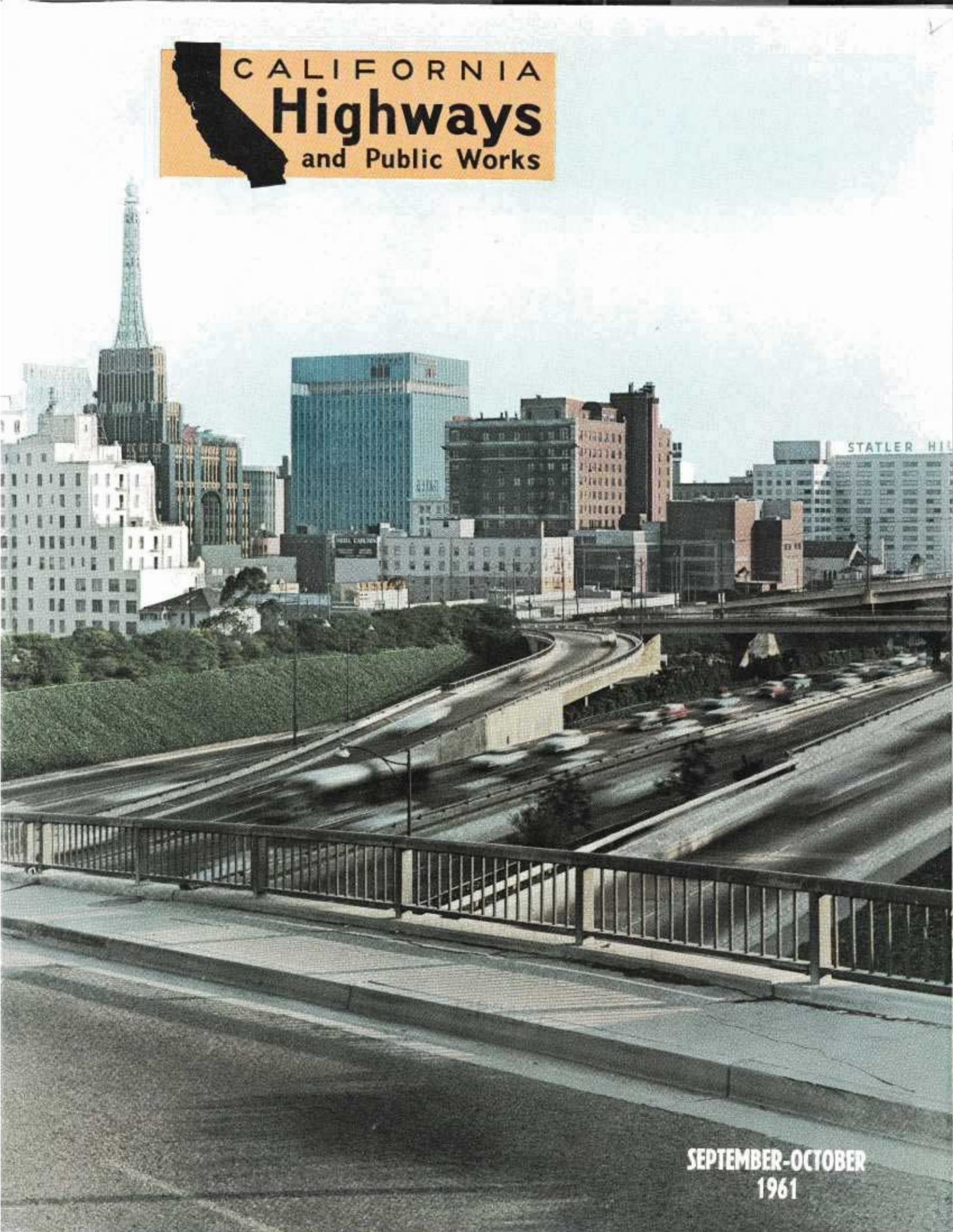
CALIFORNIA Highways and Public Works



SEPTEMBER-OCTOBER
1961

Toll Bridge Project Is Expanded

The California Toll Bridge Authority took action on September 14 to provide for a high-level double-decked fixed span structure for the San Mateo-Hayward Bridge where it crosses navigational waters, instead of retaining the existing lift span in connection with the bridge remodeling project.

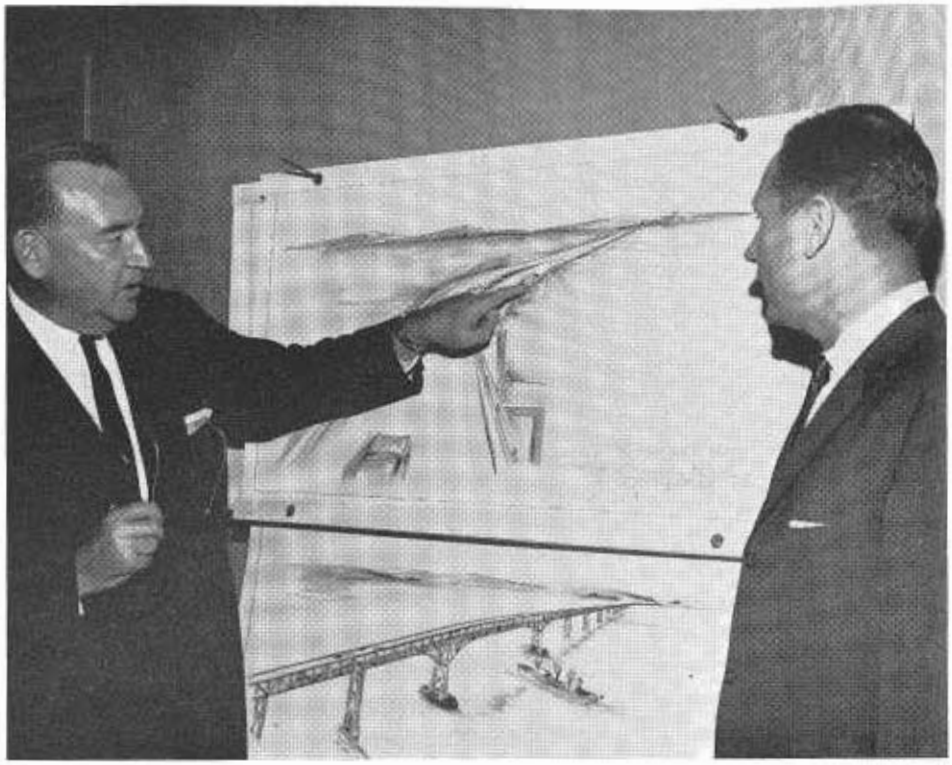
Estimated over-all cost of the high-level plan is $65,000,000, as compared with $35,000,000 for the original proposal to convert the existing two-lane facility to a four-lane low-level concrete trestle and a double-deck lift span.

The Toll Bridge Authority, with Governor Edmund G. Brown presiding, acted favorably on a recommendation by Director of Public Works Robert B. Bradford.

Funds for increasing the capacity of the bridge were made available by the 1959 Legislature out of toll revenues of the San Francisco-Oakland Bay Bridge and the San Mateo-Hayward and Dumbarton Bridges. However, that legislation imposed a time limit of December 31, 1962, on the availability of these revenues. At the 1961 session, the Legislature extended the toll revenue commitment until June 30, 1964, which will provide sufficient funds for the high-level structure.

The lift span on the present bridge must be raised from six to 12 times a day for the passage of marine traffic, sometimes resulting in long vehicular tieups. An increase in ship traffic as well as vehicular travel in the area is expected.

The high-level fixed span structure will have a daily traffic capacity of 50,000 vehicles, according to Norman C. Raab, Chief of the Division of San Francisco Bay Toll Crossings. This would provide adequate, free-flowing traffic service for many years.



Governor Edmund G. Brown, left, chairman of the California Toll Bridge Authority, is shown discussing with Lieutenant Governor Glenn M. Anderson, an artist's sketch of the transition structure and double-deck portion of the proposed high-level fixed span San Mateo-Hayward Bridge improvement. The Authority approved a recommendation to substitute the high-level structure for the originally planned double-deck lift span over the navigational channel, as made possible by recent legislation. Other members of the Authority are Director of Finance Hale Champion, Director of Public Works Robert B. Bradford and James F. Thacher of San Francisco, public member.

The next step in preparing for the high-level structure will be to obtain the necessary permits from Federal Government authorities.

Work on the four-lane concrete trestle section of the bridge is now under way. The trestle section has been designed for possible ultimate widening to six lanes. The fixed-span high level section would be built for six lanes initially, according to Raab.

The San Mateo-Hayward Bridge was completed in March, 1929, as a privately-owned toll bridge. The State acquired it in 1951.

California Highways and Public Works

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Vol. 40 September-October 1961 Nos. 9-10

Bradford Heads New Transport Agency

Robert B. Bradford

The formation of an eight-member Cabinet to serve as the policy-making body for the executive branch of State government was announced on October 1 by Governor Edmund G. Brown. The Cabinet includes four newly-appointed administrators of new agencies established by the 1961 Legislature.

One of the statutory posts is Administrator of the Highway Transportation Agency. The Governor's appointee to this position is Robert B. Bradford, State Director of Public Works since January, 1959.

