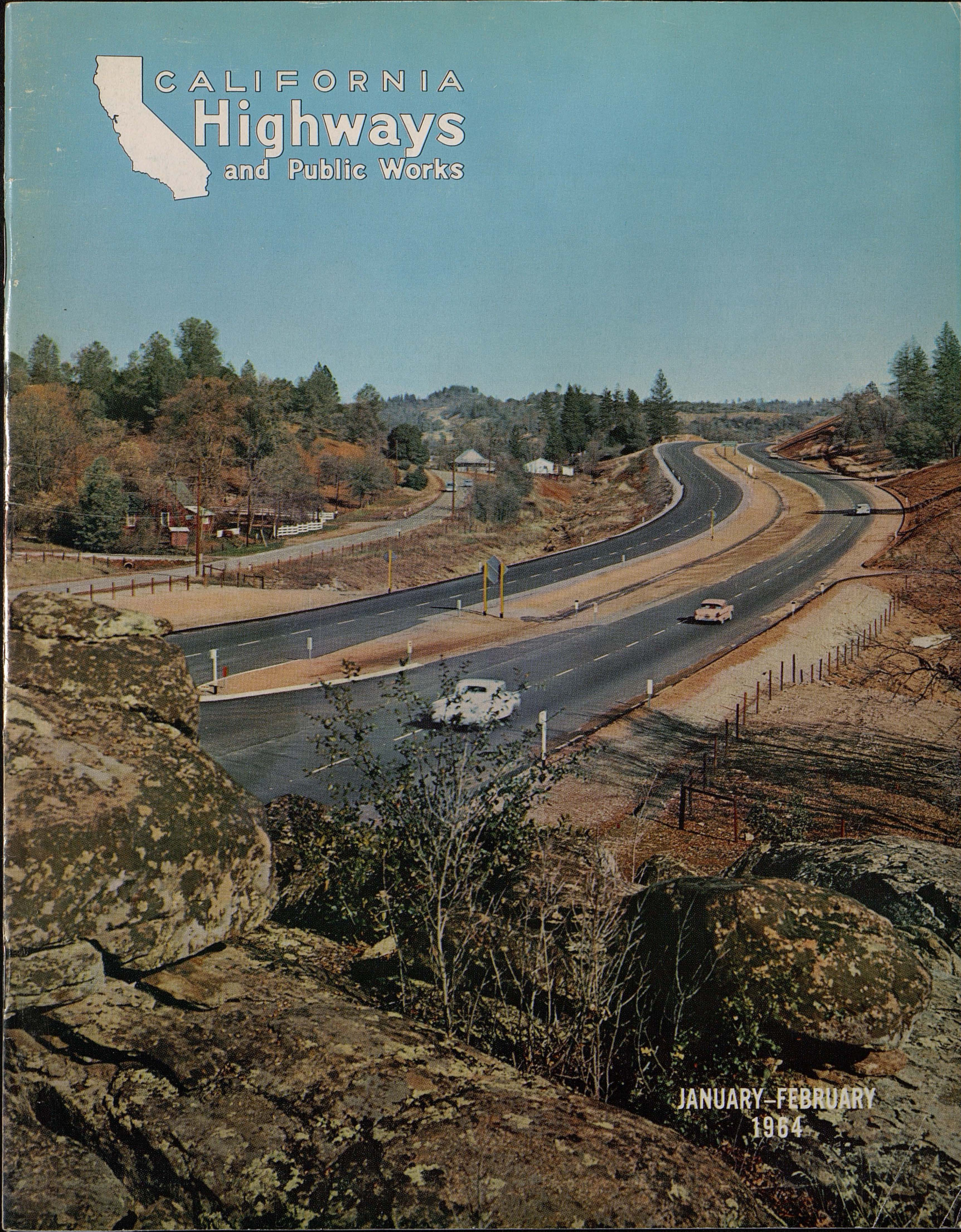
CALIFORNIA
Highways
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JANUARY–FEBRUARY
1964

All Contracts Include Fair Employment Provisions

Standard fair employment practices provisions, backed up by compliance reports, are now a part of all construction contracts administered by the Division of Highways. These provisions apply not only to major construction jobs, but also to right-of-way clearance contracts, informal bid and minor contracts, and any other service contracts which involve employment of labor.

Where federal aid funds are involved in highway projects, there have been federal government requirements in effect for some time which prohibit discrimination by the contractor because of race, creed, color or national origin.

On all other construction contracts administered by the Division of Highways, the long-standing provision of the State Labor Code to this effect is now amplified and strengthened by new fair employment practices provisions issued pursuant to Governor Edmund G. Brown's Code of Fair Practices. These provisions are spelled out in Department of Finance Management Memo No. 63-20.

Under these provisions, each contractor to whom work is awarded agrees as follows:

> (1) The contractor will not willfully discriminate against any employee or applicant for employment because of race, color, religion, ancestry, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, ancestry, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the awarding authority setting forth the provisions of this fair employment practices section.

In addition, the contractor is required, among other things, to:

—Advise labor unions of his fair employment practices commitments and attempt through labor negotiations to "implement an affirmative antidiscrimination program . . . to the end that qualified minority workers will be available and given an equal opportunity for employment."

—Submit, before the contract is awarded, a signed statement he will take positive action to notify his own staff and all employment sources of the contents of the antidiscrimination clause. (Posters and notices are supplied by the Division of Highways.)

—Agree to permit access to his employment records by the Fair Employment Practices Commission or other appropriate state authority for investigation to ascertain compliance.

—Include these fair employment practices provisions in subcontracts.

The provisions also provide for penalties for "willful violation" of this section of the contract. These may include monetary damages and revocation of the contractor's prequalification or his eligibility as a "responsible bidder."

Two compliance reports are required on all contracts amounting to more than $5,000. The first one, containing detailed questions on the steps taken to carry out the FEP policies and procedures, must be filed within 90 days of the approval of the contract (within 10 days if completion is expected within 90 days). A final report is required after completion of the contract. On contracts less than $5,000 one report is required.

The department's policy in this regard was stated by Director of Public Works John Erreca in a recent circular calling attention to Governor Brown's expressed concern that "the task of achieving equal opportunity for all our citizens continue with a renewed sense of urgency."

"I want to be sure," Erreca said, "that both formally and informally our department does everything possible to support and to strengthen the carrying out of this vital public policy."

State Highway Engineer J. C. Womack, in a followup circular letter, called the attention of all district engineers and other staff officials to this policy and emphasized the "necessity for immediate and full compliance."

3/25/64

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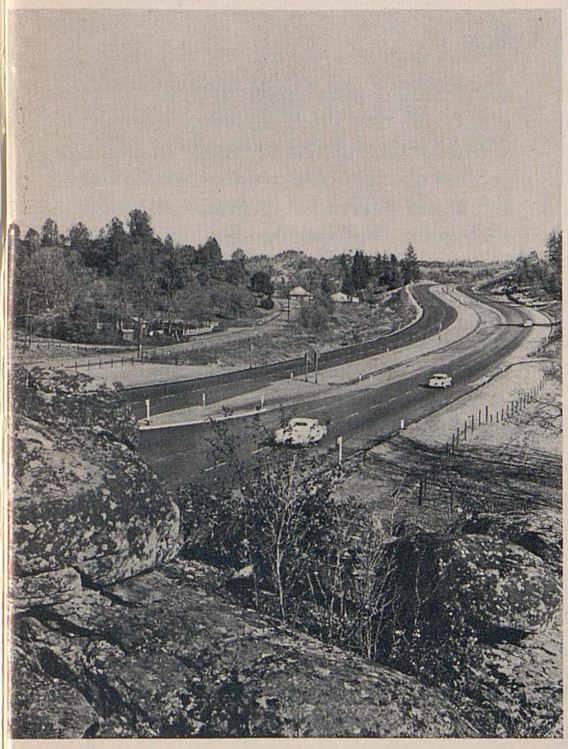
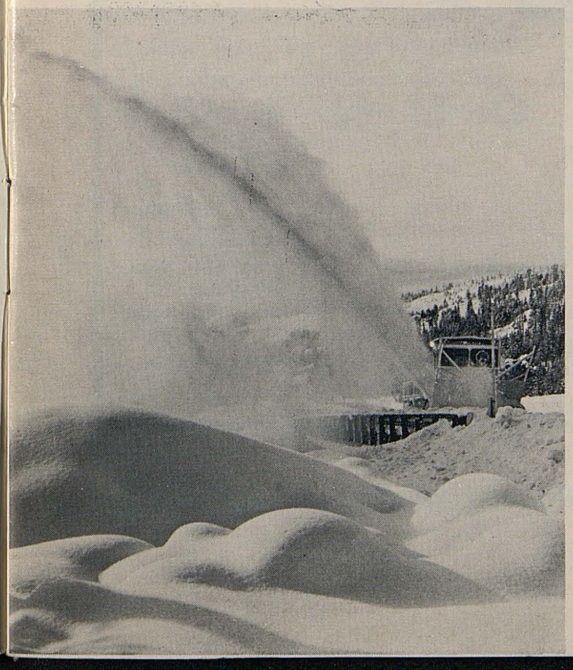


FRONT COVER: Illustrated is the new section of expressway west of Twain Harte on Sign Route 108 (Sonora Pass Highway), Tuolumne County. This is a popular route for winter sports enthusiasts and summer recreationists also. Photo by Robert Mulno.

BACK COVER: Rotary plow throws snow from windrows placed by fixed plows on Interstate Route 80 near Kingvale. Picturesque humps in foreground are piles of snow thrown clear after a previous storm, and since clothed with several inches of fresh snow. Photo by Robert Dunn.



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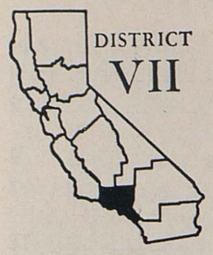
Antelope Valley Freeway

By CAROLE KRETZER, Assistant Information Officer



The 2,500-square-mile Antelope Valley is a right triangle with one side pushing across the entire northern boundary of Los Angeles County and another side leaning against the county's eastern boundary as far south as Route 59. Its hypotenuse is formed by the San Gabriel Mountains, and it is only through this range that motorists from Greater Los Angeles can reach the valley.

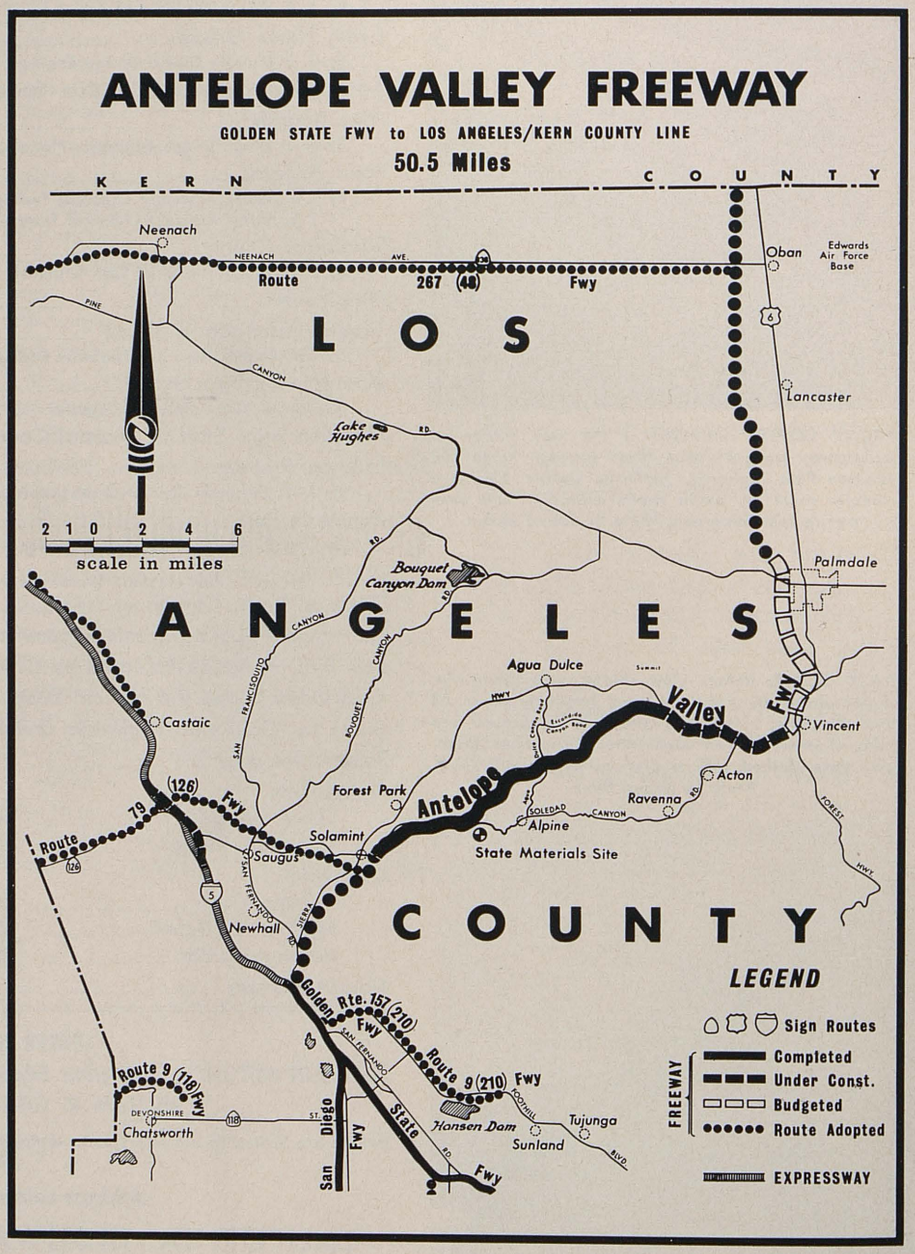
Until last October, there were two principal connections between the valley and the metropolitan area to which its economy is tied. Motorists from the San Fernando Valley could enter via Newhall on the state facility (Sierra Highway) or the county's Soledad Canyon Road. Or from the San Gabriel Valley, they could travel the scenic but twisting Angeles Crest-Angeles Forest route.

Neither choice was particularly desirable. Both are two-lane facilities with curves and hills that limit passing opportunities. A relatively high percentage of truck traffic (10 percent of the total) passes from Los Angeles to the Antelope Valley, and automobiles pulling trailers or boats toward the High Sierra also slow the traffic pace.

Last October 15, the situation was eased considerably as the barriers were removed from the first 14.4-mile stretch of the Antelope Valley Freeway—an important segment which climbs from an elevation of 1,437 feet at Soledad Canyon Road, near Solemint, to Ward Road Overcrossing just a little southeast of the 3,262-foot summit.

The facility is a modern four-lane freeway with an extra lane provided for trucks wherever the uphill grade is 3 percent or more, or the downhill grade is at its 4½ percent maximum. The median is wide, separating traffic by 22 feet at minimum and 72 feet at maximum. Two miles shorter than old Sierra, the freeway saves motorists 1,000 hours a day travel time and is expected to prevent 45 accidents and save 7 lives a year.

Although this new segment feeds into Sierra Highway at both ends, it is some three miles from the old route much of the way, moving through virtually untouched territory in parts. It affords motorists a view not visible from old Sierra as it passes through the scenic Vasquez Rocks, where the notorious Mexican bandit holed up in the 1850's.



Welcomed by the Valley

"This first link is the wedge that will open the heretofore bottled-up potential of the Antelope Valley," said Lamont Odett, general chairman of the Antelope Valley Freeway Committee at the dedication August 23. "As additional sections are completed, the reality of what this freeway can mean to us will become even more apparent."

His sentiments are typical of all Valleyites who have pinned their ambitious growth plans largely on the availability of water and the completion of the freeway from the Golden State Freeway to the Kern county line. Although this freeway will never bear the heavy traffic of metropolitan freeways, it is a federal aid primary route and is important as a defense road, as an access route to recreational areas, and as a connector to busier freeways in the Los Angeles area.

Will Be Complete by 1970

As plans currently stand, and subject to future California Highway Commission budgets, the valley should have its freeway completed to the total length in Los Angeles County (50.5 miles) around 1970. Total construction cost is estimated at $52.6 million, and about $7 million will be invested in rights-of-way. It will have taken about 10 years to construct, and some portions will have been 50 percent financed by federal funds. Formerly signed as U.S. Highway 6, the road is designated as Route 14 under legislation enacted in 1963.

Beginning at the western (or southern) terminus, the timetable now looks like this:

Golden State Freeway (Interstate 5) to Soledad Canyon Road near Solemint, 7.5 miles, tentatively scheduled for construction in about three years.

Soledad Canyon Road to Ward Road Overcrossing, 14.4 miles, complete and opened to traffic October 15, 1963.

Ward Road Overcrossing to Vincent, 7.6 miles, under construction since October 1963 and scheduled for completion in May 1965.

Now under construction, the Antelope Valley Freeway (artist's rendering at left) will contrast sharply with the two existing roadways at right. Sierra Highway is center with the Angeles Forest Highway coming in from the right. This busy junction is located near Vincent.

Vincent to Avenue P8 near Palmdale, 5.9 miles, included in the 1964-65 fiscal year budget.

Avenue P8 to Avenue I northwest of Lancaster, 7.2 miles, tentatively scheduled for stage construction, with contracts to be awarded in three to four years.

Avenue I to Kern county line, 7.9 miles, tentatively scheduled for stage construction, with contracts to be awarded in one to two years.

Right-of-way and Design

Approximately half the right-of-way for the entire route has been acquired. Only 427 parcels are needed, and the average right-of-way cost per mile runs about $140,000, a very low figure in District VII.

Design of the route, which is also about halfway complete, features a wide median throughout, the maximum being 130 feet for the ultimate eight lanes on the contract currently going just west of Vincent. According to District Design Engineer Wallace Griffin, this feature permitted design of the opposing roadways to be treated as separate units, with the result that grading problems were eased and special consideration could be given to aesthetics and reduction of headlight glare.

Initially, the freeway will be a basic four-lane facility throughout, with passing lanes built as needed, especially through the mountains.

Crosses Diverse Terrain

The Antelope Valley Freeway will have two distinct characteristics. It will curve east by northeasterly through rugged, mountainous terrain for about half its length, then dogleg almost due north at Vincent through the flat, high desert known as Antelope Valley.

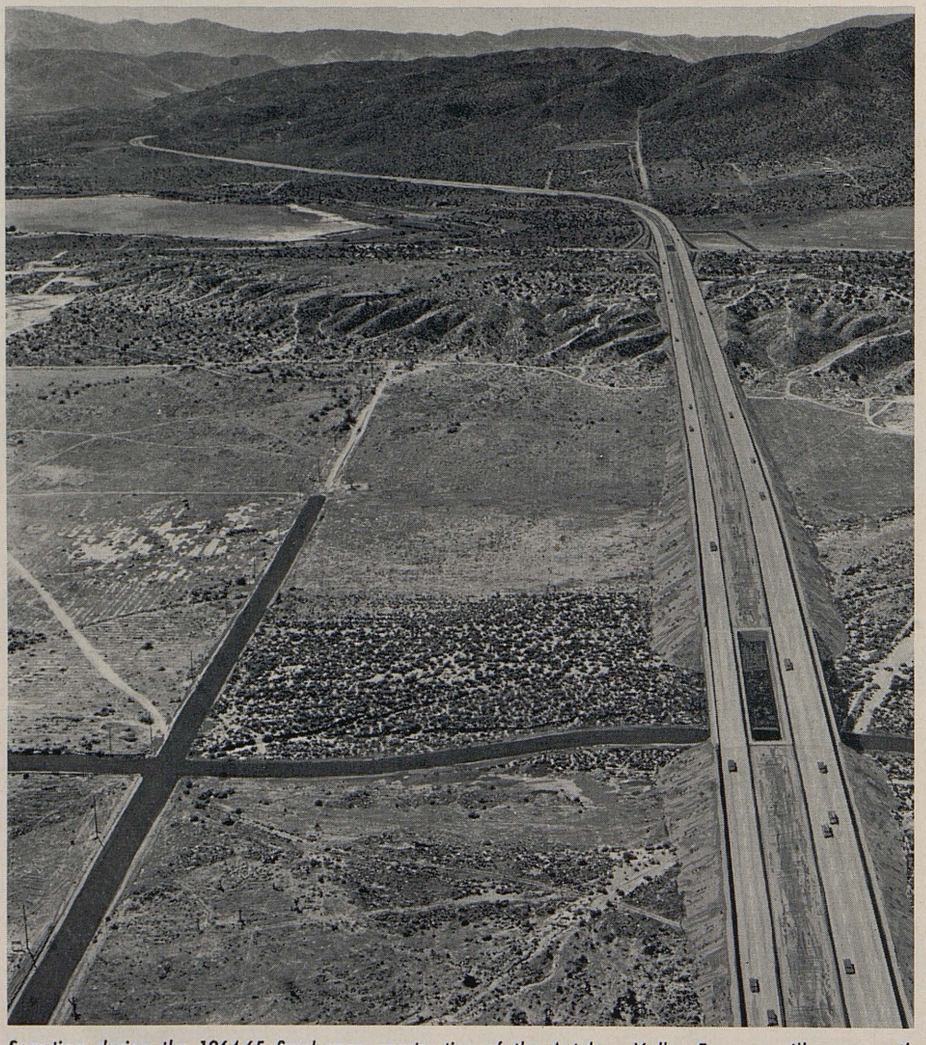
Through the mountains, the primary design problem was to achieve alignment and grade that would be compatible with safety and high speed. The 14.4-mile stretch now open to traffic settles well into the terrain, and although it traverses numerous faults, all structures are founded on a solid base. Irregular attitude of the bedding in the fault areas caused only minor problems in stabilizing the slopes.

Large Earthmoving Job

Grading for this completed portion required one of the largest excavation jobs in recent years. The original contract, awarded in December 1960, at $7,400,000, to Darkenwald Construction Company, Inc., and Morrison-Knudsen, Inc., required removal of 7,700,000 cubic yards of earth and rock to create a roadbed 140 feet wide along a 10-mile stretch. Using 27 tractors, 24 scraper and truck-type hauling units, and two conveyor-type belt loaders, the contractors moved up to 31,000 cubic yards per eight-hour day, averaging 20,000 cubic yards, to complete the job in September 1962.

An additional contract, awarded in November 1961, at $6,600,000, involved removal of another 1,800,000 cubic yards by Frederickson & Watson, Kirst & Jack L. Adams Construction Companies in a joint venture, for a total earth removal of 9,500,000 cubic yards. Although this total comes nowhere near the mammoth 18,000,000 cubic yards removed from the Santa Monica Mountains to accommodate the San Diego Freeway, the Antelope Valley project required earth excavation from numerous locations along the 16-mile contract limits, and involved 100,000,000 station yards of overhaul. Cuts along the route ran as deep as 200 feet and fills as high as 180 feet.

This excavation was also of special interest because it acted as a check on the first seismic tests conducted in District VII to determine rippability of rock. Back in 1960, prior to award of the grading contract, the Engineering Services Department set off small dynamite charges in cut areas along the route and, using sensing equipment which measures the speed of seismic waves, related the speed to density of material and estimated the cubic yards of material that could not be removed without blasting. Although the contractor was able to rip 9.2 percent more material without dynamiting than the estimate had indicated he could, the error was considered reasonable for "testing the test." Further, because of poor access, usual methods of calculating rippable material would have been highly impractical. (See *California Highways and Public Works*, May-June 1960 and 1963.)



Sometime during the 1964-65 fiscal year, construction of the Antelope Valley Freeway will move north out of the mountains and into the desert. Intersecting road rendered in the foreground is future Avenue R. The road parallel to the rendering of the freeway is Division Street. Water at upper left is Palmdale Reservoir.

Mountain Drainage

In addition to calculating extensive earthwork problems, District VII design engineers had to plan a large drainage system through the mountains to accommodate heavy runoff from the high canyons.

Reinforced concrete arch culverts with special structural design to withstand high overfills were used in the higher terrain. These culverts are unusually large for Southern California, each being 400 to 500 feet long and up to 17 feet in span. If laid end to end, the culverts necessary for the 14.4-mile route would stretch 9 miles.

Not the least problem in installing the culverts was that the contractors

had to haul the concrete for some of these drains without benefit of roadways along two miles of the Vasquez Rocks area. Other problems arose in blasting and in placing the culverts in the craggy rocks. For one of the 14-foot arch culverts, 60 percent of the foundation area into which it was fitted had to be dynamited, and the culvert had to be placed to follow the smooth, flat curve of a streambed for about 400 feet.

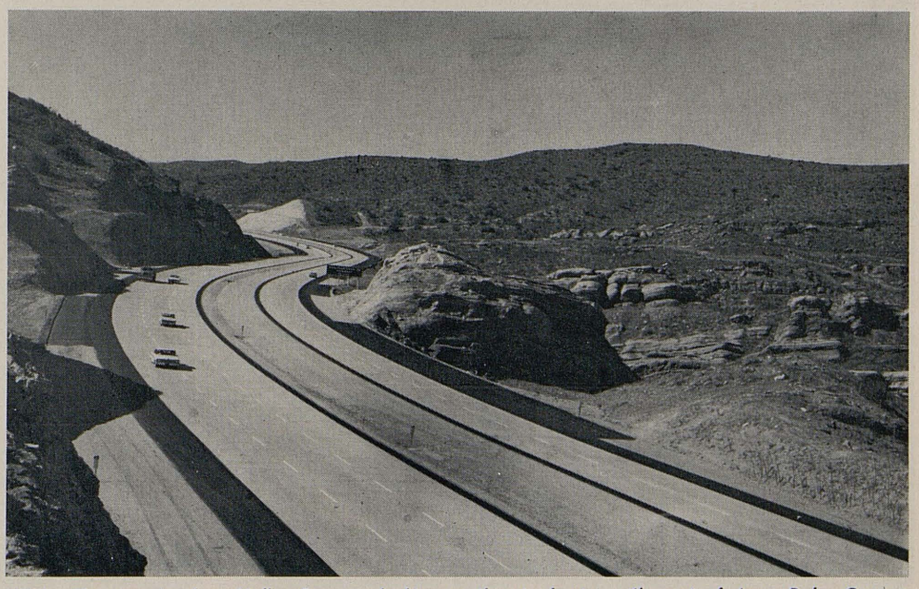
Santa Clara River

The close proximity of the Santa Clara River to the freeway for about three miles from Solemint west made it necessary to provide additional slope protection at intermittent points. Because the river occasionally reaches a flood stage of 131,000 cubic feet per second current flow, a special stone protection was needed for embankment slopes. Built to a depth of anticipated scour about six feet below and six feet above the streambed, the special embankment was constructed from rock extracted from the job farther east.

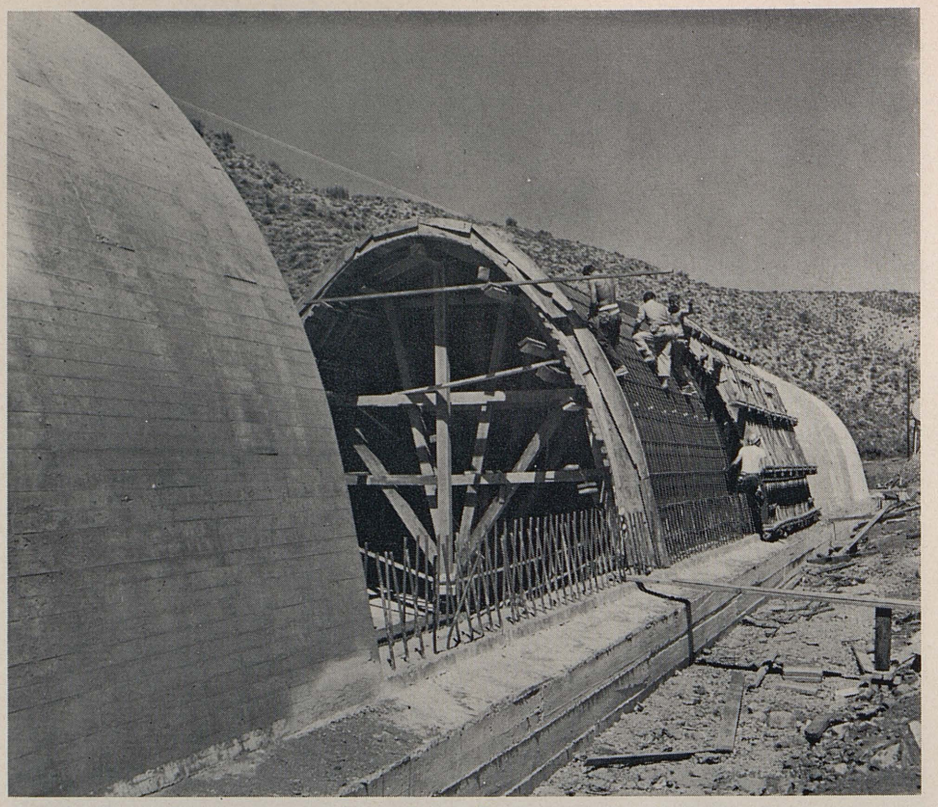
When it came to developing water, however, the river was a blessing. Pumping from the Santa Clara River, the contractors developed six reservoirs along the line. They had to install about 60,000 lineal feet of pipeline nearly 9 inches in diameter to supply water for roadbed compaction. The water system alone cost the first contractor about $500,000, exclusive of application, and with further water development accomplished by the second contractor, a total of nearly 12 miles of pipeline was installed at a cost of about $700,000.

Resident Engineer Howard Meinke estimates that three months could have been saved had water been more easily obtainable and had access to the freeway site been easier. From preliminary survey work through actual construction, a four-mile area between Agua Dulce Canyon Road and Escondido Canyon Road was extremely difficult to reach. After preliminary survey crews reported that it took two hours to reach the Vasquez Rocks area and another two to return, primitive access roads were bulldozed to the roadway site. Even then, the heavy earth-

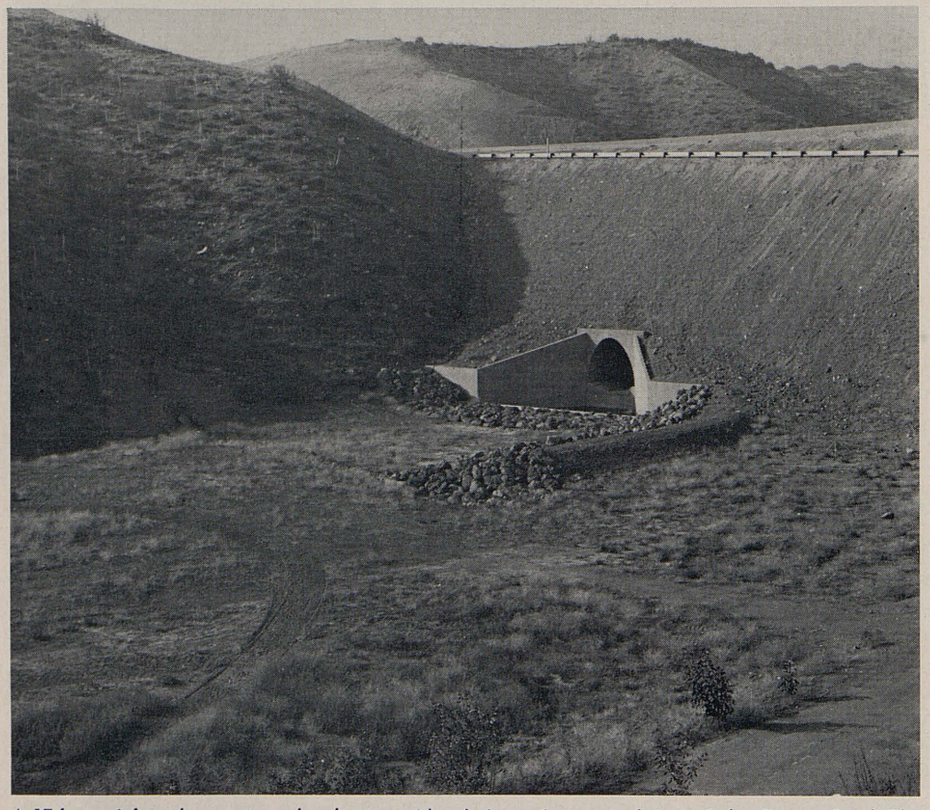
OLD. Traffic using Sierra Highway last August, before opening of the Antelope Valley Freeway, was often slowed by hills and curves through the mountains, such as on this section through Mint Canyon northeast of Solemint.



NEW. The new Antelope Valley Freeway looking southwest about a mile east of Agua Dulce Canyon Road. The graded roadbed width is sufficient to accommodate an ultimate eight lanes.



An arch culvert under construction on the Antelope Valley Freeway. Photo by Morrison-Knudsen Company.



A 17-foot reinforced concrete arch culvert provides drainage just west of Agua Dulce Canyon Road. The embankment is 90 feet high.

moving equipment that later moved in found the going rough.

Material Site Purchased

An equally important problem—the dearth of nearby commercial material sites—was solved with the State purchase of a materials site about five miles east of Solemint. Had the site not been purchased and developed, material would have had to be hauled from Little Rock or the San Fernando Valley, some 20 to 25 miles from various points along the job.

Paying 3½ cents a ton, the contractor developed all construction material himself, including 630,000 tons of subbase, 295,000 tons of base material, 120,000 cubic yards of Portland cement concrete, and 100,000 tons of asphaltic concrete.

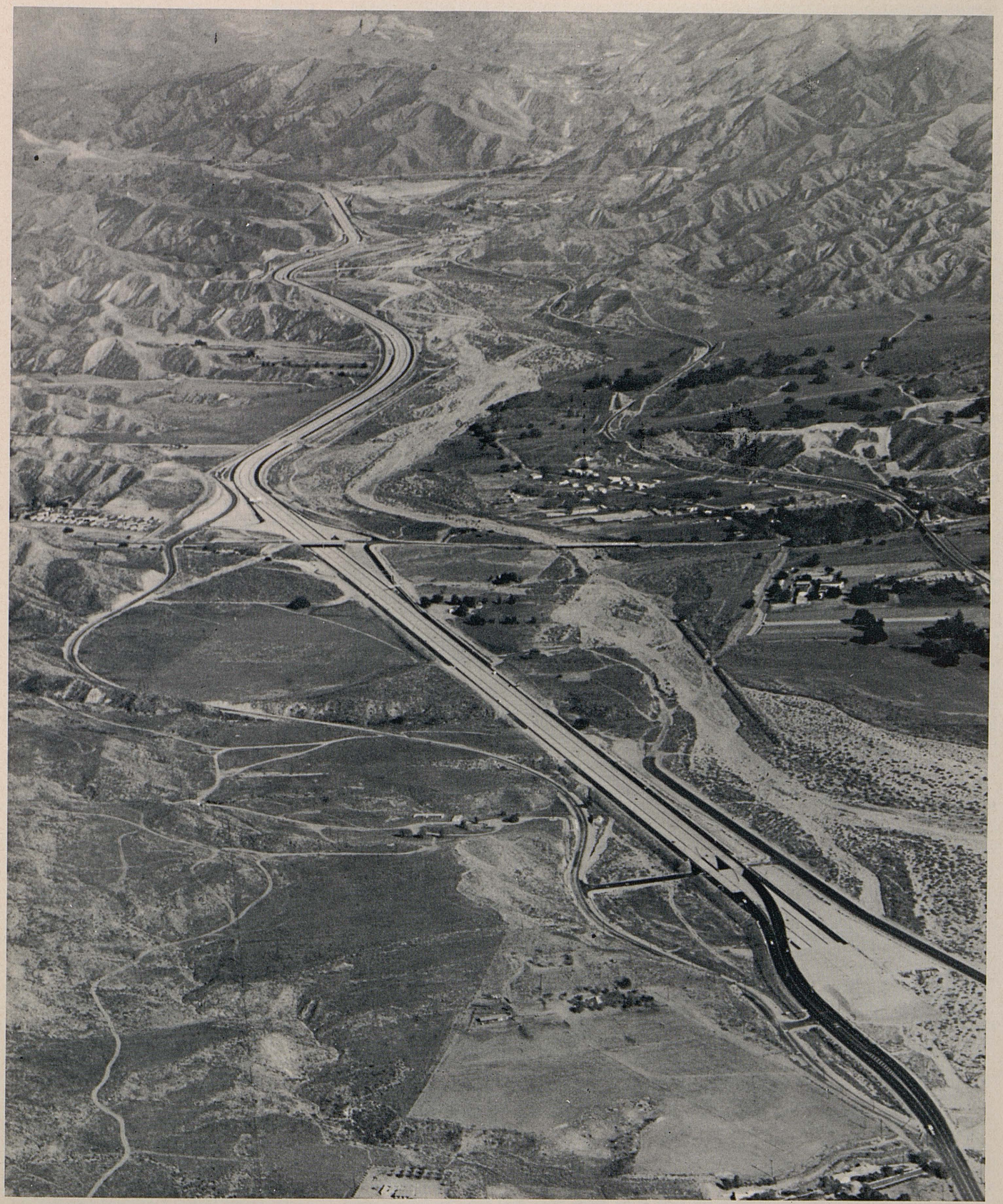
Longest Paving Job

The 16-mile job is one of the longest single concrete paving contracts ever awarded by the State. To accomplish the task, the contractor used a Gunnert-Zimmerman slip-form paver, placing both lanes (and all three, when three were specified) at once. Paving sometimes became difficult along the mountainous route, especially wherever the paver came out of one curve and went into a reverse arc where the tangents were short.

