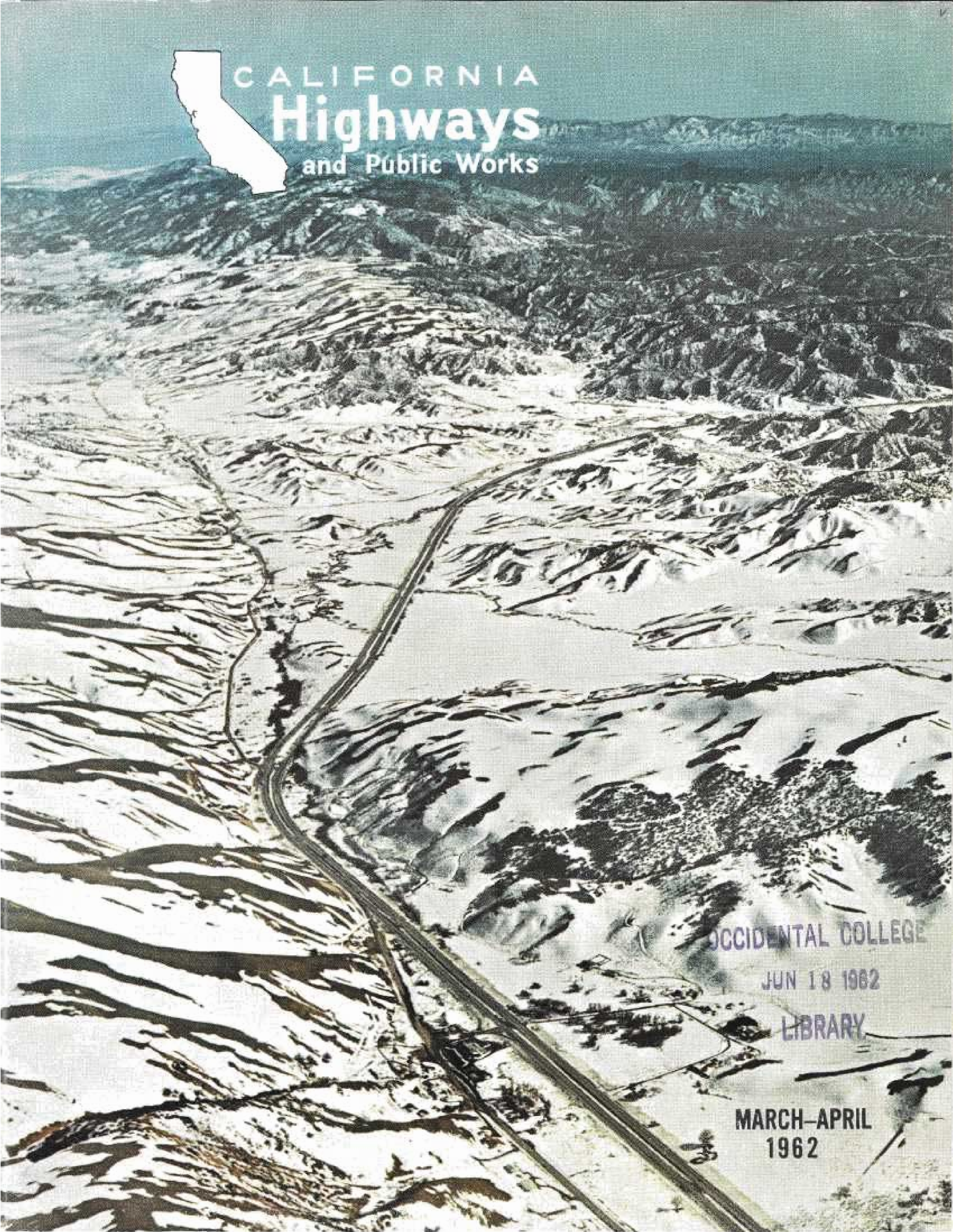


CALIFORNIA Highways and Public Works

MARCH–APRIL 1962

April 5, 1962

SENATE RESOLUTION NO. 24

By Senators Richards, Arnold, Backstrand, Begovich, Brown, Burns, Christensen, Collier, Dolwig, Donnelly, Fisher, Geddes, Gibson, Grunsky, Holmdahl, Johnson, Lagomarsino, McAteer, Miller, Murdy, O'Sullivan, Quick, Rattigan, Regan, Shaw, Short, Stiern, Sturgeon, Teale, Weingand, J. Howard Williams, and Robert D. Williams.

Senate Resolution No. 24

Relative to the California Highway Commission and the Division of Highways, Department of Public Works

Whereas, Questions have arisen in certain other states over the efficiency, quality and integrity of the highway program in their states; and

Whereas, The State of California has been constructing a system of freeways which is the envy of all the other states and the world; and

Whereas, This tremendous undertaking has been accomplished on a sound and efficient basis and without a whisper of scandal; and

Whereas, This has been due in great measure to the work of the California Highway Commission and the Division of Highways, Department of Public Works, under and pursuant to a legislative plan designed to assure the solution of highway problems on a statewide and community basis, and in the overall public interest; and

Whereas, The successful handling of this great program has been largely due to the consistent, honest and dedicated service of the members of the above Commission and Division; now, therefore, be it

Resolved by the Senate of the State of California, That the California Highway Commission and the Division of Highways, Department of Public Works, are hereby commended for the excellent freeway system now enjoyed by the citizens of this State; and be it further

Resolved, That the Senate of the State of California wishes to express its satisfaction concerning the honesty and the manner in which the commission and the division have carried out the responsibilities delegated to them by law; and be it further

Resolved, That the Secretary of the Senate is directed to transmit a copy of this resolution to the California Highway Commission and the Division of Highways, Department of Public Works.

Resolution read, and unanimously adopted on motion of Senator Collier.

(Excerpt From Senate Daily Journal)

California Highways and Public Works

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

Vol. 41 | March-April 1962 | Nos. 3-4

FRONT COVER—After several years of drought, January and February this year saw the State swept by storm after storm, with snow piling deep in the mountains. One storm which drove far south blanketed the Tehachapis and many parts of Southern California with rare snowfalls, creating many traffic problems (see page 37 et seq.). The aerial photo on the front cover shows US 99, "The Ridge Route," looking south at Gorman, Los Angeles County, just as the snow was beginning to melt. Robert Rose, Photographer.

BACK COVER—Golden foothill country in the summer, with yellow and digger pines, manzanita, and black oak. The road is State Sign Route 49 between Auburn and Grass Valley, on a recently improved section constructed as a two-lane expressway. Photo by John Meyerpeter.

CONTENTS

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

HELEN HALSTED, *Assistant Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

Scenic Routes

Report to Legislature Urges Protection of 'Corridor' Vistas

Governor Edmund G. Brown has proposed the designation of 5,000 miles of "scenic highways" in California "to preserve for future generations of motorists and tourists the beauty of our golden State."

The Governor's proposal was made in approving a report of the Advisory Committee on Scenic Highways and an interdepartmental committee.

The Governor recommended that the committee continue its study and develop specific legislative proposals for the next general session of the Legislature in 1963.

The 48-page report contains 19 recommendations covering highway design, location and right-of-way acquisition policies, roadside facilities and the control of development of "scenic corridors," which include what the motorist sees as he travels as well as the roadway itself.

Most of the 5,000 designated miles of roadway already exist. They traverse every section of the State and include coastal, forest, mountain and desert areas.

The work of the two committees is the second phase of a study ordered by Governor Brown in January 1960, followed by a Senate resolution authorizing the project.

Farr Authors Resolutions

The author of two resolutions in 1960 and 1961 establishing the first study and the two committees was Senator Fred Farr of Monterey County.

"This is a most important report," Farr said. "I am asking the Senate to study it carefully.

"I intend to introduce legislation at the 1963 session of the Legislature to activate this program."

The report, entitled "A Preliminary Plan for Scenic Highways in California," was filed with the Legislature on March 15. Dee W. McKenzie, Chief, Design Section, Highway and Bridge Division, Sacramento County Public Works Department, was chairman of the Advisory Committee on Scenic Highways and Elton R. Andrews, Planning Officer, State Office of Planning, was chairman of the interdepartmental committee.

In his statement on the report, Governor Brown said:

"The advisory and interdepartmental committees have established a sound base for future legislative action to set up a scenic highway system in California.

"I urge the Legislature to study carefully the 19 recommendations in this report. Many of them will require legislative action if we are to protect existing 'scenic corridors' and develop new ones.

"We need particularly to study the problems of city and county participation in the plan to include local routes of interest and beauty where feasible."

Governor Will Implement

The Governor said that if the Legislature asks the committee to continue to study he will seek specific legislative action to implement the recommendations of the study group.

This study was authorized by Senate Concurrent Resolution No. 39 of the 1961 Legislature.

Among the 19 recommendations of the report:

- Emphasis on scenic values, "appropriately balanced with traffic service and economic factors," in highway location, design and right-of-way acquisition on scenic routes to be designated by the Legislature.
- Necessary legislative action to permit the State to acquire land and easements for "scenic conservation" purposes, and legal clarification of the right of cities

A PROPOSED SYSTEM OF STATE SCENIC HIGHWAYS

and counties to condemn "scenic easements."

- Increased attention to roadside parks and other public facilities to be planned jointly by the Department of Parks and Recreation and the Division of Highways for use along a designated scenic highway system.
- Review by the Legislature of present laws covering outdoor advertising "to consider whether such existing legislation and its attendant administrative proceures are adequate to protect scenic resources adjacent to designated scenic highways."

A "scenic highway" is defined in the report as one which "traverses an area of outstanding scenic quality, the location and design of which will receive special analysis for the purpose of enhancing the motorist's scenic experience."

The "scenic corridor" concept, as developed by the report, concerns "that part of the landscape abutting a highway route which contains outstanding views, flora and geology, and other unique natural attributes and historical and cultural resources affording pleasure and instruction to the highway traveler."

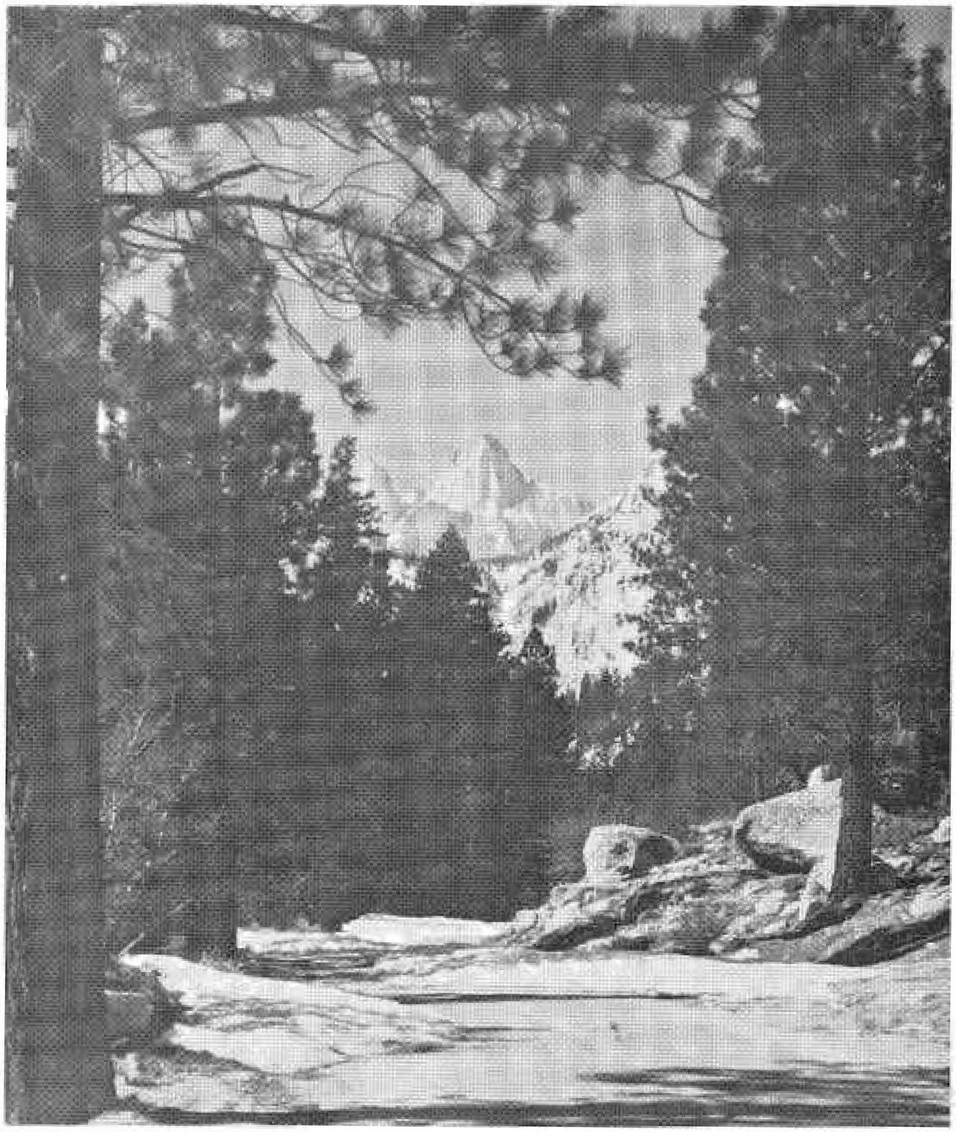
Five General Criteria

The initially proposed scenic highways were selected on the basis of five general criteria. These include the intrinsic scenic values and experiences the route would provide; the diversity of these experiences; the degree to which the route would link specific points or areas of scenic, historical or recreational interest; the relationship to urban areas, for short trips; and opportunities for bypassing major traveled routes.

The advisory committee reported to the two legislators who appointed it, President pro Tempore Hugh M. Burns of the State Senate, and Speaker Jesse M. Unruh of the Assembly.

In addition to McKenzie the advisory committee included:

Harry Schmidt (vice chairman) of Gustine, immediate past president, County Supervisors Association of California; Robert Grunwald of Hanford, landscape architect and planning consultant; Lawrence Livingston, Jr., of San Francisco, planning consultant; Proctor Mellquist of Menlo Park, editor of *Sunset* magazine; Edwin S. Moore of San Francisco, executive vice president, California State Automobile Association; and Charles Perry Walker of Manhattan Beach, immediate past president, League of California Cities.



This photograph of the east face of Mount Whitney, taken from the Whitney Portal road in Inyo County, serves as an appropriate frontispiece for the 1962 Scenic Highways report.

The transmittal of the report by the interdepartmental committee was addressed to the chairmen of the two committees specified in SCR 39: Senator Randolph Collier, Senate Fact-Finding Committee on Transportation and Public Utilities, and Assemblyman Lloyd Lowrey, Assembly Interim Committee on Natural Resources, Planning and Public Works.

Comprising the interdepartmental committee were four directors of state departments: Robert B. Bradford, Public Works; Charles A. De Turk, Parks and Recreation; DeWitt C. Nelson, Conservation; and William E. Warne, Water Resources; plus Elton R. Andrews, Planning Officer, State Office of Planning, Department of Finance.

Conference Promotes Uniform Signs, Signals

More than 50 representatives of state, city and county government units and of automotive organizations met in the State Public Works Building February 12 in a conference designed to promote greater traffic safety through adherence to uniform traffic control devices which are expected to minimize confusion on the highways.

The meeting was one of 12 regional conferences scheduled throughout the country. Present were engineers and officials of Arizona and Nevada, the U.S. Bureau of Public Roads, the California Division of Highways and of a number of California cities and counties.

The conference was sponsored by the American Association of State Highway Officials, American Municipal Association, and National Association of County Officials.

State Highway Engineer J. C. Womack of California in opening the meeting pointed out that as motor trips lengthen and traffic increases on improved highways greater dependence on uniformity in traffic control is more than ever necessary.

Uniformity will be encouraged by a Manual on Uniform Traffic Control Devices prepared by a national joint committee and accepted by the U.S. Bureau of Public Roads, the American Association of State Highway Officials and other groups. The meeting was part of a co-operative effort to put the provisions of the manual into effect.

Signs and signals will have the same meaning throughout the United States, and motorists of any locality will be trained to drive anywhere in the country, reducing ill will and confusion, Charles E. Haley, traffic engineer of Phoenix, Ariz., told the meeting.

Pointing out that uniformity is already in force on the National System of Interstate Highways, D. J. Steele, Division Engineer of the U.S. Bureau of Public Roads, Sacramento, said that compliance with the new manual would be required where the federal government participates in new construction on federal aid primary and secondary routes. He said he hoped existing traffic control devices on such roads could be brought to uniform standards by the end of 1966.

Other speakers included S. E. Farin, Regional Engineer, U.S. Bureau of Public Roads, San Francisco; D. W. Loutzenheiser, Chief, Urban Highway Division, U.S. Bureau of Public Roads, Washington, D.C., and G. M. Webb, traffic engineer, California Division of Highways.

It was brought out that some states and local governments will need legislation to enable compliance with some aspects of the new uniform standards.

HIGHWAYS–FISH AND GAME AGREEMENT SET

After extensive staff-level discussions, the Department of Fish and Game and the Department of Public Works have agreed on a joint co-operative approach to situations involving both highway construction and management of fish and wildlife resources.

The joint approach is set forth in an "Memorandum of Understanding" recently executed by the two departmental directors, Walter T. Shannon of Fish and Game and Robert B. Bradford of Public Works, on the recommendation of State Highway Engineer J. C. Womack and Deputy Director of Fish and Game Harry W. Anderson.

Highlights of the agreement are:

- Exchange of advance information on projects in areas populated by fish and wildlife which might be affected by highway construction, and on physical developments proposed by the Department of Fish and Game which might affect stream flows or highway facilities. Should either department desire to comment on the plans of the other, its recommendations are sent to the appropriate District Engineer of the Division of Highways or the Regional Office of Fish and Game.

- Appropriate personnel of each department will become more familiar with the problems and objectives of the other through the exchange and dissemination of technical information.

- Special provisions in particular highway contracts may require contractors to comply with sections of the Fish and Game Code governing practices deleterious to fish and wildlife.

- The Department of Fish and Game may invite attention to instances of damage to fish and wildlife populations from highway construction undertaken before execution of the agreement. The Department of Public Works will investigate all such instances and consult with its sister agency on remedial action and means to finance corrective measures when warranted.

- The planning and construction of highway projects may include measures and facilities to improve conditions for fish and wildlife desired as a betterment by the Department of Fish and Game provided such inclusion does not delay or interfere with the project's primary purpose and the costs of betterment are financed by other than highway funds.

The agreement is based on "the desire of both departments to co-operate to the end that the State's highway program progresses but at the same time without damage, or with a minimum of damage or loss, to the fish and wildlife resources."

Effective date of the agreement is January 19, 1962. It has been given wide dissemination among the district offices of the Division of Highways and regional offices of the Department of Fish and Game.

LUDDY NAMED VICE CHAIRMAN

The California Highway Commission today elected Arthur T. Luddy of Sacramento to serve as its vice chairman for 1962. He succeeds James A. Guthrie of San Bernardino. Luddy has been a member of the commission since February 1959. Director of Public Works Robert B. Bradford is ex officio chairman of the commission.

Bayshore Freeway

San Jose to San Francisco Is Now All Full Freeway

By W. G. REMINGTON, Resident Engineer

ON JANUARY 24, 1962, the last traffic signal on the Bayshore Highway between San Jose and San Francisco was eliminated.

On this date, the Fair Oaks Avenue Overcrossing was opened to traffic with appropriate ceremonies attended by Robert B. Bradford, Director of Public Works; California Highway Commissioners James A. Guthrie, John Erreca and Abraham Kofman; J. P. Sinclair, Assistant State Highway Engineer; L. A. Weymouth, District Engineer, and local city and county officials. These ceremonies and a luncheon were sponsored by the Sunnyvale Chamber of Commerce, together with Chambers of Commerce of other Peninsula cities.

All Is Now Full Freeway

The divided freeway was opened to the public on February 2, 1962. Resurfacing the northbound lanes and cleanup work continued for several weeks but, practically speaking, the final conversion of the Bayshore to full freeway standards was complete on that date.

One can now travel from San Jose to San Francisco, across the Bay Bridge and on to Sacramento, a distance of approximately 140 miles, without being stopped by a single traffic signal. With this final conversion there should end the final chapter of the "Old Bayshore Highway" with its frustrating delays to motorists because of traffic signals and traffic accidents, and there should begin a new period of safe high-speed freeway travel between San Francisco and San Jose.

Because of the topography, San Francisco since early days had had two inadequate vehicular outlets to the south: El Camino Real, now US 101, and the road that followed the Bay shore on narrow right-of-way and roadbed, on inferior alignment and grades.

The Bayshore Highway started in 1923 when the Legislature passed an act authorizing the Highway Commission to acquire right-of-way for and to construct a highway from the line separating San Mateo County from the City and County of San Francisco in, to and through San Mateo County at locations designated and selected by the commission, and declared the same to be a state highway. This act authorized any city and/or county to contribute money and/or property to assist in the construction and maintenance of this road. At the same time, the act provided for the reception and use of the monetary and land denotations and created a special fund for these denotations.

Traffic on El Camino Real, which connected and traversed the various Peninsula cities had long since reached an intolerable stage the entire length of the road from San Francisco to San Jose, and the Bayshore Highway was envisioned as an ultimate solution to the traffic problem. It was planned as a wide commercial highway, with no obstructions, sharp curves, or grades of more than 4 percent.

In 1925, the Legislature extended the Bayshore to a point in the City of San Jose, but stipulated that the State would not spend any state funds for the construction of the Bayshore Highway within the City and County of San Francisco. By 1947, the Legislature had extended the Bayshore Highway to Route 2 (US 101) near Ford Road and included the portion in San Francisco in the State Highway System.

First Contract in 1924

The initial contract for work on the Bayshore was approved in August 1924, with D. A. Foley and Co. of Los Angeles the successful bidder. This contract was for grading only of

W. G. Remington Served Division 41 Years

Wilfred G. Remington, resident engineer in District IV, Division of Highways, has retired after 46 years of public service, 41 years of which were with the division.

Remington was born in Great Falls, Montana, and came to California in 1911.


W. G. REMINGTON

He went to work for Stanislaus County in 1916 as an instrument man and later chief of party. In 1918 he started work for the California Division of Highways in District III but returned to Stanislaus County the following year as Acting Deputy County Engineer, a position he held until 1921. He then returned to the Division of Highways and, except for a short period in private work, has been with the State until his retirement on March 31. He received his appointment as Associate Highway Engineer in 1932. For nearly all of his career with the State he has been a resident engineer on construction projects in Districts III (notably on US 40 over the Sierras), V, and IV. He was resident on projects on the Bayshore Freeway, El Camino Real, and Cabrillo Highway.

He is a member of Elks Lodge 783 in Marysville and Masonic Lodge 690 at San Carlos. He and his wife, the former Florence Smith, have a son, Richard, who works for the Stanford Research Institute.

Lawrence Station Road Interchange on Bayshore Freeway between Morse Avenue and Brokaw Road, looking northerly. Beyond Fair Oaks Avenue Interchange in the center is the newly completed portion between Charleston Road and Morse Avenue.

5.2 miles of 60-foot roadbed between South San Francisco and Burlingame, for which the contractor bid $298,610. It was estimated that the construction of the necessary culverts and other miscellaneous items would bring the cost to $400,000. At this time, San Francisco was the sole contributor, having contributed $400,000.

Ground-breaking ceremonies were held at South San Francisco on September 11, 1924, with Governor Rolph, Harvey M. Toy, the Highway Commission Chairman, and many other dignitaries taking part.

This highway was constructed in a 125-foot right-of-way with a four-lane 40-foot portland cement concrete roadbed, with 10-foot plant-mixed or asphaltic concrete shoulders. The pavement was of several structural designs, part of which were the 11″–9″–11″ type, 11″ at the edges, then tapering in two feet to nine inches for six feet. Various systems of steel reinforcing were also tried at several different locations.

Early in 1929 the Bayshore Highway had been completed to San Mateo and by August 1933 to Lawrence Station Road, now in Sunnyvale, and by July 21, 1937, to San Jose.

C.H.C. Declares Intention

The California Highway Commission, by several actions between March 1941 and April 1958, declared their intention to convert the Bayshore Highway to a full freeway between the San Francisco-Oakland Bay Bridge and McKee Road in San Jose.

The first work converting the old Bayshore Highway began in 1946, and the total conversion was completed this spring, with a construction cost of $72,119,100 and a right-of-way cost of $42,500,000 for 54 miles of multilane freeway.

In San Mateo and Santa Clara Counties, the freeway, in general, closely follows, or parallels, the old Bayshore Highway, the most notable divergences being across Candlestick Cove north of South San Francisco, between South San Francisco and Broadway in Burlingame, and between Bransten Avenue in San Carlos and Spruce Street in Redwood City.

Many interesting features were encountered in constructing the Bayshore Freeway across Candlestick Cove and between Colma Creek near South San Francisco and Spruce Street in Redwood City. In the first contract for building a short section into Candlestick Cove, methods were developed for building the center portion of the roadbed only wide enough for "cats" and "carryalls" to turn and dump well in advance of the main fill, then to widen the fill to force the mud wave normal to the center line of construction. On later construction, when the fill had been undisturbed for over 10 hours, blasting was resorted to, to start the mud flowing again. (See article in November-December 1955 issue of *California Highways and Public Works*.)

Built Over Tidal Flats

Through the section from 16th Avenue in San Mateo to Spruce Street in Redwood City, the new sections were constructed over tidal flats. In these areas, considerable lateral displacement of the new roadbed fills were encountered, in many cases cracking the fills open as much as three feet in width and six or seven feet deep.

In several locations, it was found necessary to build earth struts to support and hold both the bridge ramps and roadway fills. Over these sections a flexible asphaltic concrete pavement was used while sections over stable ground were paved with portland cement concrete.

The last two contracts for completion of the freeway between San Francisco and San Jose were awarded in June and July of 1960. These contracts covered an 11-mile length of highway.

L. C. Smith Company of San Mateo was the contractor on the first, which extended from 0.3 mile north of Charleston Road in Mountain View to Morse Avenue in Sunnyvale and included the conversion of the Mountain View-Alviso Road (State Highway Route 113) to freeway standards from Bayshore Freeway to Borregos Avenue.

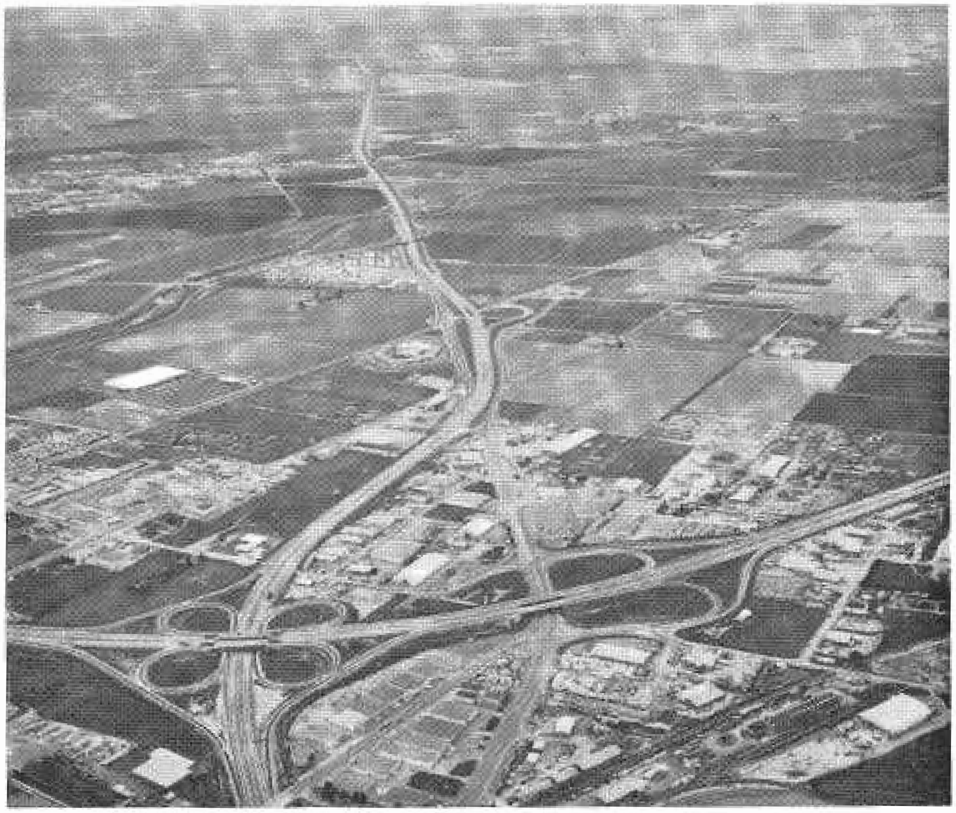
This contract included the construction of a two-quadrant cloverleaf interchange at Rengstorff Avenue, a four-quadrant cloverleaf at Stierlin Road, a diamond interchange at Ellis Street with a railroad grade separation at the same location, a four-quadrant cloverleaf at Mathilda Avenue and Bayshore Freeway, and a diamond interchange at North Mathilda Avenue and Route 113.

This contract included the relocation of the railroad spur leading into and within the grounds of the U.S. Naval Air Station at Sunnyvale, commonly known as Moffett Field, the relocation of the water supply line and communication system within the air station, and the relocation of the entrance and parking area. This work, approximating $1,000,000, had to be completed before the actual freeway construction could be started.

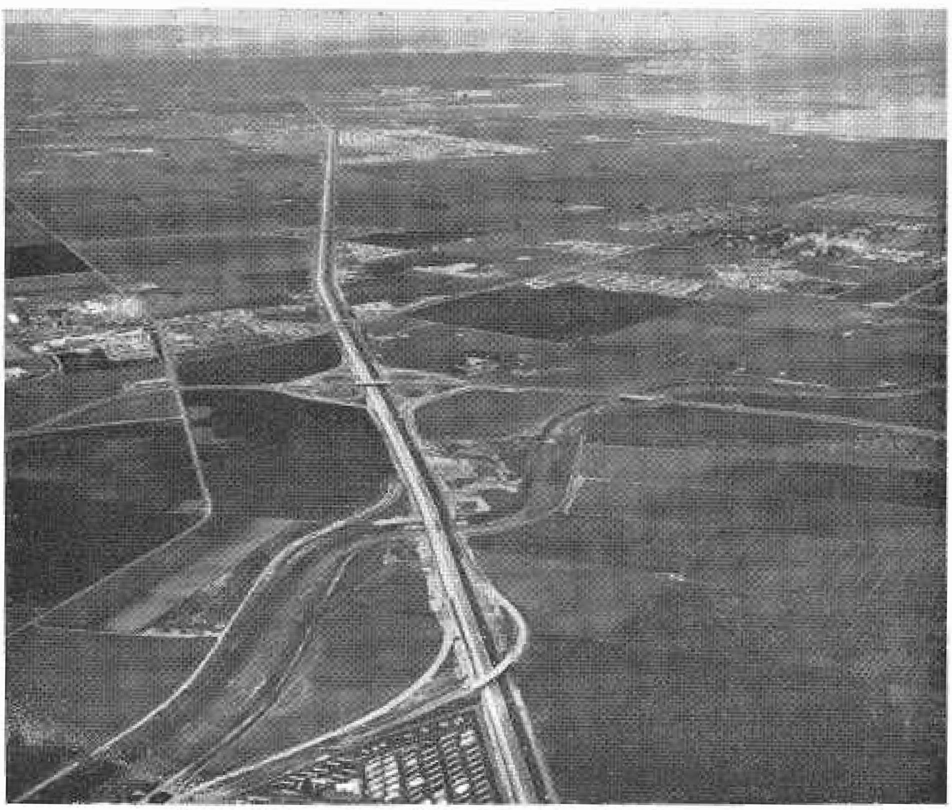
Project Completed

The resident engineer on this contract was Egon W. Strandberg. With the co-operation between the contractor, U.S. Navy personnel, personnel of Lockheed Missile Plant, officials of Mountain View and Sunnyvale and the resident engineer, the project was completed within the specified time limit.

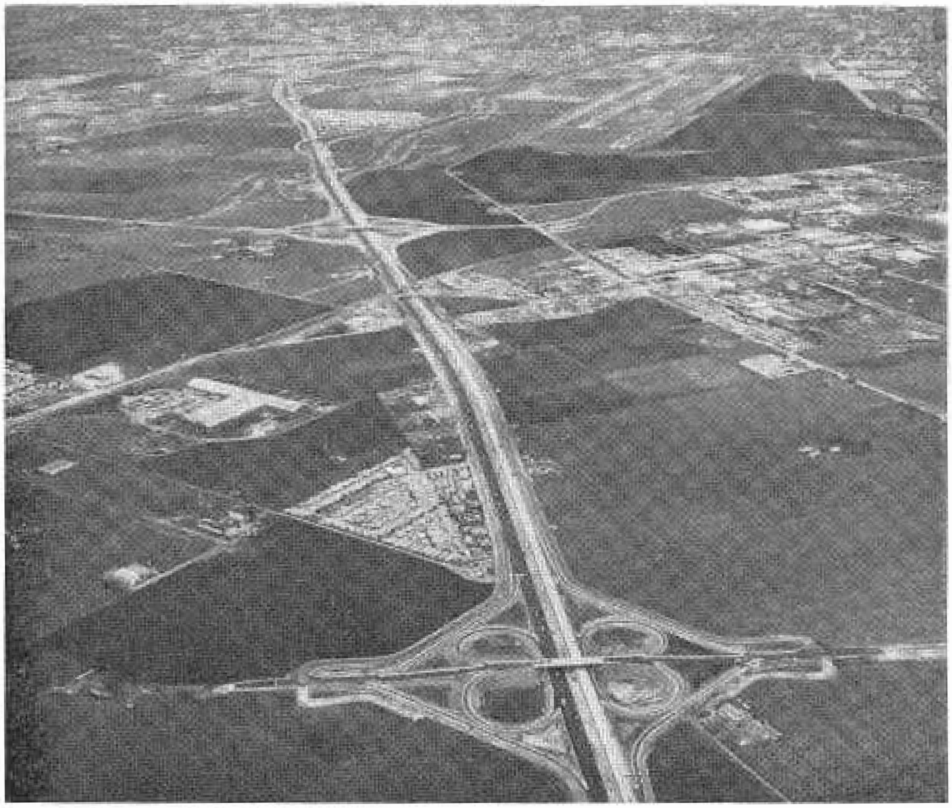
The second of the two contracts, extending from Morse Avenue to Brokaw Road, was awarded to the Allen M. Campbell Company, General Contractors, Inc., of Tyler, Tex. This conversion of the old four-lane highway to a six-lane freeway involved construction of a two-loop, four-quadrant cloverleaf at Fair Oaks Avenue, full four-quadrant cloverleaf interchanges at Lawrence Station Road, San Tomas Boulevard and Trimble Road-De La Cruz Boulevard, a grade separation at Lafayette Street, an overcrossing structure for the future Guadalupe Parkway, a railroad grade separation at the Agnew Underpass, and bridges across Calabazas Creek, Saratoga Creek, San Tomas Aquinas Creek and the Guadalupe River.



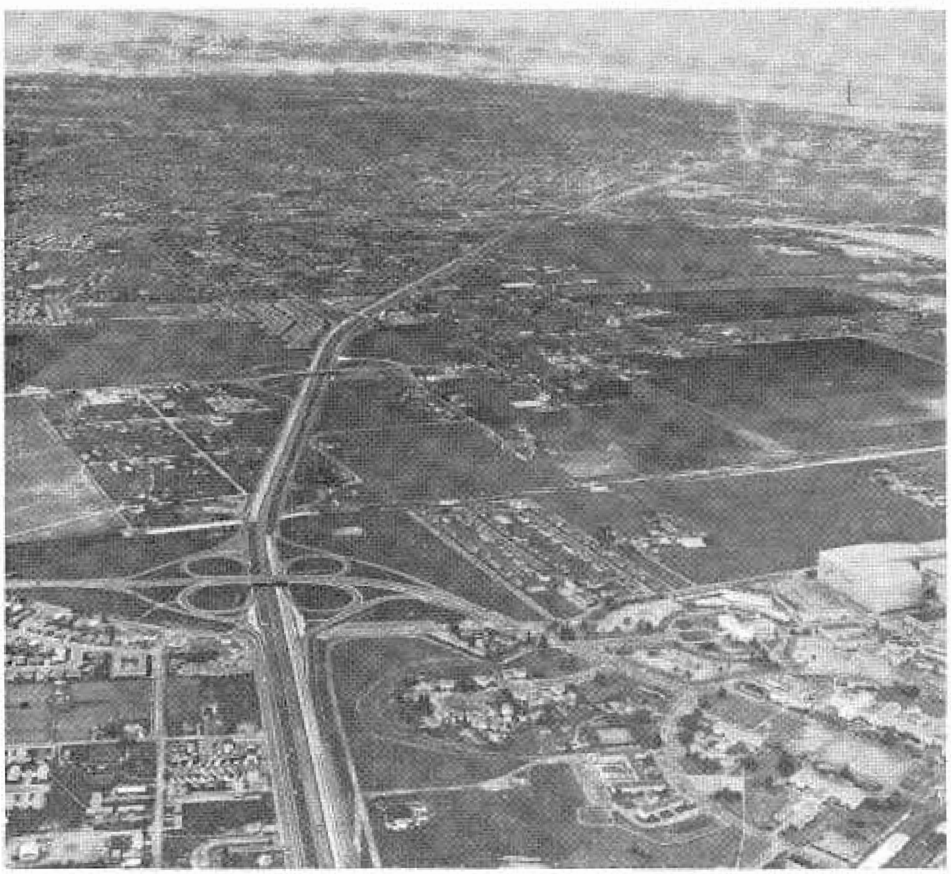
Looking northerly from Junction of Interstate 680 and US 101 Bypass at the newly completed portion of Bayshore Freeway between Morse Avenue and Brokaw Road. Guadalupe Parkway Overcrossing structure in center of photograph.



Bayshore Freeway between Morse Avenue and Brokaw Road, showing the structure for the future Guadalupe Parkway in the foreground and the four-quadrant cloverleaf at Trimble Road-De LaCruz Boulevard.



Looking southerly to the City of San Jose on Bayshore Freeway between Morse Avenue and Brokaw Road. San Tomas Boulevard Interchange in the foreground.



Bayshore Freeway looking northerly at a portion of the completed contract between Charleston Road and Morse Avenue. In the foreground is Moffett Field Interchange (not constructed in this contract).

Fill on both of these contracts for embankments below four feet below finished grade was obtained by constructing a wider and deeper Guadalupe River channel on new alignment. This was done by co-operative agreement with the Santa Clara County Flood Control District. The material was of a silty nature and required considerable effort on the part of the two contractors to obtain optimum moisture and the required density. The placing of subbase and bases was done in the conventional manner and little difficulty was encountered.

Headerboards Used

The placing of 117,000 square yards of portland cement concrete pavement was required for the construction of 5.8 miles of 36-foot pavement for the project. Paving was done by placing a 24-foot width lane and a later one of 12-foot width. Headerboards and conventional equipment were used in the paving operation.

In order to minimize traffic delay, it was specified that erection of precast, prestressed girders and steel girders for bridges over the existing roadway must be accomplished between the hours of midnight and 6 a.m. Publicity regarding each erection and of any detours involved was disseminated to newspapers and radio stations by the District Office. With this publicity and with adequate warning at the site, these erections took place without incident or complaint from the traveling public.

Prior to the construction, the old portland cement concrete paving started to show considerable distress. The slabs rocked, and spalling at the joints grew. When traffic was shifted to the new lanes, the subsealing of the old pavement was begun. This consisted of pumping air-refined asphalt into holes drilled in the old pavement at 10-foot centers. It was found that by staggering the holes the voids could be more completely filled. Asphalt was pumped at the average rate of 50 gallons per hole, which is evidence that considerable subsurface erosion existed. Subsequent to the subsealing, the resurfacing of the old lanes was accomplished, completing the conversion of the former four-lane highway to a six-lane, future eight-lane freeway.

Freeway Accidents

No Cross Traffic Keeps Rate Low

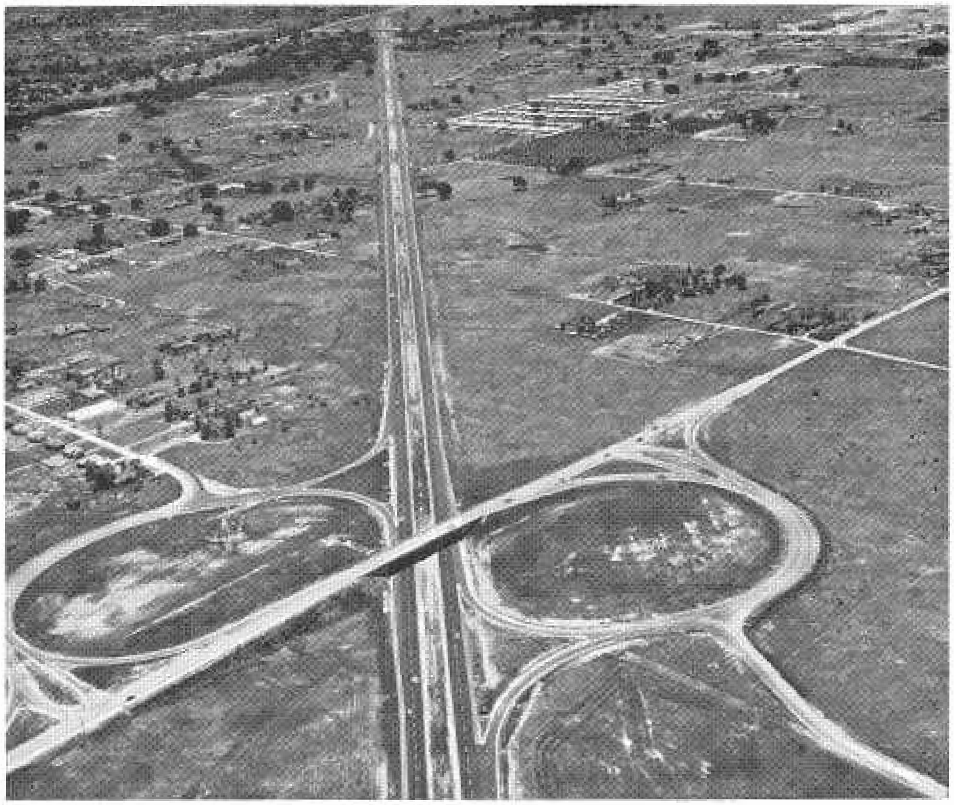
By KARL MOSKOWITZ, Assistant Traffic Engineer

Freeways are designed to carry large volumes of traffic expeditiously and safely. A freeway is an express highway with the following characteristics:

1. There are separate roadways for traffic in opposite directions, and each roadway has two or more lanes.
2. Crossroads are separated in elevation from the freeway. There is no cross traffic at grade.
3. There is no access between the highway and the roadside, except at specially designed entrance and exit roadways.
4. Traffic enters and leaves the freeway at flat angles and at speeds approaching the speed of traffic on the freeway.

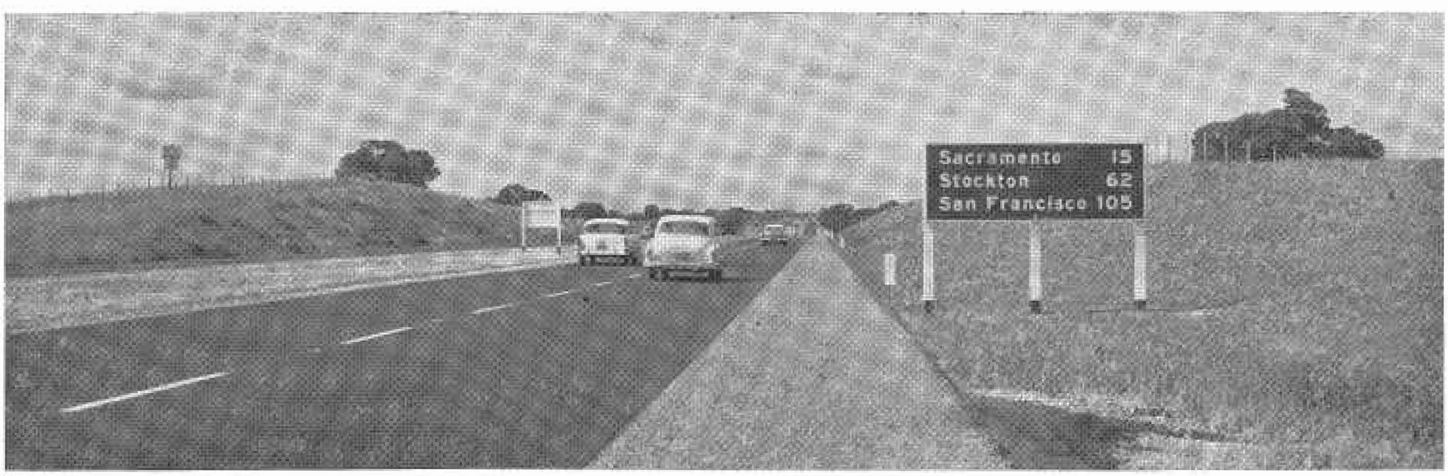
Several photographs of freeways in California are shown in a later section of this report.

At this writing there were 840 miles of freeway open to traffic in California, of which 373 miles are within cities. Although this comprises less than a 10th of the freeway mileage in the United States, many of these miles are subjected to very large traffic volumes, since it is the policy to construct this highest-type of highway in locations where the greatest benefits are provided, both in relief of traffic congestion and in reduction of accidents.



This section of the Roseville Freeway (US 40-99) north of Sacramento has an average daily traffic count of 22,200 and an accident rate of 0.51 per million vehicle miles.

