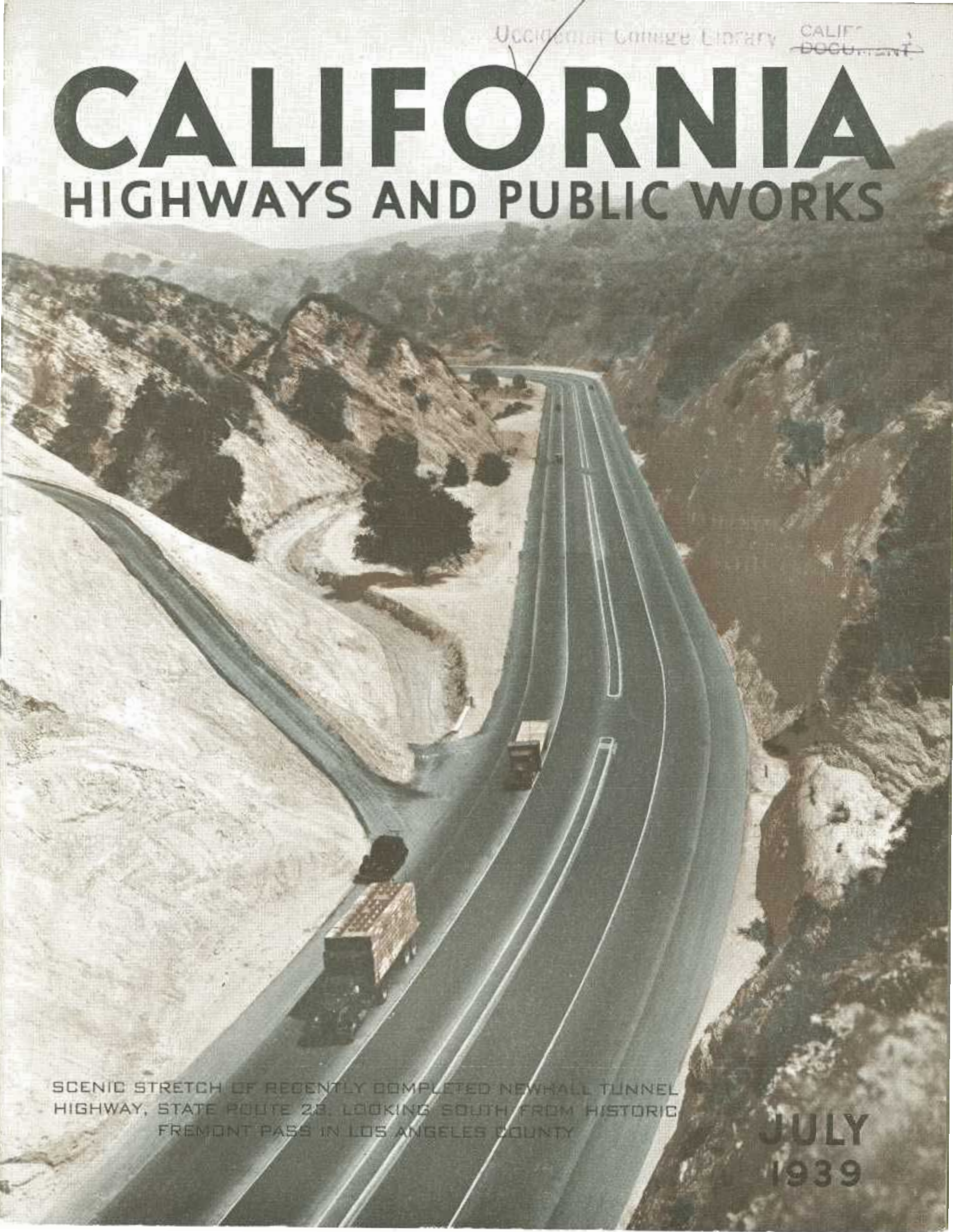
# CALIFORNIA
## HIGHWAYS AND PUBLIC WORKS



SCENIC STRETCH OF RECENTLY COMPLETED NEWHALL TUNNEL HIGHWAY, STATE ROUTE 23, LOOKING SOUTH FROM HISTORIC FREMONT PASS IN LOS ANGELES COUNTY

JULY
1939

# CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

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# Relocating of Southern Pacific Railroad for the Development of Shasta Dam Will Cost $17,500,000

THE Shasta dam development of the Central Valley Project includes a major piece of supplemental construction work comprising the required relocation of the present main line of the Southern Pacific Railroad (Shasta Route) around the reservoir which the dam will create. The new railroad now being built to replace the existing line between Redding and Delta will require an estimated capital expenditure of $17,500,000.


Sketch map shows existing Southern Pacific railroad line and route trains will follow from Redding after relocation.

This job of railroad building constitutes a large and notable construction undertaking in itself, and would be receiving greater notice were it not for the fact that it is dwarfed by the much larger and more outstanding construction work on the dam.

The original reconnaissance surveys for this railroad relocation were made by Paul Bailey, former State Engineer, and A. D. Edmonston, Deputy State Engineer, in 1925, including investigation of alternate routes on both sides of the river. As a result of these reconnaissance surveys a route on the east side was selected that generally follows the location finally adopted. It was the basis for cost estimates on the Kennett (Shasta) reservoir development in reports on the State Water Plan prepared under the direction of Edward Hyatt, State Engineer. In 1930 a preliminary survey was run by the U. S. Army Engineers along the west side of the reservoir, which again proved that the east side route was the more favorable one.

In January, 1935, prior to allocation of emergency funds for the Central Valley Project by President Roosevelt, the legislature appropriated funds for an additional survey. This survey was made by the Southern Pacific Company under a contract with the Division of Water Resources, and was directed by Russell Chase, veteran locating engineer, and J. A. Given, Division Engineer, Shasta District, for the company. Complete plans and estimates of cost were prepared and submitted in a report. The location selected and the plans prepared as a result of this survey are practically the same as the final location and plans subsequently adopted.

Preliminary negotiations for an agreement with the Southern Pacific Company for the relocation of the railroad were also carried out by the Division of Water Resources on behalf of the Water Project Authority in conformity with a cooperative contract between the Authority and the U. S. Bureau of Reclamation. A preliminary draft of agreement between the company and the United States covering the proposed relocation was prepared and submitted to the Bureau of Reclamation. The final contract somewhat modified from the preliminary agreement drafted, was executed in September, 1938.

### U. S. STANDS COST

The agreement, as executed, provides for the construction of a new railroad to replace the existing line at the entire expense of the United

By-pass tunnel through west abutment of Shasta Dam, recently placed in operation as temporary route for trains to permit construction to proceed on the dam without interference to traffic.

States. All construction is to be handled by the United States except the laying of ties and rails and the installation of an electric signal and block system which is to be done by the Southern Pacific Company and the cost thereof plus 10 per cent borne by the United States. Upon completion, the railroad company will be given sixty days within which to use the new line on a trial basis; and after acceptance is given the right to demand payment, within a period of five years, of not to exceed $350,000 for unusual maintenance costs actually incurred.

The location of the new railroad line and its relation to the existing line is shown on the accompanying perspective sketch. The existing line between Redding and Delta, built in 1884, follows a grade on a tortuous course through the Sacramento River canyon 37 miles in length. The new line leaves the existing line at the city of Redding (elevation 559 feet); crosses the Sacramento River on a steel bridge and viaduct 4346 feet in length and then proceeds on an ascending grade to the crossing of the Pit River at an elevation of 1110 feet.

This section includes the two longest tunnels on the new line, each about 2700 feet long. After crossing the Pit River on a bridge, subsequently described, the new line continues on an ascending grade to O'Brien's Summit (elevation 1218 feet) and then continues on a descending grade to the second crossing of the Sacramento River. From this point the new line follows alternately the westerly and easterly sides of the river making two more crossings before joining the existing line at an elevation of 1123 feet near Delta.

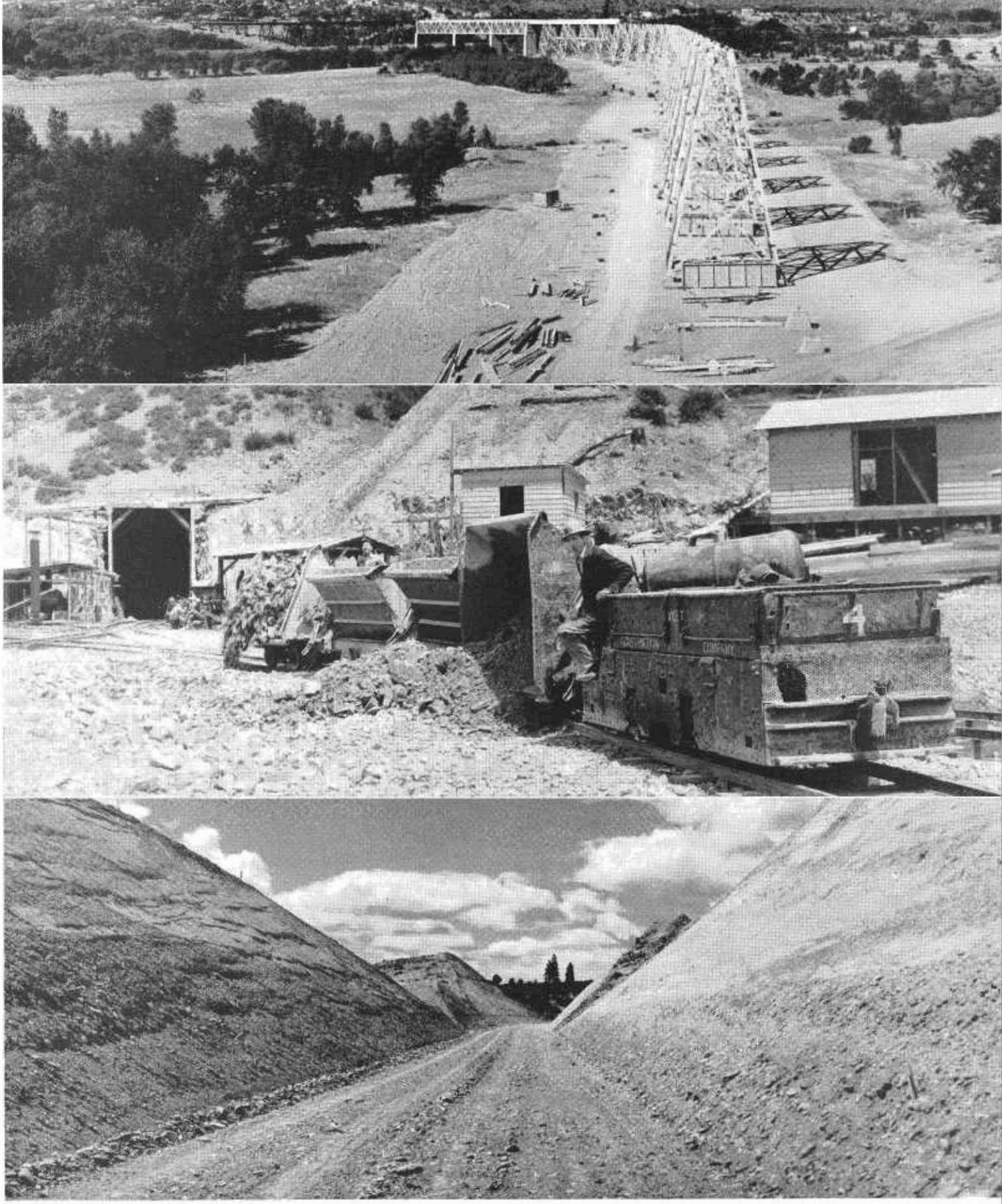
There will be five tunnels between the Pit River and O'Brien's Summit, the longest of which is 1900 feet in length; three tunnels between O'Brien's Summit and the second crossing of the Sacramento River, the longest of which is 2235 feet; and two tunnels between the third and fourth crossings of the Sacramento River, the longest of which is 1000 feet.

The total length of the new line is approximately thirty miles. It includes twelve tunnels with an aggregate length of 19,110 feet, and eight major steel bridges aggregating 12,856 feet in length.

**The construction of the new line will involve the excavation and grading of 3,900,000 cubic yards including 2,100,000 cubic yards of rock, and 420,000 cubic yards of tunnel excavation. It will require 5915 gross tons of new rail for the main track and 1331 gross tons of old rail to be salvaged from the existing line and used for sidings; 12,643 tons of bridge steel exclusive of that for the Pit River bridge which will require 16,400 tons; and large quantities of other material.**

As with the existing line, the new line will be a single track railroad although the foundations of certain structures are being built in such a manner that double tracking may be accomplished at some later time. However, as compared to the existing line it will be superior in many respects. It will have a maximum grade of 0.9 per cent, a total curvature of 2028 degrees as compared to 7129 degrees on the old line, and a maximum curvature of 4 degrees as compared to 11 degrees on the old line. Considering limitations of curvature, the new line will permit train speeds up to sixty miles per hour for passenger trains as compared to twenty miles per hour on portions of the present line. It is estimated that the running time between Redding and Delta will be decreased by forty-five minutes for

(Continued on page 23)



Construction progress on Southern Pacific Railroad relocation, Redding to Delta. Upper—4346-foot railroad bridge crossing Sacramento River near Redding. Center—One of twelve tunnels under construction. Lower—Completed section of grading north of Redding.