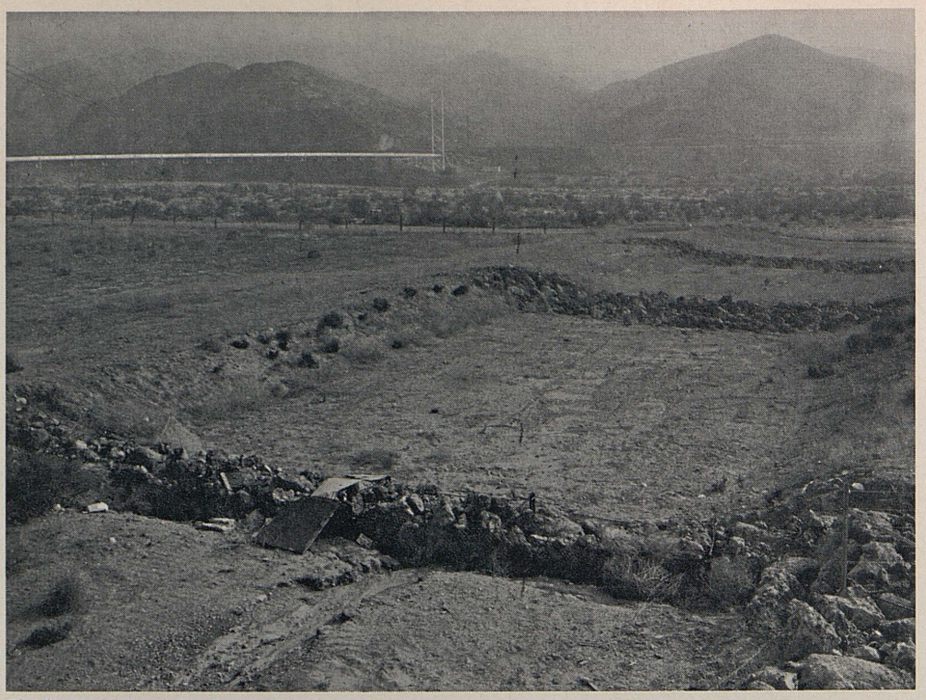
Included in this extensive concrete project is a 1½-mile test section for a shrinkage-compensated cement used in mix. The test area, which runs from Lost Canyon Bridge to Oak Springs Canyon Bridge, is divided into six quarter-mile sections. In three of them were poured air-entrained concrete —one using a normal job cement, and the two others the experimental mix at 6 sacks per cubic yard and at 6½ sacks. The same combinations were used in the other three sections, except that the concrete was non-air-entrained. The Materials and Research Department has taken shrinkage crack counts and straight gauge tests to determine the material's effectiveness and reported on the project in the September-October 1963 issue of *California Highways and Public Works.*

Desert Portion Soon Underway

The freeway will move out of the mountains and into the desert near



An eastward view of the new Antelope Valley Freeway from the present west end near Solemint. The interchange in middleground is Sand Canyon Road.



Check dams along the Santa Clara River are composed of steel rail and wire mesh double fences filled with rock. The view is downstream looking from the Tick Canyon Wash freeway bridge. The Southern California Gas pipeline spans the river in the left background.

A six-foot-high wall of riprap separates the left bank of the Santa Clara River from the freeway about two miles east of Solemint.

Vincent some time during the 1964-65 fiscal year. Although the difficulties of access and water will not be as great as they were at the higher elevations, the problem of locating a nearby material site will have to be met, and drainage will again be a greater-than-usual problem. For in the valley, the roadway will have to be protected not only from runoff, but also from flash floods. The Antelope Valley represents one of the largest drainage problems of its type in Southern California, because watercourses are undefined and the path that water will take toward the dry lakes is unpredictable.

Valley's Expectations

Perhaps nowhere in Southern California is the quick completion of a freeway more hoped for than in Antelope Valley. The valley remains the one major reserve of good, flat, developable land in Southern California, and valley leaders are convinced that the early 1970's will mark the beginning of a boom, as completion of the freeway meshes with the coming of imported water.

The valley's general economy is now based primarily on the aircraft-missile industry, which is centered almost exclusively at Edwards Air Force Base and Palmdale's Air Force Plant No. 42. Although agriculture (poultry, alfalfa, almond, pear, and peach growing) and mining also make important contributions to the valley's economy, a greater diversification of activity is sought. As stated in the Los Angeles County Planning Commission's 1960 report: "Many industries which might otherwise wish to locate in the Antelope Valley have no doubt been discouraged by lack of a fast four-lane highway running the entire route to the metropolitan area. Completion of the Antelope Valley Freeway should alleviate this problem."

If the boom does develop, the Antelope Valley is expected to grow from its present 74,000 people to over 500,000 by 1980. And by that date, three other new freeways, future Routes 48, 122, and 138, should crisscross the valley, making access easier for motorists and truckers coming from its northwest and northeast corners.

1962 Accident Report

California state highways in 1962 had a slight decrease in total accident rate from 2.76 accidents per million vehicle-miles in 1961 to 2.70 in 1962. A large increase in vehicle-miles of travel coupled with a decrease in number of accidents on urban conventional highways caused the rate reduction in spite of an increase in total number of accidents.

A breakdown of total accidents by highway type is shown in Table I.

The decrease in number of accidents on urban conventional highways results from the 1962 conversion of many miles of old city streets to urban freeways.

The increase in freeway mileage (140 miles rural and 84 miles urban) and its resultant increase in vehicle miles was the basic cause of the increase in number of freeway accidents.

The fatality rate on rural freeways rose substantially from 3.89 per hundred million vehicle-miles in 1961 to 4.88 in 1962. Every type of freeway fatal accident was up in 1962 except cross-median, head-on collisions. The total rural fatality rate dropped slightly from 8.13 in 1961 to 8.06 in 1962. (Freeway fatalities in 1961 and 1962 is the subject of a separate study.)

Table II compares fatalities (number of people killed) in 1961 with 1962 by type of facility. All categories were up except rural conventional. The total killed increased more than the increase in vehicle-miles, causing fatality rates to rise.

The fatality rate on rural conventional state highways (9.10 fatalities per 100 MVM) was almost twice that of rural freeways (4.88/100 MVM) and 3½ times that of urban freeways (2.63/100 MVM). Urban freeways, however, have a higher injury accident rate and total accident rate than rural freeways.

Table III is a comparison of the accident history for 1962 of urban freeways, rural freeways, and other rural state highways. National Safety Council figures for the United States show California freeway fatality rates somewhat higher than the national average for turnpikes.

SYNOPSIS

Total accidents in California in 1962 were up but not as much as vehicle-miles of travel, resulting in a slightly lower total accident rate. Eighty-four miles of urban freeway were opened in 1962, transferring many vehicle-miles of high-accident-rate traffic to the safer freeway.

The fatality rate on rural freeways rose from 3.89 per hundred million vehicle-miles to 4.88. On urban freeways the fatality rate increased from 2.16 to 2.63. Fog accidents, rear-ends, wrong-way drivers, accidents involving drunks, in fact every type of freeway fatal accident was up with the exception of cross-median head-on collisions.

The fatality rate on rural freeways was still approximately one half of the rate on conventional rural highways. Again in 1962, the four-lane undivided conventional highway had the highest accident rate on the rural system.

Fifty percent of the fatal accidents on all freeways were single-vehicle accidents. Three out of five of these hit a fixed object.

Travel now accumulating on lower accident rate rural freeways, annually accounts for approximately 6,000 fewer accidents than the number that would have occured on conventional rural roadways.

Table No. IV lists total accident rates by class of highway on the rural state highway system for the years 1953 through 1962. The 1962 accident rates were very similar to other years. The four-lane undivided class as always (except for 1961) had the highest accident rate. Four-lane divided, two-lane, expressway, and freeway follow in descending order as they have in the past for the predominant classes of highways. The one-lane and the three-lane classifications both have so very few miles, vehicle-miles of travel, and number of accidents that their rates are unreliable and erratic.

The accident rates for both the four-lane undivided and the four-lane divided classes are high for several reasons. One of the main reasons is that they are very often in the urban fringes and should be compared with the higher urban rates rather than rural rates. There generally are more frequent intersections and more roadside developments causing more conflicts with cross traffic, pedestrians, parked and parking vehicles, and egress from and ingress to adjacent improvements.

Table No. V lists the number of accidents, injuries, and fatalities and shows the accident rates by class of highway and severity for 1962. The highest fatality rate for the more common classes of rural state highways was the two-lane section with 10.12 per hundred million vehicle-miles. The rate for the three-lane section, 15.46 for 1962, is subject to considerable variation from year to year because of its total length of only 18 miles. Last year (1961) the same 18 miles had a rate of 8.49.

In 1961 and 1962, a breakdown of fatal accidents on all freeways (urban and rural) in the State, would show the following two-year totals:

Type of accident	*Number (1961 + 1962)*		*Percent*
Single vehicle	333		50.5
Hit fixed object	204	30.9	
Did not hit fixed object	129	19.6	
Pedestrian	84		12.7
Walking on freeway	57	8.6	
Dismounted vehicle occupant	27	4.1	
Head-on collision	104		15.8
Driving wrong way	36	5.5	
Crossed median	68	10.3	
Overtaking or sideswipe	139		21.0
Rear-end	123	18.6	
Sideswipe	16	2.4	
Totals	660		100.0

Table VI shows the number of rural accidents, the accident rates for the rural system (conventional highways,

TABLE I

ACCIDENTS BY TYPE OF HIGHWAY

Type of highway	Number of accidents 1961	1962	Percent change	Travel (billion vehicle-miles) 1961	1962	Percent change	Rates (accidents/MVM) 1961	1962	Percent change
Rural freeway	4,212	5,550	+31.8%	3.65	4.56	+25.2%	1.15	1.22	+6.1%
Rural conventional	34,117	35,242	+3.3%	14.19	13.94	−1.8%	2.41	2.53	+5.0%
Subtotal rural	38,329	40,792	+6.4%	17.84	18.50	+3.7%	2.15	2.20	+2.3%
Urban freeway	12,351	15,271	+23.6%	8.07	9.83	+21.8%	1.53	1.55	+1.3%
Urban conventional	44,344	44,229	−5.0%	8.54	8.03	−6.0%	5.19	5.26	+1.3%
Subtotal urban	56,695	57,500	+1.4%	16.61	17.86	+7.5%	3.41	3.22	−5.6%
Grand Total	95,024	98,292	+3.4%	34.45	36.36	+5.5%	2.76	2.70	−2.2%

NOTE: Total accident rate is *down* even though rate of *all* four types of highways is up. This is because the total number of accidents increased only 3.4 percent whereas travel increased 5.5 percent. The reason that accidents increased only 3.4 percent is that travel on the high accident rate systems (conventional) *decreased* 3.3 percent (760 MVM) and travel on the low accident rate systems (freeways) *increasd* 22.8 percent (2,670 MVM).

Put in another way, the overall accident rate represents a weighted average. In 1962, there was more "weight" (i.e. vehicle-miles) to the freeway portion of the total, and even though the freeway *rate* went up, a little, it was much lower than the nonfreeway *rate*, and increasing the weight of the freeway portion thus brought down the overall average.

freeways and total), vehicle miles of rural travel, and miles of rural freeway for the 12-year period of 1951 through 1962.

Table VI shows a slow growth in rural travel after 1955. This is partly due to incorporations during the 1955 to 1962 period which changed the classification of approximately 150 miles of rural highways to urban highways. Generally, these 150 miles of highways are high-volume roads.

TABLE II

FATALITIES BY HIGHWAY TYPE

Type of highway	Number of fatalities 1961	1962	Percent change	Rates (fatalities/100 MVM) 1961	1962	Percent change
Rural freeway	142	223	+57.0%	3.89	4.88	+25.7%
Rural conventional	1,310	1,269	−3.1%	9.23	9.10	−1.4%
Total rural	1,452	1,492	+2.8%	8.14	8.06	−1.0%
Urban freeway	174	259	+48.9%	2.16	2.63	+21.8%
Urban conventional	237	298	+25.7%	2.78	3.71	+33.5%
Total urban	411	557	+35.5%	2.47	3.12	+26.3%
Grand Total	1,863	2,049	+10.0%	5.41	5.64	+4.3%

TABLE III

1962 ACCIDENTS

	All rural state highways excluding rural freeways	Rural freeways	Urban freeways
Total number of reported accidents	35,242	5,550	15,271
Number of accidents involving injuries or fatalities	15,589	2,502	6,969
Number of accidents involving fatalities	1,012	186	204
Number of persons killed	1,269	223	259
Number of persons injured (not killed)	26,174	4,142	11,592
Ratio of total reported accidents to number involving injuries or fatalities	2.3	2.2	2.2
Ratio of fatal and injury accidents to fatal accidents	15.4	13.4	34.1
Ratio of total reported accidents to number involving fatalities	34.8	29.8	74.8
Number of reported accidents per fatal	28	25	59
Number of injuries per fatality	21	19	45
Fatality rate per 100 MVM	9.10	4.88	2.63
Fatal and injury accident rate per MVM	1.12	0.55	0.71
Total accident rate per MVM	2.53	1.22	1.55

National Safety Council 1962 U.S. totals are:

Fatalities	41,000
Fatality rate per 100 MVM (all highway types)	5.2
Turnpike fatality rate per 100 MVM	2.6

Freeway Role in Reducing Accidents

During the period 1951-1952, approximately 650 miles of rural freeways were opened to traffic. Total accidents have increased only 7.6 percent, whereas travel has increased 32.1 percent. This is reflected in a 19 percent reduction in the rural accident rate from 2.71 in 1951 to 2.20 in 1962. It can be said that the rural freeways have prevented a substantial increase in the number of accidents in spite of a one-third increase in the amount of travel on the rural system. This is demonstrated by Table VII, which shows the probable number of accidents that were avoided each year owing to the travel taking place on rural freeways instead of conventional highways. In the 12-year study period, over 37,000 accidents were avoided because a substantial part of the rural travel was on freeways in lieu of conventional highways.

Except for the years 1961 and 1962, there has been a downward trend in the accident rate for rural conventional roads. One of the prime reasons for the decrease in rate is that those rural sections of highways with the greatest amount of traffic and worse accident rates have generally been replaced by freeways first. Therefore, if the more than 660 miles of rural freeways had not been constructed, the rural conventional highway accident

rate might have increased instead of decreased in the past decade. A conservative estimate is that the number of accidents avoided by the rural freeway system since 1951 is in the order of 87,000. (87,000 is arrived by applying the 1951 accident rate of 2.77 to the 12-year accumulation of 201 billion vehicle-miles = 557,000 accidents. Subtracting actual number of accidents (470,000), leaves the 87,000 savings.)

Similar long-range data is not available for the urban system since accident reports on conventional urban state highways were not received by the Traffic Department prior to 1961.

However, because of the enormous amount of travel on urban freeways, the results are even more impressive for urban freeways, although the recorded history is shorter. It is estimated from the difference in the accident rates of city streets and urban freeways that if the 9.83 billion vehicle-miles of travel on urban freeways in 1962 had occurred on city streets, 35,000 more accidents would have occurred on the urban system in 1962 alone.

It is estimated that the freeway system (rural and urban) completed as of the end of 1962 has saved over 2,000 lives in the 14-year period of 1949 through 1962.

TABLE IV

ACCIDENT RATES ON VARIOUS CLASSES OF RURAL STATE HIGHWAYS
(Number of Accidents per Million Vehicle-miles)

Year	*1-lane*	*2-lane*	*3-lane*	*4 or more lanes undivided*	*4 or more lanes divided*	*Divided expressway*	*Freeway*	*Total*
1953	(a)	2.16	2.85	3.55	3.05	1.86*	(a)	2.35
1954	(a)	2.21	2.65	3.54	3.11	1.71*	(a)	2.30
1955	(a)	2.28	2.82	4.38	3.21	1.76*	(a)	2.41
1956	(a)	2.40	3.07	4.61	3.37	1.96	1.22	2.49
1957	(a)	2.44	3.04	4.35	3.07	1.85	1.05	2.36
1958	(a)	2.45	3.03	4.13	3.08	1.77	0.98	2.26
1959	(a)	2.38	2.57	4.09	2.91	1.70	1.00	2.15
1960	(a)	2.29	2.49	4.03	3.05	1.65	1.21	2.12
1961	2.95	2.42	4.80	4.13	3.06	1.71	1.15	2.15
1962	3.67	2.55	3.88	4.62	3.06	1.86	1.22	2.20

(a) Not available.
* Includes freeways.

TABLE V

ACCIDENTS AND ACCIDENT RATES ON VARIOUS CLASSES OF RURAL STATE HIGHWAY BY KIND OF ACCIDENT
(CALIFORNIA 1962)

	2-lane (a)		*3-lane*		*4 lanes undivided (b)*		*4 lanes divided (c)*		*Divided expressway*		*Freeway*		*Total*	
Miles	10,581		18		138		222		759		664		12,382	
Million vehicle-miles	8,150		71		771		1176		3,771		4,566		18,505	
Average daily traffic	2,110		10,800		15,400		14,500		13,700		18,700		4,100	
	No.	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*
Total reported accidents	20,793	2.55	275	3.88	3,562	4.62	3,601	3.06	7,011	1.86	5,550	1.22	40,792	2.20
Fatal and injury accidents	9,335	1.15	124	1.75	1,431	1.85	1,447	1.23	3,252	0.86	2,502	0.55	18,091	0.98
Injuries	15,457		195		2,345		2,427		5,748		4,144		30,316	
Vehicle occupants	15,254		190		2,248		2,364		5,708		4,108		29,872	
Pedestrians or cyclists	203		5		97		63		40		36		444	
Fatalities	825	10.12	11	15.46	65	8.43	83	7.06	285	7.56	223	4.88	1,492	8.06
Vehicle occupants	765		11		58		64		262		193		1,353	
Pedestrians or cyclists	60		0		7		19		23		30		139	

Rates shown are accidents per million vehicle-miles except fatalities rates are persons killed per 100 million vehicle miles.
(a) Includes 182 miles of one lane.
(b) Includes 29 miles of six lanes undivided.
(c) Includes 73 miles of six lanes divided.

TABLE VI

Year	*Rural accidents*	*Rural accident rates*			*Rural travel (billion VM)*	*Miles rural fwys.*
		Conv.	*Fwy.*	*Combined*		
1951	37,927	2.77	1.51 *	2.71	14.02	50 *
1952	40,462	2.78	1.56 *	2.70	14.99	61 *
1953	37,292	2.44	1.39 *	2.35	15.88	82 *
1954	37,068	2.45	1.27 *	2.30	16.10	131 *
1955	41,315	2.66	1.24	2.41	17.15	109
1956	42,828	2.60	1.22	2.49	17.19	181
1957	40,252	2.53	1.05	2.36	17.06	274
1958	38,285	2.48	0.98	2.26	16.97	371
1959	37,640	2.39	1.00	2.15	17.52	430
1960	38,138	2.31	1.21	2.12	18.01	448
1961	38,329	2.42	1.15	2.15	17.84	524
1962	40,792	2.53	1.22	2.20	18.51	664

* Rural plus urban.

Accident Reporting From Cities

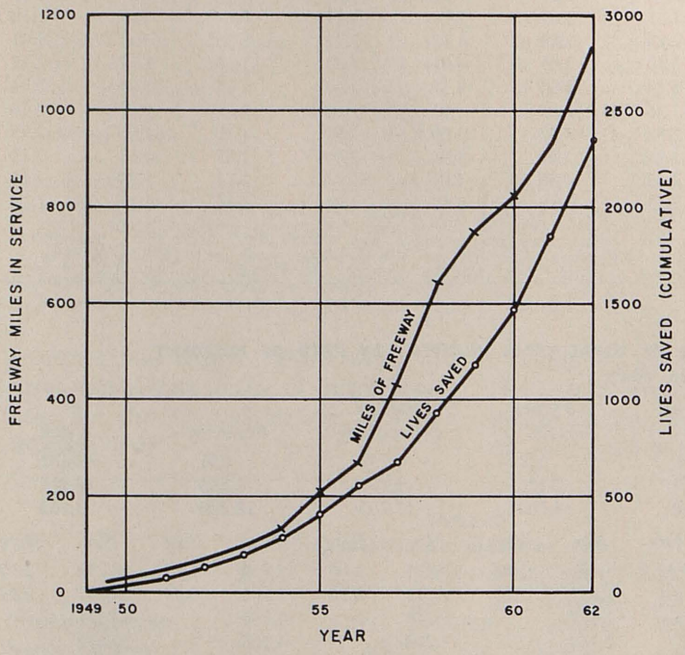
1961 and 1962 were the first two years that we received accident reports on the state highways on urban city streets. They were not coded in detail for 1961 and 1962, merely counted. In 1963, we are coding urban conventional highway accidents.

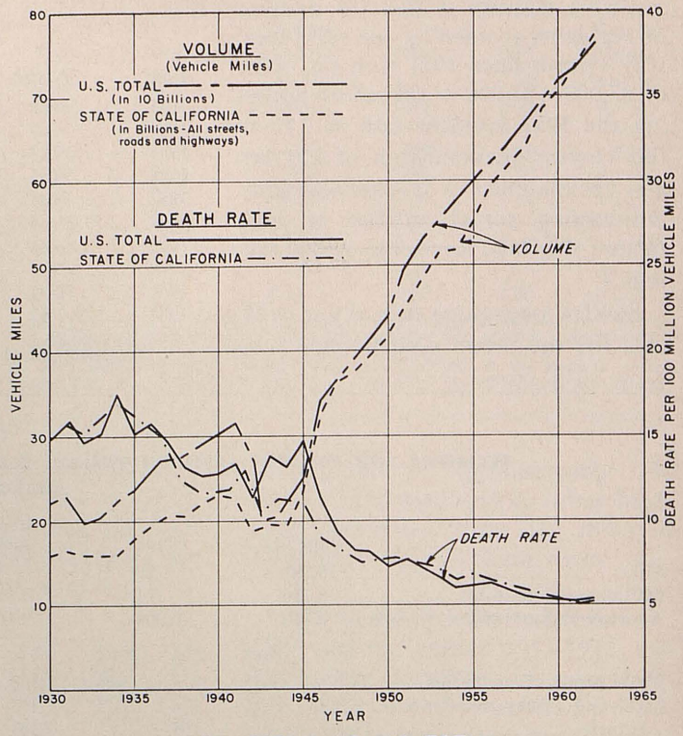
Approximately 270 cities out of 384 in the State are submitting reports on city streets that are state highways. Since most of the cities not reporting

Figure 1

CALIFORNIA FREEWAYS

ESTIMATED NUMBER OF LIVES SAVED BY FREEWAYS IN OPERATION SINCE JAN. 1, 1949





CALIFORNIA VS. U.S. TOTAL

FIGURE 2

1962

TOTAL DEATHS BY AGE GROUP

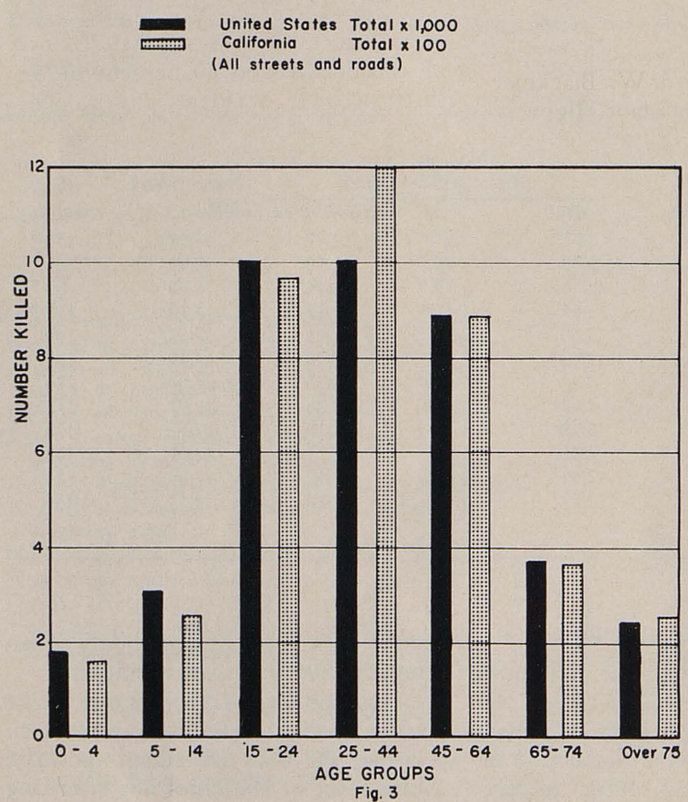
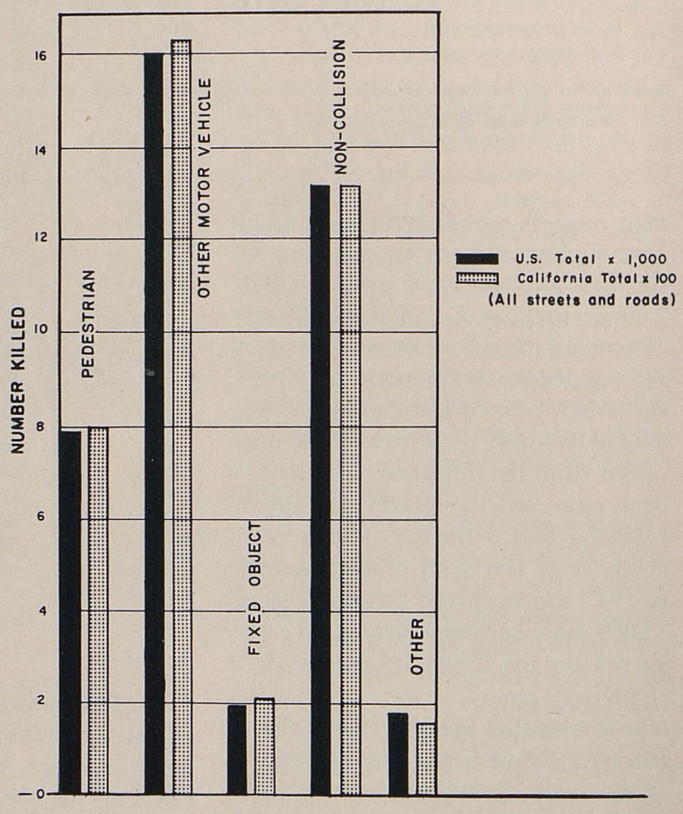


Fig. 3



1962 DEATHS BY TYPE OF ACCIDENT

FIG. 4

TABLE VII

PROBABLE NUMBER OF ACCIDENTS AVOIDED BY RURAL FREEWAY SYSTEM

Year	*Rural travel (billion VM)*	*Accident rate (rural conv.)*	*Probable number of accidents w/o freeways*	*Number of accidents that actually occurred*	*Number of accidents avoided*
1951	14.02	2.77	38,835	37,927	908
1952	14.99	2.78	41,672	40,462	1,210
1953	15.88	2.44	38,747	37,292	1,455
1954	16.10	2.45	39,445	37,068	2,377
1955	17.15	2.66	45,619	41,315	4,304
1956	17.19	2.60	44,694	42,828	1,866
1957	17.06	2.53	43,162	40,252	2,910
1958	16.97	2.48	42,086	38,285	3,801
1959	17.52	2.39	41,873	37,640	4,233
1960	18.01	2.31	41,603	38,138	3,465
1961	17.84	2.42	43,173	38,329	4,844
1962	18.51	2.53	46,830	40,792	6,038
Total	201.24		507,739	470,328	37,411

are small, we believe we are receiving over 90 percent of all the acident reports.

Figure No. 2 shows a death rate and travel volume comparison between California and the United States as a whole. The volume curves of California and the United States are very similar with respect to rate of increase. For the first time, in 1962, California exceeded 10 percent of the nation's total travel in vehicle-miles. California's death rate for all motor vehicles involving deaths remains about the same as for the United States.

Figure No. 3 compares California with the nation in ages of all victims killed in motor vehicle accidents. California deaths are very nearly 10 percent of the nation's total. Deaths in the various age groups for California parallels closely the national averages.

Figure No. 4, Deaths by Type of Accident, shows California, for all types of roadways, again following the national trend. Figure No. 4 illustrates also that pedestrian deaths were about half those caused by collisions between automobiles. For the entire street and highway network, deaths by collision with a fixed object were only 15 percent of the total single vehicle accident deaths. On freeways this type of accident causes 30.9 percent of all the deaths, and 60 percent of the single vehicle accident deaths. This does not necessarily mean that the freeway fixed object accident rate is high. The fixed object fatal accident category is a higher percentage of the total on freeways. The head-on and intersection accidents, which are a large portion of the total accident picture on conventional roads, have been virtually eliminated on freeways.

DIVISION HAS ONE-SEVENTH OF TOTAL ITTE ALUMNI

A recent almuni roster of the Institute of Transportation and Traffic Engineering indicates that 14 percent of the total—or 17 alumni—are now with the California Division of Highways. Each of these men has a degree of M.E., M.S., or D.E. in transportation engineering.

District IV employs Associate Highway Engineer Maurice W. Beckstead, District Planning Engineer Burton N. Crowell, Assistant Highway Engineer Hiroshi Eta, Associate Highway Engineer Donald K. Goodrich, District Planning Engineer Dean E. Larson, Associate Highway Engineer James W. Rae, Assistant District Engineer A. E. Simmons, and Project Engineer Frank C. Tedesco.

Headquarters has three of the ITTE graduates: Assistant Maintenance Engineer Carlton E. Forbes, and Senior Highway Engineers Max D. Rothe and Charles E. Zell, both in urban planning.

Employed in other areas are Assistant District Engineers Allison D. Mayfield and William E. Shaefer of District VII; Senior Highway Engineer Leigh Ballard of District XI, Associate Highway Engineer George O. Bischof of District II, Associate Highway Engineer Edward W. Blackmer of District III, and Assistant Highway Engineer John W. Lund of District IX.

ITTE was established by the Legislature in 1947, and organized at the University of California, Los Angeles, with this mandate: to "carry on instruction and research related to the design, construction, operation, and maintenance of highways, airports, and related facilities for public transportation."

Functioning as a part of the university, ITTE's primary objective is education and advancement of knowledge in the transportation and traffic engineering fields, through training of a graduate and professional type, various phases of in-service training, and dissemination of factual information to public agencies and groups other than those composed of technical engineers.

An annual street and highway conference is sponsored by ITTE, bringing together state, city and county engineers and others interested in transportation—such as representatives of consulting firms, material suppliers, automobile associations and transit organizations. The 16th conference was held this year on the Berkeley campus of the university, January 30, 31 and February 1.

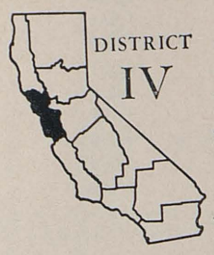
In its *Quarterly Bulletin*, ITTE regularly reviews current activities and research projects, and lists ITTE publications available.

Harmer E. Davis has been ITTE director since its establishment.

Time-Distance Study

1937, 1963 Compared; Predictions for 1980

By J. P. SINCLAIR, Assistant State Highway Engineer



A recent study, made by the District IV Traffic Department during nonpeak travel hours, reveals that as a result of freeway construction it is now possible to travel twice (and in several instances three times) as far as it was in 1937—moving in the same direction and using the same amount of time.

This study was based upon WPA Project 5577, a survey of average vehicular speeds over selected main streets in the Oakland and San Francisco Metropolitan Areas made in 1937 by the Oakland Street Department.

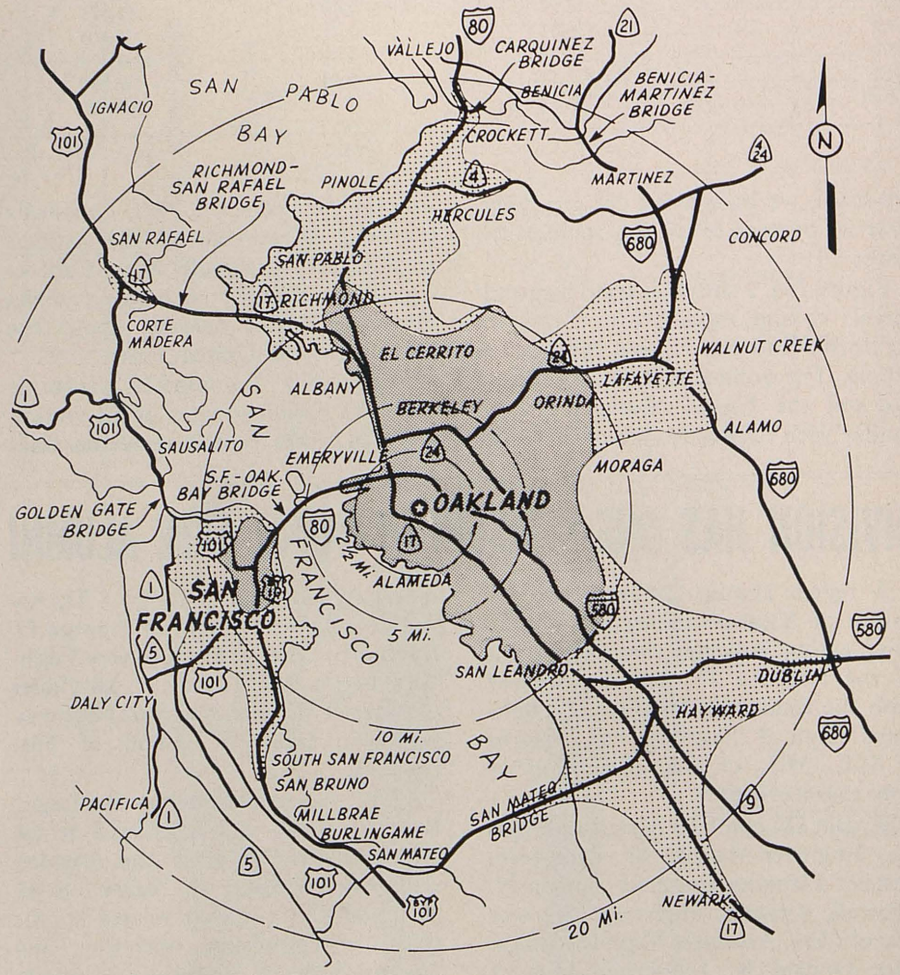
In 1937, there were 590,000 motor vehicles registered in the nine counties of the San Francisco Bay area, which had a population of about 1,680,000, and, of course, no freeways. Today's population is 4,000,000 with 1,650,000 vehicles using a freeway network of over 380 miles.