The average traffic volume on California freeways in 1959 was 35,800 vehicles per day, ranging from 4,000 to 210,000. This volume produced 8,800 million (8.8×10^9) vehicle-miles of travel involving 10,000 accidents in 1959. During the three-year period 1957-59 (with mileage and travel increasing each year), there were 21,047 million vehicle-miles and



A ground view of the Roseville Freeway shown in the above aerial.

1959 TRAFFIC FATALITY RATES

	Fatalities	*MVM**	*Fatalities per 100 MVM*
Rural freeways	108	3,052	3.54
Urban freeways	141	5,737	2.46
Total freeways	249	8,789	2.83
All other roads and streets	3,339	59,011	5.66
Totals	3,588	67,800	5.30

* MVM means "million vehicle-miles," i.e. 1,000,000 vehicles moving one mile, or 10,000 vehicles moving 100 miles each, etc.

24,834 accidents. Because this is more experience than has been available in many other jurisdictions, it is thought that some facts regarding these freeways would be of interest to participants in this conference.

Accident Rate Comparison

Table 1 shows the total reported accidents, injury accidents, and fatal accidents on California state highways in 1959, as well as some accident rates.

As may be noted in Table 1, the accident rate, injury-accident rate, and fatality rate on rural state highways other than freeways are about 2½ times as great as the corresponding rates on rural freeways. Urban freeways have a lower fatality rate, but a higher rate of nonfatal accidents than rural freeways.

Direct comparisons of urban freeway accident rates with other urban arterials are almost impossible to make, mainly because data on urban arterials are so difficult to obtain. An indication is given by comparing Columns 3 and 4 of Table 1. Column 4 is a sample of major urban arterials, representing 21 separate sections of road in various urban areas throughout the State. During the three-year period studied, the roads in this sample generated 833 million vehicle-miles and there were 5,135 reported accidents on them. As the table shows, the accident rate on these arterials was more than five times the rate on urban freeways.

1959 traffic fatality rates for California are shown in the accompanying table.

The fatality rate on freeways was just half that on all other streets and highways, rural and urban.

If the 8.8×10^9 vehicle-miles of travel on freeways had been subjected to the hazards encountered on ordinary roads and streets at the rate of 5.66 per 100 million vehicle-miles, they would have resulted in 497 deaths, instead of the 249 that did occur. In other words, freeways then operating in California saved about 248 lives in 1959.

In an attempt to examine the basic reasons for the success of freeways, Table 2 has been prepared. This table shows the accidents and accident rates for the several classes of rural state highways, broken down by kinds of accident.

Elimination of Intersections

The first thing that one notes on looking at this table is that the major credit for the freeway's over-all superiority is owing to the elimination of intersections. The lower line on the table (total excluding intersections) shows that some success also has been had in the application of other design improvements over the years.

The two-lane roads are generally the oldest, followed by three-lane, then four-lane-undivided, and so on across the table headings. Note that the single-vehicle accident rate is far higher on the two-lane roads than on any of the other kinds. This is probably due in part to more sinuous alignment, less width and less roadside clearance than the other kinds.

The reason for the bad showing of the four-lane-undivided highways, as compared with two-lane roads, can be largely accounted for by the fact that

TABLE 1

TOTAL ACCIDENTS, INJURY ACCIDENTS AND FATAL ACCIDENTS REPORTED ON CALIFORNIA STATE HIGHWAY SYSTEM

	All rural state highways, excluding rural freeways (1959)	Rural freeways (1959)	Urban freeways (1959)	One urban area study—conventional highways
Total number of reported accidents	34,574	3,066	6,944	5,135
Number of accidents involving injuries or fatalities	14,519	1,299	3,088	1,653
Number of accidents involving fatalities	1,000	88	111	24
Number of persons killed	1,255	108	141	—
Number of persons injured (not killed)	24,452	2,045	—	—
Ratio of total reported accidents to number involving injuries	2.4	2.4	2.3	3.1
Ratio of injury accidents to fatal accidents	14.5	14.8	27.8	68.0
Ratio of total reported accidents to number involving fatalities	35	35	63	214
Number of reported accidents per fatality	28	28	49	178
Number of injuries per fatality	19	22	—	105
Fatality rate per 10^8 vehicle-miles	8.68	3.54	2.46	—
Injury-accident rate per 10^6 vehicle-miles	1.00	0.42	0.54	1.98
Total accident rate per 10^6 vehicle-miles	2.39	1.00	1.21	6.16

NOTE: National Safety Council estimates for 1958 for U.S.A.:

Fatal Accidents	32,000	Number of Fatalities	37,000
Injury Accidents—Nonfatal	900,000	Number of Injuries	1,300,000
Vehicle-Miles of Travel	662×10^9	Ratio	35:1
Injury Accidents per 10^8 Vehicle-Miles	1.36		
Total Accidents, 1957	10.2×10^6		
Rate per 10^6 Vehicle-Miles	15.5		

strip development, intersections, and cross traffic are more prevalent on this type of road, which is included in this rural table whenever it is outside of city limits. The old two-lane roads near the outskirts of the cities have been widened to four lanes as congestion and cross streets have become prevalent, as a stopgap measure pending construction of freeways. As can be seen by the small mileage of four-lane-undivided highways, California is making considerable progress in retiring this type from state highway duty.

It is of some satisfaction, in studying Table 2, to note that most of the trends are to be expected; the obvious occurs more than the mysterious. Head-on accidents are twice as frequent on two-lane roads, where you must use the opposing lane for passing, as they are on four-lane-undivided roads, and, in turn, they are three to five times as frequent on four-lane-undivided roads as they are on divided highways, including freeways.

Freeway Rate Variation

Freeways in California have been constructed in widely diverse loca-

The Bayshore Freeway south of San Francisco. This is a six-lane freeway with an average daily traffic count of 59,400 vehicles and an accident rate of 0.75 per million vehicle miles.

TABLE 2

ACCIDENTS AND ACCIDENT RATES[e] ON VARIOUS CLASSES OF RURAL STATE HIGHWAYS BY KIND OF ACCIDENT

(California, Calendar Year 1959)

	2-lane		3-lane		4-lane undivided		4-lane[a] divided		Divided,[b] controlled access		Freeway[c]		Total[d]	
Miles	10,450		45		167		210		794		430		12,330	
Million vehicle-miles	8,358		232		976		1,234		3,543		3,052		17,525	
Average daily traffic	2,191		14,239		15,997		16,130		12,224		19,449		3,894	
	No.	Rate[e]	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total reported accidents	19,899	2.38	597	2.57	3,995	4.09	3,591	2.91	6,011	1.69	3,066	1.00	37,640	2.15
Single-vehicle accidents	7,058	0.84	113	0.49	367	0.38	489	0.40	1,532	0.43	862	0.28	10,481	0.60
Collisions between 2 or more vehicles:														
(a) Between intersections:														
(1) Head-on	3,152	0.42	67	0.29	197	0.20	68	0.06	216	0.06	139	0.045	4,220	0.24
(2) Non-head-on	3,675	0.44	203	0.87	966	0.99	953	0.77	2,099	0.59	1,926	0.63	9,941	0.57
(b) At intersections	5,654	0.68	214	0.92	2,465	2.52	2,081	1.69	2,164	0.61	139[f]	0.045	12,998	0.74
Total excluding intersection accidents		1.70		1.65		1.57		1.22		1.08		0.95		1.41

NOTES: (a) 4-lane divided roads have a median separating opposing traffic but roadside assess is uncontrolled.
(b) Divided controlled access roads are nearly all 4-lanes with a few miles of 6-lane. Opposing traffic is separated and there is no access except at intersections. However, intersections at grade are frequent and traffic enters and exits at large angles, approximating 90°. All State highways except freeways require approaching traffic on cross roads to stop before entering or crossing the State highway, unless the intersection is controlled by traffic signals and the light is green.
(c) Freeways are defined in the text.
(d) Total is different from sum of all columns because it includes some highways that are not classified in one of the columns.
(e) Rate is number of accidents per million vehicle-miles.
(f) Accidents at ramps.

TABLE 3

REPORTED ACCIDENTS, MVM, AND ACCIDENT RATES FOR FREEWAYS CLASSIFIED BY NUMBER OF LANES AND TRAFFIC VOLUME

1957-1959, Inclusive

		4-lane			6-lane			8-lane			Variable no. of lanes			Total			
Group No.	Average daily traffic	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	Average ADT per group
I......	Less than 5,000	36	22	1.60	......	......	......	......	......	......	......	......	......	36	22	1.60	4,000
II.....	5,000– 6,999	147	132	1.11	......	......	......	......	......	......	......	......	......	147	132	1.11	6,250
III....	7,000– 9,999	345	365	0.95	19	14	1.34	......	......	......	......	......	......	364	379	0.96	8,200
IV....	10,000– 14,999	1,269	1,518	0.84	2	5	0.38	......	......	......	48	53	0.91	1,319	1,576	0.84	12,200
V....	15,000– 21,499	909	1,020	0.89	35	33	1.05	......	......	......	191	188	1.01	1,135	1,241	0.91	18,500
VI....	21,500– 31,599	2,772	2,171	1.28	165	275	0.60	50	70	0.70	135	163	0.83	3,122	2,679	1.17	26,100
VII...	31,600– 46,499	761	663	1.15	255	298	0.85	42	70	0.60	887	796	1.11	1,945	1,827	1.06	39,800
VIII ..	46,500– 67,999	233	235	1.01	1,525	1,608	0.95	66	132	0.50	883	751	1.17	2,707	2,726	1.01	55,500
IX....	68,000– 99,999	......	......	......	4,393	3,895	1.13	735	610	1.20	2,619	1,761	1.48	7,747	6,266	1.23	91,200
X.....	100,000–119,999	......	......	......	......	......	......	......	......	......	1,949	1,243	1.51	1,949	1,243	1.57	103,000
XI....	120,000–150,000	......	......	......	......	......	......	1,687	1,130	1.49	1,298	823	1.58	2,985	1,953	1.53	142,000
XII...	Over 150,000....	......	......	......	......	......	......	......	......	......	1,378	1,002	1.35	1,378	1,002	1.37	158,000
	Total.......	6,472	6,126	1.06	6,394	6,128	1.04	2,580	2,012	1.28	9,388	6,780	1.38	24,834	21,046	1.18	37,000

tions, in relatively short sections, over a period of more than 20 years. Except for the fact that entrance and exit ramp designs have become more generous, the major design features are quite uniform; main line alignment is good for 60 MPH on almost all freeways, and right-hand paved shoulders are provided on all but the earliest few miles. For the past two years, right-hand shoulders are also provided on bridges, but most of the existing freeways provide a clearance of only two feet from the traveled lanes on bridges more than 150 feet long. Minor features such as width of median, type of drainage control, curbs or flush shoulders on the left, are quite variable among the several sections.

In 1959, the latest year for which complete data have been compiled, the 746 miles of freeway in the State were divided into 138 sections for accident analysis purposes. One hundred three of these were geographically separate, and the remaining breaks were introduced where major changes in traffic volume or year of construction occurred.

Average Rates Plotted

Table 3 shows the number of accidents, travel in MVM, and accident rate per MVM for these freeways for a three-year period, 1957-59, arrayed in volume groups and by number of lanes. The average rates for each volume group have been plotted on the accompanying chart "Accident Rate vs. Average Daily Traffic." Omitting groups I and II, which accounted for only 154 of the 21,047 MVM in the study and obviously plotted erratically, an equation was computed to relate the rates to the average daily traffic. It was found that for freeways in 1957-59, as for undivided highways in 1944-50, the accident rate increases as the 0.2 power of the traffic volume. (For this purpose, each year for each section was classified according to the volume during that year.)

Ninety-four of the sections each had more than 30 MVM of experience. Forty-seven had more than 100 MVM each. These 94 sections are plotted by rate and volume on the accompanying chart "Accident Rate vs. Traffic Volume."

It will be seen that many of the sections vary significantly from the average. The statistics for these sections were examined, and it was found that the year-to-year experience for each of them remained almost constant; in other words, the deviation from the average is probably not chance but is owing to some feature or features of the section. So far, we have not been able to identify any physical characteristics that can be expressed numerically, such as width, curve, radius, sight distance, and so on, that would explain why these sections are so much different from the average.

Subjective Appraisal Attempted

A subjective appraisal of physical features of the freeways with better-than-average and poorer-than-average rates has been attempted. In general, the freeways with better rates (lower than average) are more generous in width, they have no curbs either left or right, they have paved flush shoulders, and they have uniform cross sections, i.e. the number of lanes is constant for fairly long distances. The ramps are comparatively generous and are on the righthand side. The alignment is also very good and in many cases absolutely straight. Although these things are true with respect to the sections with better-than-average rates, it must be realized that they are also true with respect to many of the sections with average rates. The one fact that stands out is that, with one exception, the sections with higher-than-average rates all lack one or more of these favorable characteristics.

About half of the sections with higher-than-average rates have curbed medians, most of them are in urban areas (although this is also true of the sections with lower-than-average rates), and there are frequently some design features such as left-hand ramps, curb noses adjacent to the freeway lanes, short ramp terminals, and rolled gutters, which have been discontinued in later designs. None represents recent design practice; i.e. they were all designed more than five years ago. Again, however, it is emphasized that many freeways with similar features have good accident rates, within 20 percent of the average in either direction.

Spacing Is the Same

The average interchange spacing on freeways with higher-than-average rates was almost exactly the same as the spacing on the better-than-average sections.

A study made in 1959[a] showed that accidents involving ramp maneuvers occurred with a frequency of about one accident per million ramp vehicles. Exit ramps showed an average of 1.13 accidents per million vehicles leaving the freeway, and entrance ramps showed an average of 0.93 accidents per million vehicles entering the freeway. No tendency was noted for this rate to be related to traffic volume on the freeway nor to the distance between ramps.

It is easily seen, however, that the number of entering and exiting vehicles will affect the total number of accidents on the freeway, and thus the vehicle-mile rate. If the average trip length on the freeway is five miles, the accidents attributable to ramp maneuvers would themselves account for a vehicle-mile rate of 0.10 to 0.20 (depending on number of vehicles involved in each accident), which is about 16 percent of the total rate. (In the 1959 study, the ramp accidents actually did amount to 18 percent of the total.)

Average Trip Five to Seven Miles

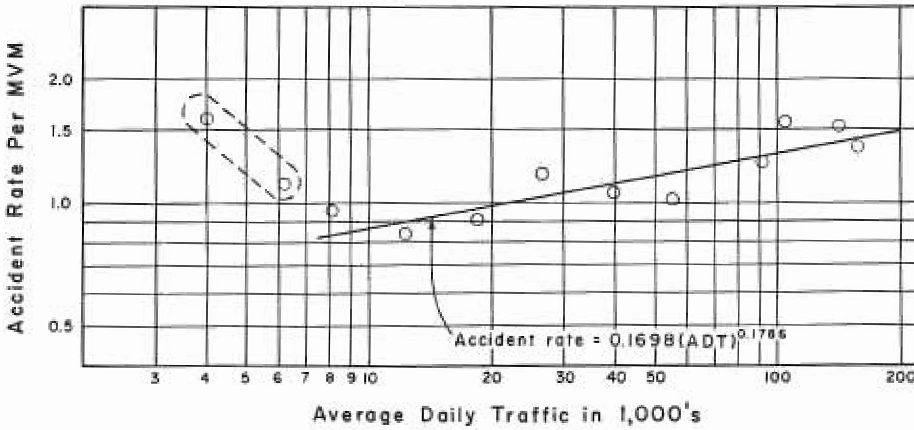
The number of ramp accidents is not reduced by reducing the number of ramps, unless the number of ramp vehicles is reduced.[b] However, there are many indications that the average length of trip on freeways in large urban areas is about five to seven miles, and whether the interchanges were spaced at half-mile intervals, one-mile intervals, or two-mile intervals would not make much difference in the number of entering and leaving vehicles. One-mile intervals as an alternative to two-mile intervals would reduce the inconvenience, circuity and total vehicle-miles (including street travel) for freeway users, and would result in a greater amount of each trip being completed on the freeway portion of the trip, but it would not change the number of trips. One-

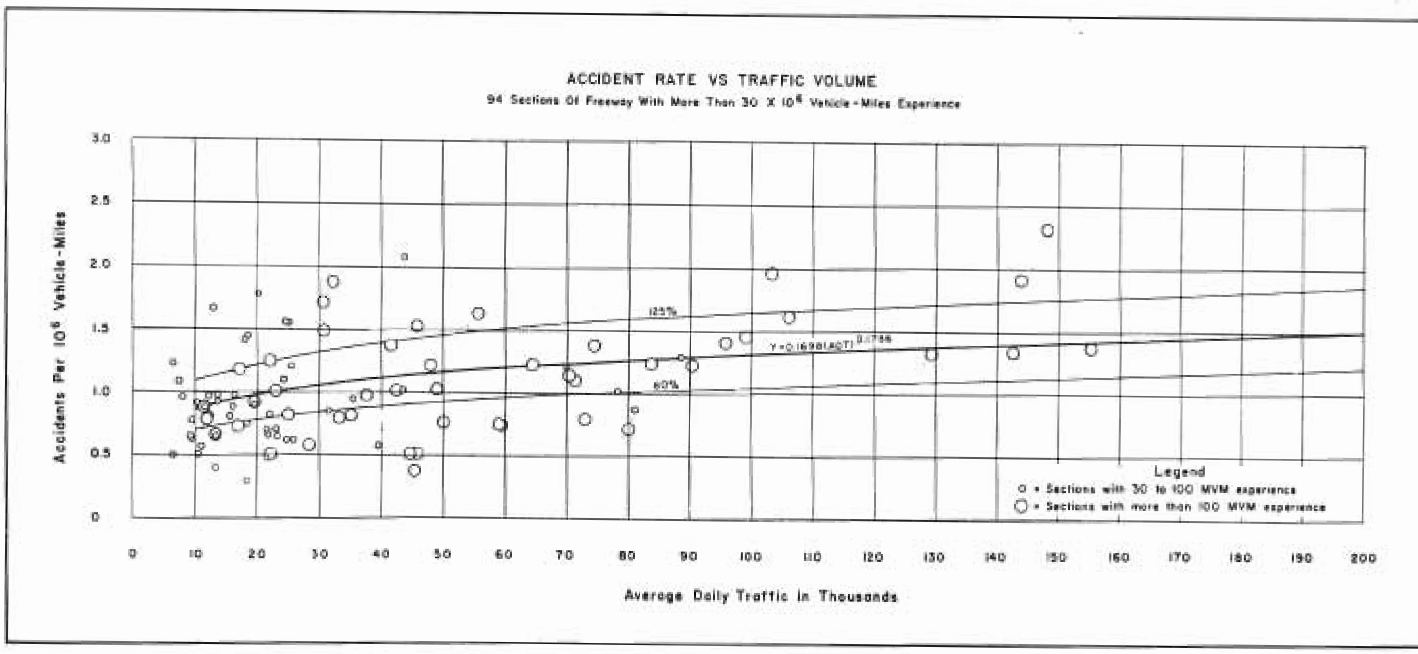
[a] "Accident Experience at Freeway Ramps" by George Langsner. This study examined 895 accidents occurring at 401 ramps on 12 freeway sections totaling 82 miles, over a 3-year period in which 948 million vehicles used the ramps.

[b] If the number of vehicles using ramps could be reduced, the trips would be made on surface streets where the accident rate is five or six times greater than the freeway rate.

Accident Rate vs. Average Daily Traffic, All Freeways in California, 1957-1959

(Based on 24,834 accidents, on 746 miles, 21,046 million vehicle miles)





mile spacing would also result in smaller, more manageable flow at each ramp than would two-mile spacing.

Although reducing the number of ramps will not reduce the number of ramp accidents, there is reason to believe that improving the shape of the ramps will. This is very difficult to prove numerically, because (a) a ramp shape cannot be expressed as a number, and (b) 80 percent of all ramps, good and bad, have less than two accidents per year. In the 1959 study, 44 percent of the ramps had no reported accidents in a three-year period.

Fatal Accidents

There were 258 fatal accidents on California freeways in 1960, which occurred at 254 locations throughout the State. Based on personal study of original reports of each of these accidents, a subjective summary of them follows:

Fatal accidents are different from other accidents in other ways than severity. They are very scattered geographically, which means that "concentrations" that would point up a geometric design shortcoming do not occur. They seem to be more inexplicable than ordinary accidents, particularly on freeways, and they seem to involve errors of kinds one cannot picture himself making. The classifications by type of maneuver, by hour of the day, and by driver error are different from corresponding classifications of lesser accidents.

Time of Day

Analyses of freeway fatal accidents by time of day have been made previously in California. A study for the three years 1957-59 showed that 37 percent of freeway fatal accidents occurred between midnight and 5 a.m., while only 5 percent of the travel occurred during those hours. The rate per vehicle-mile was 17 times as high during those hours as it was during the hours 7 a.m. to 6 p.m.

The 1960 statistics are very much the same. In 1960, 35 percent occurred between midnight and 5 a.m., and 31 percent occurred during other hours of darkness.

Because of the entirely disproportionate number of accidents occurring between midnight and 5 a.m. as compared with other hours of darkness, there is reason to believe that factors other than visibility account for much of the difference between day and night fatal accident rates.

Type of Accident

A classification of fatal accidents by type of maneuver is given in Table 4.

The interesting thing about Table 4 is that two-thirds of all fatal accidents on freeways involved but one vehicle.

The classification "vehicle left road" requires some explanation. In this context, the road is the paved surface and shoulders between side slopes or curbs or rails. There are no "fixed objects" in the road, and thus every "fixed object" accident involved a vehicle which left the road, even though the final point of rest may have been on the road. However, there are many objects at the edge of the shoulder in the same general plane as the roadway. Except for railings of long bridges, most of these are eight feet or more from the edge of the through pavement lanes. Accidents classified as "left road, did not collide with object" are those which went beyond the edge of the road shoulder, generally onto a different plane, before hitting anything.

It is very difficult to say where a vehicle loses control when it leaves the road, even if all the facts about the accident are known. Indications are that 20 of the 55 accidents in Class 1(b) of Table 4 were spinning, or skidding before leaving the road, and that about the same proportion applies to Class 1(a). Both categories include many cars which overturned.

Fixed Object Collisions

There is little question that many of the "fixed object" collisions would have been fatal even if they had not collided with a fixed object.

Pedestrian accidents accounted for 14 percent of all the freeway fatal accidents in 1960. Freeways are not designed for pedestrians and on most of them, pedestrians are prohibited by law. This is the one type of accident which the vehicle driver has the least opportunity of avoiding.

The classification "dismounted vehicle occupants" includes persons whose cars were disabled and who were outside of the vehicle, fixing a tire, wandering around, fetching gasoline, etc.

Two-thirds of the pedestrian accidents occurred during darkness preceding midnight, and they accounted for one-third of all fatal accidents during those hours.

Driving on Wrong Side of Median. This category of head-on accidents is one of the most difficult to understand. Most of them result when confused drivers enter a freeway going the wrong way on an exit ramp, but sometimes they simply turn around on the road. Ten of the 15 wrong-way drivers were drunk.

One of these accidents involved a car which entered a busy eight-lane metropolitan freeway against heavy

TABLE 4

FATAL ACCIDENTS ON CALIFORNIA FREEWAYS—1960

		No.	Percent
A. Accidents Involving One Vehicle			
1. Vehicle left road or overturned		135	52.4
(a) Collided with fixed object	80		
(b) Did not collide with object	55		
2. Pedestrian		37	14.3
(a) Walking on road	27		
(b) Dismounted vehicle occupants	10		
Subtotal		(172)	(66.7)
B. Head-on Collisions			
3. Driving on wrong side of median		15	6
4. Crossed median		28	11
Subtotal		(43)	(16.6)
C. Rear-end Collisions		43	16.7
Total		258	100

The Golden State Freeway in the Los Angeles area. This is an eight-lane freeway. The average daily traffic rate from 1957 to 1959 was 45,000. The accident rate for this period was 0.38 per million vehicle miles.

traffic, with about 3,000 vehicles per hour coming toward him, and drove *four miles* before finally colliding with a car. Hundreds of vehicles veered away from the offending car, using the other three lanes. Why the offending car did not *stop* is the question. Confusion at exit ramps is conceivable, but it is inconceivable how anyone could go on for four miles in the face of this kind of traffic.

Accident Is Exceptional

The accident described was very exceptional. All but two of the other wrong-way fatal accidents occurred during hours of very light traffic flow, in the dark, most of them in rural areas where there was no regular street pattern. The freeways are four-lane freeways, with two lanes in each direction, separated by a median.

Typically, the offending car enters the freeway via an exit ramp, going the wrong way, and drives on the right-hand side (from his point of view) of the two-lane roadway; i.e., the side next to the median. His headlights are on. The nonoffending car, or "innocent victim" comes booming along and sees headlights coming toward him for at least 1,000 feet, perhaps a mile or more. There is practically no other traffic on the road and there is nothing to keep him from pulling to *his* right and avoiding the offending car. Yet he panics, and either stays in the left lane or steers into the left lane.

Car Loses Control

Cross-median Head-on. There were 28 fatal accidents in this classification in 1960. This kind of accident occurs when a car loses control and goes across the median into the face of opposing traffic. Only 3 of the 28 involved drunk drivers, but 10 of the 28 vehicles that went across the median were little cars or sports cars.

Eleven of the 28 occurred on sections where the median is 36 feet wide or wider.

Twenty-two of the 28 cross-median fatal head-on accidents occurred on sections of freeway where the traffic volume exceeds 60,000 per day. Median barriers are being erected on all California freeways where this volume occurs.

Curbs do not prevent nor deter out-of-control vehicles from going across the median. In many cases they probably cause the vehicle to go out of control.

Rear-end Collisions. When the freeway concept originated, it was thought that rear-end collisions would be the most prevalent type. High standards of alignment and width were to eliminate single-vehicle accidents, grade separations were to eliminate intersection collisions, and separated roads for each direction were to eliminate head-on collisions. Pedestrians were to be prohibited. The only kind of accident that was not provided for was the rear-end collision.

Low Fatality Rate

It is therefore very interesting to note that the rear-end collision accounts for only one-sixth of the fatal accidents on California freeways in 1960. Here, of course, is one of the things that is different about fatal accidents. The rear-end or sideswipe is the most prevalent type of accident on freeways, but as the layman surmises, it is not often fatal.

Although trucks are involved in a small percentage of all fatal accidents on freeways, they are involved in a disproportionate share of rear-end fatal accidents.

- Of the 43 fatal rear-end collisions on California freeways in 1960, trucks were involved in 21.
- In 11 accidents, a truck was hit from behind. Two of them involved stopped trucks, and eight of them involved trucks going very slow, well below any speed limit. Raising the speed limit would have no effect on their speed.
- In 10 accidents, a truck overtook the other vehicle and could not or did not stop in time.

The preceding statistics raise serious questions regarding the advisability of raising speed limits for trucks, which is now 50 m.p.h. on California freeways.

Conclusions

Freeways are comparatively safe roads, but they are not foolproof. Their principal advantage is the elimination of cross traffic conflicts.

Two-thirds of fatal accidents on freeways involve only one vehicle. One-third of fatal accidents occur between midnight and 5 a.m., while only one-twentieth of the travel occurs during those hours.

For a prudent driver, the probability of being involved in a fatal accident is very much less than the overall statistics indicate, and the overall rate is 2.26 fatal accidents per 100 m.v.m.

More Tests

Cable-Chain, Rigid Beam Barriers Given Further Lab, Field Study

By JOHN L. BEATON, Supervising Highway Engineer, and
ROBERT N. FIELD, Materials and Research Engineering Associate

SUMMARY

1. *Head-on accidents* were *virtually eliminated* by the barriers. On the Santa Ana and Nimitz test sections, there were 49 cross-median accidents in the "before" period, including eight fatal accidents, and there were two cross-median accidents in the "after" period, one of which was fatal.

2. *Total* accidents and *injury*-accidents *increased* in the locations where barriers were installed.

3. The freeway test sections with the *cable barrier* experienced a *smaller increase* in the overall accident rate than did those with the *beam barrier*. There was no proof that the accidents involving the cable barrier were less severe. However, the findings of the controlled impact tests indicated that high-speed collisions with the cable barrier would result in much less severe injury to vehicle occupants, and it is believed that in general the accidents involving the cable barrier are less severe.

4. The *maintenance cost* of the *cable barrier is considerably higher* than that of the beam barrier. *First cost* of the *beam barrier is much greater* than the cable barrier. It would require some 19.5 years for the total expenditure to balance.

5. More accidents are evident involving the cable barrier. The *proportion of single-vehicle accidents is much higher* with the *cable barrier* than with the beam barrier. There is no indication that drivers are more reluctant to swerve into the beam barrier, but there are indications that there may be more "hit-and-drive-away" accidents involving the cable.

6. There was little difference in the cable barrier accident rate between the sections with 12- and 22-foot medians, and the maintenance cost per mile was essentially the same. There was *no evidence to indicate that the deflection of the cables led to collisions* by permitting momentary encroachment in the opposing lanes.

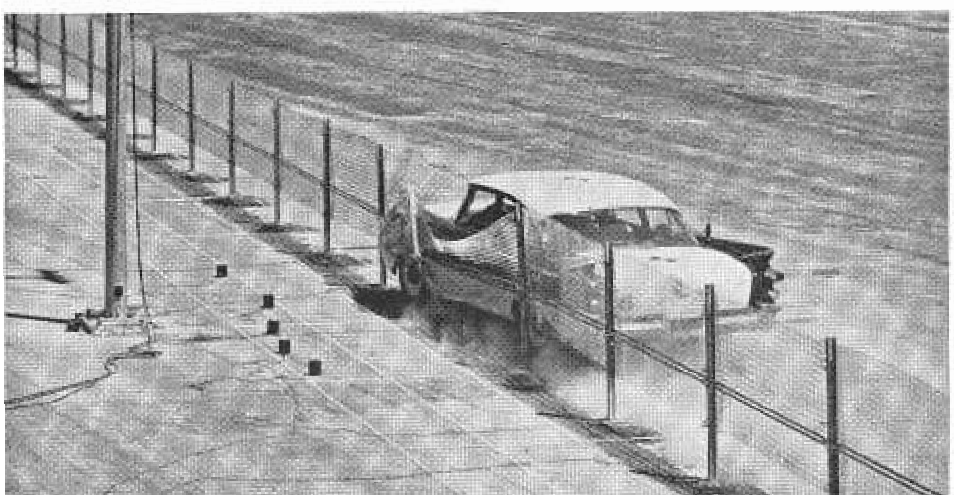
7. In installations other than the test sections, two vehicles climbed up and over the cable barrier and there were indications that others made partial climbs up the barrier.

During 1959, a full scale dynamic test program resulted in two types of median barriers for use on California Freeways. This program was reported in *California Highways and Public Works* in July-August, 1959.

Following the study, construction of the two accepted types of barriers was started immediately. The first of these installations was classified as experimental and it was planned to report on their performance after the first year of operation. This report was made in the September-October, 1961, issue of *California Highways and Public Works*.

The two types of barriers were the flexible cable-chain link type and the more rigid blocked-out metal beam barrier. The test sections, each approximately six miles in length, were installed on the Santa Ana Freeway in Los Angeles and the Nimitz Freeway in Oakland. Each of these installations was approximately evenly divided between the cable and the beam type barriers.

The one year operational study showed that while both types were successful, some improvements were needed in the cable barrier. Additional full scale tests to develop the improvements were therefor initiated and were performed during the spring and summer of 1961. The results are here reported. The following summary contains the findings of the one year operational study as well as a summary of the results of the recent test program. The detail discussion of one year of operation is included in the July-August, 1959 article.



A test car crashes into the new design cable-chain link barrier at 75 miles an hour. Note the lack of rise of the front of the car during this flat angle collision.

Subsequent controlled collision tests indicated this tendency could be minimized by *removing the lower cable* from the original design.

8. In addition to the two vehicles that climbed the cable barrier, two vehicles *jumped barriers.* One on the Santa Ana test section was apparently due to the car striking a curb in front of the barrier. The other was not on the test sections and was judged to be the result of the barrier being too low in relation to the plane of the roadway superelevated surface.

   Subsequent controlled collision tests indicate that a 30-inch-high barrier should be placed at or before the point of intersection of the shoulder slope and ditch slope. If it is necessary to place the barrier down the ditch slope, then it should be placed no farther down the slope than will result in the top of the barrier being at least 27 inches above a horizontal projection from the point of intersection of the slopes.

9. Analysis of controlled collision test results indicate that the cable in a cable-chain link barrier should be placed no higher than *33 inches* above and no lower than *27 inches* above the ground line (or surface of control elevation).

10. Details of design of the cable barrier should be such that *no fixed restraints* exist insofar as the cable clamps or chain link fabric are concerned.

11. *Expanded metal* for a more effective headlight screen substituted in place of the chain link fabric *makes little change* in the cable barrier performance.

Accident damage to blocked-out metal beam barrier on the Nimitz Freeway. Results correlate well with the experimental full scale crash tests of 1959.

OPERATIONAL FAILURES

Special detail studies were made from time to time of all accidents, and in addition of each accident where vehicles passed over, went through, or climbed the barriers. These observations were made of accidents with all installations of the new designs of median barriers rather than only on the test sections.

Overall, during the past year, three vehicles passed over new designs of barriers, three went through, and one came to rest on top of a barrier.

The three crossovers all involved cable barrier. Two of these were the result of jumps due to causes unrelated to the cable barrier and therefore could have occurred over any 30-inch high barrier. One was the result of the vehicle hitting a curb and jumping high enough to clear the barrier cable. The second was a high speed vehicle which jumped over the barrier after leaving the road on the outside of a curve. The barrier in this case was placed in a low ditch section where the roadway had been rotated to provide for superelevation. This provided the car with an inclined ramp from which to jump.

Same Cause

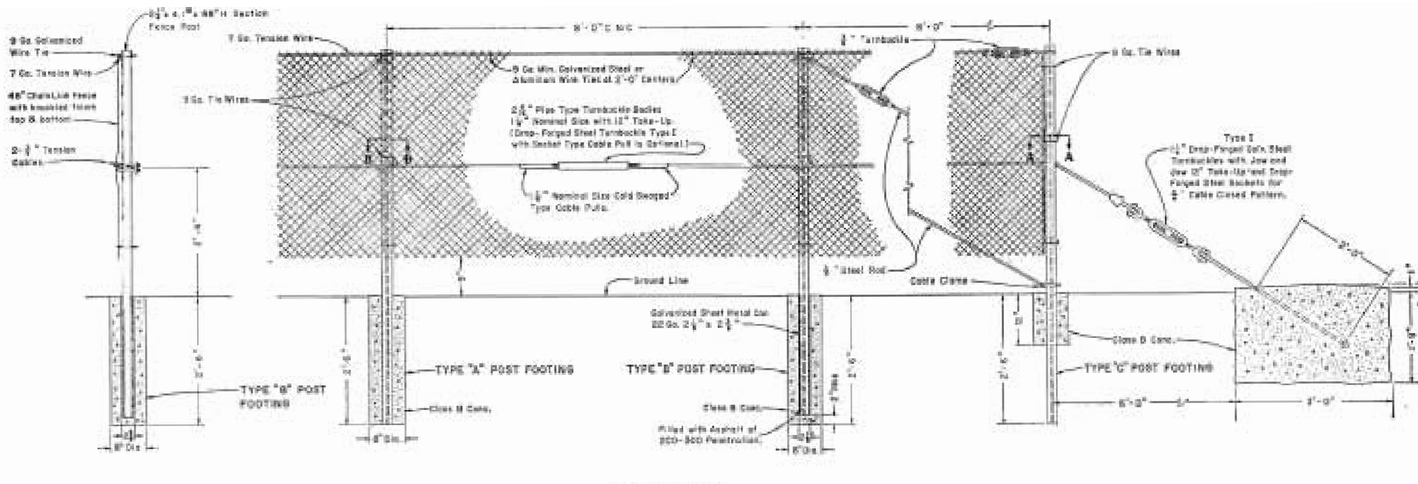
The third crossover and also the case of the vehicle coming to rest on top of the barrier also occurred on cable-chain link designs. The cause was the same in both cases.

The original cable barrier design called for a tension cable attached nine inches above the ground, and that the chain link fabric be firmly clamped between the lower cable and the post. In both of these accidents and in many others resulting in only partial climbing, it was found that the vehicles approached at a low angle (less than 15 degrees) and high speed. Under these conditions of impact, a post and the firmly secured chain link fabric, combined with the lower cable, served as a ramp for the front colliding wheel to get started in an upward direction. Such a start often elevated the automobile before the car body had an opportunity to penetrate the barrier far enough to provide for restraint by the top cable. Thus the car tended to ride the barrier down.

Two of the penetration type accidents involved trucks colliding with the blocked-out metal beam barrier and resulted in a complete failure of the system. The third penetration involved a small sports car hitting the cable barrier between posts at a high angle of collision and passing between the lower and upper cables. This car had a front end clearance of 29 inches and an overall height of 33 inches, exclusive of the windshield.

Two Categories

A careful analysis of the above barrier crossovers indicates that they could be divided into two categories: one group that probably could be pre-



END VIEW ELEVATION

A diagram of the improved design of the cable-chain link barrier. Note the absence of lower cable and alternate designs of post fittings.

cluded by improvements in design and the other that reasonably could not be prevented by a physical barrier. For instance, in the case where the vehicle hit the curb, the car apparently jumped higher than the 30 inches necessary to clear the barrier cable. Since there have been reports of accidents where cars have jumped as high as 8 to 10 feet and in other cases to have cartwheeled, it would not be reasonable to build a barrier high enough to contain every chance accident that might occur.

Because of the required strength involved, it is also not considered practical to design a barrier that will effectively and completely resist the collision of the heaviest trucks. In the two failures on beam barriers that occurred during this past year, the barrier was completely destroyed within the collision area. However, in neither case did the truck penetrate more than a few feet onto the opposing roadway. In other words, even in failure the barriers provided sufficient resistance so as to reasonably contain the vehicles.

The third penetration was an accident unique to the cable barrier in that very small sports cars can penetrate below the top barrier cable under conditions where the angle of collision is relatively high (over 30 degrees). At smaller angles of collision it is probable that the fence post combined with the cable would still function as a positive barrier against penetration of this type of car.

Functions As Expected

Analysis of the above failures indicated that the beam barrier was functioning about as well as could be expected; however, it appeared that further development work should be done on the cable barrier. Studies indicated that it should be possible to make improvements to prevent the tendency of cars to climb the barrier and also that it would be worthwhile to investigate the possible prevention of penetration by sports cars.

The accident in which the car jumped the barrier after leaving the outside of a curve showed that further information should be gathered concerning the effect of differences of grade and elevation on the trajectory of a moving vehicle. Such information could be used to determine the placement of a barrier.

Maintenance of the cable barrier showed certain improvements of details to be desirable. Most of the effort during maintenance was expended in replacing the posts and concrete footings, so this detail was worthwhile of redesign. With one exception, no problems were encountered in maintaining the cables. In one case of collision with the cable barrier, it was necessary to cut the cable so as to remove the vehicle (in this case the vehicle was a truck-trailer combination). This break was repaired by a cable splice using cable clamps and exercised no real problem.

CONTROLLED COLLISION TESTS

In order to develop details to correct the discussed failures, nine full scale tests were performed. In addition to testing corrective details, certain substitute details were also tested. These included (1) alternate post footings, (2) highway guard rail type cable, (3) alternate cable turnbuckles, (4) cable splices, and (5) expanded metal light screen.

Controlled Tests Evaluated

A crossover type of accident considered to be intolerable is where the vehicle climbs the side of a cable barrier and knocks it down as the vehicle passes on over. This type of accident is unique to the cable barrier. As stated previously, analysis of this type of crossover indicated that it was the result of a deficiency in the details of design rather than in the basic flexible barrier concept.

Controlled collision tests for the purpose of analyzing these deficiencies were made at flat angles and high speed; first on the original design, altered only by moving the chain link fabric outside the lower cables, and then by elimination of the lower cable entirely. A total of seven tests were made on designs without the lower cable.

Elimination of the chain link fabric from the lower cable clamps resulted in an improvement in the action. However, high speed moving pictures revealed that the lower cable alone gave the left front end of the car an upward impetus as the front colliding wheel passed over the junction of the cable and the post. Thus, under certain circumstances it would be possible for the car to continue on upward.

Cable Removal Tested

Removal of the lower cable resulted in penetration of the barrier by the vehicle with no tendency toward upward movement and no loss in barrier action. Post collision investigation of details of the damaged test barriers indicated that the elimination of the lower cable resulted in no loss of barrier effectiveness but did cause a slight loss in stiffness of the system behind the collision. However, any barrier damage due to this loss of rigidity was insignificant.

One of the original design considerations in placing the lower cable in the system was that it would serve to trap the car in the median area as it attempted to return to the onside roadway at the end of the collision path. Operation experience showed that at a flat angle of collision, whether or not the lower cable was in position, the car tended to spin at the end of the collision path back into the traveled lane. This was verified by test collisions.

A review of the accident reports from both the Nimitz and the Santa Ana test sections indicated that this vehicle reaction was typical of a majority of the collisions that occurred on the freeway but that in no case had a secondary collision resulted from this spin out.

Two other details of construction were tested and adopted as a result of these studies. The original design called for a standard turnbuckle every 500 feet along the cable. Since the smoothness of deceleration of the colliding vehicle with the cable-chain link barrier depends primarily upon the friction brake effect of the cable clamps stripping from the posts, it is important that this action proceed unhindered if possible. It was found that when the test collision vehicle progressed along the cable through a turnbuckle, the clamps and the contained mesh jammed at the turnbuckle. This resulted in an abrupt deceleration and violent "spin out" of the colliding vehicle.

No Effect On Deceleration

Two tests were made to judge the effect of repositioning chain link fabric outside the cables. This design eliminated binding while at the same time the removal of the chain link to the outside of the cable had no appreciable effect on the rate of deceleration of the car.

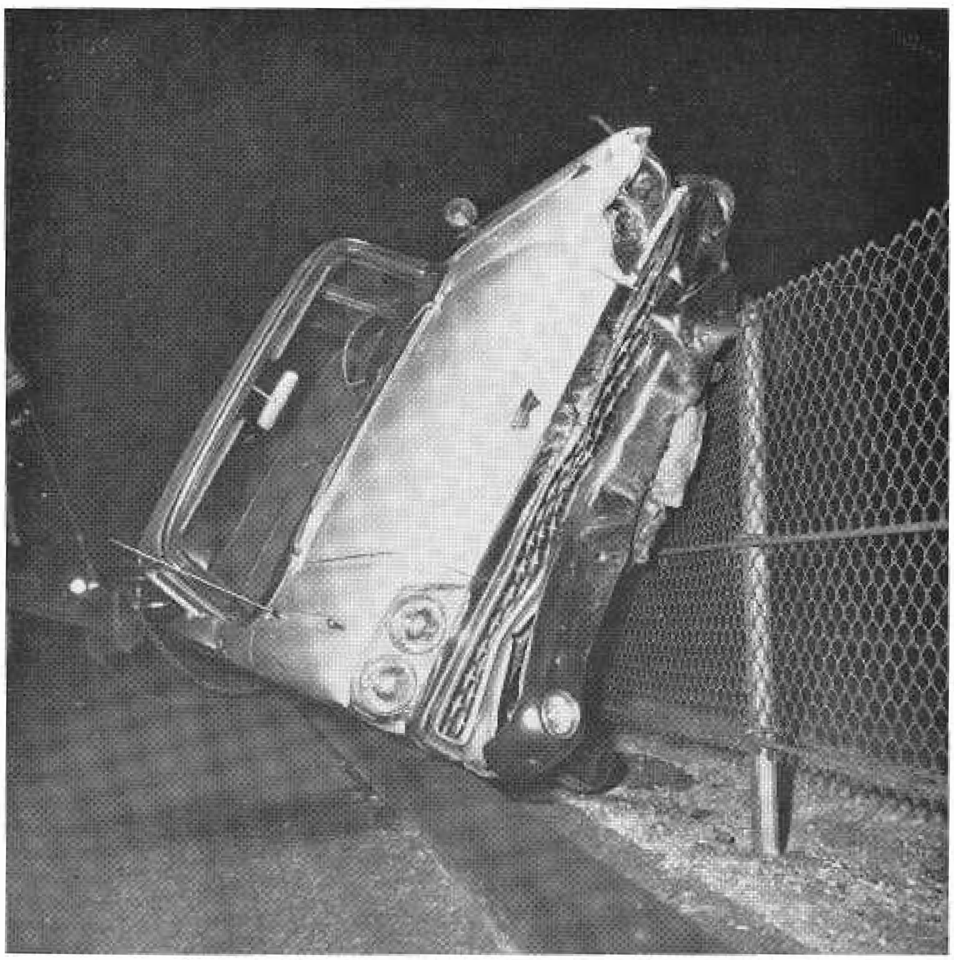
As was originally anticipated, the cable-chain link barrier on the Nimitz and Santa Ana test sections were subjected to a great deal of collision damage. The Maintenance Department found the most costly single item was the removal and replacement of the steel posts and their concrete footings. In addition to replacing the concrete and post, it was necessary for the posts to set in the new footings for at least 24 hours before the cable and chain link could be rehung on the post. This required two trips under heavy traffic conditions. It was decided that, if economically feasible, a post socket design or an otherwise modified footing could solve this problem.

Several designs were considered and all but two were eliminated for various reasons. For this selection two designs were developed and successively tested. One was a concrete collar around the upper one foot of the footing and the second a socket in a full depth footing. In the first the principle was that the earth below the collar would furnish support for the barrier while the collar was curing. Thus the barrier fabric and cable could be re-erected immediately.