# Realignment of Russian River Highway Nearing Completion

By W. A. RICE, Resident Engineer

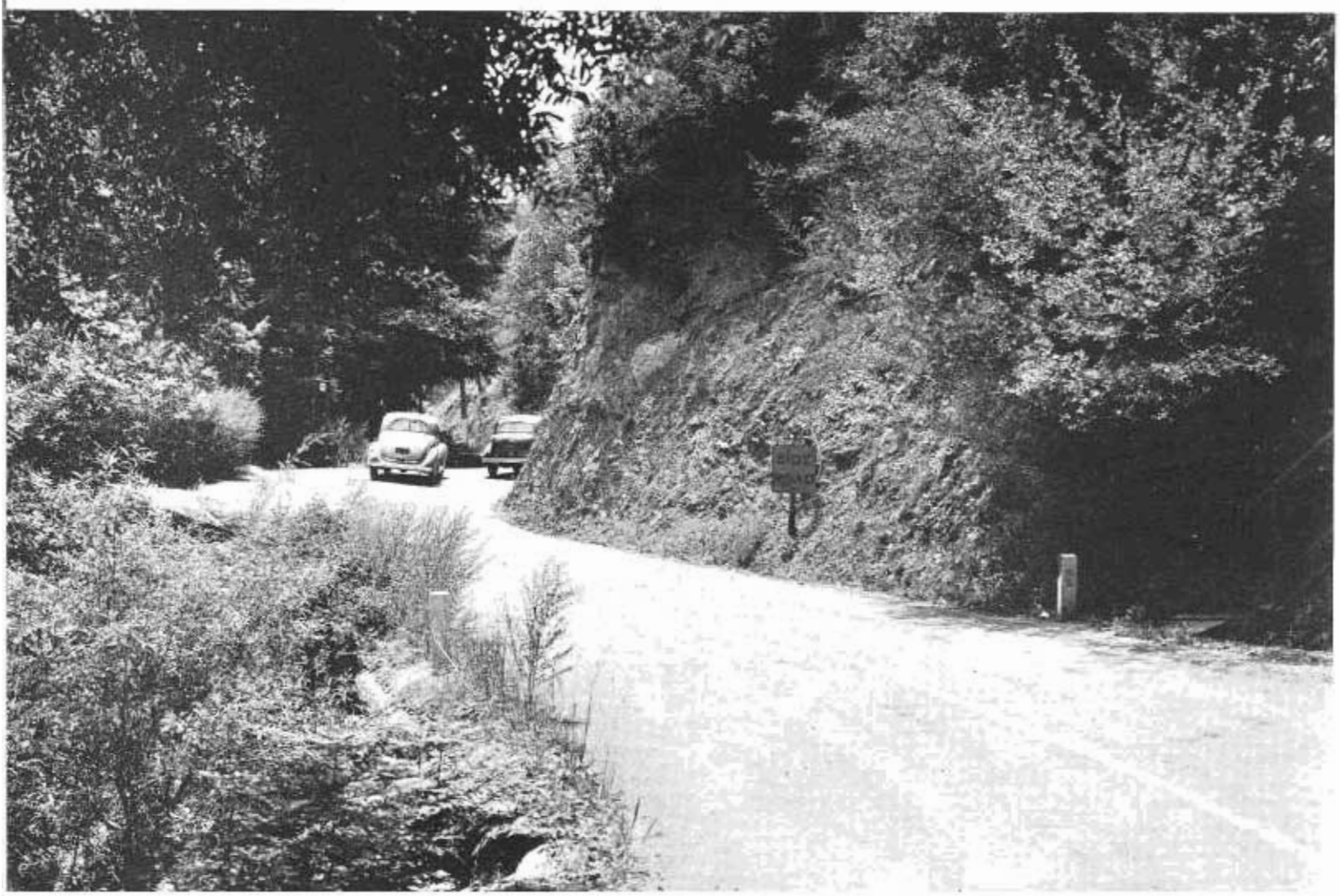
THE district adjacent to the Russian River in Sonoma County is one of the popular vacation spots and playgrounds in Northern California.

The section between Northwood Park and Guerneville has been served by a narrow, winding road which has been inadequate to accommodate the heavy summer traffic using it during the last several years.

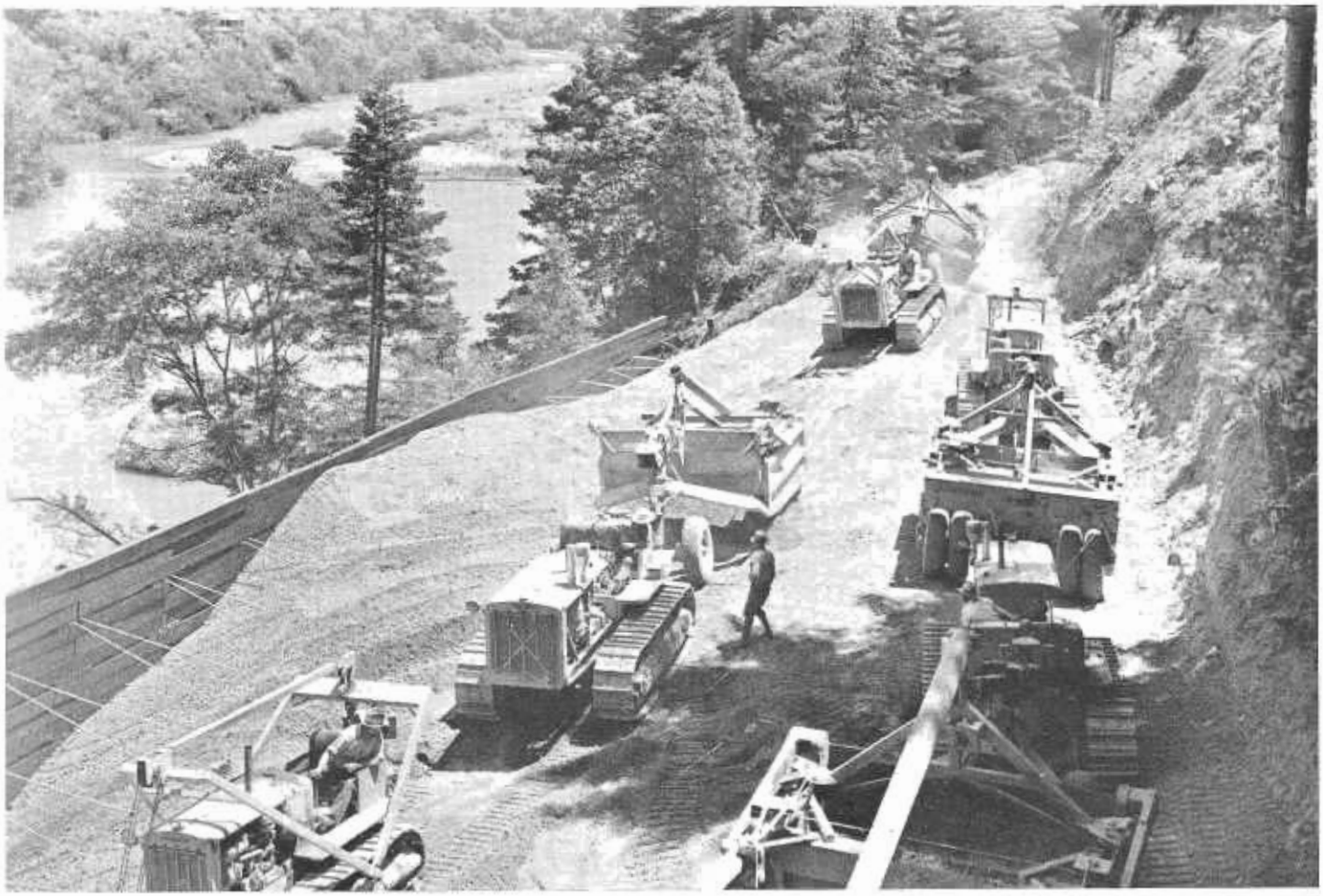
The town of Guerneville, located at one end of this project, is on the Russian River. It was first settled around 1860 and became the center of a thriving lumber community. It was named after Mr. George Guerne, who was one of the early settlers.

At one time it was known as Stump Town because of the many Redwood stumps left standing throughout the village. Many of these monuments to the majestic trees that at one time stood everywhere in this section still remain. They are scattered among the vineyards and orchards of the region.

The lumber industry ended about 1919 and this section of the river rapidly developed into a popular recreational center. The heavy increase of traffic, due to this development, has made it necessary to construct



View of existing Northwood Park-Guerneville highway showing sharp curves and grades. This highway will be replaced by new construction on easy curvature and practically level grades.



This picture shows construction crew back-filling bulkheads with porous river gravel.

a realigned standard highway to accomodate steadily increasing travel.

In contrast with the existing road the new road will have easy curves and very light grades. The roadbed of the abandoned Northwestern Pacific Railroad is utilized for the new road.

The new road follows closely along the river for practically its entire length of 3.23 miles, passing through the beautiful stand of Redwood trees in Guernewood Park. The view of the river and of the beaches to be obtained from the new road is unsurpassed.

### ROADBED 36 FEET WIDE

The roadbed will be 36 feet throughout, except where the topography made it necessary to construct retaining walls along the river side of the road. At these places the width was reduced to 28 feet. The surfacing will consist of one foot of river gravel on the graded roadbed and an armor coat surface.

At most locations where the railroad found timber trestles to be satisfactory and where the new fills would not catch, retaining walls were constructed. They consist of steel "H" beams driven at 8 foot centers, lagged with 6-inch by 12-inch treated Douglas fir timber, and anchored by steel rods to steel piles driven into the roadbed section.

The steel "H" beams were 10-inch, 42-lb. beams driven to one-half the height above ground or to refusal. The driving was through a shaly material and little difficulty was experienced in driving. The required bearing of a minimum of 5 tons for a penetration of 18 feet or under, and 2 tons for a penetration of more than 18 feet, was obtained without difficulty.

### ANCHOR AND BULKHEAD PILES

The anchor piles were of the same material as the bulkhead piles. They were driven to one-half the height of the bulkhead piles above ground with a minimum of 5 feet. Treated Douglas fir bearing blocks, 8 inches by 12 inches by 6 feet long, were placed on the bulkhead side of the anchor piles to assist in carrying the load.

Timber lagging consisted of 6-inch by 12-inch treated Douglas fir timber. It was placed on the road side of the bulkhead piles. Placing was started from the bottom. Every third plank was separated by a spacer block of treated timber. These were 4 inches by 8 inches by 3 feet long and shaped to fit around the piles. Steel "U" bolts held them in position against the piles; drift pins were used to secure them to the timber lagging.

Tie rods were of steel. The top row was placed three feet down from the top of the bulkhead piles and was of one inch round material. The second row was placed, as necessary, a maximum of ten feet below the top row, and was of $1\frac{1}{4}$-inch round material with upset ends and malleable washers. The third row of ties was placed, as necessary, and was of $1\frac{3}{8}$-inch

(Continued on page 27)

# Bank Protection and Revetment as Viewed in the Light of the Unprecedented Storms in California During the Winter of 1937-8

By G. A. TILTON, Jr., Asst. Const. Engineer

FOLLOWING widespread storms of severe intensity throughout the State during the winter of 1937-8, particularly the December, 1937, storm in Northern California and the February-March, 1938, storm in Southern California, interest in bank protective measures was promptly revived.

Not since 1914 and 1922 had California engineers had an opportunity to observe the effect of severe storms on bank protection and revetment throughout the State. Intermittently during the 16 to 24 years preceding the winter of 1937-8, localized storms producing a heavy runoff have occurred to test one type or other but none occurred that was sufficiently severe and general in character to produce comparable tests of all types at one time.

Promptly following the clearing away of wreckage after the February-March, 1938, storm in Southern California, the State Division of Highways launched a joint departmental survey and intensive study of the effectiveness of individual types throughout the State.

### SURVEY FINDINGS

Several outstanding observations were readily correlated:

(1) No one type of revetment or bank protection in general use that was encountered in the survey gave 100 per cent service under the severe action of the unprecedented runoff. One type of protection would withstand damage in a particular location and fail in another. This held true whether designed and built by governmental agencies, public utilities, or private parties.

(2) With but few exceptions, the initial cause of failure or partial failure of all of the various types of bank protection or revetment could be attributed to undermining or scouring of the bottom of the installation by high velocity currents.

(3) In cases of complete failure, it was of particular note that the protective measures returned their worth in preventing, delaying, or minimizing damage even though completely lost in the end.

(4) On most streams, tangent sections suffered comparatively little, but vulnerable places would develop on bends of the same stream at a point where the center-line tangent of the stream flow, whether narrow or wide, intersected the outer bank of the downstream curve.

(5) Channel restrictions were the cause of increased velocities in numerous cases that induced damaging scour. Jutting rock dykes, heavy growth of trees, bridge piers, and abutments, encroaching approach fills, and conflicting flows at the confluence of major streams, all told the same story.

(6) Types requiring frequent maintenance or renewal such as those incorporating untreated timber, suffered correspondingly more than enduring types that require but little maintenance.

### DETAILED STUDY

For the purpose of a detailed comparative study, all types encountered were grouped into four classifications:

**Class "A"—Revetment or facing types constructed on prepared bank slopes.**

- A-1 Clean graded heavy rock riprap.
- A-2 Sack concrete.
- A-3 Asphalt concrete mattress.
- A-4 Rock and wire mattress.
- A-5 Gunite facing with articulated aprons.
- A-6 Reinforced concrete slope paving.
- A-7 Grouted rock facing.
- A-8 Hand-placed rock facing.
- A-9 Random select bank-run rock riprap.

**Class "B"—Fence types requiring no prepared bank slope.**

- B-1 Double and triple rows of cable-connected steel rail and wire mesh (brush and rock filler).
- B-2 Double rows of heavy or light pipe and wire mesh (brush and rock filler).
- B-3 Single row of rail or pipe fence with wire mesh.
- B-4 Treated or untreated timber piling with wire mesh.
- B-5 Timber pile bulkhead.