By law, the Highway Transportation Agency will include the Departments of Public Works, Motor Vehicles and California Highway Patrol. Governor Brown also assigned to the Administrator of this agency a reporting responsibility with regard to the San Francisco Bay Area and Los Angeles Metropolitan Transit Authorities, the San Francisco Port Authority and the Board of Harbor Commissioners for Humboldt Bay.

Under separate legislation, the Department of Public Works now also includes a Division of Aeronautics, formerly the California Aeronautics Commission.

The Governor announced that he would appoint a successor to Bradford as Director of Public Works within a short time.

The other three new statutory agencies are the Youth and Adult Corrections Agency, the Natural Resources Agency, and the Health and Welfare Agency.

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LESTER S. KORITZ, *Editor*

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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SACRAMENTO, CALIFORNIA

Baker Grade

25 Miles of U.S. 91-466 Become Full Freeway

By L. M. BARNETT, District Construction Engineer

A $5,000,000, 25-mile section of Interstate 15, carrying U.S. 91 and U.S. 466 on the stretch between Barstow and Las Vegas is now completed. Work was started by Contractors Gordon H. Ball, Ball & Simpson, and E. L. Yeager in April, 1960, and the first 14 miles were opened to traffic on July 19, 1961. The entire project was completed in September.

Beginning 1½ miles east of Baker (the junction with Route 127 to Death Valley), the portion already completed has long been referred to as the "Bloody Baker Grade." This name resulted from a number of spectacular traffic accidents, mainly of the head-on collision type, which have taken place due to excessive speed on the long westbound downgrade, sometimes at speeds over 100 MPH. While a new highway cannot be expected to put the damper on such drivers, it is expected that the new four-lane divided construction, with a 100-foot median area, will provide more protection for other motorists who sometimes become innocent victims of an "out of control" vehicle.

A dramatic shot of the Cima Road Overcrossing on the newly constructed Baker Grade project.

Accident Rate Normal

In recent years, due to aerial patrols and other special enforcement by the California Highway Patrol, the overall accident and fatality rate on the Baker Grade has not been greater than normal for a rural State highway carrying in the neighborhood of 5,000 vehicles per day. Weekend peak traffic volumes, which are swelled by the Los Angeles to Las Vegas recreational trips, frequently reach over 500 vehicles per hour in one direction. For these reasons, this project near the middle of the Interstate route between Barstow and the Nevada State Line (a distance of 111 miles) was selected for first construction.

One special feature of this project was the care taken to avoid disturbance of the native desert vegetation, in order to provide erosion protection and to act as a screen between the two opposing streams of traffic. Hauling on or crossing of the median was restricted during construction, except at designated places where it was necessary to obtain access for construction of bridges or drainage structures.

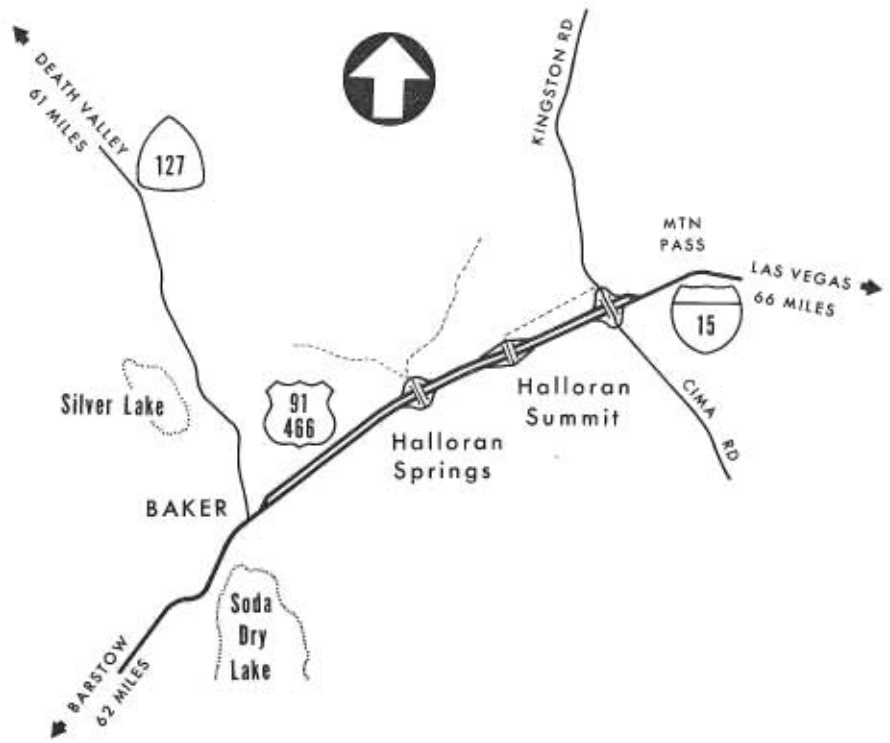
Beginning in the early design stages, the makeup of the structural section of the road, including pavement and base materials, has been of considerable

interest. The sections finally adopted are shown in the accompanying sketches. One section is being used for the new roadbed and the other as an overlay of the existing roadbed. The new roadbed utilizes a 7-inch asphalt concrete pavement (an experimental section) on an 8-inch aggregate base. Additional subbase (up to 6 inches) was called for over portions where poor basement soil was encountered.

Existing Road Resurfaced

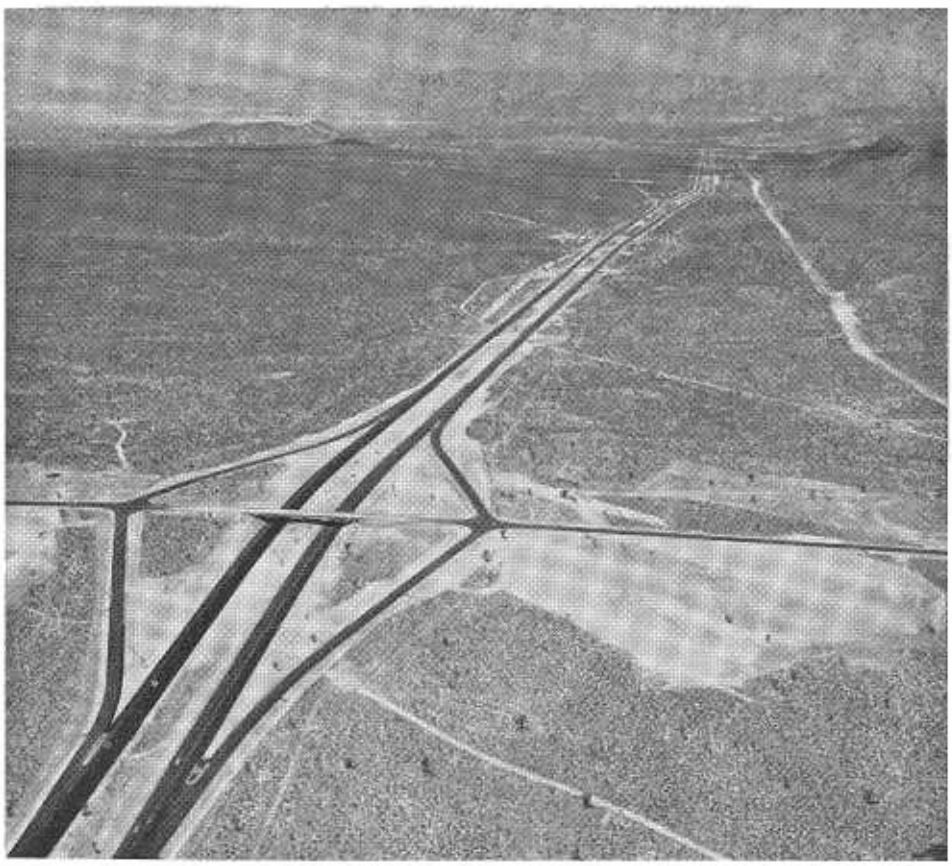
The existing road was resurfaced to serve as the eastbound freeway roadbed through most of the project. The new pavement consists of three courses of asphalt concrete topped by ½ inch of open-graded asphalt concrete. Efforts by the Contractor and inspectors resulted in an unusually smooth riding surface on the resurfaced roadbed. Leveling courses were placed by means of motor graders with highly skilled operators. The old pavement had irregular profile and variable transverse slope. Both of these deficiencies were corrected by use of a planned grade line and single cross slope put into the first leveling course. The profilograph reading on the first 14 miles of resurfaced roadbed averaged 0.14 inch per mile.

Contrary to what might have been expected, high quality alluvial gravel was not easily found in the vicinity of this project. Assorted soft, mineral bearing rocks, frequently coated with an undesirable carbonate, were more typical. The carbonate apparently results from drying out of hot weather rainfall after seeping below the surface. It is found in thin layers and pocketed throughout depths of more than 20 feet in the alluvial deposits. It was rejected for use in the upper layers of the roadbed. Extensive preliminary studies for possible aggregate sources included 11 test pits, which were left open for viewing by prospective bidders on the construction work. Borrow material was obtained from 7 sites near to the road, selected for suitability of material and economy of haul. Hauling was by means of tractor scraper units; average haul being about three miles, with some hauls of base material over six miles.