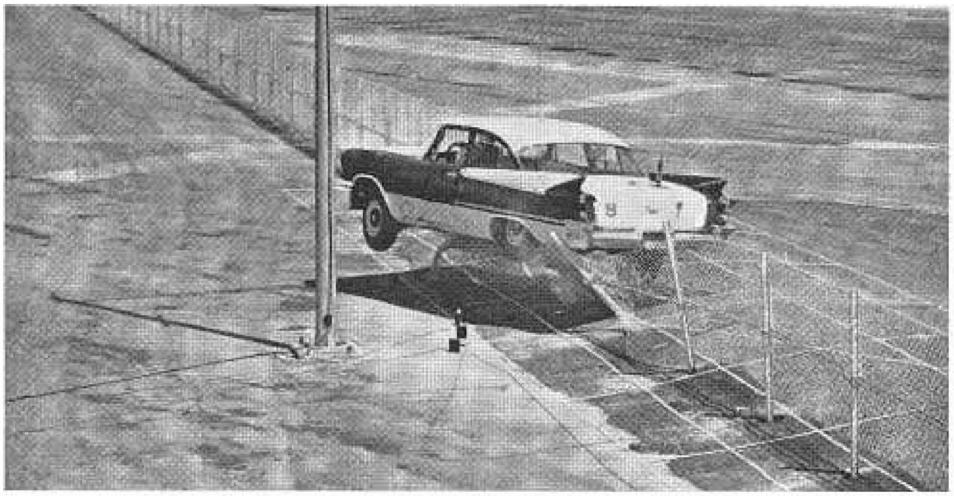
In two test collisions, the concrete collar type of footing was used and in five the socket type.

Collar Footing Adequate

The collar type of footing proved adequate. However, several of the



An accident on a freeway. This type of partial climb could have been the result of the left front wheel jumping from the berm or raising over the lower cable. Photo by Los Angeles Herald-Express.



In this test the barrier was placed at the bottom of a simulated median ditch with 6:1 side slopes. The car traveling 74 miles an hour up an eight percent superelevation from the far side jumped the cable barrier (see sketch below).

footings broke during collision. It was therefore necessary to remove the concrete piecemeal before backfilling the hole and redrilling for the new footing. While this design proved adequate, it is considered practical only for locations where the soil is fairly tight and free of rocks.

Several methods of holding the posts in the sockets were considered. Among these were the use of steel wedges, bolts, set screws, wood wedges, sand (plain and also topped with sulphur), sulphur, and asphalt. All were discarded in favor of asphalt.

However, it was considered necessary to determine the minimum restraint needed to keep the post in place during collision. Therefore tests first were made using an oversize socket with the posts held in place only with wooden wedges. In each of these two tests at least one post pulled out.

Analysis of the data films indicates that during the early part of a collision, the posts are subjected to a substantial vertical force. Sufficient resistance must be offered to prevent uplift of the posts during this period of vertical loading.

These two tests proved that wooden wedges alone provided insufficient resistance. Therefore since sand has little or no internal resistance, it also was discarded. Steel wedges, through-bolt or set screws, could be made to work but were discarded because of cost and possibility of jamming. Sulphur would also work but was discarded because of potential corrision in addition to the difficulty of cleanout or reheating of the sulphur during repair.

Sockets Filled With Asphalt

After completing tests using wooden wedges alone, the sockets were filled with asphalt which proved to be adequate. The Grade 200-300 paving asphalt that was chosen proved able to resist the shock loading with no movement. At the same time the damaged post could be removed by a slow pull and a new post placed by slow pressure. In a controlled laboratory test, it was found that a pull of 700 pounds was necessary to remove a post from an asphalt filled socket when tested at 0°F. It took one minute to complete the removal.

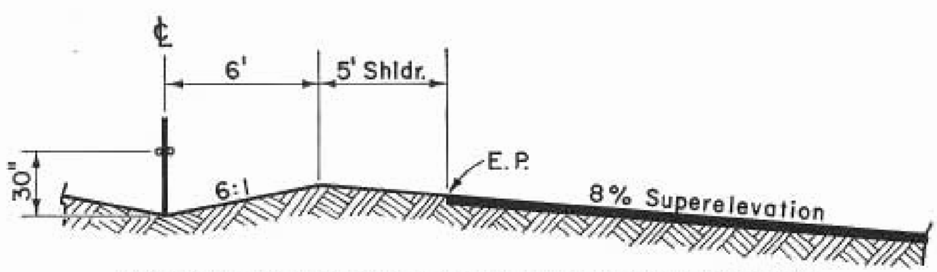
Of particular interest were tests to consider the effect of roadway slopes. For these tests a cross-section of highway found on many California freeways was simulated in which an 8 percent superelevation intersected a 6:1 sloped center drainage ditch. Actual barrier installations have been placed in the center of the ditch which is coincident with the center line of the freeway median area, with the thought that the cars on a collision course would follow the 6:1 side slope down to the barrier.

The tests showed that when the barrier was placed six feet away from the edge of the shoulder at the bottom of the simulated ditch, the car traveling at a 20° angle of collision would pass on over the barrier. After a study of the car's trajectory this was remedied in a following test by duplicating the previous test conditions but moving the barrier up the slope of the ditch to within one foot of the edge of the simulated shoulder, thus giving the car an opportunity to penetrate the barrier and become engaged under the cable.

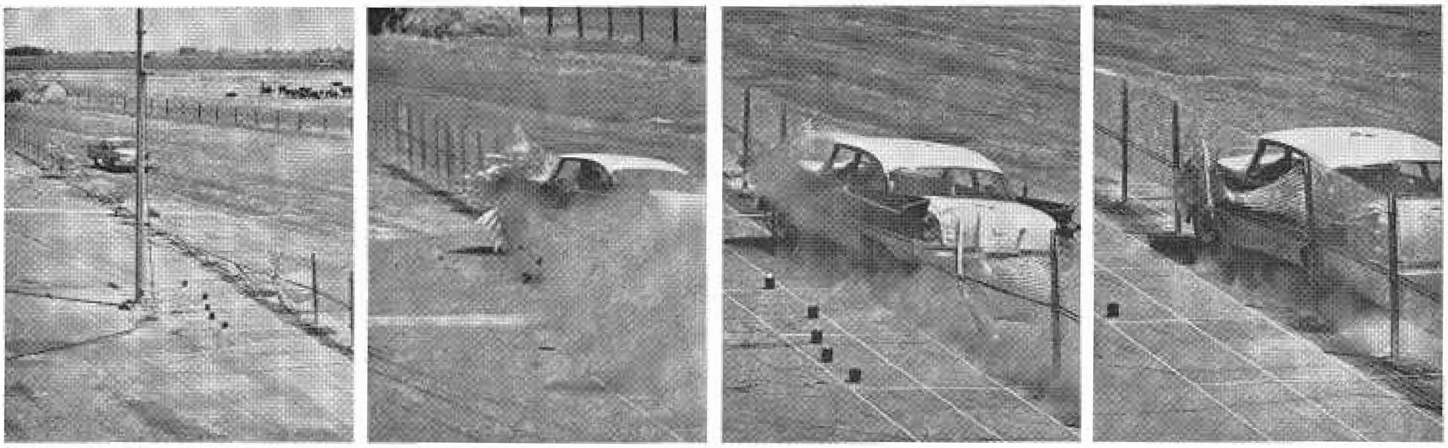
Trajectory Analysis

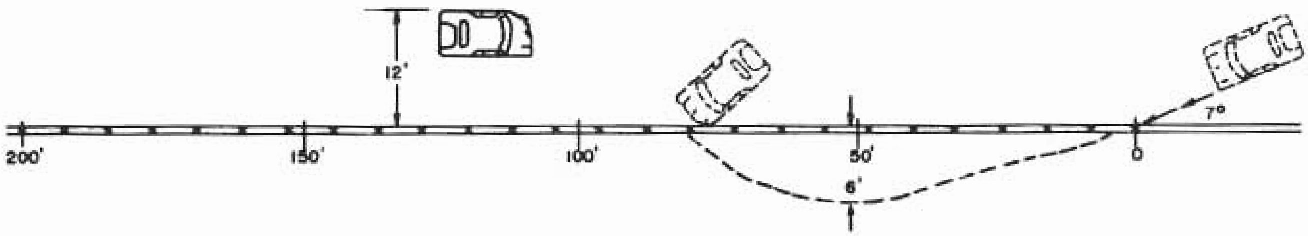
Analysis of the trajectory of the car from the moving pictures indicates that a barrier, to be effective, should be placed no lower than 27 inches above the horizontal projection from the top edge of an approaching 8 percent grade. This is about the maximum superelevation that will be encountered in roads which justify the use of median barriers. The best solution for this condition is to place the barrier on the shoulder at the top or before the top of the superelevation. If it is necessary to place the barrier on the ditch side of the cross-slope, then the barrier cable should be no lower than 27 inches above the crown nor higher than 33 inches above the ground surface.

One test was made utilizing expanded steel mesh in lieu of chain link fabric. No difference in barrier action was noted. However, first cost and maintenance costs of the expanded fabric will be markedly higher than for the chain link fabric. This is due



A cross-section diagram of the simulated median ditch shown in the above photo.





A typical test data sheet showing the result of Test No. 6 of a total of nine.

FENCE	42" 18 ga. steel expanded metal 1.33" x 3" diamond at 15" above pavt.
CABLE	¾" 6 x 19 IWRC 2 at 30" above pavement
POST FOOTING	Design C
POST SPACING	8' O.C.
LENGTH OF INSTALLATION	600'
GROUND CONDITION	Dry

FENCE DAMAGE	136' expanded metal damaged
CABLE FITTING DAMAGE	none
CABLE DAMAGE	none
POST DAMAGE	16 damaged, 1 pulled out
POST FOOTING DAMAGE	15 cracked, 1 failed
MAXIMUM DYNAMIC DEFLECTION OF CABLES	6'
VEHICLE DECELERATION (PEAK LONG)	3 g's
VEHICLE DAMAGE	$350

TEST NO.	6
DATE	7-10-61
VEHICLE	Dodge 59 Sedan
SPEED	75 MPH
IMPACT ANGLE	7 degrees
VEHICLE WEIGHT (W/DUMMY AND INSTRUMENTATION)	4,300 lbs.

primarily to the higher first cost of the expanded metal but will also be affected by the fact that this material is furnished at present only in short panels.

In two tests 7 x 7 highway guard cable was substituted for the 6 x 19 IWRC cable usually used. This 7 x 7 cable was more difficult to handle during repairs and placement. In addition its cross-section did not lend itself to proper adjustment during the tightening of the cable to post clamps. In general these tests seemed to indicate that the cross-section and relative stiffness of the 7 x 7 cable to the 6 x 19 cable make the latter cable more desirable for use as a flexible barrier member.

PROCEDURE AND INSTRUMENTATION

With the exception of the type of the cars and speed and angle of approach, this series of tests was conducted in the same manner as the full scale tests reported in 1959.

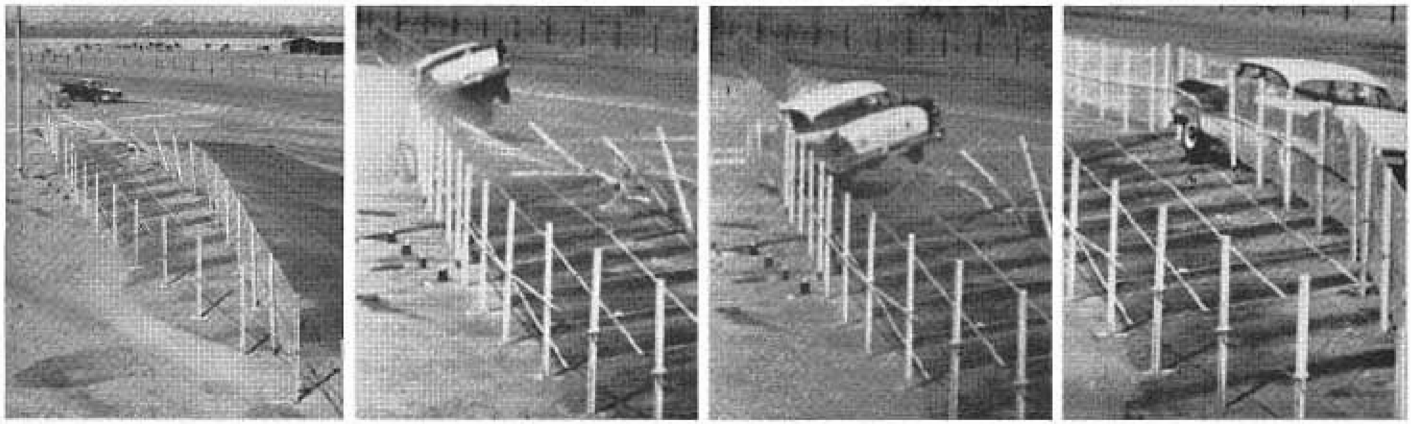
So as to more nearly simulate the type of accident that seemed to cause problems with the cable barrier, heavier cars (over 4,000 pounds) driven at higher speeds (over 80 m.p.h.) and colliding at flatter angles (10° or less) were used.

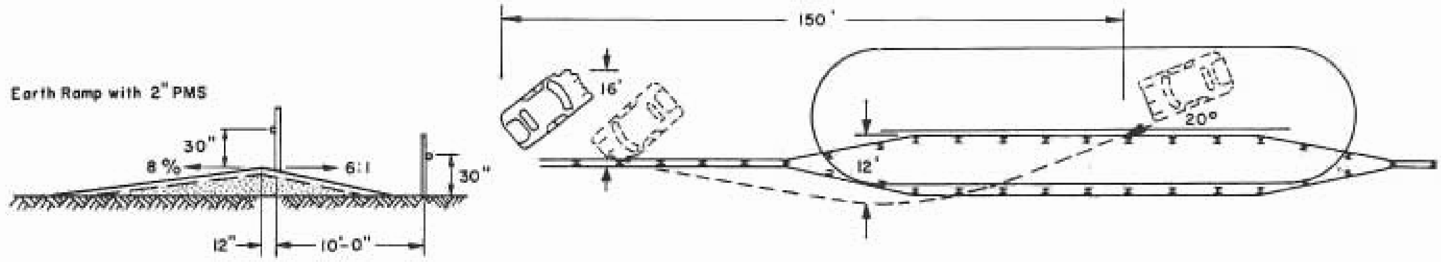
Since this series of tests were designed to test refinements of design rather than the overall effectiveness of the barriers, the instrumentation was not as complex as that previously used. Decelerations were determined from an analysis of the high speed data films rather than from decelerometers mounted in the vehicle and the dummy.

The anthropometric dummy was unrestrained, and his movements through collision were observed by a high speed data camera mounted inside the vehicle.

The photographic instrumentation was approximately as used previously, except that the following cameras were used rather than those listed in the previous test. The below listed 16 mm data cameras gave 100 percent reliability rather than the 25 to 50 percent reliability obtained in the past:

Camera Number	Type	Frame Rate	Lens	Location
1	Fastax	1200	12.5mm	100 feet behind barrier
2	Photosonics	400	12.5mm	Tower covering pre-impact
3	Photosonics	400	12.5mm	Tower covering impact
4	Photosonics	400	12.5mm	Tower covering post impact
5	Photosonics	400	4 in.	Rear ground mount
6	Photosonics	400	4 in.	Front ground mount
7	Photosonics	400	12.5mm	In crash vehicle
8	Photosonics	400	1 in.	Rear platform





Test data sheet of Test No. 9 showing action through an envelope design.

FENCE	48" chain link at 9" above pavt.	FENCE DAMAGE	136' damaged	TEST NO.	9
CABLE	¾" 6 x 19 IWRC 2 at 30" above pavement	CABLE FITTING DAMAGE	none	DATE	9-29-61
POST FOOTING	Design B	CABLE DAMAGE	none	VEHICLE	Dodge 59 Sedan
POST SPACING	8' O.C.	POST DAMAGE	22 damaged—11 slightly bent	SPEED	82 MPH
LENGTH OF INSTALLATION	400'	POST FOOTING DAMAGE	7 anchors cracked	IMPACT ANGLE	20 degrees
GROUND CONDITION	Dry	MAXIMUM DYNAMIC DEFLECTION OF CABLES	12'	VEHICLE WEIGHT (W/DUMMY AND INSTRUMENTATION)	4,300 lbs.
		VEHICLE DAMAGE	$750		

In addition to the 16mm cameras, one Bolex and one Bell & Howell 24 frames/sec. cameras were placed at various locations for documentary coverage. All sequence pictures shown in the exhibits were recorded with a 70mm Hulcher Mod. 20 camera at a 20 frames/sec. rate.

AASHO ROAD TESTS TO BE DISCUSSED

A three-day conference to discuss the findings of the $27 million AASHO Road Test will be held May 16-18 at the Sheraton-Jefferson Hotel, St. Louis, Missouri.

The road test was a five-year project aimed at determining the effect of various vehicle loads on highway pavements of various design of special interest to highway designers, materials producers, truckers, and motorists. Results are expected to have great influence on future pavement design and to provide some of the information needed by those charged with equitable taxation of highway users. The conference will be sponsored by the Highway Research Board, a unit of the National Academy of Sciences—National Research Council. Papers to be presented at the conference will cover the results of pavement and bridge research findings.

"These meetings will be open to anyone who is interested in highway research," R. R. Bartelsmeyer, Chief Engineer, Illinois Division of Highways, and Chairman of HRB, announced. "We will make provisions in the program, also, to permit free discussion of the papers."

The Highway Research Board administered and directed the huge project which was sponsored by the American Association of State Highway Officials (AASHO). The project was financed by 49 states, District of Columbia, Puerto Rico, U. S. Bureau of Public Roads, Automobile Manufacturers Association, American Petroleum Institute, and American Institute of Steel Construction, with the co-operation of the Department of Defense.

A series of reports on the AASHO Road Test are scheduled for publication prior to the St. Louis conference and will be available at nominal cost from the board, 2101 Constitution Avenue, Washington 25, D.C.

ORANGE COUNTY COLLEGE

The Division of Architecture has advertised for contracts on boiler and refrigeration equipment for the Science and Classroom Building at Orange County State College which is estimated to cost approximately $570,000. The Science and Classroom Building itself is presently under construction and constitutes a $9,400,000 project. Ultimate occupancy of the building is scheduled for September 1963.

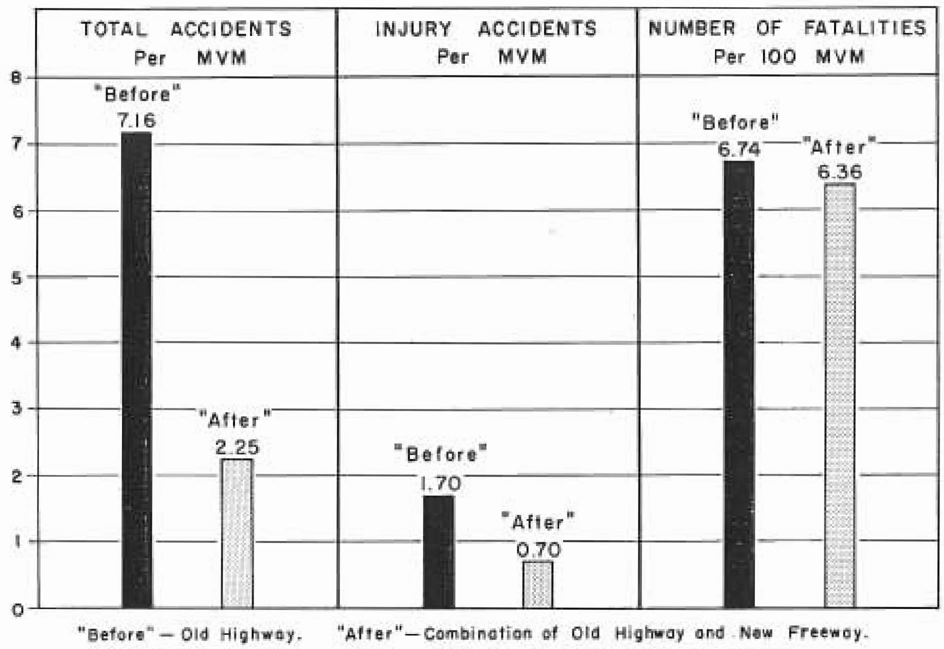
Fewer Accidents

Richmond-Carquinez US 40 Study Shows Three-Year Drop

By GLEN E. DILLON, District Traffic Engineer

A recent study by the Traffic Department of the Division of Highways San Francisco Office revealed that the number of accidents on US 40 between Richmond and Carquinez was reduced from 921 per year to 103 per year when the old highway was superseded by a freeway.

Comparing a three-year period (1954-56) before construction began with a three-year period after construction was completed, traffic on US 40 increased from 27,000 to 36,000 vehicles per day. Accidents decreased from 2,763 in three years on the old road, to 309 in three years on the new freeway. In other words, traffic increased by one-third and accidents were reduced nine-tenths. Had the old accident rate remained constant with the increased amount of traffic, 3,400 more accidents *would* have occurred than *did* occur during the first three years of the freeway's operation.

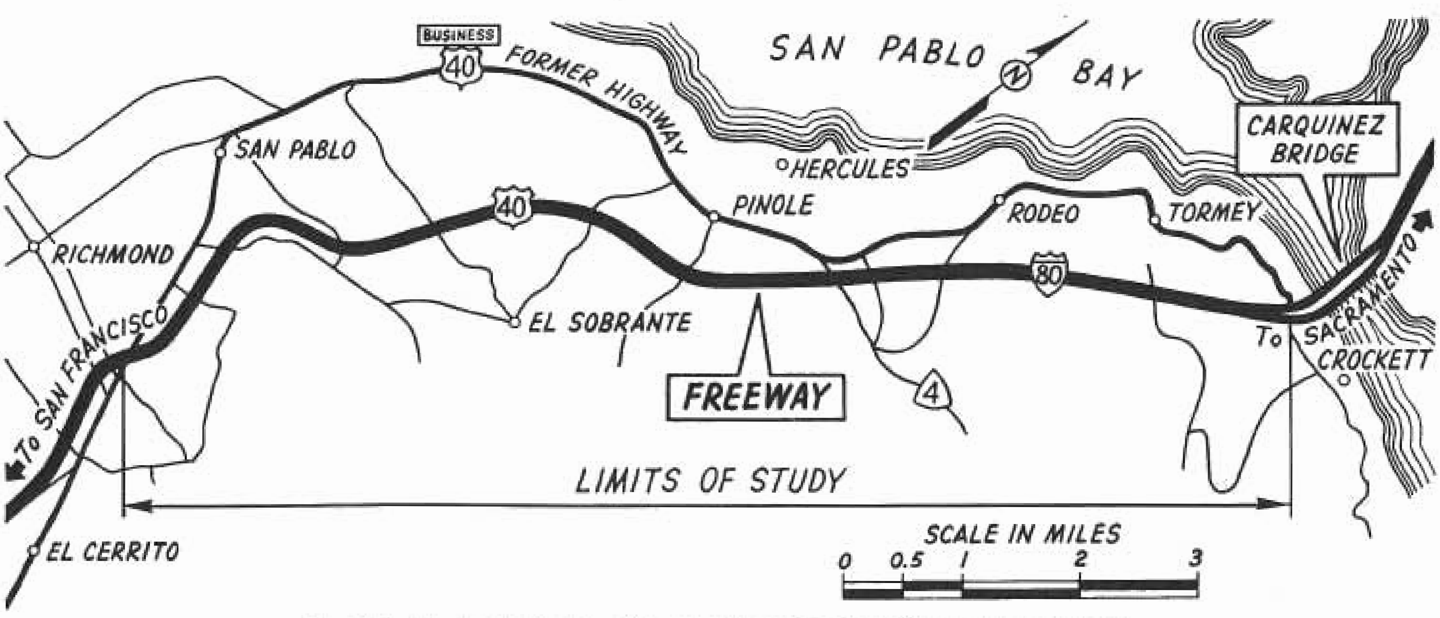


ACCIDENT RATES

Accident rates before and after the opening of the freeway are compared in the above bar chart. MVM means million vehicle miles.

Freeway Opened in 1958

The 6-lane 10½-mile freeway (now designated Interstate Route 80 as well as US 40) from San Pablo Avenue in Richmond to the Carquinez Bridge was completed under progressive contracts and opened for its full length to traffic on November 25, 1958. The



The traffic study described in this article covered the section of US 40 shown in the above map.

TABLE 1

COMPARISON OF ACCIDENTS ON U.S. 40 BETWEEN SAN PABLO AVENUE IN RICHMOND AND CARQUINEZ BRIDGE

Three Years Before and Three Years After Construction of Freeway

	Before	After		
	Old highway	Old highway	Freeway	Old highway and freeway
Distance, miles	13.00		10.53	
Travel time, minutes (approximate)	27		11	
Average daily traffic	27,000	8,700	35,900	44,600
Million vehicle-miles	385	125	410	535
Number of accidents:				
Total	2,763	897	309	1,206
Injury	654	240	137	377
Number killed	26	11	23	34
Accident rates:				
Total, per million vehicle-miles	7.16	7.20	0.75	2.25
Injury, per million vehicle-miles	1.70	1.93	0.33	0.70
Fatalities per 100 million vehicle-miles	6.74	8.83	5.60	6.36

TABLE 2

REDUCTION IN ACCIDENTS, BOTH ROADS COMBINED

(After) vs. Old Road (Before)

	Reduction in Number of Accidents	Reduction in Accident Rate
May-June 1958 p. 31 Sacramento-Roseville Freeway	48%	66%
May-June 1959 p. 2 Fresno Freeway	54%	66%
January-February 1960 p. 60 Madera Freeway	69%	72%
July-August 1961 p. 25 Vallejo Freeway	73%	78%
(This study—Richmond to Carquinez)	(56%)	(69%)

new facility provided badly needed relief for the overloaded four-lane conventional highway through the cities of Richmond, San Pablo, Pinole, Hercules, and Rodeo and the community of Tormey. The accompanying map shows the general layout of the freeway.

The accidents were tabulated for the three years 1954, 1955, 1956 of the "before" condition, prior to opening the first section of freeway as far as County Road 20. These were compared with the "after" condition on the new freeway for the three years after its opening in November 1958.

A comparison was also made between the record of the old road when it was carrying all the traffic and that of the combination of the old road and new road after the through traffic was diverted to the freeway.

In the three-year "before" period the old road served an average of 27,000 vehicles per day and experienced 2,763 accidents. In the three-year "after" period, the old road served 8,700 vehicles per day and experienced 897 accidents. As shown in Table 1, the actual rate per million vehicle-miles stayed about the same.

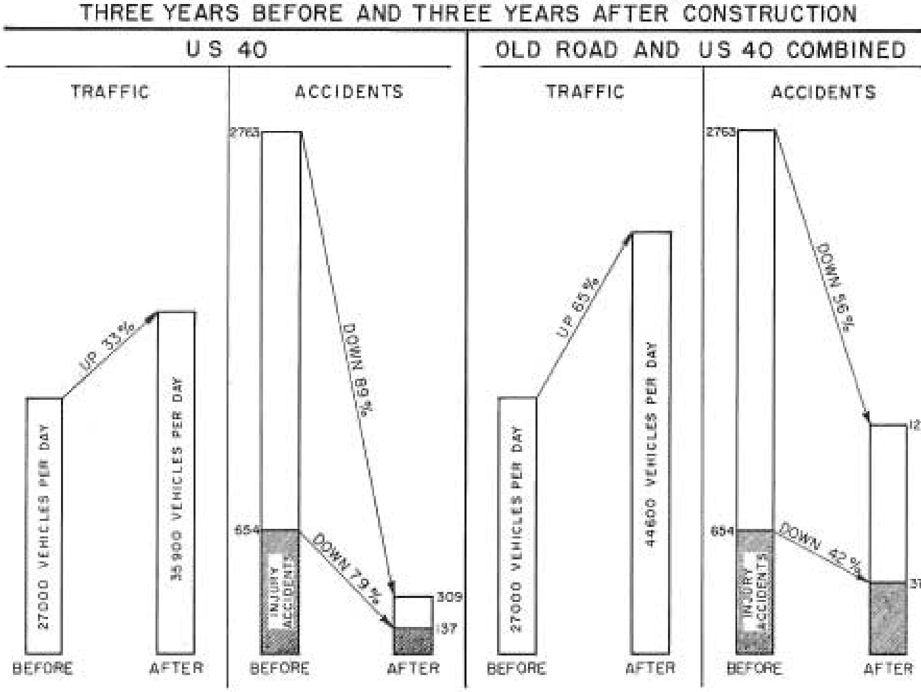
Total Travel Increases

When the experience on the old road is combined with that on the freeway, it is found that total travel on both roads increased from 385 million vehicle-miles to 535 million vehicle-miles, or 39 percent,* while accidents decreased from 2,763 to 1,206 or 56 percent.

In relation to the amount of travel on both roads, the reduction was from 7.16 to 2.25 per million vehicle-miles, or 69 percent. While this is a heartening reduction, it is seen that the amount of travel remaining on the old road is still generating plenty of accidents, and the reduction would have been greater if travel on the old road could be reduced still more. This is one of the reasons why the Division of Highways endeavors to locate freeways so that they will attract the most possible traffic from conventional roads. In order to do this it is usually necessary to locate them near traffic-generating land uses instead of as far as possible from traffic generators and existing highways.

* Although *traffic* increased 65 percent, the new route is so much shorter than the old route that *travel* increased only 39 percent.

RICHMOND – CARQUINEZ FREEWAY
THREE YEARS BEFORE AND THREE YEARS AFTER CONSTRUCTION



Motorists now enjoy the use of US 40 (Interstate 80) through the City of Richmond. The old route (San Pablo Avenue) on the left has been relinquished to the city.

Looking north from San Pablo Undercrossing in Richmond, showing the modern interstate facility which replaced the old route with its many signalized intersections (left).

Similar Studies

Similar studies which have appeared in *California Highways and Public Works* with the corresponding reduction in number of accidents and in rate of accidents are shown in Table 2.

This shows how consistently and dramatically the accident picture is improved when freeways are constructed to relieve heavily traveled conventional at-grade highways.

In view of the striking overall improvement, it is discouraging to note that the fatality rate on the new freeway is still 5.6 per hundred million vehicle-miles, which is about double the average for freeways and only 17 percent less than the old US 40. The 13 fatal accidents in three years, causing 23 fatalities, have been examined in some detail. As usual, a high proportion, 6 out of 13, involved drinking drivers. Two of the 13 were pedestrians who were on the freeway illegally, and five were single-car accidents that simply drove off of the highway which (including shoulders) is 46 feet wide on each side of the median strip. Four of the 13 fatal accidents occurred between 1 a.m. and 5 a.m., although less than one-tenth of the travel occurred during those hours. This fact is also characteristic of fatal accidents on freeways.

Fortunately, the rate during the past two years (3 fatal accidents in each of 1960 and 1961) is much improved over what it was during the first 12 months, when seven fatal accidents occurred, including two head-on, cross-median collisions. Funds for construction of a median barrier on the southern end where traffic is very heavy are included in the current State Highway budget.

LOOP SECTION OPENED

A major section of the Los Angeles freeway system was opened to travel Friday, March 30, following appropriate ceremonies marking the completion of the Golden State-Santa Monica Freeway Loop as far west as the Harbor Freeway. The new $9,360,000 link extends along the Santa Monica Freeway from Main to Oak Streets, including the interchange with the Harbor Freeway.

Sign Changes

Revised Interstate Manual Will Be Published Soon

By GEORGE M. WEBB, Traffic Engineer

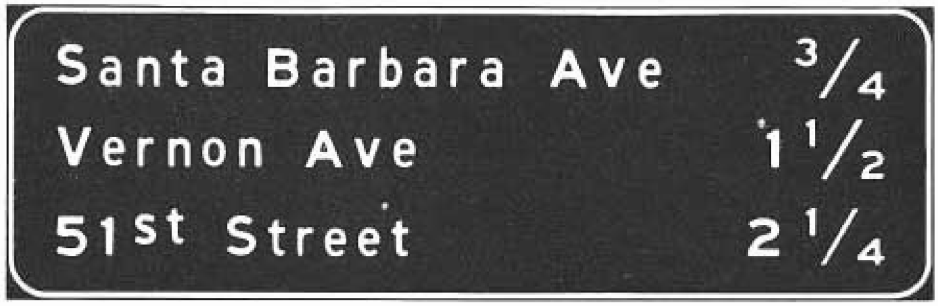
Freeway signing in California is in basic conformance with the requirements for signing the interstate system in order to provide a uniform type of signing on all California freeways.

The original Manual for Signing of the National System of Interstate and Defense Highways was issued in 1958. The signing in this manual generally conforms to that used on the eastern toll roads.

Need for Changes

In the application of the 1958 manual, the need for changes and interpretations became apparent, primarily to make signing applicable to metropolitan areas with closer-spaced interchanges.

The AASHO Committee on Traffic established a subcommittee to review suggested sign manual changes and the AASHO established a special committee on signing and marking interstate system to interpret provisions of the interstate manual.

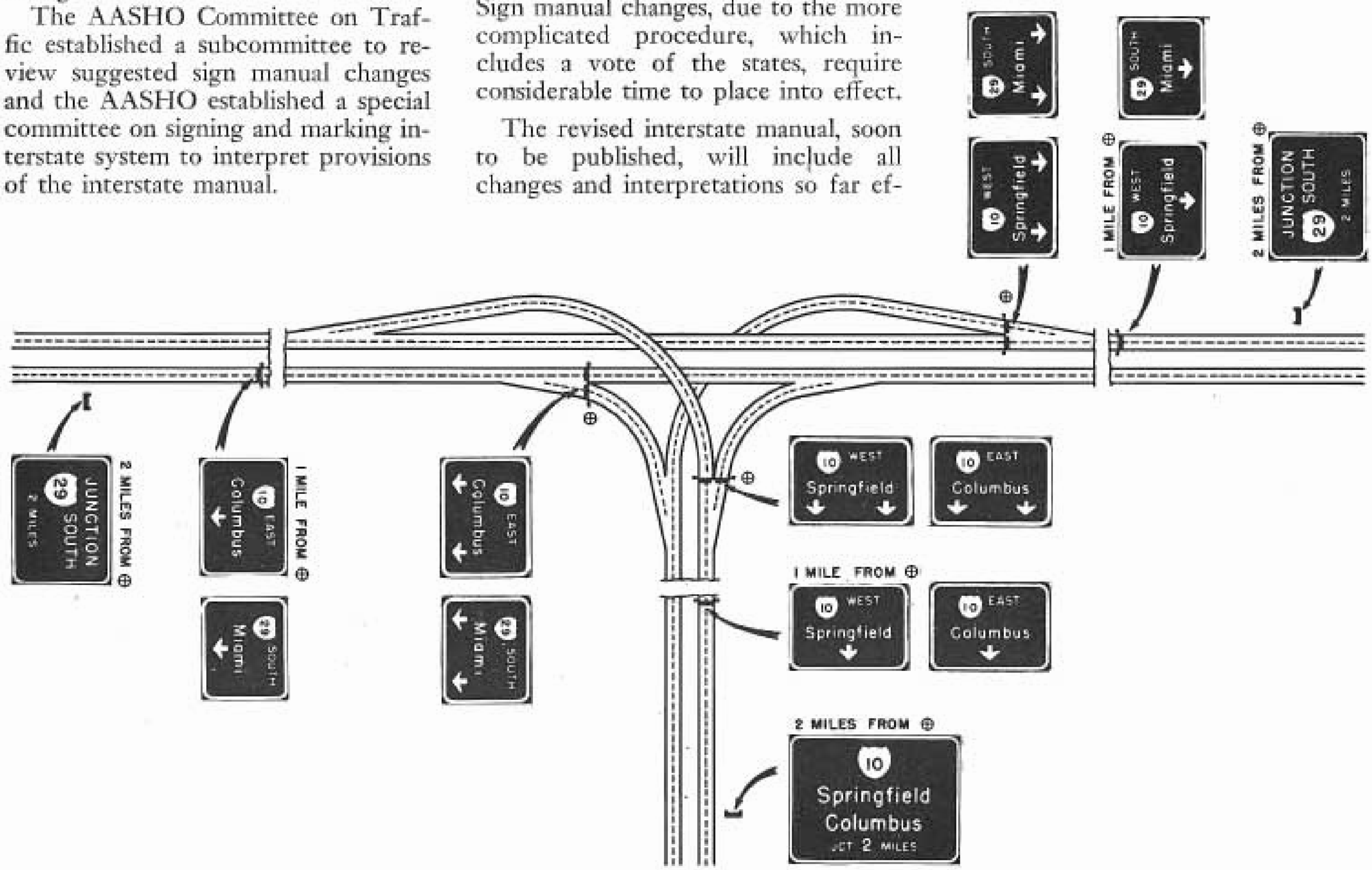


The sign used in metropolitan areas to indicate the next three exits and the distances thereto has also been adopted for similar use on the Interstate system.

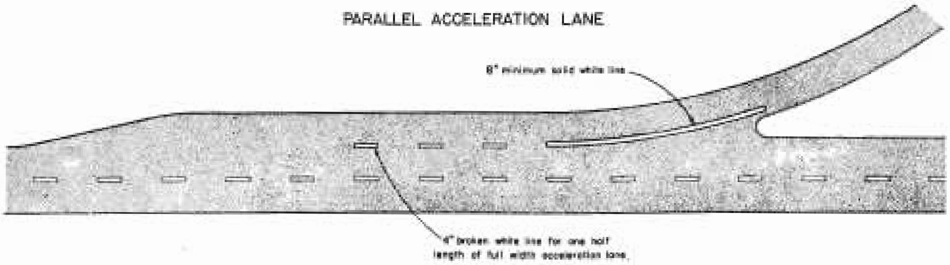
States Are Informed

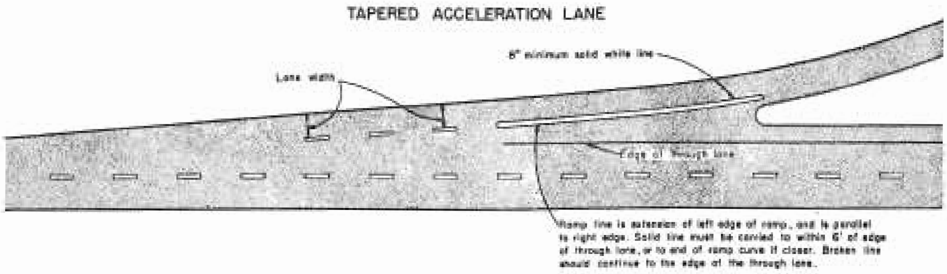
Such interpretations, if concurred in by the Federal Highway Administrator, are promptly issued to various states by the Bureau of Public Roads. Sign manual changes, due to the more complicated procedure, which includes a vote of the states, require considerable time to place into effect.

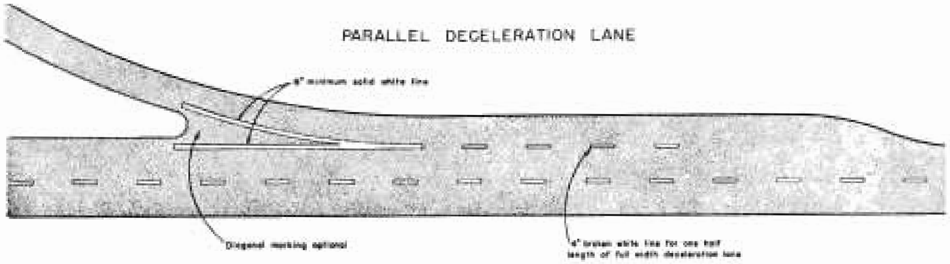
The revised interstate manual, soon to be published, will include all changes and interpretations so far effected. Illustrations used in this presentation are reproductions of plates which will appear in the forthcoming manual.

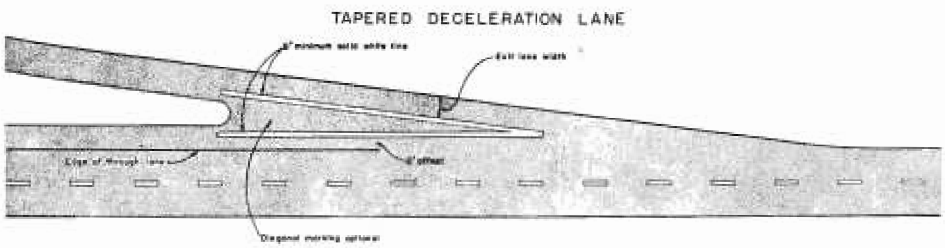


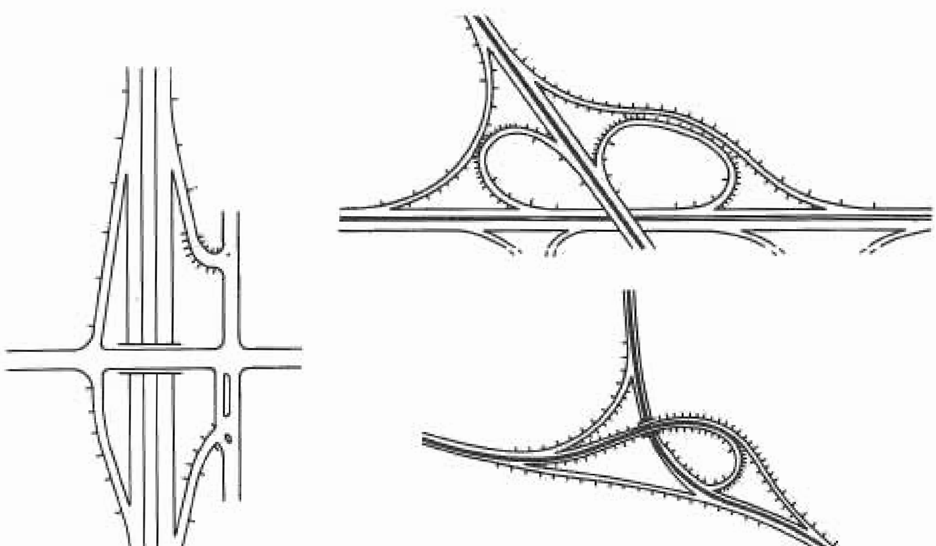
The use of "JCT ONE MILE" instead of "EXIT 1 MILE" on advanced signs when approaching a major freeway junction has now national approval. Signs in the above diagram also illustrate the new requirement that all shields used on guide signs should be displayed in their standard colors, which means that U.S. and state shields will be white with black numerals.



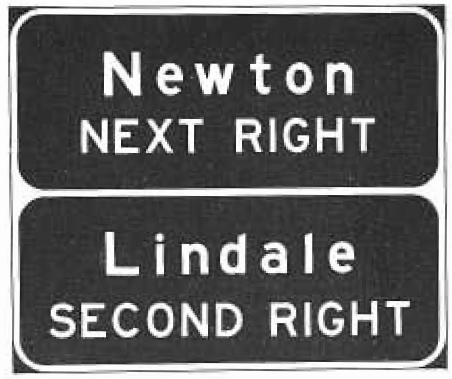




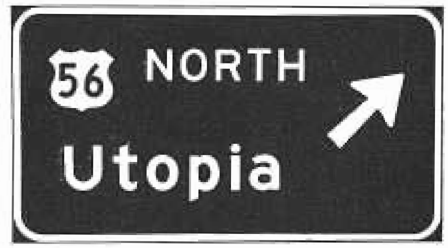




Other interstate adoptions which comply to California standards include the standard striping at entrance and exit ramps and the use of delineators on the outside ramp curves.

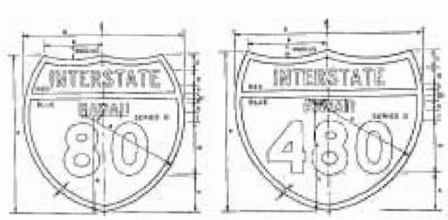


"NEXT EXIT" as used on a sign to show additional destinations at an interchange was revised to read "NEXT RIGHT" or "NEXT LEFT." The additional wordings "SECOND RIGHT" or "SECOND LEFT" are provided to indicate other destinations or services at the second ramp of a cloverleaf interchange.



All shields on guide signs will appear in their standard colors. This means that U.S. and state shields will be white with black numerals.

The "RIGHT LANE" sign has been adopted for use on the interstate system, but alphabet size has been increased for major or intermediate interchanges.



Another new look will be the widened interstate shield to accommodate three digits. California, with U.S. Bureau of Public Roads approval, has used a widened shield on overhead signs but the new change will provide a wider shield for independent post mounting.

Traffic Safety

Governor's Conference Draws 1,200 Delegates

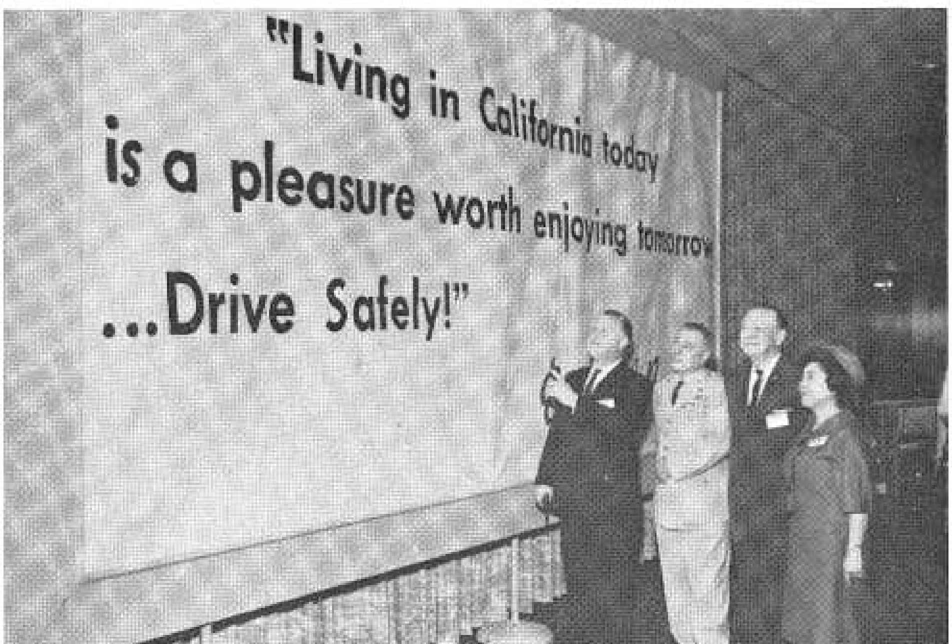
When more than 1,200 delegates, representing a cross section of California's population, assembled for Governor Edmund G. Brown's Traffic Safety Conference in Los Angeles on February 1 and 2 they were treated to a new concept in conference deliberations.