The Oakland point of origin of the 1937 study was 14th and Broadway. It took 20 minutes to reach the intersection of San Pablo and Solano Avenues in Albany, a distance of 6.0 air miles. It took the same amount of time to reach the Alameda–Contra Costa county line through the old Broadway high-level tunnel, only 4.8 miles from the starting point. The intersection of 107th Avenue and East 14th Street, a distance of 7.5 miles, was reached in 25 minutes.

Current Study

The current study reveals that it is now possible to travel 12.4 instead of 6.0 miles in the same 20 minutes from the same starting point in Oakland and arrive at the intersection of San Pablo Avenue and Road 20 in San Pablo.

In 1963 the test driver covered 8.9 instead of 4.8 miles in 20 minutes and arrived at the intersection of the Free-



LEGEND

- *Origin (14th St. & Broadway, Oakland)*
- *Concentric mile circles with zero at origin*
- *30 minute distance from origin—1937*
- *30 minute distance from origin—1963 (Not peak hours)*

EAST BAY METROPOLITAN AREA MOTOR VEHICLE TRAVEL TIME

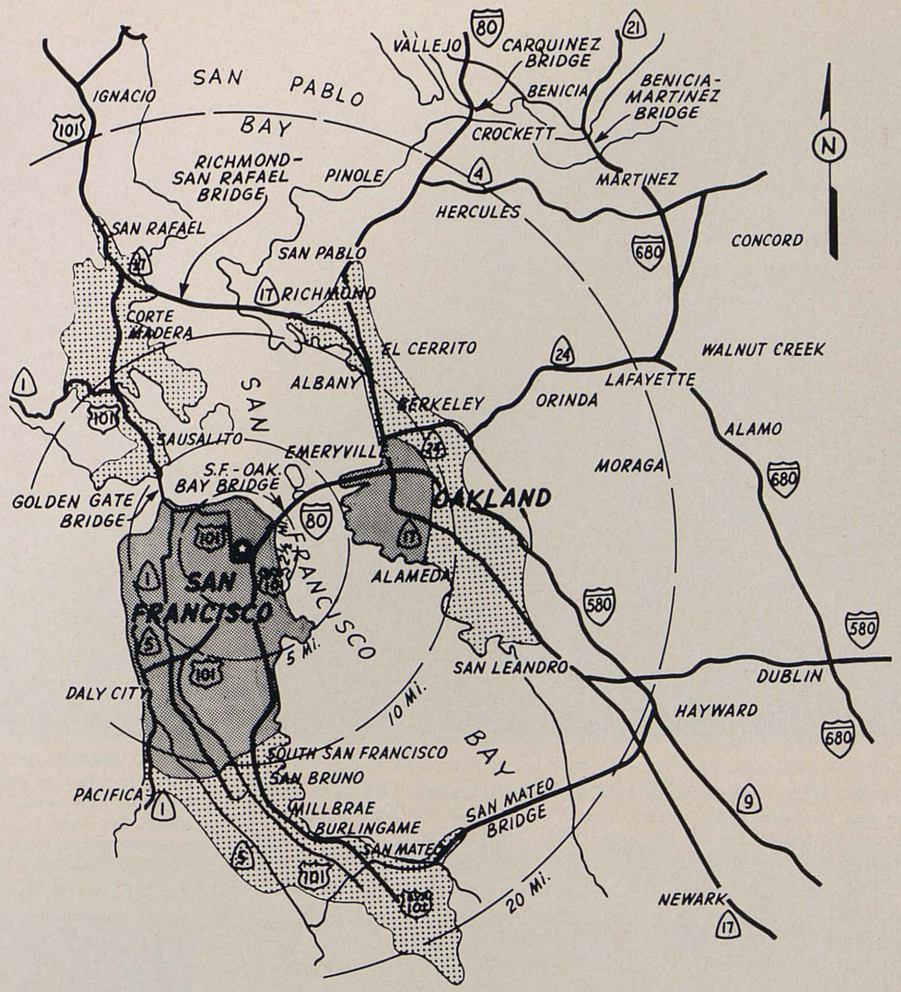
Scale

0 1 2 3 4 5 6 7 8 MILES

way and Upper Happy Valley Road in Lafayette. Where it took 25 minutes to go 7.5 miles in 1937, the test driver went 18 miles in the same direction in the same time in 1963 to the intersection of Nimitz Freeway and Alquire Road in Hayward.

The starting point in San Francisco was at Fulton and Larkin Streets. In 1937 it took 25 minutes to go 6.5 air miles to Mission Street at the San Mateo county line. The intersection of 19th Avenue and Sloat Boulevard, 5.7 miles from the point of origin, was reached in 20 minutes. It took 15 minutes to go 4.8 miles to the intersection of Third Street and Bayshore Boulevard.

Starting from San Francisco, the test driver in 1963 went 12.6 instead of 6.5 miles to the intersection of Sneath Lane and Junipero Serra Boulevard in San Bruno; 8.4 instead of 5.7 miles to the junction of Eastmoor Avenue and Junipero Serra Boulevard in Daly City; and 15.4 instead of 4.8 miles to the point where the Bayshore Freeway joins Peninsula Avenue in San Mateo—in each instance using the same amount of time it took in 1937.



Depression Year Traffic

One major factor holding down the volume of traffic in 1937 was the nationwide depression, which was still very much in evidence; although the construction of the two magnificent bridges – the San Francisco-Oakland Bay Bridge and the Golden Gate Bridge—helped make its effects felt less in the San Francisco Bay area than elsewhere in the country.

The only resemblance to an expressway in the State of California at that time—the Arroyo Seco Parkway—was in the early planning stage.

It was not until 1939 that the Legislature established the freeway principle by statute and authorized the Department of Public Works to construct any portion of the State highway system as a freeway or to make any existing State highway a freeway.

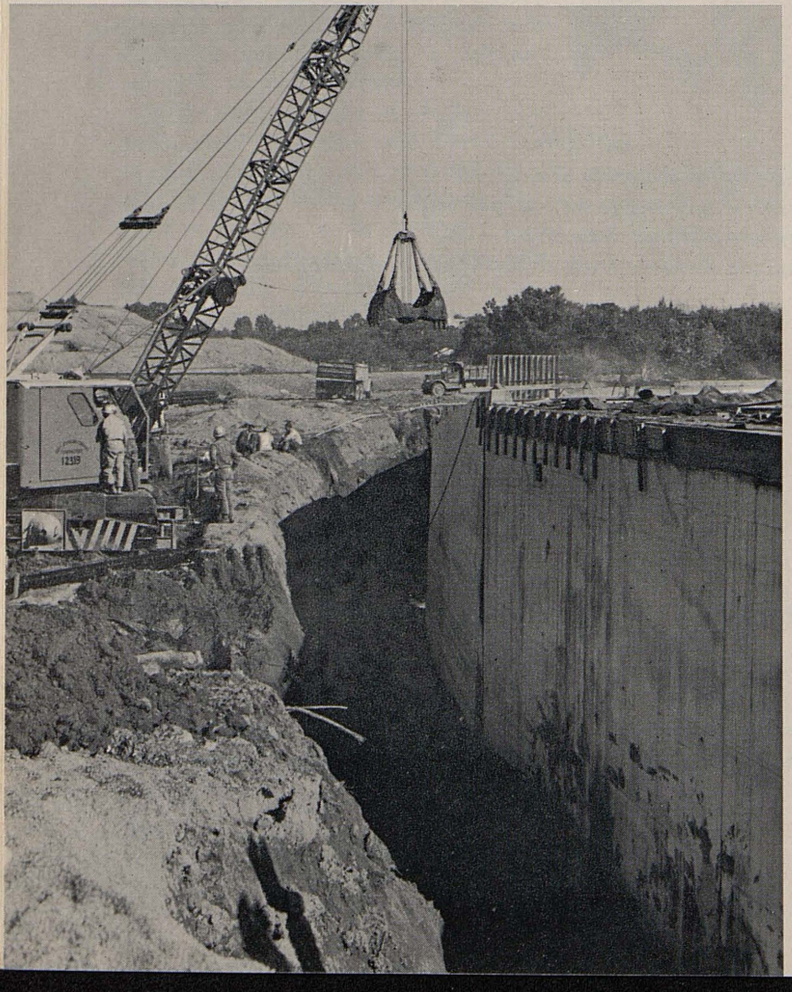
Senate Concurrent Resolution No. 26, adopted by the Legislature at the 1957 session, requested the Department of Public Works "to undertake a study which will provide a basis for an overall statewide plan of freeways and expressways for the State of California, such study not to be limited to state highways, and to locate the potential freeway and expressway routes of such a statewide system and the necessary connections thereto as nearly as is practicable in advance of detailed engineering design of project."

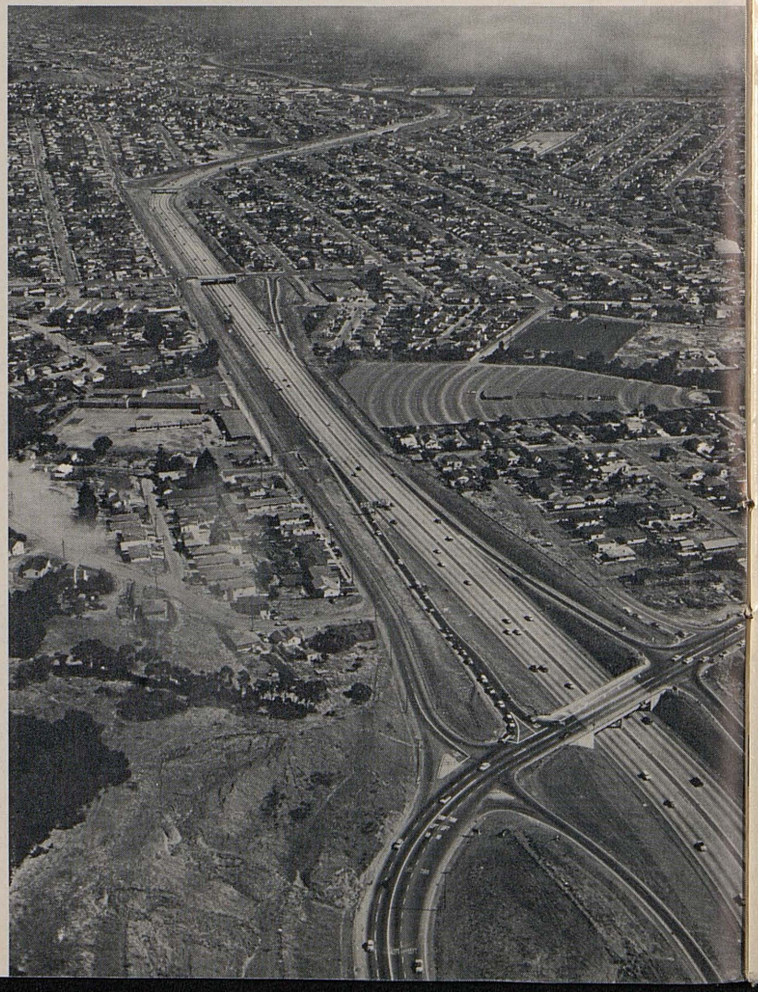
Master Plan Adopted

As a direct result of this study, the 1959 Legislature adopted a master plan

PHOTO ABOVE. Mount Diablo Boulevard (above) crowded with traffic heading east in Contra Costa County toward the Pleasant Hill Road intersection beyond the crest of the hill. The year: 1953. PHOTO BELOW. Construction on the Sign Route 24 freeway which parallels Mount Diablo Boulevard (right).

PHOTO ABOVE. San Pablo Dam Road extends up from the bottom of the photo to intersect with San Pablo Avenue (center). Right-of-way for future Interstate 80 freeway is being cleared in the area to the left of the drive-in movie. The year is 1954. PHOTO BELOW. The Eastshore Freeway (Interstate 80) takes traffic through Richmond in western Contra Costa County. Relocated San Pablo Dam Road crosses the freeway (foreground). Note the location of the drive-in movie in this and the above photo.





for the California freeway and expressway system, to be essentially complete by 1980.

Since that time the California freeway and expressway system construction has been carried on in full swing in accordance with the master plan.

At present, the District IV (San Francisco Bay area) portion of the master plan is approximately 30 percent complete. As of October 1, 1963, there were some 384 miles of freeway and expressway completed, under construction, or budgeted for to serve the 1,650,000 registered motor vehicles and the 4,022,000 inhabitants of the nine counties comprising District IV.

Just as in the rest of California, however, the freeway and expressway system in the Bay area is by no means complete.

It is planned that by 1980 there will be about 1,250 miles of freeway and expressway in District IV to carry an estimated 6,500,000 inhabitants in some 3,200,000 motor vehicles.

Freeway Median Used For Transit Line

Acquisition of rights-of-way for the joint highway-rail use of a portion of the Grove-Shafter Freeway in Oakland is now in progress, along with some redesign of the project, on the basis of a "share the cost" agreement between the State and the Bay Area Rapid Transit District.

The agreement was signed by Director of Public Works John Erreca on December 3, 1963, after extensive discussions between representatives of the State Division of Highways and the BARTD. It covers the section of freeway between 24th Street and Golden Gate Avenue, a length of about 3½ miles.

Rapid transit facilities will occupy a portion of the median strip between the roadways of the freeway, according to the agreement. Costs for right-of-way and common construction facilities will be shared in proportion to the areas occupied by each agency.

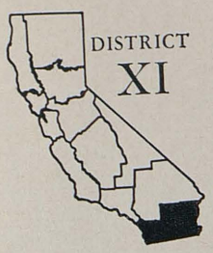
The agreement will make possible not only substantial savings but also considerably less disruption to the community than if the facilities were separately located, designed and built.

BEFORE FREEWAY. Heavy traffic on Bayshore Boulevard, going north from the Peninsula, stops at traffic light at Third Street in San Francisco. The year: 1953.

AFTER FREEWAY. The Bayshore Freeway and Third Street Overcrossing (center) after the freeway was completed in 1957.

South Bay Freeway

By A. S. HAMM, Resident Engineer



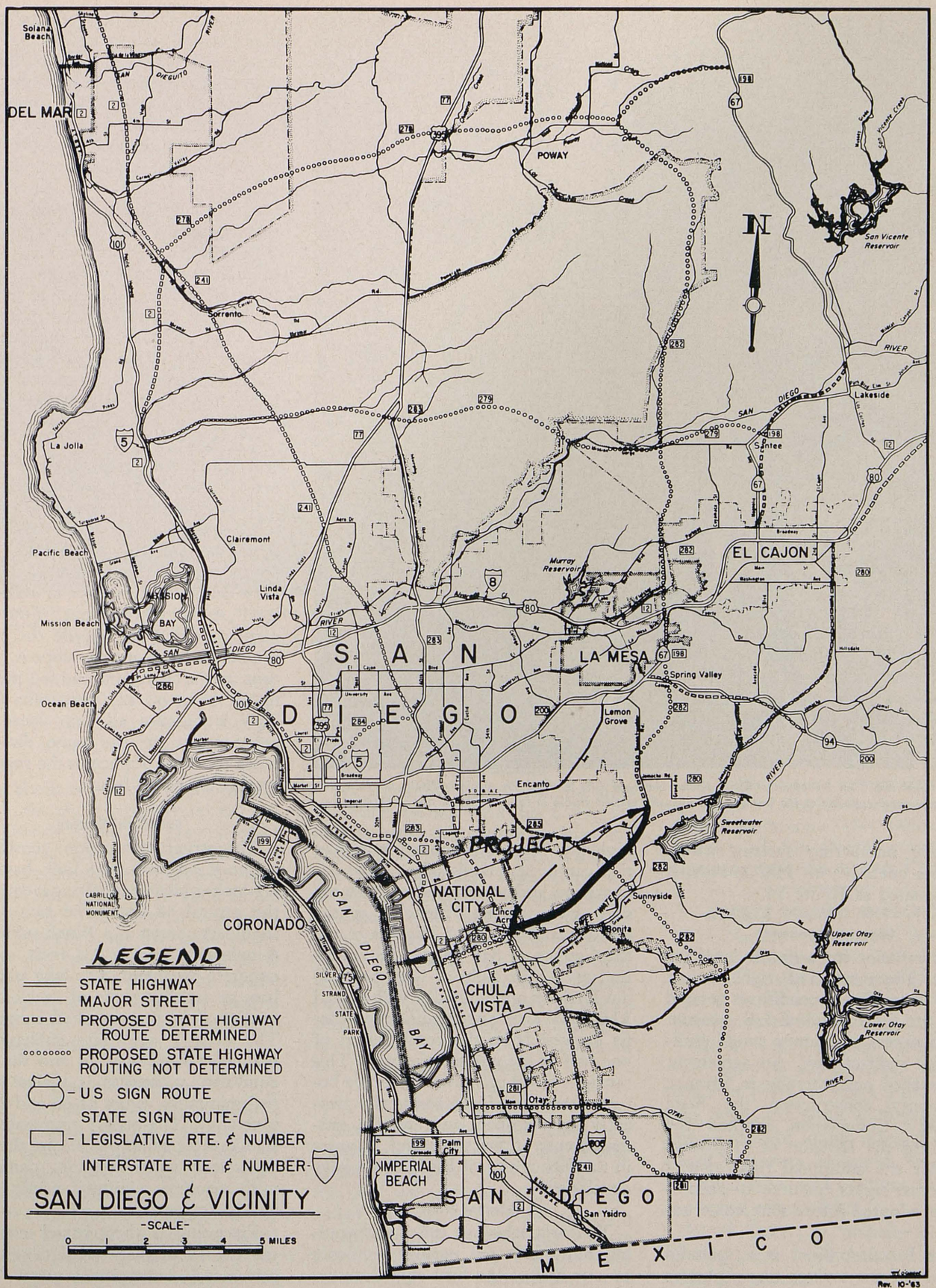
In the early afternoon of September 27, 1963, county, state and contractor personnel removed construction barricades and opened to traffic a 4¾-mile link in the South Bay Freeway. Inside of 10 minutes traffic was moving rapidly both ways between the National City—Chula Vista area and the Spring Valley area southeast of San Diego. The new freeway allows through traffic to bypass about six miles of two-lane Sweetwater Road, which meanders through the Sweetwater Valley in the Bonita area.

During commuter hours, traffic had been extremely congested and hazardous on the old route. Now the remaining local traffic can move smoothly and with improved speed on the old road, while through traffic moves swiftly and safely on the new route.

This road was the culmination of studies begun early in the last decade by the county on a proposed federal aid secondary project to run directly from Sweetwater Road at National City northeasterly to Spring Valley where Sweetwater Road joins Jamacha Boulevard. The route was settled upon in 1956. However, budget problems, traffic loads and rising land values demonstrated that the type of propect planned had become, by 1959, uneconomical and wasteful because it would be abandoned when contemplated state freeways were constructed.

Therefore, Mr. D. K. Speer, county surveyor and road commissioner proposed that this county project become the construction of the initial four lanes of an ultimate eight-lane divided freeway, initially known as Legislative Route 280 of the State Division of Highways freeway and expressway system in San Diego County. Under

Looking northeast from Sweetwater Road crossing toward reentry into Sweetwater Road at the northeast end of the project. Both large rock cuts show clearly.


Solana Beach
DEL MAR
POWAY
San Vicente Reservoir
Sorrento
La Jolla
Clairemont
Pacific Beach
Linda Vista
MISSION BAY
Mission Beach
Ocean Beach
SAN DIEGO
LA MESA
EL CAJON
Spring Valley
Lemon Grove
Encanto
Lakeside
Santee
Murray Reservoir
Sweetwater Reservoir
PROJECT
NATIONAL CITY
Sunnyside
Bonita
Upper Otay Reservoir
Lower Otay Reservoir
CHULA VISTA
Otay
CORONADO
CABRILLO NATIONAL MONUMENT
SILVER STRAND STATE PARK
SAN DIEGO BAY
IMPERIAL BEACH
Palm City
San Ysidro
MEXICO
N
LEGEND
STATE HIGHWAY
MAJOR STREET
PROPOSED STATE HIGHWAY ROUTE DETERMINED
PROPOSED STATE HIGHWAY ROUTING NOT DETERMINED
- U S SIGN ROUTE
STATE SIGN ROUTE-
- LEGISLATIVE RTE. & NUMBER
INTERSTATE RTE. & NUMBER-
SAN DIEGO & VICINITY
-SCALE-
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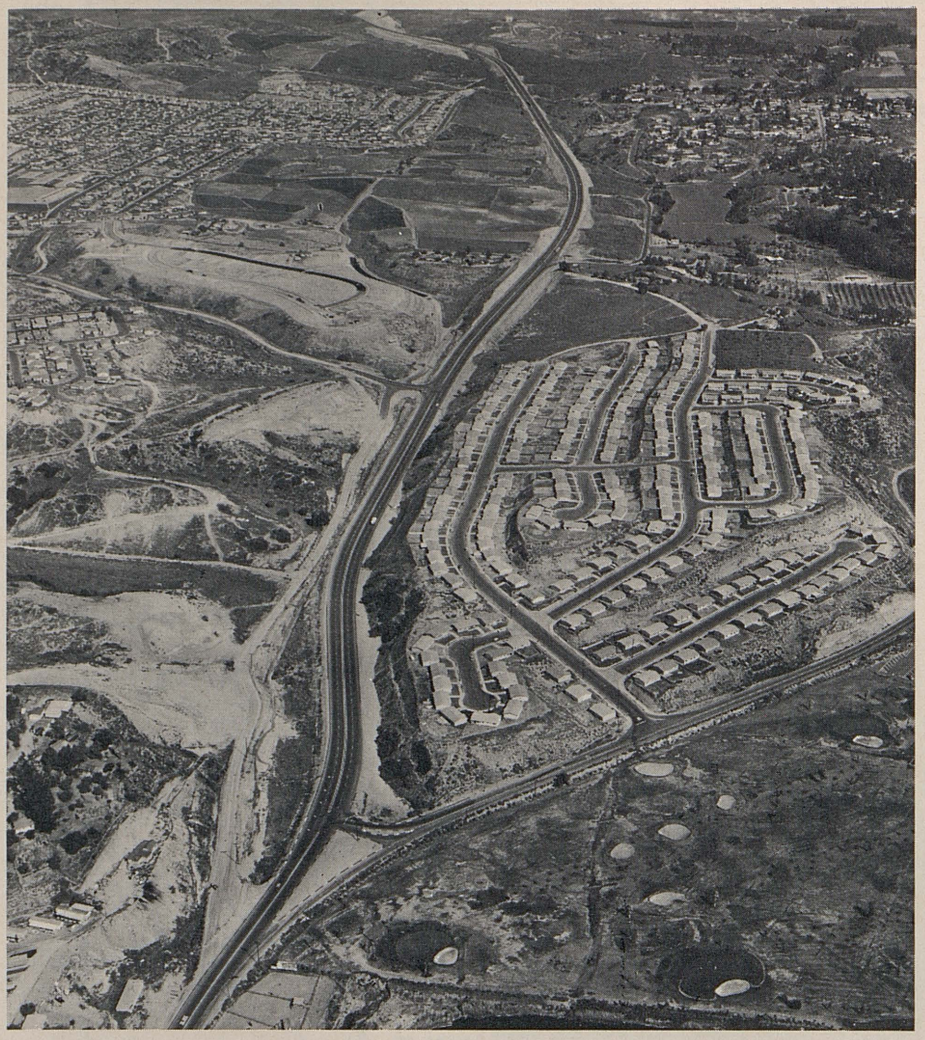


Looking northeast from Sweetwater Road at the National City end of the project. Photo on following page continues view of the freeway starting with section visible in far distance of above aerial.

the new numbering system, which becomes operative on July 1, 1964, it is designated as Route 54.

Superior Standards

The superior freeway standards for grades, alignment and right-of-way would necessitate expenditures beyond those for the original F.A.S. project, and in excess of county funds available for right-of-way. An agreement was worked out whereby in advance of county construction the State Highway Commission adopted the route and the Division of Highways paid for the additional right-of-way and access rights required to accommodate adopted future state construction.

This F.A.S. project is a splendid example of the savings to, and better highways for, the motoring public that can be accomplished by close cooperation and understanding between such governmental agencies as the California Division of Highways and the County of San Diego. The eventual saving in right-of-way costs to the Division undoubtedly will exceed $3,000,000 even disregarding the benefit derived from the construction of one-half of the ultimate freeway. This saving is based upon the difference between the cost of purchasing the presently undeveloped land and the estimated cost of the same land 10 years in the future after it has become fully developed.

Original Plans

The original plans called for grading four lanes and paving two lanes on one-half of the final eight-lane development. Evaluation of traffic and cost factors warranted paving four lanes in the initial contract. The decision has proved sound; for, only two months after completion, the daily count was 12,000 cars per day on the old and new roads—a 4,000-car increase from the old road volume. The horizon year estimate is for 112,000 cars per day, which would require the anticipated eight-lane freeway.

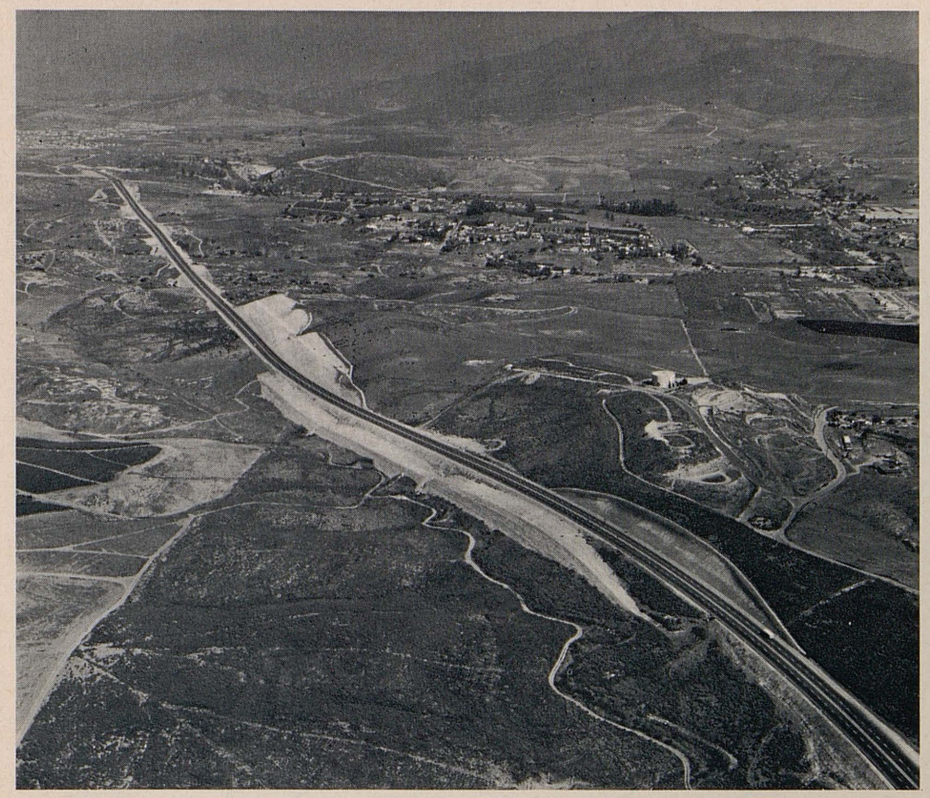
In accordance with the master plan of highways for San Diego County, this facility was engineered to become an integral connecting link with five freeways being planned for this area in the next 20 years. This freeway system is particularly important in the light of prospective port and industrial facilities in the South Bay area.

The new road is 62 feet in paved width between outer edges of shoulders. It provides two 11-foot lanes and a 7-foot shoulder on each side of a 4-foot-wide painted median strip. Designed to freeway standards, grades are easy and curves are flat, making the road pleasant to drive at maximum legal speeds throughout. Four-foot earth shoulders lie outside the paved shoulders. Normal cross slope is 5 percent on the shoulders, and is 2 percent to the right on all four traffic lanes. This is because all four lanes will carry traffic in the same direction when the State duplicates the roadway on the left in the future.

Structural Section

The structural section consists of a 1-foot subbase, an 8-inch base and a 3-inch asphalt concrete pavement in the central 48 feet. The two 7-foot shoulders consist of a 9-inch subbase, a 4-inch base and a 1½-inch asphalt concrete pavement. The base and subbase as supplied were of much better quality than the specified minimum. The class 2 aggregate subbase stabilometer value was 78 and the sand equivalent value was 51 against specified minimum values of 60 and 25 respectively. The class 2 aggregate base stabilometer value was 81 and the sand equivalent value was 54, compared with specified minimum values of 78 and 30 respectively.

Excepting a three-barrel concrete culvert, all drainage structures are of galvanized corrugated metal pipe,



View from near middle of the project to northeast end of the highway in the far left background. The heavy, sandy cuts can be clearly seen. The wide, white strip on the left of the roadway is close to 70,000 cubic yards of waste material placed for future four-lane addition.

asphalt coated where prior tests indicated corrosive, "hot" soil. All drainage structures were planned to become an integral part of the ultimate project.

For about two-thirds of the project length, the underlying natural soil was a prehistoric material of gray to white beach sand and fines containing a good percentage of rounded, hard, polished rock up to six or eight inches in diameter. The material was weak when saturated, but had good stabilometer and sand equivalent values. It was not inherently difficult to handle or compact in the fills. This natural ground stood well in deep cut banks, some up to 70 or 80 feet high.

Deep Cuts, High Fills

The northeast third of the project contained deep cuts and high fills. The cuts yielded a high percentage of sound quartizitelike rock and larger quantities of mudstone. Both kinds of stone required much shooting, but the mudstone broke down well and slaked to a high degree when wet so that good, tight, stable fills resulted. All excess cut, of about 100,000 cubic yards, was placed in the right-of-way on the left where it would economically provide fill for the coming construction in another decade.

As previously mentioned, the new four-lane facility will be converted into an eight-lane freeway when the State builds, in a few years, a median and four additional lanes along the northwest (left) side of the existing. Prompted by swiftly rising land values, which would add in excess of $3,000,000 cost in 10 years, the State and county have provided liberal right-of-way for the future construction. This explains the fact that right-of-way costs exceeded the amount of the construction contract.

New Construction Warranted

Traffic studies warrant much new construction by the State and county in the area southeast of San Diego. As this and other high-speed links are added, the need for rapid program completion will certainly grow more pressing. Already this new section is accentuating the obsolescence of streets joining this new link on the southwest Montgomery Freeway and to Highway 94 and Highway 80 (Interstate 8) on the northeast. Therefore, plans are already made for extension of the South Bay Freeway as fast as funds allow.

A breakdown of costs for this federal aid secondary project follows:

Contract construction cost	$1,159,805
Federal aid contract funds	45%
State-county contract funds	55%

Item	*Amount*	*Percent contract construction*
Total preliminary and design engineering	$74,000	6.4
Total construction engineering (county and state)	164,000	14.2
Right-of-way—State	421,238	36.3
Right-of-way—county	795,426	68.6
Totals	$1,454,664	125.5
Total cost of contract, engineering, and right-of-way	$2,614,470	

Site and soils investigation was handled by District XI of the California Division of Highways under direction of Paul Ruplinger.

Project design was under immediate supervision of Richard D. Dudley of the County of San Diego. Project design review was under the direction of John Rising of District XI.

Project construction resident engineers were Richard D. Dudley and Alton S. Hamm for the county; state project construction representatives were James V. Bell and Henry Chisholm, with Eugene Calman acting for the State as district construction engineer. Contractor was Daley Corporation of San Diego; contractor's superintendent was Robert Conley.

MICKLE NAMED DIRECTOR

The National Academy of Sciences–National Research Council has announced the appointment of D. Grant Mickle as executive director of its highway research board.

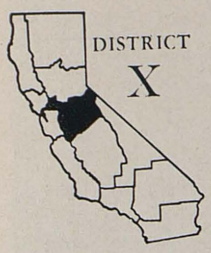
Mickle, who has been deputy federal highway administrator for the past two years, succeeds Fred Burggraf, who will retire as director following the 43d annual meeting of the board in January. Burggraf, the director since 1951, will continue to serve the board as consultant.

W. N. Carey, Jr., assistant director of the board, will become deputy executive director.

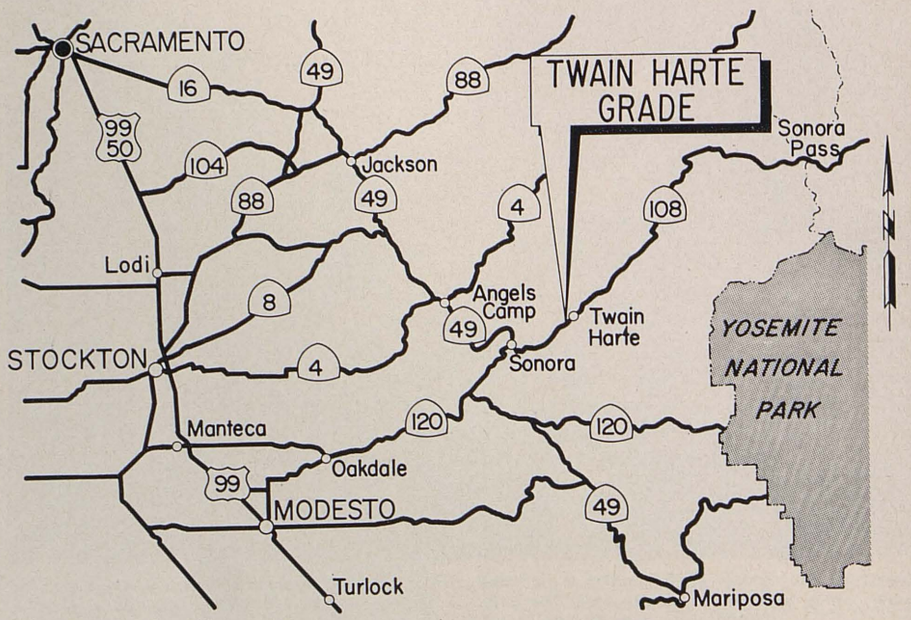
Twain Harte Grade

Modern, Scenic Freeway Was Construction Goal

By C. E. MOFFATT, District Design Engineer



To build a scenic highway in a mountain recreation area and make it a modern freeway at the same time – this was the challenging assignment and opportunity that has resulted in the recently completed "Twain Harte Grade" project on State Sign Route 108, in Tuolumne County, east of Sonora. How this opportunity was grasped and the goals realized is a revealing account of the highway engineer's recognition of the aesthetic and scenic values along the route, and the means by which the location was adjusted and the design was made to preserve these desirable values.



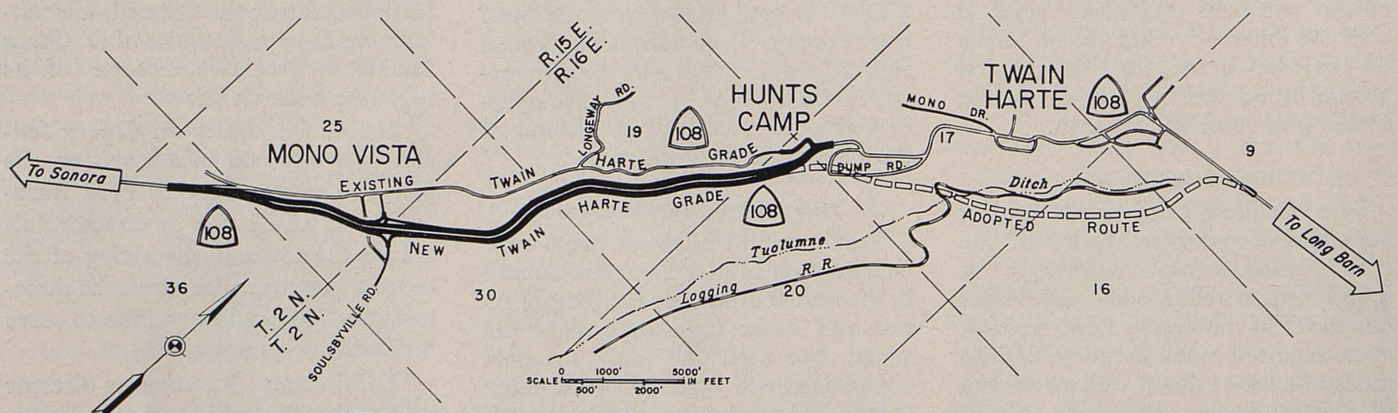
Highway 108 (Legislative Route 13) serves a rapidly growing recreational area of the Sierra Nevada from the City of Sonora to Sonora Pass and the eastern slope of the Sierra, passing through the mountain communities of Twain Harte, Sugar Pine, Mi-Wuk Village, Long Barn, and Pinecrest—to name a few.