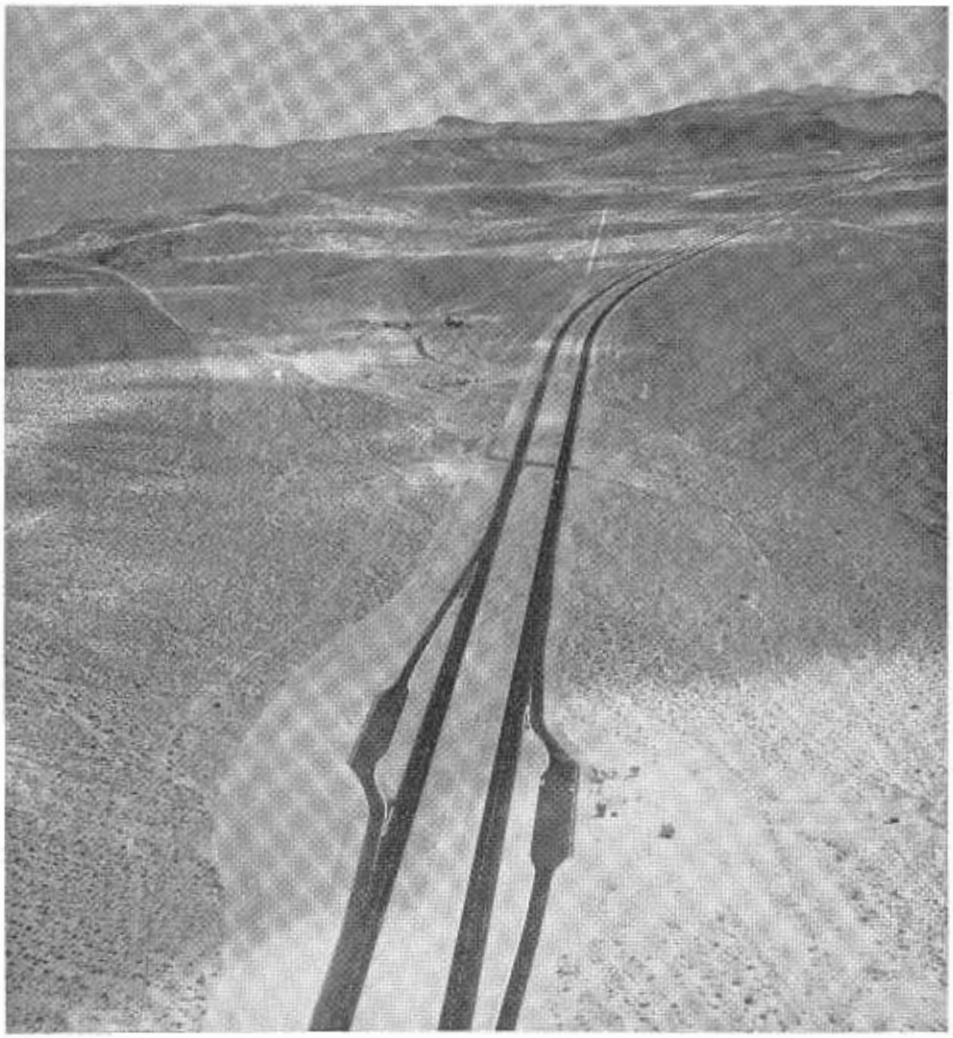


The double-lined section of U.S. 91-466 in the above map shows the location of the new section of Interstate freeway.

BELOW: Looking down the Baker Grade from Halloran Summit Overcrossing. Note the restoration planting of Joshua and native plants at the Interchange.



A sign tells motorists of this safety rest area on U.S. 91-466 some 10 miles east of Baker.



An aerial of the same safety rest area shown in the above photo.

Water Is Scarce

Water, a scarce item on the desert, required for compaction of earthwork and base material, was supplied from two reservoirs, one at Halloran Summit and one at the northeast end of the project. Wells near Cima Road supplied the reservoirs. From the reservoirs, water was piped by gravity and booster pumps to six 10,000-gallon tanks, which were strung along the job at about one-mile intervals. Tanks were moved ahead as the work progressed toward the south. About 20 miles of six-inch steel water main were used, with deliveries of over 300,000 gallons per day at times.

Grading work consisted of shallow cuts and fills for the most part, but the Halloran Summit is crossed by a cut about one mile long and of 40-foot maximum depth.

Ten bridges were included in the project, with spans of 100 to 200 feet. All were of precast deck and substructure units, hauled to the project from a casting yard at Barstow. There were also three welded steel plate girder structures, providing crossings over the freeway at Halloran Springs, Halloran Summit, and Cima Road. Although the project reaches elevations over 4100 feet at the summit, a relatively mild winter and careful scheduling by the Contractor permitted almost continuous work. Summer thunderstorms and attendant localized flash floods posed some problems during the course of the job.

First Rest Areas

This project contains the first "safety rest areas" built as part of the road contract on an interstate job in District VIII as may be seen by photographs accompanying this article. The "safety rest areas" are within the right of way and have freeway-type exits and entrances. Parking areas, water supply and landscaping were provided under the contract.

The remote location of this project made it necessary to establish living quarters for both Contractor and State personnel. Facilities in Baker were soon overtaxed by the influx of construction workers, many of whom brought house trailers and families with them. At the time of peak con-

. . . Continued on page 5

Kofman Succeeds Judge Purchio on Highway Commission

Governor Edmund G. Brown has appointed Abraham Kofman, publisher of the San Leandro *Morning News* and the Alameda *Times-Star*, as a member of the California Highway Commission to replace John J.

Abraham Kofman

Purchio of Hayward, whom the Governor appointed to an Alameda County Superior Court Judgeship on September 7.

Kofman is a native of Brockton, Massachusetts, and has been in the newspaper business since his youth. He began with a newspaper distributorship in his home city, and continued in this field when he moved to Norwich, Connecticut. He was active in civic affairs in Norwich, including service on the zoning board which administered the municipal roads.

He purchased the Alameda *Times-Star* in 1939 and started the San Leandro *Morning News* in 1950. His home is presently in San Jose, but he plans to move soon to Alameda County.

Kofman is a member and former director of the California Newspaper Publishers Association, and a member of numerous civic and fraternal organizations, some of which he has headed in the course of the years.

BAKER GRADE

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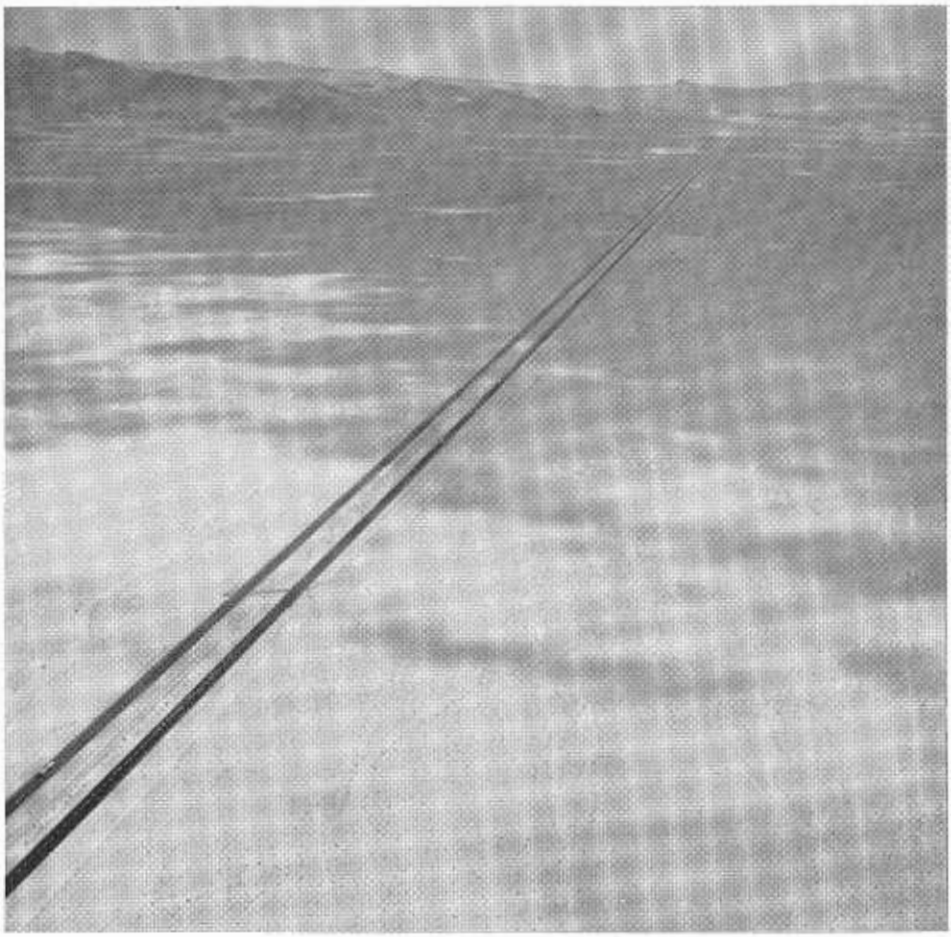


Like the proverbial parallel lines that are never supposed to meet, this section of the new U.S. 91-466 freeway extends for miles across the sun and cloud-patched desert.

struction work, eighteen State inspectors were living in quarters provided through temporary use of service station and motel buildings at Yucca Grove, near Halloran Summit. These buildings were within the freeway right of way and were removed during later stages of the work.

Resident Engineers on the job were C. M. Mauck and J. O. Erwin.

