.60. Contract awarded to Peter Kiewit Sons Co., Arcadia, $413,905.30.

SAN DIEGO COUNTY—Between 9th Street and Luneta Drive in Del Mar, about 0.6 mile to be widened with asphalt concrete and plant-mixed surfacing to be placed on shoulders. District XI, Route 2, Section A. N. M. Ball Sons, Los Angeles, $20,377.50; Griffith Co., Los Angeles, $20,627.15; R. E. Hazard Contracting Co., San Diego, $21,7[illegible]. Contract awarded to V. R. Dennis Construction Co., San Diego, $18,380.50.

North Sacramento Freeway Construction Is Advanced

(Continued from page 18)

areas and through and over the structures, curbs are provided to prevent unauthorized crossing. Fences down the center division strip are also being placed in strategic positions to prevent pedestrians crossing the freeway. The freeway right of way will all be fenced. In the more developed areas, a chain-link fence is being placed while on the remainder of the perimeter through undeveloped land, an ordinary property fence will be placed.

The progress of the job in relation to the portion of the contract time which is elapsed is good. Although the contract time will not expire until the late fall of 1947, there is every reason to expect that the work will be completed by early summer of 1947.

The contract is being administered by District III with the Contractor the Guy F. Atkinson Company of San Francisco. H. F. Sherwood is the Resident Engineer for the District and A. L. Elliott is the Bridge Department Representative in charge of the structures.

SANTA CLARA COUNTY—On Leavesley and Ferguson Roads, between Gilroy and junction of Ferguson Road with Route 32, about 4.5 miles to be graded and paved with asphalt concrete. District IV, FS 992. Piazza & Huntley, San Jose, $159,380.64; N. M. Ball Sons, Los Angeles, $164,110.75; A. Teichert & Son, Inc., Sacramento, $165,553.80; Edward Keeble, Dan Caputo, and A. J. Raisch Paving Co., San Jose, $168,876.40; Peter Sorensen, Redwood City, $219,095.50. Contract awarded to Granite Construction Company, Watsonville, $148,648.10.

SANTA CRUZ COUNTY—At Waddell Creek, about 7.4 miles north of Davenport, about 0.3 mile to be graded, surfaced with plant-mixed surfacing and a reinforced concrete bridge to be constructed. District IV, Route 56, Section C. Dan Caputo & Edward Keeble, San Jose, $114,082; Peter Sorensen, Redwood City, $115,397. Contract awarded to Granite Construction Co., Watsonville, $88,-995.50.

SOLANO COUNTY—Between State Highway Route 7 near Vacaville and 0.5 mile north of Sweeney Creek, about 5.7 miles to be graded and paved with Portland cement concrete pavement and five bridges to be constructed. District X, Route 90, Section A. N. M. Ball Sons, Berkeley, $546,103.70; A. Teichert & Son, Inc., Sacramento, $565,561. Contract awarded to Fredrickson Bros., Emeryville, $512,573.60.

SONOMA COUNTY — Across Russian River at Hacienda, between Guerneville and Forestville; a steel and concrete bridge to be constructed. District IV, Route FS 786. Carl Swenson Co., San Jose, $153,968. Contract awarded to Kiss Crane Co., San Pablo, $127,-700.11.

Only 25 Toll Roads In United States

TWENTY-FIVE motor vehicle toll roads, 240 toll bridges, six pay-as-you-enter tunnels, and 561 ferries in the United States yield approximately $96,000,000 in a normal travel year, yet these toll-ways are few when compared with the Nation's 3,300,000 miles of roads and streets and tens of thousands of bridges.

Figures collected by the Public Roads Administration for 1940, show that all the toll roads in the United States total only 346.6 miles and that this includes the 160.7 miles of the Pennsylvania Turnpike which is the country's longest toll road and 46 per cent of our entire toll mileage.

The Wilbur Cross Parkway in Connecticut, 2.15 miles long, is the shortest public toll road. The longest private toll road is Heckscher Drive in Florida with 16.1 miles, and the shortest, the Mt. Agassiz Scenic Road in New Hampshire, is one mile long.

Four States, Arizona, Nevada, New Mexico and Utah have no toll facilities of any kind. Eight States, Delaware, Idaho, Indiana, Iowa, Kansas, Minnesota, Nebraska and Wisconsin, have no intrastate but one or more interstate service. Kentucky leads the Nation with 128 toll facilities, all bridges and ferries. New York is second with 78 which includes all forms, and Illinois rates third with 62 bridges and ferries.