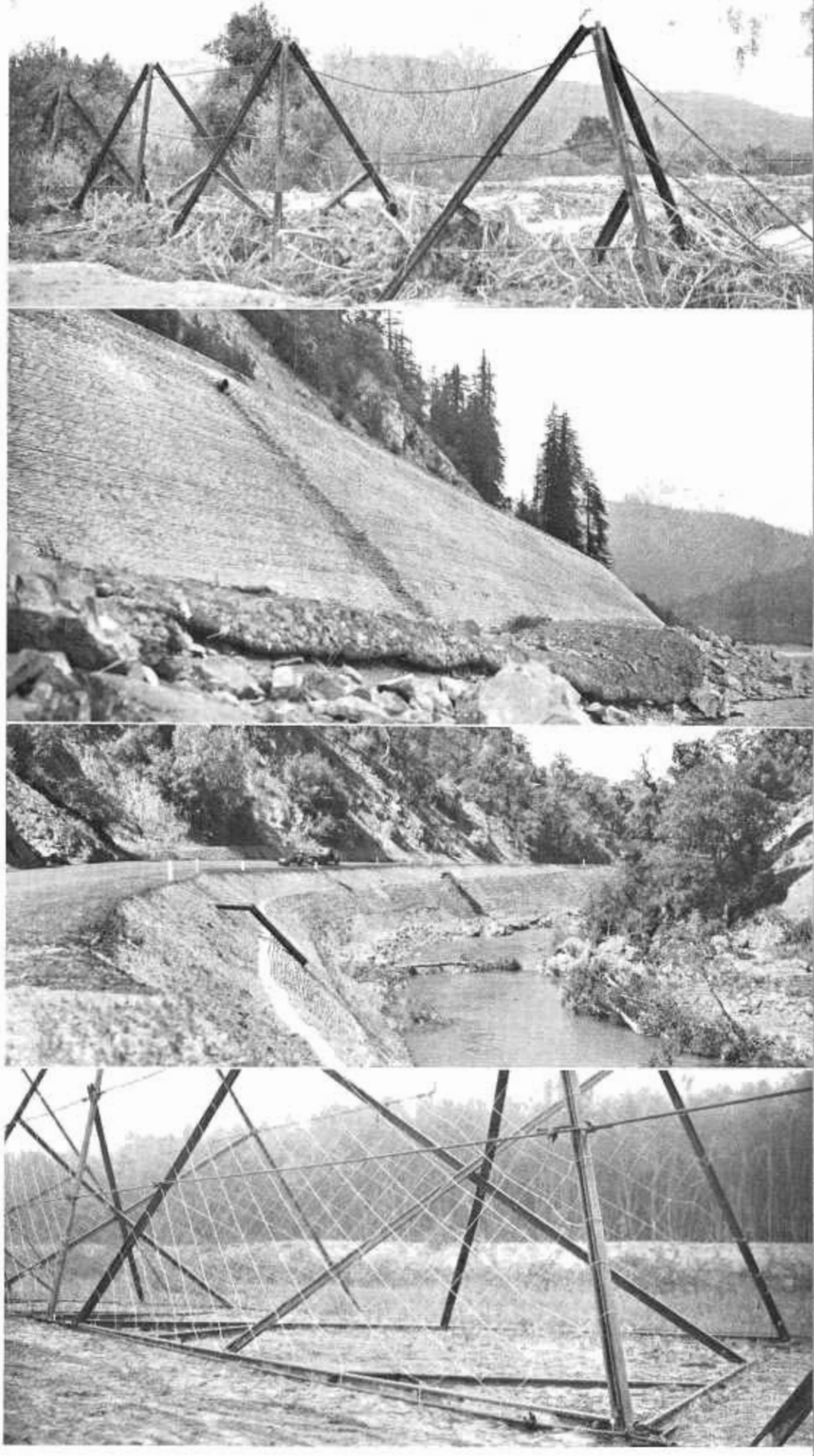
**Class "C"—Permeable flexible types.**

- C-1 Steel tetrahedrons—cable-connected.
- C-2 Concrete tetrahedrons—cable-connected.
- C-3 Steel jackstraws—cable-connected.

**Class "D"—Miscellaneous types.**

With sixteen distinct classified types under consideration that gave varying degrees of service, the field was left wide open for improvement of the older designs of bank protection as well as for development of new designs.

The need for improvement and development is accentuated by state-



From top to bottom—Bank protected by sand bar formed down stream from steel tetrahedron jetty on Santa Clara River, Ventura County. Sacked concrete revetment with wire mesh and rock toe mattress, Eel River, Humboldt County. Sacked concrete revetment on Russian River, Mendocino County. Steel rail tetrahedrons on Salinas River, Monterey County.

ments of the Los Angeles County Flood Control District in their report of May 20, 1938, on the February-March, 1938, flood.

"**From a meteorological point of view, worse conditions are possible and could be expected to produce a storm more intense and of longer duration than that which occurred from February 27 to March 4, 1938.**"

"* * * **it is evident that there is no reason why a situation such as existed on March 2 could not continue for a much longer time interval and therefore cause considerably more rain than occurred then.**"

High mean velocities at peak discharge reported by the Los Angeles County Flood Control District on Southern California streams give some idea of accurate information now available to designers.

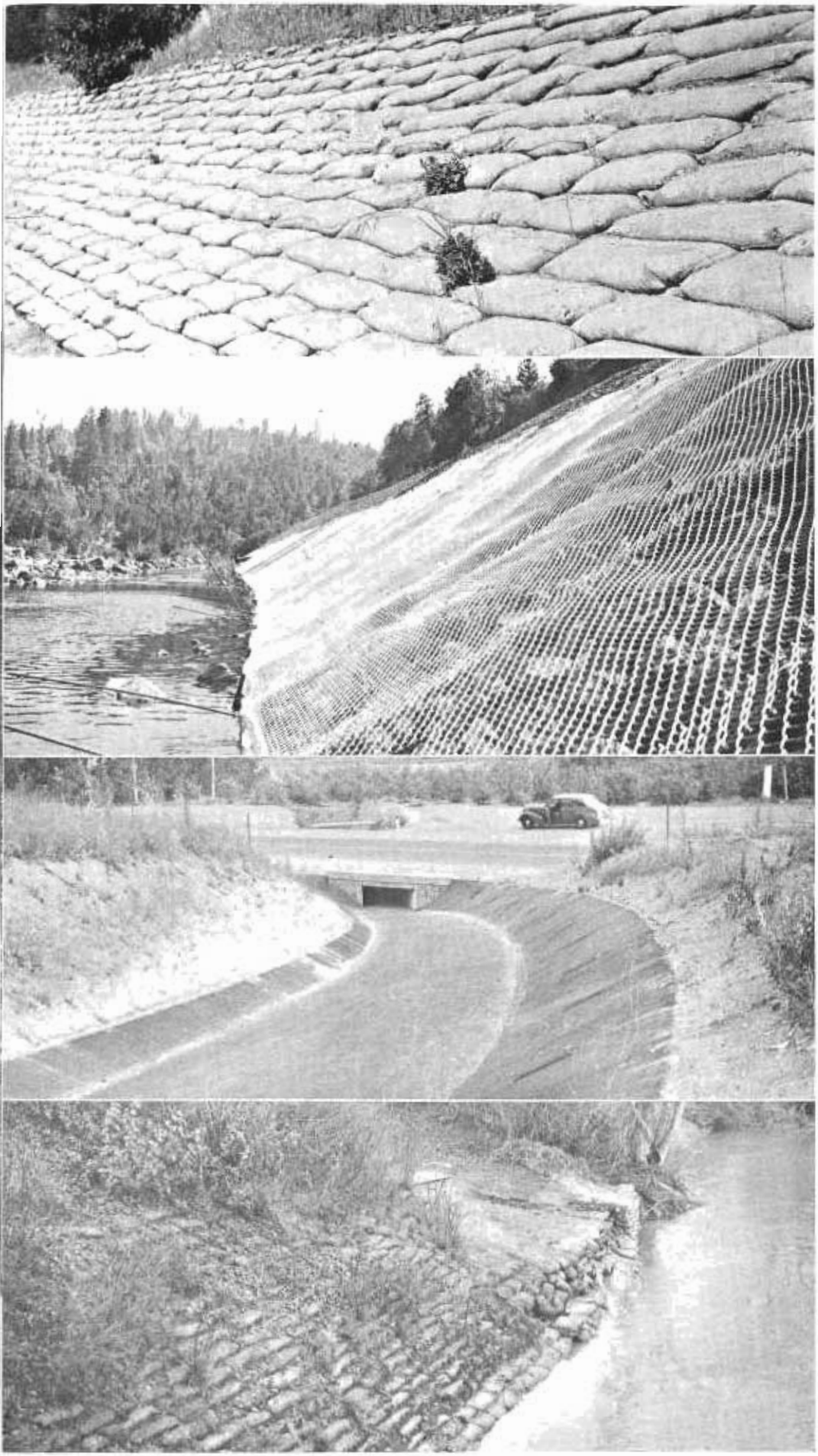
| | Ft. per sec. |
|---|---|
| Los Angeles River at Dayton Ave. | 24 |
| Los Angeles River at Stewart and Gray Road | 15 |
| Los Angeles River at State St. | 14 |
| San Gabriel River at Foothill Blvd. | 17 |
| San Gabriel River at Spring St. | 15 |
| Rio Hondo above Mission Bridge | 13.8 |
| Rio Hondo at Stewart and Gray Rd. | 15.6 |
| Ballona Creek at Sawtelle Blvd. | 12 |

## SERVICE OF CLASS "A" TYPES

### Clean Graded Heavy Rock Riprap

Of all types encountered in the survey, *clean graded heavy rock riprap* proved to be the least vulnerable; the most effective; and in many cases, the most expensive.

Its flexibility and at the same time its ability to resist displacement through the interlocking action of the individual pieces of rock, make this



From top to bottom—Sacked concrete revetment on Grizzly Creek, Lake County. Heavy wire mesh revetment on Cow Creek in Shasta County. Reinforced asphalt concrete channel lining near Fillmore in Ventura County. Sacked concrete in use ten years on the Van Duzen River in Humboldt County.

type especially adaptable to use on embankments that are subjected to the impact of debris-laden high velocity flood waters. Complete success, in common with other types, requires that the toe of heavy rock riprap be founded in a trench at or below anticipated scour. At times of excessive local scour, rock riprap tends to settle or slough without serious damage to the bank or levee and can be readily repaired during or after storms by dumping additional rock from the top of the bank.

Heavy rock riprap on slopes steeper than $1\frac{3}{4}$:1 is subject to serious sloughing when undermined.

Economic selection of this type depends primarily upon the reasonable cost of quarry rock of satisfactory quality, importance of the location, and seriousness of traffic interruption. Cost of heavy rock riprap varies from $0.60 per ton where satisfactory rock can be selected from excavation close to the work, to $2.50 per ton where rock has to be hauled or shipped greater distances.

### Sack Concrete

Sack concrete revetment, in more general use in Northern California, gave excellent service during the December, 1937, storm.

Sack concrete installations consist of bank-run gravel, and in some cases, fine sand, proportioned with cement at the rate of 3 to 4 sacks per cubic yard of mix. The mixture is placed in burlap sacks, tied and laid up in broken-joint tiers with mortar mulch oozing through the mesh of the burlap to form a moderate bond.

Compared to homogeneous types of revetment, sack concrete has the advantage, through arch action, of resisting complete failure even though a portion has been undermined and broken away. Although sack concrete has given satisfactory service on 1:1 slopes exceeding 30 feet in height, it appears advisable to limit installations on 1:1 slopes to 10 feet in height. For greater heights not less than $1\frac{1}{2}$:1 slopes should be used.

The cost of sack concrete on a unit-area basis is second to clean graded heavy rock riprap and varies from $7.50 to $12 per cubic yard, or 30¢ to 40¢ per square foot of revetted surface. Economic selection is dependent primarily upon availability of local materials.

### Asphalt Concrete Mattress

Asphalt concrete mattress installations were comparatively few in California at the time of the 1937-8 storms; **but they gave such promising service under severe test that numerous installations have been made since then. Of the Class "A" types of revetment, asphalt concrete is cheaper than any other type when compared on a unit-area basis; running from 11¢ to 19¢ per square foot.**

Successful installations consist of 6 per cent to 10 per cent Grade "D" asphalt concrete reinforced with heavy-woven wire mesh and anchored with 2-inch galvanized iron pipe driven 5 feet into the prepared slope. Compaction to 3-inch or 4-inch thicknesses is accomplished with hand rollers. The principal advantages of asphalt concrete are: ease of construction, flexibility, low cost, and in so far as can be observed at the time of this writing, low maintenance. From present indications it is probable that a weed killer may be advisable on the subgrade to prevent plant growth from penetrating cracks.

Flexible toe aprons of asphalt concrete that are adjustable to scour have been found through long experience to function successfully.

### Reinforced Concrete Slope Paving

Reinforced concrete slope paving of varying thicknesses from 4 inches to 12 inches suffered badly from undermining of cutoff walls and generally failed en masse when once damaged. Almost invariably the cause of failure could be traced to inadequate depth of cutoff or toe walls.

Reinforced concrete slope paving 4 inches to 6 inches thick is a highly satisfactory type of revetment when adequately anchored to the slope and founded on a cutoff wall designed deep enough to withstand scour. Greater thickness than 6 inches does not appear to be warranted. Cost varies from $8 to $14 per cubic yard of concrete, or 17¢ to 30¢ per square foot per 6-inch thickness including wire mesh.

### Rock and Wire Mattress

Flexible rock and wire mattresses 6 inches to 12 inches in thickness constructed on 2:1 slopes or flatter and protected with adjustable toe aprons of the same type, came through the 1937-8 storms with comparatively little damage.

This type of revetment is adaptable to vulnerable places on wide spreading streams of moderate to high velocities where flat bank slopes do not restrict the channel. Undercutting of the front of the toe mat permits the flexible mattress to adjust itself to a scoured section and retard further disturbance.

Large boulders under the outer edge of the mattress toe tend to hold it up and permit the underlying material to wash away. To prevent scour from penetrating a greater distance under the mattress, large boulders under the toe at the surface should be removed.

Economic selection depends mainly upon availability of selected rock filling and hand labor. The likelihood of corrosion of the galvanized wire mesh should be considered as might

(Continued on page 26)

Toe of gunite facing protected by conformance of articulated concrete block apron to scour on Pacoima Creek, Los Angeles County.

# CONSTRUCTION PROGRESS AND PAVEMENT RECORDS FOR 1938

By EARL WITHYCOMBE, Assistant Construction Engineer

FOUNDATION design continues to occupy the most prominent position in the planning of a project to insure that the support for the roadbed structure and for the pavement is adequate, under any and all seasonal conditions, to carry the designed load without failure.

During grading operations, rock is carefully conserved for use in the strengthening of foundations for embankments and structures. Where such material does not exist in the graded section, borrow from a local source is invariably provided to correct any existing weakness in the native geological structure over which the roadbed is to be constructed.

With the advent of the use of higher standards of grade and alignment in the construction and reconstruction of highways of major importance, the resulting height of cuts and the depth of embankments have taxed the ingenuity of engineers to design adequate foundations for the ever-increasing dimensions of the roadbed structure. Cuts in excess of two hundred feet and embankments in excess of one hundred fifty feet have become quite commonplace. To the deserving credit of the engineers charged with this feature of the design, it may be stated that failures of embankments from foundation weakness have become exceptionally rare in recent work.