The total summer population of the area between Twain Harte and Pinecrest is estimated to be nearly 20,000, consisting of those in houses and cabins, various camps sponsored by municipal, fraternal, religious, and college alumni groups, Boy Scouts, Girl Scouts, and individual campers.

New Subdivisions

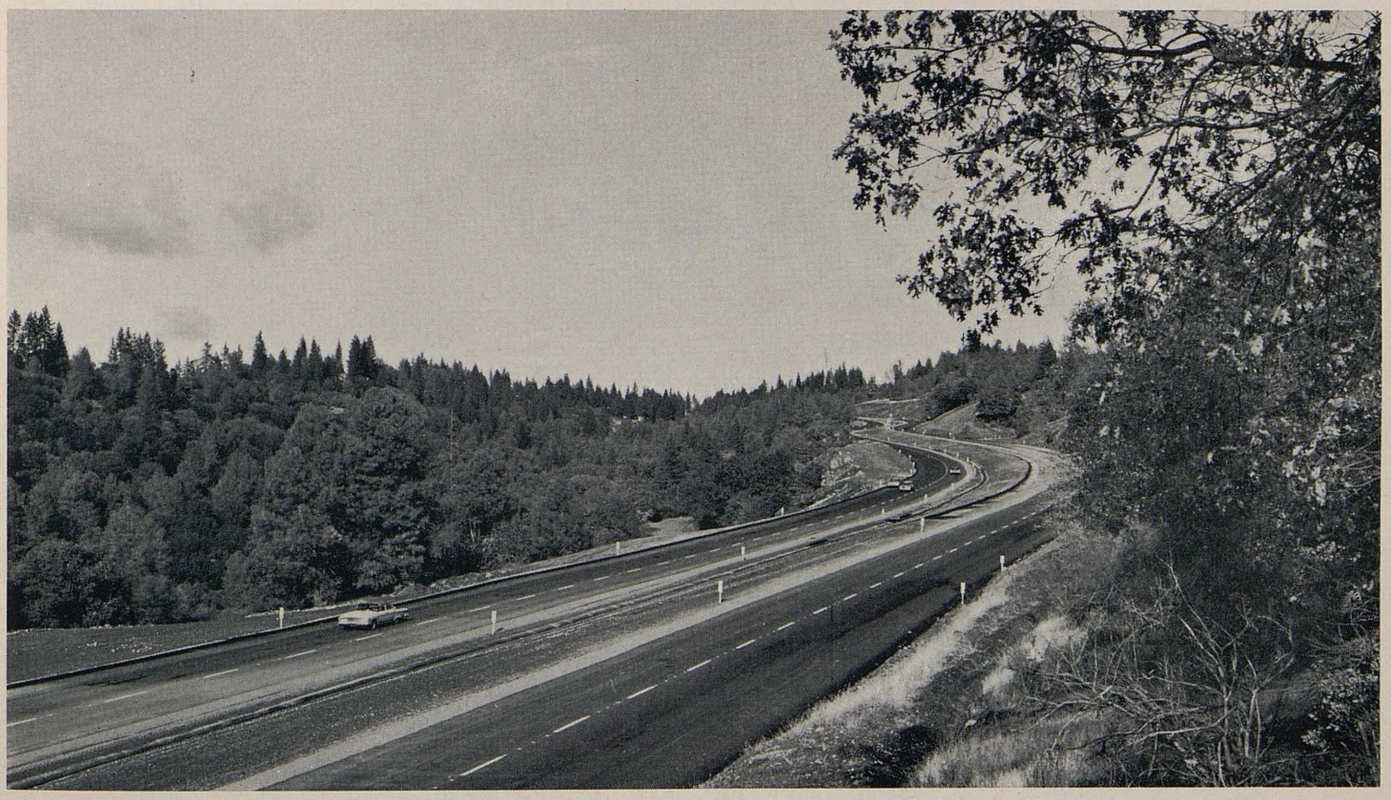
In the last year, there have been 29 new subdivisions started in Tuolumne County, 23 of which have been on or near Sign Route 108, east of Sonora. In addition to the homes being built in these subdivisions and on other pieces of land, there are many commercial buildings, motels, and other establishments being constructed to serve the needs of the summer and winter residents and visitors.

Until the last few years, summer vacationing was the most important attraction in this area, but, since the winter snow sports are becoming more and more popular, the winter travel on this road is now comparable to the summer traffic. In addition to serving the needs of people traveling from the valley and bay areas, this highway will

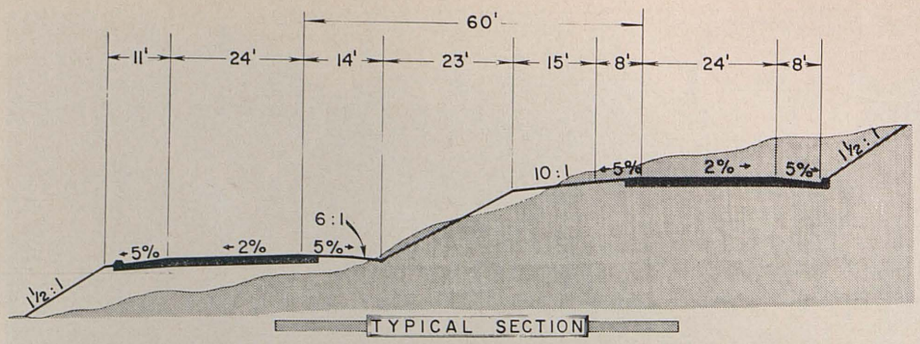


TWAIN HARTE GRADE

THE OLD. A queue of cars near Hunts Camp at the top of the old Twain Harte Grade.



THE NEW. An uphill view showing the new highway fitted to the sidehill above the old road.



SIDEHILL CONSTRUCTION

continue to handle a substantial amount of local traffic in and around the growing local communities, including logging trucks and other commercial traffic.

The development of this area was greatly accelerated during the postwar boom in travel and recreation, and it was soon evident that a major improvement of Highway 108 was needed to handle the traffic volumes that would be generated. Consequently, studies that had begun earlier were updated and tailored to meet the trend. Additionally, the road was included in the California freeway and expressway system in 1959, and it was then planned to develop an eventual full freeway; the initial construction being on an expressway basis with some private driveways and public road connections. Route studies culminated in a public meeting in Twain Harte in May 1960, where the results of the studies were presented to the residents of the area.

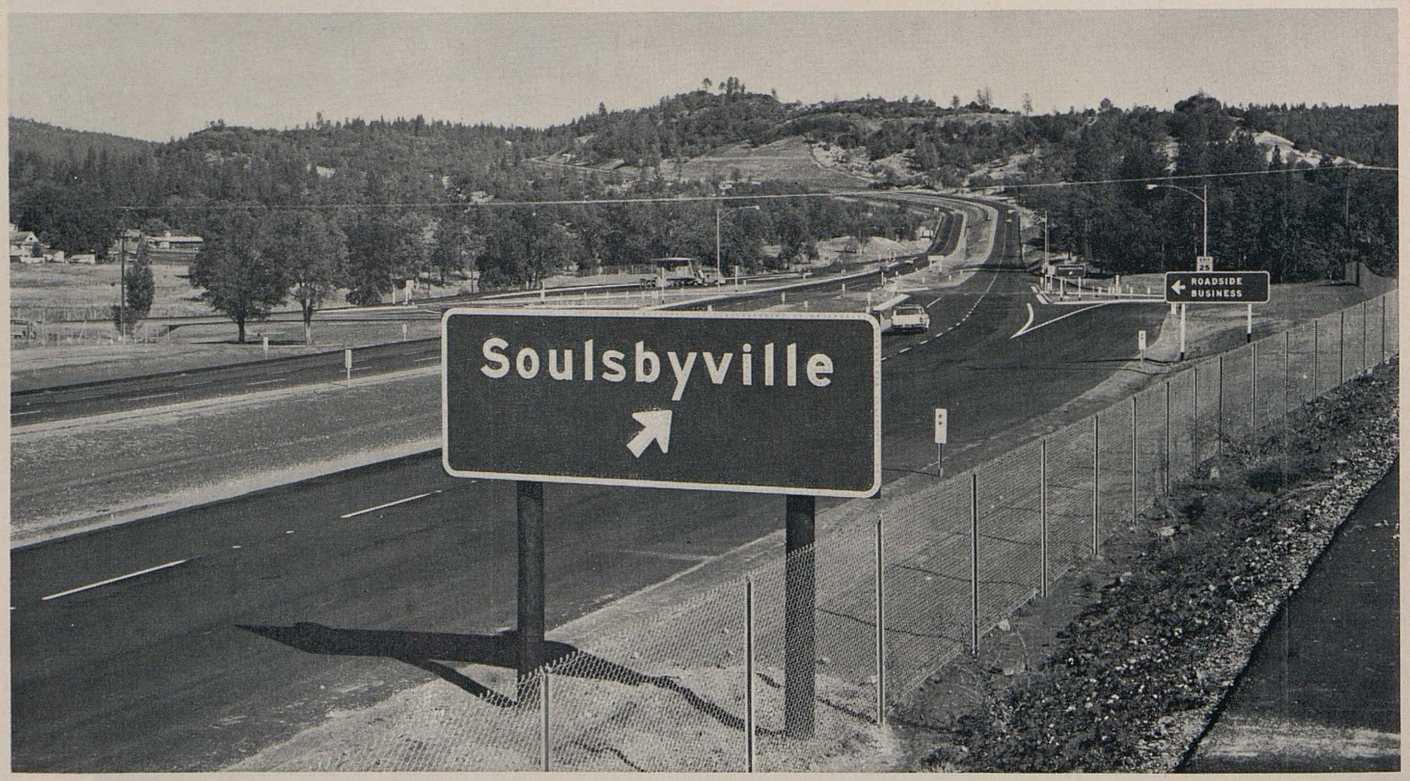
Route Adopted

After consideration of all information and viewpoints, the Highway Commission on July 20, 1960, adopted a route between Sonora and McCoy Saddle (near Pinecrest) that includes this first construction project.

The adopted route generally follows the present road, except for close-in bypasses of Twain Harte, Mi-Wuk Village, and Long Barn. The present state highway through these communities will be relinquished to Tuolumne County, but connections to the new freeway will be provided at each end of these bypasses, thus allowing quick and convenient access to the existing business and residential areas. The new highway will provide safe and convenient travel to the higher mountain areas, while leaving much of the present road to service the present and future recreational facilities. The planned ultimate development is a full freeway with interchanges at local roads and with frontage roads to serve local properties.

Notorious Grade Eliminated

The first project has eliminated the notorious Twain Harte Grade, between the small settlement of Mono Vista, about seven miles east of Sonora, and Hunts Camp, west of Twain Harte. This mile-long grade rises at a rate of 7 percent through a series of sharp curves that have been a major source of delay, frustration, incon-



The connection at Soulsbyville Road near Mono Vista. The new highway rises in the distance towards Hunts Camp, above the old road.

venience, and danger whenever there was an appreciable amount of traffic. It used to be common occurrence to have long queues of automobiles crawling uphill behind a truck, or moving slowly downhill in a single file when concentrations of homeward-bound people exceeded the capacity of the old road.

All this is a thing of the past, now that this section of new freeway has been completed. The new highway begins about one mile west of Mono Vista, passes by its southern edge, about 800 feet south of the former road, and then draws closer to the former road, running practically adjacent to it for the upper one mile, ending at Hunts at the top of the grade.

In the planning and design of this new road, the uppermost consideration of the engineers was the preservation of the unique character of the area, while keeping in mind the freeway standards that provide for the convenience and safety of the highway users. In this sensitive region, with its many homes set in natural surroundings, often in locations with pleasing views, the location and construction of a full freeway with control of access required careful consideration of many individual problems.

CALIFORNIA FEDERATION OF WOMEN'S CLUBS

December 10, 1963
Box 373
Twain Harte, California

Mr. John Meyer
District Engineer
Division of Highways, Dist. X
Stockton, California

Dear Mr. Meyer:

I am writing you to express my sincere pleasure in our newly completed highway, replacing the old Twain Harte Grade on Highway 108.

As you well know I took a deep interest in the planning and execution of that particular piece of highway and was at times volubly critical. So in fairness to you and your staff I wish to offer my congratulations on a beautiful job well done.

The safety angle alone makes it most acceptable, but it also opens up a very pleasant new panorama of our countryside.

Very truly yours,

(s) Mrs. Ruth C. Clarke
Member, Board of Directors
Twain Harte Women's Club

Scenic Surroundings Preserved

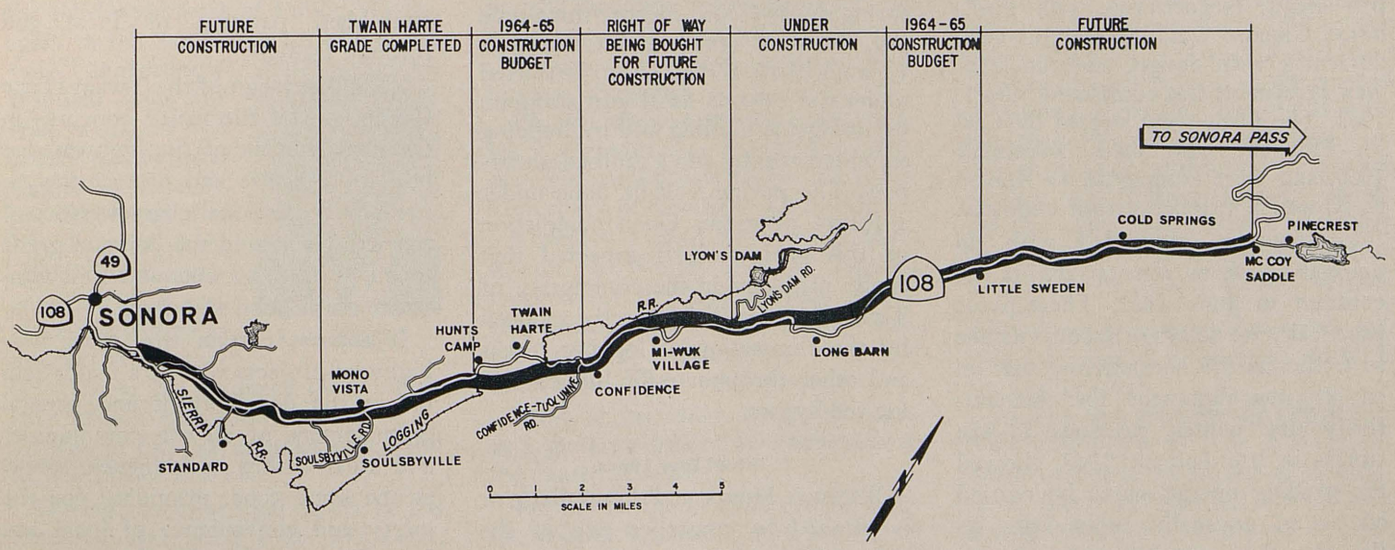
In the location and geometric design, a number of engineering techniques were utilized to minimize the disruption of the scenic surroundings. For example, an adjustment was made in the alignment which eliminated a high fill through the most highly developed portion of Mono Vista. The alignment was set along a ridge lying south of the built-up area, allowing the ascending grade to be placed where it would blend into the rolling mountain terrain.

To minimize the scarring of the hillside where heavy grading was necessary along the hillside above the present highway, the expedient of separate uphill and downhill roadways was used. The grade of the uphill roadbed was set as much as eight feet above the lower in order to fit the country more closely than would have been possible by use of a conventional four-lane section.

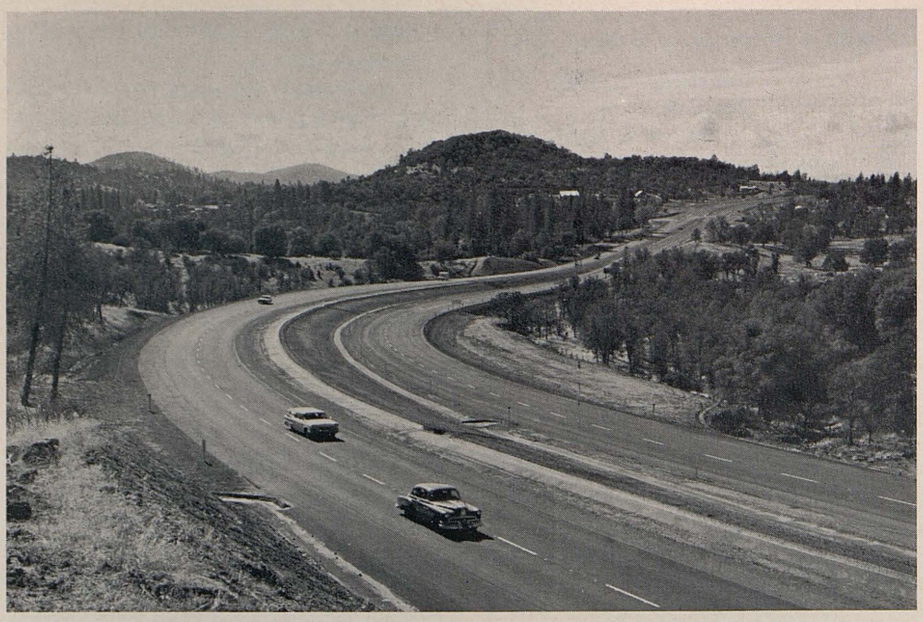
These initial four lanes are divided by a wide 46-foot median, except on the sidehill section where a 60-foot median is used. Two future interchanges have been designed into the roadway; one at Soulsbyville Road in Mono Vista, and one at the top of the grade near Hunts Camp. Here again, the design has been made to fit the terrain and to provide connections to present roads and future developments on either side of the freeway. Channelized grade connections have been constructed initially at these two places, but right of way has been acquired to accommodate the ultimate interchanges, as well as future frontage roads which can be constructed when conditions warrant them.

Weighing Facilities

An incidental problem involved the need to provide weighing facilities for westbound trucks near Mono Vista and an area for scaling platforms to



PROJECTS ON ROUTE 108



Looking west toward Soulsbyville Road from the first curve in the new grade. Note the roadways on different levels.

serve logging trucks bound for sawmills south and west of Mono Vista. These installations were placed between the freeway lanes and the exit ramp east of Soulsbyville Road, with access being from the left side of the ramp. It is expected that trucks can enter and leave the area conveniently and safely, with the least possible conflict with through traffic.

The design of the Twain Harte Grade project was started immediately after the adoption of the route, due to the urgent need of the improvement. Negotiations with Tuolumne County were carried on concurrently with design, and the freeway agreement was completed May 1, 1962. The plans were started by Carl M. Heynen, who died November 1960, and were completed by Robert F. Kraetsch, project design engineer.

Construction proceeded with no unusual problems after award of the contract in June 1962. There were practically no delays or inconvenience to traffic, as the construction was on entirely new alignment. The comparatively dry winter, previous to the storms in late January 1963, allowed the grading operations to be carried on at an unusually rapid rate, although the comparatively heavy spring rains caused some slowdowns. The project was opened to traffic October 21, 1963.

The construction was done under contract by O. K. Mittry & Sons, under the direction of F. M. Babcock, resident engineer.

A second project, between 2.4 miles west of Long Barn (Lyons Dam Road) and 1.7 miles east of Long Barn has been underway since July 1963. A continuation to 3.8 miles east of Long Barn (Little Sweden) is included in the 1964-65 fiscal year construction budget, and is expected to begin in the spring of 1964. Still another three-mile job, between Hunts and Confidence (Twain Harte Bypass), is to be started under the 1964-65 fiscal year program by doing the grading and by building an undercrossing and a railroad underpass. The paving will be done under a future program. Upon completion of this project, it is expected that traffic problems in the community of Twain Harte will be greatly reduced by the elimination of logging trucks and other through traffic, which will use the bypass.

Eventual Four Lanes

Between Hunts and Long Barn, it is planned to construct two of the eventual four lanes with initial grade connections to local roads and to certain portions of the present state highway that will become county roads.

Between Long Barn and Little Sweden, the improvement will generally consist of two new lanes on the southerly side of the present two-lane road, resulting in a four-lane facility. Here, as on the Twain Harte Grade, there will be about two miles where the new lanes will be below the present road, fitting the highway to the country by taking advantage of the sidehill terrain.

Along the portion from Long Barn easterly to Little Sweden, there has been a winter parking problem when people stop to play in the snow, and there have been times when only a single lane has been left for traffic. The addition of two lanes is expected to relieve this problem by providing a wider roadbed so that at least one lane can be kept clear in each direction.

Most Advanced Techniques

In the design for these projects, the most advanced engineering tools and techniques were used to provide for future conversion of the initial expressway to a full freeway by the construction of interchanges and frontage roads. The geometrics of the initial public road grade connections have been laid out and right of way is being acquired so that interchanges can eventually be constructed without disturbing local homes and businesses, while at the same time maintaining established patterns of local and through traffic.

As in the design of the Twain Harte Grade, one of the major concerns in the improvement of the highway has been to preserve and protect the essentially recreational characteristics of the area by setting the line and grade to minimize large cuts and fills, consistent with good standards.

It appears certain that these new highway projects will be a major factor in the development and general enhancement of all the communities and areas within its influence, while, at the same time, providing for the safety and convenience of local and long-distance traffic as only a freeway can.

L.A. DEPUTY CHIEF COUNSEL G. C. HADLEY RETIRES

George C. Hadley, Deputy Chief Counsel in charge of the Southern California Law Department and its San Diego branch office of the Division of Contracts and Rights of Way, retires on March 4, 1964, after completing a state legal career covering more than 30 years.

To succeed him, Chief Counsel H. S. Fenton appointed Reginald B. Pegram, who has been Hadley's chief assistant for the past 18 years.

GEORGE C. HADLEY

Hadley was born in New York but soon moved to California where he received his schooling in Whittier, Los Angeles, and San Francisco. He attended Stanford University and was graduated from Hastings College of Law in 1927.

He began his state legal career as a trial lawyer for the California Highway Commission in 1931, in San Francisco. From 1933 to 1936 he served as special attorney for Friend W. Richardson, Building and Loan Commissioner, to assist in the liquidation of defunct building and loan companies.

In 1936 he returned to the field of eminent domain law as trial lawyer for the Department of Public Works, again in the San Francisco office, but with increasingly frequent trips for trial work in the courts of Southern California. In 1945 he established the Los Angeles legal offices for the department and was placed in charge as its chief trial attorney. Under his guidance these offices have grown to a total staff of 34 attorneys in the Los Angeles office and its San Diego branch.

R. B. PEGRAM

During this long legal career he has prepared and tried over 300 cases; many of these have reached the appellate courts, and their decisions have to a great extent established our present eminent domain law.

As a specialist in eminent domain law, Hadley has lectured before appraisal and right-of-way professional organizations, and has written numerous articles which have been published in *The Appraisal Journal*, and in its manual on "Condemnation Appraisal Practice," published in 1961; he co-authored the "Digest of Cases on Eminent Domain," published by the Department of Public Works, for use by its attorneys and for distribution among the State's judiciary and public attorneys.

He is a member of the State Bar of California and has served for many years on its eminent domain committee; a member of the Los Angeles Bar Association serving on its eminent domain committee, as well as serving as one of its delegates to the State Bar conference for the past several years; and a member of the Los Angeles Lawyers Club.

His fraternal associations consist of Alpha Tau Omega (Stanford); member of American Masonic Lodge; Signet Chapter Royal Arch Masons; Los Angeles Commandery of Knights Templar; Al Malaikah Shrine Temple; and Elks Lodge No. 99, Los Angeles.

Hadley has accepted a partnership in a Los Angeles law firm, for which he will establish a real property and eminent domain trial section.

Hadley and his wife, Virginia, have one son, William.

Pegram, the new deputy chief counsel, is a graduate of Stanford University. He studied law there and at the University of Southern California.

From 1934 until he entered Navy service in World War II, Pegram worked for the land division of the Department of Water and Power, City of Los Angeles, first as a title officer and later as an attorney.

Most of his Navy duty was spent as a gunnery officer on destroyers in the North Atlantic.

He joined the Department of Public Works legal staff as a senior attorney in January 1946 and has been with the Los Angeles office ever since, being promoted to assistant chief in September 1963.

Pegram is a member of Chapter 1, American Right of Way Association, and is currently an adviser to its executive board. He and his wife Wanda live at 2016 North Vermont Avenue, Los Angeles. They have a son and two grandsons.

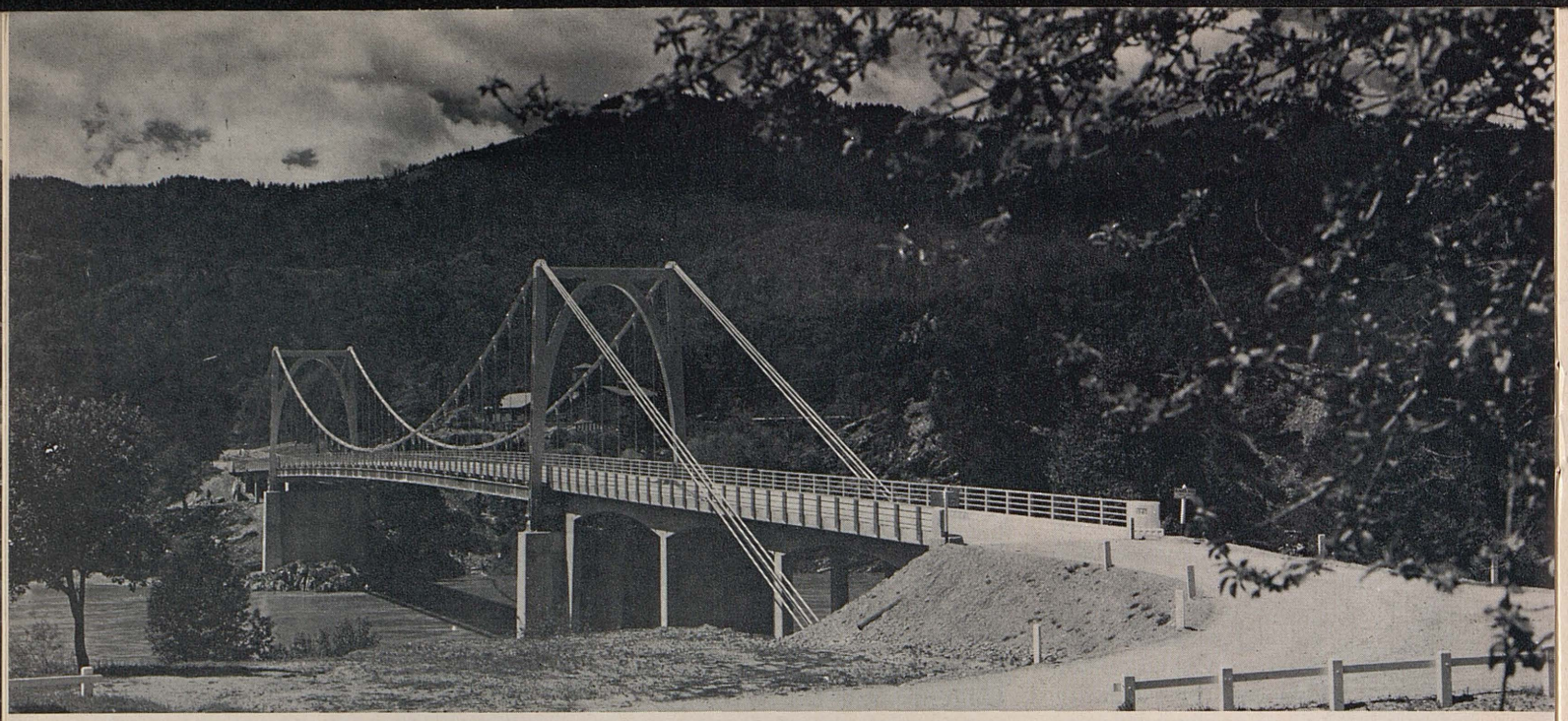
Agency Inaugurates Television Series

Leading off with Governor Edmund G. Brown's personal introduction, California's Highway Transportation Agency marked its entry into the field of regularly scheduled television on January 26th with a public information series produced by the agency. All phases of highway transportation are explored in this series, from the viewpoint of all the three departments – Public Works, Motor Vehicles, and Highway Patrol.

Initial air time is on KABC-TV Los Angeles, at 2.30 p.m. every Sunday through March – 10 weeks in all – with air time provided by the station in cooperation with the Farmers Insurance Group Safety Foundation. Governor Brown will introduce and close each show. Plans are now under discussion between Farmers and the agency to re-release the series elsewhere in the state, following its initial airing in the Los Angeles area.

Four of the programs, each 13 minutes, 40 seconds in length, were filmed in color for future reuse on TV or as information films used by the division's information departments. The balance of the series is being presented "live" with film and slide illustrations.

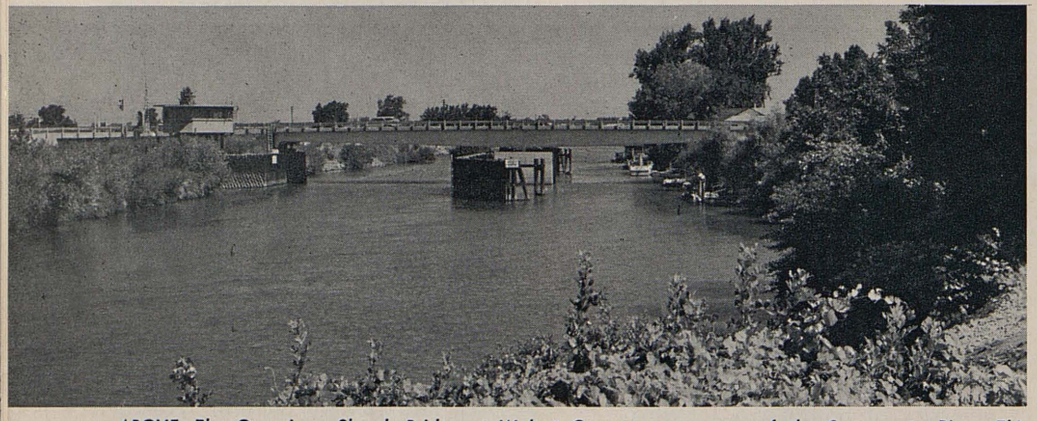
Filmed subjects are: "The Car Hunt," highlighting the highway communications network as it goes to work on a typical hit-and-run accident; "The Newcomer," illustrating the experiences of one of California's 2,000-daily new drivers in the process of getting a permit, licensing a vehicle, etc.; "Youth at the Wheel," on the facts and problems of teenage driving; and "Elbow Room," attacking the congestion problem and illustrating the freeway and expressway system as the State's answer to congestion.



The Klamath River Bridge at Orleans. This beautiful little suspension bridge in the mountains of Northern California was the Division of Highways first prize winner.

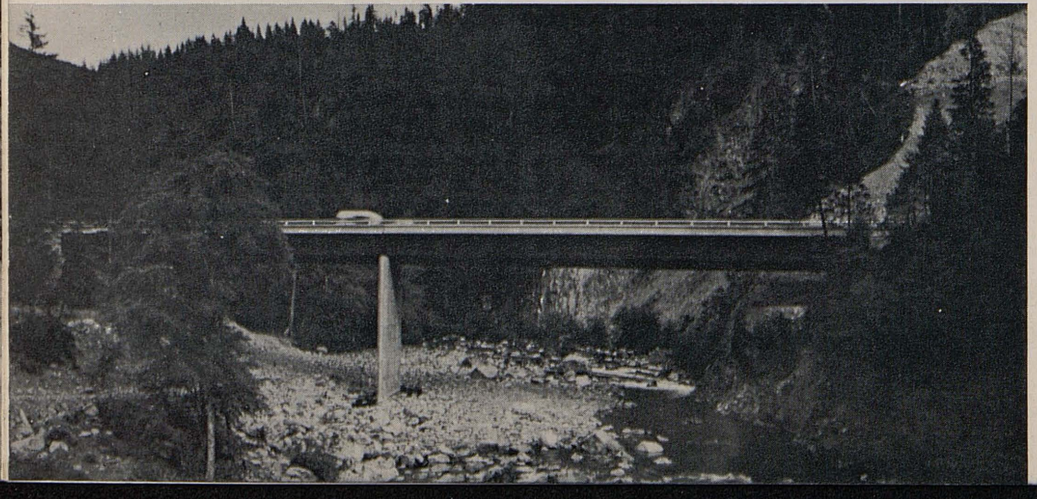
PRIZE BRIDGES

By A. L. ELLIOTT, Bridge Engineer—Planning



ABOVE. The Georgiana Slough Bridge at Walnut Grove over an arm of the Sacramento River. This structure, designed and built by Sacramento County with the collaboration of the Division of Highways, won the first prize for movable bridges in the 1962 competition.

BELOW. The Howard Griffin Memorial Bridge across the Middle Fork of the Smith River northeast of Crescent City, which won an award in the 1962 contest.



CALIFORNIA CAPTURES FOUR MORE STEEL BRIDGE PRIZES

What is a good-looking bridge? And how do you design a good-looking bridge? These are pertinent and timely questions right now when more and more people are getting interested in the appearance of our highway structures.

In the face of this increased interest, California can again be proud of the record the Division of Highways made in 1963 in the national beautiful steel bridge contest sponsored by the American Institute of Steel Construction. A first prize and two awards of merit were received by the division's Bridge Department for bridges completed in 1962. A first prize was also received by Sacramento County for one of their designs in which the Division of Highways collaborated.

The first prize winner in the medium-span bridge class was the George C. Cole Memorial Bridge over the Eel River at Myers Flat. This green-painted, simple, three-span, all-welded structure found in the surrounding redwoods and the beautiful river a most attractive setting.

A similar attractive setting framed the Howard Griffin Memorial Bridge

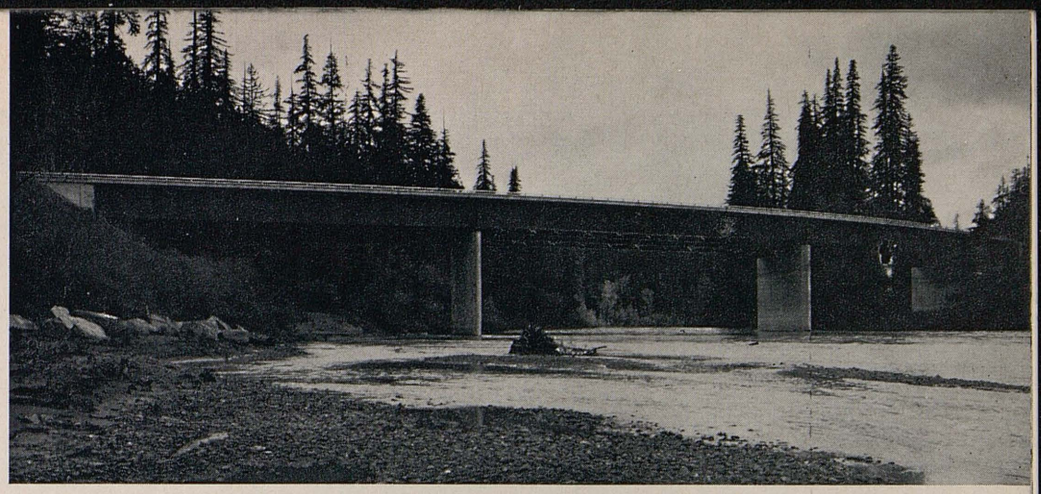
over the rushing Middle Fork of the Smith River as it approaches Crescent City out of the Siskiyou Mountains in Northern California. The jury gave an award of merit to this two-span structure.