Appointment Announced

Edward Hyatt, State Engineer, has announced the temporary appointment of V. G. Horton, engineer from the Sacramento office of the State Division of Water Resources, to the position of Construction Superintendent in charge of the Division's flood control maintenance headquarters at Sutter, Sutter County, left vacant through the recent resignation of James M. Berry who occupied that position for many years.

"On the day my wedding occurred . . ."

"Pardon the correction, but weddings, receptions, dinners and such affairs 'take place.' It's only calamities that 'occur.' Do you see the distinction?"

"Yes, I see. Well, as I was saying, on the day my wedding occurred . . ."

Ten-Year Highway Program Is Proposed to Joint Fact-Finding Committee

(Continued from page 4)

experience in the highway field, J. Paul Buckley and Carl E. Fritts. They had the responsibility of developing the technical data of the report, under Mr. Kennedy's direction. Robert L. Steinle developed the graphic presentation of the material, the art work and the lay-out of the report. Raymond F. Law served as writer and editor.

The State Division of Highways made available the basic material on the California Highway System. Much helpful information was obtained from other State departments.

The Public Roads Administration contributed materially to the study by providing information and personnel. Pierce A. Carmichael of the Sacramento office was loaned to the committee. Two members of the Washington staff, Fred B. Farrell and O. K. Normann, visited Sacramento to work with the engineering staff.

Thus, while the study was made independently, it represented the cooperative efforts of a large number of organizations, governmental agencies and individuals interested in highway development.

WATER MEETING TO BE HELD

San Francisco will be host to the 27th annual convention of the California Section, American Water Works Association, on October 23, 24 and 25.

The convention will open at 8 a.m. Wednesday the 23d with a golf tournament under the direction of Claude T. Faw. The entire morning will also be spent in registration at the Civic Auditorium. At 2.30 that afternoon Carl M. Hoskinson, Chairman of the California section, will preside over the opening of the technical sessions. Following a speech by San Francisco Mayor Roger Lapham, there will be three papers. "Water Development Plans in California" by Edward Hyatt, State Engineer; "State Highway Expansion and its Effect on Public Utilities" by Fred J. Grumm, assistant State Highway Engineer of California, and "The Effect of Owens Lake Litigation on Water Appropriation in California" by C. T. Waldo, deputy city attorney of Los Angeles, for the Department of Water and Power.

Fourteen Miles Three Flags Highway Resurfaced

(Continued from page 14)

The gravel base for the imported borrow and plant-mixed surfacing was obtained from a state-owned pit which is located along the ancient shore of the Great Basin or Lake Lahonaton and was composed of layers of gravel material ranging from very fine sand to medium coarse gravel in an alternating pattern which had a total thickness of approximately nine feet and lay on a formation of scattered two-foot boulders imbedded in a very fine sand with no gradation between the boulders and the sand.

IMPORTED GRAVEL BASE

The two-foot overburden properly blended with the underlying gravel made up the aggregate for the imported gravel base. The material was hauled to the main hopper by means of a 14-cubic yard Woolridge Scraper, powered by a D-1700 Caterpillar. The material from the hopper was carried to the screening plant by an 80-foot steel conveyor, powered by a 15 horsepower electric motor through a Pan-type automatic feeder. The screening plant consisted of a double deck Niagara scalping screen, powered by a 10 horsepower electric motor mounted on a two-compartment, 15-cubic yard steel bin.

The ¾-inch material was scalped and the imported gravel base delivered to the road by dump trucks and deposited in a windrow along each side of the roadbed by means of a Galion spreader box, mixed with water, laid and compacted.

The mineral aggregate for the plant-mixed surfacing was blended at the pit in the ratio of two parts of coarse and one of fines, and delivered to the screening plant from which it was stockpiled on top of a 40-foot wood tunnel by means of a 100-foot steel conveyor. The screening plant served only to scalp ¾-inch material. The aggregate was fed from the stockpile to the dryer through a 40-foot tunnel, with a 40-foot conveyor belt and 8-foot belt feeder, powered from a tail pulley, through a dryer, and fed by a hot elevator into a 3000-pound "Standard" paving plant, where it was separated into two sizes and mixed with liquid asphalt 200-300 penetration at an approximate temperature of 260 degrees Fahrenheit. The bitumen ratio was approximately 7 per cent. The material was hauled to the street in 5-cubic yard dump trucks where it was spread with a Barber-Greene paving finisher.