Judge Purchio, former Hayward city councilman and mayor, had served on the Highway Commission since January 15, 1960. He is a native of New York, a graduate of Fordham College and Fordham Law School, and served as an intelligence officer with the U. S. Air Force in Europe in World War II. He has practiced law in Hayward since 1947.

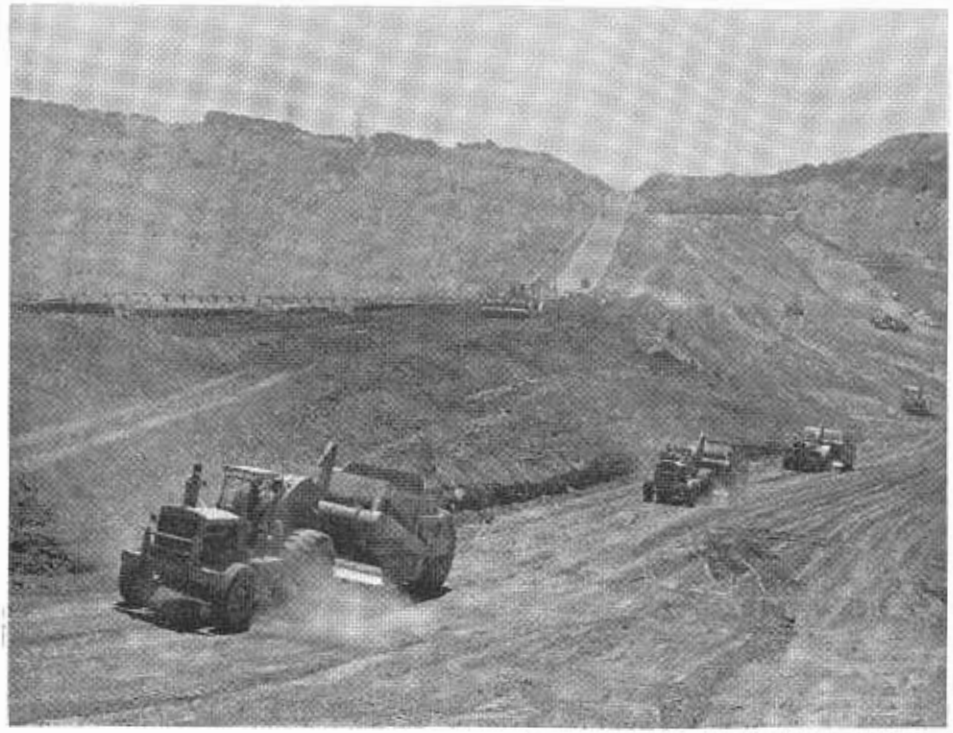
Study of New Bay Crossing Assigned

The Division of San Francisco Bay Toll Crossing has been assigned the completion of a study of a proposed toll crossing from San Francisco to Marin County by way of Angel Island. The Division had made the earlier study.

Completion of the study is directed by Senate Bill 1273 (Chapter 2142) of the 1961 Legislature, which appropriated up to $500,000 from the Highway Fund for the purpose, to be repaid out of the proceeds of the first sale of revenue bonds for construction of the crossing. The study will include comparison of an alternate route via Alcatraz Island.

Progress on U.S. 40 —

By J. G. MEYER, District Engineer



Scrapers move 1,500,000 cubic yards of material for embankment to widen U.S. 40 at American Canyon, and make this section eight lanes.

THE first half of the program of converting U.S. 40 in District X to full Interstate freeway standards is drawing to a close and we find that the schedule originally proposed has been met both in time and accomplishments.

In 1956 the last two contracts were awarded that completed the reconstruction of U.S. 40 to four-lane expressway standards just in time to start the new freeway program. Approximately $7,200,000 of construction monies had been expended between 1941 and 1956 to provide this facility.

When in 1956 the Federal Interstate Highway program was inaugurated, U.S. 40 was included in the Interstate

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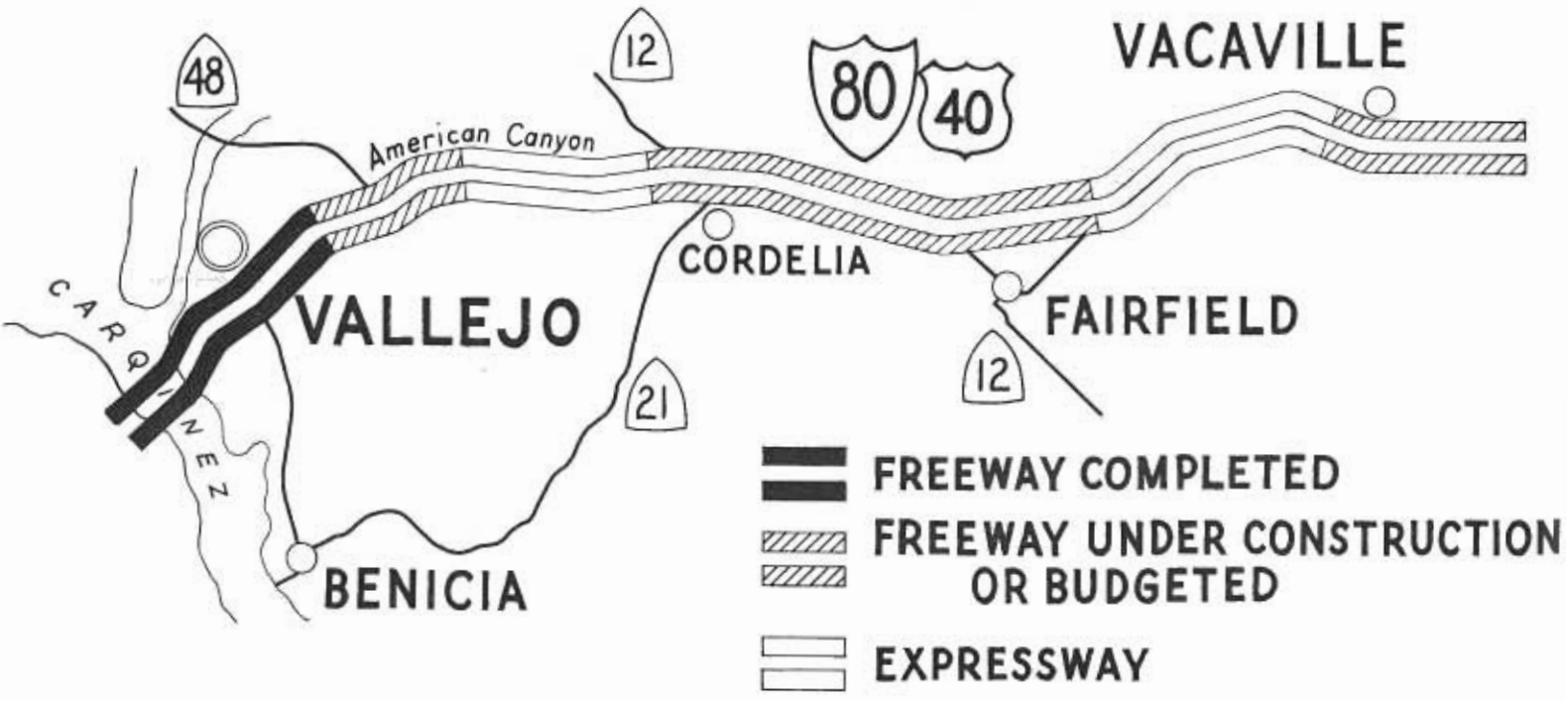


—Carquinez to Sacramento

By ALAN S. HART, District Engineer

ORIGINALLY, of course, there wasn't any road between Vallejo and Sacramento. Barely a path, in fact.

Then John Marshall's discovery of gold sparked the beginning of California's economic development that was to include the evolution from paths to trails to wagon roads to highways to freeways.

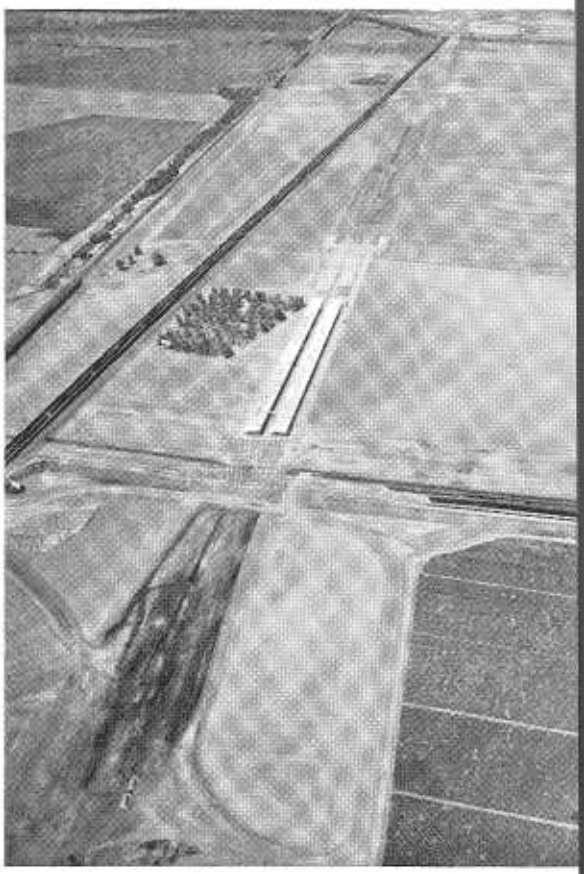
But it wasn't until 1916, with the completion of the Yolo Causeway, that a vehicle—motor or otherwise—could be driven over the route year around. Before then, the usual annual flooding of the Yolo Bypass Basin dictated that the traveler to Sacramento detour south by way of Tracy, then up through Stockton. The three-mile ground-level route across the Basin would be hopelessly awash in several feet of water.