State Route 45 through Altamont Pass in Alameda County. Two 22-foot road-mix surface lanes with 4-foot dividing strip.

### SOIL TESTING IMPROVEMENT

Selection of soils within a project for use in the subgrade is being given increased attention. With the establishment of soil-testing laboratories in the district headquarters, the elapsed time between sampling and the return of test data has been materially reduced. This has resulted in a decided improvement in the selection of the most suitable materials.

Standards of design with respect to depth of surfacing and depth of blanketing material for various subsoil conditions, have undergone considerable revision from time to time. The results obtained by the method of testing adopted by the department have been so correlated to service performance that the inequalities of over- and underdesigning have been largely eliminated.

Stabilization with cement, oils, and emulsions has been included in the pavement construction program dur-

State Route 2 near Morgan Hill in Santa Clara County, showing 33-foot asphalt concrete pavement.

ing the past few seasons with the hope of developing data from which a more intelligent analysis can be made of the possible economies that might be effected under certain conditions by the use of this type of foundation improvement.

## Portland Cement Concrete

### CONSTRUCTION METHODS

Automatic proportioning was used largely throughout the season's work to proportion aggregates for concrete paving mixtures. The results obtained in uniformity are very gratifying, and it is proposed to require this method on all major construction projects in the future.

Concrete with five sacks of cement to the cubic yard was used on 76 per cent of pavement construction. With the exception of a one-mile project, the remainder of the work was constructed with six sacks cement to the cubic yard.

A one-mile project in Orange County, between Orange and Olive, Contract 07XC8-87XC31, Road VII-Ora-181-A, was experimental in that the cement content was reduced to four sacks per cubic yard of concrete. During the progress of the work, a further reduction to three sacks per cubic yards of concrete was made on a 500-foot section in each 11-foot lane.

A surface application of sodium silicate was applied to one-half the area of the three-sack concrete to determine the effect of surface hardening. An exceptionally fine sand was used in the low cement content mixtures, and they handled and finished remarkably well.

The ten-day compression tests averaged 2267 pounds per square inch for four-sack concrete and 855 pounds for three-sack concrete.

The twenty-eight-day compression tests averaged 3082 pounds for the four-sack concrete and 1220 pounds for the three-sack concrete.

The ninety-day compression tests averaged 3532 pounds for the four-sack concrete and 1700 pounds for the three-sack concrete.

The seven-day beam tests averaged 506 pounds for the four-sack concrete and 348 pounds for the three-sack concrete. The fourteen-day beam tests averaged 576 pounds for the four-sack concrete and 382 pounds for the three-sack concrete.

In Contract 010TC5, Road X-Mer-4-A, Merced to six miles southerly, was included 403 cubic yards of three-sack concrete in a 5-inch base course for a 2-inch asphalt concrete surface. The average twenty-eight-day compression test of the three-sack concrete on this project was 1230 pounds per square inch.

The greater part of the work constructed last season was finished with the new type mechanical drag finisher, which has given such excellent results. The average roughness for the seventeen projects finished in this manner was 6.9 inches per mile, and for the five projects finished in the ordinary manner, the average was 13.5 inches per mile.

Cotton mats were used to cure some 27.5 miles of concrete pavements during the 1938 season.

### CONSTRUCTION RECORDS

The maximum *average daily output* for portland cement concrete pavement per 8-hour day was placed on Contract 07XC13-87XC34, Road VII-L.A-158-L.A, from San Fernando Road to Brand Boulevard, by Matich Brothers, 461.2 cubic yards being produced per day. C. N. Ainley was resident engineer, with J. F. Mulgrew as street assistant. The average daily output for the entire State was 408 cubic yards during 1938, as compared to 396 cubic yards in 1937.

The *average compressive strength* at 28 days for Class "A" concrete pavement was 4760 pounds per square inch in 1938, as compared to 4470 pounds in 1937, and for Class "B" concrete pavement an average strength of 3890 pounds was obtained in 1938, as compared to 3417 pounds in 1937.

During 1938 the highest average strength for Class "A" concrete pavement was 5667 pounds, obtained on Contract 05TC1, Road V-Mon-2-D, Soledad Bridge approaches, Granite Construction Company, contractor; F. C. Weigel, resident engineer; and S. N. Isham, street assistant. The strongest Class "B" concrete pavement averaged 4706 pounds on Contract 03TC5, Road III-Pla-17-A, Roc., 0.6 mile east of Roseville to Rocklin, Fredericksen & Westbrook, contractor; W. G. Remington, resident engineer; and R. J. Mehren, street assistant.

The record for *cement control* was made on Contract 07XC7-87XC32, Road VII-Ven-138-A, LaCross to Oakview, the average variation being 0.14 per cent.

J. E. Haddock and Crow Bros. were contractors; W. I. Temple-

# PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1938

| Location | Contractor | Resident Engineer | Street Assistant | Average cu. yds. laid per 8-hr. day | Average strength, 28 days, lbs. per sq. in. | Per cent average daily variation in cement | Roughness index, inches per mile |
|---|---|---|---|---|---|---|---|
| At Red Bluff | N. M. Ball Sons | F. N. Drinkall | A. A. Bigelow | 183.5 | 4762 | 1.59 | 22.6 |
| 0.6 mi. E. of Roseville—Rocklin | Fredericksen & Westbrook | W. G. Remington | R. J. Mehren | 444.7 | 4706 | 0.65 | 5.0 |
| Ignacio—San Rafael | A. G. Raisch | W. A. Rice | L. J. Stephenson | 377.0 | 3480 | 2.04 | 13.3 |
| Salinas River Bridge approaches—Soledad | Granite Construction Co. | F. C. Weigel | S. N. Isham | 247.3 | 5667 | 0.45 | 6.5 |
| Easterly boundary—1 mi. N. of Rincon Creek | C. O. Sparks & Mundo Eng. Co. | J. C. Adams | F. C. Weigel | 197.3 | 4207 | 1.30 | 9.1 |
| Trancas Beach—Walnut Canyon | Macco Construction Co. | C. N. Ainley | H. D. Johnson | 441.0 | 4604 | 0.48 | 8.2 |
| Encinal Canyon—Trancas Beach | Macco Construction Co. | C. N. Ainley | H. D. Johnson | 436.2 | 4865 | 0.43 | 8.8 |
| At Big Sycamore Canyon | Macco Construction Co. | F. A. Read | H. D. Johnson | 419.0 | 5084 | 0.78 | 8.3 |
| Philadelphia Street—Painter Avenue | Geo. R. Curtis Co. | W. J. Calvin | J. R. Rubey | 323.7 | 4281 | 0.93 | 13.2 |
| 0.4 mi. E.—0.8 mi. E. of Huntington Beach | Griffith Company | C. L. Gildersleeve | H. D. Johnson | 288.7 | 4450 | 0.78 | 6.1 |
| LaCross—Oakview | J. E. Haddock & Crow Bros. | W. I. Templeton | H. D. Johnson | 447.7 | 3830 | 0.14 | 7.6 |
| Orange—Olive | Vido Kovacevoch | F. B. Cressy | C. J. McCullough | 297.6 | 3082 | 0.99 | 6.0 |
| Valley Boulevard—Las Tunas Drive | J. E. Haddock, Ltd. | R. J. Hatfield | H. D. Johnson | 398.6 | 4587 | 0.44 | 4.0 |
| Fair Oaks Av., S. Pas.—Glenarm St., Pas. | J. E. Haddock, Ltd. | R. J. Hatfield | C. J. McCullough | 380.3 | 4865 | 1.55 | 7.2 |
| Sepulveda Blvd., San Fernando Rd.—Brand Blvd. | Matich Bros. | C. N. Ainley | J. F. Mulgrew | 461.2 | 4439 | 0.40 | 9.0 |
| L. A. County Line—Colton | Matich Bros. | C. V. Kane | Warren Ford | 455.4 | 3623 | 0.53 | 5.1 |
| New Avenue, Redlands—Crystal Springs | Claude Fisher Co. | E. A. Bannister | B. Nelson | 440.0 | 3955 | 0.32 | 11.3 |
| Jahant Corner—1 mi. N. of Galt | Fredericksen & Westbrook | A. K. Nulty | F. L. Lucas | 451.9 | 3760 | 0.52 | 6.1 |
| Modesto—Salida | Fredericksen & Westbrook | R. H. Lapp | J. C. Witherell | 455.0 | 4098 | 0.51 | 5.1 |
| 6 mi. S. of Merced—Merced | Hanrahan Company | G. R. Hubbard | H. S. Marshall | 436.6 | 3619 | 0.83 | 4.8 |
| San Onofre—Northerly County Line | B. G. Carroll | F. D. Pearce | L. B. Munro | 326.0 | 4390 | 0.20 | 8.8 |
| Barnett Avenue—Miramar Road | David H. Ryan | F. D. Pearce | G. S. Kibby | 388.0 | 4061 | 1.50 | 17.4 |
| | | | Averages | 408.0 | 4760(A) 3890(B) | 0.72 | 7.8 |

# ASPHALT CONCRETE PAVEMENT RECORDS FOR 1938

| Location | Contractor | Resident Engineer | Street Assistant | Average tonnage laid per day | Average stability of surface mixture in per cent | Average relative Gravity of surface mixture in per cent | Roughometer index, inches per mile |
|---|---|---|---|---|---|---|---|
| Delevan—Logandale | Hanrahan Company | H. O. Ragan | H. A. Towne | 1048.0 | 24.0 | 92.0 | 14.5 |
| Coyote—Llagas Creek | Jones & King | H. S. Payson | P. M. Morrill | 1037.0 | 37.1 | 91.9 | 12.9 |
| Ignacio—San Rafael | A. G. Raisch | W. A. Rice | L. J. Stephenson | 387.0 | 29.3 | 92.6 | 23.2 |
| Hanford—Alcorn Bridge Corner | Piazza & Huntley | J. R. Hayes (County) | P. A. Boulton | 689.0 | 44.5 | 92.3 | 14.6 |
| At Selma | Union Paving Co. | F. W. Howard | E. Thomas | 510.0 | 35.0 | 92.8 | 9.8 |
| 1 mi. N. of Grapevine Sta.—10 mi. S. of Bakersfield | Griffith Company | D. G. Evans | W. M. Nett | 578.0 | 34.0 | 93.3 | 13.3 |
| Tustin Avenue at 17th Street | C. O. Sparks & Mundo Eng. Co. | F. B. Cressy | H. B. Lindley | 382.3 | 47.0 | 90.0 | 11.0 |
| Pasadena Ave.—Avenue 22 | Bebek & Brkich | E. A. Parker | L. F. Phillips | 349.0 | 32.4 | 93.7 | 17.6 |
| Fair Oaks Ave., S. Pas.—Glenarm St., Pas. | J. E. Haddock | R. J. Hatfield | W. C. Winkler | 577.3 | 28.8 | 93.5 | 13.1 |
| Sepulveda Blvd., San Fernando Rd.—Brand Blvd. | Matich Bros. | C. N. Ainley | J. F. Mulgrew | 369.0 | 41.0 | 94.0 | 26.5 |
| Intersection Firestone Blvd. and Santa Fe Ave. | Griffith Company | C. P. Montgomery | J. R. Rubey | 255.0 | 35.0 | 95.7 | 14.6 |
| West. Bndry.—San Bernardino (widening) | United Concrete Pipe Corp. | J. M. Hollister | J. A. Hutchinson | 673.0 | 40.4 | 95.5 | 19.0 |
| Los Angeles County Line—Colton | Matich Bros. | C. V. Kane | W. Ford | 707.0 | 28.0 | 96.7 | 13.4 |
| Barnett Avenue—Miramar Road | David H. Ryan | F. D. Pearce | E. C. Dodson | 660.0 | 27.0 | 94.2 | 16.4 |
| | | | Averages | 660.0 | 35.4 | 93.5 | 15.3 |

ton, resident engineer; and H. D. Johnson, street assistant.

The average variation for the State during 1938 was 0.72 per cent, as compared to 0.81 per cent for the year 1937.

The record for *surface smoothness* was made on Contract 07XC6-87XC30, Road VII-L.A-168-C, Valley Boulevard to Las Tunas Drive, with an average of 4.0 inches of roughness per mile.

J. E. Haddock, Ltd., was the contractor; R. J. Hatfield, resident engineer; and H. D. Johnson, street assistant.

The average for the State in 1938 was 7.8 inches per mile, as compared to 8.2 inches per mile for the year 1937.