For the first time delegates, whether traffic safety experts or interested individual citizens, were given the opportunity to present their ideas, to advance new theories, or to criticize existing techniques—all in the interest of reducing accidents on the streets and highways of the State.

In keynoting the conference, the Governor stressed that while progress is being achieved toward greater highway safety there is no room for complacency when people are being killed and maimed in traffic accidents.

He cited recent accomplishments in California, including more stringent legislation against the drinking driver; the requirement that all new vehicles sold in the State after January 1, 1962, must be equipped with seat belt mountings; and the broadened research program now underway.

Governor Brown delivers keynote address to the 1,200 delegates gathered from all over the State for the safety conference. Seated is Benjamin H. Swig, Conference General Chairman and member of the President's Committee for Traffic Safety.



A billboard safety message is inspected by Robert B. Bradford, State Transportation Agency Administrator; Major General Perry B. Griffith, Deputy Inspector General for Safety, U.S. Air Force; State Senator Benjamin J. Arnold, Sr., of Arizona, and Mrs. Ruth Kodani, Los Angeles. Arnold and Mrs. Kodani are members of the President's Committee for Traffic Safety.

Fine Co-operation Praised

Praising the fine co-operation of the departments in the new Highway Transportation Agency in efforts to advance traffic safety through unified action, the Governor expressed optimism for the eventual success of present research.

The Governor also announced a $175,000 grant from the Federal Department of Health, Education and Welfare, for research to show how well a driver really sees from a moving vehicle. It is hoped that the new program, being conducted co-operatively by the University of California's Institute of Transportation and Traffic Engineering and the Department of Motor Vehicles, will establish relationships between certain vision test scores and driving records of applicants for driver licenses.

Urges Graphic Means

Governor Brown also called on the Highway Transportation Agency to develop graphic means of retraining motorists in safe freeway driving methods. He urged instruction on proper ways of entering and leaving freeways, proper signalling and lane changing, use of rear view mirrors, and the need for motorists to be alert to developing traffic situations far in advance of their own vehicles.

Other actions urged by the Governor included expansion of behind-the-wheel training in high schools, and the establishment of more schools for traffic law violators.

The conference also featured a call for action by Benjamin H. Swig, conference general chairman and member of the President's Committee for Traffic Safety. Swig urged delegates to work toward a meeting of all Governors to support enactment of uniform vehicle laws. He acknowledged the importance of state and local control in traffic safety endeavors, but warned that without more vigorous action there remains the distinct possibility of the federal government being forced to enter the accident prevention program.

Hearst Is Chairman

These same points were reiterated by William R. Hearst, Jr., in his remarks at the luncheon concluding the conference. Hearst, editor-in-chief of the Hearst newspapers, is chairman of the President's committee. Hearst called for an aggressive action program.

One of the features of the 1962 Governor's Conference was the inclusion, for the first time, of a Women's Activities Division, chaired by Beth Bennett, Deputy Director, California Department of Motor Vehicles. Tom M. Bright, Director of Motor Vehicles, served as conference co-ordinator, and Robert B. Bradford, Administrator of the Highway Transportation Agency and Director of Public Works, summarized the need for support of the 1962 Action Program during the conference windup luncheon.

The California Traffic Safety Foundation and the California Federation of Safety Councils served as co-sponsors of the conference, co-operating with the official agencies of state government.

After approval by the various division chairmen, a priority list of items for the Action Program will be distributed by the foundation.

F.A.S. CHIEF LaFORGE RETIRES; BEER NAMED

Harold B. LaForge, engineer in charge of Federal Secondary roads and state-county partnership in road matters for the past 17 years, retired from state service on May 1. He has had 42 years of service with the State Division of Highways beginning shortly after his return from World War I overseas duty in 1919.

Charles G. Beer, assistant district engineer for the Division of Highways at San Bernardino, will succeed LaForge.

The Federal Aid Secondary program which LaForge has administered for the Division of Highways since 1945 has involved an estimated $220,000,000 to date in construction contracts on about 3,500 miles of county roads and 500 new bridges in all parts of the State.


HAROLD B. LaFORGE

LaForge, who is widely known among county officials throughout California through his long identification with the F.A.S. program, was born in Wadsworth, Nevada, but moved to Sacramento as a child and was educated in Sacramento.

In World War I he served overseas with the 311th Engineers. On his return, he went to work for the Division of Highways on survey crews, first in the Central Valleys and later in the Central Coast area.

In 1926 he moved to the Fresno district, where he spent the next 11 years as resident engineer. He is credited with major innovations in methods of placing asphaltic concrete pavement.

From 1937 to 1942 LaForge served as district maintenance engineer in the Redding district, and then moved to Division Headquarters in Sacramento as assistant office engineer in charge of War Production Board contracts.

He was placed in charge of the Federal Aid Secondary road program in June 1945. His work in this position was summed up in 1960 by R. P. O'Neill of Butte County, then president of the County Engineers Association of California.

"Red LaForge has undoubtedly done more to raise the standards of our county road administration, engineering and personnel than any other single individual."

LaForge is a member of the American Society of Civil Engineers. He and his wife, Marjory, plan to move to Auburn. They have two daughters, Mrs. Ann Parker of Pleasant Hill, and Mrs. Jane Ohmer of Oroville, and seven grandchildren.

His successor as engineer of Federal Secondary roads, Beer, has been on the Division of Highways staff for 26 years and has been assistant district engineer in charge of administration for District VIII, with headquarters in San Bernardino, since 1955.

Beer was born and educated in Los Angeles and received his bachelor's degree in civil engineering at the University of California at Berkeley in 1940. He received a master's degree in meteorology in 1945 at the University of California at Los Angeles, during World War II served as an Air Force meteorologist.


CHARLES G. BEER

He entered state service full time in 1936 in the Fresno district. He left in 1942 for four years of military service, and on his return specialized for the next four years in bridge engineering, mainly in Southern California.

From 1950 to 1955 Beer was assistant traffic engineer for the Los Angeles district, and then was promoted to assistant district engineer in San Bernardino.

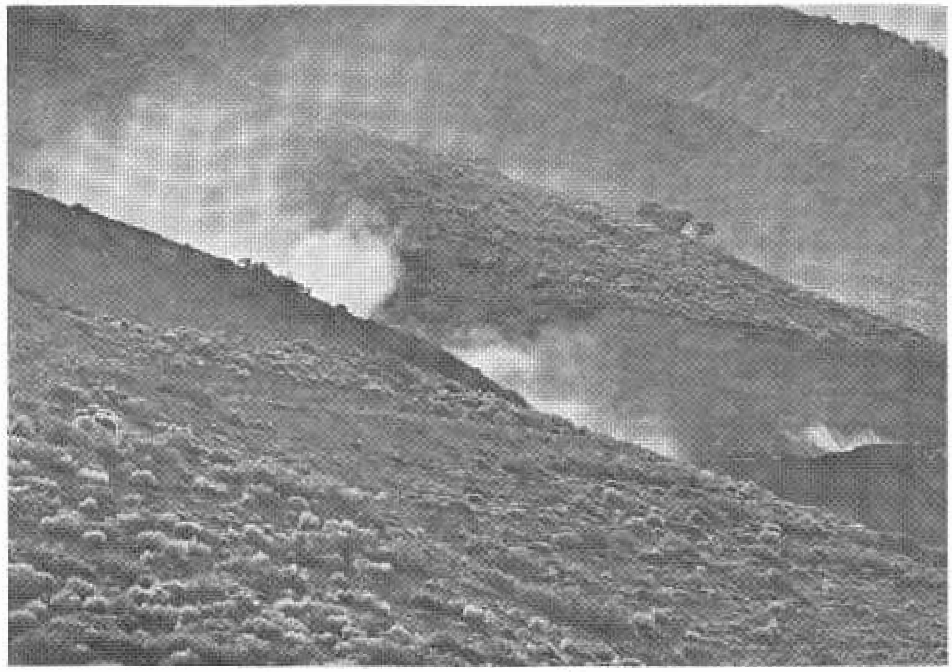
He is a member of the American Society of Civil Engineers and the American Meteorological Society. He and his wife, Lucille, have three children.

Onion Valley

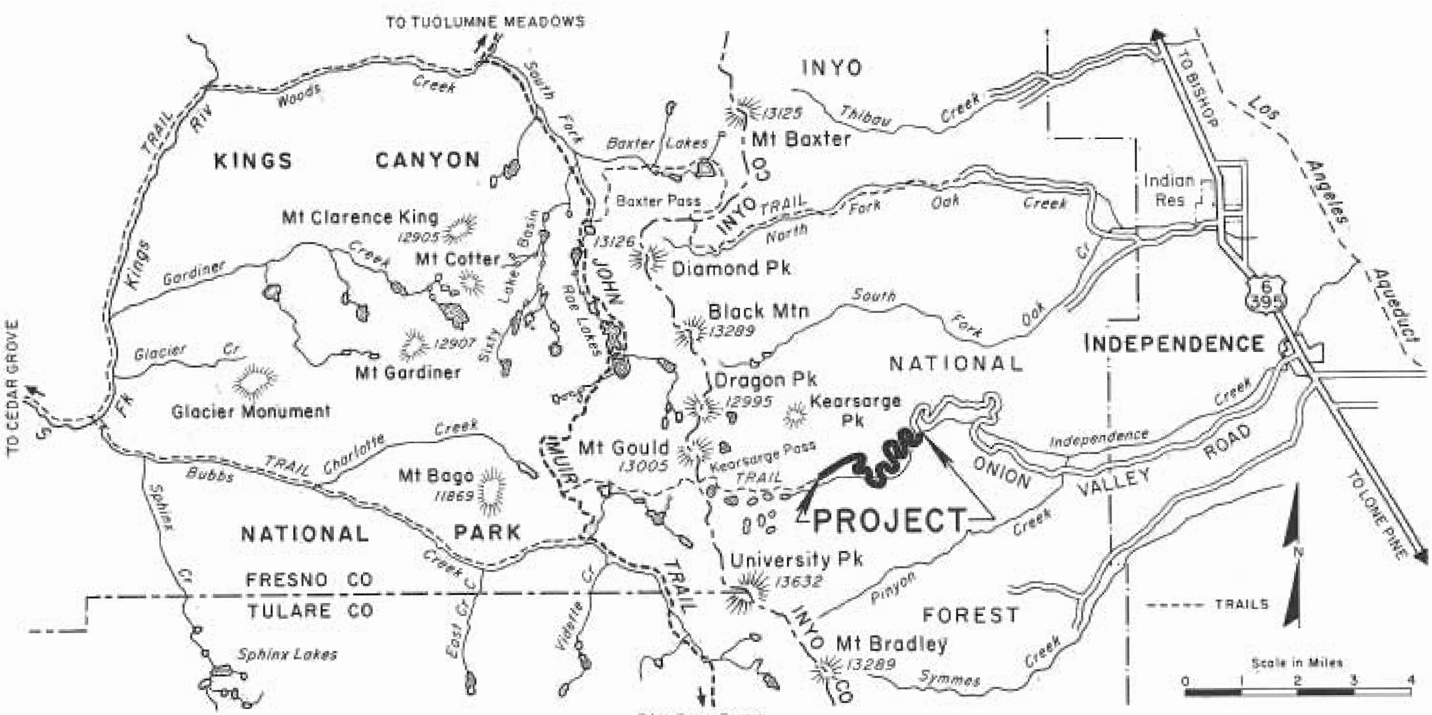
Inyo County's New F.A.S. Road Opens High Sierra to Motorists

By R. D. BOTTORFF, Resident Engineer, Inyo County Road Department

There are few mountains that are more rugged than those of the eastern slopes of the High Sierra in Inyo County, California. Lying west of historic Independence, the county seat, is Onion Valley at an elevation of 9,200 feet above sea level and at the edge of a primitive area. From Onion Valley over Kearsarge Pass at elevation 11,800, pack trains and hikers have access to the Kings Canyon and Sequoia National Parks and unlimited back country. Kearsarge Pass is one of the most heavily traveled in the Sierras. The immediate vicinity of Onion Valley offers many areas of recreation: hunting, fishing, camping, mountain climbing and potential winter skiing.



Construction equipment is silhouetted against the dust raised by grading operations on the Onion Valley F.A.S. Route 1183 project in Inyo County.



The Onion Valley Road, as indicated in the above map, will give access to a High Sierra primitive area traversed by the famous John Muir Trail. Inyo County has spent or pledged Federal Aid Secondary Funds during five fiscal years since 1955 toward the improvement of this route.

In order to reach the pack station at Onion Valley, recreation seekers have had to drive from U.S. Routes 395 and 6 in Independence over a narrow, winding, rough, dusty road having 17 switchbacks within the upper 5 of its 15 miles and grades with a rise of 18 feet per hundred feet of travel.

Plans for Upper Portion

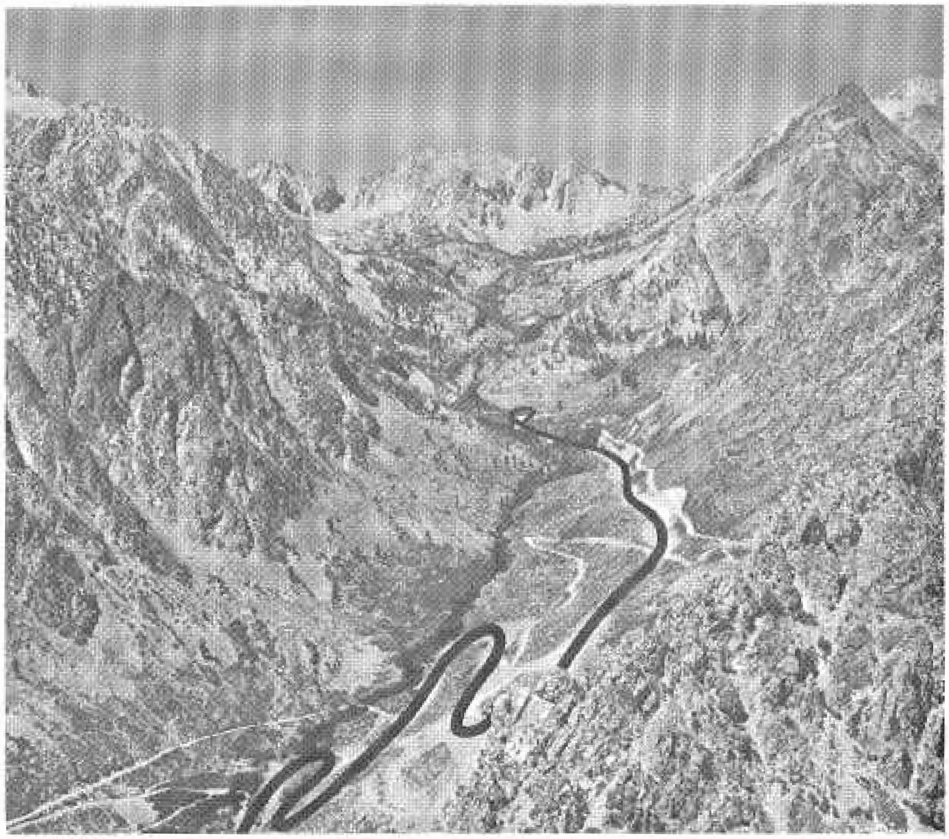
Having improved the lower 8.5 miles of the Onion Valley Road to modern standards by 1956, Inyo County officials began immediately to plan for improvement of the upper portion so as to provide better access to recreation areas needed by California's rapidly growing population. The board of supervisors requested the extension of federal-aid secondary route 1183 to Onion Valley in order that federal-aid and matching state highway funds available to the county could be used to finance construction projects thereon. With this extension, FAS Route 1183 became the longest of five county FAS routes that penetrate the Sierra.

The first construction on the extension was a grading and drainage contract awarded in June 1960 and now nearing completion. Recently advertised is a contract for placing base rock and road-mixed asphaltic surfacing on the same 5.4 miles. Although contracts under California's federal-aid secondary highway program are awarded by the State Department of Public Works, the projects are designed by and construction is supervised by county personnel.

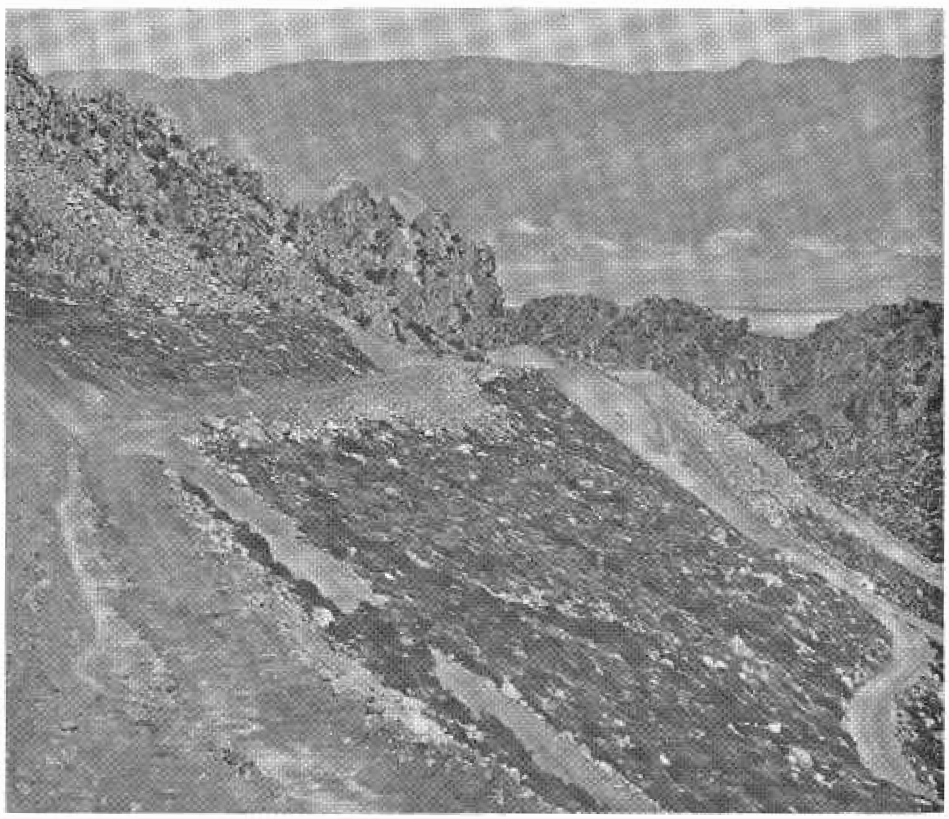
Saves 1½ Miles

The new alignment is located and limited to the southern exposure of Kearsarge Mountain with a ruling grade of 8 percent, and saves 1½ miles of travel, requiring only nine switchbacks. Through cuts are daylighted or flattened to a 10-on-1 slope on the exposed side to facilitate snow removal and melting. The roadway width when completed will be 28 feet minimum with 22 feet of surfacing.

Construction of the project has presented the contractor with many problems, traffic being one of major importance. The new alignment diagonally crosses the old road at many locations completely obliterating the



A view of F.A.S. Highway 1183 looking toward its western terminus in Onion Valley at the foot of the Kearsarge Pass Trail. Asphalt surfacing, not yet placed, has been delineated on the photo.



Looking eastward over rough grading operations on the Onion Valley Road project toward Owens Valley in the distance beyond Independence, County Seat of Inyo County.

existing traveled way. This required the programming of work so that temporary connections could be made between the two routes. Safety precautions were given prime consideration, particularly during pioneering, when boulders ranging from 6 inches to 12 feet in diameter could easily escape and go crashing down upon men and equipment below.

Some Drilling, Blasting

Only about 10 percent of the total 617,000 cubic yards of excavation required drilling and blasting. Much of the excavation was done with power shovels plus small (by present-day earthmoving standards) hauling units and scrapers. The use of larger equipment was restricted by the limited road width and many sliver cuts and fills typical of sidehill construction. Many embankments were constructed exclusively with bulldozers, there being as many as 19 on the job at one time.

Water was supplied to excavation and embankment areas by 30,000 feet of 2-, 3- and 4-inch diameter aluminum gravity flow pipeline system from Independence Creek. Dissipators were required in some locations to control allowable working pressures.

Engineering functions by county employees are under the general direction of Road Commissioner John K. Smith with on-the-job supervision of the writer. The grading work is being performed by R. A. Bianchi and R. A. Bianchi Construction Company.

WONDERS OF AMERICA

"The importance of California's freeway system—not to be confused with the toll ways of other states—is one of the wonders of America.

"In Southern Alameda County, the people no longer judge distance by miles, but by the clock. San Jose is no longer 'so far away' from San Leandro, but little more than half an hour leisurely driving away. San Francisco is in most cases, less than half an hour away. . . .

"The only problem of freeways that has not been solved is the man behind the wheel."—From an editorial in the *San Leandro Morning News.*

IN MEMORIAM

District III

Harry Disbro, Highway Equipment Operator-Laborer

District IV

Floyd W. Black, Highway Maintenance Man III

Jake G. Arfsten, Laborer

Donald L. Tice, Assistant Highway Engineer

Yvonne C. Holland, Intermediate Typist Clerk

District VI

Paul C. Tibbitts, Supervising Groundsman

Dwight Wonacott, Highway Superintendent

Maurice E. Trew, Highway Equipment Operator-Laborer

District VII

Lyman Weiderheft, Groundsman

District VIII

Harold O. Hodges, Groundsman

District X

James Keller, Engineering Aid I

Edward Lowe, Highway Engineering Technician I

District XI

James S. Gulley, Highway Equipment Operator-Laborer

State-owned Toll Bridges

Harry B. Davis, Stock Clerk

Materials and Research Department

James V. Leslie, Highway Engineering Technician I

Bridge Department

Martin C. Blair, Highway Engineering Technician I

John G. Gaillard, Assistant Bridge Engineer

TRAFFIC RELIEF IN L.A.

Opening to traffic of the Santa Monica-Golden State Freeway Loop offers major relief to the downtown Los Angeles area in providing an alternate bypass route skirting the Civic Center formerly served by the Hollywood Freeway alone.

Department Lists New 25-Year Awards

Headquarters Office

George Minisan

District I

Charles L. Pelascini

District II

Roy W. Poole
Charles W. Shults

District IV

Fred R. Melgar
Gladys V. Solvin

District VI

Clifford R. Donnelly
Paul M. Hine
Marie Frances Park

District VII

Peter M. Cowie

District VIII

C. J. Clanton

District IX

Dave E. McAllister

District X

Robert O. Stone

Bridge Department

William N. Hedgpeth

Materials and Research Department

Charles W. Clawson

Shop 4

Frank P. Erwin
Freeman L. Vacher

Shop 5

William R. Ramsay

Shop 6

Herbert L. Carroll

FREEWAY CONVERSION

The State Department of Public Works has awarded a $1,027,971 contract for constructing an interchange and frontage road to convert a section of US Highway 99 in Kern County from expressway to four-lane freeway standards between Laval Road south of Wheeler Ridge and State Sign Route 33-166 at Mettler.

Whiskey Creek

Two-lane Structure Built to Provide for Future Widening

By J. D. PETTINE, Associate Bridge Engineer

IN JANUARY 1960, the relocation of five miles of State Highway US 299 between 2.5 miles east of Tower House and 2.5 miles east of Whiskeytown was made necessary by the U.S. Bureau of Reclamation's planned construction of Whiskeytown Dam. The project is located in Shasta County 11 miles west of Redding and provides a two-lane expressway with a 40-foot roadbed width. Whiskeytown Dam, currently under construction on Clear Creek two miles downstream from Whiskeytown, will inundate the townsite as well as the existing highway with a reservoir storing 250,000 acre feet of water. The reservoir is a portion of the Central Valley Project and serves as an intermediate step in diverting water from the Trinity River at Lewiston to the Sacramento River at Keswick.

Tributary to Clear Creek

Whiskey Creek is a tributary to Clear Creek and was the major control point in selecting the route for the highway relocation around the reservoir. The Whiskey Creek arm of the lake forms an opening that is spanned by an embankment 1,800 feet long and an 875-foot structure. The depth of water under the structure will be more then 160 feet. Construction of the bridge across Whiskey Creek was one of the major items of work on the project.

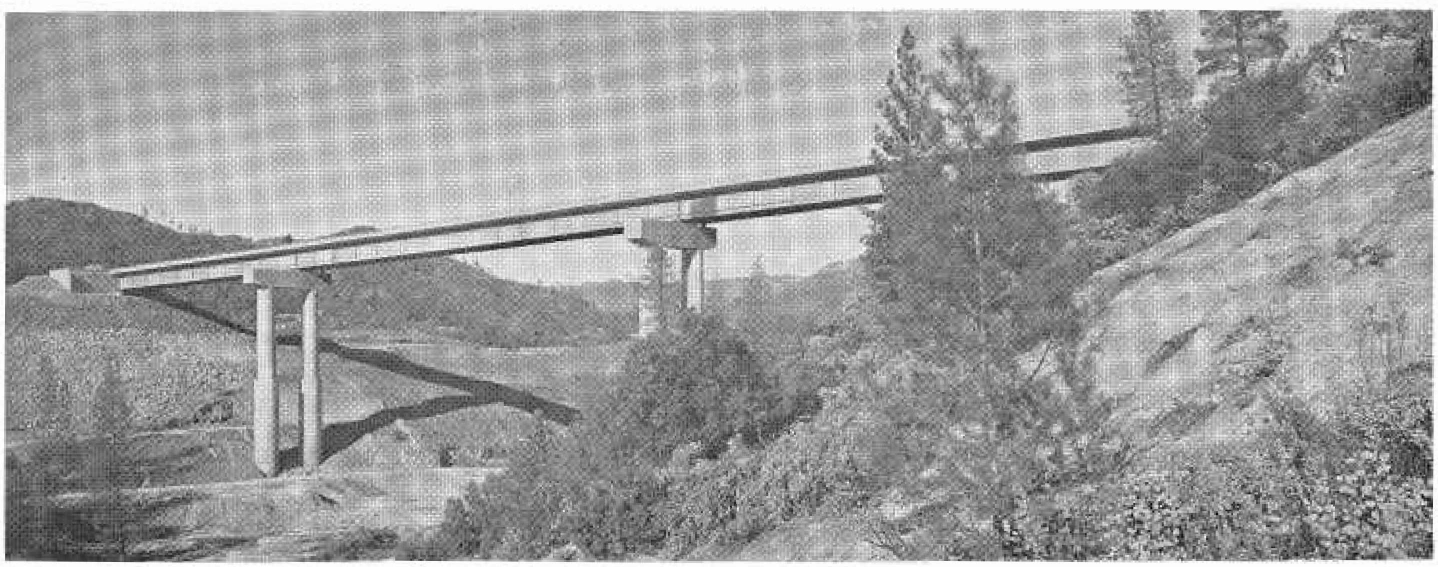
The bridge is a reinforced concrete deck on steel girders with a trussed cross bracing, consisting of three spans, having a total length of 874 feet, supported on round concrete column bents and concrete abutments with wingwalls on spread footings and steel piles. The completed deck width is 28 feet between wheel guards to accommodate two lanes of traffic and the substructure includes provisions for expansion to a four-lane facility in the future.

Structural Steel Girders

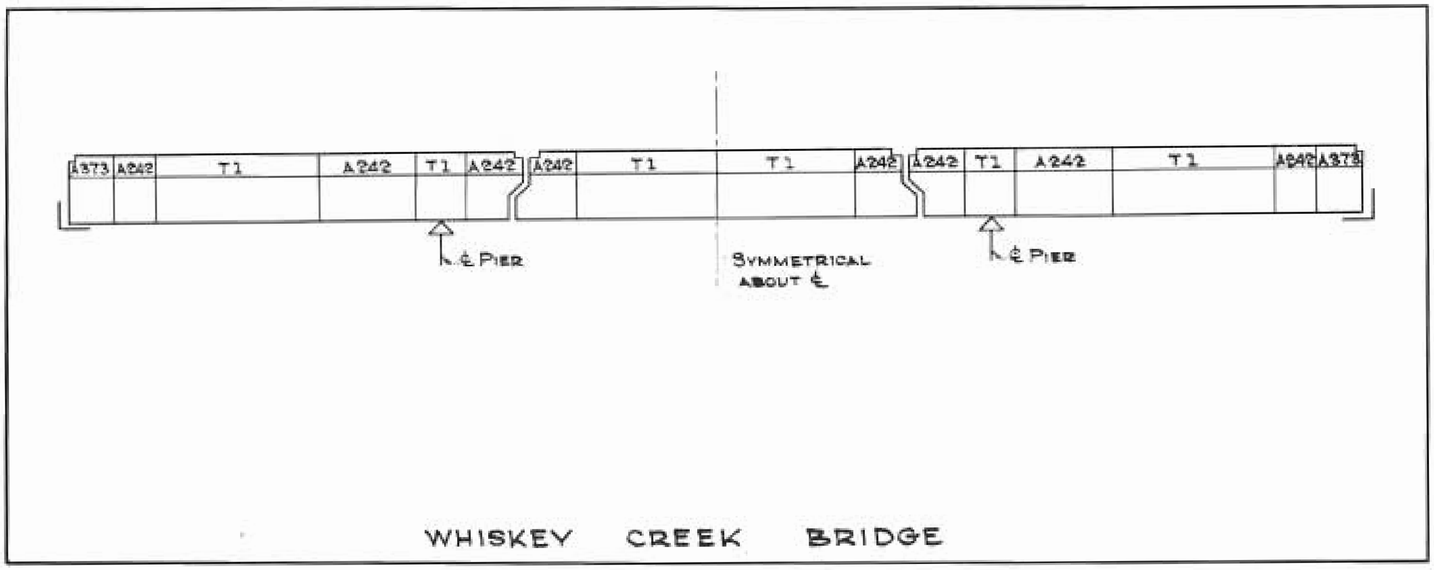
A combination of three types of steel were incorporated in the two main steel girders, portions of the plate girders subject to high bending moments were fabricated from "T-1" steel having a yield strength of 100,000 PSI, portion subject to moderate stress employed A242 steel, while that under lower bending moments used A373 structural carbon steel. Yield strengths of the latter steels are 50,000 PSI and 33,000 PSI respectively.

The accompanying drawing illustrates how these three types of steel were combined to most economically meet stress requirements while maintaining a uniform web depth and thickness and a uniform section of flange.

All structural steel was fabricated by United States Steel Company in Texas, and was shipped to Redding via rail. The 300-foot girders were shipped in lengths of 100 feet. All steel was then trucked to the jobsite for final assembly in the field. Structure work started on November 21, 1960. Considerable difficulty was encountered during excavation of pier footings due to slipouts at pier two and the necessity of drilling and blasting through 24 feet of solid rock at pier three. Pier footings were placed against undisturbed material and re-



The new Whiskey Creek Bridge on the relocated section of U.S. 299 between Redding and Weaverville. The view is westward.



The above drawing shows how three types of steel were combined to meet stress requirements most economically while maintaining a uniform web depth and thickness as well as a uniform section of flange.

quired approximately 800 cubic yards of concrete per footing.

Column Measurements

Pier columns are 16 feet in diameter for one-half their heights or 70 feet and 12 feet from there to the pier cap. Each column contained from 72 to 96 2¼-inch reinforcing steel bars, weighing 13.6 pounds per foot. All bar steel was trucked to the job site full length so that weld splicers would not be required.

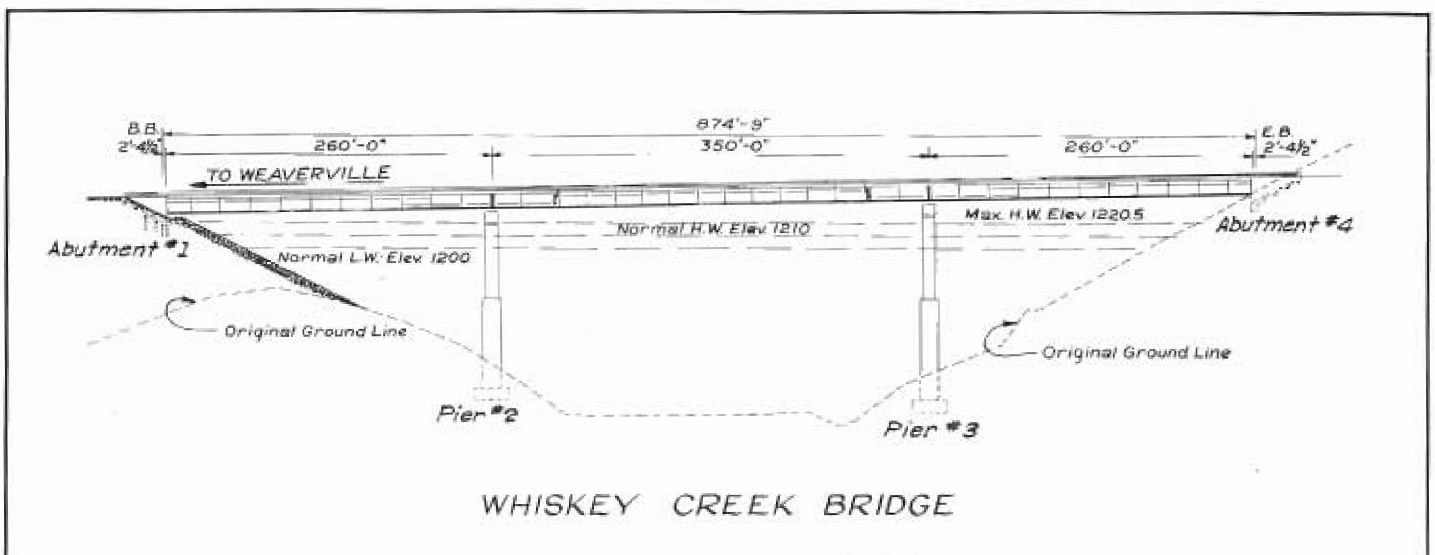
The subcontractor employed a unique method for supporting the column steel. A structural steel tower, with circular rings attached, was erected inside the column steel location. The reinforcing steel was then lifted by truck crane, placed against the rings and fastened thereto. The lower portion of the tower was left in place and is imbedded in the completed work. As the pouring of the concrete columns progressed and the bar steel became rigid enough to support itself, the remaining portions of the tower were removed for reuse in the other columns.

All columns were formed using split steel forms, 8 feet in height and stacked so that a total height of 32 feet was poured at the time.

Built-in Form Sections

Falsework for the pier caps was built on the ground in four sections and raised into position by truck crane.

Two 36-inch WF beams were placed across the columns and set atop four WF posts rising from the top of columns. Cap falsework was suspended from the beams with hangers and she-bolts. Each pier cap required 330 cubic yards of concrete and 26 hours to pour.



A profile sketch of the bridge to show the location of the piers and normal low, normal high and maximum high water levels.

Abutment One is located atop a previously placed embankment and is supported on steel piles to insure stability, as the fill is expected to settle approximately one foot after the lake is filled. Steel piles were placed in holes drilled through the fill and then driven to 100 tons bearing. The maximum depth of drilled hole was 123 feet on a one-to-three batter. Considerable difficulty was encountered in drilling, due to various sized rock encountered in the fill.

Drilling was started on January 27, 1961, and completed on May 19, 1961. Support piles were driven with a 15,000 foot pound energy single acting hammer with swing leads, supported by a 70T crane.

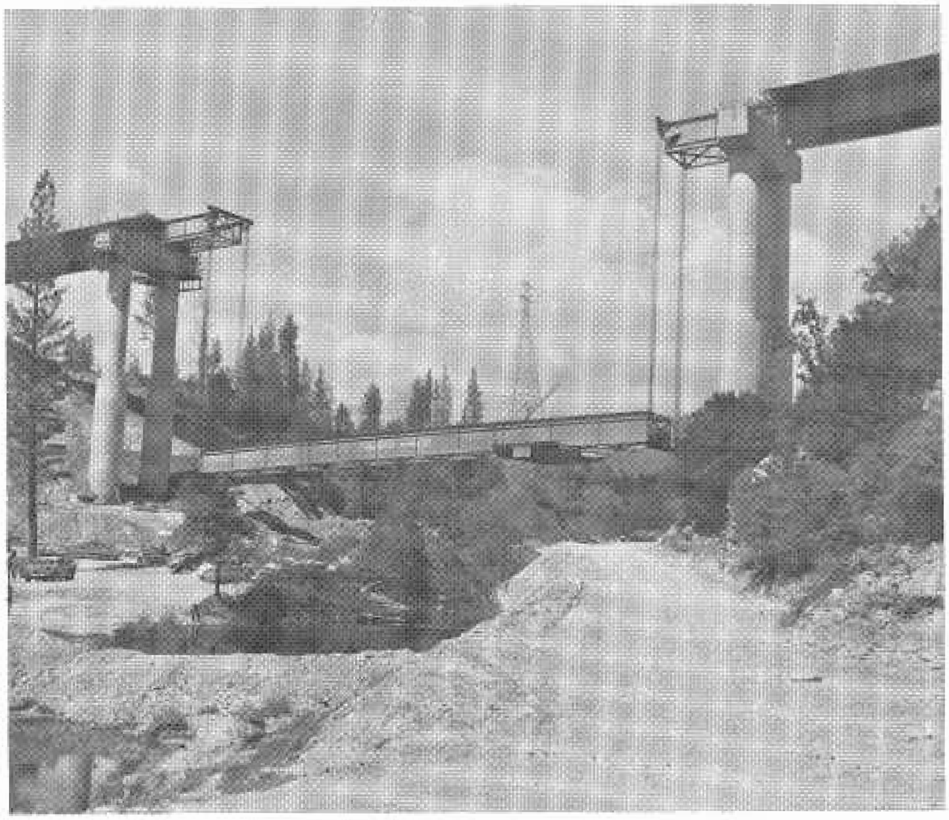
Set on Timber

The various sections of steel girders were set atop timber nests which were then adjusted so that camber requirements were met. The three sections were then welded together, making up one span length plus a 45-foot cantilever arm which overhangs into Span Two.

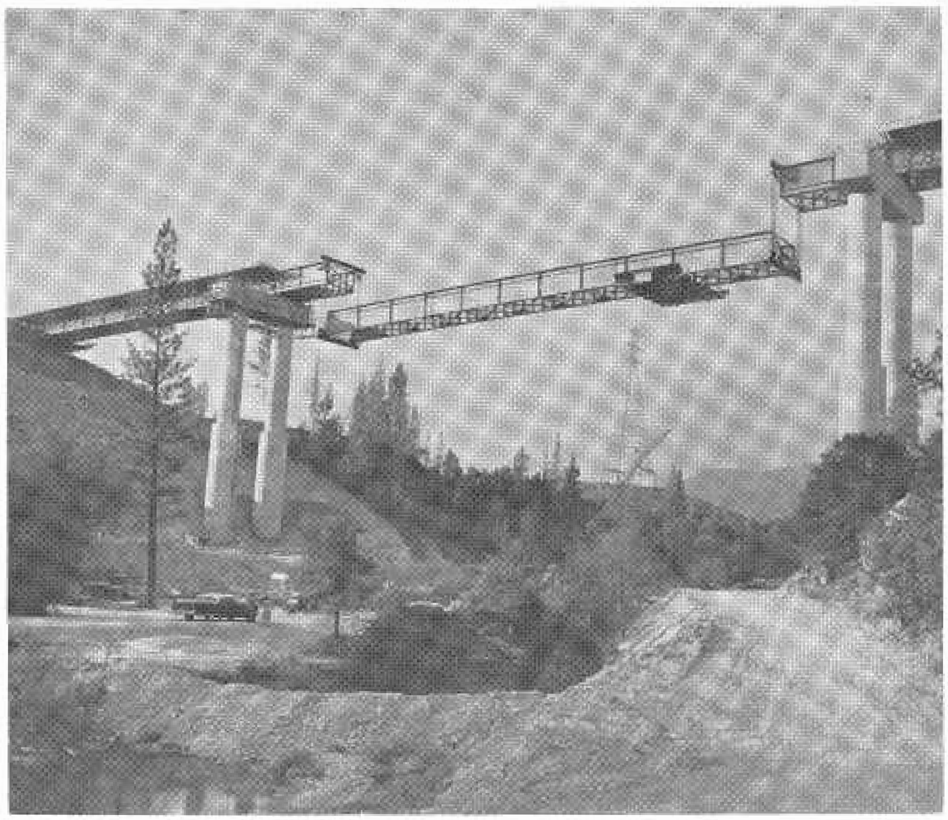
The dead load weight of the concrete deck, which amounted to over two tons per foot, was provided for in a predetermined camber. This camber as theoretically calculated was fabricated into the steel girders. Spans one and three were fabricated with 0.74 feet of camber, span two was fabricated with 1.48 feet of camber. A total of 12 field welds were made requiring over 100 man-hours per weld. A rigid control was maintained on all preheat and welding procedures used, with inspection and radiographic work being done by the Material and Research Department.

After all welding was completed the cross-bracing was bolted into place and the entire unit prepared for rolling out. The girders were then set on a 3 percent slope and pulled out, employing a cable and pulley system, attached to a 14K donkey engine.

A supplemental structural steel falsework tower was constructed halfway between the piers and abutments, to support the girders during rolling out operations. Specially designed roller nests were set atop the piers and



Two 14,000-pound lead line pull engines secured to the bridge approach start to lift the 260-foot center span into place on the new Whiskey Creek Bridge.



The lifted center span almost in place. The span was raised in eight hours with the two lead line pull engines and a series of wire rope lifting falls. Above photos by U.S. Steel Corporation.

false-bent which allowed for maximum movement with a minimum of effort. Over 300 tons of steel was rolled out; 350 feet in less than two days' time.

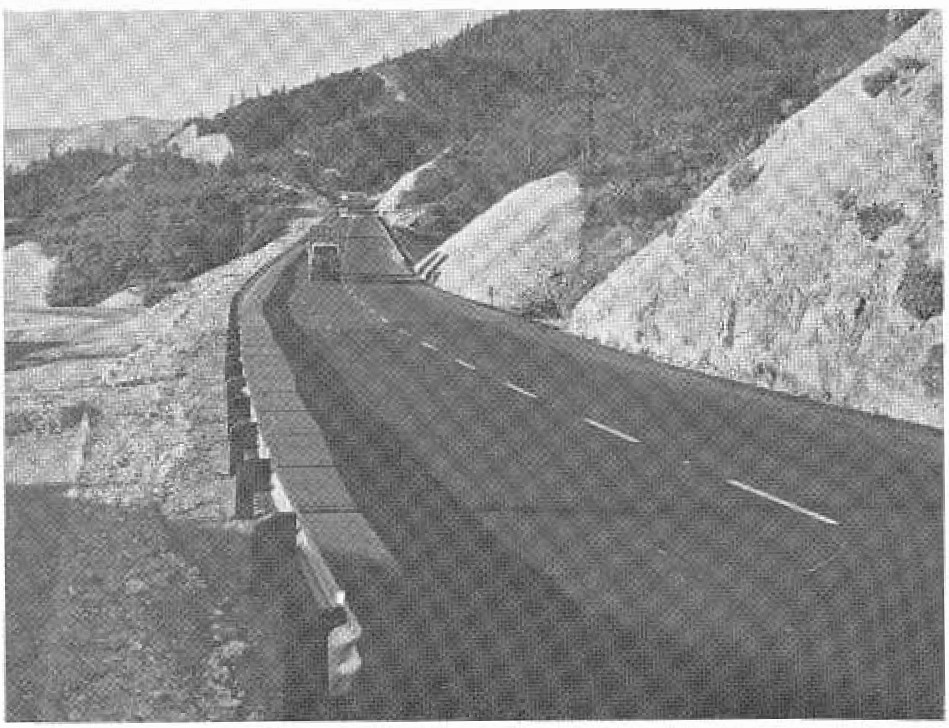
End Span Girders

As previously mentioned, the two end span girders cantilever into the center span and support the center span girders with 15″ x 2⅛″ "T-1" hangers and nine-inch A237 pins. A unique method was used to hoist the center span, 190 feet into final position. Steel beams were welded and braced to the top of the cantilever sections and a similar arrangement was used on the bottoms of the girders to be hoisted. A set of falls was placed between the top and bottom girders, using a 19 part ¾-inch cable at each point.

The total weight of structural steel was over 250 tons and was lifted with two 15,000-pound stationary hoists.

The new Whiskey Creek Bridge showing the completed roadway with provision for future expansion to four lanes.

The limited cable capacity of the hoist drums necessitated lifting one end of the girders 10 feet, which would reel in 200 feet of cable, dogging off this cable and then reeling in the other end up a similar amount until the girders were in place. The center span was lifted and the hinge pins set, in less than two days.



A view of a section of the new relocated US 299 highway made necessary by construction of the Whiskey Creek Dam.

Scaffolding Used

All deck falsework was placed and removed from a scaffolding, suspended from the bottom flanges of the two main girders.

The project was opened to public traffic on November 6, 1961, and is complete except for painting of structural steel on the bridge and applying a chip seal coat to the traveled way.

The cost of the bridge across Whiskey Creek was $1,080,000 and the total construction cost of the entire project will be $4,300,000. The project is financed jointly by the Division of Highways and the U.S. Bureau of Reclamation, the bureau's share approximately 90 percent based on a "replacement in kind" cost.

Design and construction staff were chief designer, R. D. Sunbury; branch construction engineer, J. D. Pettine; assistant construction engineer, George L. Johnson; district resident engineer, M. P. Brower; steel and welding inspection, Frank Boeger, Bob Miliron; bridge subcontractor, Lew Jones Construction Company and bridge superintendent, Jerry Dooley.