Incidentally, the Yolo Bypass Basin is a portion of the fertile north-south lowland strip that absorbs the flood waters of the Sacramento River. It runs the length of eastern Yolo County connecting on the north with the Sutter Bypass and on the south continuing into Solano County and down to the rich delta area. It is extensively cultivated.

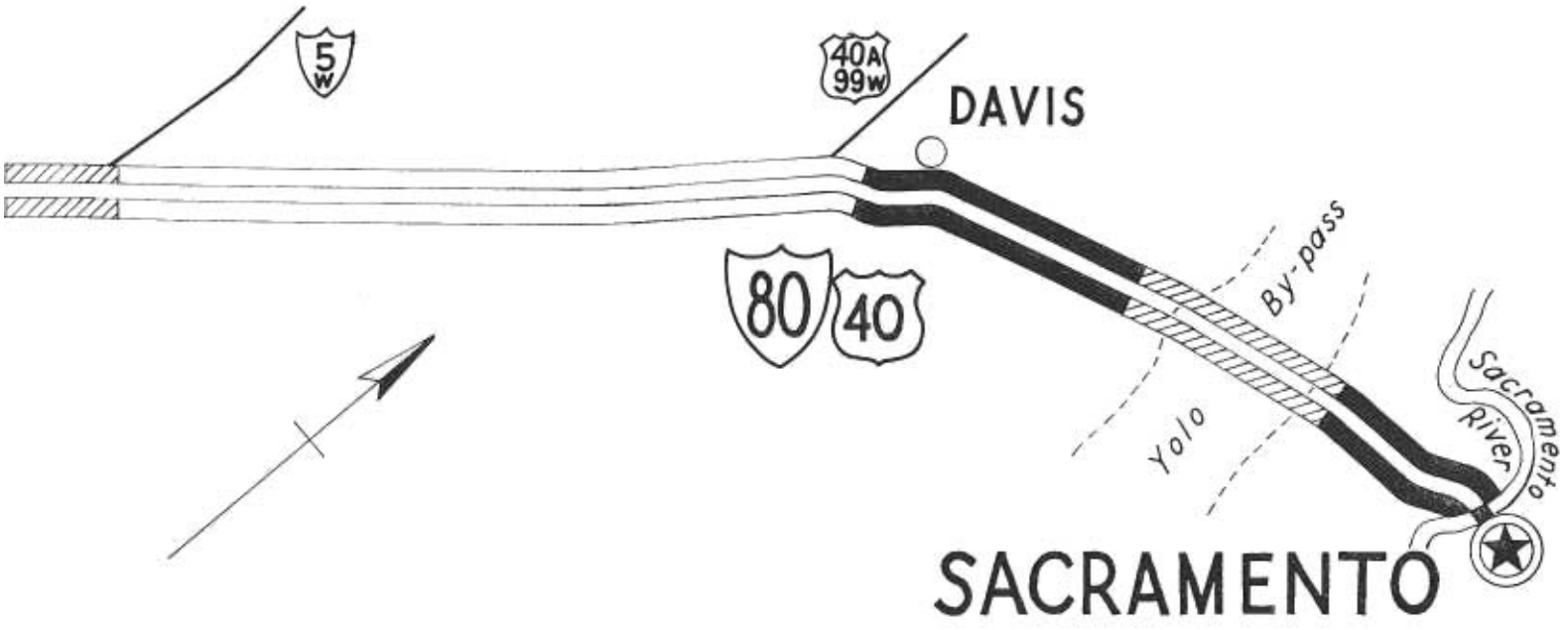
Best known as U.S. 40, the portion of this road in District III is also a section of U.S. 99W. And the entire route between San Francisco and the Nevada state line is a part of Interstate 80.

District X Formed

Solano County was a part of District III until 1924 when it was included in the newly formed District X. The boundary between districts is the Solano-Yolo county line which coincides with Putah Creek near Davis, and it is the 13 miles in Yolo County – Davis to Sacramento – that will be discussed in this article.



Aerial view of U.S. 40 construction across Yolo Bypass, looking east, with structure portion of new six-lane freeway seen underway at right. Existing four-lane undivided causeway is dark line running diagonally from left center to upper right.



Today the status of this road as it now skirts to the south of Davis is 1) a new six-lane freeway from the county line to Swingle, 2) a new Yolo Causeway under construction, and 3) a four-lane freeway from the Causeway to the Sacramento River.

Briefly looking into the past: The first paving of the route in Yolo County was completed in 1915-16. It was an asphaltic surfacing over a cement concrete base, and extended from the Woodland Wye due west of Davis into and through that town over what is now a county road, Russell Boulevard. Adequate for the times, pavement width varied from 15 to 18 feet.

The section from Davis east to near the Causeway was completed about the same time under several contracts.

The Causeway, of course, was the most dramatic of those early day contracts. In fact, it was one of the first really big jobs of the then fledgling highway department. This two-lane structure, with a clear roadway width of 21 feet, was built of reinforced concrete piles and deck, with an asphaltic wearing surface called a Topeka Top.

Paving Completed

Also at this time, the paving between the Causeway and the Sacramento River was completed, making a total of 14 miles of surfaced highway across Yolo County.

Approximately one mile was dropped from the route in 1941 when a realignment bypassed Davis to the south. This was the first section of four-lane divided highway on District III's share of the route, and extended east to Swingle.

Last fall a new six-lane freeway, with provision for eight lanes, was completed on approximately this same alignment at a cost of $2.5 million.

In 1933 the Causeway was doubled in width when an all-timber trestle was constructed next to the south edge of the original structure. In 1950 a continuous lighting system was installed.

The new six-lane divided Causeway-freeway project which started in January of this year, will span the Yolo Basin with two structures connected by nearly a mile of embarkment. Under a $6,950,000 contract with Fredrickson & Watson and Lew Jones Construction Co. of Oakland, the total 5.7-mile project will be on a new alignment beginning at the six-lane section at Swingle. It will be just south of the existing road.

The west Causeway will measure about 2,800 feet, the intervening fill section about 4,700 feet, and the east structure 8,500 feet. Both structures will be built as parallel bridges of three lanes each plus eight-foot shoulders, supported by cast-in-a-drilled-hole reinforced concrete piles. At some locations piles will be driven.

Possible 1962 Completion

In late August the project was about 30 percent complete with completion estimated for possibly late 1962 or sometime in 1963, depending on weather, availability of materials, and other unpredictables.

On the four miles between the Causeway and the Sacramento River, the major improvement following the 1916 job was completion of the Tower lift bridge in 1936. Then during 1951-54 a number of contracts totaling nearly $3,000,000 were let for construction of the present four-lane divided freeway on a new alignment to the south of the old road.

Future planning for this section calls for expansion to six lanes with the final mile just west of the river to follow a new, recently adopted alignment which will connect with a future freeway through Sacramento.

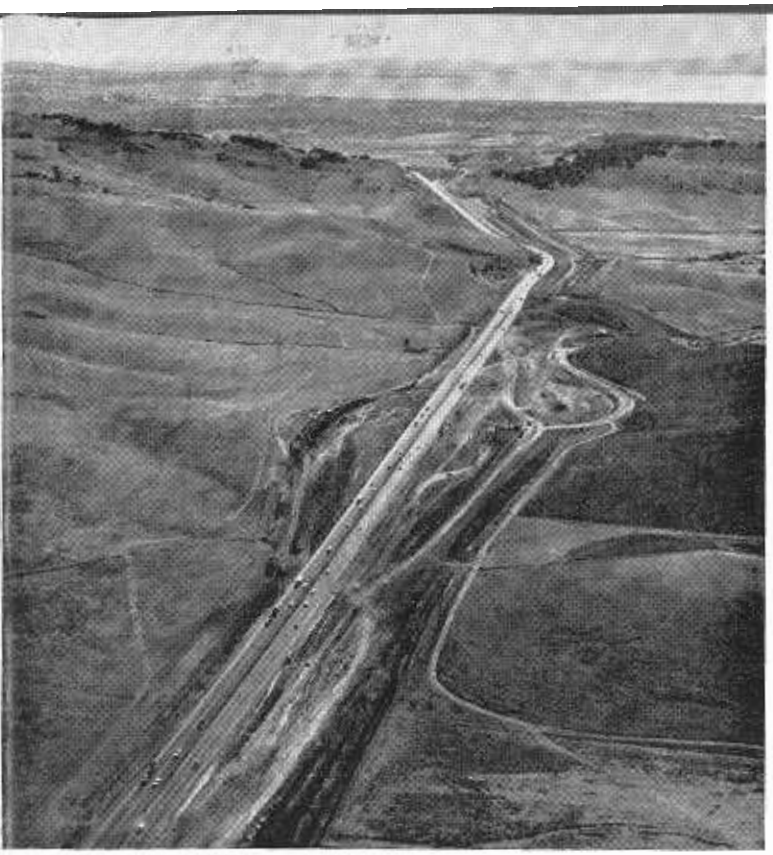
Ultimate plans include widening the entire 13 miles to an eight-lane full freeway.