## Asphalt Concrete

### CONSTRUCTION METHODS

One entire project in 1938 was constructed with asphalt of a penetration ranging from 101 to 120 and consisted of 19 miles of 22-foot pavement on

# BITUMINOUS TREATED SURFACES, RECORDS FOR 1398

## Plant-mix

| Location | Contractor | Resident Engineer | Roughness Index Inches per mile |
|---|---|---|---|
| At Greenlaw Bluffs | Harold Smith | W. H. Chase | 38.4 |
| Southerly Boundary—Hopland | Hanrahan Company | C. M. Butts | 26.9 |
| Stegemeyer Bluffs—Myers | Hemstreet & Bell | H. M. Hansen | 29.6 |
| Nubieber—8.5 mi. NE. of Bieber | Poulos & McEwen | H. K. Ward | 19.4 |
| Coppervale—Susan River | Mountain Construction Co. | C. A. Potter | 30.2 |
| 1¼ mi. W. of El Dorado—Clark's Corner | Hemstreet & Bell | H. F. Sherwood | 25.0 |
| Tarke—1 mi. S. of Sutter City | Hemstreet & Bell | W. G. Remington | 22.8 |
| Mountain House—Contra Costa County Line | Geo. French, Jr. | S. W. Brackett | 46.8 |
| 1.5 mi.—3.9 mi. SW. of Sebastopol | Embleton-Schumacher | E. Carlstad | 75.3 |
| Ignacio—San Rafael (por.) | A. G. Raisch | W. A. Rice | 32.7 |
| San Luis Obispo Creek—Cuesta Siding | Metropolitan Construction Co. | V. E. Pearson | 18.1 |
| Guadalupe—Santa Maria | Basich Bros. | H. J. Doggart | 30.3 |
| 1.8 mi. W. of Merryman—Yokohl | N. M. Ball Sons | C. F. Oliphant | 40.5 |
| Morton St.,—Mulberry St., Porterville | N. M. Ball Sons | C. F. Oliphant | 50.6 |
| Trancas Beach—Walnut Canyon | Macco Construction Co. | C. H. Ainley | 15.2 |
| Trancas Beach—Encinal Canyon | Macco Construction Co. | C. H. Ainley | 13.9 |
| Near Oso Creek | C. O. Sparks & Mundo Eng. Co. | W. D. Eaton | 18.0 |
| Near Galivan | V. R. Dennis Const. Co. | W. D. Eaton | 17.1 |
| Valley Blvd.—Las Tunas Drive | J. E. Haddock | R. J. Hatfield | 10.6 |
| 190th St.—Lomita Boulevard | Griffith Company | F. B. Cressy | 14.3 |
| Sepulveda Blvd., San Fernando Road—Brand Blvd. | Matich Brothers | C. N. Ainley | 27.5 |
| Fair Oaks Ave., S. Pas.—Glenarm St., Pas. | J. E. Haddock, Ltd. | R. J. Hatfield | 12.2 |
| Route 60—¾ mile northerly | State Forces | L. R. McNeely | 26.8 |
| 2 mi. S. of San Bernardino County Line—Beaumont | Oswald Bros. | E. A. Bannister | 17.1 |
| Through Mojave | S. A. Cummings | M. W. Ellis | 20.2 |
| Diaz Lake—Alabama Gates | Basich Bros. | J. N. Stanley | 12.0 |
| Southerly Boundary—5 mi. N. of Rosamond | G. W. Ellis | F. R. Pracht | 9.2 |
| 2.5 mi. E. of Valley Springs—San Andreas | Piazza & Huntley | R. J. Munro | 19.2 |
| Douglas St., Eagle St.—University Ave. | V. R. Dennis Co. | C. R. Hagberg | 15.8 |
| 1 mi. S. of San Onofre—North County Line | B. G. Carroll | F. D. Pearce | 16.7 |
| Brawley—Mulberry Avenue | R. E. Hazard & Sons | R. C. Payne | 12.2 |
| Holtville—Brawley | G. W. Ellis | C. R. Hagberg | 24.9 |
| On E. Main St., 5th St., 6th St. | G. W. Ellis | W. T. Rhodes | 25.4 |
| | | Average | 23.5 |

## Road-mix

| Location | Contractor | Resident Engineer | Roughness Index Inches per mile |
|---|---|---|---|
| Spanish Creek—Quincy | Harms Bros. | R. L. Gerry | 38.2 |
| Route 28, 1.0 mi. NE. of Bieber—2.5 mi. N. | Poulos & McEwen | H. K. Ward | 20.4 |
| At China Gulch | Lee J. Immel | J. C. Young | 31.0 |
| Cougar—Macdoel | Oilfields Trucking Co. | R. E. Ward | 26.1 |
| 7.0 mi. W.—10.5 mi. W. of Willows | Lee J. Immel | P. C. Sheridan | 103.0 |
| 3 mi. N. of Esparto—NE. Cor. of Rancho Guesisosi | Claude C. Wood | H. C. Looze | 62.2 |
| Mountain House—Greenville | Granfield, Farrar & Carlin | L. G. Marshall | 20.2 |
| Atascadero Summit San Gabriel Ave. | Geo. K. Thompson & Co. | H. J. Doggart | 32.4 |
| Los Olivos | Macco Construction Co. | A. L. Lamb | 45.6 |
| Paicines—Tres Pinos | N. M. Ball Sons | F. C. Weigel | 44.4 |
| Lake Arrowhead Dam—Junction Route 43 | State Forces | G. E. Malkson | 22.0 |
| At Independence | Basich Bros. | J. N. Stanley | 19.3 |
| 1.5 mi. W. of Bishop—Bishop | Basich Bros. | M. W. Ellis | 19.2 |
| W. City Limits, Bishop—Main St. | Basich Bros. | M. W. Ellis | 19.2 |
| S. Fork Mokelumne River—Herbert's Ranch | Garcia Construction Co. | L. E. Ford | 131.1 |
| New River—2 mi. W. of Calipatria, 5 mi. W.—2 mi. W. of Brawley | R. E. Hazard & Sons | R. C. Payne | 39.9 |
| | | Average | 38.7 |

## Miscellaneous Types

| | | | |
|---|---|---|---|
| Ben Ali—U. S. Airport | A. Teichert & Son (Armor Coat) | R. B. Vernon | 130.5 |
| 0.7 mi. N. of Biggs—Route 45 | Chas. Kuppinger (Armor Coat) | W. W. Greer | 849 |
| N. line of Las Uvas Rancho—Croy Road | Bodenhamer Const. Co. (Armor Coat) | H. H. Deardoff | 93.4 |
| San Geronimo—1 mi. N. of Fairfax | Granfield, Farrar & Carlin (Armor Coat) | B. Van Dalsam | 32.9 |
| Over Welby Hill | Granite Construction Co (Rock Asphalt) | L. L. Lenger | 28.1 |
| 1.7 mi. E. of Los Banos—Easterly Bdy. | Fredericksen & Westbrook (Armor Coat) | E. W. Ray | 28.4 |
| Oakville—Calistoga | Rock & Gravel Trucking Co. (Armor Coat) | R. Engelking | 150.7 |
| | | Average | 83.0 |

Contract 06VC3-86VC4, Road VI-Ker-4-A,B,C, from one mile north of Grapevine Station to ten miles south of Bakersfield, connecting on the north with the experimental project of 1937. Griffith Company was the contractor; D. G. Evans, resident engineer; and W. M. Nett, street assistant, the same contractor and State personnel that constructed the adjoining experimental section in 1937. The technique for laying high penetration mixtures

on this project was worked out under the direction of Mr. Evans. Variations in the grading of aggregate were tried out on this project with the object of improving stability and surface texture. It was found that a reduction in added commercial filler to 3 per cent and a passing 10-mesh content of 28 per cent, considerably improved the stability results and gave a surface texture much more desirable than the average grading of a Type "A" surface mixture and at the same time was impermeable with the softer grade of asphalt. The same relative amount of asphalt to the coarse and fine aggregate was maintained in all of the mixtures.

*Automatic proportioning* has become standard procedure for all major asphalt concrete projects, and all of the 1938 contracts with any sizeable tonnage employed this method. Automatic proportioning equipment has been perfected to such accuracy that errors in the payment weights over truck scales have been detected and corrections made upon comparing the weights obtained by the two methods. The average daily output has been materially increased from plants equipped with automatic proportioning.

The amount of asphalt used in the mixture continues to be varied on the basis of the particular characteristics of the binder being used, and since this practice was put into effect, the uniformity of performance of the various projects has been greatly improved. It is the present tendency to use as much asphalt as is possible, compatible with stability results. In so far as is evident at the present time, the same relative amount of the higher penetration asphalt is required as was used of the 40-60 penetration.

Coast Highway near Big Sycamore Canyon, Ventura County. Two 22-foot portland cement concrete pavement lanes separated by a 6-foot plant-mix center strip.

## CONSTRUCTION RECORDS

The highest *average daily output* of asphalt pavement tonnage since 1932 was placed on Contract 03TC2, Road III-Col, GLe-7-C,A, between Delevan and Logandale, where 1048 tons were placed by Hanrahan Company, contractor; H. O. Ragan was resident engineer; and H. A. Towne, street assistant. Another project averaging in excess of 1,000 tons per day was Contract 04TC5, Road IV-SC1-2-B,C,MgH, between Coyote and Llagas Creek, where Jones & King, contractor, placed an average of 1037 tons per day. H. S. Payson was resident engineer and P. M. Morrill, street assistant. The average daily output for the State in 1938 was 660 tons, as compared to 550 tons in 1937.

The highest *stability of surface mixture* was obtained on Contract 07XC5, Road VII-Ora-43-A, between Tustin Avenue and 17th Street, where the average was 47 per cent. Sparks & Mundo Engineering Company was the contractor; F. B. Cressy, resident engineer; and H. B. Lindley, street assistant. The average stability for the State was 35.4 per cent in 1938, as compared to 36 per cent in 1937.

The *densest surface mixture* was placed on Contract 08XC1, Road VIII-SBd-26-C,D,Ria,Col, between Los Angeles County Line and Colton, where the average relative specific gravity was 96.7 per cent. Matich Bros. was the contractor; C. V. Kane, resident engineer; and W. Ford, street assistant. The average for the State in 1938 was 93.5 per cent, as compared to 94.6 per cent in 1937.

The record for *surface smoothness* was secured on Contract 06TC1, Road VI-Fre-4-A,Sel, at Selma, on which the average was 9.8 inches per mile. The contractor was the Union Paving Company; F. W. Howard was resident engineer; and E. Thomas, street

Divided four-lane highway on Coast Route at Trancas Beach, Ventura County, consisting of an 11-foot interior lane of plant-mixed surfacing and a 12-foot lane of concrete on each side of a 4-foot planted and curbed division strip.

assistant. The average for the State in 1938 was 15.3 inches per mile, as compared to 15.5 inches in 1937.

## Bituminous Treated Surfaces

The plant-mix type maintains the lead in mileage placed in 1938, with a total of 116.5 miles, as compared to 92 miles of road-mix.

Traveling mixers performed nearly all of the road-mixing during 1938. The efficiency of mixing with these machines has on the whole been excellent. The road-mix method of construction does not permit the accuracy of oil control or the uniformity of grading of the aggregate, as compared to plant-mix, but it does have a definite place in construction of secondary highways.

The tendency toward the use of plant- and road-mixes on major highways as stage construction, is becoming more pronounced from year to year. This type of construction has in many similar locations given remarkable service in the past.

About 26.5 miles of armor coat oil surfacing was constructed in 1938 under supervision of the Construction Department, and a one-mile project of native-rock asphalt.

The record for surface smoothness of plant-mix, 9.2 inches per mile, was made on Contract O9VC4, Road IX-Ker-23-A, between Southerly Boundary and 5 miles north of Rosamond. G. W. Ellis was the contractor and F. R. Pracht, the resident engineer. The average for the State was 23.5 inches per mile in 1938, as compared to 28.6 inches in 1937.

The record for surface smoothness of road-mix, 19.2 inches per mile, was duplicated on two adjoining projects, Contracts O9XXC4 and O9XXC6, Roads IX-Inv-76-B,Bis and IX-Iny-76-Bis, from 1.5 miles west of Bishop to Bishop and from West City Limits of Bishop to Main Street. Basich Bros. was the contractor on both projects and M. W. Ellis was resident engineer. The average for the State in 1938 was 38.7 inches per mile, as compared to 31.6 inches in 1937.

The record for surface smoothness of armor coat work, 28.4 inches per mile, was made on Contract O1OWC3-61OWC9, Road X-Mer-32-C, between 1.7 miles east of Los Banos and Easterly Boundary. Fredericksen and Westbrook was the contractor and E. W. Ray, resident engineer. This record is considered exceptional for armor coat work.

The native-rock asphalt project gave an average smoothness of 28.1 inches per mile and was constructed under Contract 05TC2-85TC5, Road V-Mon-2-F, over Welby Hill, by Granite Construction Company, contractor, with L. L. Lenger, resident engineer.

# Proposed Transcontinental Toll Highways Opposed by U. S.

TRANSCONTINENTAL toll superhighways are neither needed nor are they feasible at this time, U. S. Bureau of Public Roads officials declare. Views of the federal road experts are revealed in recent statements of Thomas H. MacDonald, chief of the bureau, and of H. S. Fairbank, chief of the Bureau's Division of Information.

Testifying before a House subcommittee on appropriations, Mr. MacDonald said, "We definitely recommend against a system of transcontinental toll highways. Our position is, as we have been convinced through the years, that highways should first be developed to take care of local traffic. Our long distance highways should be extensions of these local roads.

"Transcontinental superhighways to be constructed and maintained by tolls have been proved illogical."

# New Divided Approach to City of Merced Solves Flood Problem

By R. E. PIERCE, District Engineer

ANOTHER unit of four-lane divided highway on U. S. 99, Golden State Highway, has been completed, extending for 5.7 miles southeasterly from Merced.

Due to a series of wet winters and changed conditions caused by irrigation ditches and other factors, the highways in the vicinity of Merced have been flooded for four consecutive winters, beginning with 1935. This recurrent flooding and the inconvenience and hazard to the traveling public has been the cause of much concern.

U. S. 99 was the most immediate problem, carrying as it does a heavy local and through traffic, which was seriously inconvenienced, due to the depth of the flood waters, making it necessary to detour traffic many miles out of direction for considerable periods.

### HIGHER GRADE BUILT

Thought was first given to raising the grade of the existing road and enlarging the drainage structures. However, the volume of traffic indicated the necessity of additional traffic lanes, and plans were therefore made for an entirely new grade adjacent to and northeasterly from the old road, built high enough to clear the highest observed flood, and with drainage structures generally equaling the size of those through the Southern Pacific railroad grade which is adjacent to, parallel with, and to the southwest of the old road.

It was also considered necessary to construct some new drainage structures in the old road opposite those on the new road in order to allow for free passage of flood waters and avoid damage to the old road.

Due to lack of finances, it was impossible to eliminate all the flooded stretches; so the first project was planned to care for the worst portion, extending from Merced southeasterly for 5.7 miles.

The project now completed will be, in effect, a four-way divided highway most of the time. During extreme floods, there may be periods of a few days when the old road will be closed, and traffic will use the new high grade as a two-way road, until the flood waters subside.


View of new Merced highway, on right, showing its elevation to escape flood waters. Old highway on left.

Another view of Merced highway, showing difference in grade between new road, right, and old road, left.

The work, in general, on this project consisted of widening the existing roadbed and building a new roadbed above the flood plane; constructing portland cement concrete pavement; placing asphalt concrete surface course on a short section with portland cement concrete base; placing plant-mixed surfacing and untreated crushed gravel or stone surfacing; constructing borders of untreated crushed gravel or stone surfacing adjacent to the newly constructed pavements, and placing asphalt concrete transitions from the new pavement to the existing pavement.

Reinforced concrete bridges were constructed on both the new and old roads. Penetration oil treatment was applied to borders, shoulders, and road approaches, and many other minor items of work were done.