Combining the unique construction of curved steel girders with all-welded construction, the Elysian Viaduct in Los Angeles displays pleasing lines which captured another award of merit.

A simple, attractively designed swing bridge over Georgiana Slough as it nears the Sacramento River downstream from Sacramento at Walnut Grove, won for Sacramento County the first prize in the movable bridge division. The Division of Highways, after collaborating with the county in the design, felt pride in the finished result and submitted the bridge in behalf of the county.

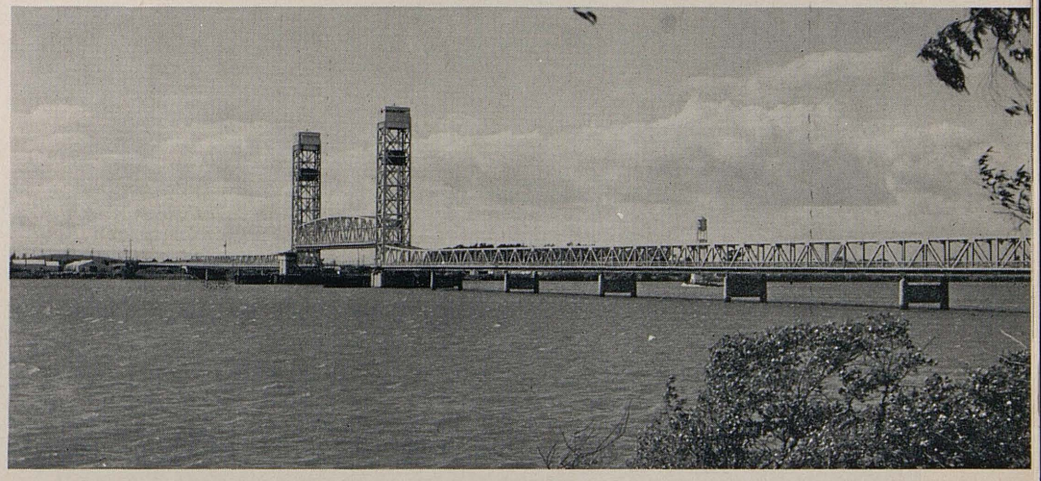
This nationwide prize bridge competition has been held annually since 1928. Each year awards are given with first prizes in four categories and awards of merit as the jury feels are justified. The four categories are:

1. Long span bridges—one or more spans over 400 feet.
2. Medium span bridges — costing less than $500,000 and with no span longer than 400 feet.
3. Short span bridges—costing less than $500,000.
4. Movable span bridges.



ABOVE. The George J. Cole Memorial Bridge across the Eel River at Myers Flat, a very attractive steel structure in the redwood country which received a first prize in 1962.

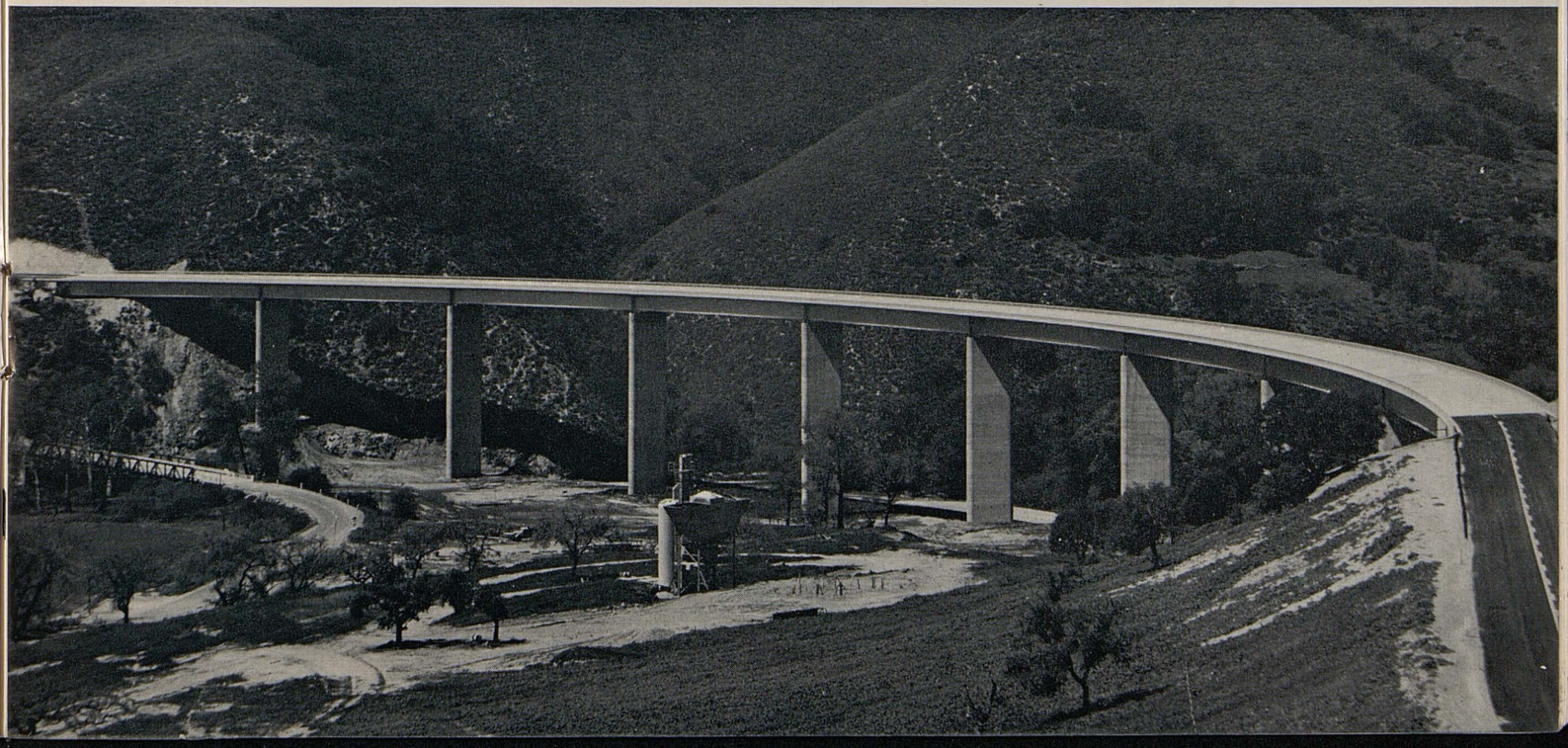
BELOW. The Rio Vista Bridge over the Sacramento River received a first prize in 1960 in the movable bridge classification.



Over the years, California bridges (state, county and, in 1937, the Golden Gate Bridge and Highway District), have won 7 first prizes and 17 awards of merit.

Although the AISC contest started in 1928, California did not appear in the win column until the 1935 award for the M Street or Capitol Avenue lift bridge over the Sacramento River

BELOW. Huasna River Bridge crossing an arm of a new reservoir near Santa Maria received a first prize in the 1959 AISC contest.



ABOVE. West Bay Crossing, San Francisco-Oakland Bay Bridge. An award winner in 1936 in the large structure class.

BELOW. The Elysian viaduct in Los Angeles using curved steel girders and all-welded construction, won an award in the 1962 contest. (See back cover, California Highways and Public Works, November-December 1963.)

at Sacramento. California next entered the limelight with a first prize awarded to the Golden Gate Bridge. This was not a state highway project, but this beautiful structure, in its unique setting, brought honor to all of California.

In the next year, 1936, the San Francisco—Oakland Bay Bridge won an award. Competition was keen among big structures that year and first prize went to the Triborough Bridge in New York City.

The Division of Highways gained its initial first prize in 1940 when the graceful suspension bridge across the Klamath River at Orleans took the top prize for the medium span bridges. This proved a great incentive and in subsequent years more entries were submitted. The effort paid off and in the years since 1940, numerous awards

and several first prizes have come our way.

The first prizes are notable. They include the 9th and 10th Streets Connection in San Francisco (1953). This was one of the first major welded structures. During the next six years California collected six more awards and then in 1959 again got the top billing with a first prize for the Huasna River Bridge near Santa Maria. This prizewinner was accompanied the same year by three other awards, making a sweep of four places for the year.

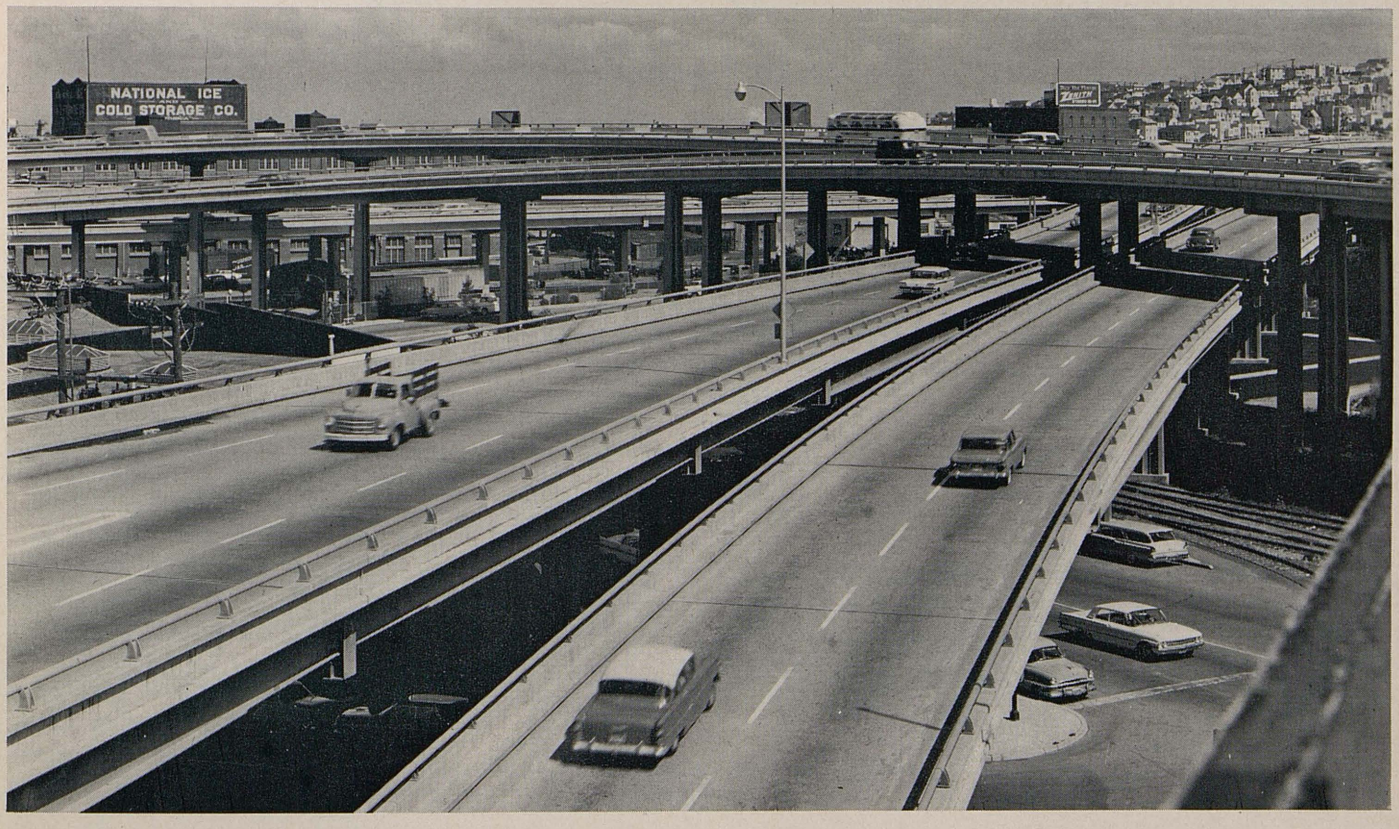
First Prize in 1960

In 1960, California again scored with a first prize for the Rio Vista vertical lift bridge. Along with it, a California county design also won an award. The following year brought only one award and then came the most recent success with two first prizes and two awards.

Coming at a time when the appearance of structures is of prime interest in many circles, this evidence of competitive excellence of the California designs is most gratifying.

ABOVE. The "M" Street or Capitol Avenue Tower Bridge over the Sacramento River at Sacramento. This structure was California's first recognition in the AISC contest and took an award in 1935.

BELOW. The Ninth and Tenth Street Connection Viaducts in San Francisco. These first all-welded major steel structures received a first prize in the 1953 contest.



Paint Analysis

Accurate and Faster Tests Done With New Instruments

By T. L. SHELLY, Associate Chemical Testing Engineer and
T. E. BURNS, Assistant Chemical Testing Engineer

Equipment

During the last 10 years a number of analytical instruments have become available to the Materials and Research Department laboratory which have greatly increased the efficiency in enforcing specifications. Since the majority of materials tested by the chemical unit of the department have specifications of the compositional type, it is imperative that methods and equipment be available to determine the composition of samples submitted as thoroughly, accurately, and quickly as possible. Among these new tools could be listed such instruments as the flame photometers; infrared, visible and ultraviolet spectrographs; gas chromatographs; and X-ray emission and diffraction spectrographs. These instruments have made it possible to do some types of analysis more rapidly than conventional chemical and in many instances made possible analyses which were previously virtually impossible.

The Materials and Research Department recently purchased a General Electric XRD-5 X-ray emission and diffraction spectrograph. This instrument will have many applications such as the identification of clay minerals, quantitative and qualitative analysis of metals, cements, and paint pigments. This discussion will be limited to the application of the X-ray diffraction equipment in the examination of a black and a white paint pigment.

A diagram of the apparatus used is shown in Figure 1. During the test the sample and the detector are rotated so that the X-ray strikes the sample at different angles. Certain angles give maximum reflection which depends upon the crystal structure of the material being analyzed. These angles of maximum reflection are detected and recorded graphically. As a scan of the sample is made over a range of several degrees, a curve such as shown on Chart I is obtained. The position of the peaks serves to identify the particular material but the height gives only an approximation of the amount of the material present.

Sample Preparation, Analysis

A completed paint pigment is generally a mixture of several raw materials most of which will exhibit a unique pattern in the X-ray diffraction spectrograph. In the completed paint pigment the pattern of each raw material will be evident. However, a peak of one raw material may overlap that of another.

All curves shown were obtained from paint pigments or raw materials. The paint pigments of completed paints were extracted by centrifuging to obtain the pigment for analysis. In routine control, however, a paper panel dipped in the finished paint and allowed to dry is satisfactory as a test specimen.

Charts I through IV show raw materials submitted by the manufacturer for the white paint. Chart V shows paint made in the laboratory using these raw materials. The major peaks used for analysis are identified on both raw materials and finished paints by number for easy comparison.

Chart VI shows a sample submitted by a manufacturer which agrees with Chart V except for minor variations in the height of the peaks.

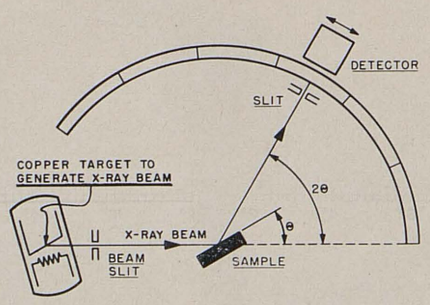


FIGURE 1. Schematic representation of X-ray diffraction equipment.

Chart VII and VIII show samples submitted by a manufacturer where the peak for calcium sulfate ($CaSO_4$) has a much lower intensity (Chart VII) or is entirely absent (Chart VIII). Subsequent chemical analysis confirmed this deficiency and the paints were rejected.

Chart II and Chart IX show the raw materials used in formulating the black paint. Chart X shows a paint made in this laboratory using these raw materials. Chart XI shows a factory sample giving a satisfactory curve. Chart XII shows a sample submitted which contains a pigment completely different than the one required by specifications. Talc (compare with Chart I) was used as a substitute in this instance.

Many thousands of gallons of these two paints were rejected as a result of the above analysis. In each case the deviation from the specification was confirmed by other methods of analysis before rejection.

It is anticipated that the use of X-ray diffraction together with X-ray emission will be of great value in many other types of analysis. A much more refined technique than that described in this article will often be necessary to obtain quantitative results accurate enough to determine specification compliance by X-ray analysis only.

Acknowledgments

This work was performed by the chemical unit, a part of the Technical Section under the direction of D. L. Spellman.

Appreciation is due to F. N. Hveem for his interest in promoting better laboratory control through instrumentation.

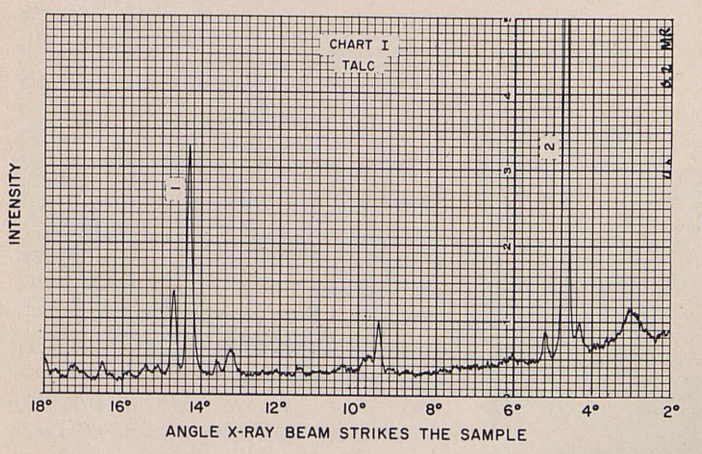


CHART I
TALC
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

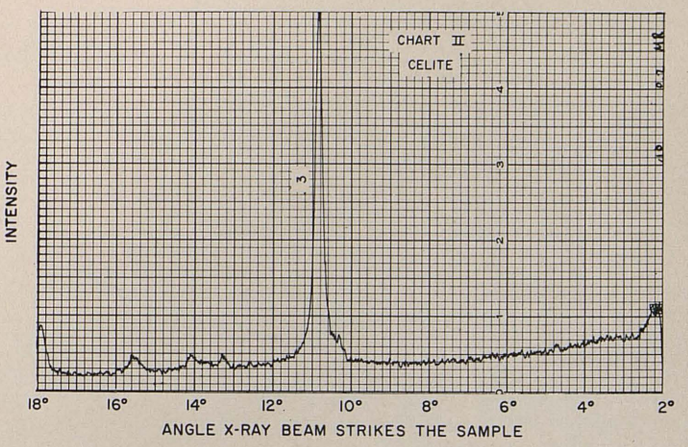


CHART II
CELITE
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

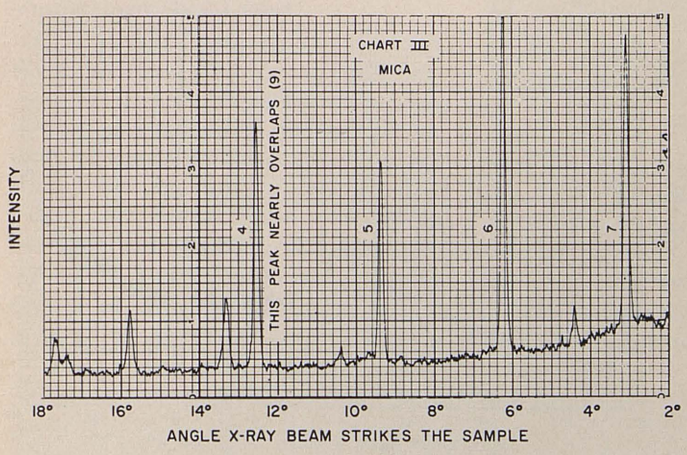


CHART III
MICA
THIS PEAK NEARLY OVERLAPS (9)
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

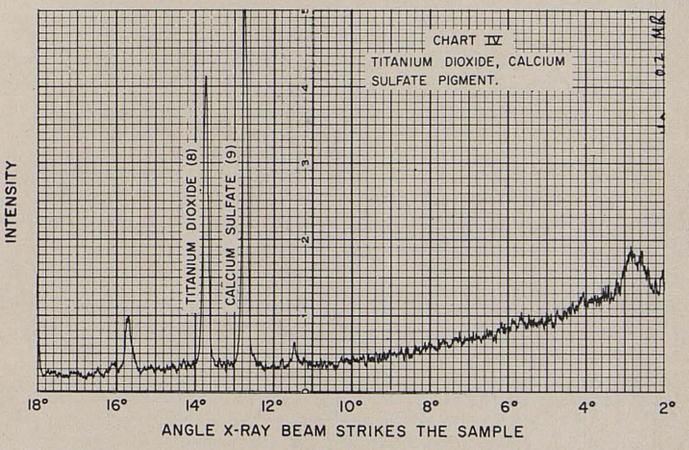


CHART IV
TITANIUM DIOXIDE, CALCIUM SULFATE PIGMENT.
TITANIUM DIOXIDE (8)
CALCIUM SULFATE (9)
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

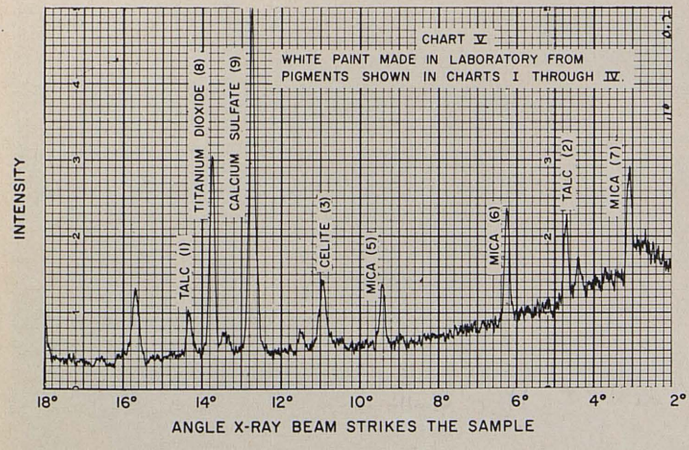


CHART V
WHITE PAINT MADE IN LABORATORY FROM PIGMENTS SHOWN IN CHARTS I THROUGH IV.
TALC (1)
TITANIUM DIOXIDE (8)
CALCIUM SULFATE (9)
CELITE (3)
MICA (5)
MICA (6)
TALC (2)
MICA (7)
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

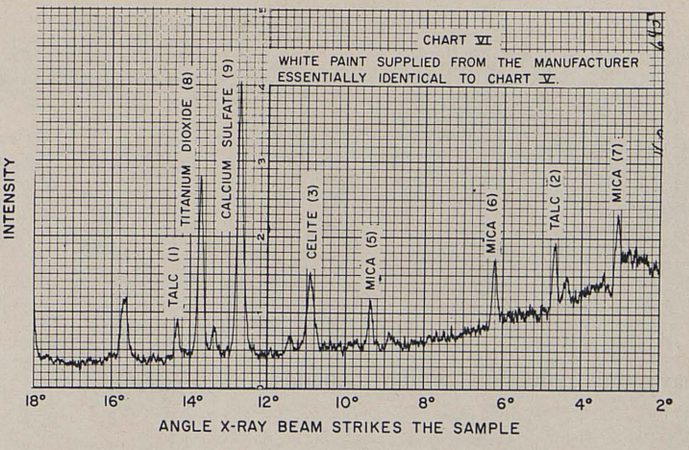


CHART VI
WHITE PAINT SUPPLIED FROM THE MANUFACTURER ESSENTIALLY IDENTICAL TO CHART V.
TALC (1)
TITANIUM DIOXIDE (8)
CALCIUM SULFATE (9)
CELITE (3)
MICA (5)
MICA (6)
TALC (2)
MICA (7)
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

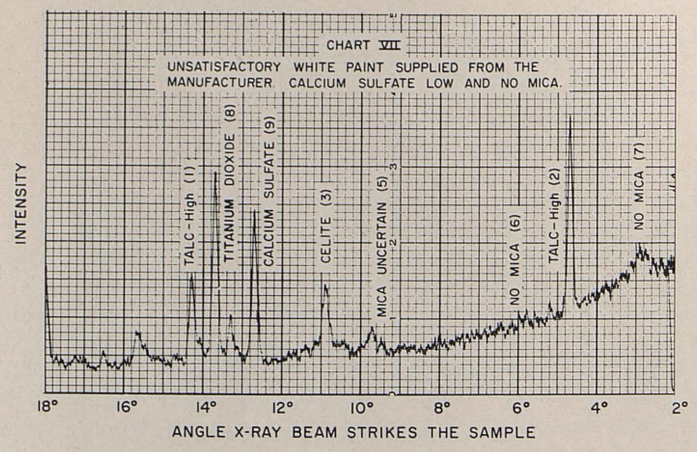


CHART VII
UNSATISFACTORY WHITE PAINT SUPPLIED FROM THE MANUFACTURER. CALCIUM SULFATE LOW AND NO MICA.
INTENSITY
TALC - High (1)
TITANIUM DIOXIDE (8)
CALCIUM SULFATE (9)
CELITE (3)
MICA UNCERTAIN (5)
NO MICA (6)
TALC - High (2)
NO MICA (7)
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

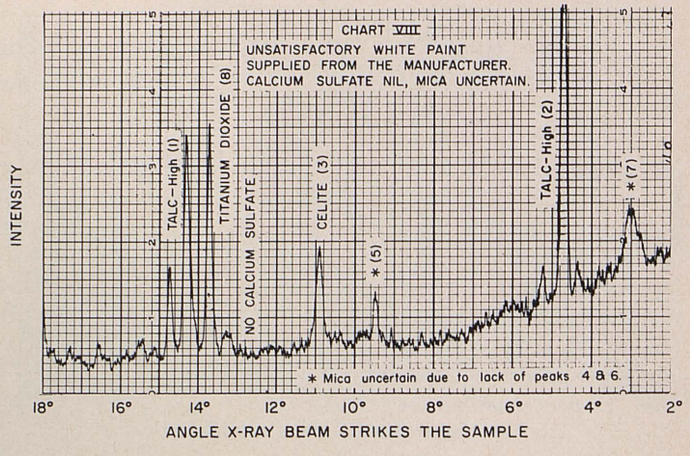


CHART VIII
UNSATISFACTORY WHITE PAINT SUPPLIED FROM THE MANUFACTURER. CALCIUM SULFATE NIL, MICA UNCERTAIN.
INTENSITY
TALC - High (1)
TITANIUM DIOXIDE (8)
NO CALCIUM SULFATE
CELITE (3)
* (5)
TALC - High (2)
* (7)
* Mica uncertain due to lack of peaks 4 & 6.
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

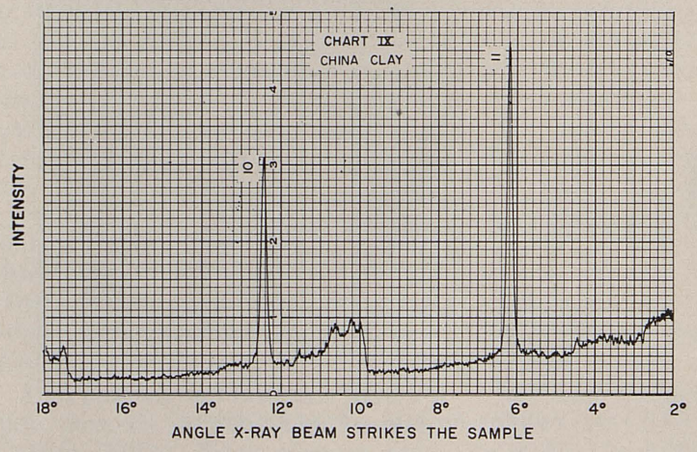
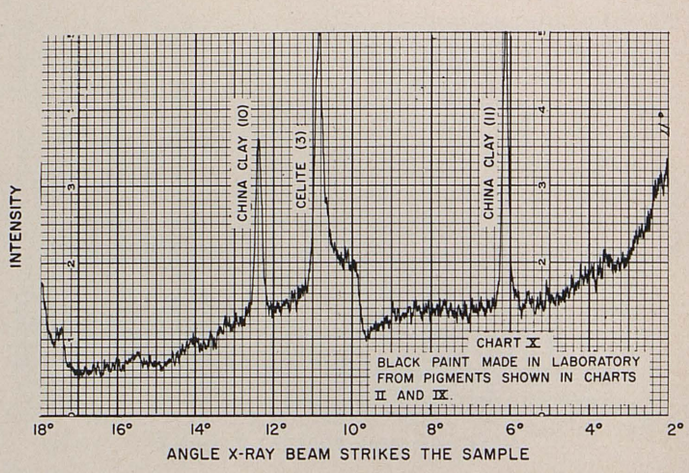


CHART IX
CHINA CLAY
INTENSITY
(10)
(11)
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE


CHINA CLAY (10)
CELITE (3)
CHINA CLAY (11)
CHART X
BLACK PAINT MADE IN LABORATORY FROM PIGMENTS SHOWN IN CHARTS II AND IX.
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

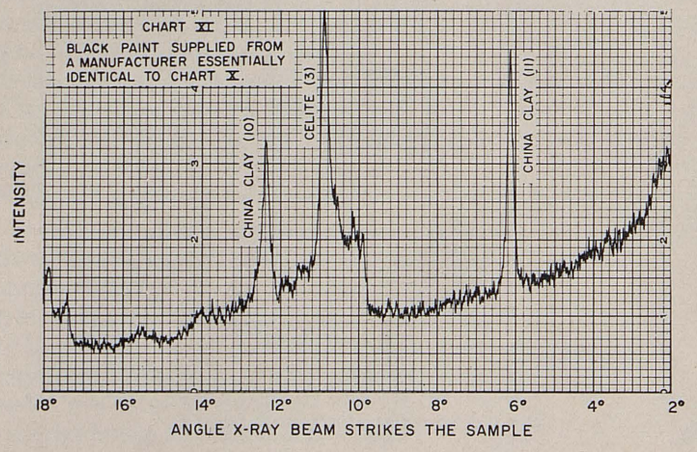


CHART XI
BLACK PAINT SUPPLIED FROM A MANUFACTURER ESSENTIALLY IDENTICAL TO CHART X.
CHINA CLAY (10)
CELITE (3)
CHINA CLAY (11)
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

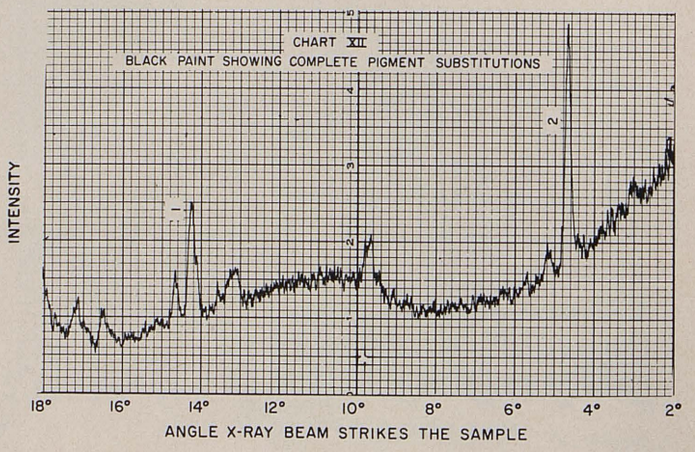
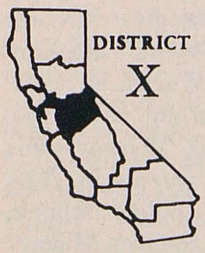


CHART XII
BLACK PAINT SHOWING COMPLETE PIGMENT SUBSTITUTIONS
INTENSITY
18° 16° 14° 12° 10° 8° 6° 4° 2°
ANGLE X-RAY BEAM STRIKES THE SAMPLE

Stanislaus County

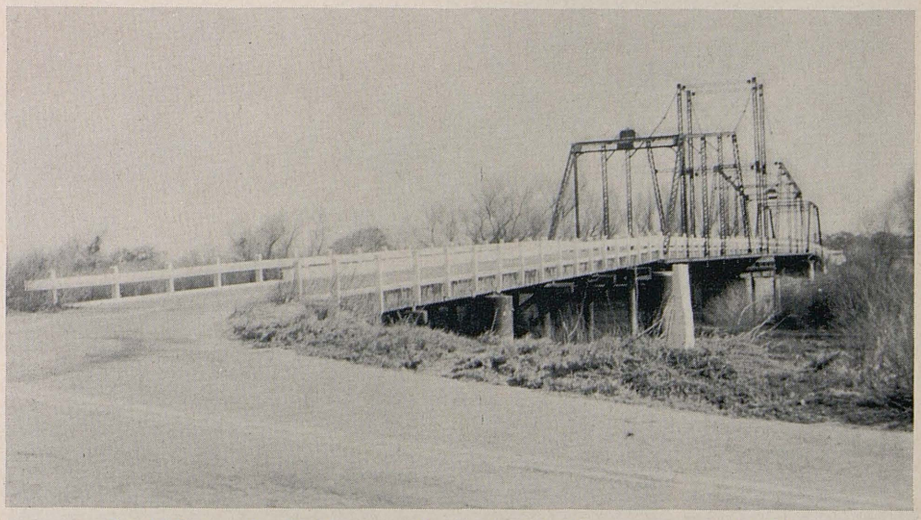
Progress Report on Construction Projects

By HARTER R. BRUCH, Chief Civil Engineer, Stanislaus County



Two recently completed federal aid secondary projects on Stanislaus County roads have added five miles of road, constructed to F.A.S. standards, and have reduced the number of substandard bridges in the county by two. These improvements were made possible by the authorization, in 1956, of a $5 million bridge and highway improvement bond issue.

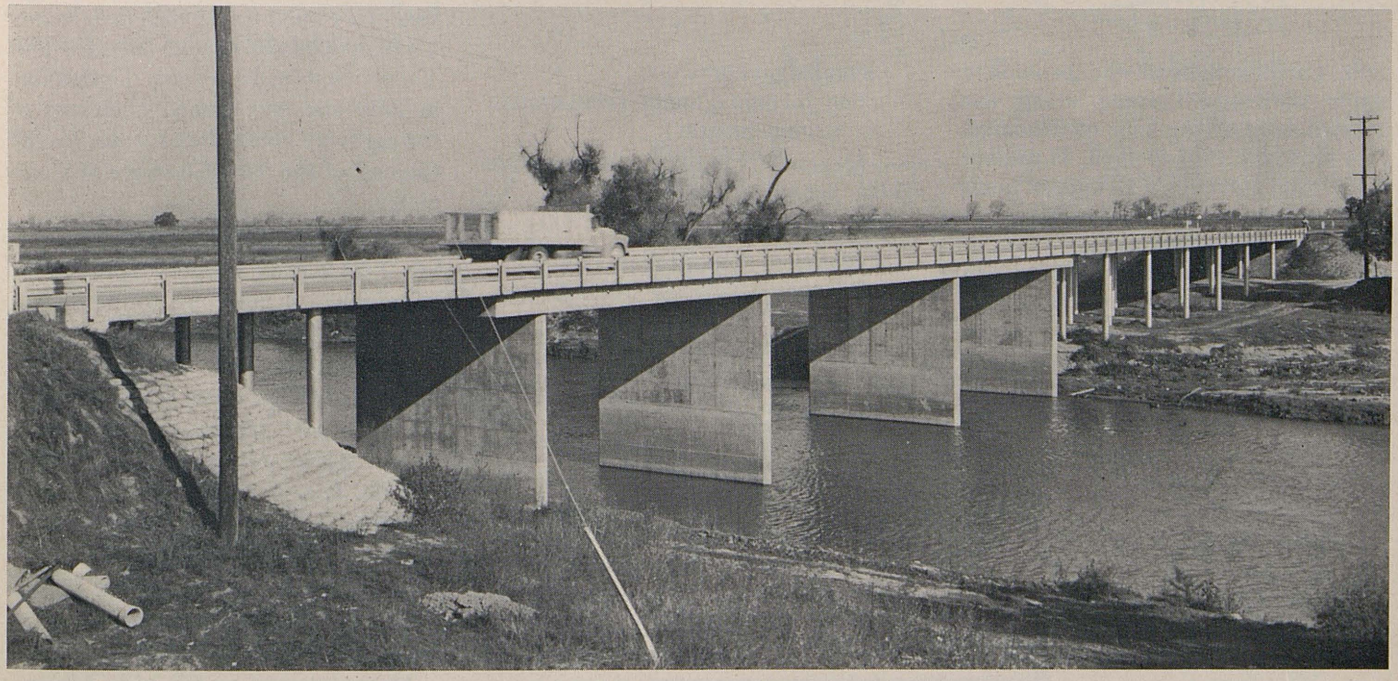
One of the projects, on Grayson Road, included 3.3 miles of road construction and the replacement of two bridges across the San Joaquin River. One of these bridges, the Grayson Bridge, west of Modesto, was the first major river bridge to be constructed in Stanislaus County, and was designed as a swing bridge to permit the passage of riverboats and barges. The original bridge was constructed in 1892. Both the replaced Grayson and the Laird Slough Bridges had been posted for a 12-ton load limit.