Looking east along completed section of six-lane freeway in Yolo County. Interchange connects with city of Davis.

51 PROJECTS ADVERTISED

During August the Department of Public Works advertised for bids on 51 highways projects with an estimated value of $31,849,000. Since January 1, 1961, projects for $277,861,300 have been advertised. There were 59 contracts for $29,719,600 awarded dur- August and 49 contracts for $14,999,-500 were completed.

During August bids were opened for 60 projects for which 293 contractors' bids were received, an average of 4.9 bidders per project.



Looking south along current freeway construction on U.S. 40, city of Vallejo and San Francisco Bay in distance. Interchange will connect with relocated American Canyon Road.

Wagon drill in operation as first step in blasting for roadway excavation and fill at American Canyon. Blasted material will be used for fill below.

PROGRESS ON U.S. 40

Continued from page 6 . . .

System as Interstate 80 and a new era in construction began. As the first step in converting this pioneer route to full freeway standards, bonds were issued for the construction of a parallel bridge across the Carquinez Straits, new toll facilities and the reconstruction of the existing bridge and approaches. At the same time Federal Interstate funds and State highway user monies were allocated to convert U.S. 40 from the bridgeheads through Vallejo to the foot of the American Canyon to full Interstate freeway standards, all construction being done to provide room for a minimum of six traffic lanes.

New Parallel Bridge

The first four contracts were awarded in a total amount of approximately $17,540,000. These bond monies provided a new parallel bridge, revamped the old bridge and approaches, and installed the new toll plaza ready for traffic.

Another contract was awarded to Fredrickson & Watson Construction Company and Ransome Company on May 14, 1956. On December 6, 1957, the Director of Public Works accepted the project which provided an eight-lane divided facility, 1.25 miles long, from the bridgeheads to just north of the Vallejo "Wye" at a cost of $1,885,000.

The first road contract utilizing highway user funds to convert the expressway through part of Vallejo to a freeway was awarded April 23, 1957, to Harms Bros., C. M. Syar, and Erickson, Phillips & Weisberg. On January 6, 1959, 1½ years and $4,513,000 later, the new six-lane facility with six overcrossings and a separation structure at the intersection of U.S. 40 and State Route 74 (Benicia Road). This project was only 3.5 miles long, but it represents the most highly developed section of the entire 43.3 miles of U.S. 40 in District X.

On April 4, 1960, a contract was awarded to Gordon H. Ball to construct 4.4 miles of six lanes divided freeway with six bridges, three overcrossings, a separation structure at the intersection of U.S. 40 and Sign Route 21 and an overhead structure at Cordelia. Construction is 90% complete and will be finished in January 1962 at a cost of $4,178,000.

Widening Is Planned

Plans are now being prepared to widen SSR 21 between Cordelia and Benicia to freeway status. This is due to the attractiveness of the route for East Bay residents bound for Sacramento and points east. Upon completion of the Benicia-Martinez Bridge, this route is destined to increase in popularity and is part of the reason for building into the U.S. 40 project room for two additional lanes so that minimum disturbance of public traffic will result due to future widening.

On June 27, 1960, a contract to eliminate the "Fairfield Lights" was awarded to Charles L. Harney, Inc. This project is 1.6 miles long and provides a six-lane divided freeway, two bridges, one overhead, and a separation structure at U.S. 40 and Sign Route 12. The anticipated cost of

eliminating the last intersection controlled by traffic signals between Sacramento and San Francisco is $1,960,000. This project should be ready for traffic late in November 1961.

On February 16, 1961, a contract was awarded to Wunderlich Company for constructing 4 miles of eight-lane divided freeway, one overcrossing and a separation structure at the intersection of U.S. 40 and Sign Route 48 at a cost of $4,800,000. This is the first project for widening the American Canyon section of U.S. 40. Foundation problems have been intensified by the heavy grading features of the project which include fill heights of 100 feet and cuts having depths of 260 feet.

Subdrainage Increased

Stabilization trenches were provided for in the contract, but after opening up new cuts and benching into the old fills and encountering vast quantities of water in both locations, it was necessary to increase all subdrainage items. To date this amounts to an increase of 10% to 15% of the original drainage items.

Looking north on U.S. 40 in Solano County, Abernathy Road interchange in foreground, city of Fairfield in background. Interchange under construction near Fairfield will eliminate last remaining traffic signal between Sacramento and San Francisco.

Looking north on U.S. 40 near Cordelia. Green Valley Road overcrossing in foreground, interchange with State Sign Route 21 (to Benicia) center; Mangels Road interchange in background.

Conversion of a five-mile section of expressway through the Vacaville-Nut Tree area is financed in the 1961-62 State Highway Budget with an allocation of $5,400,000. Bids for this project will be opened November 15, 1961.

The remaining sections of U.S. 40 in Solano County are either in the stage of completion design, with right of way acquisition in progress; or in various stages of design work.

Thus today we stand with 24% of the 43.3 miles constructed, 39% planned and ready to advertise, and 37% under design. If financing can be arranged, 63% of U.S. 40 in District X could be completed by 1965.

The target date of 1972 for completion of the Interstate System may be difficult to hit for the system as a whole, but it would appear that District X will be able to anticipate that date by several years, given adequate financing.

Elysian Viaduct

Key Structure in Complex L.A. Interchange Nears Completion

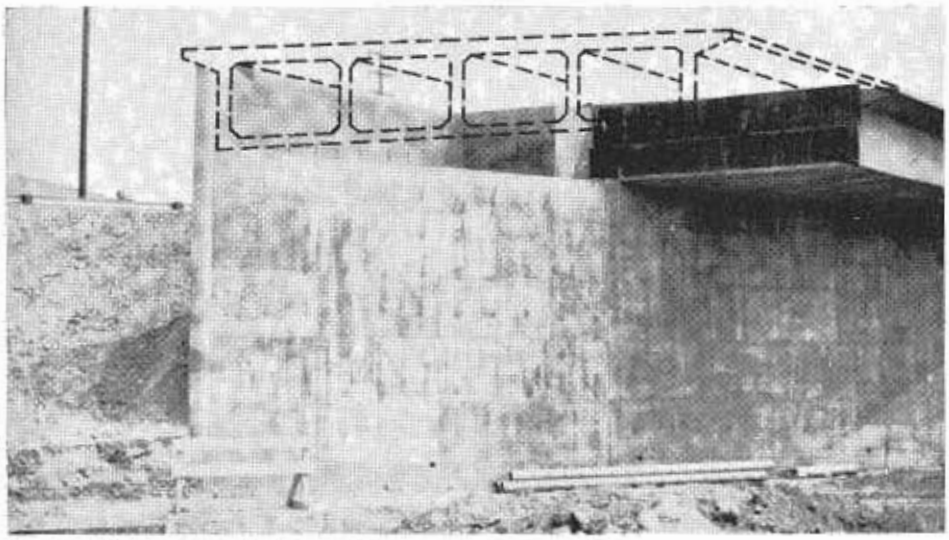
By ALBERT P. BEZZONE, JR. and GORDON MORSE, Associate Bridge Engineers

THE COMPLEX Golden State-Pasadena Freeway Interchange now nearing completion, features unusual structural solutions to several unique problems created by the difficult site and alignment controls. Because of the restrictions imposed by the Los Angeles River, the Arroyo Seco Channel, the existing Pasadena Freeway, extensive Southern Pacific Railroad yards and existing city streets,—all tightly concentrated—the layout of interchanging ramps had to be custom tailored to fit.

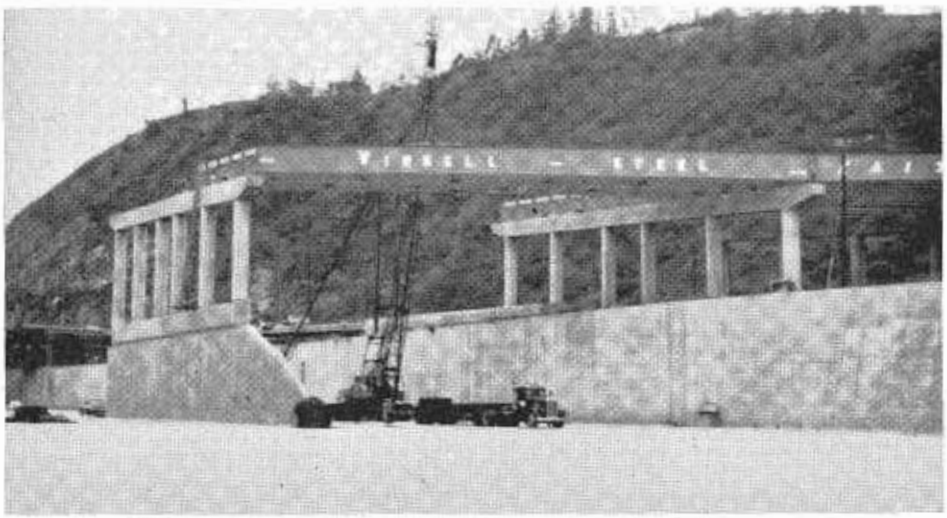
Key structure is the half mile long Elysian Viaduct which will carry Golden State Freeway traffic over the many obstructions below, and at its southerly end develops into a system of curved ramps which cross and merge in an intricate pattern to make possible the interchange with the Pasadena Freeway. The viaduct is a minimum of eight lanes in width and features long span welded steel girders in the northerly section and concrete box girders in the southerly section where the structure develops into three levels.