There is, in general, a 21-foot horizontal separation between the old and the new pavements, with cross-overs between the two pavements limited to county roads.

### IMPROVED DRAINAGE

Under agreement with the Southern Pacific Company, improvements were made in the drainage between the highway and the railroad, by means of ditches and levees which to some extent will prevent the flooding of the old road during moderate flood runoff.

Portland cement concrete curb islands at the south and north ends of the project are used to aid in traffic channelization. These islands are lighted with mercury vapor 250-watt lights. Standard reflectors and flashers are installed in the face of the curbs.

Native soil being of adverse nature, it was necessary to import satisfactory material for subbase and subgrade.

The improvement consisted generally of constructing a graded roadbed 36 feet wide with Class "B" portland cement concrete pavement 23 feet wide and .55 feet thick with thickened edges in the outer 2 feet and providing for 11-foot and 12-foot traffic lanes. Crushed gravel borders 2 by 5 feet, after compaction, are built on each side of the pavement.

Imported borrow with a minimum thickness of 1 foot at center line has been placed throughout the entire length of the project. Shoulders and slopes are oil treated. At the approach to the city of Merced, the pavement is asphaltic concrete with all other details the same as the portland cement concrete pavement.

### ITEMS OF CONSTRUCTION

The construction provided for: three new bridges on both the new and old roads, six new bridges on the new road only, one bridge on the old road lengthened, four reinforced concrete culverts on both new and old roads, two reinforced concrete culverts on the new road only, one reinforced concrete culvert on the old road increased in size, and four irrigation siphons extended across the new road.

With the exception of imported borrow, all road materials were commercial products.

The major construction items and approximate quantities are as follows:

| | |
|---|---|
| Imported borrow | 145,000 cu. yds. |
| Reinforcing steel | 617,000 lbs. |
| Class "A" portland cement concrete (strs.) | 2,650 cu. yds. |
| Class "B" portland cement concrete (pvmt.) | 12,600 cu. yds. |
| Asphaltic concrete | 3,600 tons |
| Untreated crushed gravel or stone | 10,000 tons |
| Pavement dowels and/or tie bolt assemblies | 24,000 each |

The finished work cost approximately $355,000.

# Restoring Cajon Pass Highway

By A. EVERETT SMITH, Assistant Highway Engineer

CONSTRUCTION work is progressing on portions of State Highway between Devore and Camp Cajon. This is a link common to both the National Old Trails Highway and the Arrowhead Trail Highway. It leads over mountainous terrain and through the Cajon Pass.

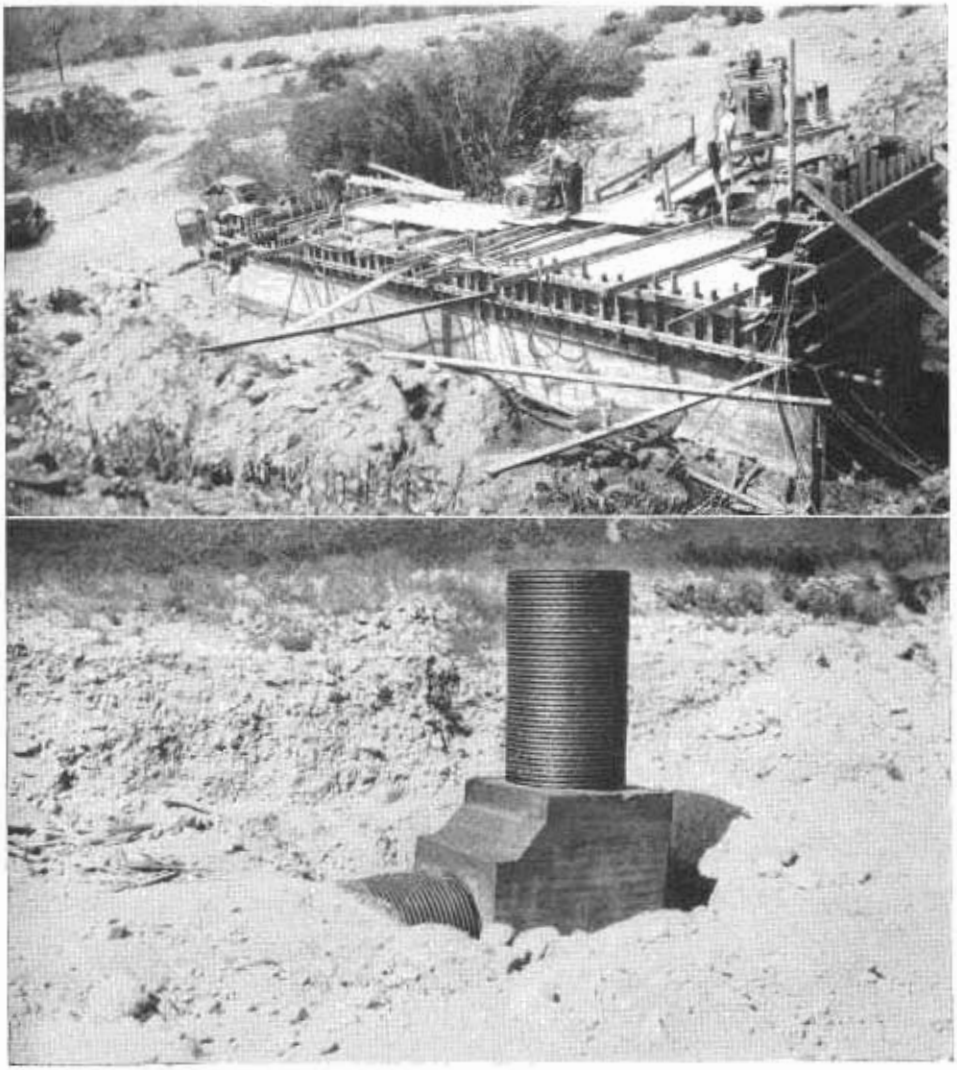
The work was made necessary by the flood of March, 1938, and is of a restoration nature.

During the flood period high velocity runoff water from the adjacent mountains carried great quantities of sand, gravel and boulders. In numerous cases this material was deposited in stream channels above drainage structures, raising the streambed above the structures.

An accompanying picture shows a chimney type inlet designed to admit drainage to a culvert. The top of the chimney is at the approximate new elevation of the streambed.

At a location known as the Blue Cut the flood waters raised the bed of Cajon Creek and washed out the portion of the roadway that was in embankment. To prevent a reoccurrence, the roadway alignment was shifted farther into the hill so that the entire roadway will be in a cut section of rocky material.

Other work in connection with this project involved minor line changes, correction of and placing new drainage structures and constructing metal cribbing retaining walls. At some locations, ditches and dikes are designed to control drainage runoff. Plant-mixed surfacing is to be placed throughout the project, to conform to the existing road.



Top—Reinforced concrete box culvert being constructed where Cajon Pass highway is on new alignment. Bottom—Chimney type inlet to corrugated metal pipe culvert on new Cajon Pass highway.

## Awards to Contractors for Roadside Development Projects Planned

IN ORDER to stimulate interest among highway contractors in roadside-development projects along State highways throughout the country, *Contractors and Engineers Monthly* announces the first of a series of annual awards to contractors or their superintendents for excellence of execution of roadside-developments, or for the best suggestions for more effective methods to achieve better results or greater economies on such projects.

An award of an engrossed certificate will be made in each of the four geographical sections, East, South, Central and West, and one of the winners in one of these sections will receive the national award of an engraved trophy as evidence of his outstanding contribution to better roadsides in the United States.

Nominations for the awards will be made by State highway departments in each State and must be submitted before September 15. Each State will

(Continued on page 26)

# Benefits of Gas Tax Expenditures Within Cities Are Enumerated

By L. V. CAMPBELL, Engineer of City and Cooperative Projects

**Following is the text of an address delivered by L. V. Campbell, Engineer of City and Cooperative Projects of the Division of Highways before the Monterey Bay Area Division of the League of California Municipalities meeting at Salinas, June 14, 1939.**

THE allocation of a specified amount of gas tax revenue for expenditure within cities has been in effect almost six years. Originally, the expenditure was limited to the designated State highway routes within cities. Two years later the act was amended to increase the amount and extend the use of the funds to streets of major importance other than State highways as may be agreed upon between the city and the State Department of Public Works. Prior to this time expenditures of gas tax funds by the State within cities were budgeted for specific projects by the Highway Commission. Projects were generally selected in those municipalities which cooperated financially in the improvement, except in the case of the lesser populated cities. As a consequence many urgently needed projects within cities had to be omitted due to lack of financial cooperation, and expenditures were not uniformly distributed among the cities.

The amounts thus budgeted by the Commission for expenditure in cities would average close to the amount derived from ¼ cent of gas tax revenue. It must be remembered that of the three-cent State gas tax, two cents were expended by the State and one cent was apportioned to the counties for expenditure by the supervisors upon county roads. At that time the State expenditure both in municipalities and rural areas, was limited by statute to those roads which were officially designated as State highways. There was no specific mandate in the law requiring the department to extend the State highways into or through municipalities, and as a consequence, the Highway Commission generally halted the State highway at the corporate limits.

Six years ago, however, brought a different, more comprehensive and surely a more equitable view of the situation. This view contemplates a State highway system, not as a disjointed system of roads terminating at the corporate limits, but as a system

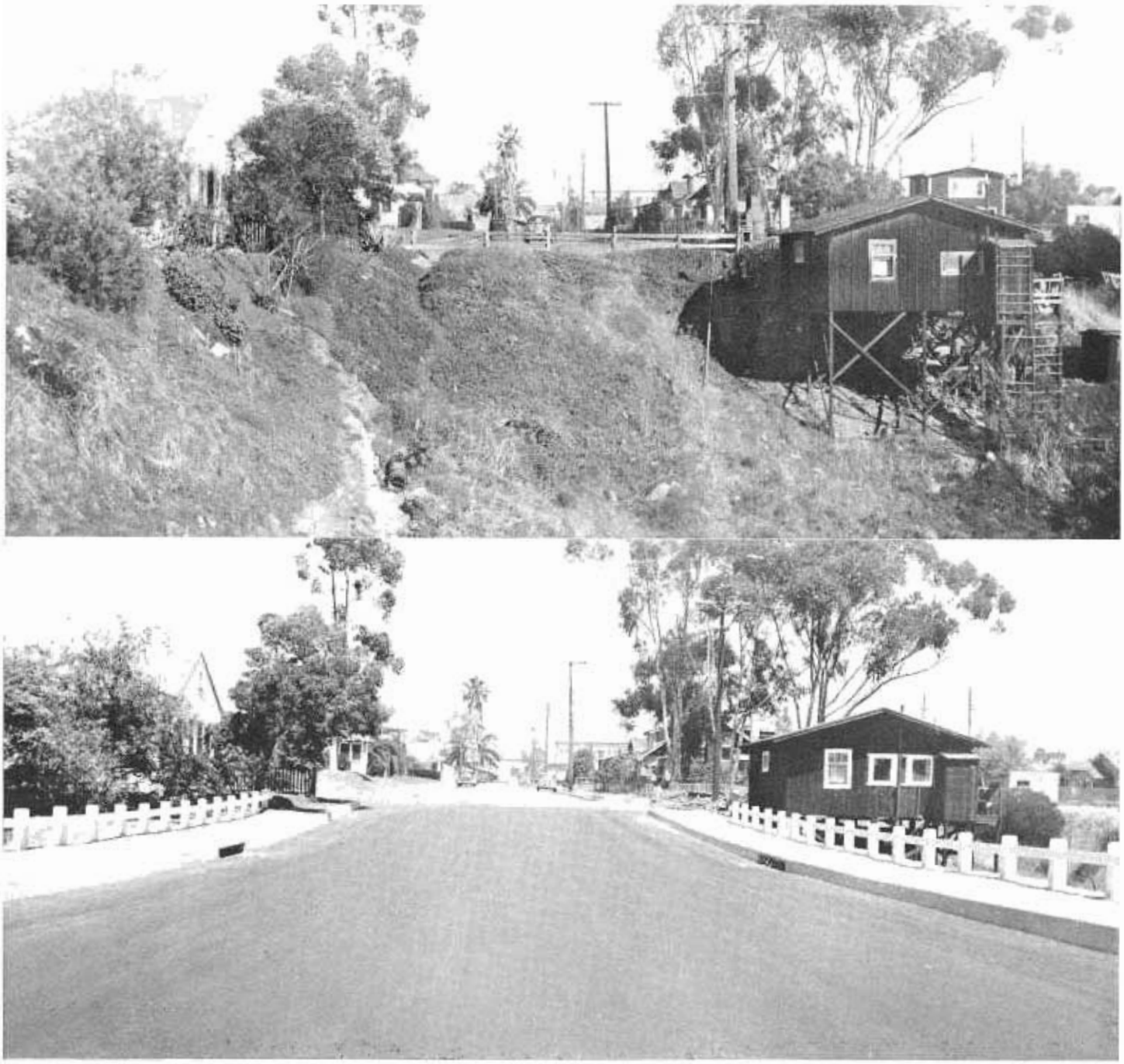
L. V. CAMPBELL

that should provide a continuous route improved to State highway standards through the city. Heretofore the motorist found himself, you might say, deserted at the city limits and confronted with the difficult problem of navigating his passage through a city which for many reasons did not possess the resources to provide an adequate standard of street improvements. Besides this condition. the motorist was compelled to depend upon himself to find his way through the city. This he found in many cases, however, was the preferred procedure, for when the route was marked by signs he followed the course decided upon by local influence and frequently meandered by devious ways with many turns past the town's commercial enterprises, parks, fountains and streets.

Such conditions, however, with the aid of the ¼ cent gas tax and the splendid cooperation of the cities, have been or rapidly are being corrected. State highways leading into and through municipalities have been selected and adopted following the most expeditious routes through each city in the State. These routes are marked with mileage and directional signs and in many cases with State route markers and U. S. route shields with which all motorists are acquainted and which serve to guide the motorist through the complexities of strange cities.

The allocation of gas tax revenue to cities, as all of you well know, provides one quarter cent for expenditure upon State highway routes within cities and one quarter cent for expenditure upon streets of major importance within cities other than State highways. Of the 285 incorporated cities in California, the State highway passes into or through 253 of them. The remaining 32 cities may expend the ¼ cent allocated for State highways upon streets of major importance.