The old Grayson Road bridge across the San Joaquin River was constructed in 1892.

Carpenter Road

The second and most recent project was on Carpenter Road, along the west side of Modesto. The length of the project was 1.8 miles. This is the second F.A.S. project on Carpenter Road, the first being a new bridge across the Tuolumne River immediately to the south. A third proposed project, extending north, will com-



The new bridge across Laird Slough replaced an old structure posted for a 12-ton load limit.

The new bridge on Grayson Road across the San Joaquin River. See photo on the previous page.

plete Carpenter Road and provide a major north-south route along the western edge of the City of Modesto.

In six years, 1957 to 1962, $3 million of the total authorized $5 million bond issue have been combined with funds from other governmental agencies, to accomplish approximately $6 million worth of improvements to the bridges and highways in Stanislaus County. Other agencies which participated in these improvements under terms of cooperative agreements include the following:

Federal Government
- F.A.S. funds
- Flood damage funds

State Government
- State matching funds (F.A.S.)
- Flood damage funds
- State highway funds (cooperative funds)

County Governments
- San Joaquin County (cooperative bridge project)
- Merced County (cooperative bridge project)

City Governments
- Modesto (cooperative city-county highway projects)

14 Old Bridges Replaced

By the end of 1962, 14 antiquated bridges had been replaced, 7 bridges strengthened and 3 new major river crossing bridges constructed together with approach roads, to greatly improve the overall circulatory system. The total number of structures posted for load limits has been reduced from 38 to 13. In addition, a total of 13 miles of road have been constructed to federal aid secondary standards.

Chester H. Warlow

Chester H. Warlow of Fresno, former member and vice chairman of the California Highway Commission, died on December 10, 1963, after a long illness.

He was first appointed to the commission by then Governor and now Chief Justice Earl Warren in 1943. He served on the group until 1961.

A native of Illinois, Warlow came to Fresno with his parents in 1889, where he attended public schools. Later he studied at Kemper Military Academy in Boonville, Missouri, Stanford University and Harvard Law School.

He became a first lieutenant in the Army Air Corps during World War I.

Warlow began his bareer as an attorney and later became a banker and oilman.

In 1925 he helped organize the Sierra National Parks Highway Association. He was a leader in the program to get highways built into the Kings Canyon area, the Generals Highways linking Kings and Sequoia National Parks and the highway leading from Fresno to Yosemite National Park.

He helped form the San Joaquin Valley Statewide Water Committee in 1929 and was named chairman of the highway committee for the Valley Council of the State Chamber of Commerce.

His constant dedication to forwarding the highway program through his long career earned him the nickname of "Mister Highways."

Warlow has been lauded as a man who, during his time, unquestionably played a part greater than any other single individual to help the valley and the State generally solve its traffic problems through construction of more and better highways.

Warlow was a Past Grand Master of Masons in California and was an honorary 33d degree Mason.

He is survived by his wife, Marian.

New Routes

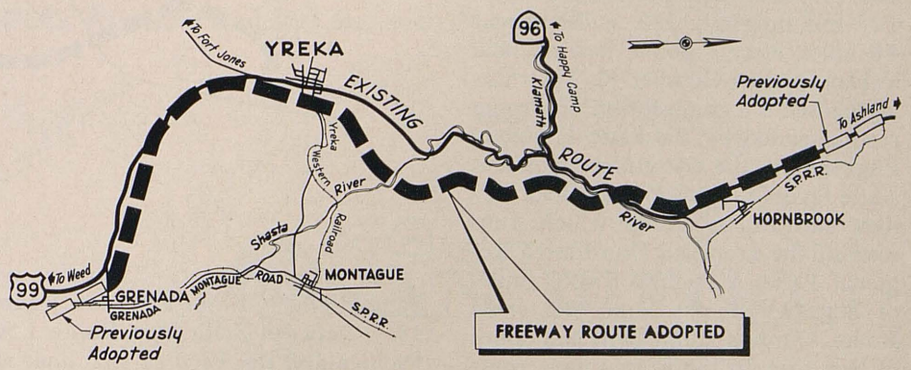
Location Completed for State's 800-mile Stretch of Interstate 5

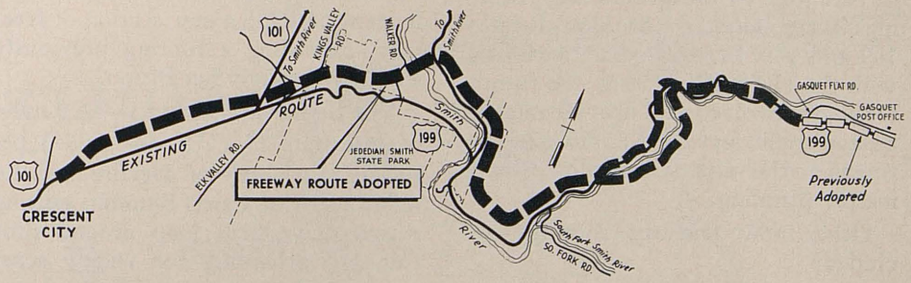
Freeway and other highway routings adopted by the California Highway Commission during the last part of 1963 were predominantly in the northern and central areas of the State, including one of the few interstate system sections which had not already been determined.

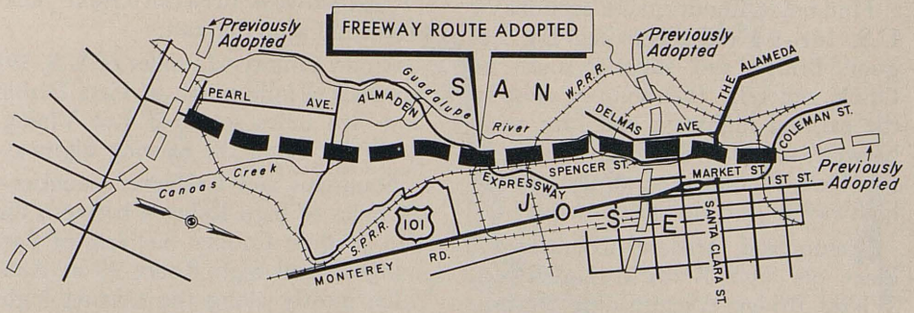
The interstate system routing adopted was a 26.5-mile section of Interstate 5 (old route U.S. 99) in the Yreka area of Siskiyou County. This action by the commission, at its November meeting, completes the route selection process for all of Interstate 5 in this State, covering 800 miles from the Mexican border south of San Diego to the Oregon line north of Yreka.

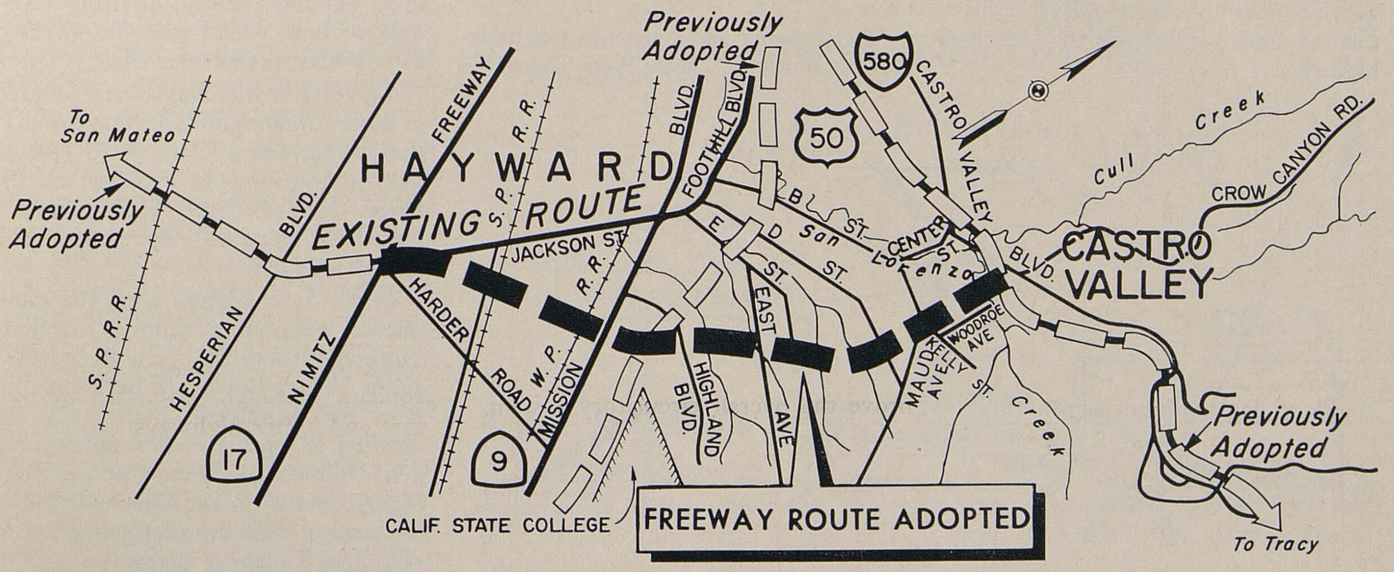
Other significant freeway routings adopted were in northern Del Norte County and in the urban areas of Hayward, San Jose and Fresno, as well as several in other sections of the State.

The Del Norte County routing involved 16.2 miles of U.S. 101 and U.S. 199 northeast of Crescent City. The routing runs to the north of the existing highway where it traverses a portion of Jedediah Smith State Park, and was endorsed by the State Division of









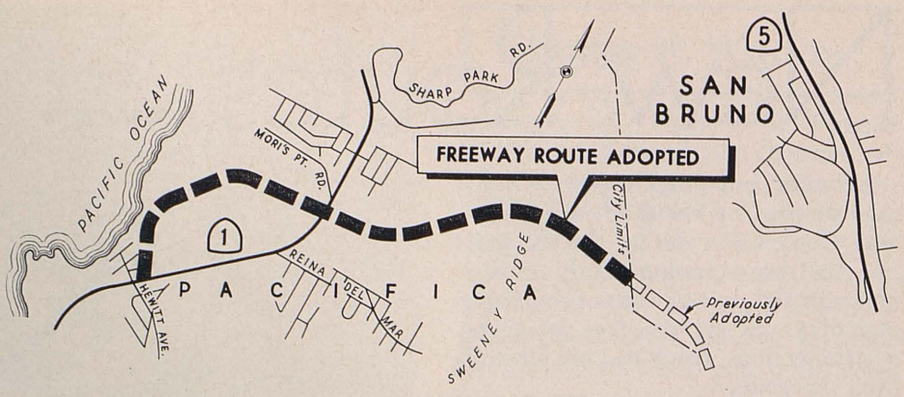
Beaches and Parks and by the U.S. Forest Service.

In the Hayward-Castro Valley area the commission adopted a routing for State Highway 92 (old Routes 105 and 259) between the Nimitz Freeway and Interstate 580, a distance of 4.6 miles, after a public hearing held in Hayward on October 10. The routing chosen is a combination of a route recommended by the State Highway Engineer for the westerly portion and a line favored by various local authorities and organizations which runs west of the proposed Don Castro Regional Park. A routing for 6.7 miles of State Highway Route 292 (new Route 87) was adopted in and south of San Jose. In the Fresno area, routings were adopted for Sign Routes 180 and 168. In both communities, as with the Hayward routing, the future freeways involved will provide metropolitan traffic service. Adoption of the routes at this time will facilitate local master planning.

Other new freeway routings included:

Humboldt County, two sections of U.S. 101—9.2 miles between Big Lagoon Bridge and slightly south of Orick, generally following or close to the existing highway; and four miles between south of Scotia and north of Rio Dell, running east of the existing highway in the latter community.

Fresno and Madera Counties—6.7 miles on Sign Route 145, between Whites Bridge Avenue near Kerman and just north of Avenue 5½; slightly east of and parallel to the existing highway.



San Mateo County—2.2 miles on State Highway Route 229 (new Route 186), between State Sign Route 1 in Pacifica and the Pacifica city limit at Sweeney Ridge; a new section of freeway, extending a routing previously adopted through San Bruno.

San Bernardino County—13.1 miles of Interstate 15 (U.S. 66-91-395) between just north of Devore and 1.4 miles north of Cajon Summit; cutting across a westerly loop around Blue Cut and providing for widely separated roadways between Cajon Junction and Cajon Summit.

Mono County—22 miles of U.S. 395 between a mile north of Casa Diablo and two miles south of Lee Vining; generally along the existing highway.

Stanislaus and Calaveras Counties—28 miles of Sign Route 4 between the San Joaquin County line east of Farmington and Sign Route 49 at Altaville; mostly along the existing highway.

San Joaquin and Calaveras Counties—14.7 miles of State Sign Route 8 (new Route 26) between the Calaveras River near Bellota and Sign Route 12 nea Valley Springs; generally following or north of the existing highway.

San Diego County—6.4 miles of State Highway Route 283 (new Route 103) between just south of U.S. 80 (Interstate 8) and U.S. 395; along existing Ward Road and Murphy Canyon Road.

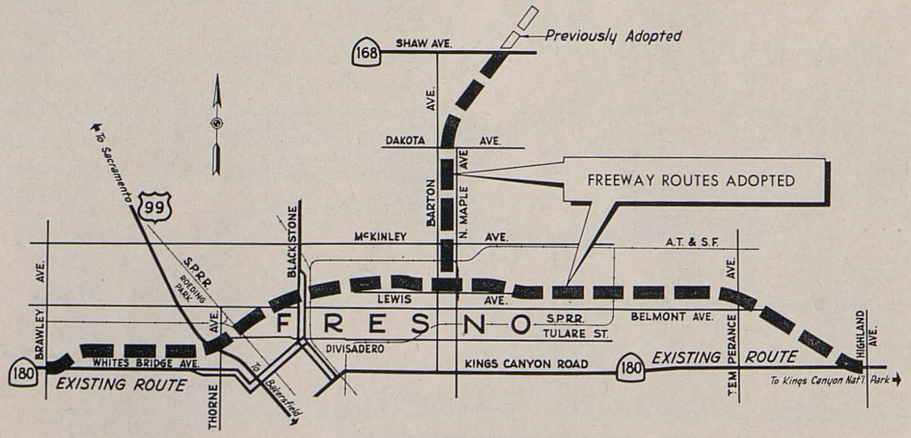
The commission also adopted several sections as conventional highways (nonfreeway) or as traversable routings.

One of these, in Chico, will move State Sign Route 32 from its present location in the vicinity of Chico State College to a new location to the south and west, using Eighth and Ninth Streets as a one-way couplet and then Walnut Street.

Another adopted routing extends a total of 10.8 miles between Georgetown and Sign Route 49 near Cool, in El Dorado County, omitting a 1.8-mile section which may be affected by a potential reservoir site.

Traversable highways were adopted in Butte County and Calaveras County, the former along Clark Road (Route 191) in and south of Paradise and the latter along Federal Aid Secondary Road 597 between Mokelumne Hill and West Point.

In the Los Angeles area, the commission adopted a routing for State Highway Route 163 (new Route 187) along Venice Boulevard between Lincoln and Sepulveda Boulevards, according to legislative description; and a 1.5-mile northerly extension of State Sign Route 27 in the Chatsworth area to connect with the adopted route for the Sign Route 18 Freeway.



Tijuana-Ensenada Highway

By EARL ROGERS, Associate Highway Engineer, District XI

U.S. Interstate Highway 5 begins at the international boundary near San Ysidro. It begins in a vast reservoir of humanity; of Mexican commuters and American tourists, of immigrants and vendors and uniformed border guards. Vehicles of every description, 54,000 on a summer Sunday, cross the border into Mexico and return—sports cars, rattletrap trucks, sleek limousines, big diesel semitrailers. Mingling with the autos are pedestrians, 24,000 of them, streaming into the sprawling city of Tijuana.

Interstate 5 has a common beginning with its counterpart in the Mexican State of Baja California. It is Mexico's Federal Highway 1 which may someday extend the length of the peninsula over 1,000 miles. At present it connects the border city of Tijuana with the deep-water port of Ensenada, 65 miles to the south.

Ensenada is, in a sense, the frontier of Baja California; for beyond is an immense wilderness of mountain and desert, of indescribably beautiful seacoast, of sparkling emerald bays, of missions whose crumbling walls are a haunting reminder of the Franciscans and the Jesuits before them.

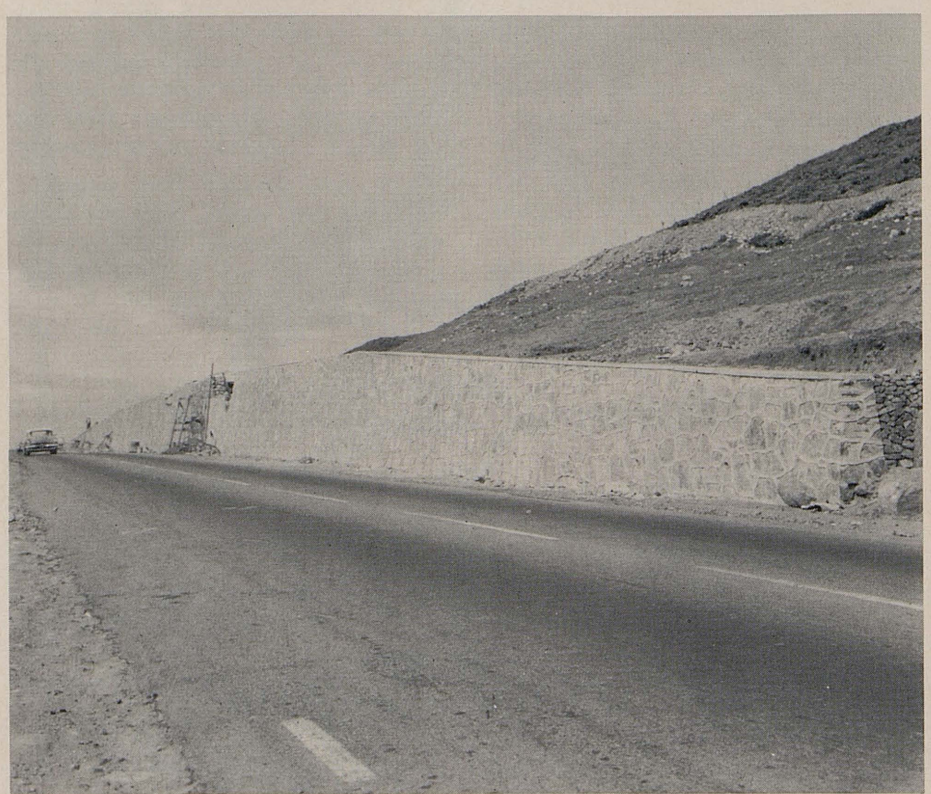
Baja California is a sleeping giant. The stimulants needed to awaken it are water and highways. Water will come later, but the modernization of highways has already begun.

A two-lane paved road carries today's traffic south from Tijuana. It handles a growing volume of tourists traveling to the resorts and sport fishing facilities at Ensenada. It carries the adventure-smitten in their jeeps and campers bound for the surf fishing, the hunting, and the exploring of the remote regions of the Baja Peninsula. It carries increasing commercial traffic, for this is also farm country. Olives, wine, cotton, produce, and cattle must find their way to market.

It suffers from modern ailments; from too much traffic, substandard alignment, a high accident rate. It was built in 1935, improved in the intervening years, but a widened bridge or a straightened curve can no longer keep pace with the growing traffic volumes.

The new Tijuana-Ensenada Highway will skirt the west coastline of Baja California more closely than the old route, as shown in the above map.

Grading operations on the new highway showing windrowed base material on the southbound lane in the foreground. The northbound lane is in the background; the old highway is upper right.



A native stone gravity retaining wall along the old highway. New construction can be seen on the hillside, upper right.

The freeway concept is the only solution—controlled access, grade separations, a divided roadway. A 65-mile project is now under construction. When completed, it will provide uninterrupted traffic flow from the outskirts of Tijuana to Ensenada.

Design

A Mexico City firm, Ingineros y Arquetectos S.A., in addition to being the prime contractor, has also been responsible for designing the project. Centerline location and topographic mapping were done by field survey. Standards for horizontal and vertical alignment are based on a design speed of about 68 m.p.h. (110 k.p.h.).

A 24-foot median will separate the roadways with two 12-foot lanes for each direction of travel and 8-foot shoulders to the right of traffic. Separate grade lines for each roadbed will take advantage of the natural terrain, improve aesthetics, and help to economize on grading in sidehill locations. Grades will not exceed 6 percent. Fill slopes are about 1½:1. Cut slopes are steeper, ½:1 in most cases.

Four interchanges are planned; near Rosarito, El Descanso, La Misión, and Ensenada (see map). In addition to the interchanges, there will be seven major stream crossings requiring bridges. The longest structure (533 feet) crosses the tidal lagoon at La Misión. It will be a concrete box girder on reinforced concrete piling. Another major structure at El Morro has reinforced cylindical shells for the bent footings. Still another structure is founded on massive, unreinforced native stone bents and abutments.

Construction

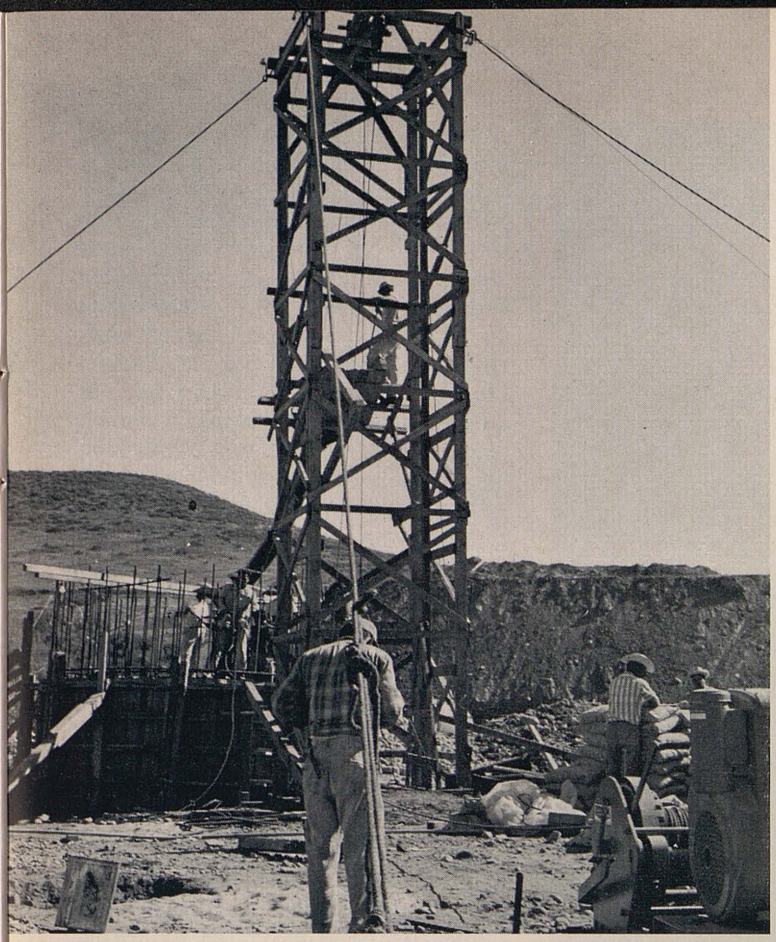
All heavy grading is done by earthmoving equipment purchased from the San Diego area; tractors, scrapers, motor graders, carryalls, and shovels.

Trenching is done entirely by hand.

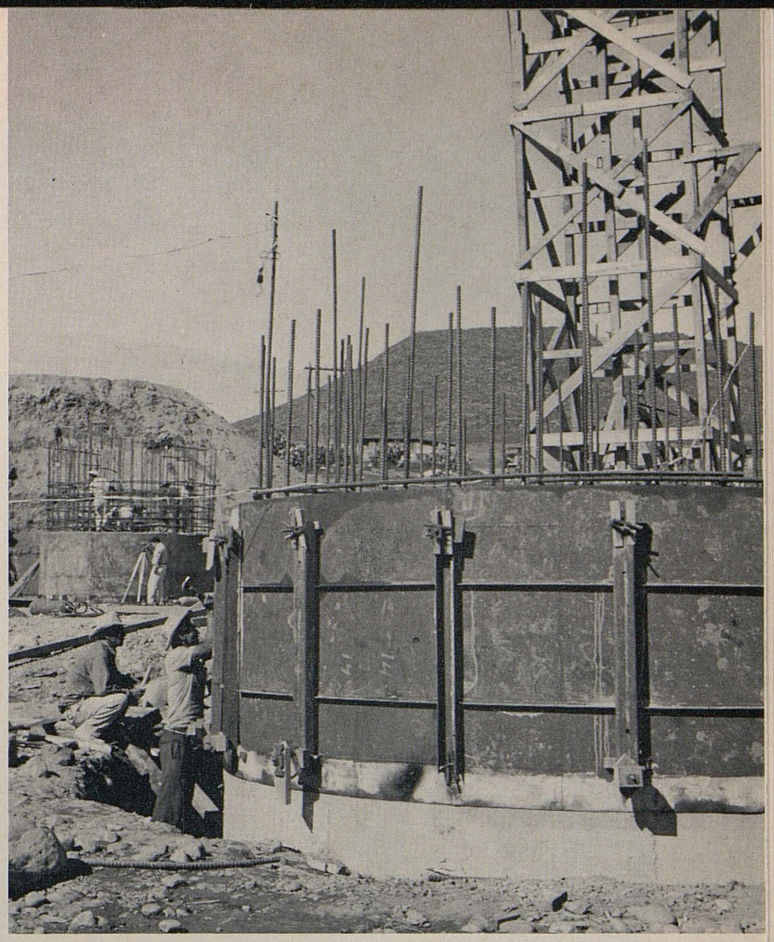
Arch culverts, pipe headwalls, and retaining walls are all unreinforced gravity structures made from native stone.

Reinforced concrete pipe is made near the jobsite.

If some of the construction techniques seem unmechanized, the reason is one of simple economics. Stone masons make about $3 per day. Heavy equipment operators make $6 per day with a bonus for dirt hauled. Form



A concrete pour on thin shell bent footings. The concrete is carried by wheelbarrow to the timber cage, lifted by hoist and dumped into the chute.



Construction of thin shell bent footings at El Morro.

lumber is imported from the U.S.A. and considered expensive; thus masonry construction is used wherever possible.

Materials

Quality control is achieved by sampling and testing all materials. Bridge concrete is controlled by slump tests and compression tests on concrete cylinders.

Native stone used in retaining walls, drainage structures, and bridge bents is tested for deterioration by immersion in sodium sulfate solution. Axial compression and specific gravity tests are also made.

The roadway structural section consists of two layers of subbase 10 cm. each, a layer of base at 15 cm., and 6 cm. of asphalt concrete surfacing with a fog seal of RC 800. Atterberg limits and the California bearing ratio (CBR) are tests used to control the quality of base material.

The Proctor test measures relative compaction. Embankment requires 90 percent compaction to within 50 cm.

Grading on the new highway. The old highway is to the left. The pole line in the center will be moved outside of the right-of-way.

Workmen construct a native stone bridge pier.

of finished grade. Above 50 cm. the requirement is 95 percent.

Administration and Financing

Mexico has a system of federal, state and toll highways similar to the U.S.A. The federal highway system is administered, financed, and maintained under the direction of the secretary of transportation and communications. State highways are built by the states from general revenue funds. Toll highways and toll bridges come under the jurisdiction of Puentes y Caminos Descentralisados de México.

The existing Tijuana to Ensenada Highway is a part of the federal system. The new highway, when completed, will be turned over to Puentes y Caminos, etc. and become a toll road. The exact toll charge will not be set until construction is complete, but is expected to fall between $1 and $1.20.

Adolfo Briones Martínez is the engineer representing the secretary of communications and transportation.

Project cost is $16 million. Bridges account for $960,000 of that figure.

The contractor is working more than 700 men on two eight-hour shifts per day in an effort to complete this 65-mile project by September 1964.

The location of the new highway was deliberately chosen to afford a scenic view of the rugged, primitive coastline of Baja California. The motorist will see desolate stretches of sandy beach washed by white foam and clear water; rocky inlets lashed by incessant waves; and jagged cliffs rising vertically from the blue Pacific. He will roll across the tidal lagoon at La Misión where the seabirds rest on placid waters and he will climb high above the crashing surf along the cliffs swept by the sea breeze and the salt spray of angry winter storms. He will finally see the gentle sweeping curve of the Bay of Todo Santos with wispy marestails etched against the brilliant sky, and, like sentinels, the far-off mountain peaks of the Sierra Juárez.

Frank Balfour Leaves ARWA Secretary Post

Frank C. Balfour, National Executive Secretary for the American Right of Way Association and former chief right-of-way agent for the California Division of Highways, retired on February 1. Balfour who founded the association some 30 years ago, will continue to spend a great deal of his time working for the association as national coordinator.

He has been succeeded in the executive secretary's post by Robert R. Stone, who, until recently, was a supervising right-of-way agent with the division in Los Angeles.

Born in Pomona, Balfour graduated from the University of Santa Clara with a degree in electrical engineering in 1914.

He joined the Division of Highways in 1931 as an assistant right-of-way agent and was appointed chief right-of-way agent in 1943.

Under his direction, California's highway right-of-way organization came to be recognized as one of the outstanding of its kind in the country, a position which it has never relinquished.

Balfour was instrumental in the establishment of the Division of Highways policy which assures the payment of fair market value for property required for highway purposes.

Mountain Springs Grade

By DON W. GRAY, Resident Engineer

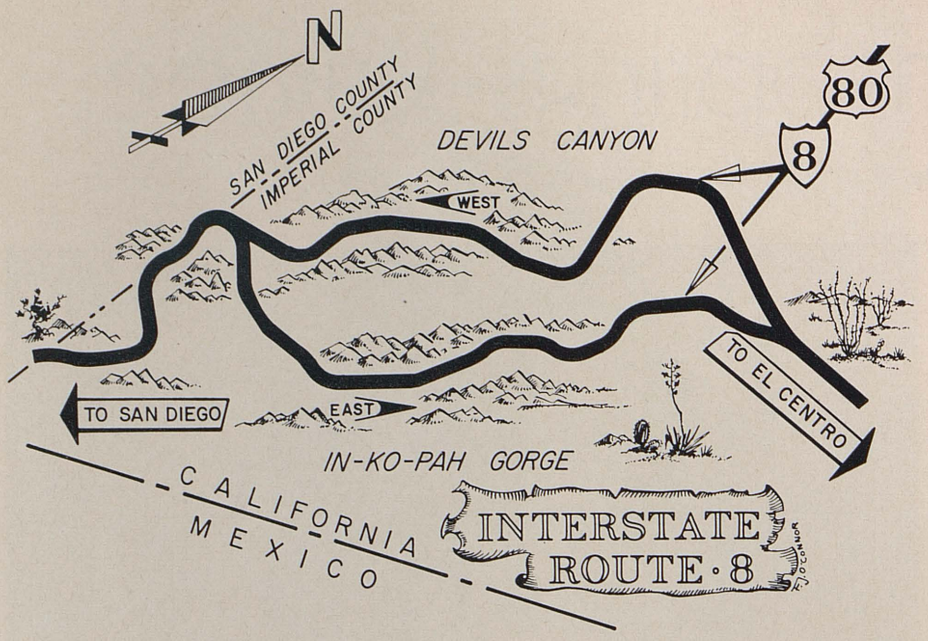
"Only the courageous or the desperate attempt to cross the mountains between San Diego and the Colorado River." These were words used to describe the hardships of travel through eastern San Diego County in the early California period prior to the Civil War. In addition to rugged mountains, an arid desert wasteland had to be faced in what is now the Imperial Valley, one of the largest agriculture-producing centers in the nation. Hostile Indians, politically inspired rivalry between the North and the South over the location of mail routes to the Pacific Coast, and the fact that large deposits of gold had first been discovered in Northern California, all tended to discourage development of little more than foot trails through the southern mountain ranges.

The mail route established by James E. Birch, which for a brief period of less than a year, in 1857, carried mail from San Antonio to San Diego by muleback was derisively referred to by northern partisans as the "jackass mail," or "the route from nowhere to nowhere." In 1863 two enterprising teamsters, Pete Larkins and Joe Stancliffe, built a small house at Mountain Springs, selling supplies and assisting the few hardy travelers up a 30-percent grade with teams of oxen. There is no indication that the road was heavily traveled.

Mineral Resources Discovered

By 1870 the discovery of valuable mineral resources in the Arizona Territory prompted the San Diego County Board of Supervisors to grant the San Diego and Fort Yuma Turnpike Company authority to establish a toll road in Mountain Springs Canyon. Although steep, narrow, and rocky, the road was successful. Typical charges

Devil's Canyon Bridge No. 2 under construction. The concrete forming can be seen protruding over the left side of the bridge.



were as follows: sheep and hogs, 1 cent each; horses and cattle, 5 cents each; horse and rider, 25 cents.

Additional pressure to establish a good road developed in the early 1900's when it was brought to the attention of San Diego civic leaders that $10 million worth of business from Imperial Valley and Arizona was being transacted with a northern neighbor. In the days before gas tax funds were available, the rather unusual method of a public subscription was used to raise $60,000 in order to construct a road suitable for automobile travel. In the words of a newspaper article of the day "The present road is of 22½-percent grade and includes 9 miles of sand. This will all be eliminated and made 11.3 miles long with 1 mile of 7-percent grade, 3 miles of 6-percent grade, 2 miles of 5-percent grade, and 5 miles of 4-percent grade with only 1 mile of hardly noticeable sand."

Construction began on November 2, 1912, under the guidance of Fred A. Rhodes, who was later to hold many responsible positions in San Diego City government. Mr. Rhodes recalled that there were numerous hardships. Good water was scarce. When a new well was dug, one of the mules was permitted to take a drink. If he reported for duty the next day, the water was satisfactory. If not, the well became the mule's final resting place. Arsenic is often encountered in the springs of these mountains.

Heavy Labor Turnover

It is not difficult to understand the reason for a heavy turnover in labor, since the 150-man crew lived in tent camps 50 miles from the nearest towns. Tents would be literally flattened under the 80-m.p.h. winds blowing down the canyon, leaving the men to seek shelter behind sand scoured rocks. A typical equipment spread of the day consisted of 40 mules, together with plows, wagons and stoneboats. All drilling was done with single jacks (one- to two-pound hammers) and hand-held drills. Black powder was the favorite explosive for blasting. The prime movers, the mules, were known for their sure-footedness on the narrow trails, as well as their ability to tell when lunch and quitting time came. They would stop pulling and bray. Apparently in the mule labor code, there was no such thing as overtime. In spite of dire predictions of failure, Mr. Rhodes not only completed the highway on schedule, but managed to conserve $13,000 of the original $60,000, which was returned to the subscribers.

The basic alignment of this highway was widened and paved with concrete in 1927. The last major realignment work in the area was completed in 1941 which served until late last year taking U.S. 80 traffic up the grade via Myer Creek Canyon.