Snow in the South

Maintenance Crews Meet Unusual Challenge

By JOHN O'MALLEY, Highway Superintendent

On January 19, 1962, the barometer at the Ridge Route Station started down from its normal reading of 30.02 and by the morning of the 20th rain was falling throughout most of Southern California, with snow in the mountains above the 5,000-foot elevation. Chains were required on the Angeles Crest Highway above this elevation. By 11 a.m. on the 20th it was necessary to close the upper limits of the Angeles Crest due to falling rocks, drifting snow and extremely poor visibility. By 12 noon the San Gabriel Canyon road was closed due to rock slides.

In the afternoon, as the temperature dropped the snow line crept down with it. By nightfall the rain had turned to wet snow at Tejon Summit on the Ridge Route but was still not sticking in quantity to the pavement. Some sand mixed with rock salt was spread to help the heavy trucks and trailers and in the hope the snow would continue to melt as it fell to the pavement.

Snow Down to 3,000 Feet

The hope was ill founded, since by 2 a.m. on the 21st, snow was falling and sticking at the 3,000-foot level. By then sand was being applied all up and down the Ridge Route and in some short locations in Mint Canyon on US 6. Traffic was still moving, although cautiously, without chains.

Other districts were having their problems also. At 5 p.m. San Bernardino called requesting a closure on our side of SSR 138 at Victorville Junction due to a traffic tieup on Cajon Pass Road, US 66, near SSR 138 junction. At 9 a.m. reports came in that snow was now falling in the vicinity of Littlerock in the Antelope Valley. By 4 p.m. it was snowing throughout the desert areas. Mint Canyon Highway was slick with slush in many spots.

Every few minutes calls were being received from our own patrols and from various law enforcement agencies reporting locations where plows or sand was needed. Earlier in the day arrangements had been made to rent additional privately owned motor graders and the foremen were instructed to call them as the need arose. All were equipped with headlights, taillights and flashing amber lights for night use.

Snow was now falling along the entire length of the Ridge Route from Castaic to a point near Lebec in District VI, and at 8 a.m. the route was closed to both north and south bound traffic. It was re-opened approximately two hours later to all vehicles but with chains required. The intervening two hours was spent extracting traffic caught in the snow or on slippery grades without chains.

At 8.30 a.m. on the morning of the 22d, the road was again closed to all traffic because of zero visibility in the vicinity of Gorman. Gale winds blowing fine powder snow made visibility so bad maintenance crews could not find the roadway and were driving into side borrow ditches and becoming stuck themselves.

Editor's Note: Every decade or so, a freak combination of weather factors produces snow in the Los Angeles area. In close proximity to the densely settled series of valleys occupied by Los Angeles and several score smaller cities, there are great open spaces of desert, and mountain ranges 8 and 10 thousand feet high. Two inches of snow in Pasadena mean several feet in the mountains, and heavy drifting on the high plateaus of the open desert. In these adjacent stretches of desert, and in the mountain passes, Southern California motorists, unaccustomed to driving in snow, unequipped with tire chains, quickly get into trouble.

The storms of late January 1962, were no exception.

Weekend visitors to vacation cabins at elevations as low as 2,000 feet found themselves snowbound, with limited supplies. Huge drifts piled up by desert winds closed the routes into Los Angeles, so that the town of Mojave, with a population of 2,500, perforce became host to 1,600 stranded visitors, and the little town of Rosamond nearby had hundreds more.

The Ridge Route, US 99, main north-south route between Los Angeles and the Central Valley, had more than a foot of snow, with drifts many times that deep in places. The run-off from the melt in the daytime froze into black ice at night, creating death traps for the unwary. In the San Gabriel and San Bernardino ranges the problem of getting out trapped week-end recreationists was complicated by the thousands who wanted to go to the mountains to play in the snow.

The accompanying unassuming narrative is an account of what the highway maintenance man faces when one of these freak storms strikes. In it a man whose job it is to organize the struggle against the storm tells of the various phases in the struggle—a struggle not only to keep the routes open for commerce, but in many cases to keep open routes by which people could reach vitally needed shelter.

Two Inches of Snow in Glendale

Meanwhile all roads in the territory were by now completely covered with from 2 inches of snow in the Glendale and San Fernando Valley areas to 48 inches at Kratka Ridge on the Angeles Crest Highway. At Newhall 8 to 10 inches of snow piled up. At Tejon Summit the depth was 18 inches with drifts up to 4 and 5 feet.

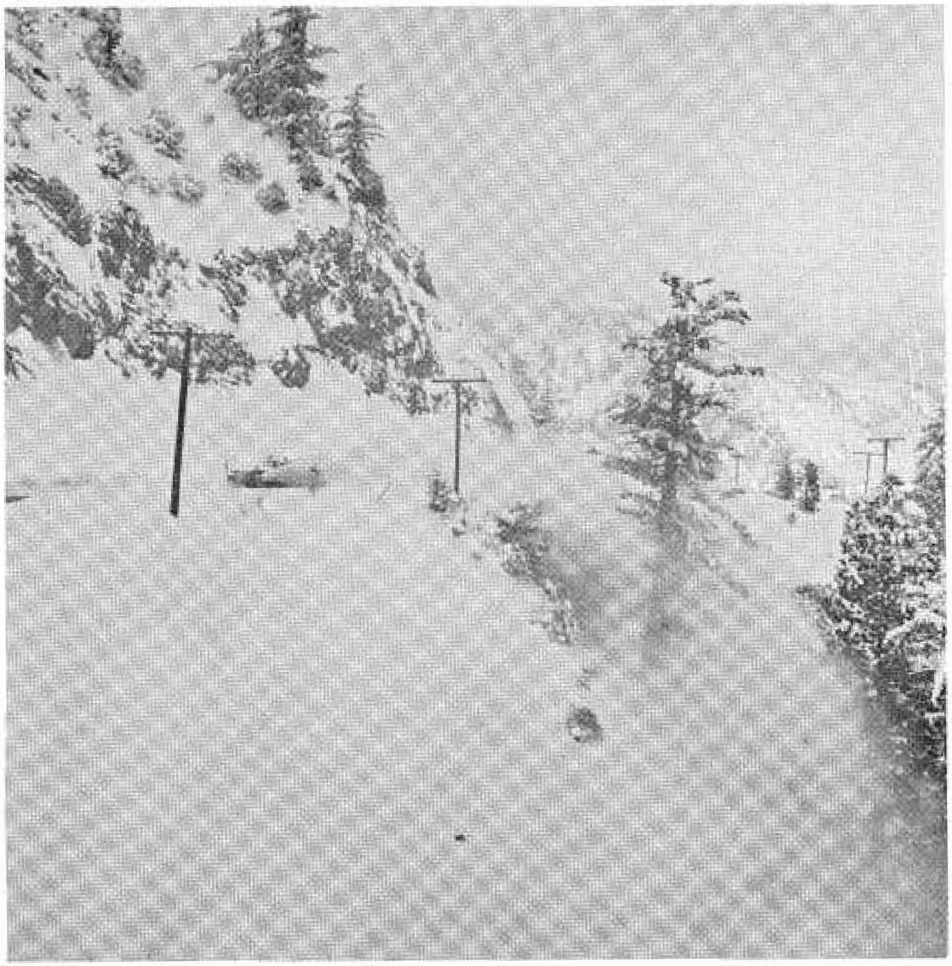
Because of reports of marooned vehicles and occupants and because one of our own plow trucks was broken down in a drift on the Gorman to Lancaster cut-off, another plow was dispatched from Gorman to meet it. When finally the foreman reported the plow unable to buck the wind driven drifts, a call via radio was made to Wrightwood for a FWD plow. This is a new truck equipped with a 48 inch high reversible push plow, mobile radio, and carrying an auxiliary 300 gallon gasoline tank on skids in the truck bed.

Leaving Wrightwood around 5 p.m., maintenance man Paul Johnson plowed through light snow to the Lancaster Station, arriving around 8 p.m. Receiving instructions and directions from the foreman, Johnson headed north on US 6 and west on SSR 138. The FWD truck moved along with little effort in the 12- to 18-inch snow depths but had to do some backing and cutting where drifts had piled up to four or five feet deep on the highly superelevated right angle turns.

Plow Breaks Road Open

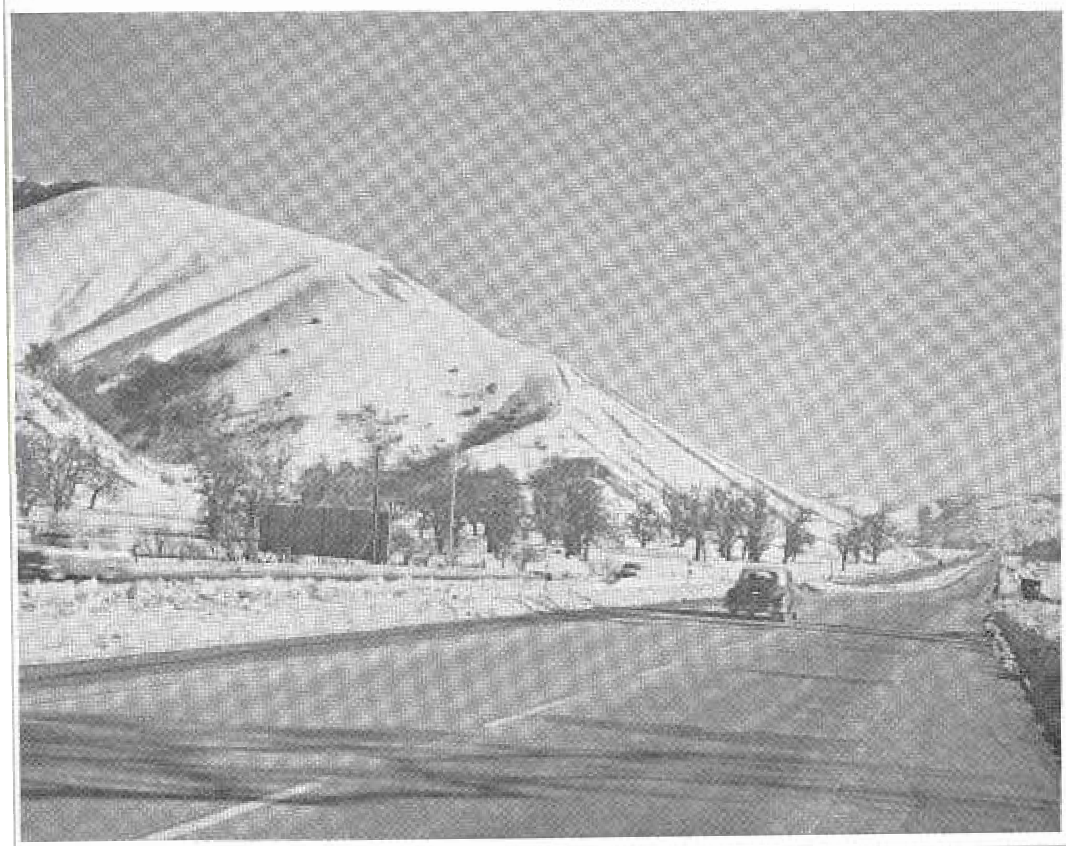
By early morning of the 23d Johnson had plowed across SSR 138 west of US 6 and had made contact with the foreman from the Ridge Route. Between them they had collected together 8 to 10 cars including 1 from the Lancaster Office of the Los Angeles County Sheriff's Department. Turning east now, Johnson in the FWD plow led the cars back to the junction of the US 6 highway, from which location they were able to proceed to Lancaster without further help from the plow.

At this point he again reversed his course and returned west across the desert to work out the following day on the Ridge Route. (Johnson is new to the Wrightwood section and had never traveled over SSR 138.) His only guides were a line of power poles running alongside the highway. Total distance from Wrightwood to US 99 near Gorman is 98 miles. Including doubling back it is estimated he covered approximately 180 to 190 miles on this trip. Reports from the Sheriff's Office indicate that except for inconvenience and discomfort none of the marooned persons were any the worse for wear. Without this or a similar type plow it is only a guess as to what might have been.



Rotary snow plow clearing State Sign Route 18 in the San Bernardino Mountains between Lake Arrowhead and Big Bear.

On the morning of January 25th, storm is over, pavement is clear and dry with normal traffic movement over the Ridge Route, US 99.



Meantime other crews were having their own problems with urgent calls by the California Highway Patrol and the local Sheriff's offices. In the La Canada area, the chain control sign was removed from its usual location 12 or so miles north of Foothill Boulevard on the Angeles Crest, right down to Foothill Boulevard itself.

US 99 Closed in L.A. City Limits

On US 99 (Golden State Freeway) the snow was falling and sticking well inside the city limits of Los Angeles. This condition brought out the Los Angeles Police Department where at the junctions of US 99 and Sepulveda Boulevard they called for barriers and signs and manned a "road-closed" blockade. Although officially the road was closed, they allowed all residents and those having business in the Newhall-Saugus area to proceed if they had chains on.

Off and on between January 22d to the 23d various routes were closed, opened and closed again as conditions of snow, ice and traffic congestion warranted. The push plows on the Ridge Route had about reached their capacity to windrow the snow to the sides of the road, so on the 23d a radio message to Chilao on the Angeles Crest started one of the rotary plows on its way to the scene. By now the storm was tapering off to some extent and all equipment was concentrated on sanding the ice, scraping and heeling back the pushed snow and the rotary plow was busy spewing the five- to six-foot high reefs of snow far from the road.

During the night of the 23d and early morning of the 24th, traffic was allowed to proceed over the Ridge Route in groups of 25 to 30 vehicles without chains. This was so that in the event anyone became stuck, it would be a relatively simple matter extricating them without the loss of time attendant on hundreds of cars and trucks being released at one time and all stuck together. By early morning all traffic was running without any wait on either end and all controls were eliminated. On the 24th, the sun came out, the storm was over, and the next couple of days were spent in cleanup work, servicing of all equipment and in general getting back to normal.

260 Miles of Road

Where normally 90 miles of roadway is under snow or ice as a maximum in this area, the January storm covered 260 miles in varying depths from two inches to four feet with some drifts six feet deep in desert areas and side hill drifts 15 feet or more in the mountains. Seven private contractor graders were used along with the State-owned equipment enumerated previously. Twenty-four tons of rock salt mixed with approximately 1,200 to 1,400 cubic yards of sand was spread, most of this over a one night and day period.

Angeles Crest Highway in San Gabriel Range on 26 January, 1962. Photograph is made less than 40 miles from downtown Los Angeles.

Simple statistics can't tell the story of the battle waged by each individual, but during a storm of this type the spirit of the men assigned the task of keeping the roads passable is admirable. The work is hard on men and equipment. Operations are necessarily continuous. Most of the time it is not possible to provide a relief operator at the end of a regular shift. In such cases the men carry on until they can be relieved.

The storm is over; not as spectacular as those occurring on some of the northern mountain passes and with less lasting results, since a week later with the temperature soaring into the 80's all the snow is gone with the exception of that in the higher elevations of the Angeles Crest. We hope the average between these "unusual" storms holds true in which case it will be at least 1970 before the next one—but then who knows—maybe next week.

NEW RECORD FOR REGISTRATION FEES

A record of $264,406,499 in registration and drivers' license fees was collected in 1961 by the Department of Motor Vehicles.

This is nearly $6.5 million more than the revenue collected in 1960.

Parts of the $264 million are apportioned for use by cities and counties, and for state highway planning, construction and maintenance.

The motor vehicle fee is a major source of funds for California's highway program. More than $56 million of the 1961 motor vehicle fees is earmarked in the current state budget for this purpose. This large sum is exceeded only by funds from gasoline tax and federal highway aid.

More than $127 million is divided equally between cities and counties, apportioned on the basis of population. This is the amount received from the 2 percent valuation fee assessed vehicles in lieu of local property taxes.

Counties may use their apportionments as their governing bodies direct, but legislation limits use of cities' funds to three areas: law enforcement, traffic control and regulation, and fire protection of highway traffic.

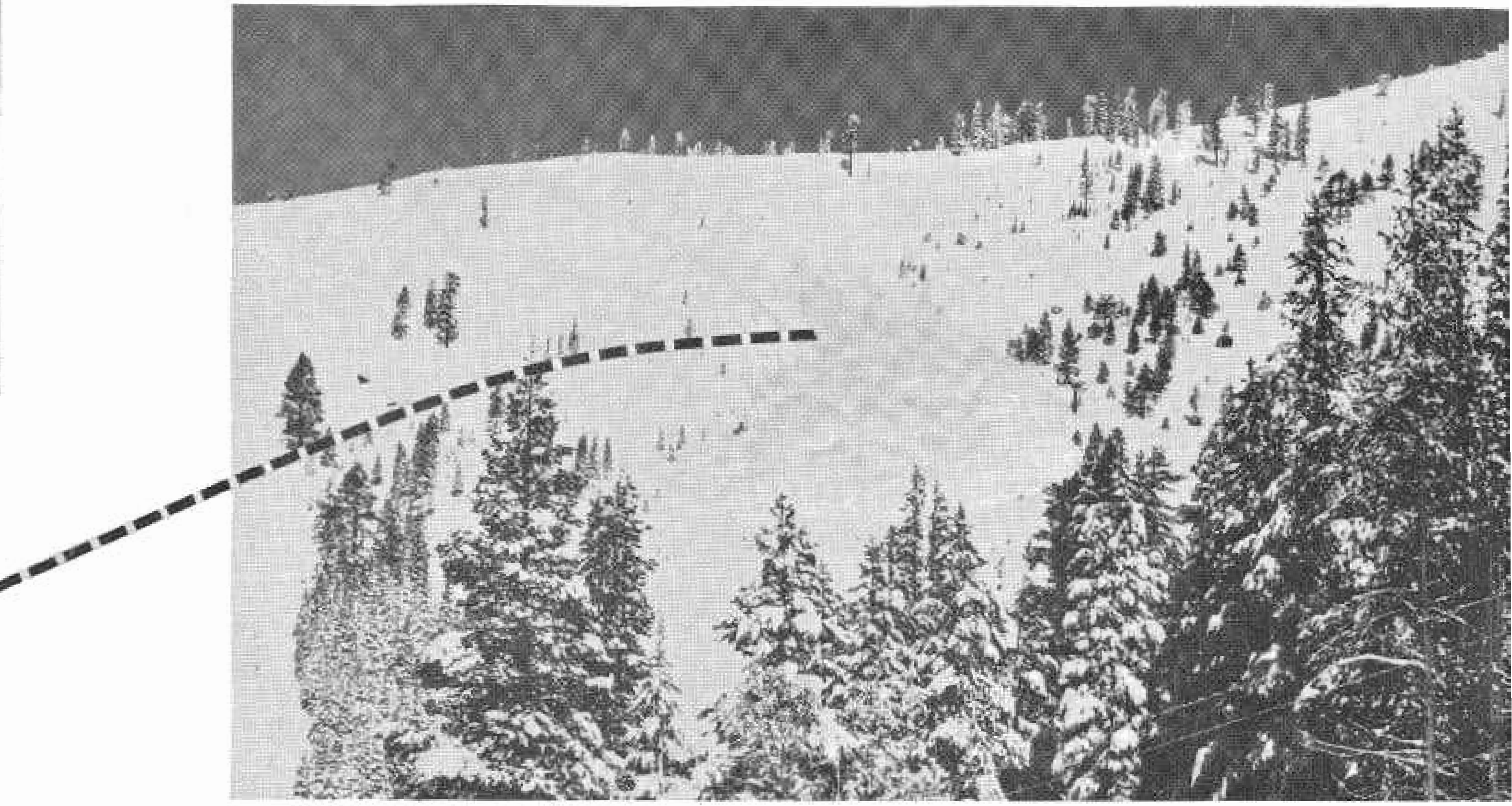
Part of the balance remaining after apportionments to cities and counties and to highway programs is used to support law enforcement and public safety activities of the California Highway Patrol. Another part of the balance is used to support driver licensing, driver improvement, vehicle ownership identification, and record maintenance services of the Department of Motor Vehicles.

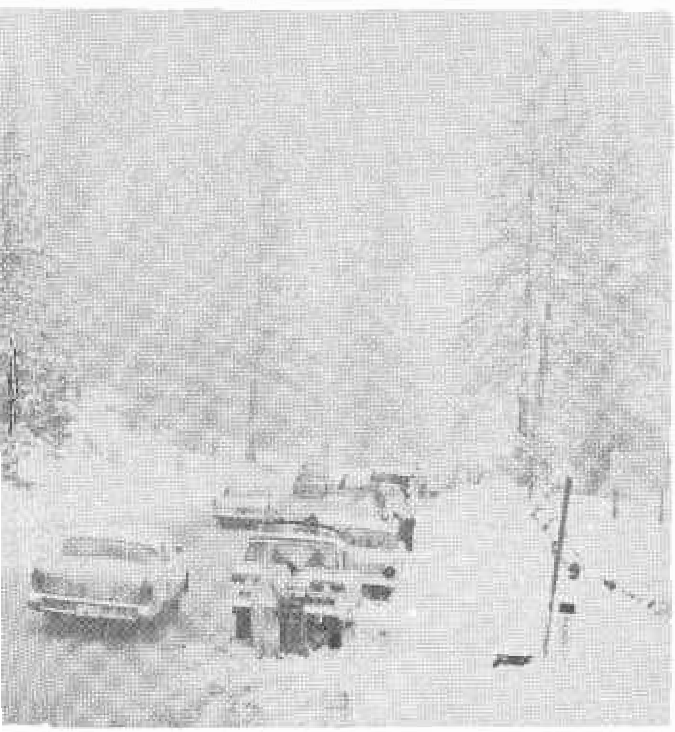
Snow! Snow! Snow!

The snow had barely melted in Southern California (see previous page) when a series of storms again swept in from the Pacific. Rain fell heavily over most of the State, with snow in the mountains. One station in the northern Sierra Nevada recorded 45 inches of snow in one day.

Snow built up on the high ridges, and overhanging cornices began to form. On a section of US 50 west of Echo Summit which had to be closed because of avalanche danger, the National Guard gun crew pictured below, with its jeep-mounted 105 mm. recoilless rifle, fired several rounds into a series of cornices above the closed section of road. The resultant slides removed the danger.

ABO





OVE: Chain control station at Strawberry on US 50 during heavy snowstorm. (See page 61.)

BELOW: Cornices above Meyers Grade section of US 50 were bombed by helicopter in attempt to loosen hanging snow.

L.A. Area Freeways

By E. T. TELFORD, Assistant State Highway Engineer

Although 1961 was not an impressive year for actual freeway mileage opened to traffic in District VII, the construction program in point of dollar investment accruing from several fiscal years showed substantial gains over previous years. Despite the fact that only 11.2 additional miles of freeway were made available to the motoring public, $251,890,368 in construction funds was invested in minor and major highway contracts of all types during the single month of November, accumulating from jobs let during the year.

The quarter of a billion dollar peak was indicative of the intensive construction program in Orange, Ventura and Los Angeles Counties; and portended a banner year of freeway completions for 1962, when an estimated 50 miles of freeways worth $150,000,000 would be opened to public use.

As of February 20, 1962, District VII had 334 miles of freeway and expressway completed and in operation, 83 miles under construction and 721 miles of adopted routes. Los Angeles County alone had 225 miles of freeways-expressways completed and 63 miles of freeways under construction. The total investment in freeways for the three counties of Los Angeles, Orange and Ventura, including rights-of-way and construction, was $1,191,158,000, as of December 31, 1961.

Freeway Loop Dedicated

Perhaps the most important single event occurred on March 30, 1962, when 23 miles of the Interstate Santa Monica-Golden State Freeway Loop was dedicated by Governor Edmund G. Brown. It marked a major breakthrough in freeway development for the Los Angeles Metropolitan Area; since in effect an entirely new route, formed by portions of the two freeways, was added to the metropolitan network. Of special significance was the fact that an alternate bypass facility skirting the fringes of downtown Los Angeles and more or less paralleling the existing Hollywood Freeway was now a reality.

Traffic could now avoid the heavily travelled Hollywood Freeway—a daily average traffic of 195,000 vehicles per day in 1961 just west of the four-level structure—and find its destinations along the Santa Monica-Golden State Freeway connection. Moreover, interchange facilities were provided with other mainline freeway routes, such as the Santa Ana, San Bernardino, Pasadena, Glendale and Ventura Freeways.

Conservative traffic estimates held that 15 to 20 percent of the traffic using the Hollywood Freeway would be diverted to the new route. In addition, traffic congestion on busy San Fernando Road and Riverside Drive would be sharply reduced in that an estimated 80 percent of the traffic on these two arterials in the vicinity of the downtown area would divert to the new freeway.

Freeways Being Extended

The Santa Monica-Golden State Freeway Loop has its origin at the Harbor Freeway at Venice Boulevard and its terminus at Lankershim Boule-

The completed Glendale Freeway, looking southwest to Glendale Boulevard. In the foreground is the Glendale-Golden State Freeway Interchange.

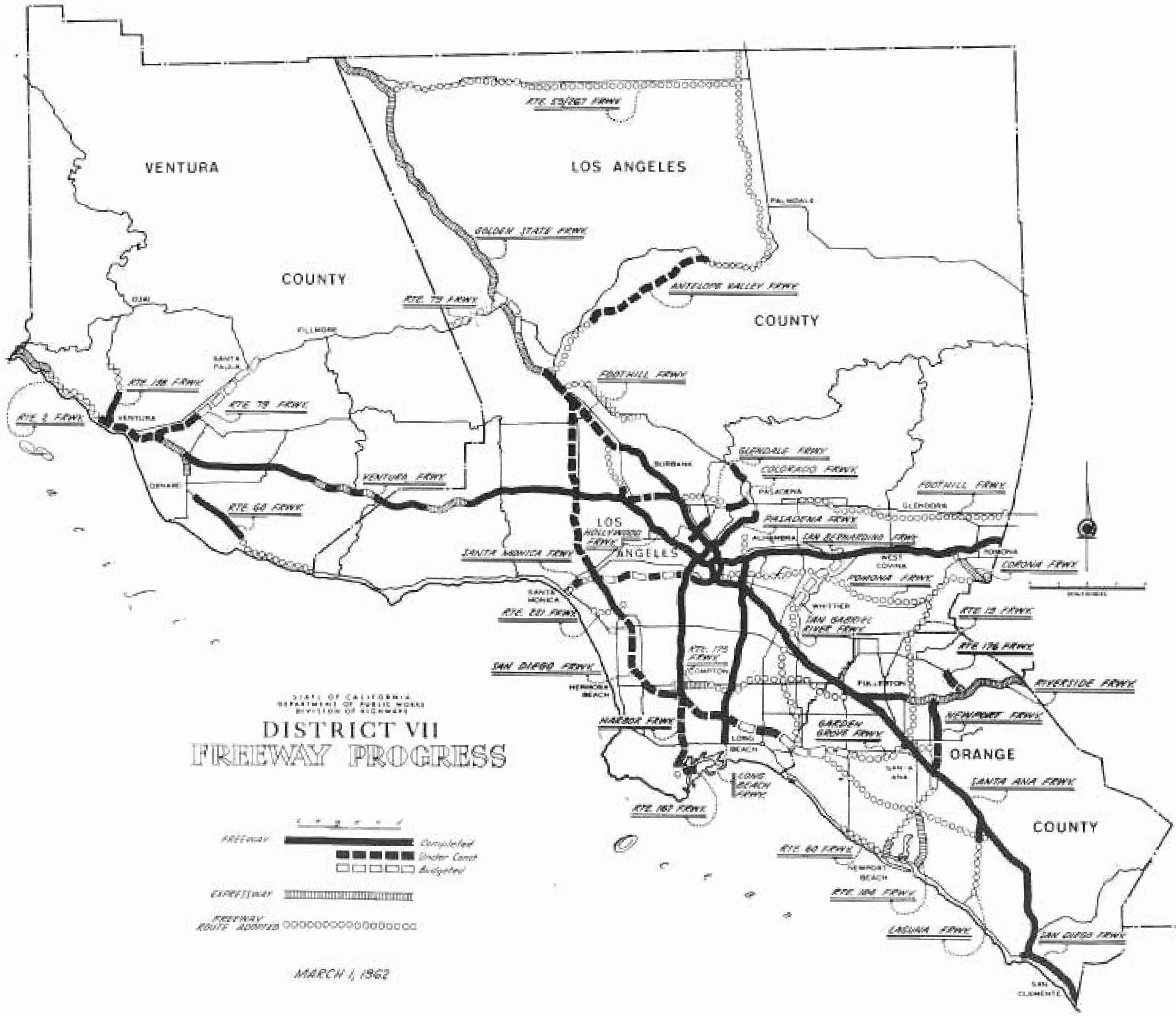
vard in the San Fernando Valley; however, independently, both freeways are being extended west and north. The Santa Monica Freeway will eventually terminate at Pacific Coast Highway in Santa Monica and the Golden State Freeway continue north into Kern County.

The 23 miles of the loop has been built at a construction cost of over $95,000,000 and a right-of-way cost slightly in excess of $88,000,000 since the first contract on a Golden State Freeway link was completed in September, 1957.

Anticipated traffic use of the Santa Monica Freeway portion of the loop as far west as the Harbor Freeway is 70,000 vehicles per day in 1962; by 1980 this freeway will be carrying 180,000 vehicles between Los Angeles and Santa Monica. The Golden State Freeway is expected to be carrying 163,000 vehicles per day in 1980. The East Los Angeles Interchange, where the Santa Monica and Golden State Freeways converge, will be carrying an estimated 450,000 automobiles and trucks, or 600,000 individuals, by 1980.

"Thus another component is added to the growing network of freeways in Metropolitan Los Angeles that will begin to function as a system, providing alternate routes to accommodate the areawide traffic flow patterns. To

The desirability of business locating next to a freeway, in this case the San Diego Freeway in the Dominguez area, is illustrated by this realtor's sign.



GOLDEN STATE - SANTA MONICA FREEWAY LOOP

(23 Net Miles)

The location of the Golden State-Santa Monica Freeway Loop is shown in the above map.

the individual, system operation will mean greater speed, safety, convenience and comfort in the movement of himself and his goods between points of his choice at a time suitable to him. The completion of this important distribution complex will implement the switching of traffic between freeways and the diffusion of traffic into local streets." ("L. A. Renaissance," *California Highways and Public Works*, September-October, 1961.)

Interstate System

Freeway development in District VII and throughout California has been greatly accelerated under the National System of Interstate and Defense Highways, beginning in 1956. The 41,000-mile system is largely financed from the federal gasoline tax. There are a total of 2,179 miles of freeway on the Interstate System in California, of which 654 miles were completed and opened to traffic as of December 31, 1961. The Interstate network in District VII totals 328.5 miles, of which 167 miles were completed and opened to traffic on December 31, 1961.

During 1961 only eight miles of Interstate freeways were added to the 115 miles in operation at the end of 1960; exclusive of the 44-mile Golden State expressway portion; however, work was carried forward on 37 more miles under construction by the end of the year. Completion of the work now under way will in significant measure bring to the travelling public a realization of the free-flowing peak-hour traffic conditions which can be afforded by a system of modern freeways.

Right-of-way activity was extensive during 1961 in preparation for the projects budgeted by the end of the year, which will add 38.4 miles to the system.

In review, the Interstate System is of prime importance to the District VII freeway pattern. It is so constituted that it will not only efficiently perform its function of interstate travel and national defense but will also incorporate some of the most important elements of our freeway network. Some measure of its importance is reflected by the fact that about 35 percent of the annual highway expenditures during the next decade will be needed for Interstate freeways. Three hundred thirty of the 920 miles of freeways and expressways to be placed under construction in the district by 1972 will be Interstate freeways. Nearly 80 percent of the mileage will have eight or more through lanes and nearly all the rest will be six-lane freeways. Thus 36 percent of the freeway mileage in operation by 1975 will carry over 45 percent of the freeway traffic.

At the end of 1961 Interstate freeways (including present expressways) totalled 167 miles or 51 percent of the 327 miles of freeways and expressways in operation in District VII. Two hundred fifty-six miles or 35 percent of the 721 miles adopted are Federal Aid Interstate routes.

San Diego Freeway

The San Diego Freeway, Interstate Route 5 and 405, is 93.6 miles in length in District VII, originating at junction with the Golden State Freeway at the San Fernando Reservoir and extending past San Clemente into San Diego County. As of December 31, 1961, $220,345,000 had been invested in this route for both rights-of-way and construction.

As of this writing, the route is under construction from the Golden State Freeway to Burbank Boulevard, under two contracts totalling almost $8,000,000 a distance of 10 miles (two grading projects having been completed earlier). The freeway is completed from Burbank Boulevard to Valley Vista Boulevard, from which point it is under construction under $19,993,000 contract across the Santa Monica Mountains to Casiano Road in West Los Angeles. South of Casiano Road the freeway is completed to Jefferson Boulevard.

A continuous line of active construction projects worth $42,673,000 takes the freeway 17.5 miles south and east to Alameda Street in the Dominguez area, where it connects with a previously completed link to the Long Beach Freeway, opened to traffic on January 25, 1962. Other San Diego Freeway roadway and bridge contracts are in progress east of the Long Beach Freeway to Studebaker Road. (See *San Diego Freeway*, by James E. Martin, *California Highways and Public Works*, January-February, 1962.)

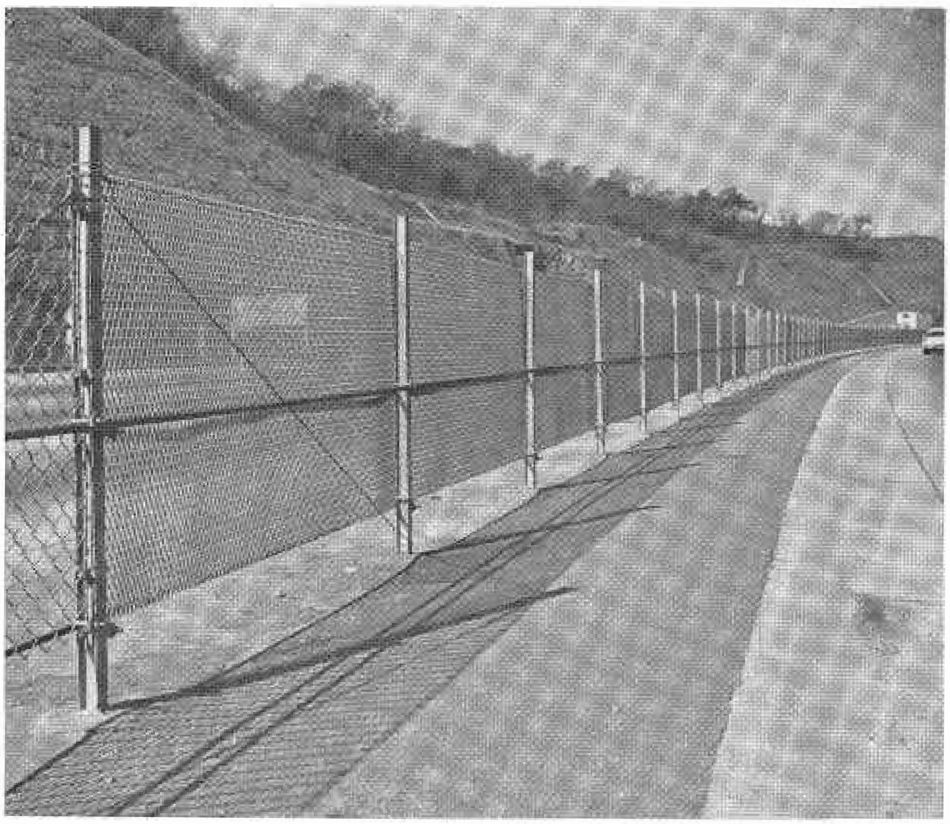
The 1962-63 Highway Budget provides $23,000,000 for the completion of this route to ultimate freeway standards as far as Bolsa Chica Road in Orange County.

The remaining unbudgeted and unconstructed portion of the San Diego Freeway in Orange County is about 22 miles in length and extends from Bolsa Chica Road at the Garden Grove Freeway to a junction with the Santa Ana Freeway near El Toro. Initial construction will provide eight lanes from Bolsa Chica Road to Central Avenue and six lanes from Central Avenue to the Santa Ana Freeway.

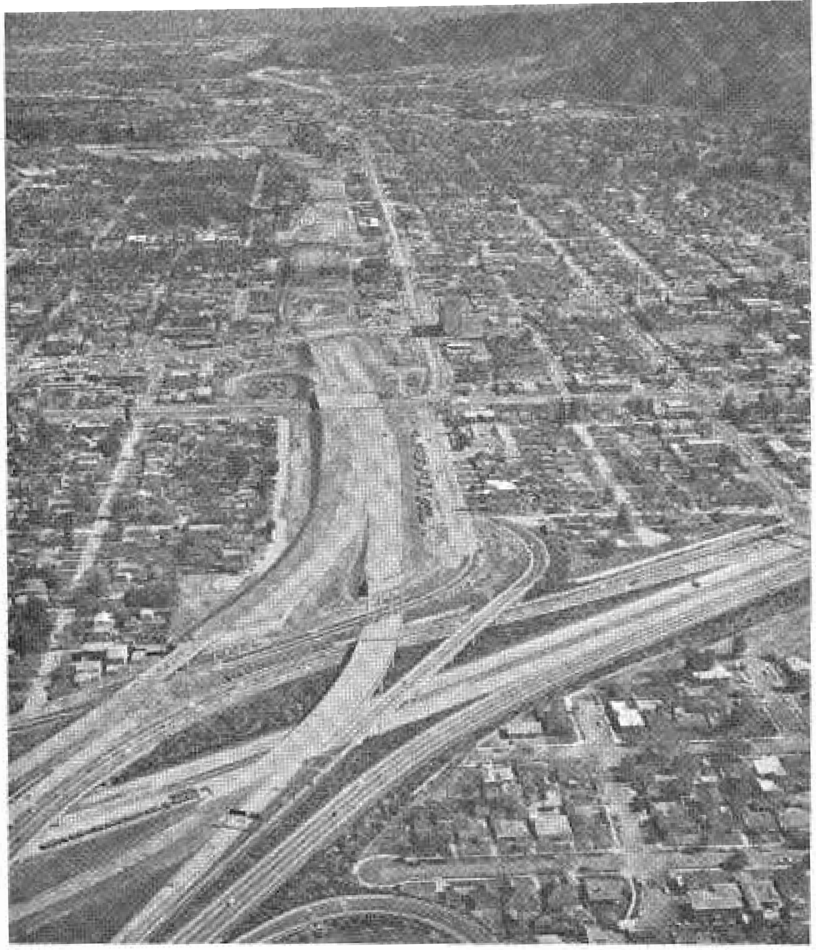
Road Settlement Indicated

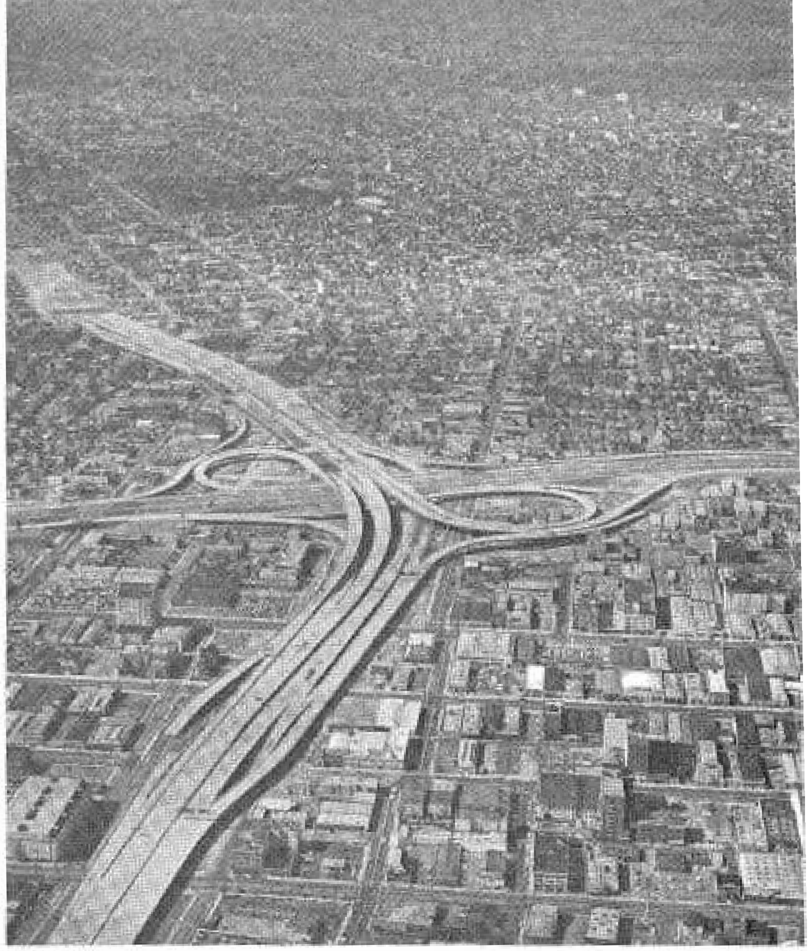
In the Cities of Westminster and Huntington Beach, there are peat deposits located within the proposed freeway limits. Tests indicate substantial settlement can be expected in the roadway embankments constructed over these deposits. Therefore, roadway embankments will be constructed at an early date to provide the maximum time for settlement prior to construction of the freeway pavement.

Looking east along the Santa Monica Freeway viaduct. Note the translucent headlight glare shield mounted on the concrete divider (left).



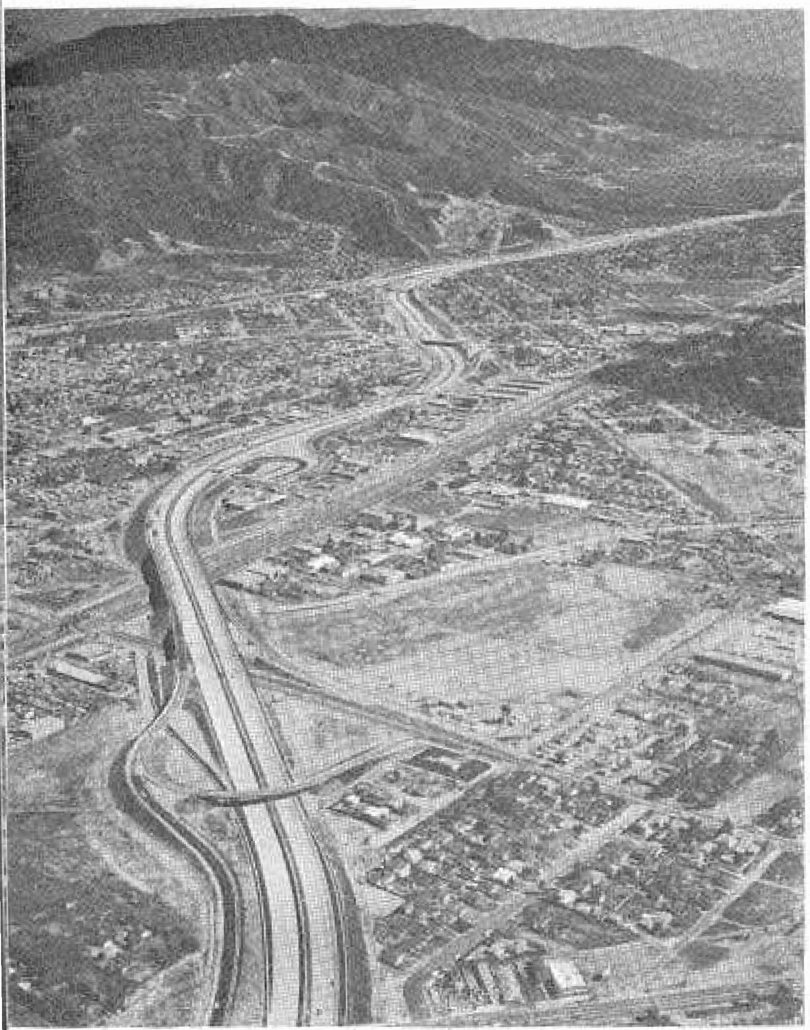
Chain-link cable-reinforced median barrier fence is being installed on District VII freeways. This is an experimental section at Kellogg Hill on the San Bernardino Freeway. It is equipped with an expanded metal anti-glare shield.





ABOVE—An eastward view of construction on the Ventura Freeway from the Hollywood Freeway Interchange (foreground). BELOW—The temporary end of the loop portion of the Golden State Freeway. The view is east with San Fernando Road running diagonally (center).

ABOVE—The Santa Monica-Harbor Freeway Interchange at Venice Boulevard. This is the temporary terminus of the Santa Monica Freeway and end of the loop. BELOW—Looking east along the San Bernardino Freeway. The Atlantic Boulevard Interchange is center and, at left, the Ramona Convent.



This will be accomplished under a separate contract for constructing embankments and fence between Edinger and Bolsa Avenues for which the California Highway Commission voted $700,000 in January 1962.

Design of 5.8 miles of the San Diego Freeway between Beach Boulevard and Bolsa Chica Road is scheduled to be completed during 1962. This unit will provide freeway interchanges at Springdale Street, Westminster Avenue, Golden West Street, Bolsa Avenue and Beach Boulevard, plus crossings at Edwards Street and Sugar Avenue. In excess of 85 percent of the right-of-way required for this project has been acquired.

From Beach Boulevard, southeasterly to Harbor Boulevard, a distance of 5.3 miles, design is well under way and about one quarter of the necessary right-of-way has been acquired. Interchanges will be located at Edinger Avenue, Cannery Street, Warner Avenue, Brookhurst Street, Talbert Avenue, Euclid Street and Harbor Boulevard. Newland Street and Bushard Street will cross over the freeway.

Design on the final section of the San Diego Freeway between Harbor Boulevard and a junction with the Santa Ana Freeway near El Toro, about 11 miles in length, will get under way as soon as the matter concerning the compatibility of the proposed Orange County Airport improvement and the adopted route for the San Diego Freeway is resolved.