DIRECT THROUGH ROUTE

The total length of the project was 14 miles. The finished riding surface consisted of a two-inch by 20-foot pavement, with two-foot borders and a Class "A-Fine" seal coat in the 20-foot center portion.

This road is known locally as the Susanville-Alturas Highway, and is designated in the Federal Highway System as U. S. 395. Traffic consists of a small amount of local farm-to-market travel and a fairly heavy volume of through and interstate traffic. This road is a part of a direct through-route from Central Oregon and Washington to Reno and Los Angeles, and a considerable increase in this latter type of traffic is to be expected.

The contractor was E. B. Bishop and the work was done under the general direction of District Engineer F. W. Haselwood, and District Construction Engineer H. C. Amesbury.

Foreign Bitumen Experts On Visit to California

Fifteen bitumen experts from seven foreign countries, on tour of the United States to study road construction and maintenance, airport surfacing and related uses of asphalt, were guests of the Testing and Research Laboratory, Division of Highways, Sacramento, on September 27th. All are representatives of Shell Associates in their respective countries. The members of the party are:

England—John Frederick Thomas, W. L. Campbell, Charles F. Jackson, E. J. R. Kennerell, J. S. La Trobe-Bateman, Baron W. F. Van Asbeck.

France—George L. Linckenheyl, Paris.

Holland—F. W. Lutter, H. W. Slotboom, J. C. Stoop and Mr. DeGraaff.

Egypt—George Melville, Cairo.

New Zealand—D. H. Scott, Wellington.

India—L. A. T. Shannon, Bombay.

Australia—J. Wearing Smith, Melbourne.

Committees for A. A. S. H. O. Are Hard at Work

(Continued from page 5)

Grumm, J. G. Standley, R. H. Wilson, T. E. Stanton, T. H. Dennis, R. M. Gillis, J. W. Vickrey, A. M. Nash, E. F. Wagner, E. N. Whittemore, Hodge L. Dolle, Geo. C. Hadley, A. D. Griffin, Harold Norton, Roy Higgins, G. F. Hellesoe, F. W. Haselwood, C. H. Whitmore, Jno. H. Skeggs, L. H. Gibson, E. T. Scott, S. V. Cortelyou, E. Q. Sullivan, S. W. Lowden, P. O. Harding, E. E. Wallace, F. W. Panhorst.

Men's Reception Committee—A. H. Henderson, Chairman, Assistant Director of Public Works, California; G. F. Hellesoe, F. W. Haselwood, C. H. Whitmore, Jno. H. Skeggs, L. H. Gibson, E. T. Scott, S. V. Cortelyou, E. Q. Sullivan, S. W. Lowden, P. O. Harding, E. E. Wallace, Howard C. Wood, E. F. Wagner, S. W. Elliott, J. G. Standley, R. H. Wilson, T. E. Stanton, R. M. Gillis, T. H. Dennis, F. W. Panhorst, A. M. Nash, L. V. Campbell, R. H. Stalnaker, J. W. Vickrey, E. R. Higgins.

Earl Carroll Banquet Committee—F. W. Panhorst, Bridge Engineer, Chairman; R. N. Gillis, J. W. Vickrey, J. G. Standley, Harold Norton, Roy Higgins, T. G. Sibley, W. E. Rose.

Banquet Committee, Biltmore Hotel—R. M. Gillis, Construction Engineer, Chairman; F. W. Panhorst, T. H. Dennis, Fred J. Grumm, Harold Norton, Gilbert Clarke, Kenneth Trenholm.

Friday Caravan Committee—A. N. Nash, Engineer of Surveys and Plans, Chairman; S. V. Cortelyou, J. W. Vickrey, T. H. Dennis, Leo J. McCarthy, Wm. L. Mills. Aides—R. L. Coor-Pender and F. B. Cressy.

Broadcasting Program Committee—E. N. Whittemore, District Right of Way Agent, Los Angeles, Chairman; A. D. Griffin, Louis R. Ardouin, Leo J. McCarthy, Harold Norton.

Secretarial Service Committee—R. H. Wilson, Headquarters Office Engineer, Chairman; R. C. Myers, A. D. Griffin, W. L. Fahey.

Orator—"In this great land of ours there is no North or South, nor East or West."

Listener—"No wonder we frequently don't know where we are."

State of California

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Department of Public Works

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printed in CALIFORNIA STATE PRINTING OFFICE 62526 8-46 18,900

California Highways and Public Works
Division of Highways
P. O. Box 1499
Sacramento, California
Return Postage Guaranteed

CALIFORNIA STATE HIGHWAY SYSTEM