Furthermore, when all State highways within a city are improved to adequate standards and provision made for their maintenance, any surplus of the quarter cent allocated for State highways may likewise



These two views vividly show what the City of San Diego was able to do with ¼ cent city street gasoline tax funds. The picture at the top shows the site of the Douglass Street extension before construction. The one at the bottom shows the extension after completion. Both photographs were taken from the same spot. The slope at the left of the house in the upper picture was filled in to make the grade shown in the picture below.

be expended upon streets of major importance.

One quarter cent of gas tax revenue will yield in round figures four million dollars per year. Thus, under the gas tax allocation there are four million dollars per year expended upon State highway routes within cities and another four million dollars per year expended upon city streets other than those constituting the designated State highway routes within cities. This makes a total of eight million dollars expended annually upon the State highways and other streets of major importance within cities.

When it is realized that seventy-five per cent of the people living in California reside in incorporated cities, it is readily seen that the benefit of the expenditure of the gas tax funds within cities is brought to the front door of a large block of the State's population. What this means to the urban taxpayer may be better understood when it is realized that this

amount of money represents a tax rate of 16.86 cents per one hundred dollars of assessed valuation within cities. From data contained in the annual report of financial transactions of municipalities and counties, published by the State Controller, I have calculated that the average tax rate of all cities within the State amounts to $1.915 per one hundred dollars of assessed valuation.

According to the State Controller's report above mentioned, the total expenditure by municipalities during the fiscal year ending 1937 upon highways, roads, and streets within municipalities, in round figures amounted to $20,746,000. This figure is analyzed as follows: General administration, $2,780,000; maintenance of streets, bridges, etc., $10,583,000; prevention of street dust, $225,000; street lighting, $3,343,000; other street structures $582,000; outlays, $3,233,000. Excluding the cost of street lighting, the net amount expended upon streets and roads attributable as a direct benefit to vehicular traffic amounts to $17,403,000. The cost of street lighting is excluded from the total for purposes of comparison, since the use of gas tax funds for street lighting is prohibited by law. Furthermore, the figure for street lighting heretofore mentioned, undoubtedly does not represent the total expenditure for that purpose. There are numerous special assessment districts for street lighting within cities. Expenditures of proceeds from special assessments are reported as "Special Assessment Expenditures," and are not segregated and reported under the classification to which the expenditure belongs, making it impossible to ascertain the total amount expended for street lighting. The eight million dollars per year of the gasoline tax expended upon State highways and city streets within municipalities amounts to nearly one half the total expenditure by cities for street and highway purposes exclusive of the cost of street lighting. This figure includes only the gas tax allocation required by law, and does not take into consideration any gas tax money the Highway Commission may budget for State highways in cities in addition to the two quarter cent allocations, nor of any Federal aid or Federal grade separation funds available to the Highway Commission which may be apportioned for expenditure within cities. If any such additional amounts were included with the gas tax expenditures within cities the ratio would be increased; and the Highway Commission has continued to budget additional gas tax funds in increasing amounts for the improvement of State highway routes within cities.

The act provides that each city shall prepare a budget of proposed expenditures of the ½ cent for streets of major importance to be made during the ensuing fiscal year. There is little discretion left to the department in the approval or disapproval of the budget, other than to see that the proposed expenditures are in accordance with the provisions of the act. The act does not require the department to consult with cities in the expenditure of the quarter cent allocation for State highways. Nevertheless, at the time the allocation of gas tax funds for expenditure upon State highways within cities was first enacted in 1933, the department as a matter of policy turned over to the cities the preparation of the budget or program for the expenditure of the money. The wisdom of such a policy has been fully demonstrated. During the past six years, the many difficulties attendant upon the inauguration of a procedure for the expenditure of this money, have been ironed out and there has developed a cooperation between the cities and the department based upon mutual confidence and respect.

In accordance with the provisions of law, the gas tax allocation to cities is expended by the State department of public works or is delegated to the city for expenditure. Work conducted by the department is performed by State forces or by contract under the direct supervision of the Division of Highways. Arrangements are made whereby the expenditure of the gas tax is delegated to the city where it is equipped to conduct the

This is Cliff Drive in the City of Santa Barbara, which was paved with Santa Barbara's allocation of ½ cent gas tax moneys for streets.

This picture shows a fine example of what cities can do with their ½ cent gas tax funds. It was taken in Monterey. The old dirt road on the right followed a route to the right of the line of white posts. It was replaced by the modern paved alignment shown on the left.

particular work contemplated in an efficient and economical manner. This delegation is compulsory upon the department in the case of the quarter cent allocation for expenditure upon streets of major importance, and has been followed as a matter of policy in the expenditure of the allocation for State highways, since its enactment in 1933. In determining whether a city is properly equipped to perform the work, the department will leave that to the city to decide.

Aside from the mandatory provisions of the act, the department prefers, and sincerely urges the cities themselves to expend the gas tax revenue allocated to cities. This applies with equal force to expenditure on State highways as well as on streets of major importance. As so frequently happens, the work within a city should be performed at a particular time of year in order to take advantage of the most favorable weather conditions or to avoid having the streets torn up during some celebration or convention. That is usually the time when work on the rural State highways is at its peak. Unless the city is doing its own work the result is obvious and the work within the city is apt to suffer delay. With the city responsible for the work, the schedule of operations can be arranged to best fit in with local conditions, and there is better satisfaction all around. Those cities which do not have a full time city engineer may retain a consulting engineer to prepare plans, specifications and supervise the work.

The cost of such services are a proper charge against the gas tax funds.

## Thomas A. Bedford Retires from State Highway Service

WITH a record of seniority dating back to 1911, Thomas A. Bedford, veteran engineer of the State Division of Highways, retired from active service on July 15.

Graduating from the Southwest University of Georgetown, Texas, in 1891, Mr. Bedford for ten years was a private engineer and county engineer of Knox County, Texas. Thereafter, for seven years he was division engineer of the Kansas City, Mexico and Orient Railway in Old Mexico. He turned to highway engineering when he became principal assistant to A. B. Fletcher, Chief Engineer for the San Diego County Highway Commission, in 1908. He served in this capacity until 1911.

When Mr. Fletcher became Chief Engineer of the State Division of Highways, Mr. Bedford was appointed Division Engineer in District II on December 9, 1911. Later he transferred to District I. In 1928 he took a year's leave of absence to serve as assistant general manager for the Kaiser Construction Company in Cuba. He returned to State service in 1929, since which time he has been on duty in the Surveys and Plans Department of the Division of Highways in central office in Sacramento.

T. A. BEDFORD

Mr. Bedford was tendered a farewell dinner by his associates in the Division of Highways on June 29 and then departed on a vacation at the end of which he plans to travel extensively in Canada and throughout the United States to make a personal study of modern highways.

# Relocating Southern Pacific Railroad Costs $17,500,000

(Continued from page 2)

passenger trains and at least twenty-five minutes for freight trains. There will be more grade rise on the new line but maximum gradients of the new and old lines are about the same. It is believed that the new line will be much cheaper to operate than the existing line.

The new railway will be equipped with centralized train control instead of the usual automatic block signals. This method of controlling traffic has recently been developed and under certain conditions varying with each installation, will increase the traffic capacity of a single track line by from

RALPH LOWRY
Construction Engineer

50 per cent to 80 per cent. As the relocated line could handle considerably more trains and tonnage in a given time than the existing line, the change in traffic capacity involves postponement of the time when and if double tracking is needed.

CONSTRUCTION PROGRESS

Actual construction of the new railroad was started in October, 1938. Contracts have now been let on all of the work except for the section between the Pit River and O'Brien Summit on which bids will be received on July 14th, the Pit River bridge, and two small additional bridges over O'Brien and Salt creeks.

Progress on major construction contracts up to date is as follows:

Sacramento River Bridge at Redding, substructure under contract to Clifford A. Dunn—complete.

Steel erection on super-structure under contract to American Bridge Company —two-thirds complete.

Grading between Sacramento River crossing to Bass Hill, 12½ miles, under contract to Granfield, Farrar & Carlin—75 per cent complete.

Section from Bass Hill Ridge to Pit River under contract to West Construction Company, 1900 feet of tunnel excavated.

Section from O'Brien Creek to second crossing of Sacramento River under contract to R. G. Clifford, 4 miles—work started June 20, 1939.

Section between second and third crossings of Sacramento River, 5 miles, under contract to Granfield, Farrar & Carlin, including 2½ miles of highway relocation —work started on new highway alignment.

Northernmost section, about 1 mile, under contract to United Concrete Pipe and Construction Company—two tunnels about completed and work started on substructure for bridges.

Additional contracts are under way on other bridge crossings.

PIT RIVER BRIDGE NEXT

The last contract expected to be let will be that covering the construction of Pit River bridge. This will be an outstanding structure in many respects. When completed it will be the highest double deck bridge ever built, rising about 500 feet above present stream level, and having a total length of 3590 feet. The main structure will consist of eight truss spans of various heights. The central portion will be a Cantilever structure with 630 foot main opening and 496 foot anchor arms; simple spans will complete the structure at each end. The structure will be supported by concrete piers extending to solid bedrock. The lower deck of the bridge will carry a double track railroad and the upper deck will be used as a highway crossing with a pavement 44 feet wide flanked by walkways 2½ feet wide. This will provide the crossing for the main state highway (Route No. 99) portions of which will also have to be relocated around the reservoir.

WORK UNDER SUPERVISION OF BUREAU OF RECLAMATION

This railroad relocation work is under the general direction of Ralph Lowry, Construction Engineer in charge of the Kennett Division of the Central Valley Project including Shasta dam and appurtenant works, and under the immediate direction of Roy M. Snell.

Walker R. Young, Supervising Engineer of the Central Valley Project, estimates that the new line will be completed and ready for operation by September 1, 1941. In the

ROY M. SNELL
In charge of relocation

meantime a by-pass tunnel has been completed through the right or westerly abutment of Shasta dam to temporarily reroute the existing railroad through the dam site so that excavation and construction of the dam can proceed without interrupting rail traffic. Trains are now running through this tunnel and will continue to use the existing line until the new railroad is completed.

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"Honey, as a dancer you are without a peer."

"Don't worry, big boy! I'm going to England to get me one."

Cutting barricade on Los Gatos-Santa Cruz Highway. Left to right—Mayor Vertin, Los Gatos; Supervisor George Ley, Santa Cruz; Supervisor Joseph McKinnon, Santa Clara; Mayor Hinkle, Santa Cruz, holding end of saw; Lieutenant Governor Patterson; Byron N. Scott, Secretary Highway Commission; Director of Public Works Frank W. Clark; Col. Jno. H. Skeggs, District Highway Engineer; Donald Younger, Santa Cruz.

# Million-Dollar Highway Opened

WHILE a large throng of jubilant motorists vociferously expressed their satisfaction, officials of the State and of Santa Cruz and Santa Clara counties assembled near the summit of the new road and formally dedicated the million-dollar link of the Los Gatos-Santa Cruz Highway between The Oaks and Inspiration Point on Saturday afternoon, July 1.

Following a program of speeches and a dedicatory address by Director of Public Works Frank W. Clark, the new four-lane highway was declared open to the public by Lieutenant Governor Ellis D. Patterson, representing Governor Culbert L. Olson. At a signal from the Lieutenant Governor, Mayor C. D. Hinkle and Supervisor George Ley of Santa Cruz, and Mayor Marc Vertin of Los Gatos and Supervisor Joseph McKinnon of Santa Clara County, expertly handling two huge saws, cut through a redwood log barrier and a cavalcade of waiting automobiles sped over the highway to Santa Cruz, where another celebration was staged, with Lieutenant Governor Patterson and H. R. Judah, former chairman of the California Highway Commission, as the principal speakers. A banquet at the Hotel Palomar on Saturday night brought the day's festivities to a close. Donald Younger was master of ceremonies throughout the afternoon and at the banquet.

**Governor Culbert L. Olson expressed his regret that he could not attend the Los Gatos-Santa Cruz Highway dedication in the following telegram to Donald Younger, chairman of the celebration committee:**

**"Regret it will be impossible to be with you and the good people of Santa Cruz County for the opening of the Los Gatos-Santa Cruz Highway. Please express my regrets to the people and congratulate them on their accomplishment. Also assure them of this administration's continuing support in all progressive matters."**

During his address Director Clark took occasion to urge that all citizens of California take a greater interest in governmental affairs at Sacramento and keep in closer touch with their legislative representatives on matters of public importance.

Present at the dedication was Col. Jno. H. Skeggs, District Highway Engineer, who supervised the building of the entire Los Gatos-Santa Cruz Highway project, including the

(Continued on page 28)

# Highway Funds Inadequate to Meet Present Day Road Demands

SPEAKING at the dedication on July 1 of the completed link of the Los Gatos-Santa Cruz Highway between The Oaks and Inspiration Point, Director of Public Works Frank W. Clark called attention to the inadequacy of funds to meet the highway demands of today. He said:

"The State of California finds itself today in a somewhat difficult position with respect to its nearly fourteen thousand miles of State highways. This State, having been one of the first to undertake the task of providing its citizens and its thousands of visitors with facilities for motor travel, has created for itself a reputation throughout the nation for the quality and extent of its highway system.

"At the present time, we are confronted with an ever-increasing volume of highway usage by individuals who demand not only that this State's highways shall be of a higher standard than they would look for elsewhere but also that these facilities for travel be improved to even higher standards of safety and convenience.

"To meet these demands, however, funds available for the purpose have become increasingly inadequate. This circumstance is illustrated by the fact that for the next two years it is estimated that the total sum available for major construction projects will not exceed $28,000,000 whereas a conservative estimate of the amounts required at the present time to modernize the existing highway system in accordance with current traffic requirements may be briefly summarized as follows:

| | |
|---|---|
| For reconstruction, new construction and surfacing | $324,650,500 |
| For widening major arteries to provide divided multi-lane roads | 76,675,700 |
| For bridges, flood protection and railroad and highway grade separations | 70,565,000 |
| For freeway construction through congested areas | 36,000,000 |
| For miscellaneous improvements | 3,110,000 |
| Total | $511,010,200 |

"These figures are the result of detailed studies made by the eleven district engineers of the Division of Highways as published in the recently completed report of the California State-wide Planning Survey conducted by the United States Bureau of Public Roads and the California Division of Highways.