San Gabriel River Freeway

The San Gabriel River Freeway, Interstate Route 605, extends 22.6 miles from the San Bernardino Freeway in El Monte to the Garden Grove Freeway in Westminster. Studies are in progress to extend the adoption of this route north from the San Bernardino Freeway to the Foothill Freeway and south from the Garden Grove Freeway to Pacific Coast Highway. Right-of-way purchases on this route amounted to $25,007,000 as of December 31, 1961, with an additional $5,100,000 included in the 1962-63 fiscal year.

Initial construction on the San Gabriel River Freeway is now under way, a $649,432 contract having been awarded on February 6, 1962, for the Peck Road overcrossing and interchange in the Whittier area.

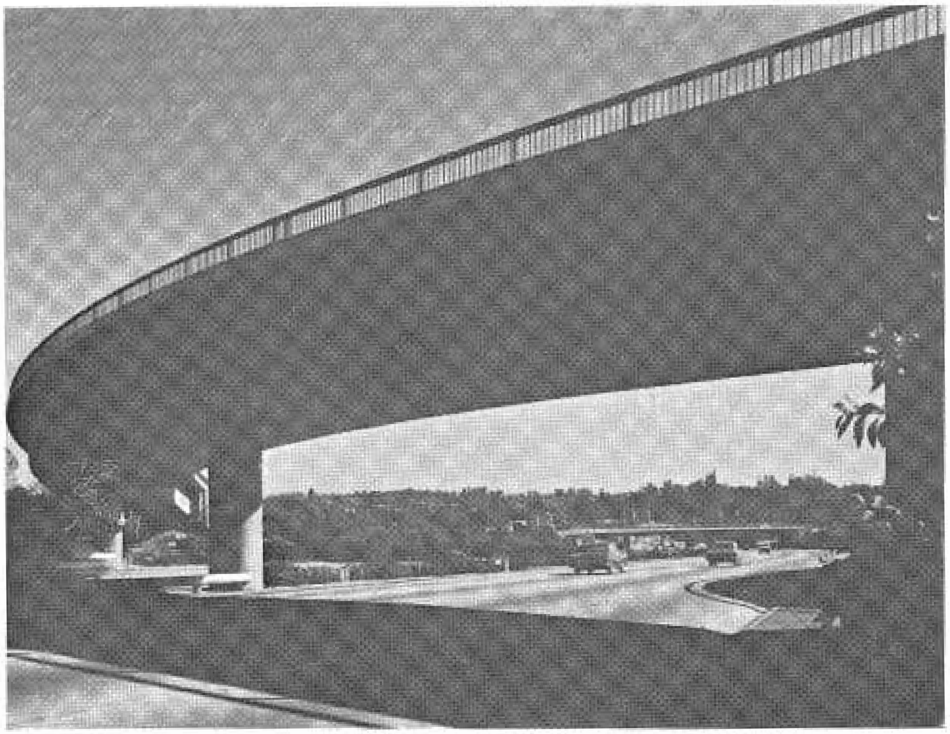
The 1962-63 budget includes $11,550,000 for construction of seven miles of the San Gabriel River Freeway between Whittier Boulevard and the San Bernardino Freeway. It is anticipated that two contracts covering this section will be under construction by late 1962. Plans are rapidly nearing completion for the remaining 15.4 miles of the San Gabriel River Freeway between the Garden Grove Freeway and Whittier Boulevard.

It is anticipated that the design of the portion of the San Gabriel River Freeway between the Garden Grove Freeway and the Orange-Los Angeles County line near Katella Avenue will be completed early in 1963. The initial construction will provide full freeway facilities with four lanes in each direction separated by a 36-foot median. Construction of this three-mile section could commence in 1963, subject to financing. The estimated construction cost is $7,000,000.

Golden State Freeway

The Golden State Freeway, Interstate Route 5, is virtually completed to freeway-expressway standards from junction with the Santa Ana-Santa Monica Freeways in East Los Angeles to the Kern County line north of Gorman, a distance of some 73 miles. Two construction projects in progress now between Lankershim Boulevard and San Fernando Road, stretching eight miles and costing $14,774,000, will make the route continuous from central Los Angeles to the north Los Angeles County limits by the summer of 1963. The total investment in the

Construction on the San Diego Freeway through the Santa Monica Mountains. The view is northward. The black roadway is realigned Sepulveda Boulevard.



The sweeping curve of the Griffith Park Road overcrossing on the Golden State Freeway.

route as of December 31, 1961, for both rights-of-way and construction, was $153,603,000.

During 1961 two vital links were completed and opened to traffic on the Golden State Freeway: Burbank to Roscoe Boulevards, 3.4 miles, $5,-980,000; and Roscoe to Lankershim Boulevards, 1.9 miles, $3,724,000. Two other jobs, across the Glendale and Pasadena Freeways, were opened to traffic in March 1962 between Pasadena Avenue and Glendale Boulevard, at a construction cost of $21,573,000, adding four continuous miles to the route and filling in the loop portion of the Golden State Freeway.

Plans are afoot to convert the existing 43.6-mile expressway section of the Golden State Freeway to full freeway standards from the north city limits of Los Angeles to the Kern County line. This portion of Interstate 5 carries traffic northward over the Tehachapi Mountains into the San Joaquin Valley and the San Francisco Bay area. At the present time the average daily traffic is 15,000 motor vehicles, but it is expected to increase to 45,000 in the next 20 years. Almost 20 percent of the traffic is generated by commercial vehicles.

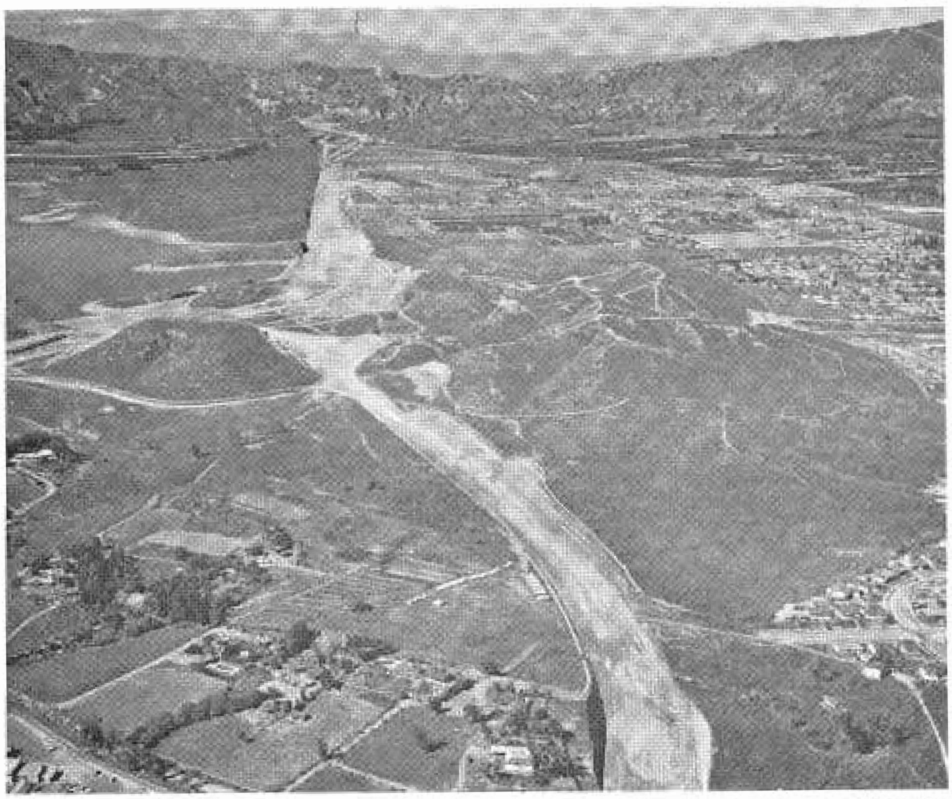
In June 1961 a public hearing covering the northerly 13 miles of the route was held in Gorman. Another hearing on the southerly 18 miles of the expressway section was held on January 4, 1962, followed by a notice of intention by the California Highway Commission to adopt a route. Following formal adoption of a freeway line, all of the route will be under active design. Conversion to full freeway standards will cost an estimated $5,000,000 for right-of-way and $90,-000,000 for construction.

The 1962-63 construction budget provides $5,500,000 for initial work on 4.5 miles of the Golden State Freeway (together with a connection to the future Sign Route 126 Freeway paralleling the Santa Clara River at Saugus-Ventura Road) south of Castaic.

Design is presently under way on the Golden State Freeway south of the Kern County line. At a point seven miles south of the line there will be a connection with the proposed Metropolitan Bypass and the future Lancaster Freeway, which will provide a more direct route to the Antelope Valley and San Bernardino in lieu of passing through the Los Angeles area.

Foothill Freeway

The Foothill Freeway, Interstate Route 210 and State Sign Routes 9



Looking north along construction on the San Diego Freeway at the San Fernando Reservoir (left). This will be the future location of the San Diego-Golden State Freeway Interchange.

and 190, measures almost 53 miles in length from the Golden State Freeway to the San Bernardino County line. Thirty-four miles of the route have been adopted, and a California Highway Commission hearing on a 5.6-mile link (estimated to cost $46,300,000) through the cities of Pasadena and Arcadia was held on March 27, 1962. Except for a short section of the freeway built in the Flintridge-Altadena area in 1955 at a cost of $2,098,000, the freeway is in planning and design stages. Total expenditures on the Foothill Freeway to December 31, 1961, were $10,857,000 for both rights-of-way and construction, with an additional right-of-way allocation in the 1962-63 budget of $7,500,000.

Development of the Interstate mileage of the Foothill Freeway to 4-, 6-, and 8-lane standards from the Golden State Freeway to junction with the future Corona Freeway extension, a distance of 42 miles, is estimated to cost an additional $89,000,000 for construction and $94,000,000 for rights-of-way.

Route location studies for the not yet adopted link of the Foothill Freeway between the completed part across Arroyo Seco Park near the Rose Bowl and Foothill Place near Hansen Dam (10 miles) will be announced in the near future. However, studies for the link between the Colorado Freeway and Arroyo Seco Park (2 miles) are in progress.

Santa Monica Freeway

The Santa Monica Freeway, Interstate Route 10, extends for a distance of 17 miles from Pacific Coast Highway in Santa Monica to the Santa Ana Freeway in Los Angeles. At the close of 1961, $129,090,000 had been expended on this route for rights-of-way and construction.

After preliminary bridge work completed between 1957 and 1959 in the downtown area, the first usable link of the Santa Monica Freeway was completed and opened to traffic on December 4, 1961, connecting with the East Los Angeles Interchange. The one-mile link from 8th Street to Hooper Avenue cost $9,305,000 to construct. In January 1962, another 1.2-mile segment from Hooper Avenue to Main Street was completed at a cost of $7,295,000, followed by the Main Street to Oak Street portion and interchange with the Harbor Freeway, dedicated at special ceremonies by Governor Edmund G. Brown on March 30, 1962. This tail end of the loop measures almost a mile in length and cost $9,360,000 to build.

The San Bernardino-Golden State Interchange. The view is east along the San Bernardino Freeway.

Other jobs on the Santa Monica Freeway west of the Harbor Freeway are in progress under bridge and roadway contracts, pushing completion of the entire freeway westward to the coast by 1965.

These jobs are as follows: Oak Street to Vermont Avenue, 0.6-mile, $4,898,000, estimated completion date June 1962; Hoover Street to Hillcrest Drive, 0.4-mile, $3,874,200, estimated completion date November 1962; and Colby Avenue to 21st Street in Santa Monica, $1,157,200, estimated completion date June 1963. Bids were opened on March 8, 1962, and construction is in progress under a $3,477,609 contract on still another project between Overland Avenue and Sawtelle Boulevard.

Budgetary allotments in the 1962-63 fiscal year plus projects in progress assure the completion of this route to full freeway standards from downtown Los Angeles to the San Diego Freeway. Construction funds allocated, limits and lengths of the projects are as follows, from east to west: $10,800,000, Hoover Street to Fairfax Avenue, 5 miles; $3,700,000, Fairfax Avenue to La Cienega Boulevard, 0.5-mile; $6,700,000, La Cienega Boulevard to Overland Avenue, 2.2 miles; and $7,300,000, Overland Avenue to Sawtelle Boulevard, 2.6 miles. Also, $6,900,000 has been budgeted to acquire additional right-of-way necessary for the Santa Monica Freeway.

The Santa Monica Freeway is an important radial route, forming the most direct route to the beach areas from the central Los Angeles area; it will form the first and most important west-east freeway serving the southwest Los Angeles area, linking the several outlying "belt" routes to the central metropolitan area; allowing a greater variety of alternate routes within the system; and finally forming the main link between the greater Los Angeles area and all points east.

Completion of the last 3.4-mile unit of the Santa Monica Freeway will cost $7,500,000 for construction. Also, an estimated $10,800,000 will be required to purchase the balance of the right-of-way on the entire 17-mile route. These moneys have not yet been budgeted but early financing is anticipated.

San Bernardino Freeway

The San Bernardino Freeway, Interstate Route 10, has been completed for a number of years in this district, from its origin at the Santa Ana Freeway near the Los Angeles River to the San Bernardino County line in Claremont, a distance of 30.6 miles. As of December 31, 1961, a total of $62,322,000 had been invested in this route, including rights-of-way and construction.

The San Bernardino Freeway was put into full operation as a 4- and 6-lane highway prior to 1958 by 13 major contracts amounting to $31,100,000. Before 1961, $5,600,000 had been spent on 28 other contracts for widening, roadside development and other minor projects.

Completed during 1961 were five contracts for median barriers, widening and interchange work in the amount of $4,400,000. Jobs in progress or placed under construction during the year totalled three, worth $400,000. Three more projects were financed in the 1961-62 budget year for $500,000. A widening project between Holt Avenue near Covina and San Dimas Avenue is under $841,850 contract scheduled for completion in September 1962, which will add another lane to the freeway for a distance of three miles.

Future plans call for 10 other projects on the San Bernardino Freeway to include widening, roadside development, median barriers and interchange work to complete the route as an eight-lane freeway (with additional through lanes in critical areas) at a cost of $18,100,000 for construction. Further expenditures for right-of-way to complete this portion of Interstate 10 to full freeway standards are estimated to amount to nearly $12,000,000, primarily for minor realignment and widening.

Santa Ana Freeway

The Santa Ana Freeway, Interstate Route 5, is another freeway that has been in operation as a 4- and 6-lane facility since 1958. As of December 31, 1961, a total of $75,746,000 had been obligated on this 42.8-mile route for rights-of-way and construction from the vicinity of El Toro in Orange County to Spring Street in Los Angeles.

This route, as well as others on the Interstate System, is being modernized to meet growing traffic demands. During 1961 several miscellaneous contracts for improvement of the route were completed at a cost of $939,000, including a widening project between Eastern Avenue and Atlantic Boulevard. At the close of 1961 other similar projects amounting to more than $1,250,000 were in progress, and on February 23, 1962, a $1,169,200 contract was awarded for widening to six lanes of the freeway between South Street in Anaheim and the Santa Ana River, four miles, with an anticipated completion date of November 1962.

On January 3, 1962, a $3,620,000 contract was awarded for improvements of the Santa Ana Freeway in

The Broadway Shopping Center along the Santa Ana Freeway in Anaheim.

The May Company Shopping Center in West Covina along the San Bernardino Boulevard.

the vicinity of Santa Ana River as a part of construction of the Santa Ana, Orange and Garden Grove Freeway Interchange. Additional allocations remain in the 1961-62 fiscal year to complete the interchange and reconstruct the Santa Ana Freeway between the Santa Ana River and Main Street.

The portion of the Santa Ana Freeway between Main Street in Santa Ana and the proposed junction with the San Diego Freeway near El Toro is at present a four-lane facility. Detailed plans for the addition of a median lane in each direction are expected to be completed by March 1963. The estimated cost of the addition of these lanes is $3,500,000 for the 12 miles involved.

After the 1962-63 fiscal year, six widening projects and interchanges are planned for the Santa Ana Freeway to bring it up to interstate standards as a six- and eight-lane freeway. These improvements are estimated to cost $16,100,000 for construction and $11,600,000 for rights-of-way, primarily for future freeway interchanges.

The Sears Shopping Center in El Monte along the San Bernardino Freeway.

Noninterstate Routes

It is evident from the foregoing résumé of interstate routes that continued federal aid at present levels is furthering the rapid development of the National System of Interstate and Defense Highways in District VII to the extent that one-half of the proposed network is already completed and opened to traffic. This network constitutes the skeleton or nucleus of the overall state system of freeways and expressways planned for Los Angeles, Orange and Ventura Counties, representing a combined interstate and noninterstate mileage of 1,577. The key role of interstate freeways in the projected comprehensive network is and will continue to be manifest as noninterstate freeways are constructed to provide interconnecting or system operation.

Good progress is being made on the planning, design and construction of the numerous noninterstate routes in the district. Key links in the freeway system already have been or will be completed and opened to traffic during the course of 1962, some of the more significant of which are as follows:

Ventura Freeway, Telephone Road to Palm Street, 4.5 miles, $8,948,000, September, 1962; Palms Street to west of the Ojai Freeway, 2.7 miles, $6,848,000, July, 1962; Hollywood Freeway to Buena Vista Street, 2.8 miles, $6,479,000, November, 1962; Buena Vista Street to Golden State Freeway, 2.4 miles, $3,811,000, March, 1962.

Glendale Freeway, Los Angeles River to Riverside Drive and Riverside Drive to Glendale Boulevard, 1.3 miles, $3,156,000, March, 1962.

Hollywood Freeway Extension, Vineland Avenue to Chandler Boulevard, 0.7-mile, $2,588,000, August, 1962.

Harbor Freeway, 208th Street to Pacific Coast Highway, 4 miles, $6,035,000, July, 1962.

Newport Freeway, Riverside Freeway to Chapman Avenue, 3 miles, $4,400,000, March, 1962; and Chapman Avenue to Santa Ana Freeway, 3.5 miles, $4,158,000, September, 1962.

Economic Impact

The impact of the freeway network on the growth and economic stature of communities and areas is varied and far-reaching. The picture is not new. The economic strength of our nation has been and is the free flow of interstate commerce over our transportation systems. The economics of transport are time and operating costs. The modern freeway and freeway system reduces both time and operating costs in the motor transportation field.

What are the more immediate effects of these freeways on a community or area? Again it is not a new story but the old one of accessibility to a transportation system. As a new freeway is projected into an area, it increases accessibility to areas of employment and trade. The immediate result is a "spill-out" of population from the more crowded areas. This is particularly true in the Los Angeles area, where the tendency has been to

The Santa Ana Freeway passes through the East Los Angeles Interchange (left foreground). The Santa Monica Freeway connection is to the left, the Golden State Freeway connection is to the right.

suburban type living coupled with the fact that no metropolitan area in the United States is more dependent upon the automobile.

This increase in population soon creates a demand for additional housing and retail business establishments to serve its needs. Major shopping centers appear and offer additional opportunity for local employment and attract customers from other areas—factors which bolster financial economy. These developments also play an important role in the production of public revenues by not only adding their own assessed valuation to the tax rolls, but also by their direct effect of increasing the value of surrounding properties and enhancing their economic stability.

Location of major shopping centers in relation to the Freeway System in District VII provides an illustration of this:

Fashion Square, Santa Ana — Located adjacent to the completed Santa Ana Freeway and the proposed Garden Grove Freeway in an area formerly devoted to a citrus grove. Features a new department store, which draws trade from outside of Orange County, and a variety of high-class specialty stores.

Broadway Shopping Center, Anaheim—Located immediately north of Santa Ana Freeway on former agricultural land. Features a major department store and about 20 other stores.

Eastland Shopping Center, West Covina—Located on the northerly side of the San Bernardino Freeway on formerly undeveloped land. Features a major department store and numerous other variety and specialty shops.

Five Points Shopping Center, El Monte—Located adjacent to the San Bernardino Freeway in an area composed of vacant lots and small single family residences. Features a retail and mail order department store and many other shops.

Sherman Oaks—Located northerly of the Ventura Freeway on property formerly used for a boys' home. This is a new shopping center now under construction.

It will feature a major department store and specialty stores.

It is obvious that the presence of a freeway does not totally determine the location of major shopping centers. The economic impact of the freeway system on the area, however, plays a very important role in creating the need for these centers. Accessibility to the freeway system greatly influences the size of their potential area of service.

Importance of Industry

Industry is also an important factor in the growth and economic stature of a community. Factors affecting industrial growth are: (1) a potential labor market; (2) economic transportation of raw materials to its doors; and (3) rapid delivery of the finished product to marketing centers. The effect of the availability of a freeway facility that is a part of or connects to a national network of freeways, such as the Interstate System, on the transportation factor cannot be overemphasized. By reducing commuting time, the freeway also expands the potential labor market by increasing the area from which industry may draw upon for labor.

Within District VII we note along the Santa Ana Freeway the expansion of the Los Angeles Central Manufacturing District, the industrial development westerly of Buena Park and in the Anaheim area. In the Woodland Hills-Canoga Park area and at Newberry Park along the Ventura Freeway we see new manufacturing centers being established.

In its brochure to industry the Pomona Chamber of Commerce stresses the availability of the existing San Bernardino (Interstate Route 10) and Corona Freeways, as well as the proposed Foothill and Pomona Freeways. In the northeastern section of Anaheim adjacent to the Riverside Freeway a rapid expansion of industrial and manufacturing plants is taking place. In southern Santa Ana near the proposed intersection of the Newport Freeway (under construction), the proposed San Diego Freeway and MacArthur Freeway, a high concentration of new industrial plants is occurring.

Example of Freeway Influence

As an example of the widespread influence of freeways, let us look at the City of San Clemente. This city is essentially a residential and seaside resort community located approximately halfway between Los Angeles and San Diego. In 1955, when the State was acquiring right-of-way for the San Diego Freeway, residential lots of average size could be purchased for $1,000 to $1,500. Today with the completion of Interstate Route 5 between San Clemente and Los Angeles, these same properties sell for $4,000 to $6,000, roughly a 400 percent increase in six years.

What is the story behind this phenomenal rise in property values? Certainly it is not due to the completion of the freeway alone. Improvements in public facilities such as water supply and sewers, increased activities at nearby Marine Corps bases and the phenomenal population increase in Orange County have all played a part.

On the other hand, we do have the situation that in 1955 the nearest major area of employment, the Tustin-Santa Ana-Anaheim area required a commuting time of approximately one hour over a conventional highway, the bulk of which was a two-lane road carrying an appreciable amount of truck traffic. With the completion in 1961 of the last link of the freeway now connecting these two areas, this commuting time has been reduced to an average of 30 minutes. Couple this with the industrial growth of the Tustin-Santa Ana-Anaheim area providing increased opportunities for profitable and stable employment and we can readily see the direct influence of the freeway on the economic welfare of the City of San Clemente.

Local influences within the city itself have been the removal of the through auto and truck traffic from one of the two main business streets permitting a free flow of local traffic. The business district is now expanding along the former highway, which eliminates the necessity of the business district located on the cross street to encroach any further into a desirable residential area.

Reflected in Major Centers

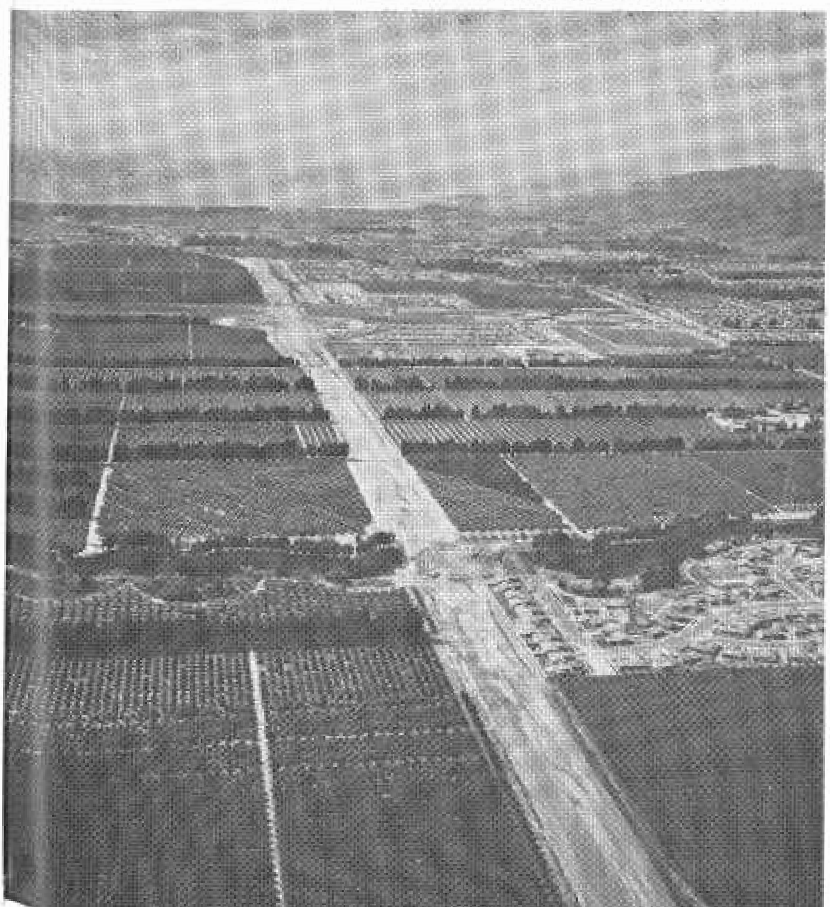
It must be remembered that the economic impact of a freeway system is not confined to the new areas or communities which it makes more accessible. It is also reflected in the major centers from which it emanates and connects together.

Los Angeles, the nation's third largest manufacturing center and second largest population and retail center, has experienced the impact through the increased accessibility to the Ports of Los Angeles and Long Beach by the direct freeway links to them. In particular, the Long Beach Freeway, which also connects directly to Interstate Route 5 (a north-south route) and 10 (an east-west route), is a direct line between the Central Manufacturing District and the Port of Long Beach.

A five-day field survey by the Automobile Club of Southern California covering 342 miles of surface streets and freeways over 17 routes from various suburban areas to downtown Los Angeles during morning and evening peak hours showed these results: With the addition of 47.5 miles of freeway system between 1957 and 1960, an overall average speed was found to be 26 miles per hour as against 24 miles per hour in 1957 in spite of an increase of 11 percent in the number of vehicles in the area.

As more miles of freeway are completed in this area, the reduction in travel time, in spite of increased numbers of vehicles, continues. Through this increasing reduction in commuting time, outlying areas and adjacent communities are becoming more homogeneous and the economic stature of the entire area is increased.

Looking toward Ventura and the sea along construction on the Sign Route 126 Freeway. Cross Street in the foreground is Harmon Baranca.



Construction on the Ventura Freeway in the City of Ventura. The view is westward.

In conclusion, these economic influences are not limited to the District VII area. A study of reports from other areas in the United States all indicate the same economic impact. Through a reduction in time and operating costs for motor transport and individuals, the growth and economic stature of an area is increased by an adequate system of modern freeways.

Route Adoptions

The District VII freeway route planning program is presently being accelerated in anticipation of the continually increasing District VII right-of-way and construction budget and to facilitate district planning with a larger store of adopted routes.

Portions of four freeway routes were adopted during 1961 totaling approximately 25.6 miles and an estimated right-of-way and construction cost of $75,000,000.

A total of eight public hearings were held in 1961, and Highway Commission hearings were held for portions of the Antelope Valley Freeway and Newport Freeway adopted in 1961.

The Highway Commission adopted a 36.3-mile section of the Lancaster Freeway from the Golden State Freeway to the Antelope Valley (estimated to cost $17,000,000) on January 25, 1962, and has just adopted (March 28) a 13.6-mile section of the Simi Valley Freeway across Santa Susana Pass between Madera Road in Ventura County and Mason Avenue in Los Angeles, estimated to cost $29,600,000.

A California Highway Commission hearing was held on 5.8 miles of the Foothill Freeway through Pasadena on March 27, 1962.

The San Diego-Harbor Freeway Interchange. The view is south along the Harbor Freeway.

Route location studies are in progress on 373 miles of unadopted interstate and noninterstate freeways in District VII, representing an ultimate cost of approximately $1,610,000,000.

Construction

During the calendar year of 1961 the district witnessed a period of strongest growth in construction to date. Dollar value of contracts increased from the $180,000,000 set in January to over the $250,000,000 mark in November. (In February, 1962, $251,841,930 was the value of going contracts.) These contracts consisted of freeway work, regular highway work, bridge construction, roadside development, signalization and channelization, federal aid secondary projects, maintenance stations, minor contracts and state park contracts administered by the Division of Highways. During 1961, 148 contracts were awarded for a value of $128,290,000. Of the awarded work, $101,500,000 was for freeways; 121 jobs were completed at a value of $46,581,000, a net gain of 27 jobs over the previous year.

Median Barriers

Installation of chain-link and metal beam median barriers designed to prevent head-on collisions was increased during the year, with much of the work being done on already completed and opened freeways. The work of installing the barriers in narrow medians under high speed traffic presents a difficult problem.

However, at the end of the year approximately 33 miles of median barriers on freeways were completed and an added 42 miles were under construction at a cost of $3,185,000. (See "Barrier Report," *California Highways and Public Works,* September-October, 1961.)

As more median barriers are being erected on District VII freeways, repair costs are mounting proportionately. In fiscal 1959-60 the total cost of repairs was $232,959, of which $145,591 or 62 percent was collectable or collected; in 1960-61 cost of repairs was $280,764, of which $167,197 or 60 percent was collectable or collected from the vehicle owners responsible. Thus, losses to the State over two previous years have amounted to more than $200,000. Any monetary losses, of course, are more than offset by the human factor of the lives saved through the installation of the protective median barrier fences between opposing streams of traffic on our heavily traveled freeways.

Special Studies

In 1961 the District VII Traffic Department completed a joint study with the University of California's Institute of Traffic and Transportation Engineering to develop several techniques for field and office investigation of traffic on freeways.

License plate methods, including dictation into portable tape and wire recorders and high-speed photography, were used to determine travel time and flow percentages on the westbound Santa Ana Freeway between the San Bernardino Freeway Interchange and the 4-Level Structure. Speeds and headways were measured and volume counts taken.

A mailing questionnaire was used to establish surface street paths the drivers took to get to certain onramps of the network. A response of 60 percent of the original mailing of 400 indicated that this particular technique of obtaining the names and addresses of the registered owners for origin and destination questioning was quite effective. The technique has been used since on a much larger scale as a result of the study.

Traffic Counts

Beginning on January 1, 1961, a new state-wide traffic census program was innovated. Traffic volumes after that date were measured fully automatically as opposed to the former mid-July manual count.

Operations section personnel operate 35 control stations, which are counted seven days each month to establish flow patterns on the various state highways in the district. Associated with these stations are approximately 2,700 satellite or profile stations, which are counted for one day only; these data, when correlated with control data, will provide daily traffic flow profiles on all state highways in the district. Utilized for recording control data is a new recorder, which produces raw count data on punch tape for translation onto punch cards required for computer analysis.

Looking south at construction on the Harbor Freeway toward the Pacific Coast Highway. The diagonal road to the left is Sepulveda Boulevard.

For an even more sophisticated approach to measuring traffic volumes on high-speed, high-volume freeways, four permanent stations are operative which use ultra-sonic principles for vehicle detection. Located on the Hollywood, Harbor, Santa Ana and San Bernardino Freeways, ultrasonic sound waves are transmitted and received by detector heads placed over each freeway lane; electronic devices relay this data to the punch tape records providing high counting accuracies.

Also of interest, the district has been conducting a testing program of a new device for multilane traffic detection whose principle is electrical impulses. This is a surface or subsurface installed flat strip containing electric components encapsulated in a plastic compound. By intricate arrangement of components, it is possible to count traffic by individual lane with almost complete accuracy and the values can be recorded by many types of terminal equipment

1961 Average Daily Traffic

Hollywood Freeway (westerly of four-level structure)	195,000
Pasadena Freeway (Elysian Park)	120,000
Santa Ana Freeway (@ Long Beach Freeway)	155,000
San Bernardino Freeway (@ Long Beach Freeway)	125,000
Harbor Freeway (@ four-level structure southerly)	200,000
Colorado Freeway (@ Linda Vista)	24,000
Long Beach Freeway (@ Pacific Coast Highway)	62,000
Using four-level structure	343,000
San Diego Freeway (@ Olympic Blvd.)	72,000
Golden State Freeway (@ Los Angeles River)	85,000
Ventura Freeway (@ San Diego Freeway)	75,000

The Elysian Viaduct on the Golden State Freeway where it crosses the Pasadena Freeway (foreground).

as total volume or by various lane combinations. The product has apparent revolutionary concepts in traffic counting and speed measurement and when fully tested may be widely adopted for traffic counting.

"LARTS" Study

The *Los Angeles Regional Transportation Study* in 1961 made significant progress in developing the information which can be used by State and local agencies in planning for the movement of people and goods throughout the greater Los Angeles area.

Determination of the 1960 average daily traffic and average speeds on the 7,000-mile network of freeways, ma-

STATUS OF DISTRICT VII FREEWAY PROJECTS

Summary as of December 31, 1961

Name of freeway	Route number	Total miles		Completed projects				Under construction			Total obligated cost to date
				Freeway		Expressway		Freeway			
		Planned	Adopted	Miles	Cost	Miles	Cost	Miles	Estimated cost	Right of way cost	
Antelope Valley	23	54.6	54.6		60	0.3	450	14.9	14,791	1,238	16,539
Artesia	175	21.6	18.9		844	4.9	2,324			8,502	11,670
Colorado	161	8.3	7.8	2.3	6,325					2,465	8,790
Corona	77, 240	9.7	4.4			3.2	837			231	1,068
Corona Del Mar	184	6.3	6.3			2.2	215			132	347
Foothill	157, 9, 190	52.7	34.2	2.3	2,409					8,448	10,857
Garden Grove	179	15.4	15.4		1,922					9,630	11,552
Glendale	162, 61, 266	21.8	3.2	1.1	2,914			1.3	3,156	6,798	12,868
Golden State	4, 161	73.2	73.2	17.6	40,057	43.6	6,901	12.0	36,602	70,043	153,603
Harbor	165	22.6	22.6	17.7	42,902			4.5	7,459	52,923	103,284
Hollywood	2, 159	17.3	17.3	10.9	33,946			0.7	2,952	35,578	72,476
Laguna	185	9.4	8.4				570			138	708
Long Beach	167	26.2	21.5	19.7	32,931				22	23,172	56,125
Marina	60	2.6	2.6							180	180
Newport	43	17.7	17.7			3.3	1,772	6.6	8,581	9,513	19,866
Ojai	138	8.2	6.0	2.7	1,360	0.9	376	0.3	909	1,862	4,507
Orange	19, 273	26.9	16.6							3,183	3,183
Pacific Coast	60	112.1	24.3	7.9	3,099					2,831	5,930
Pasadena	165, 205	8.2	8.2	8.2	11,151				1,125	1,291	13,567
Pomona	172, 19	30.0	30.0		45					15,692	15,737
Riverside	175, 43	19.1	19.1	5.7	6,248	13.4	3,920		42	4,939	15,149
San Bernardino	26	30.6	30.6	30.6	43,664				400	18,258	62,322
San Diego	2, 158	93.6	93.6	29.4	42,363			25.7	85,226	92,756	220,345
San Gabriel River	170	29.7	22.6		246					25,007	25,253
Santa Ana	2, 174, 166	42.8	42.8	42.8	55,015				1,331	19,400	75,746
Santa Monica	173, 60	17.1	17.1	1.8	21,048			3.0	25,697	82,345	129,090
Seaside	167	6.8	2.2					1.6	15,683	1,358	17,041
Slauson	221	19.6	0.6								
Ventura	161, 2	75.1	75.1	24.9	34,741	29.7	7,790	12.4	27,656	44,477	114,664
Yorba Linda	176	13.0	3.1							964	964
Route 79	79	51.1	20.6					5.1	4,159	3,568	7,727
Other freeways		398.9									
Totals		1,342.2	720.6	225.6	383,290	101.5	25,155	88.1	235,791	546,922	1,191,158

(COST IN $1,000)

jor arterials and collector roads in the five county LARTS study area is complete.

Five origin and destination studies have been completed and are in various stages of machine processing. Several other origin and destination surveys were conducted in 1961 to determine the travel characterictics of special traffic generators such as shopping centers, Disneyland, Marineland, supermarkets, Los Angeles County Fair and the Newport Beach area. A previous origin and destination survey at Los Angeles International Airport has been recoded to LARTS zones.

A land use survey, which includes an inventory of 1960 land uses in each LARTS zone, is in progress and should be completed shortly.

A floor area study of all buildings three stories and higher in non-residential use is now in progress. (See "L.A.R.T.S. Study," *California Highways and Public Works*, January-February, 1961.)

Conclusion

The three counties of Los Angeles, Orange and Ventura, together forming District VII of the State Division of Highways, are an area of progressive growth and expansion. December 31, 1961 figures indicate 102 incorporated cities inside the District with an aggregate population of 5,878,089, which is an increase of three cities within the past year and an increase in population of 151,669 or 2.6 percent. The total population of the District, including incorporated and unincorporated areas, is 7,379,000, with a motor vehicle registration of 3,978,-700. These same statistics for the previous year were 6,942,000 population and 3,840,000 motor vehicle registration.

The District VII annual freeway-highway budget drafted by the California Highway Commission has been in the $160,000,000 range for the last two fiscal years. The announced 1961-62 budget was $157,500,000, the current 1962-63 budget $163,000,000. Maintaining this level of financing on a year by year basis without any ap-

. . . Continued on page 69

Record Sampling

Highway Testing Program Checks Structural Sections

By LYMAN R. GILLIS, Assistant State Highway Engineer

Prior to the inauguration of the record sampling and testing program, it was generally accepted that roadbed structural layers were being placed within reasonable limits of planned amounts. This deduction was based upon the observed performance of control methods and apparent capabilities of the equipment being used.

In 1959 a limited program of record sampling and testing was initiated in California on an experimental basis to learn more of completed roadway structural sections. This program of record sampling and testing was expanded as a cooperative program with the Bureau of Public Roads to include all grading and paving projects completed after January 1, 1960. The record sampling and testing of the samples has been done by the Materials and Research Department on all major projects including FAS projects, and the results of these samples are charted in Headquarters Construction office.

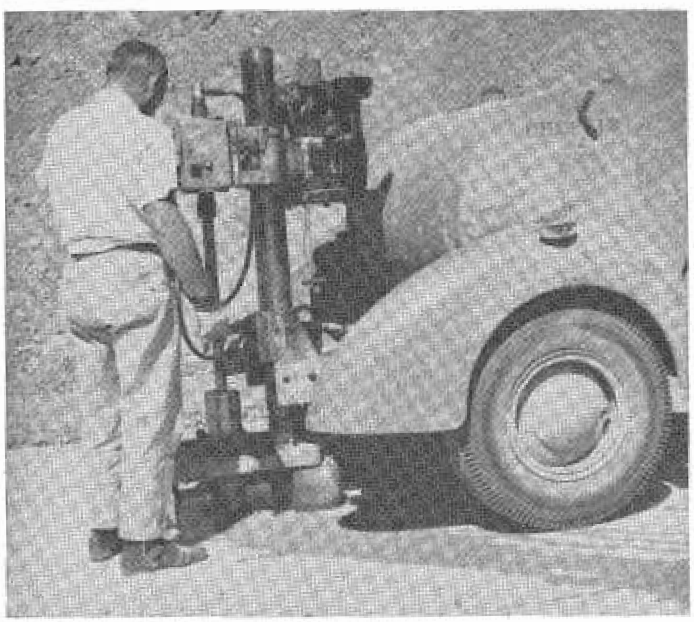
Variations Greater

After obtaining the results of a group of the tests made at the beginning of the current program, it became apparent that the variations reported were greater than had been generally believed were being obtained. With the additional knowledge gained through the record testing program conducted to date, and the efforts made by the state engineers with the cooperation of the contractors, a definite improvement has taken place. Current test results demonstrate that most projects are showing minor variations which are reasonable and practical with the equipment currently in predominant use.

During the period from June 1960 until the present, there have been new methods developed for construction of highways and, after short experimental stages, the product of a majority of these new processes have been accepted by the construction industry and the contracting agency. The new specifications which became effective January 1960 included new controls for placing of both treated and untreated bases and also required more stringent controls on other construction items.

As has been experienced in the past, in order to succeed in the highly competitive field of highway construction, the contractor is always seeking new methods and equipment which will permit increased production rates without increasing his costs. The equipment industry is called upon to develop or furnish equipment which will not only permit increased production, but will encourage adoption of new methods and materials to permit production beyond those required for balance of costs.

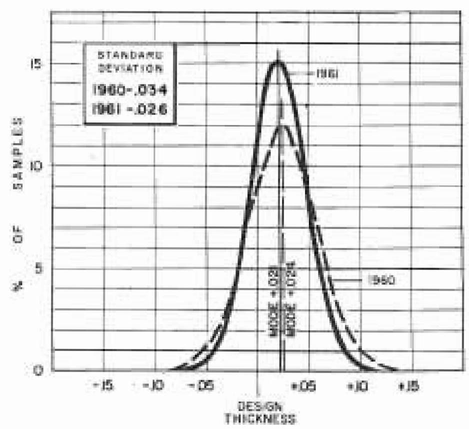
The contracting agency in the meantime is requiring conformance with specifications. Contract specifications must be written to allow the use of new methods and equipment that will produce the desired results if



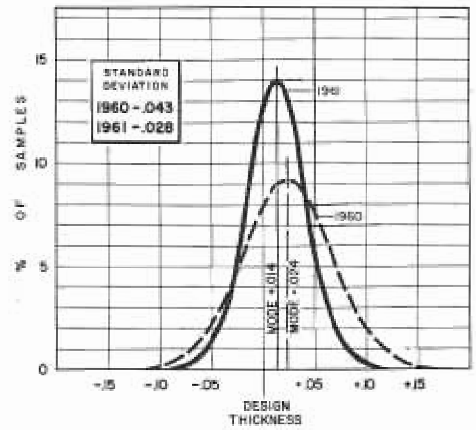
A closeup of the drilling machine used to cut cores through completed concrete pavement in order to measure layer thickness.

A hole cut in the completed lower portion of the structural section prior to placing the P.C.C. surfacing layer. The hole exposes the planes between each structural layer from which the layer thicknesses are measured.

SURFACE

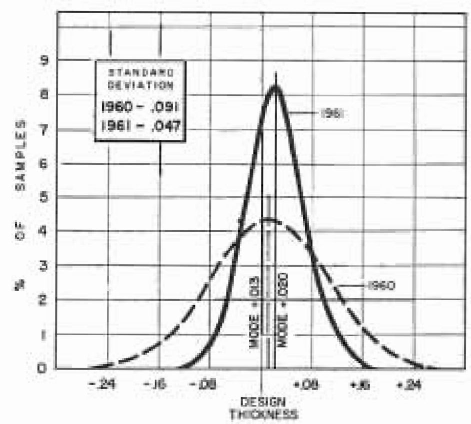


Portland Cement Concrete

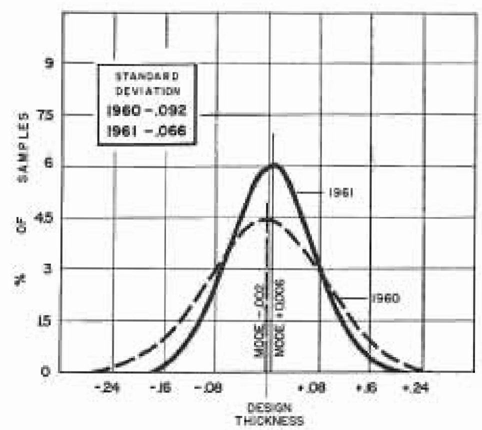


Asphalt Concrete

BASE

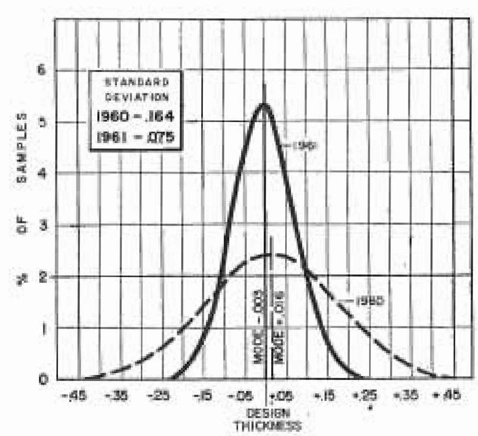


Under P.C.C.

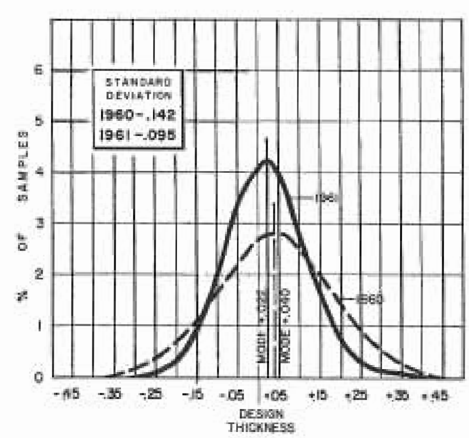


Under A.C.

SUBBASE



Under P.C.C.



Under A.C.

progress is to be made in highway construction without forcing contract prices to increase.

New Equipment Adopted

As a result of these incentives, new equipment has been adopted on state contracts for spreading untreated base material and for mixing and spreading treated base materials. New methods and equipment have been used on placing pavement, both asphalt concrete and portland cement concrete. All of these have been placed in operation and their product accepted since the 1960 Standard Specifications have been effective.

In order to gain a visual concept of the degree of improvement realized by these improved techniques and equipment, the accompanying bell-shaped or, theoretically, normal frequency distribution curves, have been developed from the record sampling and testing results obtained in 1960 and compared with those taken through September 1961.