During construction emphasis was placed on minimizing inconvenience to traffic by scheduling construction operations and timing lane closures for

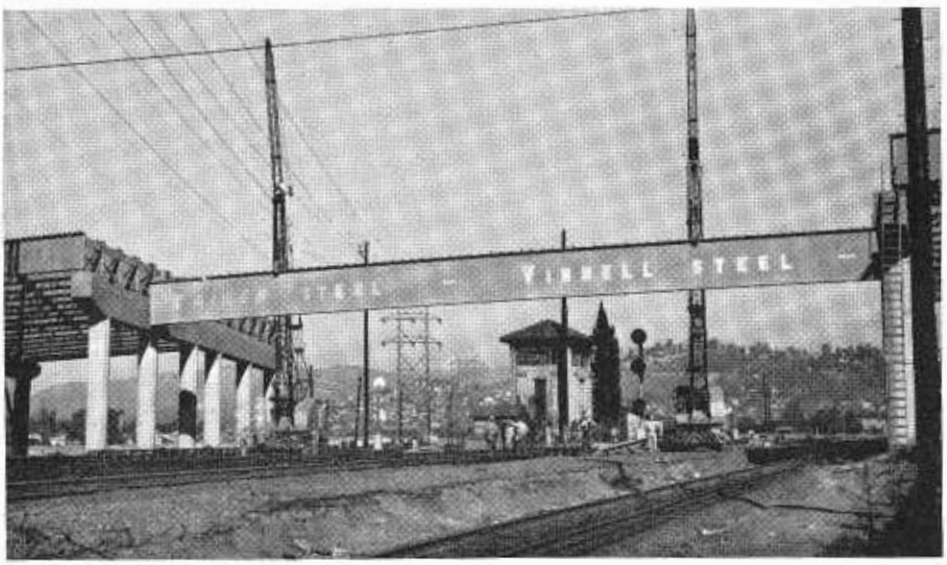
The numbers in the above photo indicate various construction features of the interchange.



The overhanging abutment at the north end of the Arroyo Seco Channel Off-Ramp will support the box girder shown dashed in the photograph.



Erection of structural steel for the Elysian Viaduct is shown at the crossing of the Los Angeles River.



Steel erection for the Elysian Viaduct is shown at the crossing of the Southern Pacific Railroad yard.

off peak hours. Movement of the steel girders to the site and erection of steel over the Pasadena Freeway were often scheduled for early morning hours. Daytime erection of girders over the Southern Pacific tracks was made possible by the cooperation of the Southern Pacific in scheduling and routing trains.

Curved Steel Bridge

The first curved steel girder bridge in California carries the westbound on-ramp connection from the Pasadena Freeway across the Arroyo Seco Channel at a sharp skew and on a 400 foot radius curve. With all girders curved to fit the roadway curvature, this structure may be the first of its kind anywhere.

The girders were fabricated by cutting the flange plates to the prescribed curve and welding web plates to the curved flanges in the conventional manner. The girders were assembled in the shop in braced pairs and trucked to the job site in an after-midnight caravan timed to avoid heavy traffic.

The curved girders produce a symmetrical deck section with uniform girder spacing and slab overhangs which result in economy in formwork. Additional advantages are the simplicity of detail and the functional, attractive appearance.

Prestressed Carrying Girders

Three ramps cross Arroyo Seco Channel on severe skews. Prohibitively long spans would have been required to bridge the entire channel and yet not supports were allowed in the channel. This problem was solved by providing prestressed carrying girders to pick up the heavy column loads. The carrying girders were concrete box structures reinforced with post-tensioned high strength steel rods. Working forces for these girders varied from six million to nine million pounds.

The carrying girder at the Arroyo Seco Channel On-Ramp was nine feet deep by twenty feet wide and consisted of two cells. The carrying girders at the Arroyo Seco Channel Off-Ramp and at Bent 22–9 of the Elysian Viaduct were single cell box structures ten feet deep by fifteen feet wide.

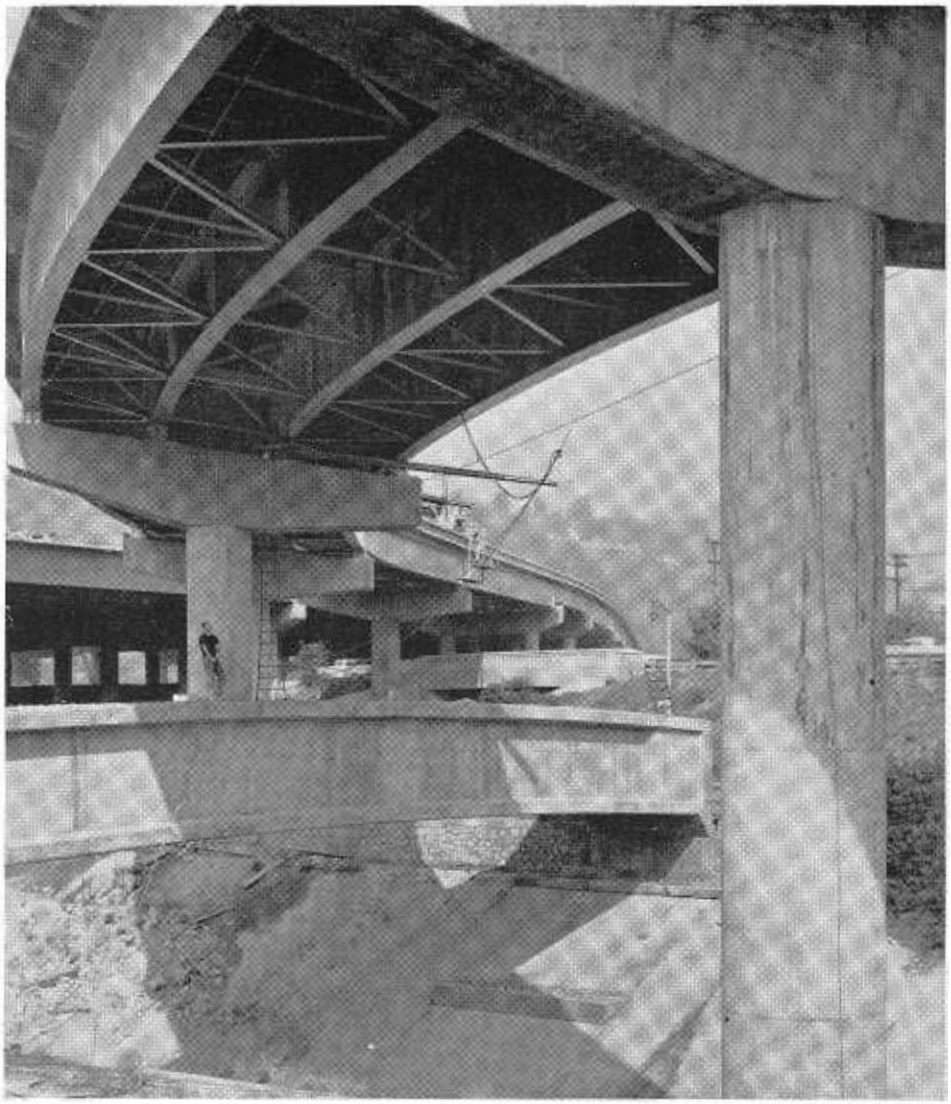
Variety of Structural Types Used

The Los Angeles River-Riverside Drive Modification provides four new lanes northbound from the existing Dayton Avenue Bridge. This is accomplished with a complicated transition structure at Dayton Avenue and an elevated structure along the existing channel wall. Total length of new construction is 578 feet and is supported on piles for its full length to avoid adding pressure to the Los Angeles River Channel lining.

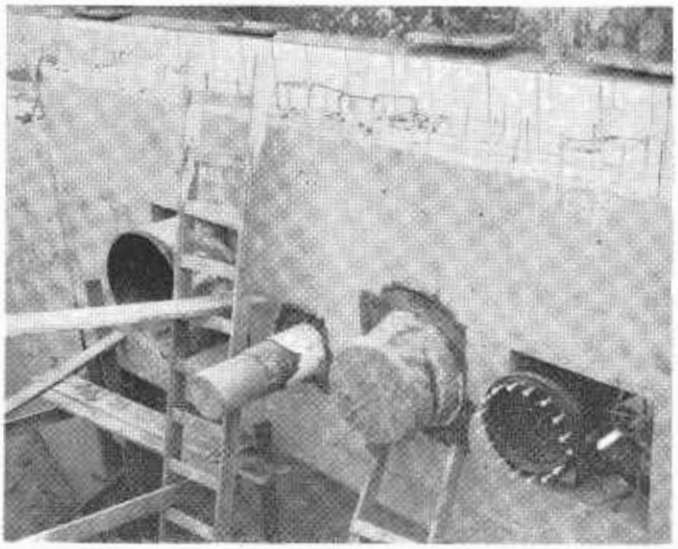
Railroad Underpasses south of the main viaduct carry the Union Pacific and The Atchison, Topeka and Santa Fe tracks over the Golden State Freeway. The Humboldt Street Underpass carries both vehicular and rail traffic. The railroad section is a riveted plate girder and the highway section is a concrete box girder which provides space for a large number of utilities in its cells. The Lacy Street Underpass carries two tracks of The Atchison, Topeka and Santa Fe and features spans almost 100 feet in length.