Similar Problems

Muleskinners were replaced by cat-skinners on the recent contract which saw 10 miles of Interstate 8 completed at a cost of $5½ million. The probems faced were similar, however, the most important merely being able to get to the site of the work in the first place. The principal portion of the project follows Devil's Canyon, a mile and a half north of the present Highway 80. The alignment selected fell largely on steep boulder-strewn and faulted hillsides rising from the canyon floor at a 1:1 slope or greater. For the coming year the newly constructed 36-foot paved section will carry two-way traffic while work is proceeding on the realignment of existing Highway 80 in Myer Canyon. At the conclusion of this contract a four-lane divided highway with a mile and a half median (in places) will result. Myer Canyon will carry two lanes eastbound and Devil's Canyon will serve westbound traffic. The addition of extra lanes will expedite traffic through the area at the saving of boiling radiators and tempers when slow-moving vehicles would tie up long lines of motorists on the present route.

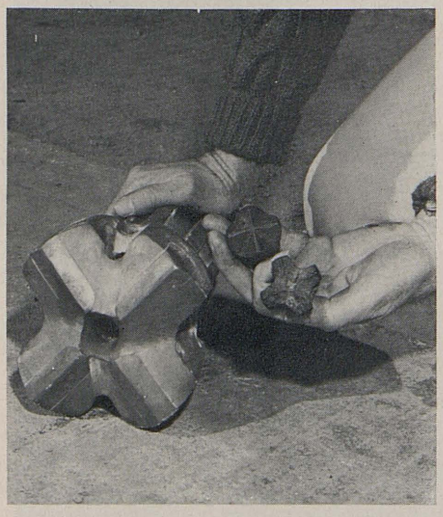
Isbell Construction Company, with main offices in Reno, Nevada, was the successful bidder on both contracts. The original critical path schedule prepared by Isbell showed a completion date six months in advance of the allotted contract time. Despite numerous setbacks, principally slides of already completed slopes, and adverse weather, the schedule was realized after time adjustments were granted for the additional work.

Project is Divided

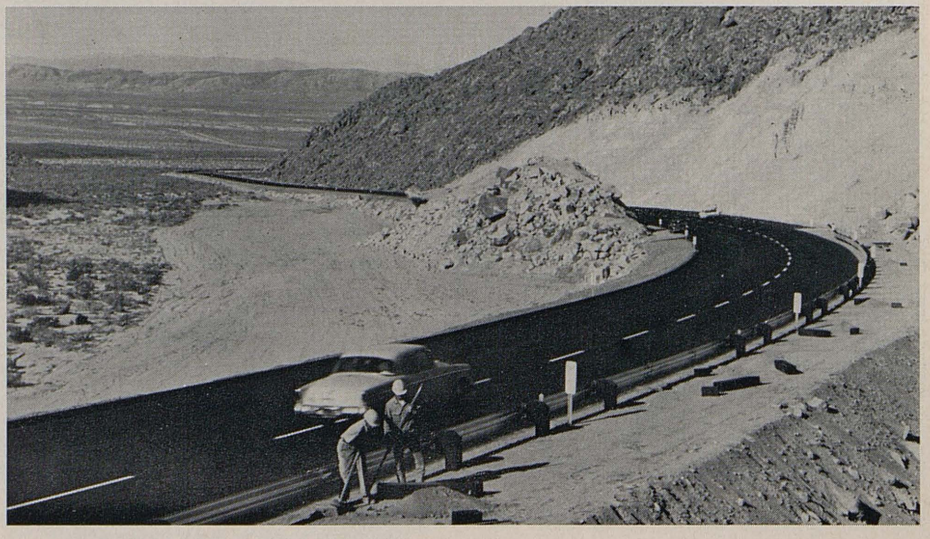
Because of inaccessibility, the project was divided into three distinct areas, each separated by the two major steel girder bridges rising 140 feet

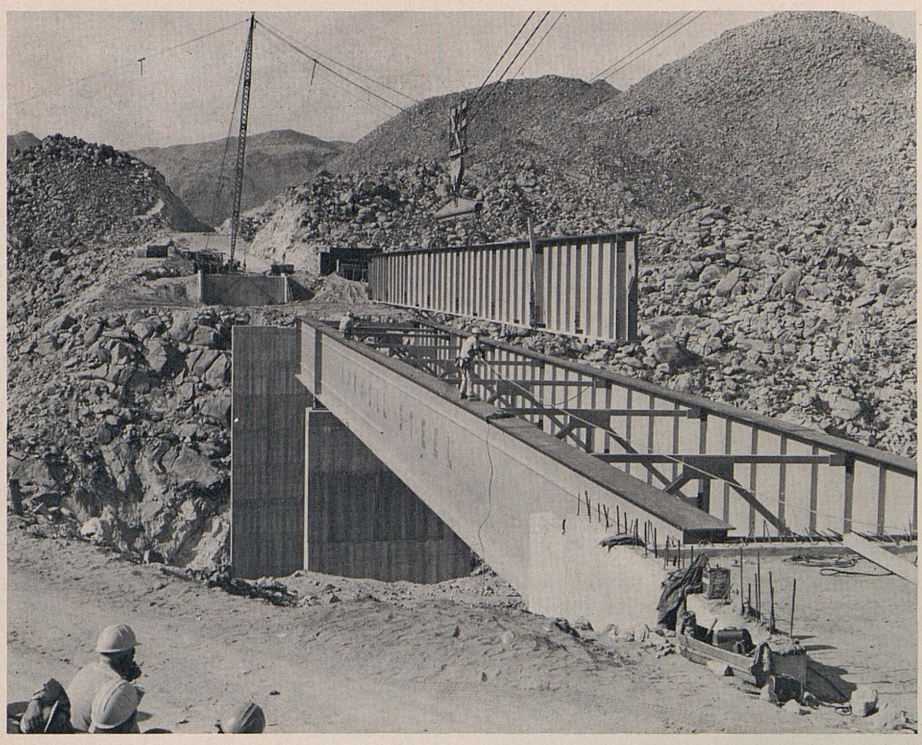
Looking south over the Mountain View—Devil's Canyon area. Bridge No. 2 is in the left foreground; Bridge No. 1 in right background. Community of Mountain Springs is visible in center background.

PHOTO ABOVE. Devil's Canyon Bridge No. 1 looking southeast. The old freight road can be seen in left middleground. PHOTO BELOW. A northeasterly view of a section of the new roadway showing cleanup operations in progress. The desert floor is visible in the distance.



Comparison of modern carbide insert drill bit (above) with two types from old projects.





A steel girder is moved into place on Devil's Canyon Bridge No. 2.

above the floor of Devil's Canyon and located in the geographical heart of the job. Pioneering and grading in each section had to be carried on independently of the adjacent sections, the only access being the remnant of a flood-washed early day freight road down Devil's Canyon and the roads blasted and dozed along the steep canyon sides by the contractor.

The preparation of the bridge sites and the erection of the girders accounted for a considerable portion of the total cost of the project. The girders, some of which measured 167 feet, are among the longest shop-fabricated on the West Coast. They were hauled to the near vicinity of the job by rail, transferred to trucks, and swung into place over the canyons by a 1,000-foot, 2-inch cable highline.

While the bridge crews were spanning the canyons, a double-shift grading operation was in progress moving 1,700,000 yards of rock to the fills. The two main production units were a 5- and a 6-cubic-yard electric shovel, each feeding a string of 20-yard rock trucks. These shovels work with deceptive quietness and efficiency. Loaded trucks rolling down steep grades under restraint of engine brakes and the day-and-night chatter of rock drills left no doubt that work was in progress.

Hydraulic Monitor

The fills were watered in ordered amounts by a modern adaptation of an early-day mining tool, the hydraulic monitor. The contractor purchased water in Jacumba Valley, 8 miles west of the project, and placed 17 miles of 16-inch and 4-inch waterline to supply water to the monitors and to conventional water trucks when the going became smooth enough to use them. State-furnished water load counters were installed on two trucks. These counters are designed to count each load of water and will operate only when the truck is completely filled and then emptied to within an inch of the tank bottom. An unexpected result occurred in that the counters showed more loads used than the driver reported. Traveling on rugged steep haul roads may have caused enough surge in a partially filled truck to trip the device and thus indicate an erroneous reading.

Drainage facilities consisted of corrugated metal pipe culverts. A structural plate pedestrian underpass at Mountain Springs has served at least one customer. A rare Borrego mountain sheep was observed trotting blithely through the installation. The same ram had been seen on other occasions acting as sidewalk superintendent overlooking drilling crews as they worked. Beside mountain sheep, snakes, and lizards, the culverts handled the heavy unseasonable autumn rains as designed.

Slopes are Flattened

The rocky appearance of the mountains proved deceptive in that 75 percent of the cut slopes had to be flattened or benched in order to achieve stability. The geological section of Materials and Research responded to many "mayday" calls to give recommendations on slope treatments. One report described an area as containing faulted, shattered, crushed, and pulverized zones with huge boulders and joint blocks 10 to 30 feet in diameter. The presence of those 30-foot boulders kept the contractor's explosives bill high. Three hundred fifty-six tons of ammonium nitrate fuel oil mixture and dynamite were used. Careful shooting was the rule, with an average of three-fourths pound of ammonium nitrate per yard required.

While the project might not qualify in record books as the "toughest" rock job, it will long be recalled by those who worked on it as the hottest (120° temperature in summer), the coldest (4° temperature in winter), windiest (80+ mph winds still blow), rockiest, or sandiest piece of highway in memory. Scenic vistas with easy grades and slopes give little evidence now of the trials of early pioneers, or for that matter, of Isbell in constructing this modern highway.

The contractor was represented by project managers Larry Callahan, who handled the organizational phases of the work, Harry Varischetti, who served in the early production period, and Gus Jeppson, who completed the project for the Division of Highways. Eugene Calman served as district construction engineer, D. W. Gray as resident engineer, and R. Dean Brown, Bridge Department representative.

TWENTY-FIVE-YEAR LIST

The following employees received 25-year awards since the July-August issue of the magazine.

Headquarters Office

Arnold H. Carver
Robert B. Ely
Arthur H. Green

Headquarters Shop

Kenneth M. Runyon

Shop Nine

Herbert H. Junker

State-owned Toll Bridges

Cecil Wilkins Mills
Herman Tompach

Materials & Research

Margaret D. Lark

Bridge

Donald M. Daigle

District I

Darinka L. Gutsch
Edwin F. Parkhurst

District II

M. J. Elmslie
Hilmon Salinas
Lloyd M. Roth
James F. DeGusta

District III

Lucille Forrest (Palmer)
Harold Penrose
George H. Tanner
Herbert P. Trenery

District IV

Edward M. Hill
Erwin D. Houde
Lilia McAuliffe

District V

W. C. Henning

District VI

William H. Geier
Joseph H. Buckle
James E. Robinson

District VII

Betrice N. Waddington
Charley B. Lee
O. Paul Slagle
O. E. Bafford

A. C. Elofson
Bradford Shaffer, Jr.
Elizabeth Putman

District VIII

Ermal G. Boyd

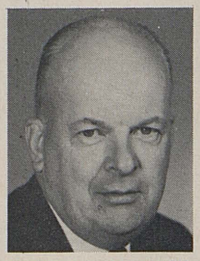
District X

Harold L. Valverde
Maurice C. Riley
Leland N. Hack

Marsden Joins Staff Of Judicial Council

Warren P. Marsden, of Sacramento, an attorney for the State Department of Public Works for the past 14 years, has been appointed to the staff of the Judicial Council. Marsden will join the Administrative Office of the California Courts, the council's staff agency, which is located in San Francisco.

In announcing the appointment the Director of the Administrative Office, Mr. Ralph N. Kleps, said, "Warren Marsden's experience in both public and private law practice will be of great assistance to us. We are also counting on his extensive background in the field of legislation."



WARREN P. MARSDEN

Marsden practiced law in Seattle, Washington, and was on the staff of the Attorney General of the State of Washington prior to Navy service during World War II when he was communications officer on the staff of a destroyer squadron in the Central and Western Pacific areas. He practiced in San Francisco from 1945 to 1949 when he entered state service as a deputy legislative counsel. In addition to his regular assignments in the legal division of the Department of Public Works, he has assisted every Governor since 1949 in the review of legislation prior to gubernatorial action.

A native of Seattle, Washington, Marsden was educated in Seattle public schools and the University of Washington. He is a member of the California, Washington, and Sacramento County Bar Associations.

IN MEMORIAM

Headquarters Office

Sam Lunetta, senior reproduction machine operator; Norman B. Deuel, information officer I.

District I

Vernon Bickford, highway engineering technician I.

District III

Clyde F. Moeckly, highway foreman; Ronald B. Hammons, delineator; Patsy L. Bagwell, engineering aide I.

District IV

James Harden, Jr., groundsman; Betty Wong, delineator; Lee M. Scoggins, highway foreman.

District VI

Gladys McKay, intermediate account clerk.

District VII

Augustine Lopez, highway engineering technician I; Pearson S. Shinn, engineering student trainee "D"; Merlin S. Berg, highway engineering technician II; John S. Elliot, highway engineering technician I.

Shops

William Gosney, automobile mechanic; Mary McPhee, intermediate stenographer.

Bridge

Edward W. Hartman, engineering aid II.

State-owned Toll Bridges

Norman Chabot, toll collector; Albert Fawcett, toll bridge maintenance man II.

NEW HRB CHAIRMAN

Wilbur S. Smith, a highway engineering consultant of New Haven, Connecticut, has been elected 1964 chairman of the Highway Research Board.

Smith succeeds C. D. Curtiss, of Washington, D.C., an official of the American Road Builders Association and former U.S. Commissioner of Public Roads.

Lompoc Projects

Approach Highways to Missile Bases Improved

By J. M. STURGEON, District Construction Engineer

The California Division of Highways and the County of Santa Barbara have completed three, and are working on a fourth, of a series of relocation, reconstruction and realignment projects on the highways serving the missile complexes in the vicinity of Lompoc.

West of Lompoc, the Navy has developed its facility at Point Arguello as both an operational and research center.

North and west of Lompoc, the Air Force has its Vandenberg Base.

The development of these bases has resulted in heavy increases in traffic in the past several years. All this increase was dumped onto a road system designed to serve a relatively quiet farming and mining community.

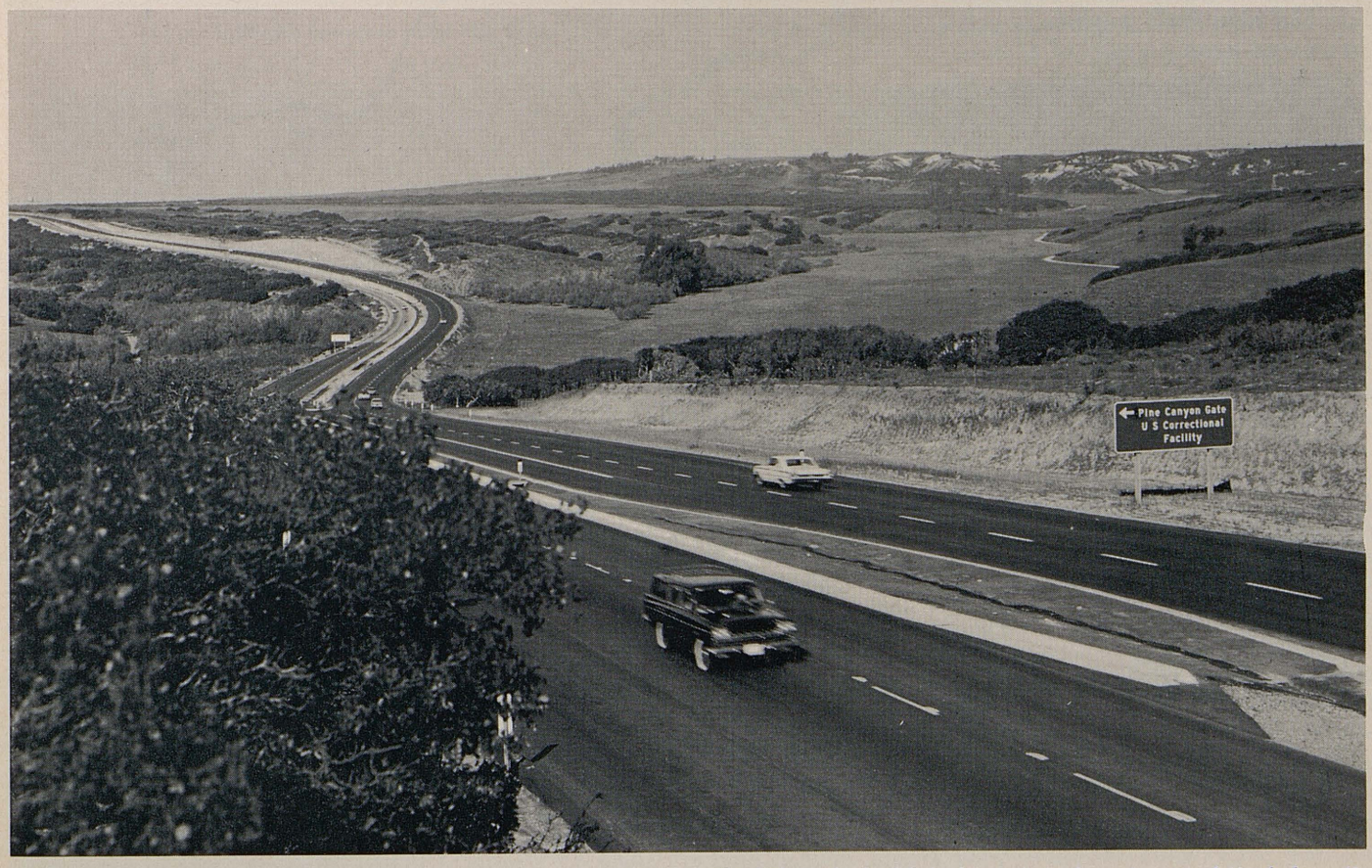
Highway 154, which serves Point Arguello, had a peak average daily traffic count of 1,523 vehicles in 1953 at the west city limit of Lompoc. By 1962 this had climbed to 6,200 vehicles. Traffic had increased more than 400 percent in nine years.

Traffic to Vandenberg

Vandenberg, served primarily by county roads, created an even greater surge in traffic demand.

In March of 1962, the Division of Highways received bids for reconstruction of about 2.6 miles of Highway 154 from the small railroad community of Surf on the coast back toward Lompoc. The low bid of $579,026.90 was submitted by E. C. Young of El Cajon.

Basically, this project involved reconstruction on new alignment of the existing narrow, twisting, structurally inadequate road to create a high-capacity two-lane highway around the perimeter of the Point Arguello facility, from the coast back to the main entrance. One bridge had to be constructed over San Miguelito Creek where it drained into the coastal



A section of the new four-lane, divided expressway on Lompoc–Casmalia Road. The highway leads (left background) to the main gate of Vandenberg Air Force Base.

sloughs. Construction problems were the usual standard ones of wind, weather and soil variants. Of more concern was the necessity of dealing with the agencies involved in adjoining properties.

Near the middle of the project a "back door" feeder road to Vandenberg joined the new alignment, so the Air Force had an interest in the work. A Santa Barbara County coastal park also had to be served by this new facility. So the county had an eagle eye on and an interest in the work. Most concerned, of course, was the Navy, for whom this road will serve as a main access to its facility at Point Arguello.

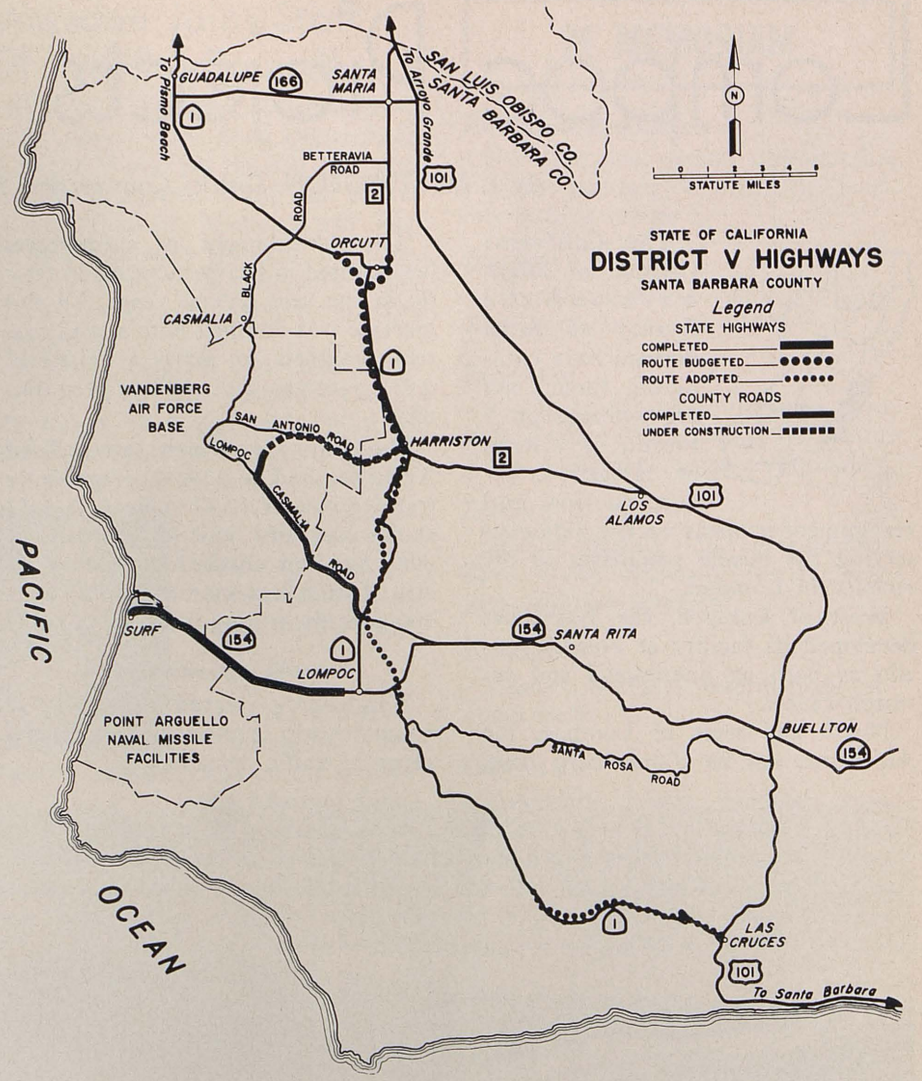
It is a compliment to the cooperative spirit of all parties concerned that there was no difficulty, argument or disagreement among or with any of the various organizations involved at any time during construction.

Missile Firings Cause Delays

Well—there was one *little* problem. Every time a missile was going to be launched from Point Arguello, a very determined-looking group of Marines arrived to escort everyone out of the area. This included contractor's forces, inspectors and the entire population of Surf. Arrangements had to be made, of course, to see that the contractor was granted a commensurate extension of contract time for each of these delays.

The project was originally scheduled for completion prior to April 25, 1963. Weather and rocket delays extended this, and the project was accepted on July 25, 1963.

In the meantime, on August 1, 1962, bids on a companion project from the end of this one on to the City of Lompoc, a distance of about 6.4 miles, were opened, and E. C. Young was again low bidder. This project was for $938,855. Work started on August 21, 1962, and continued for the next 11 months. While this contract also required reconstruction on new alignment, the new alignment topped, crossed, recrossed and paralleled the old so completely that traffic could not be carried on the old lanes while the new were built. Consequently, traffic had to be carried through construction at all times and in all phases.



A map showing the location of the various road improvements which serve the missile facilities in Santa Barbara County.

In spite of the traffic and a high water table, the contractor finished the project on July 9, 1963.

The completion of these two jobs means that for the first time the Point Arguello Naval Facility has adequate access to and from the City of Lompoc and the surrounding areas.

County Completes Plans

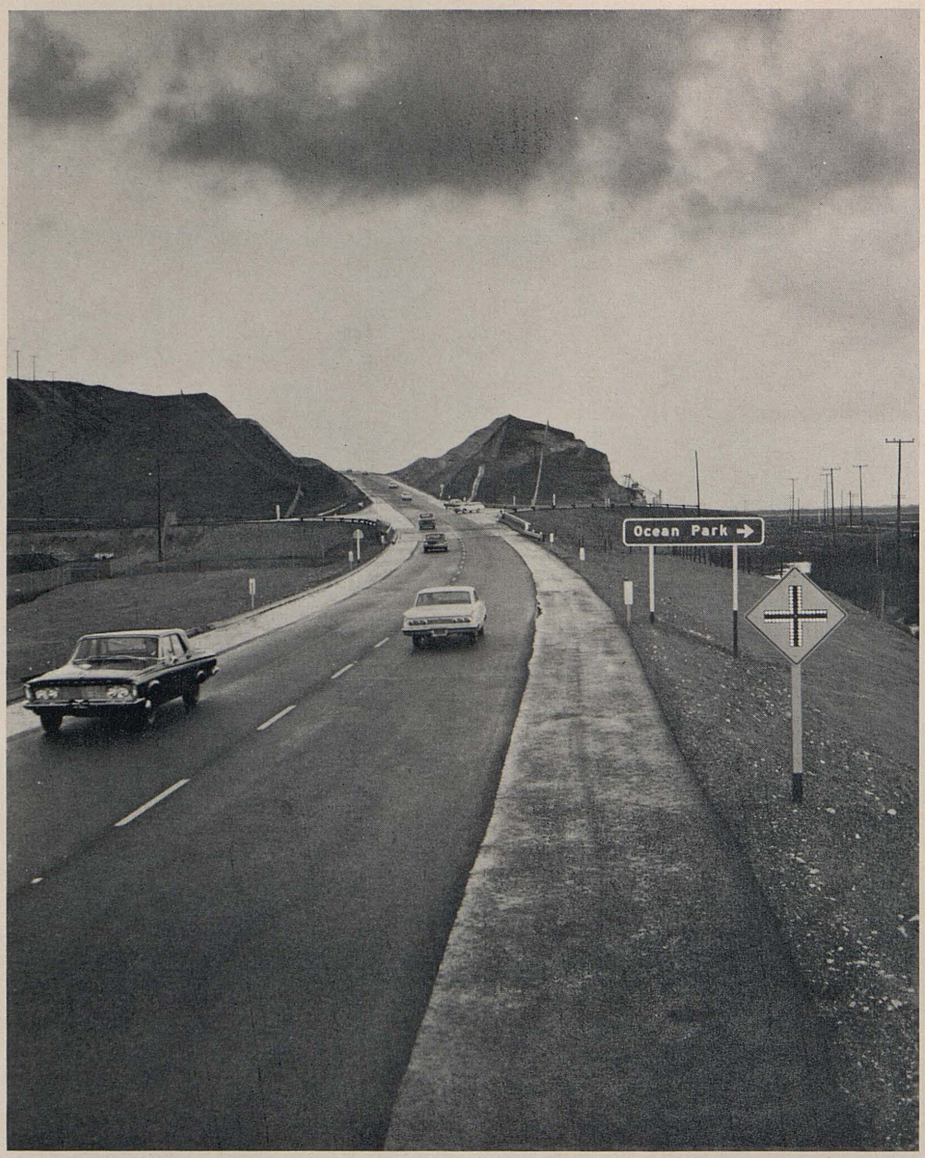
While these access projects were being pushed ahead for the naval missile facility, the County of Santa Barbara completed plans and advertised for bids for reconstructing as a four-lane divided highway some 6.7 miles of the Lompoc–Casmalia Road, the main thoroughfare to Vandenberg AFB. Low bidder on this project was Coxco, JV, of Stanton. Work started on this $707,103.70 job on December 6, 1962. Though designed by the Santa Barbara County Road Commissioner's office, job engineering and inspection were carried out by Division of Highways personnel.

As construction proceeded, several minor changes in design were requested by the Air Force and were all incorporated into the work with little difficulty. As a result of excellent scheduling and coordinating by the contractor, the project was completed on August 19, 1963.

These three projects are only the start of the revised road net complex

Grading operations on the "Big Sand Cut" section of San Antonio Road east of Vandenberg Air Force Base.

The Lompoc–Casmalia Road at the main gate of Vandenberg Air Force Base.



Looking west along a new section of Sign Route 154 toward the seaside community of Surf. This highway also carries traffic to the Point Arguello naval missile facilities.

that has been planned by county and state forces to handle highway needs of these space age installations.

On April 17, 1963, bids were opened on another county road project. This one provided for construction, mostly on new alignment, of a feeder road between the Main Gate at Vandenberg and State Sign Route 1 at Harriston, south of Orcutt. Again, Coxco, JV, of Stanton was low bidder; this time at $1,146,635.50 for some 6.95 miles of road. The first three miles are to be a four-lane divided facility on completely new alignment. The last three miles follow existing San Antonio Road but "beef up" the structural section. Santa Barbara County is now working with the Air Force on plans for another project to carry the four-lane section on through to State Route 1 on new alignment.

Scheduling Is Important

Progress on this contract has been, again, characterized by skillful detailed planning and scheduling on the part of the contractor.

The major portion of the four-lane construction was completed and turned over to the county by December of 1963, beating the rainy season. By March 1964 the entire project will be complete and available to ease the load of commuter traffic on the existing road net.

To tie onto this project, the California Highway Commission has included in its 1964-65 fiscal year budget some $4,860,000 for a project to be advertised in the summer of 1964 for the construction of a four-lane freeway on Highway 1 from Harriston to Orcutt. This will result in the completion of state-county expressway-freeway facilities from Santa Maria and points north to Vandenberg, on to Lompoc, and from Lompoc to Point Arguello Naval Facility, a two-lane "freeway."

Not one of these projects in itself involved any departures from normal standard construction procedures (with the possible exception of having to stop work when missiles were launched).

Continuous Cooperation

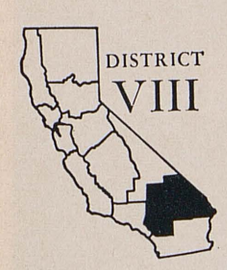
Of outstanding interest, however, was the daily and continuous cooperation between many various interested agencies that was involved. State, county, Air Force, Navy, Bureau of Public Roads, city officials, railroad officials and private property owners all had to cross-consult, confer, discuss, be kept informed and most definitely cooperate for even the concept of these projects to be possible. The successful completion of these three projects and the pending completion of the fourth emphatically illustrates the doctrine that no one agency, no one individual, nor one organization can accomplish anything if the effects of the endeavor on others is ignored.

Resident engineer on the two Coxco, JV, contracts has been M. D. McAllister, Assistant Highway Engineer. The Surf to Main Gate at Point Arguello project was under Dyer C. Campbell, Associate Highway Engineer; and the project from Main Gate at Point Arguello to Lompoc was under B. D. Hensley, Assistant Highway Engineer. All the projects started and three completed under District Engineer E. R. Foley. The fourth was completed under R. J. Datel, now district engineer of District V.

Mountain Pass

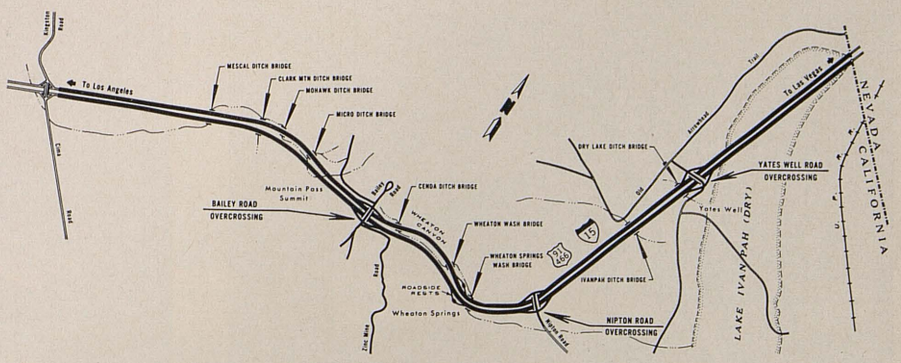
Another 23 Miles Completed On Interstate 15 in Desert

By CARL B. WOLFRAM, Resident Engineer



A high-standard freeway now traverses the Mescal and Clark Mountain ranges via Mountain Pass in the Mojave Desert and connects with the completed Nevada portion of Interstate 15 at the state border.

At a cost of over $6,000,000, the 23-mile improvement beginning 25 miles east of Baker will relieve the traffic congestions experienced in the past.



The newly completed freeway closes the gap between previously constructed portions of Interstate 15 east of Cima Road and north of the state border.

Regular cross-country traffic, combined with Los Angeles–Las Vegas trips, resulted in many a frustrated queue of cars moving up the curving grades, impatiently waiting for a chance to pass the slow trucks ahead. These sights are now scenes of the past.

Alignment Straightened

The new four-lane divided freeway follows a straight alignment up a steady incline for five miles, starting at the western end of the project to the vicinity of Clark Mountain Bridge. Here, the separated roadways gradually swing apart to form a wide median area providing room for a "dry" streambed.

With roadways converging again, the freeway approaches Mountain Pass Summit. Here, the motorist begins the 11-mile descent to the Ivanpah Dry Lake bed over 2,000 feet below the summit.

Scenic Values Preserved

Entering Wheaton Canyon, the roadways again sweep far apart, with Wheaton Wash (located on the bottom of the canyon) forming the median. This portion shows a good design solution for a divided freeway through confined, rugged terrain without destroying scenic values. A magnificent view awaits the motorist as he continues towards Nipton Road Overcrossing. The entire Ivanpah Valley extends below, with the New York Mountain Range forming the background.

The roadways again converge, separated by a 100-foot median, and continue for about 10 miles along a straight alignment toward the eastern end of the project.

Present Highway Widened

The existing highway was resurfaced and widened to form the new freeway at three locations. Furthermore, the new alignment crosses the old highway at several places. Construction, therefore, was scheduled in stages, requiring 12 temporary connections or detours, to facilitate the safe and orderly movement of existing traffic patterns.

Some existing service stations had to be removed to accommodate the wider highway. For the benefit of the traveling public during construction, 30 barrels filled with radiator water were placed at intervals along the entire project. During the hot summer months, these water points served as welcome oases for stranded motorists.

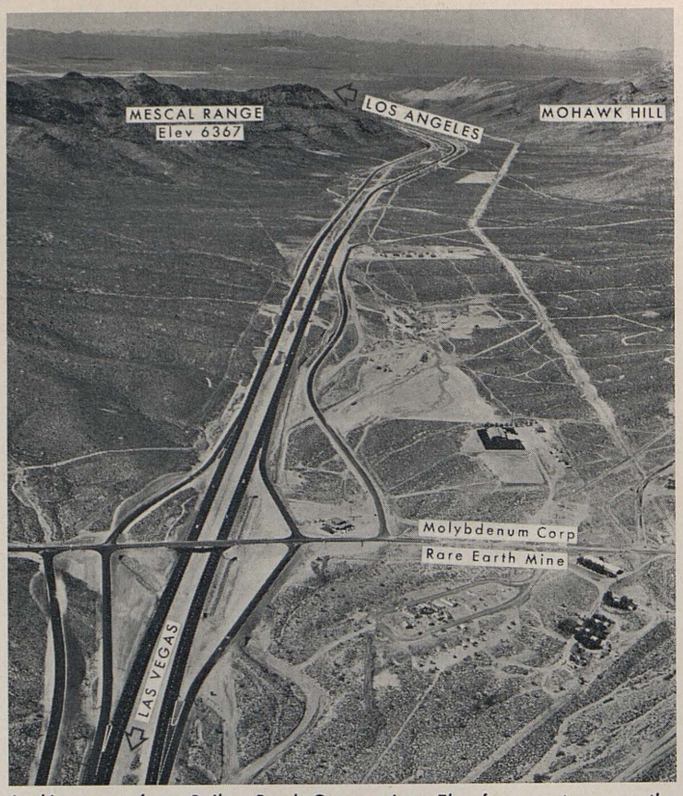
Safety Rest Areas

Presently, one tree-planted safety rest area for each roadway provides parking facilities and water for the traveler. The water is supplied from three spring sites at nearby Wheaton Springs and piped under gravity flow to drinking fountains at each of the roadside rest areas. Due to the extreme distance between interchanges and commercial facilities in this area, the roadside rests are used frequently.