"Under the circumstances, therefore, the problem confronting the California Highway Commission and the Division of Highways becomes not solely one of building roads but of exercising the utmost care in selecting for improvement those portions of the system where the need is demonstrably the most urgent.

"A large number of you no doubt remember the old narrow, twisting

(Continued on page 26)

Director of Public Works Frank W. Clark, delivering dedicatory address at celebration of opening of Los Gatos-Santa Cruz Highway. Seated, left to right—Mayor Hinkle, Santa Cruz; Mayor Vertin, Los Gatos; Lieutenant Governor Patterson.

# Storms in California During the Winter 1937-38

(Continued from page 9)

be the case near salt water. Costs vary from 11¢ to 30¢ per square foot, dependent upon thickness. Thicknesses more than 8 inches do not appear to be necessary.

### Gunite Facing

Gunite facing 2 inches thick is comparatively light in design and has little resistance to progressive failure when undermined or subjected to the heavy impact of debris.

### Grouted Rock Facing and Hand-placed Rock Facing

Grouted rock facing 8 inches to 12 inches thick and hand-placed rock facing of the same thicknesses are light in design and limited to selected locations where rock or cobblestone and labor such as WPA are available. Grouted rock facing is adaptable to 1½:1 slopes. Success of ungrouted hand-placed rock facing is dependent upon a flat slope of not less than 2:1. Costs run from $2.50 to $4.50 per cubic yard.

### Random Select Bank-run Riprap

Ungraded selected bank-run rock excavation containing excessive fines, where subjected to nominal low-velocity flow, generally proved satisfactory, but when subjected to the higher velocities of streams at flood, particularly at points of stream impingement, failure was extensive almost without exception.

***This is the first installment of an article prepared by Mr. G. A. Tilton, Jr., for California Highways and Public Works and Pacific Road Builder and Engineering News. The second installment will appear in the August issue of this magazine.—Editor.***

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An analysis of pedestrian fatalities in the District of Columbia by American Automobile Association discloses that over an eight-year period an average of 70 per cent of all traffic fatality victims were pedestrians. Sixty per cent of these were killed during hours of dusk or darkness and nine out of ten pedestrians killed who were old enough to operate a motor vehicle were not licensed drivers and not familiar with operating a motor vehicle. Nearly half of the pedestrians killed were 55 years of age or over.

## Deserved Praise

State of California

DEPARTMENT OF MOTOR VEHICLES

California Highway Patrol
E. Raymond Cato, Chief
Sacramento, Calif.

Salinas, California,
June 5, 1939.

Lester H. Gibson,
District Engineer,
Division of Highways,
P. O. Box 841,
San Luis Obispo, California.

Dear Mr. Gibson:

I desire to call to your attention the cooperation and assistance rendered by Messrs. Kay Willis, Bob Clinch and Charles Snider, located at the Big Sur Maintenance Station. It was through their untiring efforts and training in first-aid that in the accident of May 23d near Anderson Canyon there was no greater loss of life.

These men were first at the scene of the accident and stayed there until all assistance had been completed. Two of these men were injured when they answered this call, yet their injuries were forgotten in their desire to serve the people of the State of California. It is cooperation and assistance of this nature that brings the various State organizations closer into one unit, giving that assistance to the motoring public which we, as members of Civil Service, strive to render.

I highly commend these men for their loyalty and assistance. Will you please convey the thanks of Officer Williams and myself to these men? It is with gratitude and satisfaction to be able to know that we can depend on these men for further assistance in emergencies of this character.

Very truly yours,

L. T. TORRES,
Captain, San Benito-Monterey Co.

# Highway Funds Inadequate for Road Demands

(Continued from page 25)

roadway replaced by the section being dedicated today. There can be no question in the minds of anyone as to the urgency of the reconstruction of this particular section.

The several earlier projects completed since the reconstruction of this route connecting Santa Cruz and Los Gatos was started in 1932, involved expenditures of $961,636. This section opened today cost $1,064,000. There remains to be constructed only the section 1.6 miles in length between The Oaks and the city of Los Gatos to complete the modernization of the entire route.

"It will be of interest to all present to know that there has been included in the construction budget for the coming biennium beginning July 1, 1939, the following major projects in this immediate vicinity:

| | |
|---|---|
| Santa Clara County—Between The Oaks and Los Gatos—1.6 Mi. | $300,000 |
| Santa Clara and Santa Cruz Counties—Supplemental work from Inspiration Point to The Oaks | 100,000 |
| Santa Clara County—Line change at Austin Corners—1.3 Mi. | 85,000 |
| Santa Cruz County—Between Watsonville and Rob Roy Junction—7.3 Mi. | 360,000 |

"In addition to these major construction projects, there is also contemplated for expenditure in this vicinity from funds allocated for minor improvement and betterment projects the sum of approximately $70,000."

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## AWARDS TO CONTRACTORS

(Continued from page 18)

be permitted a maximum of three nominations each year. These nominations will be judged by sections for the sectional awards and the winners of these awards will then be eligible for the national award, the recipient of which will be made known at the next annual convention of the American Road Builders' Association.

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Salesman—"I would like to see someone with a little authority."

Office Boy—"Well, I have as little as anyone around here."—*Winnipeg Tribune.*

# Russian River Highway Nearing Completion

(Continued from page 5)

round material with upset ends and malleable washers.

TIE RODS PROVE PROBLEM

The placing of the tie rods was the only phase of the work where difficulty was experienced. This was due to the limited space available in which to shift the rods endwise to facilitate placing. It was necessary to bend the rods in order to fit them, then straighten them after they were in place.

The maximum length of pile driven in the bulkheads was 50 feet. The total length of bulkhead amounted to 1230 lineal feet and required approximately 140,000 board feet of treated Douglas fir timber.

Another major item on the contract was the construction of two concrete deck bridges on timber pile bents. The one across Hulbert Creek has a length of 177 feet with 9 bents. The one across Fife Creek is 127 feet long with 6 bents. Hulbert Creek Bridge is built alongside of an existing concrete bridge, the only connection between the two bridges being curb returns at each end.

UNIQUE DECK SUPPORT

By using both bridges a two-way divided structure will be provided at the entrance to Guernewood Park, a very popular recreational spot. This is near the connection between the old and new roads. Seventy to eighty-foot piles were used in this structure. A unique method of deck support was used by the contractor in his form work. He eliminated the use of false bents by supporting the deck falsework from the piles. One and one-half inch "U" bolts were placed over the tops of the piles and extended down through 8-inch by 16-inch cross pieces on each side of the bent. By tightening or loosening the nuts on the bolts, the deck could be readily adjusted to the desired elevation. The cross timbers to which the "U" bolts were fastened in turn supported the stringers which formed the deck support. Fife Creek Bridge is a standard bridge with a 26-foot roadway and two sidewalks.

Grading was done with tractors and carryalls and has been completed. Several slides developed after the grading was started, but at the present time they are not moving appreciably.

Northern California motorists who frequent the Russian River resorts are looking forward with pleasurable anticipation to the opening of the new highway, which will greatly facilitate travel between Northwood Park and Guerneville, popular recreation spots.

The contract was awarded to the Heafey-Moore Co. and Fredrickson & Watson Construction Co., on a bid of $184,009.10. The time limit was 150 working days; the completion date is August 31, 1939.

This view of construction on the Northwood Park-Guerneville Highway, looking towards Monte Rio, shows steel piles and treated timber bulkheads.

# Million-Dollar Highway Opened

(Continued from page 24)

link the completion of which was the occasion for the celebration on July 1. Commissioner L. G. Hitchcock of Santa Rosa and Secretary Byron N. Scott represented the State Highway Commission.

HEAVY TRAFFIC ON ROUTE

Formal opening of the project between Inspiration Point and Oaks Road represents the completion of another link in the construction of the highway between Santa Cruz and Los Gatos.

This particular stretch of highway comprises one of the most heavily traveled recreational highways in California, connecting the densely populated San Francisco and peninsula areas with the scenic attractions and playground facilities of the Santa Cruz and Monterey coast lines.

How increasingly advantageous it will be to the thousands of pleasure seekers who used the existing obsolete highway may be judged from the fact that the traveled distance between Los Gatos and Inspiration Point is reduced nearly two miles.

**The number of curves has been decreased from 132 to 20; total curvature will be 1118 degrees instead of 7700 degrees, and the present 75-foot minimum radius of curves is increased to 500 feet. The average surface width of the new highway is 46 feet as compared to the 20-foot existing roadway.**

Of the 132 curves on the old road, forty have a radius of one hundred feet or less. The elimination of these traffic hazards alone is believed by the Division of Highways engineers to fully justify the cost of the relocation.

The first contract for the realignment of the Los Gatos-Santa Cruz Highway was let in 1932 and called for a four-lane highway through the heavy mountain sections where curvature is naturally limited, and a three-lane construction through the valleys and flats where easier curvature alignment could be secured. Contracts for additional improvements have been continuously under way since 1932. An important link in the undertaking was completed in 1937 with the opening to traffic of the Scotts Valley reconstruction at the Santa Cruz end.

FOUR LANES FOR TRAFFIC

The old road, which was graded in 1915 and paved in 1922, is a 15 to 17 foot by 4½ inch, portland cement concrete surface flanked by 1½ foot of 4 inch oil treated shoulders. The shoulder surfacing was added in 1929, 1930, 1931. The new highway provides four lanes for traffic two in each direction—with three-foot shoulders. Through one short radius curve of 500 feet at Moody Gulch, a center division strip was provided.

The total cost of the project amounts to $1,064,000 of which the grading cost for 2,183,000 cubic yards of earth and rock excavation comprises approximately $524,000.

The Contractors were Heafey-Moore Co. and Fredrickson Watson Construction Co.

This photograph, looking towards Los Gatos, shows new four-lane Los Gatos-Santa Cruz Highway between The Oaks and Inspiration Point, on left, which replaces old highway on right with its dangerous curves and two-lane pavement.

# State of California

## CULBERT L. OLSON, Governor

# Department of Public Works

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

## FRANK W. CLARK, Director of Public Works

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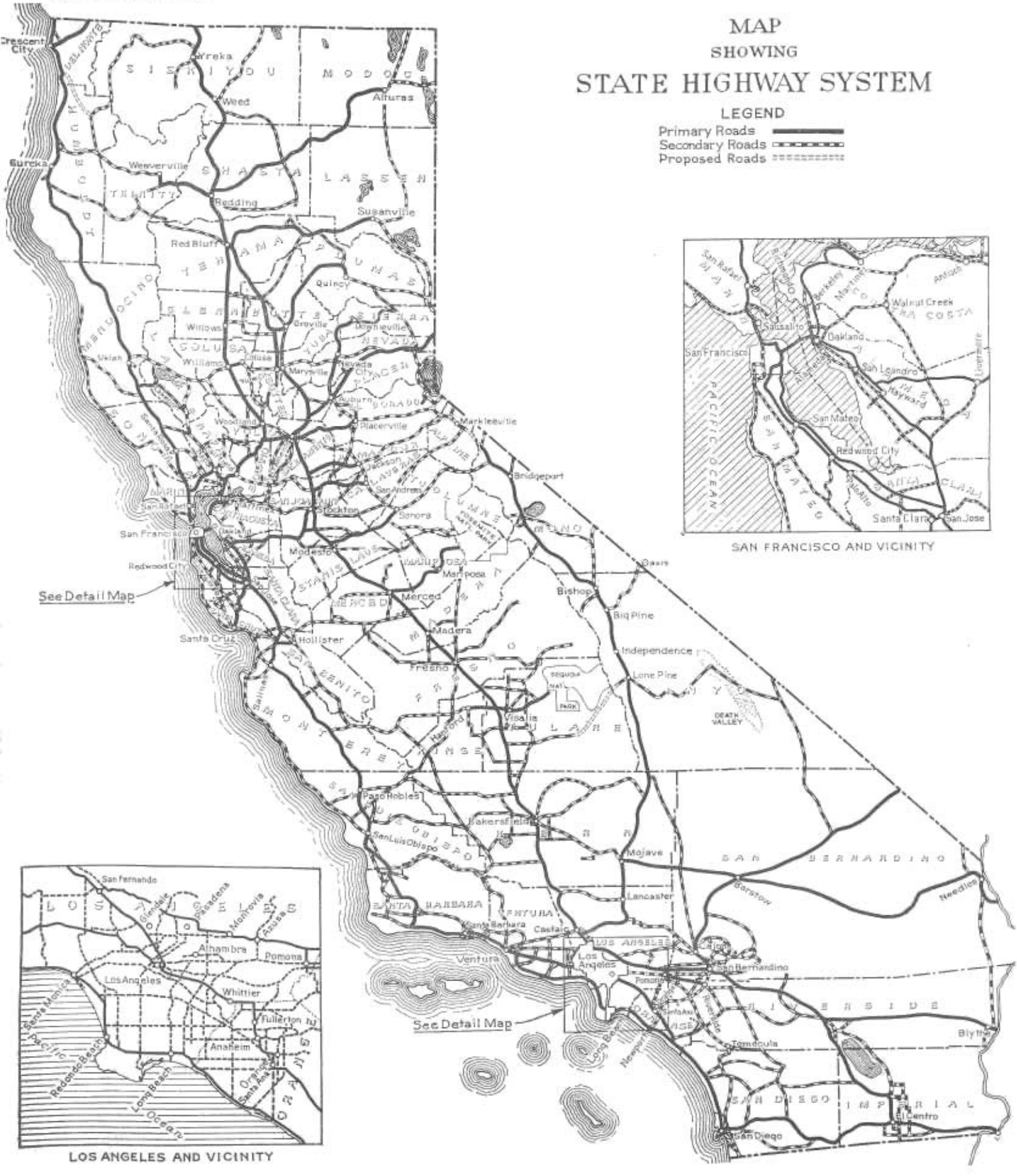
# MAP
## SHOWING
# STATE HIGHWAY SYSTEM

LEGEND
Primary Roads
Secondary Roads
Proposed Roads







SAN FRANCISCO AND VICINITY




LOS ANGELES AND VICINITY