The many measurements made upon the completed structural sections were tabulated in a manner to give the number of measurements in each .01′ increment of variation from the planned amount for each structural layer. The number in each increment was then reduced to a percent of the total samples for the particular period and structural layer under consideration. From these actual data reduced to a percent of the total, the "normal" or theoretical frequency distribution curve was mathematically fitted to the actual data resulting in the curves shown. In this manner, all curves are reduced to a so-called common denominator and a uniform pattern so that any curve may be compared to all other curves on an equal basis.

Measured Variation Indicated

The interval shown on the horizontal or X axis indicates the measured variation from the planned amount. For example, where in a particular project the measurement reported for a particular structural layer was exactly equal to the planned amount, the variation would be recorded as 0.00′, whereas if a particular structural layer measurement was reported as being 0.55′ while the planned amount for the same structural layer was 0.50′, the variation is indicated as being +0.05′.

The vertical or Y axis represents the magnitude of the number of samples expressed as a percent of the total for the period and layer involved for each increment of variation. In order to judge the relative degree of improvement, an optimum condition would be a condition where all or 100 percent of the measurements were exactly as planned, in which case all points would lie along the line extending vertically from the 0.00′ interval on the horizontal axis, and the vertical line would extend to the 100 percent point on the vertical axis.

The mode is the value of the interval upon which the greatest number of samples fall. This value is reported for each comparison period and structural layer presented in the graphs. As the mode approaches the 0.00′ ordinate or optimum condition on the horizontal axis, it indicates that more samples are being measured closer to the planned amount.

Standard Deviation Presented

In addition to the mode, the standard deviation is presented for each curve. The standard deviation is a mathematical measure of the average deviation from the mean. In curves showing a normal distribution, such as those presented here, the mode is equal to the mean. If a distance equal to the standard deviation is measured from both sides of the mean along the horizontal axis, approximately 68 percent of the samples will be within these limits. As the standard deviation becomes smaller then it indicates that the variation between samples is smaller. Another way of describing the significance of the standard deviation is that as the value of the standard deviation becomes smaller, it indicates that the samples are being grouped closer to the mean.

Each graph presents a dashed line curve based upon data obtained in 1960 with a solid line curve superimposed on it based upon data obtained in 1961. Separate *groups* of charts are presented for the asphalt concrete structural sections and for portland cement concrete structural sections with each group showing the variations from planned thickness for the surfacing, base, and subbase layers. For ease in comparing the same relative layer of the structural section, the graphs are arranged so that the thickness of the asphalt concrete surfacing may be compared with the thickness of the portland cement concrete surfacing; thickness of base under asphalt concrete pavement with thickness of base under portland cement concrete pavement; and thickness of subbase under asphalt concrete with thickness of subbase under portland cement concrete.

Reader May Confirm

With this brief background of the meaning of the charts, the reader may confirm the following evaluation of the record test results. An examination of the various charts presented indicates that the samples taken in 1961 in every case showed improvements over those taken in 1960. This is evidenced by the mean or mode approaching the optimum ordinate of zero variation from the planned amount. It will be noted that this improvement is evidenced for each of the 1961 layers. In addition, the standard deviation for 1961 is less than that computed for samples taken in 1960, indicating less variability in each case. This indicates a condition of improvement along not one, but two phases of the operation, namely that the planned amount is being approached and it is being approached with less variation between samples.

The above evaluation can only result in the conclusion that improvement is being achieved in the production control phase of construction. Improvement of this nature can only be the result of the combined co-operative efforts of both the contractors and state construction personnel.

Through this research and combined effort a measure has been obtained of practical thickness tolerances which are consistent with available equipment and developed methods.

The resulting knowledge of practical tolerances will assist in preventing thickness deficiencies in base and surfacing and will provide a better basis for structural design.

Extra Lanes

Passing, Chain Control Areas On US 50 Prove Their Worth

By DAVID E. CURRIER, Resident Engineer

A total four miles of new four-lane chain control and truck passing sections completed last summer on US 50 in central and eastern El Dorado County proved their worth this winter in expediting traffic during the heavy snow season.

The six locations are shown on the two accompanying maps.

The route between Placerville and Lake Tahoe, adopted in 1895 as California's first section of state highway, traverses the Sierra Nevada range and is heavily traveled by trucks (14½ percent of total volume), both interstate transports and local logging and timber rigs operating in the surrounding forests.

Also, the increasing development of subdivisions and recreational facilities in the Echo Summit-Lake Tahoe region has made it a major year-round residential and vacation area—resulting in growing traffic volumes which are especially heavy on weekends.

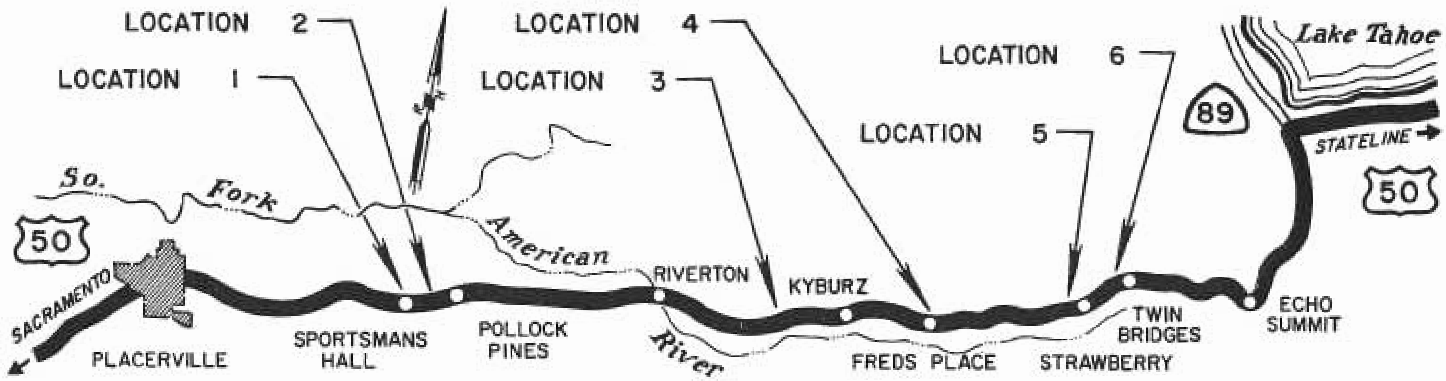
Between Placerville and Nevada, a distance of about 63 miles, US 50 is mainly two-lane conventional highway of inadequate width and minimum shoulders. Exceptions are the stretches from Placerville to east of Camino and from Pollock Pines to Riverton which are four-lane expressways. Funds for any extensive freeway construction are not considered imminent.

Route Elevations

From the 2,000-foot elevation at Placerville, the route climbs to about 3,700 feet at Sportsmans Hall and peaks at around 4,200 feet a short distance east of Pollock Pines. The descent to Riverton takes motorists to about 3,200 feet where the road crosses the south fork of the American River and begins climbing to Kyburz at 4,100 feet. From there it is a continual upgrade to approximately 6,200 feet at Twin Bridges. Further east is the top of Echo Summit at 7,377 feet.

The result of the two peaks and intervening valley is that the snowline is sometimes such that chains are necessary to negotiate the climb in the Sportsmans Hall-Fresh Pond area, yet there will be tractionable pavement on the approximately 15 miles to Kyburz where chains will be again required.

The eastbound chain control lane on US 50 at Strawberry during a snowstorm on February 6.



The new widened sections of US 50 between Sacramento and Lake Tahoe are indicated on the above map. Locations 1, 2 and 5 are chain control areas; Locations 3, 4 and 6 are passing lane areas.

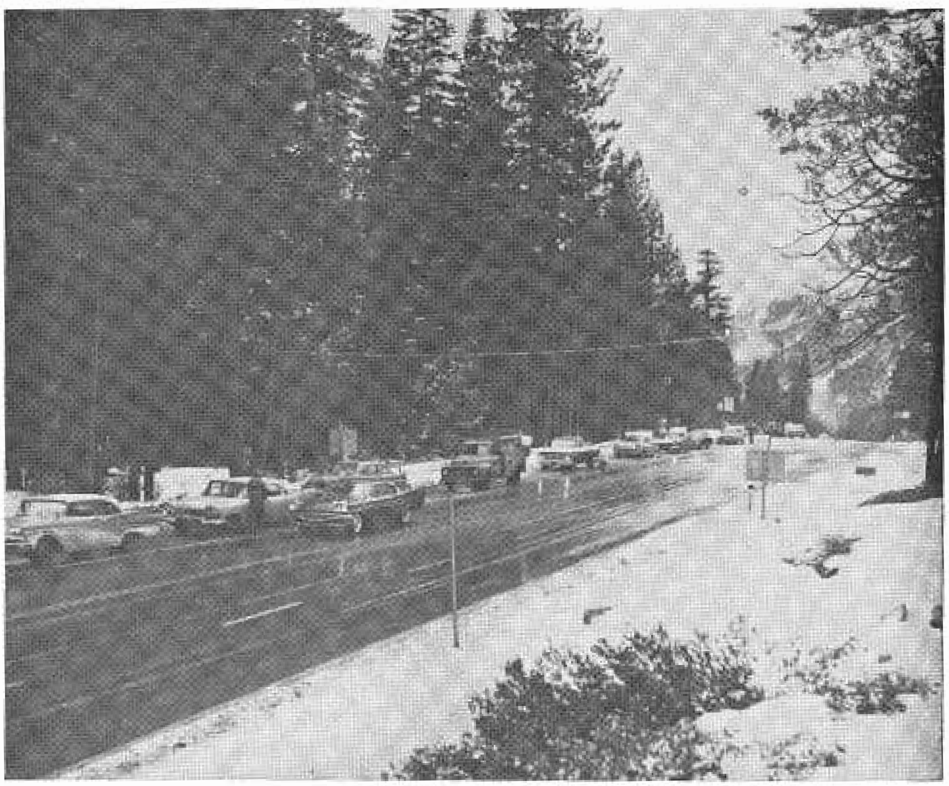
Another result is the larger number of chaining areas than ordinarily would be found along a route of this length and elevation.

The six new facilities extend and widen previous chain control and passing lanes which had become inadequate due to the increased traffic.

Because of the insufficient length and width of these former chaining lanes, cars often parked on the highway itself, causing hazardous situations. The new lanes range from 1,700 to 2,100 feet with widths the same as passing lanes. During snowfree months these can also be used as turnouts for trucks and other slow-moving vehicles. Shorter chain changing lanes still exist at four other locations.

Former Lanes Inadequate

The former passing lanes were short three-lane sections which became inadequate to speed up the long slow-moving queues of cars that formed behind trucks and trailered vehicles on some of the sustained grades along the route. Each year it was taking longer and longer to drive across El Dorado County, both in summer and winter.



A portion of the Twin Bridges passing lanes being used as a chaining area for the climb over Echo Summit. The cars are headed east.

These passing lanes now range from 4,200 to 4,900 feet in length and permit passing for both eastbound and westbound traffic simultaneously. In effect, each new section provides nearly a mile of four-lane highway with excellent vertical and horizontal sight distance.

In addition to eliminating much of the former congestion, providing safer parking areas for mounting and removing chains, and lessening the driving time between Placerville and Lake Tahoe, the improved facilities will also reduce maintenance costs at Twin Bridges.

Formerly there was a vertical cut through a rock outcropping about 250 feet in length and averaging 20 to 28 feet in depth. During snowstorms wind would funnel through the cut, piling up extremely heavy drifts which closed the road. Rotary plows were useless because the vertical cut permitted no throw space. The drifts had to be repeatedly removed by tedious and time-consuming push plowing with truck-mounted blades and motorgraders. Widening the cut and flattening the slopes by extensive blasting now allows rotary snow removal, freeing personnel and equipment for other troublesome areas.

Structural Section

In general the structural section of the widened areas consists of three inches of asphaltic concrete on a lime-treated base which is eight inches deep under passing lanes and six inches under chain control lanes. At the same time, the existing highway was given a one- to three-inch blanket for the length of each location.

The use of lime-treated base on a heavily traveled highway is unusual in District III and was done on an experimental basis. Lime was added to dry aggregate in the proportion of five per cent by weight of dry material, and mixed in one layer for the six-inch sections and in two layers for the eight-inch depth. Prior to surfacing, the base was primed with SC-2 at the rate of 0.25 to 0.35 of a gallon per square yard with good penetration.

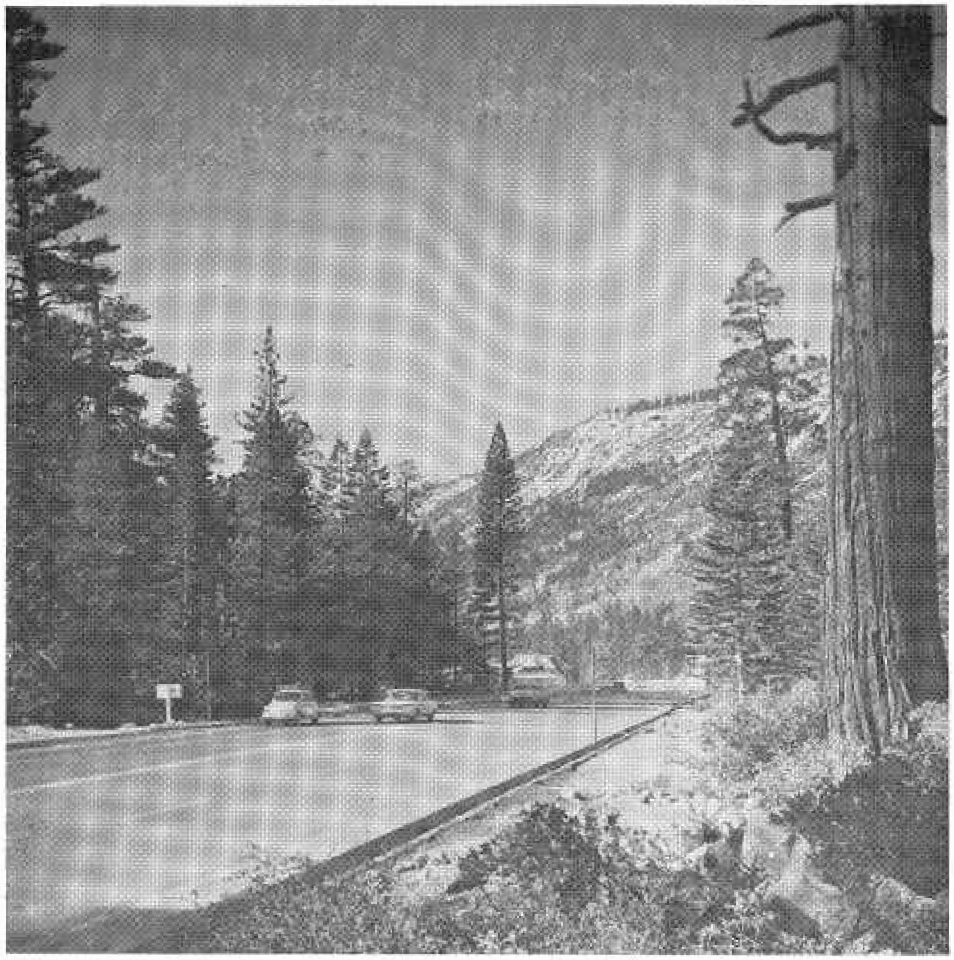
The lime was spread using a modified asphaltic concrete spreaderbox chained beneath bottom-dump trucks and dragged along the grade. This proved to be an unsatisfactory technique for several reasons: The grade had to be compacted before the box could be pulled over it. Once it started, the lime had a tendency to flow like water, spilling over the box to the extent that the amount of lime spread depended on the speed of the truck, the gate opening, and the setting on the box.

Spreading Control Needed

A more positive control of spreading rate needs to be developed, perhaps similar to the augering method used for cement. The modified spreader box was used because it was discovered that it takes an excessive amount of time to transfer lime through a standard eight-inch cement bazooka to a distributor truck, apparently due to its lighter weight (35 pounds per cubic foot) and other physical properties.

After the lime had been spread, the base was scarified and shaped into one or more windrows which were mixed with a Woods-Pettibone Model 54 Mixer. Water was added at the mixer in the amount normally required for optimum moisture. However, compaction was very difficult until more water was added. The treated material was bladed to one side and compacted in thin lifts by pneumatic, segmented, and vibratory type rollers. None was successful when the material contained normal optimum moisture. All were successful when additional moisture was introduced into the treated material.

The contractor found it difficult to mix the full depth in some areas due to inadequate scarifying and it was necessary to remix. Where this was required, the treated base broke out in good sized chunks which had to be crushed with a 26-ton segmented wheel roller.



Looking west at passing lanes at Location 6 near Twin Bridges. The photo was taken at the beginning of February before the heavy snows began. By mid-March the snow pack here was 49 inches.

Samples Tested

Samples of lime were taken from each truck to be tested at the jobsite the first day and at the Sacramento materials lab on following days to check for the specified 85 per cent minimum of calcium hydroxide. All tests were satisfactory with the average above 90 per cent.

Depth of lime treatment was checked by dribbling phenolphthalein down the sides of test holes. The solution turns red in contact with lime; otherwise it is colorless. This test worked very well.

Because of the great distance (31 miles) from one end of the project to the other and due to the high traffic volumes, the contractor experienced some difficulty in maintaining a balanced operation and production rates were low. However, this was anticipated because of hazardous blasting conditions, heavy traffic problems with time lost in equipment delays, the scattered locations, and the mountainous location of the project. And it was reflected in higher than usual unit prices.

The contract was done as a joint venture of I. L. Croft & Son, Inc., and Union Construction of California, of Saugus, at a cost of $510,000.

TUNNEL 40% COMPLETE

The Division of San Francisco Bay Toll Crossings reported that in March the lowering of the upper deck pavement through the Yerba Buena Tunnel of the San Francisco-Oakland Bay Bridge was 40 percent complete. The Division had five contracts of a total value of $23,087,441 under way in the project to convert the bridge to one-way traffic on each deck.

14th I.T.T.E. Meet

Stresses Urban Problems

THE EVER-INCREASING problem of the city, and what to do about transporting its people and goods, was echoed in the addresses of speaker after speaker at the Fourteenth California Street and Highway Conference this year.

Hundreds of state, county and city traffic engineers, as well as representatives of many private organizations, attended the three-day meeting January 25-27, on the University of California at Los Angeles campus. The meeting was sponsored by the Institute on Transportation and Traffic Engineering and the University Extension, University of California.

Many Well Known Speakers

Speakers included Rex M. Whitton, Federal Highway Administrator; State Senator Randolph Collier, Chairman of the Transportation Committee; State Assemblyman Jack Beaver, Chairman of the Assembly Transportation and Commerce Committee; Douglas J. Carroll, Jr., Direcor, Chicago Transportation Study; Richard Zettel, Research Economist, I.T.T.E.; Joseph E. Havenner, General Manager, Automobile Club of Southern California; Carl Fritts, Vice President, Automobile Safety Foundation, Washington, D.C.; Ellis L. Armstrong, President, Better Highways Information Bureau, Washington, D.C.; and Captain Joseph A. McHenry, U.S. Navy, retired, Assistant Vice President of J. H. Pomeroy & Co., Inc. Many city, county, and state engineers presented papers in the various discussion groups held during the afternoon sessions.

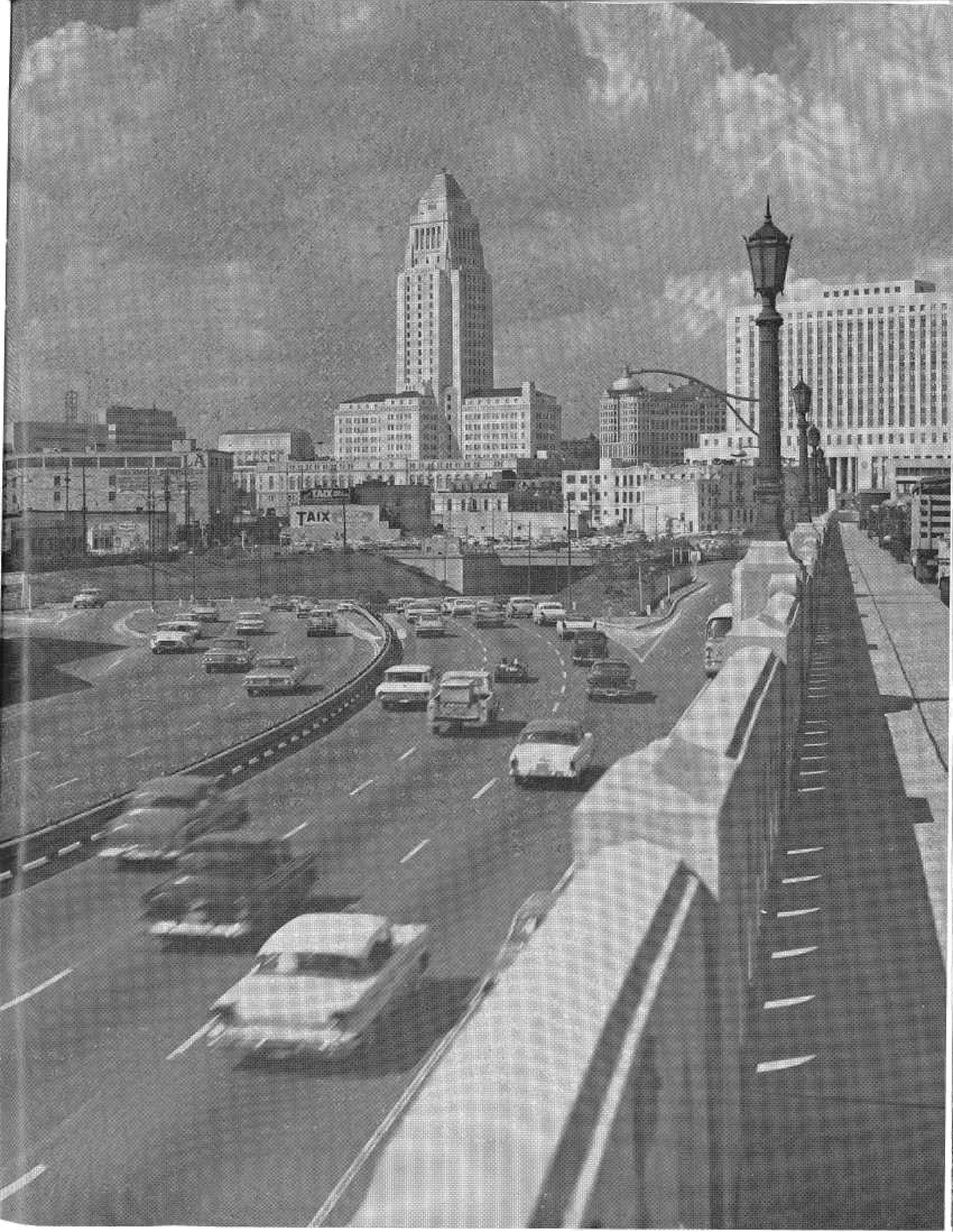
In the opening address, Mr. Whitton spoke on Highway Transportation Planning, but generally confined his talk to aspects of such planning in urban areas. Speaking of the current tendency to blame our urban transportation problems on the automobile, Mr. Whitton said:

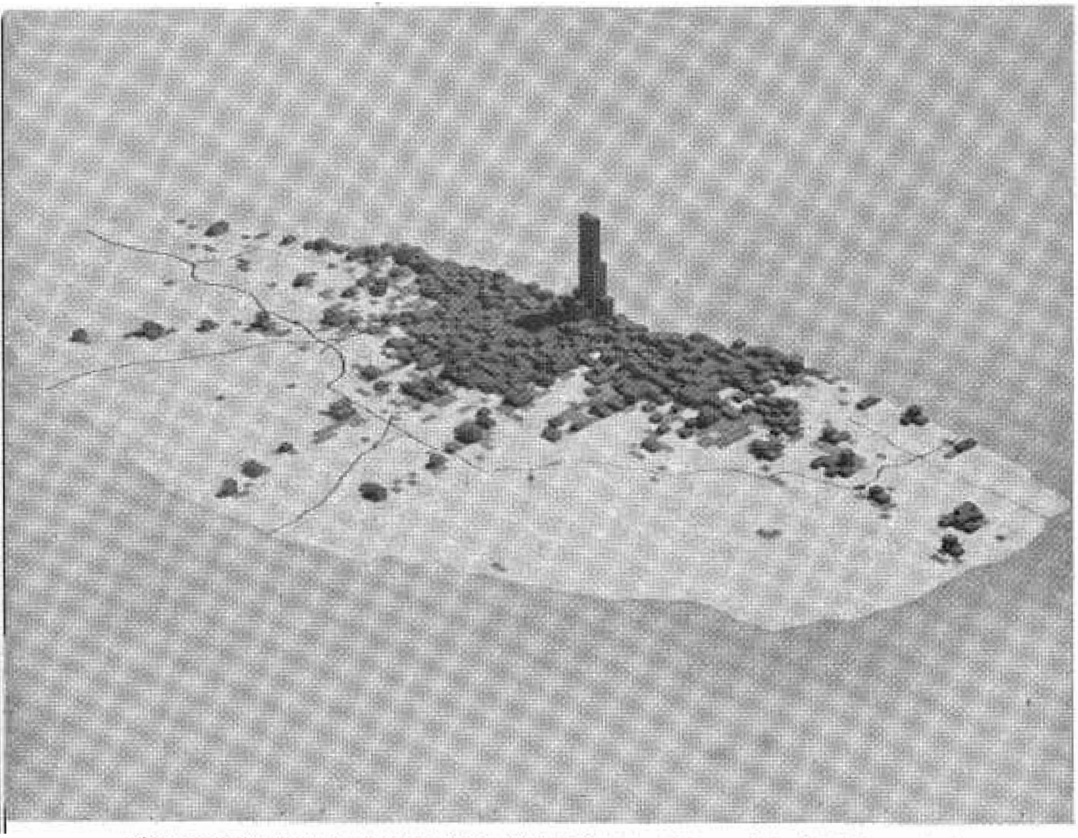
"If I were going to try to fix the blame for what has happened in our cities, I'd be inclined to pin it not on the Duryea Brothers, who built the first automobile in 1893, but on Elisha Graves Otis. In case you don't recognize that name, Otis built the first passenger elevator, in New York City back in 1857. He is the man who launched the vertical transportation system which made high-rise buildings practical. I conclude then, that the elevator is responsible for urban congestion.

"Now this may seem a little silly to you, but it's no worse than blaming the automobile. For better or worse, the elevator has helped to change our way of life and it is obviously here to stay . . .

Automobile Here to Stay

"I'm satisfied that the automobile is also here to stay," Mr. Whitten said, "and we must plan accordingly . . . Our urban areas—and our highways—have grown like Topsy, in many cases, without guidance or pattern. It is cer-


TAIX



This model shows the distribution of the 10,212,000 person trips made in the Chicago study area on an average work day in 1956. The highest blocks represent 144,000 trip destinations per quarter square mile grid, the lowest blocks 5,000, the shaded areas less than 5,000 but more than 2,500.

tain that they are going to keep on growing . . . Highway planning obviously must be a part of broader transportation planning, which in turn must be a part of general planning of the urban area as a whole.

"This is not primarily an area for isolated, ivory-tower research, however," Mr. Whitton stated. "The cities and their people are necessarily our laboratories.

"At the risk of belaboring the obvious, I reiterate that co-operation is going to be the foundation of any success we may achieve in planning and in putting that planning to use. All who are concerned must put aside emotional attitudes and snap judgments. Only through harmony, mutual respect, acceptance and use of real and unvarnished facts, and also the willingness to make honest compromises, can we hope to attain success . . ."

Senator Collier reviewed legislation of recent years, and said that three major goals had been accomplished: (1) modernization of the Mayo formula (for distribution of state highway construction funds) should be satisfactory for a long time to come; (2) establishment of a State Highway Transportation Agency (although the Senator would have preferred a *transportation* agency he said) and (3) passage of Senate Bill 1217 which provides $100,000 for highway safety research.

"From what I have seen," the Senator said, "a thoughtful program is being developed in several promising directions; and the departments involved are working more closely together and with other specialists than ever before.

State Freeway Program

"The magnitude of our state freeway program is staggering," Senator Collier said, "and bears constant repeating—more than 12,000 miles of limited access highways costing more than $10.5 billion and designed to accommodate 17 million vehicles. . . .

"The important thing is that we remember the basic reasoning upon which the program was predicated: First, that a statewide freeway system will provide the best bargain for those who pay the bill—faster, safer, and more economical transportation service. Second, that the establishment of our basic arteries and early acquisition of the necessary rights-of-way will be least disruptive to our economy in the short run and most beneficial in the long run. We cannot allow this program to be interrupted."

The Senator discussed tax legislation and possible tax measures at some length, concluding that the defeated 1961 proposal for financing local roads must be said to be one that would have "added another dull patch to a crazy quilt of intergovernmental fiscal relations in the highway field. A bold new program—one that stirs the imagination — may have a better chance."

Assemblyman Beaver, as Chairman of the Assembly Transportation and Commerce Committee, emphasized the importance to local officials of keeping their Assemblyman informed on road matters. He urged particular attention to educating newly elected representatives on statewide problems.

Los Angeles Regional Transportation Study

On Friday morning, Fritz Zapf, City Engineer of Pasadena, discussed the benefits of the Los Angeles Regional Transportation Study, more commonly called "LARTS," which is being co-ordinated by the California Division of Highways, with co-operation from the Federal Bureau of Public Roads. Participating counties are Ventura, Los Angeles, Orange, San Bernardino, and Riverside, with 110 cities in these counties also participating.

The purpose of the LARTS study is to determine the transportation needs of the area for 1960, 1965, 1970, 1975, and 1980, with some extrapolation into the future beyond 1980. Modern high-speed computers and the latest study techniques are used to analyze and relate the movement of persons and goods to land use.

From this study a land use model will be developed to project and distribute changes in population, employment, and land development. Factors used in arriving at these analyses are distribution of past, present, and proposed land use; employment; population; land costs; topography; and the availability of water, sewers, highways, etc.

Mr. Zapf pointed out that approximately 8 million persons are now living in the area encompassed within the study, and that by 1980; 15 million people will inhabit the area. There are currently 4 million motor vehicles in the area under study which will increase to about 8 million in 1980. In terms of area and numbers, this transportation study is by far the largest undertaking of its kind in the world.

Continuous Planning Operation

"The study is intended to be a continuous planning operation," Mr. Zapf said, "utilizing new data at regular intervals and leading toward greater refinements of study techniques. The first two-year phase of this study will be oriented primarily toward vehicular travel, including trucking and mass transit. Subsequent phases are planned to include the possibility of other modes of travel and any other likely innovation in the movement of people and goods."

Four basic and immediate uses of the study are (1) furnishing a pattern for the movement of people and goods in the area during the study years; (2) analysis of the vehicular transportation needs on a local and regional basis, as well as daily traffic volumes on freeways, major arterials, and collector streets; (3) evaluations of present and future land use plans, as proposed by local planners in terms of transportation needs; (4) detailed information on population, employment, motor vehicle ownership, etc., plus an inventory of land use for every local community concerned.

The other featured speaker Friday morning was Dr. Douglas J. Carroll, Jr., Director of the Chicago Area Transportation Study.

In the Chicago study much concern has been given to intercity movement which develops at entries to the 30-mile square area. Airports, docks, and railway stations are all considered entries or "gates" to the city.

Special charts of desire lines have been made by a magnetic tape process which gives a very fine white line on the black background for each trip. The result, as Dr. Carroll pointed out, is somewhat as though each vehicle had a small light on its top and was photographed at night from several miles above the city with a time exposure. Dr. Carroll showed slides of these charts, also slides of a special three-dimensional model of destination studies which adds a thin layer for each vehicle destined for that spot. When the study is complete, the three-dimensional representation bears a startling resemblance to a city skyline with tall skyscrapers in the city center.

Public Transport

In the Chicago area, public transport handles most of the movement of persons who work in the city's center. This is because Chicago is a relatively old city compared to West Coast cities, and the development of transportation routes in the early days stimulated residential development along their lines. The study shows that this pattern will be about the same in 1980. The great increase in automobile traffic in the same period must be met by development of new high-speed routes with limited access which draw traffic off the city streets where the bulk of deaths and accidents occur.

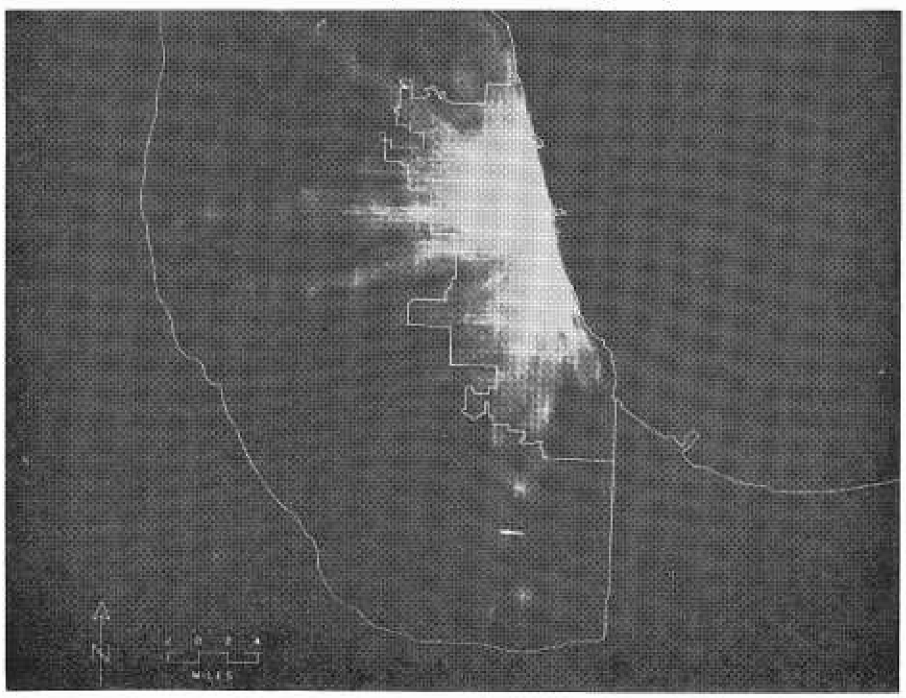
Doctor Richard Zettel, Research Economist of the Institute of Transportation and Traffic Engineering, talked on intercity freight transport which he said was harrassed by extravagant claims and counter claims. One of the dangers that Dr. Zettel fears in urban planning is an increasing tendency toward considering urban freight transport as separate from economic transport.

Piggy Back Loadings

In Dr. Zettel's opinion, the intercity transport of goods will continue to be generally by truck and generally short haul. In this connection, he pointed out that the extravagant estimates a few years back on the potential of "piggy back" freight movement probably would not be realized. Piggy back loadings today are running about 550,000 to 600,000 per year, but this figure may be tapering off, and even now represents less than 2 percent of truck freight movements.

Keynote speaker on Saturday morning was Ellis L. Armstrong, Head, Better Highways Information Bureau, Washington, D.C. Mr. Armstrong's talk was on "Government Controls on Federal-aid Highway Projects." "To survive," Mr. Armstrong said, "a program must be in the public interest, and must advance the basic fundamental goals and progress of the public. No program or service, no method of providing the program or service, or for that matter, no part of our government itself, has an inherent right to be perpetuated unless it is to the public advantage—and unless it is so understood by the public."

This graph summarizes the concentration of average weekly travel by rapid transit, by bus, by automobile drivers and passengers in the Chicago study area.



Highway Week

President Designates May 20-26; Governor Sets State Observance

The week of May 20-26, 1962, will be observed in California and throughout the nation at the second National Highway Week, having been so proclaimed by President John F. Kennedy.

Keynote for California's observance was set by Governor Edmund G. Brown in a statement issued in April (*see adjoining column*).

Organizations interested in the highway program in California, particularly in the southern part of the state, are planning various events to highlight the observance, as was done last year. Emphasis in many areas will be on local highway progress.

District offices of the Division of Highways are co-operating in the observances in various communities.

Text of the President's proclamation follows:

"WHEREAS our Nation, with its expanding economy and growing population, is largely dependent on its highway network for the safe and efficient movement of people and goods; and

"WHEREAS the inadequacies of our present highway network are responsible in large degree for one of the great American tragedies of our time—the costly and inexcusable annual toll of deaths and injuries on the highways; and

"WHEREAS the Congress, at my request, last year made financial provision for completing the finest road network the world has ever seen, geared to our future as well as present needs; and

"WHEREAS the American people should be reminded of their vital interest in this program and the boundless benefits it will produce:

"NOW, THEREFORE, I JOHN F. KENNEDY, President of the United States of America, do hereby proclaim the week of May 20-26, 1962, as National Highway Week in recognition of the vital role of highway transportation in our way of life; and I urge the Governors of the States and mayors of cities to issue similar proclamations.

"I also ask the appropriate officials of the Federal, State, and local governments, as well as public and private organizations and the general public, to join in observance of this significant occasion.

"During this period I encourage all Americans to consider and appreciate the value of highway transportation to their own activities and to our national welfare."

As was the case in 1961, the nationwide effort to observe National Highway Week has been given major impetus by the Better Highways Information Foundation. This is an organization based in Washington, D.C., and interested in the cause of highway improvement.

The B.H.I.F., in literature, posters and radio and television programs, has called attention to the fact that "Better Highways Now—Save Lives, Time and Money" as a theme for National Highway Week this year. Ellis L. Armstrong, former U. S. Commissioner of Public Roads, is president of B.H.I.F.

EDMUND G. BROWN
GOVERNOR

State of California
GOVERNOR'S OFFICE
SACRAMENTO

California's more than 9,000,000 registered motor vehicles make this a highway-minded and highway-oriented state. It is not surprising that we have the finest state network of toll-free, pay-as-we-go modern highways in the nation, with 2,400 miles of divided highway in operation, most of it of the freeway type. We have thousands more miles under construction or on the drawing boards in accordance with a well-established, long-range plan.

The efficient mobility which these freeways give us is gratifying but it is not the whole story. We are building every possible safety feature into them--and they are saving hundreds of lives every year. We make them serve the whole community as well as the motorist. We insist that they be attractive as well as functional.

President Kennedy, in his proclamation of May 20-26, 1962, as National Highway Week, cited the "boundless benefits" our planned road network will produce when it is completed. Californians have already reaped substantial benefits in terms of lives, time and money saved and jobs and opportunity enhanced through the freeways and other modern highways we now have.

As Governor, I encourage all interested groups and individuals in California to take part in the events scheduled in observance of National Highway Week, and especially to take this occasion to inform themselves more fully concerning the progress of our State Highway Program and its importance to our safety and prosperity.

EDMUND G. BROWN, Governor

HIGGINS LEAVES; BURRILL IS SUCCESSOR

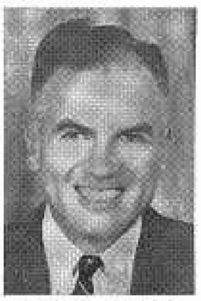
E. Roy Higgins, who has been supervising the fiscal aspects of California's state highway program for the past 31 years, retired from state service on February 28.

Appointed to succeed him is John C. Burrill of San Francisco, who recently terminated a 24-year career as an officer in the U.S. Navy.

E. ROY HIGGINS

Higgins' total length of state service is 40 years. He is a charter member and past president of the California State Employees Association and has been active in a wide range of state and civic affairs in the Sacramento area.

Higgins was born and raised in Healdsburg, Sonoma County, and received his bachelor of arts degree from the University of California in 1919 after serving in the Army in World War I.



JOHN C. BURRILL

His first accounting jobs were with the U.S. Shipping Board and a steamship company. He became an accountant for the State Department of Finance in 1922 and moved to the Department of Public Works as chief accountant in 1928. Three years later has was named comptroller.

At that time the Division of Highways had a total annual budget of about $30,000,000. The division's current annual budget, covering a wide range of functions, is more than $650,000,000. Higgins has had the responsibility for planning, organizing and directing the accounting and other fiscal operations for the division. He has also been responsible for investing available state highway funds in short-term interest-bearing securities, and for administering revenue bond issues of the California Toll Bridge Authority.

Higgins was one of the founders of the California State Employees Association in 1931 and has been active in its affairs ever since, including a term as state president in 1935. He also helped organize the State Employees Credit Union No. 1 in 1932, has continuously been one of its directors, and became its president in 1960 after nine years as vice president.

When the City of Sacramento took over operation of bus service in the area in 1955, Higgins was appointed by the City Council as a member of the new Sacramento Transit Authority. He has since been twice reappointed, and has served a term as chairman.

He has served on the executive board of the Golden Empire Council, Boy Scouts of America, since 1941 and as president of the Golden Empire Council, his service being recognized by the Silver Beaver Award; director for several years of the local United Crusade and its predecessor, the Community Chest; membership on the Sutter Hospital Advisory Committee since 1952; and director of the Sacramento County Appeals Review Board since 1945. He is also treasurer of the Sacramento Council of the Navy League.

Higgins is a member of the Sutter Club (director for three years), University Club, Elks, American Legion, State Men's Club and Sacramento and Fort Sutter Yacht Clubs.

Since 1928 he has been a member of the Uniform Accounting Committee of the American Association of State Highway Officials.

He and his wife Helen live in Sacramento. They have two children, Donald R. Higgins of San Rafael, a senior bridge engineer for the Division of Highways, and Mrs. Shirley J. Black of Walnut Creek; and six grandchildren. A freighter trip around South America is the first item on the Higgins' retirement agenda.

Burrill, Higgins' successor, was a captain in the U.S. Navy Supply Corps, serving with the Western Sea Frontier.

Born and raised in Milwaukee, Burrill was graduated from the U.S. Naval Academy in 1938 and the Naval Supply and Finance School in 1941. He has since held supply, fiscal and other administrative posts in the United States and the Pacific. During World War II he served as purchasing and supply officer at Pearl Harbor, with the Seventh Fleet, and at the U.S. Naval Supply Depot at Brisbane, Australia.

For five years beginning in 1954 Burrill handled interservice purchasing problems for the entire Navy. His assignments for the past year, in San Francisco, have included assistant supply officer for the 12th Naval District and his current duties of transportation officer, assistant logistics officer and interservice supply officer for the Western Sea Frontier.

Burrill is married and has three children. He was senior tennis champion of the Pacific Fleet in 1960.

L.A. AREA FREEWAYS

Continued from page 57 . . .

preciable right-of-way or construction cost increases, will assure the scheduled completion of the California Freeway and Expressway System by 1980, as envisaged by the 1959 California Legislature.

"The California Freeway System and the National System of Interstate and Defense Highways enable Southern Californians to enjoy great mobility, access to a wonderland of recreational areas, and freedom of choice as to the location of work, play, residence and worship.

"California's Freeways are Yours—Use them well, and they will serve you well." – Automobile Club of Southern California.

Including funds already invested, an estimated $4,367,311,000 will be expended on 1,342 miles of freeways within the 1980 planning program in the district. Completion of these routes will give Los Angeles County 904 miles of freeways at a cost of $3,406,122,000; Ventura County 199 miles at a cost of $291,100,000; and Orange County 239 miles at a cost of $670,039,000.

U.S. 99 FREEWAY

The State Department of Public Works has awarded a $672,080 contract for converting a 6-mile section of US 99 from expressway to full freeway in Tulare County between Goshen and Traver.

District Staff

Three Named to New Jobs In Districts IV and VII

Appointment of three additional district engineers, two in the Los Angeles District and one in the San Francisco District of the California Division of Highways, has been announced by State Highway Engineer J. C. Womack.

The new appointees, all three promoted from Assistant District Engineer positions in their respective districts, are:

A. C. Birnie, to be District Engineer – Administration, District VII, Los Angeles.


A. C. BIRNIE

A. W. Hoy, to be District Engineer – Design, District VII, Los Angeles.

Haig Ayanian, to be District Engineer–Planning, District IV, San Francisco.

The appointments were effective April 1, 1962.

Increased volume of state highway work in the two major metropolitan areas, including greater emphasis on long-range urban transportation planning, made the additional appointments necessary, Womack said. The changes include some reassignment of top level staff duties, primarily in the fields of planning and design.

The state highway construction budget for the 1962-63 fiscal year, including rights-of-way, amounts to about $163,000,000 in District VII, comprising Los Angeles, Orange and Ventura Counties; and $103,000,000 in District IV, comprising nine counties in the San Francisco Bay area.

The top staff organization in District VII will now include four district engineers reporting to Assistant State Highway Engineer E. T. Telford. G. A. Hill will continue as District Engineer – Planning and A. L. Himelhoch as District Engineer–Operations, in addition to the new assignments given to Birnie and Hoy.

In District IV there will be three district engineers reporting to Assistant State Highway Engineer J. P. Sinclair. R. A. Hayler, who has been District Engineer–Planning, will now be in charge of Design, with Ayanian succeeding to his former title. L. A. Weymouth will continue as District Engineer–Operations.

Birnie, who moves up to the newly-established position of District Engineer–Administration, is a native of Barre, Vermont. He joined the California Division of Highways staff in District IV, San Francisco, in 1947, after 13 years of highway engineering work in his home state and military service in World War II with the Army Engineers.

In District IV he worked on highway planning and location, particularly for freeways in Alameda and Contra Costa Counties, and later on budgets and administration, including personnel and public information duties. In January 1960, he was promoted to Assistant District Engineer –Administration in District VII, Los Angeles.

Birnie is married and has two daughters. He lives in Canoga Park.


A. W. HOY

Hoy, assuming the newly-established duties of District Engineer–Design, has been with the California Division of Highways since shortly after his graduation in civil engineering from the University of Michigan in 1929. He was born and raised in Huntley, Illinois.

His career has covered practically all aspects of highway engineering, but since his return from military service in World War II as a Seabee officer he has concentrated in the fields of traffic engineering, planning and budgets. He was promoted to Assistant District Engineer – Traffic in 1947, transferred to advance planning duties in December 1949, and was placed in charge of programs and budgets in December 1955.

Hoy is a resident of Pasadena. He and his wife have two sons.