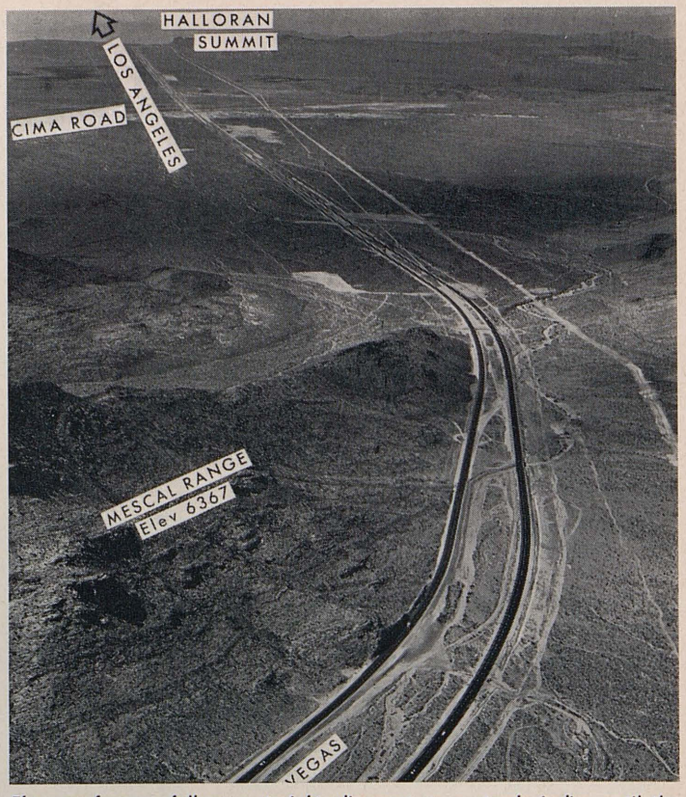
Two Structural Sections

Two structural sections were used for this project. The resurfacing section consisted of a minimum of 0.42-foot asphalt concrete over the existing highway. For the major portion of the freeway, the following structural section was constructed: 0.25-foot asphalt concrete on 0.5-foot cement-treated base and 0.33-foot aggregate base. In areas with low-quality basement material, aggregate subbase was placed in addition. Fifteen material sites throughout the project provided the required material for roadway embankments.

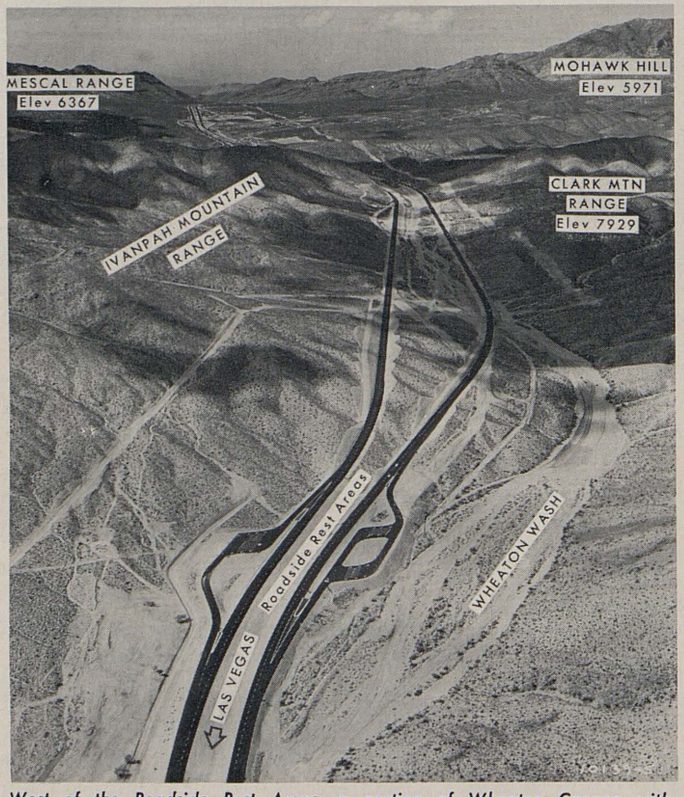
Extensive blasting was required to penetrate massive igneous and metamorphic rock formations in the Wheaton Canyon area. The contractor processed nearly 250,000 tons of aggregate for asphalt concrete from rock obtained from the roadway prisms.



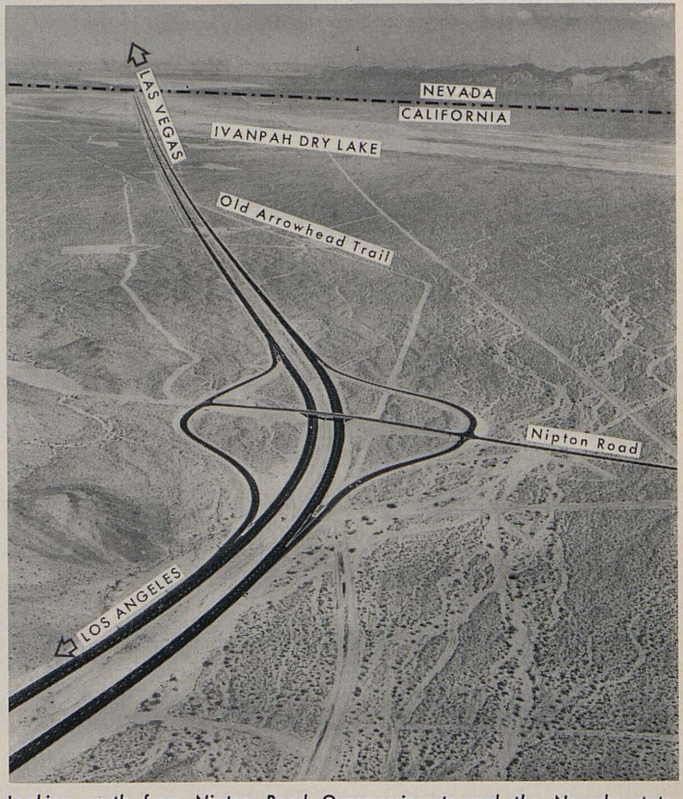
Looking west from Bailey Road Overcrossing. The freeway traverses the mountain pass plateau.



The new freeway follows a straight alignment up a steady incline until the roadways gradually swing apart to form a wide median.



West of the Roadside Rest Areas, a portion of Wheaton Canyon with Wheaton Wash, a "dry" streambed, dictated the alignment of widely separated roadways.



Looking north from Nipton Road Overcrossing toward the Nevada state line, a distance of nine miles. The freeway follows the old highway (now new southbound roadway) with a maximum grade of 5.8 percent. Note old Arrowhead Trail of 1924.

Aggregate for base material was obtained and processed by screening operations at a site near the lower part of Wheaton Wash, where high quality alluvial sand and gravel deposits were found.

Self-propelled Machine

The contractor used a self-propelled, track-mounted machine to spread aggregate base and cement-treated base in a very efficient manner. The machine is equipped with strikeoff devices, so arranged as to spread windrowed material to a uniform depth and to the full width of two traffic lanes in one operation. A uniform state of consolidation was obtained by means of oscillating rakers. Oscillating cutting screeds, set to uniformly strike off the material to the full width and to the predetermined thickness, accomplished the final shaping of the spread material.

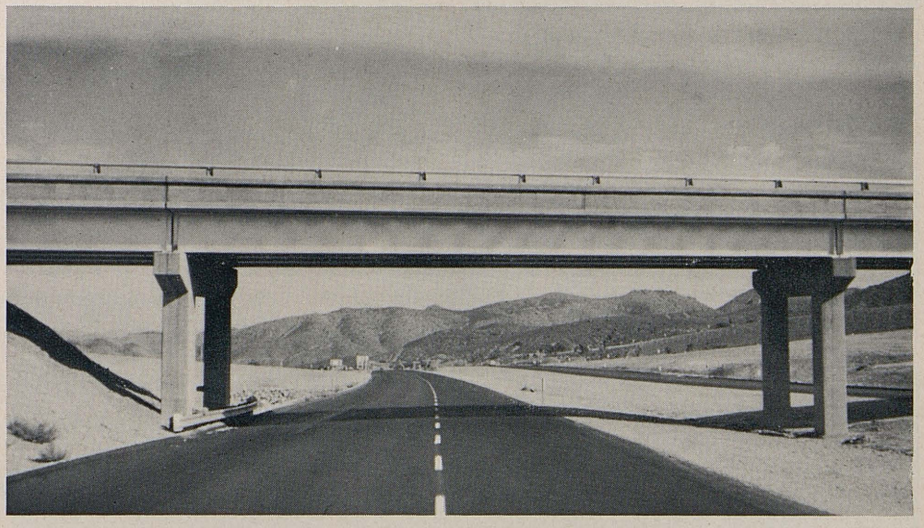
Embankments across Ivanpah Dry Lake were covered with a six-inch blanket of rock to provide protection against the effect of wave action and possible erosion by saturation. An eight-inch layer of the same material was placed under the structural section to protect against saturation of the base by capillary action. Equalizer pipe culverts were installed at 1,000-foot intervals. These precautions are well founded. The danger of large quantities of runoff water filling the "dry" lake from either side always exists following high-intensity summer thunderstorms.

Water Supply Sufficient

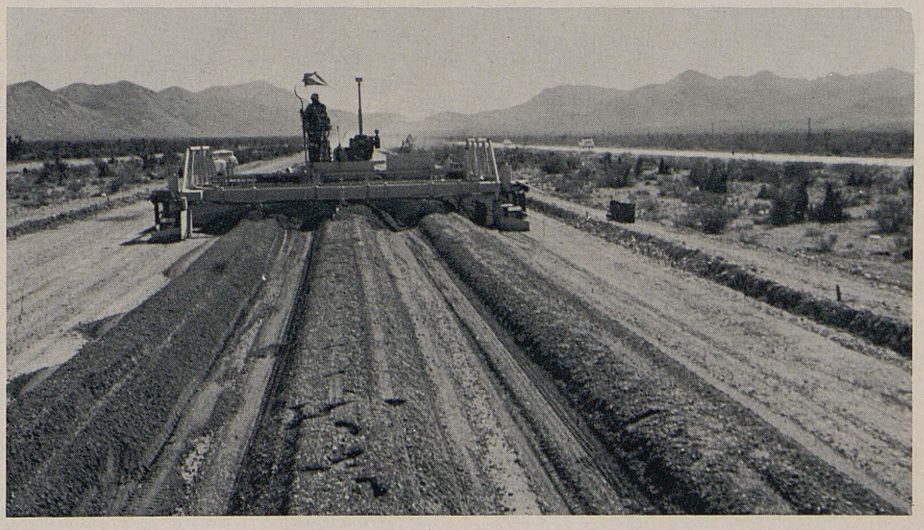
Water, relatively plentiful through this portion of the Mojave Desert, was supplied by four wells near the west end of the project and was piped for 20 miles. Pumped to reservoirs at the Mountain Pass Summit, the water proceeded from there under gravity flow to a terminal reservoir at Yates Well Overcrossing.

Many existing timber bridges had to be removed. This was accomplished by collapsing the concrete deck and igniting the timber pile bents, which were extensively sprayed with oil. Smoldering all night, these burning structures must have been a sight of disbelief to the unsuspecting motorist. Nine new reinforced concrete slab

BEFORE. Snow surrounding Joshua trees at mountain pass summit, before construction.



AFTER. The same scene after construction showing Bailey Road Overcrossing as seen from west roadbed looking east.



Self-propelled track-mounted machine spreading aggregate base.

bridges span various "dry" streambeds located throughout the project. Three welded steel plate girder bridges are part of interchanges at Bailey Road, Nipton Road, and Yates Well Road.

As on other projects in the past, special care was taken to preserve native vegetation within the right-of-way. Any necessary disturbed areas, including material sites visible from the highway and roadway slopes, were seeded with native buckwheat at the end of construction activities.

Wide Variety of Weather

A wide variety of weather conditions was encountered during the construction period. Temperature variations of over 50° F. in a 24-hour period were recorded during almost any month of a year. Snow above 4,000 feet during the winter seasons did not interfere with construction operations as much as did low temperatures. Severe dust and sandstorms within the Ivanpah Dry Lake bed or high-velocity winds through the Mountain Pass area were a common occurrence. Localized thunderstorms of high intensity and of short duration caught many by surprise and caused moderate damage to not yet completed portions of the freeway. During the summer months of 1962, temperatures approaching 120° F. in the Dry Lake area created some uncomfortable working days for state and contractor's personnel alike. Generally, however, beautiful high desert weather conditions prevailed throughout the 20 months of construction activities.

Remains of long-abandoned mining camps are scattered throughout the area. Near Bailey Road Overcrossing, ruins and foundations of Nantan, a busy mining community in 1890, with weekly Wells Fargo stage coach service, are relics of a bygone era. Gold, silver, lead, and copper were successfully mined in the past. A copper smelter is still standing near the western end of the project. Today, only adobe ruins remain of old Ivanpah, a silver camp during the 1870's.

Rare Earth Deposits

The largest known rare earth deposits in the world exist near Mountain Pass Summit. Today, the Molybdenum Corporation of America is processing the highly concentrated rare earth ore, the only remaining productive mining activity in the area.

Prior to 1924, an unpaved road known as Arrowhead Trail, which was oil-treated shortly thereafter, generally followed meandering "dry" streambeds through Mountain Pass and Wheaton Canyon. Between 1933 and 1937, a greatly improved two-lane highway was constructed, which served as U.S. Highway 91 and 466 until 1963.

Construction on the new freeway was completed on October 25, 1963. J. B. MacDonald and Carl B. Wolfram were resident engineers for the State.

Retirement Claims 41 More Division Employees

The following employees have retired from the Division of Highways since the last list was published in September-October 1963 issue of *California Highways and Public Works.*

District I

Francis H. Rogers, senior highway foreman, 31 years.

District II

James M. Asher, maintenance man II, 35 years.

District III

Oscar E. Beach, highway superintendent, 37 years.

District IV

John E. Barrett, highway foreman, 42 years; Jack J. Bartlett, highway maintenance man III, 27 years; Anthony Correia, highway maintenance man II, 37 years; Esly J. Clogstone, highway maintenance man II, 27 years; Wetherby Boorman, highway field office assistant, 24 years; Lilia McAuliffe, senior clerk, 21 years.

District V

Paul W. Freeborn, highway maintenance man III, 26 years; Philip B. Stearns, senior highway engineer, 34 years; John A. Schorr, highway foreman, 29 years.

District VII

Myrtle F. Bachand, supervising clerk II, 32 years; Charles F. McCaffrey, associate right-of-way agent, 15 years; Marshall W. Burke, laborer, 30 years; Guy A. Lander, highway foreman, 31 years.

District VIII

Warren Ford, assistant highway engineer, 39 years; Ben R. Bond, highway superintendent, 39 years; Chester B. Jolley, highway foreman, 37 years; George Robinson, highway maintenance man II, 4 years; Troy L. Robertson, groundsman, 14 years; Joe F. Reith, laborer, 34 years; Frances Tyson, intermediate stenographer, 10 years.

District IX

James L. McCreary, highway foreman, 19 years.

District X

George A. Rhoan, highway maintenance man II, 35 years; Charles S. Diaz, highway maintenance man II, 36 years; James D. Forbes, senior delineator, 16 years.

District XI

John C. Krabill, highway maintenance man III, 30 years; Eugene C. Hatfield, highway maintenance man II, 19 years.

Headquarters

Dorris M. Robinson, intermediate typist-clerk, 7 years.

Bridge

Ivan Vinoff, assistant bridge engineer, 15 years.

Materials and Research

Francis N. Hveem, principal highway engineer, 45 years; Clifton C. Smith, janitor, 6 years; Margaret J. Fredericks, intermediate typist-clerk, 36 years.

State-owned Toll Bridges

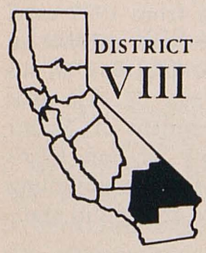
Ivan P. Bunce, assistant highway engineer, 33 years.

Shops

Charlie H. Rosenbaun, highway maintenance man II (11), 33 years; Dan C. McRae, account technician III (2), 37 years; Leroy Shackleford, auto mechanic (6), 40 years; Charles W. Tracy, supervisor account clerk II (7), 31 years; Fred L. Greer, heavy equipment mechanic (2), 19 years; Alvin J. Koster, highway equipment supervisor I (1), 26 years.

Operation Carryall

Group Studies Possibility of Atomic Blast Excavation



A technical feasibility study recommending further evaluation of the practicability, safety and costs of conducting a series of nuclear explosions to open a two-mile railway and highway pass through the Bristol Mountains in California has been submitted to the U.S. Atomic Energy Commission, the State of California Division of Highways, and the Atchison, Topeka and Santa Fe Railway Company.

The report was prepared jointly by staff personnel of the railway, the highway group and the AEC's San Francisco operations office. The AEC's Lawrence Radiation Laboratory, at Livermore, provided technical assistance. The report recommends a more detailed study costing about $330,000 for engineering and public safety evaluation of a site in the Mojave Desert about 11 miles north of Amboy.

The joint group concluded that the application of nuclear explosives to blast such a cut through the Bristol Mountains for railway and highway use would be technically feasible. According to the report, it appears initially also that such a project could be conducted without endangering public health and safety. However, any decision on safety would be subject to much more detailed and exhaustive studies, such as studies of the seismologic, meteorologic, hydrologic, and geologic conditions of the area; and evaluation of predicted blast, shock and radiation effects.

A closeup of a section of the Project Carryall model showing the roadway excavation and the drainage crater (right foreground).

Plans for Retirement

The study resulted from plans of the Santa Fe to realign its route between Goffs and Ash Hill to eliminate 15 miles of trackage and reduce grade and curve problems to speed up transcontinental service. Preliminary investigations by the railroad indicated a line through the Bristol Mountains, but such a route would have required a tunnel through a large mountain or a detour to the south, both of which would have been uneconomic. In seeking a less expensive solution, the Santa Fe expressed interest to the AEC in the possibility of using nuclear explosives to make the cut.

The California State Division of Highways in turn was contacted as to the possibility of relocating the future alignment of Interstate Highway 40 (U.S. Highway 66). The Santa Fe's proposed line runs about one mile south of the future highway location

recently adopted by the California Highway Commission.

As visualized in the preliminary review, about 68 million cubic yards of earth would be removed, creating a cut about two miles long and ranging in depth from 100 to more than 350 feet, and having an average bottom width of 325 feet. Such a cut would permit construction at the bottom of a double-track railway and a four-lane divided highway capable of being expanded later to eight lanes.

22 Nuclear Blasts

About 22 nuclear detonations, totaling 1,730 kilotons, would be detonated in series, half of them at a time, to accomplish the removal of earth and rocks from the cut. An additional 100-kiloton explosion would be considered to excavate a sump to provide drainage for the area.

The study has been designated "Carryall" and is one of several feasibility studies being considered by the Atomic Energy Commission under its Plowshare Program for developing the peaceful uses of nuclear explosives. No excavation projects have been authorized under this program, although a 100-kiloton cratering experiment, Sedan, was conducted in 1962 at the Nevada Test Site, and a scientific experiment, Gnome, involving underground detonation of a nuclear explosive of about 3 kilotons, was conducted near Carlsbad, New Mexico, in 1961 as part of the Plowshare Program.

Nuclear weapons effects cratering experiments also have been conducted at the AEC's Nevada Test Site, and have contributed valuable data to the Plowshare excavation program. In addition, experimental cratering work has been carried out in recent years with conventional explosives to obtain data required in nuclear projects.

Civilian Uses Promoted

The development of nuclear devices especially designed for civilian uses continues at the Lawrence Radiation Laboratory, which is operated for the AEC by the University of California. The principal objective of this development work is cheaper devices producing a minimum of radioactivity.

The report estimates that cost of the sections of railroad and highway realignments affected by the nuclear excavation would be $21,722,000 by conventional methods; $14,552,000 for the railroad and $7,170,000 for the highway. (The railroad found the cost of rerouting by conventional methods was prohibitive.) The portion of the railroad realignment covered by the study is about 4½ miles and for the highway about 18 miles. Excluding charges for the nuclear devices the cost for achieving a joint realignment using nuclear explosives would be $13,765,000. The charges for the required nuclear devices are not estimated in the report because of uncertainties as to how much the charges may be reduced by development work.

The study will be reviewed carefully within the AEC.

Wyatt C. Winkler

Wyatt C. Winkler, associate highway engineer, died in Sacramento December 26 following a lingering illness.

Winkler, who has been with the division since 1935, was born in Blackwell, Oklahoma, March 10, 1906. He attended Oklahoma A. & M. and also the University of California, Los Angeles, before his employment as a junior engineering field aid in the District VIII office in San Bernardino. He alternately served this office and the District VII office in Los Angeles in varying engineering capacities until 1942, when he resigned to accept a position with the U.S. Engineers for construction of the Pan-American Highway.

He rejoined the division in 1943 as assistant highway engineer in District VII, and in 1950 was promoted to associate highway engineer. In 1953 he transferred to Headquarters, specifications section, where he served until the time of his retirement. December 14.

Winkler is survived by his wife, Georgia, who lives at 4489 25th Avenue in Sacramento, and three daughters. Survivors also include two brothers, two sisters, all of Southern California; and six grandchildren.

Ralph A. Tudor

Ralph A. Tudor, who served the Division of Highways and the Division of Bay Toll Crossings in many responsible capacities from 1929 until he joined the Eisenhower cabinet in 1953, died November 15, 1963, in his Atherton home at age 61. He was founder and vice president of Tudor Engineering Company of San Francisco, currently involved in designing and planning the Bay area rapid transit system.

Tudor joined the Division of Highways as a bridge engineer in 1929, and participated in the investigations, designs and construction of the San Francisco–Oakland Bay Bridge. In 1937 he was in charge of operation and maintenance.

In 1938 he was assistant administrative officer of the California Commission for the Golden Gate International Exposition on Treasure Island. As principal bridge engineer during 1939-40, he had charge of operation and maintenance of state-owned toll bridges, and assisted in the economic studies which led to the purchase by the State of Carquinez and Antioch Bridges and the refinancing of the San Francisco–Oakland Bay Bridge.

In 1941, Tudor—a West Point graduate—entered military duty, serving in Intelligence and also with the U.S. Army Engineers.

After the war he joined Morrison Knudsen International Company, and conducted a rail, highway, water and transportation survey in China.

When the Division of San Francisco Bay Toll Crossings was formed in 1948, Tudor was named chief engineer. In 1949 he was selected to organize a brigade of engineers for the U.S. Army Engineer Reserve, which was sponsored by the State Department of Public Works.

Appointed to President Eisenhower's cabinet in 1953, he spent 18 months as Undersecretary of the Interior, after which he returned to his own engineering firm, where he remained active until his death.

Tudor is survived by his wife and one daughter.

'Tempus Fugit' Corner

The following items appeared 25 years ago in *California Highways and Public Works:*

January 1939 — "Bay Bridge Terminal Officially Opened"

"As this issue of the magazine goes to press, Governor Culbert L. Olson is scheduled to officially dedicate the San Francisco-Oakland Bay Bridge terminal, initiating train operations on the monumental structure spanning San Francisco Bay.

"One of the most imposing buildings in San Francisco, the Bridge Railway terminal is on Mission Street between First and Fremont. . . . Approximately 60,000 persons, it is conservatively estimated, will pass through the terminal daily. Due to the convenience of the terminal location, 50 percent of these will be within walking distance of their destinations. This is comparable to 25 percent now within walking distance from the Ferry Building terminus. . . ."

February 1939 — "Bay Bridge Terminal Dedicated"

With a few formal words uttered at the dedication ceremonies held in San Francisco January 14, Director of Public Works Frank W. Clark turned over to Lieutenant Governor Ellis E. Patterson, representing Governor Olson, the state-owned Bay Bridge and state-built Bay Bridge terminal building and electric railway, the first railway ever to operate directly between Sacramento, Alameda County and San Francisco. . . .

"In completion of the formal steps necessary to the occasion, Lieutenant Governor Patterson then turned to the railroad representatives present and said: 'In accordance with the agreement between the California Toll Bridge Authority and Interurban Electric Key System, and Sacramento Northern, I formally place the use of these railway facilities in the hands of representatives of the railroads here today. I am certain, gentlemen, that it will be your policy to operate these facilities to the best interest of the public.'

"A. T. Mercier, President of Interurban Electric; Alfred J. Lundberg, president of the Key System, and H. A. Mitchell, president of Sacramento Northern, then formally accepted the use of facilities for their companies.

"C. H. Purcell, Chief Engineer of the Bay Bridge and its railway facilities . . . said: 'Into this project have gone the skill and experience of the engineering profession—civil, electrical and mechanical. Great praise is due the staff of engineers employed by the State Department of Public Works on design and in the field. Also to Bridge Engineer Charles E. Andrew and to Engineer of Design Glenn B. Woodruff, who worked faithfully, conscientiously, and ably, special praise is due.'

"Ceremonies were held in front of the newly completed terminal building facing Mission Street in San Francisco with more than 1,500 dignitaries from cities of northern California, Alameda and San Francisco Counties participating before a great throng of citizens (more than 5,000) who came to witness the epochal event."

Returning to the present (January-February 1964), this once highly useful system has given way to a $35,000,000 bridge reconstruction program which began in 1957, removing the Key System rails and substituting motor coaches; and converting the double-deck bridge to provide five lanes of westbound traffic on the upper deck and five lanes of eastbound traffic on the lower — a changeover which became effective October 12, 1963.

Several additional contracts will conclude the huge project. One of these, awarded in December 1963, is for cleaning and painting concrete and structural steel, and resurfacing passenger loading platforms in the Transbay Transit Terminal Building, which now serves transbay bus operations.

Two forthcoming contracts will provide modernization in the way of installing more call boxes for both spans, and for resurfacing the bridge's lower deck.

Norman B. Deuel

Norman B. Deuel, information officer I with the Division of Highways, died on November 12 after a brief illness.

He joined the division in 1953 after a long career as a newspaperman.

Born in Chico, Deuel was the son of the late State Senator Charles H. Deuel, after whom the Deuel Vocational Institution at Tracy is named.

He attended local schools in Chico and Stanford and Columbia Universities, after which he worked for several newspapers in California.

He had experience as a newspaperman in Paris and other European points before joining the United Press as wire editor and reporter. He served as UP correspondent in Moscow from 1936 to 1940 and covered the Russo-Finnish War in 1939.

In 1941 he joined the federal government as a news analyst and during World War II was a Navy officer attached to the embassies in London and in Ottawa, Canada, where he was assistant naval attaché.

After the war he worked for several years on the Sacramento *Union* as political editor before joining the State.

One of his assignments with the *Union* was a series of articles on the Mother Lode country. He retraced this last summer for an article on State Sign Route 49, the Mother Lode Highway, which appeared in the July-August 1963 issue of *California Highways and Public Works* under the title "Highway Through History."

Deuel was a Mason and a member of the State Mens Club and the Sacramento Public Relations Round Table.

He is survived by his wife, Frances, an employee of the State Department of Education.

Traffic records on the bridge continue to set new highs. The average daily traffic in 1963 was 119,506 vehicles per day which represents a 20-percent increase over the daily traffic count of 99,597 for the year 1958.

Three Highway Supers Join Retired Ranks

Three long-time highway maintenance superintendents of the Division of Highways have retired from state service.

They are: Oscar Beach, of Chico, 39 years with the division; Charles L. Biggs, of Santa Maria, 42 years; and Adam Franklin Jeffrey, of Porterville, 40 years.

Beach has been in charge of the Chico maintenance territory for the past 12 years.

Born and educated in Delta, Colorado, he worked for the highway departments in Colorado, Arizona and Nevada before joining the California Highway Division.

He was advanced to foreman in 1927 and to superintendent in 1951.

Beach and his wife, Gwendolyn, have five children and eleven grandchildren.

Born in Santa Cruz, Biggs attended El Centro High School in San Diego and entered state service at Fairfield. He has been stationed in Madera, Delano and Brea, was promoted to superintendent at Red Bluff and transferred to Santa Maria in 1952.

Biggs served with the Seabees in England and Africa during World War II.

Biggs and his wife, Erin, have a son, Edward.

Biggs is a Mason. His retirement plans include a trip to Spain and work with the YMCA.

Jeffrey started his career as a truck driver for District VI in 1923 and was a member of the crew that laid the first oil on the Merced County side of the Pacheco Pass.

He was promoted to foreman at Midpines (seven miles east of Mariposa) in 1928. Later assignments took him to Bakersfield, Porterville, Madera, Lemoore and Fresno. He received his permanent appointment as superintendent at Porterville in 1948.

Jeffrey and his wife, Erma May, plan to do some traveling after his retirement. They will maintain their home in Porterville.

Low Bid on Bonds Accepted by CTBA

The California Toll Bridge Authority on October 23 accepted the low bid submitted by a group of four underwriting firms represented by Blyth and Company, San Francisco, for $75,000,000 in refunding bonds on the Carquinez Strait Toll Bridges.

The successful bid involved a net interest rate of 3.6273 percent, which was estimated by the authority's financial consultants as amounting to a saving of almost $1,000,000 in interest costs over the life of the bonds in comparison with the original bonds issued in 1955 and 1959 to finance construction of the parallel Carquinez Bridge and the Benicia–Martinez Bridge.

The only other bid submitted was that of a group of firms headed by F. S. Smithers and Company of New York City, whose offer involved a net interest rate of 3.6464 percent.

Part of the funds from the new bond issue will be used to realign and reconstruct the present two-lane State Highway 21 for 12 miles between Benicia and Interstate 80 near Cordelia as a four-lane divided highway serving as an approach to the Benicia–Martinez Bridge.

Governor Edmund G. Brown (Chairman of the Toll Bridge Authority) presided at the bid-opening meeting.

Cost Index Shows 2.6 Percent Drop

The California Highway Construction Cost Index for the fourth quarter of 1963 stands at 243.0 (1940 = 100), a decrease of 6.5 points or 2.6 percent under the third quarter of 1963.

The index for the year 1963 has been computed at 246.8, 9.4 points or 3.7 percent lower than the figure for the year 1962.

The quarterly and yearly indices confirm the prevailing trend of stability in highway construction cost. This trend is also indicated nationwide by the small fluctuations in the Bureau of Public Roads Highway Price Index during the past 12 months.

Governor Appoints Scenic Committee

Governor Edmund G. Brown has appointed a seven-man advisory committee on a master plan for scenic highways created by the Legislature at its last session. They are:

Nathaniel Owings, of Big Sur, internationally famed architect whose designs include the Lever House in New York City and the Town of Oak Ridge, Tennessee.

Edwin S. Moore, of San Francisco, executive vice president of the California State Automobile Association.

Robert Grunwald, of Hanford, an expert in city and regional planning, community development and head of a landscape architecture firm.

Richard Leonard, of San Francisco, an active conservationist and for many years, a director of the Sierra Club.

Harry P. Schmidt, of Gustine, a Merced County Supervisor who has maintained a long-time interest in highway matters and scenic conservation.

Dee W. McKenzie, chief of the highways and bridges division of the County of Sacramento Department of Public Works and a veteran highway and bridge design engineer is chairman of the committee.

Charles P. Walker, of Manhattan Beach, is an engineer and economist who has served three terms as Mayor of Manhattan Beach and was 1961 recipient of the Earl Warren award for civic activities.

McKenzie, Schmidt, Walker, Moore and Grunwald served on a citizens advisory committee appointed by the Governor which helped pave the way for scenic highway legislation during the last legislative session.

"I consider this committee one of the strongest tools we have in the task of creating a network of scenic highways which will preserve and enhance the great heritage of natural beauty in California," the Governor said.

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SUBJECT INDEX

The "Annual Report Issue"—November-December of each year—is devoted to budget information and general summaries of activity carried on by the various departments within the Divsion of Highways.

AUTHOR INDEX

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'Liberated' Ferry

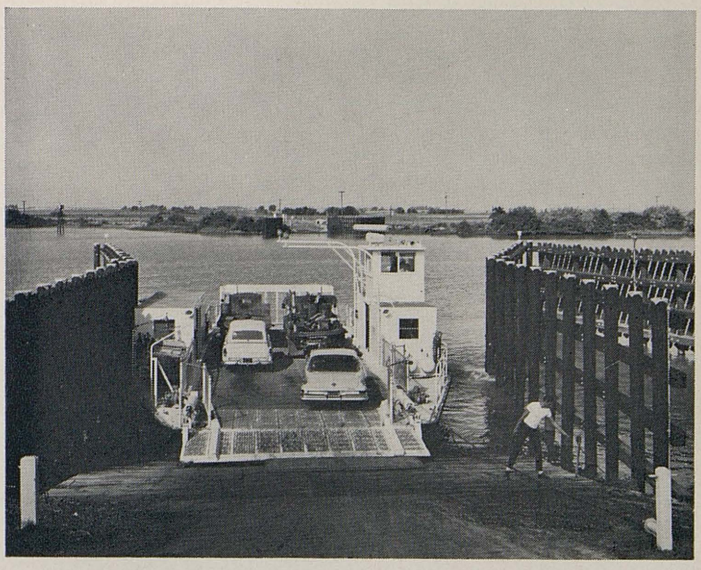
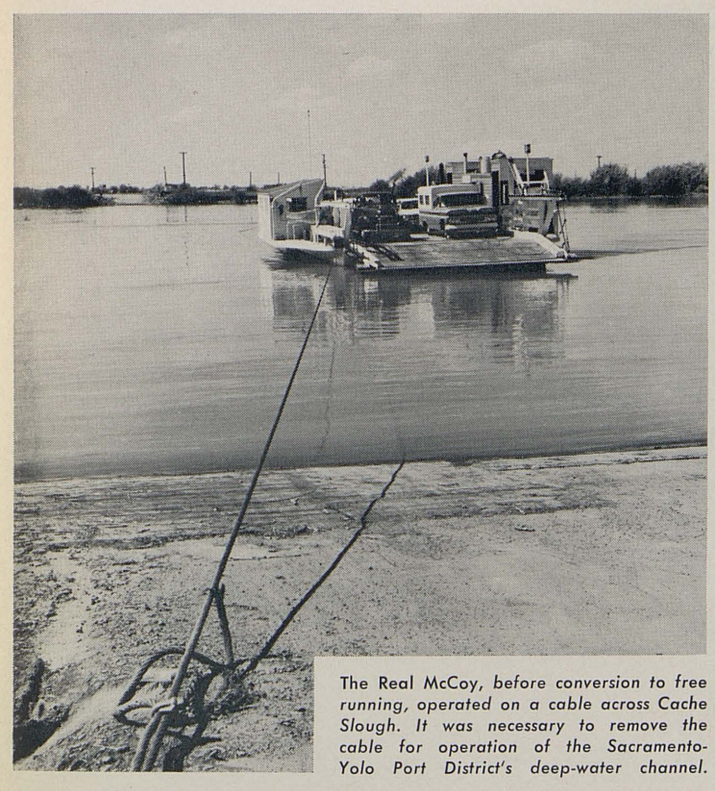


Photo right: Ready for another trip across Cache Slough. The Real McCoy loads trucks and passenger cars in her new ferry slip. Slip was not needed when the vessel operated on a cable.



The Real McCoy, before conversion to free running, operated on a cable across Cache Slough. It was necessary to remove the cable for operation of the Sacramento-Yolo Port District's deep-water channel.

After nearly 20 years as a captive, cable-operated vessel, the *The Real McCoy* began a new career August 27 as a free-running ferry. It operates on Cache Slough from the mainland near Rio Vista to Ryer Island.

Entirely refurbished and gleaming in white paint, *The Real McCoy* now is diesel-powered, steered and driven by propellers amidship on both sides. It is equipped with modern appurtenances, including radar.

Conversion of the vessel was necessary so that the cable formerly used across Cache Slough could be removed for operation of the Sacramento-Yolo Port District deep water channel. The cost of approximately $96,600 was met by the port district under agreement with the Department of Public Works.

It was also necessary to construct ferry slips and fenders to accommodate the free-running ferry. This was done under separate contract.

During conversion the ferry *Scooter*, a reserve cable-operated vessel, maintained service. The conversion was done under contract by Colberg, Inc., Stockton.