Ayanian, District IV's new District Engineer–Planning, has spent most of his California Division of Highways service, which began in 1937, in the construction field. He was born in Niagara Falls, New York, but came to California as a child and attended the University of California at Los Angeles.

His first engineering job, in 1936, was as a surveyor's aid on the Mono Craters Tunnel project of the Los Angeles Department of Water and Power. After joining the Division of Highways the following year he worked in the San Diego and Stockton districts before being assigned to District VII, Los Angeles, in 1940.


HAIG AYANIAN

After returning from World War II service with the Seabees, Ayanian was resident engineer on major freeway contracts near downtown Los Angeles, then served as a construction engineer for the district. In 1956 he was promoted to Assistant District Engineer for District IV, and moved to San Francisco to take charge of that district's construction program.

Ayanian's home is in Millbrae. He is married and has a son and daughter.

NEW L.A. LOOP LINK

A new link in the Los Angeles Freeway Loop has added another mile to the route which heads east to the East Los Angeles Interchange and northwesterly along the Golden State Freeway to Lankershim Boulevard in the San Fernando Valley, a total distance of 23 miles. The combined cost of the 23-mile loop for both rights of way and construction was approximately $183,000,000.

New Routings

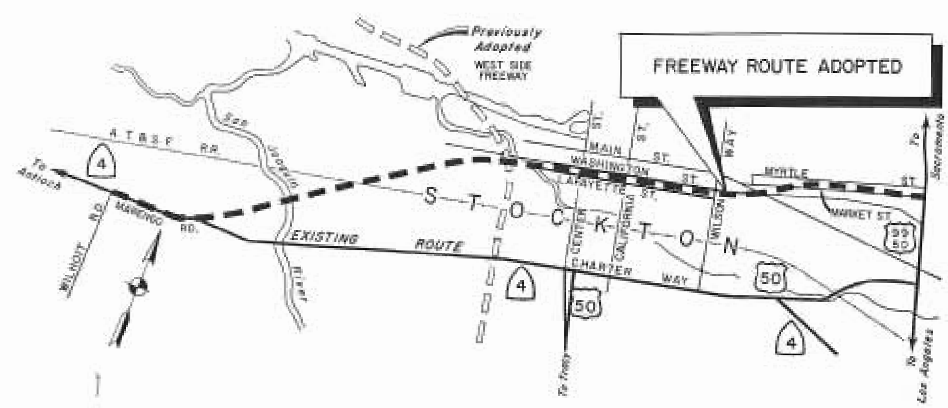
Commission Adopts 13 Freeway, 7 Conventional Highway Routes

Thirteen freeway routings and seven conventional highway routings for sections of highway throughout the State were adopted by the California Highway Commission at its January and February meetings.

The commission also held a public hearing in Lakeport on Monday, February 19, in connection with its consideration of a freeway routing for six miles of State Sign Route 29 in Lake County between Hopland Road (State Highway Route 16) and the vicinity of Wilkerson Road one mile south of Kelseyville.

One freeway routing adopted was for the relocation of 9.5 miles of U.S. Highway 50 in San Joaquin County between 3.4 miles east of the Alameda County line and the adopted route for the Westside Freeway east of Tracy which follows existing US 50 in that area. The adopted route runs through the northern tip of Tracy.

Another freeway route adopted is for 6.7 miles of State Sign Route 4 in and near Stockton. The adopted route is the "Washington-Lafayette" line recommended by State Highway Engineer J. C. Womack and supported by a Stockton delegation which appeared before the commission in November.

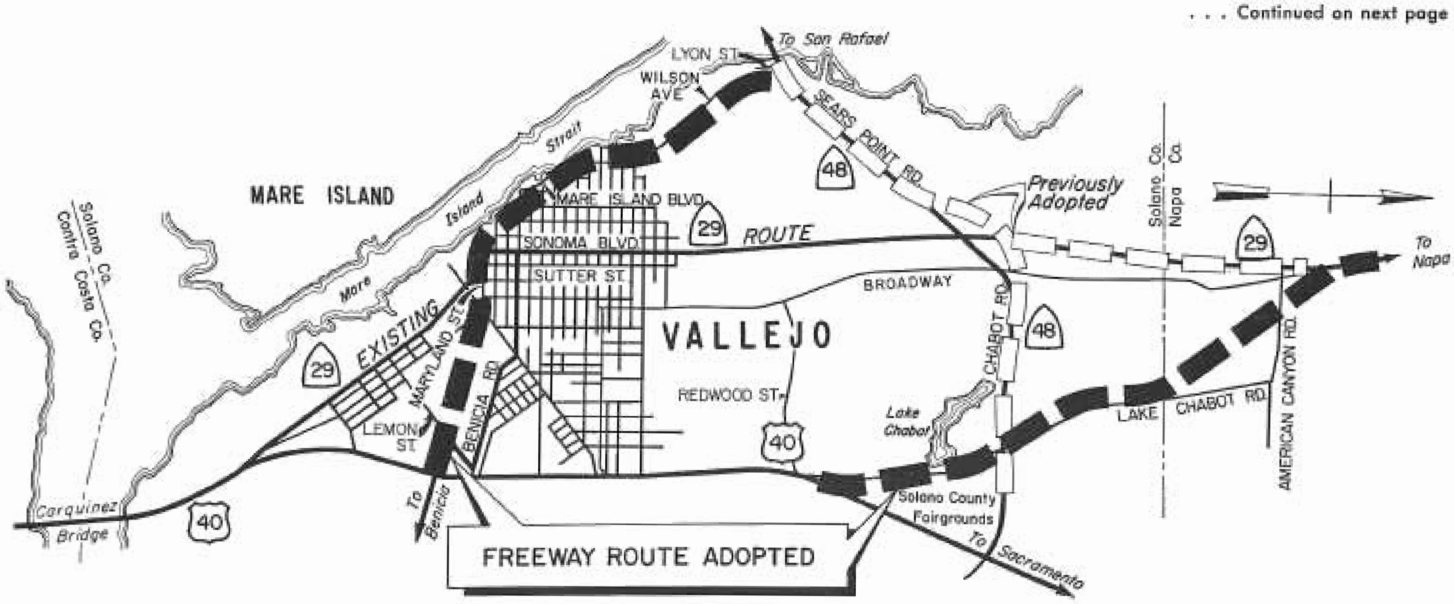


Redwood Highway

In Mendocino County a freeway routing was adopted for the relocation of approximately 20 miles of US 101 (Redwood Highway) between 0.6 mile north of Tan Oak Park and the Humboldt County line. The adopted route follows the general course of the present highway but at a number of locations is on the opposite side of the South Fork of the Eel River from the existing road.

Freeway routings were adopted for two sections of State Highway Route

. . . Continued on next page



State Architect Anson Boyd Retires

Anson Boyd, fifth State Architect since the division was created in 1907 and for 21 years Chief of the Division of Architecture, retired February 21.

Since Boyd's appointment on June 1, 1940, he has supervised the design and construction of facilities totaling over $1 billion, or about 92 percent of all work handled by the division during its 54-year history.

ANSON BOYD

In two decades he developed the division's architectural capacity from a small handful of men doing work amounting to less than $2.75 million a year to an organization of over 1,000 men and women in administration, architecture, engineering, and construction supervision, handling a capital outlay program amounting to about $100 million annually.

Since World War II, 30 new hospital institutions, state college campuses, and correctional institutions have been planned and built under Boyd's supervision.

The facilities of 25 existing institutions have been doubled or tripled in size and capacity. In addition, numerous office buildings, fish hatcheries, armories, and other facilities, including restoration of historic buildings, have been accomplished.

Since 1940 Boyd's Schoolhouse Section staff has checked the plans of 18,950 school projects with a total value of $3.5 billion.

Boyd came to California from New York in 1924. He practiced architecture in Los Angeles, designing buildings in California and Hawaii.

He studied architecture at the University of Pennsylvania under a Sims Memorial Scholarship, and attended the Museum School of Industrial Art in Philadelphia.

In New York he was a designer in the offices of McKim, Mead and White, and York and Sawyer.

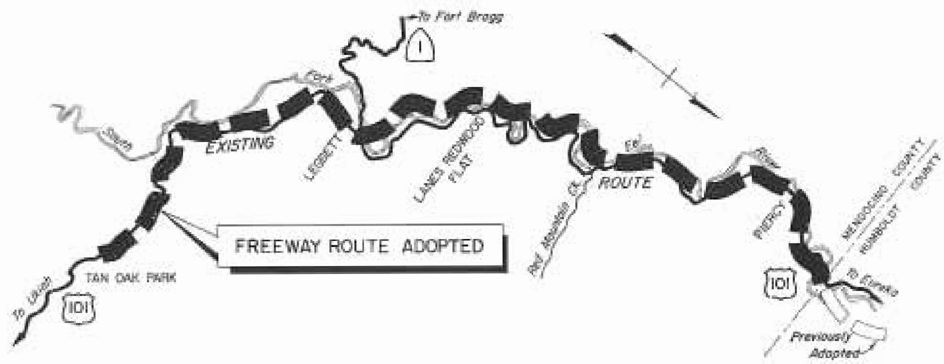
Boyd plans to return to private practice.

Earl W. Hampton, Deputy Chief of the Division (Architecture and Engineering), has been designated Acting State Architect pending the appointment of a successor to Boyd.

NEW ROUTINGS

Continued from page 71 . . .

74 in Solano and Napa Counties in and near Vallejo. One section, 4.2 miles in length, is between State Sign Route 48 (Sears Point Road) near Lyon Street and a junction with U.S. 40 near Lemon Street. The existing highway on this section is designated as Sign Route 29. The other section, 4.1 miles in length, is between Sign Route 29, 1.3 mile north of the Solano-Napa County line near American Canyon



Road and U.S. 40 near Redwood Street.

Other freeway route adoptions:

Alpine County—6.4 miles of Sign Route 4-89 between Markleeville and Woodfords.

Calaveras, Alpine Counties—10.4 miles of Sign Route 4 (Ebbetts Pass Highway) between Ganns and 2.8 miles east of the Calaveras-Alpine County line.

Los Angeles County—36 miles of Sign Route 138 between U.S. 99 southeast of Gorman and the adopted freeway route for the Antelope Valley Freeway (U.S. 6) north of Lancaster.

Placer County—4.2 miles of Sign Route 49 between Rock Creek and 0.2 mile south of the Placer-Nevada County line at Bear River.

North of Crestline

San Bernardino County—8.5 miles of State Highway Route 188 between 5.4 miles northerly of Crestline and about three quarters of a mile west of Las Flores Road. (Relocation to be necessary because of construction of the proposed Cedar Springs Reservoir.)

San Diego County—3.4 miles of State Highway Route 279 in the City of San Diego. This is a new route added to the State Highway System in 1959 and is part of the California Freeway and Expressway System. It will provide an east-west connecting highway between a number of existing and planned north-south freeways.

Shasta, Lassen Counties—Feather Lake Road (Sign Route 44) between Sign Route 36 five miles west of Susanville and Sign Route 89 near Old Station.

Solano County—13.5 miles of Sign Route 12 between Denverton and the Sacramento county line (Sacramento River) at Rio Vista.

Tulare County—20.4 miles of Sign Route 65 in Tulare County between Avenue 228 at Lindsay and four miles north of Woodlake.

Conventional highway routes adopted included:

Mendocino County—Relocation of nine-tenths of a mile of Sign Route 1 in the vicinity of Mallo Pass Creek five miles north of Manchester. Will eliminate curves.

San Luis Obispo County—For portions of State Highway Routes 125 and 137 between the Salinas River east of Atascadero and a tenth of a mile west of Huer Huero Creek. The routing follows the Creston-Eureka Road and its adoption is in effect an exchange of roads with San Luis Obispo County.

HOWARD WOOD RETIRES; SWEET APPOINTED

Howard C. Wood, Principal Bridge Engineer in charge of the maintenance and operation of state-owned toll bridges in California, retired March 20, after 32 years of state service.

HOWARD C. WOOD

Wood's successor will be Charles L. Sweet, now Assistant Operations Engineer for the Bridge Department of the State Division of Highways in Sacramento.

The bridges under Wood's jurisdiction include the eight-mile-long San Francisco-Oakland Bay Bridge, the twin Carquinez Bridges, the Richmond-San Rafael Bridge, the San Mateo - Hayward Bridge and the Dumbarton Bridge.

CHARLES L. SWEET

These bridges have come to play a vital role in the highway transportation and traffic picture in the Bay area, carrying more than 62,000,000 vehicles in a single year. The Bay Bridge alone handles 110,000 cars on an average day with some peak daily counts as high as 133,000.

Wood's successor will also have under his charge the maintenance and operation of the Benicia-Martinez Bridge as soon as it is completed later this year.

Wood came to work for the State in 1929 with the Division of Highways in Sacramento. He was a design engineer on the San Francisco-Oakland Bay Bridge from 1931 to 1939. He was appointed a Senior Bridge Engineer in 1933 and assigned to his present position in 1941. He was promoted to Principal Bridge Engineer in 1945.

Wood was born in Danville, Contra Costa County, where he attended grade and high school. He served with the U.S. Army during 1918 after which he went to the University of California at Berkeley where he received his B.S. in civil engineering, graduating with high honors including membership in two honor fraternities, Phi Beta Kappa and Tau Beta Pi.

After graduation he was inspector of construction on the Carquinez Bridge, built as a private toll bridge and purchased by the State in 1951. Later, he was assistant engineer on the construction of the Bucks Creek Power Plant on the Feather River.

Wood and his wife, Bernice, live in Berkeley.

He is a member of the American Society of Civil Engineers, the Commonwealth Club of California, the Pan American Society and Sigma Xi.

Sweet, the new engineer in charge of toll bridges, was born in Bellingham, Washington, and is a graduate of Rensselaer Polytechnic Institute of Troy, N.Y.

He started work with the State Division of Highways in San Diego in 1928 and transferred to the Bridge Department the following year.

From 1931 to 1942 he served as assistant resident and then resident engineer on many bridge construction projects both in Southern and Northern California.

During World War II Sweet was a lieutenant commander with the Navy Seabees.

In 1947 he was appointed construction supervisor for Northern California for the Bridge Department and in 1950 was promoted to supervising bridge engineer in charge of county and co-operative projects. He was appointed Assistant Operations Engineer in 1953.

Sweet is a member of the American Society of Civil Engineers.

He and his wife, Isabelle, live in Sacramento. They have a daughter, Mrs. George Selleck, of North Hollywood.

FREEWAY JOB AWARDED

The State Department of Public Works has awarded a $2,181,642 contract for grading and paving on 5.6 miles of four-lane freeway on US 101 in Mendocino County between Ford Road near Ukiah and one-half mile south of Forsythe Creek.

G. N. Cook Served Five Division Chiefs

George N. Cook, Jr., of Sacramento, administrative assistant to the State Highway Engineer and assistant secretary of the California Highway Commission, retired February 1 after 40 years with the State Division of Highways.

GEORGE N. COOK

Cook first went to work for the division in 1922 as a senior clerk in the highway maintenance department at the Sacramento headquarters. In 1924, he was appointed secretary to then State Highway Engineer R. M. Morton.

He has been secretary or assistant to every state highway engineer since then.

Cook also was appointed Assistant Secretary of the California Highway Commission in 1937.

In this post, he received and processed countless legal documents, special reports, hearing transcripts and other papers, plus the heavy correspondence required in connection with the various commission responsibilities such as the adoption of freeway routes and the budgeting of highway funds.

He has also assisted with arrangements for hundreds of appearances by groups and individuals before the Highway Commission.

A native of Sacramento, Cook graduated from Sacramento High School in 1917 and was in the U.S. Army during World War I.

He is a member of Sacramento Masonic Lodge 40, Post 61 of the American Legion, and the Sacramento Trade Club. He is a charter member of the California State Employees Association.

He is being succeeded in the administrative assistant and assistant secretary posts by Robert T. Martin, former administrative assistant at the Division of Highways District II office in Marysville.

RETIREMENT FOR 89 HIGHWAYS WORKERS

The Division of Highways has announced that the following 89 employees have retired since the previous list which appeared in the September-October, 1961, issue of the magazine:

Headquarters Office

Neil T. Austin, Associate Chemical Testing Engineer, 32 years; Wm. Bock, Supervising Highway Engineer, 41 years; George N. Cook, Administrative Assistant, 38 years; Robert V. Cozier; Highway Engineering Technician I, 15 years; Coral E. Davis, Supervising File Clerk I, 39 years; Herbert S. Marshall, Assistant Highway Engineer, 36 years; Ruth C. Nelson, Calculating Machine Operator, 20 years; Lucy H. Sanchez, Intermediate Clerk, 15 years, James W. Trask, Deputy State Highway Engineer, 33 years; Mary A. Close, Accounting Technician II, 19 years.

District I

George D. Hanson, Highway Maintenance Man II, 26 years; Tollie G. Hinton, Highway Maintenance Man II, 34 years; Ivan G. Lawson, Highway Maintenance Man II, 26 years; Lee R. Redden, Senior Highway Engineer, 39 years; John P. Smith, Highway Maintenance Man III, 32 years; Ernest C. Larsen, Highway Equipment Operator-Laborer, 37 years.

District II

James W. Curlee, Highway Maintenance Man II, 27 years; William H. Easley, Highway Field Office Assistant, 38 years; Guy S. Higgins, Highway Maintenance Man III, 33 years; Harry W. Jerden, Carpenter, 17 years; Harold P. King, Highway Equipment Operator-Laborer, 14 years; Paul K. Miles, Highway Maintenance Man II, 25 years; Herbert H. Prather, Highway Foreman, 33 years; Harry E. Sheffield, Highway Equipment Operator-Laborer, 30 years; Ora E. Smith, Highway Maintenance Man I, 29 years.

District III

James C. Cleek, Highway Maintenance Man I, 27 years; John A. Hardie, Highway Foreman, 39 years; Edward J. O'Donnell, Highway Tree Maintenance Foreman, 23 years; Herbert A. Sale, Highway Foreman, 22 years.

District IV

John G. Barnes, Associate Highway Engineer, 16 years; George L. Beckwith, Senior Highway Engineer, 32 years; James G. Burke, Highway Bridge Maintenance Foreman, 33 years; Cyrus R. Burns, Associate Highway Engineer, 33 years; Reuben E. Freitas, Highway Maintenance Man II, 29 years; Leo Immel, Highway Maintenance Man II, 27 years; Catherine J. Moriarty, Supervising Clerk I, 33 years; Henry A. Simard, Associate Highway Engineer, 39 years; Harold A. Summers, Senior Highway Engineer, 31 years; Wilford W. Coles, Highway Engineering Technician I, 31 years.

District V

Lawrence P. Davis, Associate Highway Engineer, 29 years; Edwin J. Eggler, Highway Foreman, 25 years; Matthew L. Miller, Highway Maintenance Man II, 16 years; Manuel L. Pimentel, Highway Equipment Operator-Laborer, 19 years; Louise D. Waltz, Supervising Stenographer I, 19 years; Claude S. Young, Accounting Technician III, 35 years; Clarence C. Canham, Highway Equipment Operator-Laborer, 31 years.

District VI

Michael J. Gilevich, Highway Foreman, 28 years; Eugene F. Ingham, Highway Maintenance Man III, 15 years; John Lorentzen, Highway Maintenance Man I, 15 years; Oscar O. Miller, Highway Maintenance Man II, 27 years; Harry T. Vinyard, Highway Maintenance Man II, 25 years.

District VII

Rulon W. Garn, Delineator, 32 years; Paul M. Harris, Senior Highway Engineer, 31 years; Dallas C. Locker, Highway Engineering Technician I, 7 years; Alfred P. Lund, Assistant Highway Engineer, 15 years; Roy J. Thurman, Laborer, 17 years; Aaron L. Olmstead, Highway Superintendent, 25 years.

District VIII

Lawrence Cleaver, Highway Equipment Operator-Laborer, 29 years; David Lawrence, Highway Maintenance Man III, 30 years.

District IX

W. Earl Compton, Highway Foreman, 4 years; James W. McGee, Highway Equipment Operator-Laborer, 25 years.

District X

William A. Johnson, Senior Highway Foreman, 28 years; Louis J. Malatesta, Assistant Right of Way Agent, 31 years; Joseph H. Perrin, Highway Foreman, 27 years.

District XI

Kenneth C. Madden, Assistant Highway Engineer, 14 years.

Bridge Department

Lena B. Babcock, Intermediate Clerk, 11 years; Forrest Manhart, Assistant Bridge Engineer, 39 years; Eugene A. Welch, Associate Bridge Engineer, 44 years; Harold J. Whitlock, Senior Electrical Engineer, 35 years; Edward B. Brier, Associate Bridge Engineer, 14 years.

State-owned Toll Bridges

Edgar C. Fraser, Highway Equipment Operator-Laborer, 29 years; George A. Gee, Laborer, 13 years; Thomas B. Narducci, Laborer, 19 years; Mike Pedranti, Highway Equipment Operator-Laborer, 38 years; Roy H. Proffer, Structural Steel Painter Foreman, 24 years; Joseph R. Warne, Highway Chief Clerk I, 30 years.

Materials and Research Department

Roy B. Stratton, Junior Engineering Aid, 27 years; Bailey Tremper, Supervising Materials and Research Engineer, 9 years.

Headquarters Shop

Albert C. Briney, Associate Equipment Engineer, 33 years; Homer T. Forschler, General Superintendent of Highway Shops, 40 years; Dorothy F. Franklin, Bookkeeping Machine Operator II, 25 years; Frank F. Green, Senior Equipment Engineer, 30 years; Ray N. Henderson, Highway Main-

. . . *Continued on page 79*

Bridge Costs

1961 Average is 6½ Percent Higher Than Previous Year

By H. K. MAUZY, Senior Bridge Engineer, and
W. J. YUSAVAGE, Associate Research Technician

The general trend of bridge construction costs during 1961 has been upward. The construction cost level at the close of 1960 was 249 and, during the following four quarters, rose to successive levels of 259, 261, 269, and 273, or to an overall increase of 9.6 percent. In terms of annual averages, the cost level of 1961, with an average index value of 264, was 6.5 percent higher than the average index value of 248 for 1960.

Although the current rate of increase in bridge construction costs appears unusually large, an analysis of the trend during the years since 1950 and especially, since 1957 shows that the long-term trend has been of the order of a 3 percent annual increase or one which is in line with the general run of the economy. The rather dramatic rise during 1961 is in part a compensatory adjustment for the continuous decline in the level of bridge construction costs from 1957 to the first quarter of 1960. The total decrease in costs during the three year period was 12.4 percent or about 3 percent greater than the increase for the period 1960 to the final quarter of 1961.

The level of costs for successive periods is presented graphically in an accompanying chart which summarizes the course of California bridge construction costs since 1934.

Construction Activity

As a consequence of the Federal Interstate Highway Program, the annual totals for bridge work have increased considerably since 1955. The total value of low bids for the bridge work included in 142 contracts awarded during 1961 was $85,541,483. There were also two contracts, partially financed by a bond issue, for work on the San Pedro-Terminal Island suspension bridge. The total amount for the two contracts was $14,008,140 which together with the $85,541,483 add to a total of contract awards for 1961 of $99,549,523.

The current rate of contract awards in current dollars is more than twice the rate of 1954 and slightly less than twice the rate in terms of 1954 dollars. Bridge construction activity was thus doubled in the period of the past seven years. All future budgets to 1975 anticipate outlays greater than $85,000,000.

Bidder Activity

Bidder activity was significantly curtailed during 1961. The total number of bids submitted for 142 projects was 827 or an average of 5.8 bidders per project. The corresponding figure for 1959 was 8.8 and for 1960, 7.3. The three averages show that the intensity of competition was decidedly falling off during the past three years. Declines in the rate of bidder activity are generally associated with rising bridge costs. Bridge costs followed the pattern during 1961; they were about 6.5 percent higher than during 1960.

Average Unit Prices

The average unit prices of most bridge construction items increased during 1961. The prices of a few of the more significant items have developed trends which are described as follows:

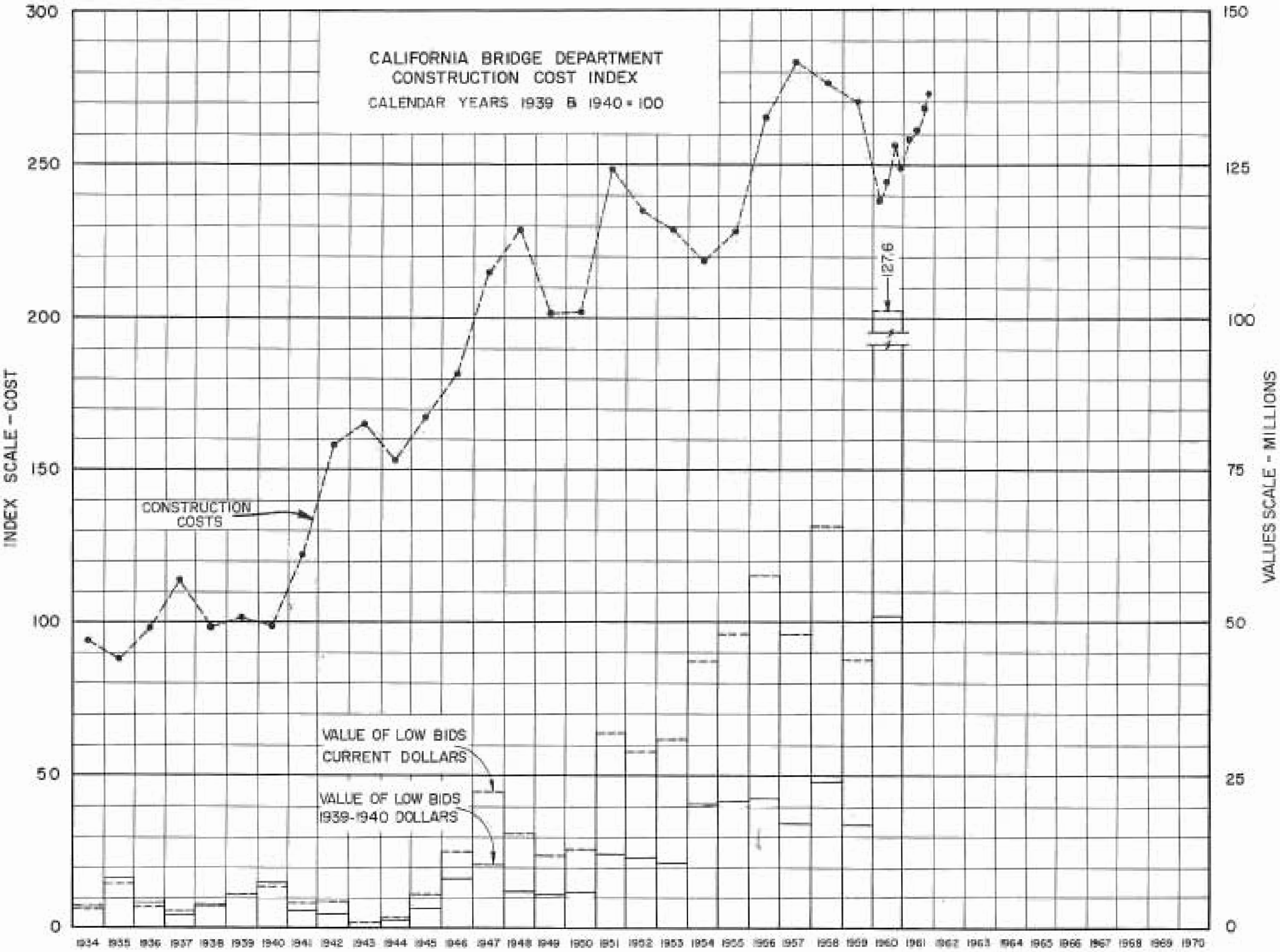
Class A Portland Cement Concrete. The weighted average unit price of the items was in decline for the three years following 1957 when it reached a peak of $58 per cubic yard. The price dropped to $55 per cubic yard in 1958, to $52 in 1959, and to $50.60 in 1960. The trend was sharply reversed in 1961 when the unit price increased to $56 per cubic yard, a 12.6 percent increase over the price of 1960. The geographical pricing pattern for concrete has also changed considerably during the past several years; whereas even a year ago it was common to receive bid prices of between $48 and $52 per cubic yard in the Los Angeles area, bid prices for concrete during 1961 rarely dropped below $54 per cubic yard. On the other hand the prices for concrete in the San Diego area which a few years ago were bid more often in the range of $58 to $60 per cubic yard are currently bid at about $52 per cubic yard. Competition is now more aggressive in the San Diego area than it is in the Los Angeles area.

Bar Reinforcing Steel. The trend of unit prices for bar reinforcing steel has been unusual in that it has been consistently downward since 1958. The weighted average unit prices during 1958 and 1959 were $0.124 and $0.113 per pound. During 1960 the price dropped to $0.097 per pound and, in 1961, dropped still further to $0.094 per pound. Recent bid prices for bar reinforcing steel indicate that the low level prices are still in effect in 1962.

Structural Steel (plate girder). There has been only a moderate change in the unit price of structural steel over the past four years. The corresponding weighted average unit prices for the three years 1958, 1959, and 1960 were $0.164, $0.163, and $0.169 per pound. During 1961 the average unit price increased moderately to $0.173 per pound. The pattern of prices from which the foregoing average prices were computed is apparently continuing into 1962.

Prestressed Concrete. The summary unit price of prestressed concrete is expressed in terms of the price of a composite cubic yard in place. The unit price accordingly includes the cost of the concrete, reinforcing steel, stress steel, anchorages, prestressing operations, as well as the cost of erection.

The corresponding weighted average prices per composite cubic yard of prestressed concrete for the years



1955 to 1960 inclusive have been $135.27, $163.03, $164.48, $144.74, $134.94, and $138.97. During 1961 the weighted average unit price increased to $150.22 per composite cubic yard, or for an increase of 8.1 percent over 1960 prices.

In combination the foregoing items comprise about 76 percent of the total annual cost of bridge construction. For the past two years the low unit prices bid for bar reinforcing steel have, in the aggregate, exerted a strong depressing effect on the overall level of construction costs. Had the prices for bar reinforcing steel followed the general trend of prices of other construction items, the current level of costs would be up another 5 percent.

Summary

An analysis of the general trend of bridge construction costs shows that it parallels the more general trend of the national economy. Accordingly, the bridge cost curve is characterized by high points in the years 1948, 1951, and early 1957, and by low points which coincide with the periods of national recession in 1949, 1954, and 1959. The current rise in bridge construction costs is again accompanied by a resurgence in the vitality of the general economy. The most likely explanation for the correlation of trends is the rise and fall in the rate of competitive bidding; when the national economy is on the rise, there is a concomitant rise in the demand for the services of the construction industry and consequently less interest in bridge construction. The situation is reversed when the general demand for the construction services decreases. Thus there was an average of 8.8 bidders per project during the period of recession in 1959, 7.3 bidders per project during 1960 when the nation was coming out of the recession, and 5.8 during 1961 when the economy was well out of the recession.

In view of the historical relationship of the trend of bridge costs with the trend of the general economy and in view of the current consensus of economic opinion that activity during 1962 will be moderate, it is anticipated that there will be only a moderate increase in competition for bridge projects and, consequently, little change in the current level of bridge construction costs in 1962.

Hawthorne, Belford Retire From State

Two long-time Division of Highways employees have retired in Los Angeles.

Henry Hawthorne, Senior Highway Engineer, closed a 41-year career with the California Division of Highways, most of it spent in District VII, when he retired February 1.


HENRY HAWTHORNE

He was born in Shutesbury, Massachusetts, a descendant of Nathaniel Hawthorne, and studied civil engineering at Carnegie Tech. Before coming West he worked for four years as a transitman and chief of party with survey crews.

He joined the Division of Highways in 1921 and was sent to District I, Eureka.

Early in 1929 Hawthorne transferred to District V, San Luis Obispo, where he worked in surveys for a few months before moving to Los Angeles. He became a Senior Highway Engineer in 1947, and for several years was in Design, working on many of District VII's freeway projects. In 1955 he transferred to the rapidly expanding Right-of-way Engineering Department in an administrative capacity.


H. E. BELFORD

Herbert E. Belford, Senior Highway Engineer, ended 41 years in Southern California highway construction with his retirement on January 31. His career embraced the development of the freeway system in District VII from its beginning with the Arroyo Seco Parkway (now the Pasadena Freeway) to the present 337-mile network.

A native of Williamsport, Pennsylvania, he served in the Army during World War I from 1917 to 1918, then moved to California.

His service with the Division of Highways began February 7, 1921, in Fresno, where he worked for seven years as a civil engineering draftsman and assistant chief draftsman.

In September 1928, he transferred to District VII, Los Angeles. For the first seven years he was supervising designer. In 1935 he was appointed Assistant District City Projects Engineer.

In 1942, he became resident engineer and for most of the years from that time until his retirement he was resident or assistant resident on freeway construction jobs. He worked on the Golden State, Ventura, San Bernardino, Harbor and Hollywood Freeways, and Arroyo Seco Parkway. At the time of his retirement Belford was supervisor of construction projects in the northern part of District VII. It was estimated that he had supervised more than $100 million in construction contracts.

Road Super Garrison Retires in Woodland

Fred R. Garrison, state highway maintenance superintendent for the Woodland territory, retired March 1 after nearly 43 years with the California Division of Highways.

Since 1940 he had been head of the Woodland territory which includes 213 miles of state highways in Yolo, Colusa, and Sutter Counties. Maintenance stations with foremen and a total of 28 maintenance men and drawbridge operators are located at Esparto, Williams, and two at Woodland.


F. R. GARRISON

Born and graduated from high school in Ripon, Garrison started to work for the State in 1919 as a steam shovel engineer.

He was promoted to foreman in 1922 and to highway superintendent in 1930, first heading a traveling crew specializing in mud-jacking operations in various districts throughout the State, and then serving briefly as superintendent of the old Williams territory.

He was superintendent of the foothill-mountain territory, with headquarters in Nevada City, from 1933 to 1940.

In addition to his regular job, Garrison was lieutenant of the Woodland Fire Department for many years.

He and his wife have a son, Fred C., of Los Angeles.

Garrison is past exalted ruler of the Woodland Lodge of Elks as well as past district deputy grand exalted ruler. He has served a total of nine years as president of various chapters of the California State Employees' Association.

Electrical Engineer Whitlock Retires

A long engineering career which has included many major bridges, tunnels and subaqueous tubes came to a close with the retirement of Harold J. Whitlock, Senior Electrical Engineer with the State Division of Highways.

In recent years, Whitlock has been responsible for the design of ventilation and electrical features of such major projects as the Webster Street Tube, connecting Oakland and Alameda, and the Randolph Collier Tunnel in Del Norte County. Additional accomplishments include design of mechanical features of movable bridges such as the Tower Bridge in Sacramento, the Bay Farm Island Bascule Bridge in Alameda, the bridge across Three-mile Slough in Sacramento County and many others.

Early in his career, Whitlock served as an engineering officer and ensign in the United States Navy during World War I, and as an electrical engineer with the Pacific Gas and Electric Company. His first service with the State of California was with the California Civil Service Commission from 1926 to 1930. At that time he began a long career with the Division of Highways which has spanned 31 years.

During World War II, Whitlock served as a commander in the United States Navy and was design superintendent and assistant to the public works officer at the Mare Island Navy Yard.

Whitlock and his wife have two daughters.

Lab's Bailey Tremper Retires January 31

Bailey Tremper, Supervising Materials and Research Engineer, retired on January 31 after 10 years of service with the State of California. Tremper was in charge of the Technical Section, Materials and Research Department Headquarters Laboratories.


BAILEY TREMPER

For 31 years prior to coming to California, Tremper was Materials and Research Engineer for the State of Washington.

Graduating from the University of Washington with a B.S. in chemistry, Tremper was employed in various company laboratories until 1921 when he organized the Laboratory Division for the Washington State Highway Department. While in Washington Tremper carried on original work with asphalts, studied the degradation of aggregates, and developed means of testing traffic paints.

Tremper assumed direction of the Technical Section of the California Materials and Research Laboratory in 1952. He has carried on many research activities in the field of concrete including: reducing the volume change of concrete, concrete mix design, the effects of water reducing additives, durability of concrete in contact with sea water and the effects of freezing and thawing.

He is a member of the American Society for Testing Materials, American Concrete Institute, American Association of State Highway Officials, Highway Research Board, and the Portland Cement Association sponsored Long-Time Study of Cement Performance in Concrete, and others.

Following his retirement Tremper will move to Riverside, California, where he will continue to work on cement and concrete problems with the California Portland Cement Company.

The number of drivers' licenses outstanding in the State at the last completed monthly count was 8,133,198.

Bridge Designer Manhart Retires

Forrest R. Manhart, Assistant Bridge Engineer with the California Division of Highways in Sacramento, retired on January 31 after 40 years as a state engineer.

Most of Manhart's career has been in designing state highway bridges.

Some of the better-known projects on which he has worked include the parallel Carquinez Bridge, the new Colorado Street Arch Bridge in Pasadena, the Benicia-Martinez Bridge, the Whiskey Creek Bridge near Redding, the West Branch of the Feather River Bridge above Oroville and the orthotropic bridge now under construction across Ulatis Creek near Vacaville.

He also prepared design material used in the Hoover-Young Report on the San Francisco-Oakland Bay Bridge, the current San Diego-Coronado Bridge Study and Standards for Elliptic Arch Culverts.

Manhart joined the Division of Highways in 1920.

Manhart is a native Sacramentan and attended local schools. He is a member of the Masonic Lodge.

Manhart and his wife have two daughters: Mrs. Joyce Brady, of Sacramento and Mary Ann, of San Francisco; and three grandchildren.

DIVISION ENGINEERS WIN AWARDS

Two Division of Highways projects have received national awards.

The National Safety Council has announced that "Research Report on Dynamic Full Scale Tests of Highway Median Barriers," submitted by Francis N. Hveem, Materials and Research Engineer, was one of the top three entries submitted to the Metropolitan Life Award for research in accident prevention.

The James F. Lincoln Arc Welding Foundation has announced that its national fifth place award has been given to John J. Kozak and Albert P. Bezzone, of the Bridge Department, for their design of the curved steel girders on the Elysian Viaduct in Los Angeles.

C. R. Burns Retires In San Francisco

C. R. (Bob) Burns, Associate Highway Engineer, retired on February 7, 1962, in San Francisco, after 34 years of state service with the Division of Highways.

He is well known as one of the oldtime location engineers. He has worked on such projects as Castella-Shotgun Creek and Feather River Canyon in District II; Willow Creek, Carmel, San Marcas Pass, and Foxen Canyon, Buellton, in District V; Petaluma Bypass, Santa Rosa Freeways, and Monticello Dam Highway Relocation in District IV.


C. R. BURNS

Burns is a native of the State of Washington. He started his surveying career at the age of 17 with the Idaho and Washington Northern Railway at Spirit Lake, Washington. In 1918, he went to work for the Washington State Highway Department as a Resident Engineer at the Spokane Division. Burns joined the Oregon State Highway Department in 1920, as Locating Engineer. He started to work for the California Division of Highways in 1928 as Resident Engineer in District II.

In 1930 he transferred to District V. Early in 1943 he went to District IV where he was in charge of numerous survey parties until his retirement.

NEW STATE BUILDING

State Director of Public Works Robert B. Bradford has announced that the Division of Architecture has completed plans for the $14.8 million Retirement Building at 9th and O Streets in Sacramento. The general, electrical, mechanical, and elevator portions of the work were advertised for bids Friday, April 20.

The Division estimates this phase of the project will cost about $10,000,000. Bid proposals will be opened in Sacramento on May 22.

ARCHITECT DIVISION LOSES FOUR RETIREES

The following recent retirements have been announced by the Division of Architecture:

Mae Sullivan, for 40 years secretary to the State Architect, retired on January 31.


MAE SULLIVAN

Except for 11 months' service with the Department of Public Health in 1926-27, Miss Sullivan had served continuously with the Division of Architecture since July 1922.

Her first position after graduation from the Sacramento High School in 1917 was as stenographer with the Standard Oil Company.

When she started with the division, there were 48 employees in the office which was then in the Forum Building at 9th and K Streets. With her retirement, only one of those 48 remains in the division.

Miss Sullivan, who has traveled extensively, will depart early in March for the Orient. She will be accompanied by Fay Barrett, retired secretary to the chief counsel, Division of Contracts and Rights-of-way. They plan to continue around the world, moving from place to place without time limitation or particular direction.

Architectural Supervisor Albert Keating retired on January 31.

Keating joined the Division of Architecture in August 1926, and except for short lay-off periods due to lack of work, and a stint with the U.S. Army Engineers during World War II, remained with the division until his retirement. He received his supervisor's rating in 1949.


ALBERT KEATING

After his graduation from Sacramento High School in 1915, he was postmaster at the State Capitol for two years, followed by two years in the Army Air Service. Following his discharge, he did contracting and building work in Sacramento.

Architectural Supervisor Stanley Havlik began his retirement December 1, 1961.

Havlik was born and educated in Chicago, Ill. While attending Armour Institute, he worked for Chicago architects Lonek & Houda and Worthman & Steinbach.


STANLEY HAVLIK

In the early 1920's, he was assistant superintendent of construction of the Pasadena Rose Bowl, and later chief draftsman for Pacific Ready Cut Homes, Los Angeles.

During the early 1930's he was assistant superintendent of construction of the Pasadena Dam, Los Angeles County, and of a large dam in the Canal Zone.

During World War II he was construction expediter for Campbell Construction Co., Sacramento. He rejoined the division after the war and obtained his supervisory rating in December 1956.

Supervising Architect John P. Morgan, who during the few years he was with the Division of Architecture contributed much to state hospital planning and prison design, retired January 1.


JOHN MORGAN

Morgan came to the division in July 1947 from Washington, D.C., where he was hospital architect for the U.S. Public Health Service.

In November 1948 he transferred to the Department of Finance as assistant to the supervising construction analyst. He returned to the division in March 1953, and in October 1954 was appointed supervising architect.

Morgan was born in England, coming to this country in 1912 to study architecture at Carnegie Institute of Technology. World War I interrupted his studies, and for two years he was with the U.S. Army Engineers, American Expeditionary Forces in France.

Following the war he worked in the offices of the late Maj. Henry Hornbostel, Pittsburgh's best known, most colorful and most controversial architect.

In 1923 Morgan returned to Europe for travel and study in England, France, Italy and Spain.

In 1932 he and six others organized a group known as "Sociographics" which engaged in the analysis and graphic presentation of statistics for the Pennsylvania Department of Labor and Industry.

Immediately prior to and during the early years of World War II, Morgan was an architect and group chief of design for the Bureau of Yards and Docks, Navy Department, Washington. He spent the last two war years with the War Production Board.

In recent years Morgan worked closely with the Department of Corrections in developing design studies of new rehabilitation-type prisons, contrasting in concept to older institutions which emphasized, essentially, security.

These original studies became prototypes for the new California Conservation Center, now under construction near Susanville, the three-year-old satellite institution at Soledad, and for the recently completed California Men's Colony at Los Padres.

RETIREMENTS

Continued from page 74 . . .

tenance Man II, 26 years; Ralston W. Hill,* Assistant Highway Mechanic Foreman, 36 years; Philip R. Pallissier, Senior Account Clerk, 16 years.

Shop 2

Harry A. Long, Heavy Equipment Operator, 16 years; Ogle N. Byers, Assistant Equipment Superintendent, 42 years.

Shop 4

Arthur M. Gehl, Assistant Highway Mechanic Foreman, 26 years.

Shop 7

Harold Naylor, Highway Mechanic Foreman, 23 years.

* Disability

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)
T. F. BAGSHAW . . . . Assistant Director
JOHN H. STANFORD . . . . . . Assistant Director
JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . Comptroller
L. L. FUNK . . . . Planning Engineer
MILTON HARRIS . . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . Office Engineer
A. M. NASH . . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . . Equipment Engineer
E. L. TINNEY . . . . . . Maintenance Engineer
W. L. WARREN . . . . . . Engineer of Design
G. M. WEBB . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . . Assistant Chief
RAY E. O'BIER . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . . Assistant Chief

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . District I, Eureka
H. S. MILES . . . . District II, Redding
ALAN S. HART . . . . District III, Marysville
L. A. WEYMOUTH . . . . . District IV, San Francisco
R. A. HAYLER . . . . . . District IV, San Francisco
HAIG AYANIAN . . . . . District IV, San Francisco
E. R. FOLEY . . . . . . District V, San Luis Obispo
W. L. WELCH . . . . District VI, Fresno
A. L. HIMELHOCH . . . . . District VII, Los Angeles
GEORGE A. HILL . . . . . District VII, Los Angeles
A. C. BIRNIE . . . . . . District VII, Los Angeles
A. W. HOY . . . . District VII, Los Angeles
C. V. KANE . . . . . . District VIII, San Bernardino
C. A. SHERVINGTON . . . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
J. DEKEMA . . . . District XI, San Diego
CHARLES L. SWEET . . . . Bridge Engineer
State-owned Toll Bridges

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . Chief Counsel

GEORGE C. HADLEY . . . . Assistant Chief
HOLLOWAY JONES . . . . Assistant Chief
HARRY S. FENTON . . . . Assistant Chief

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . Assistant State Architect (North)
TOM MERET . . . . Assistant State Architect (South)
CHARLES M. HERD . . . . Chief Construction Engineer

---

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . Director, Chief of Division

o

printed in CALIFORNIA STATE PRINTING OFFICE

58624 3-62 48M

Lest We Forget

The photograph at the top of the page was made in March, 1949, when clearance work was just beginning for the first contract of the Hollywood Freeway and the now world-famous four-level interchange in downtown Los Angeles. The aerial photograph just above was made when construction had begun, and was retouched to show the plan for the finished system. Below is a recent aerial photograph of this section of Los Angeles, showing the completed freeway and "The Slot"—the depressed section of the Santa Ana Freeway south of the four-level interchange—which now carries just about 200,000 vehicles daily.