The Cypress Avenue Pedestrian Overcrossing bridges all of the lanes of the Pasadena Freeway with a span of 147 feet. This span is the longest for a steel pedestrian structure in California. In addition to pedestrian traffic, the structure accommodates a 30 inch pressure gas line.

Structural features include all welded construction, light steel decking in the long center span and a conventional concrete deck slab in the



This photograph shows the curved steel girders supported by the prestressed carrying girder over the Arroyo Seco Channel.



This photograph shows six utilities emerging from the abutment of the Humboldt Street Underpass.

The Cypress Avenue Pedestrian Overcrossing is a welded steel structure, 440 feet long, which replaces an old timber truss structure.

The On-Ramp to the Elysian Viaduct from the south is a steel girder structure curved to fit the roadway curvature.

comparatively short side spans. Two existing concrete piers constructed many years ago for a proposed vehicular crossing at Cypress Avenue were modified for use as supports for the pedestrian structure.

Arroyo Seco Channel Ramps

The ramp structures which cross the Arroyo Seco Channel and provide on and off connections to the Pasadena Freeway were a formidable challenge to the bridge designers. Because of the curvature and sharp skew angle of the channel crossings, prestressed carrying girders were used to maintain an unobstructed channel.

In addition, at the north end of the Off Ramp Overcrossing an overhanging rigid frame abutment was used to shorten the span over the Pasadena Freeway inbound lanes. This is illustrated in an accompanying photograph.

The On-Ramp Overcrossing combines the use of long continuous concrete box girder spans with the support provided by the special prestressed carrying girder, to produce a unique structure. The northerly abutment has an eccentric footing which is set back to clear the existing channel wall footing.

Design and Construction Staff

Design engineers for the various structures were as follows:

Elysian Viaduct: A. P. Bezzone, Jr., Ostap Bender.

Humboldt St. Underpass: H. J. Berbert.

Humbolt St. Pumping Plant: R. F. Lee, J. A. Tryens.

Lacy Street Underpass: Ostap Bender.

Riverside Drive Modification: A. E. Dirckx.

Cypress Ave. Pedestrian Overcrossing: Ostap Bender.

Avenue 26 Undercrossing: R. F. Lee.

Arroyo Seco Channel On Ramp: L. H. Caldwell.

Arroyo Seco Channel Off Ramp: R. E. Shields.

The Resident Engineer for the project is Kenneth P. Mock. Bridge Resident Engineer is Gordon Morse, with A. E. Waddel, A. Sousa and T. Fraser as his principal assistants.

General Contractor for the Pasadena Avenue to Arnold Street project is the Vinnell Corporation, Vinnell Constructors and A. S. Vinnell Company. Kaiser Steel Corporation fabricated and erected part of the structural steel including the curved girders. Additional subcontractors for structural steel were the Vinnell Steel Company and the Bethlehem Steel Company.

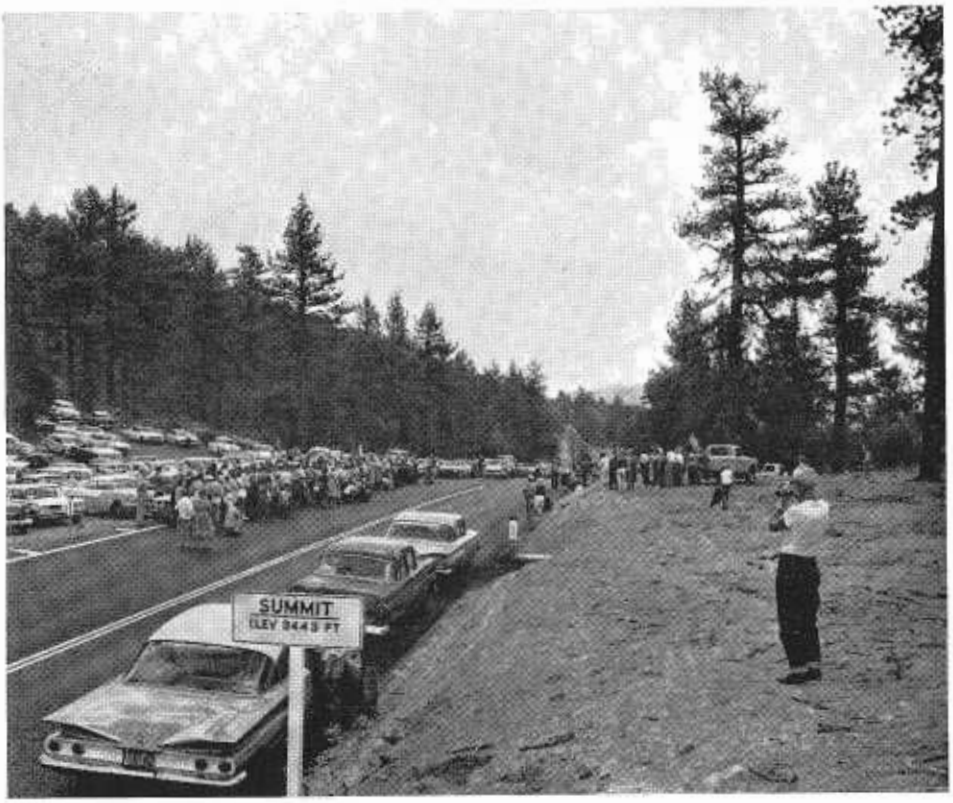
For the general Contractor, Project Superintendent is Robert Hayden and Bridge Superintendent is Al Thronson.

Big Bear Loop

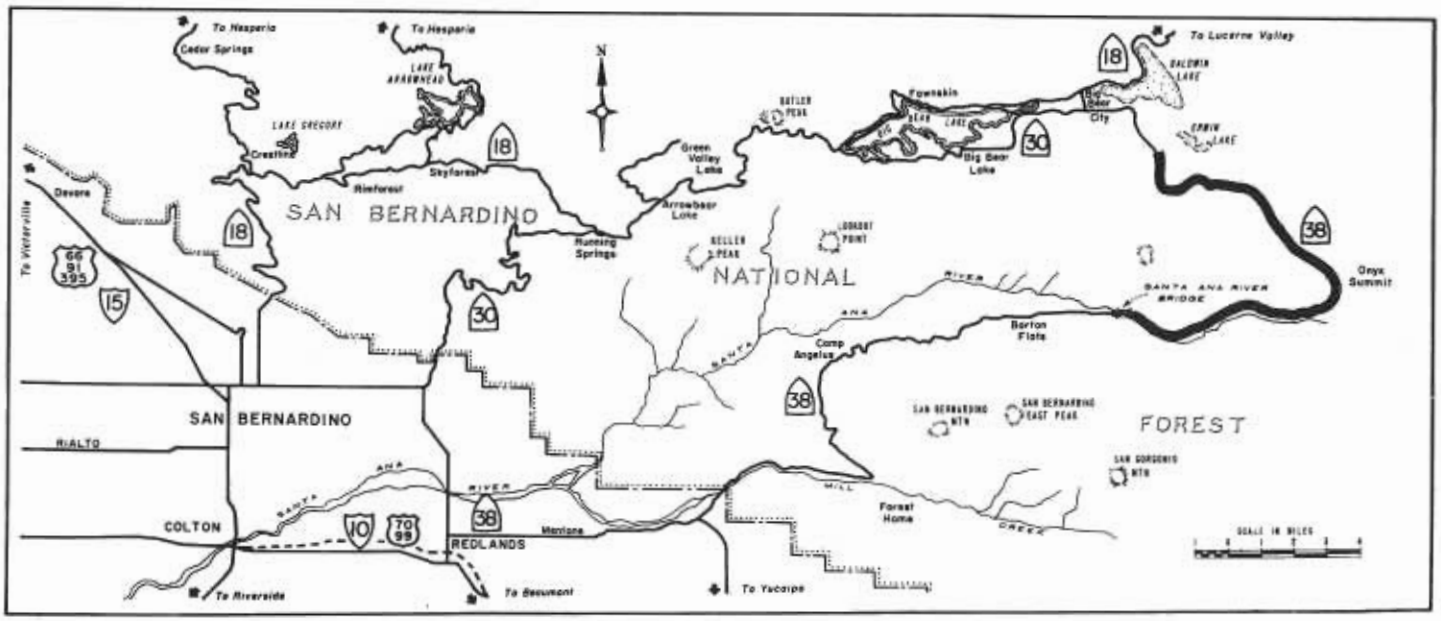
New 16-Mile Highway Opens Up Large Scenic Recreation Area

COMPLETION of a 16-mile paving contract in July has opened up for scenic and recreational travel a large area of the San Bernardino National Forest, previously inaccessible by public road. The area lies in the upper reaches of the Santa Ana River watershed. Frequently referred to as the "Barton Flats to Big Bear Loop", the new section of highway closes a gap which has prevented direct connection between the popular mountain resort areas on either side of the river.

Construction of the new road was accomplished under several contracts administered by the U.S. Bureau of Public Roads. The U.S. Forest Service and the California Division of Highways participated in financing and in acquisition of right of way over private lands. The highway is a part of the State Highway System, and will be maintained by the State. In recognition of the importance of this new link in the system, the highway from

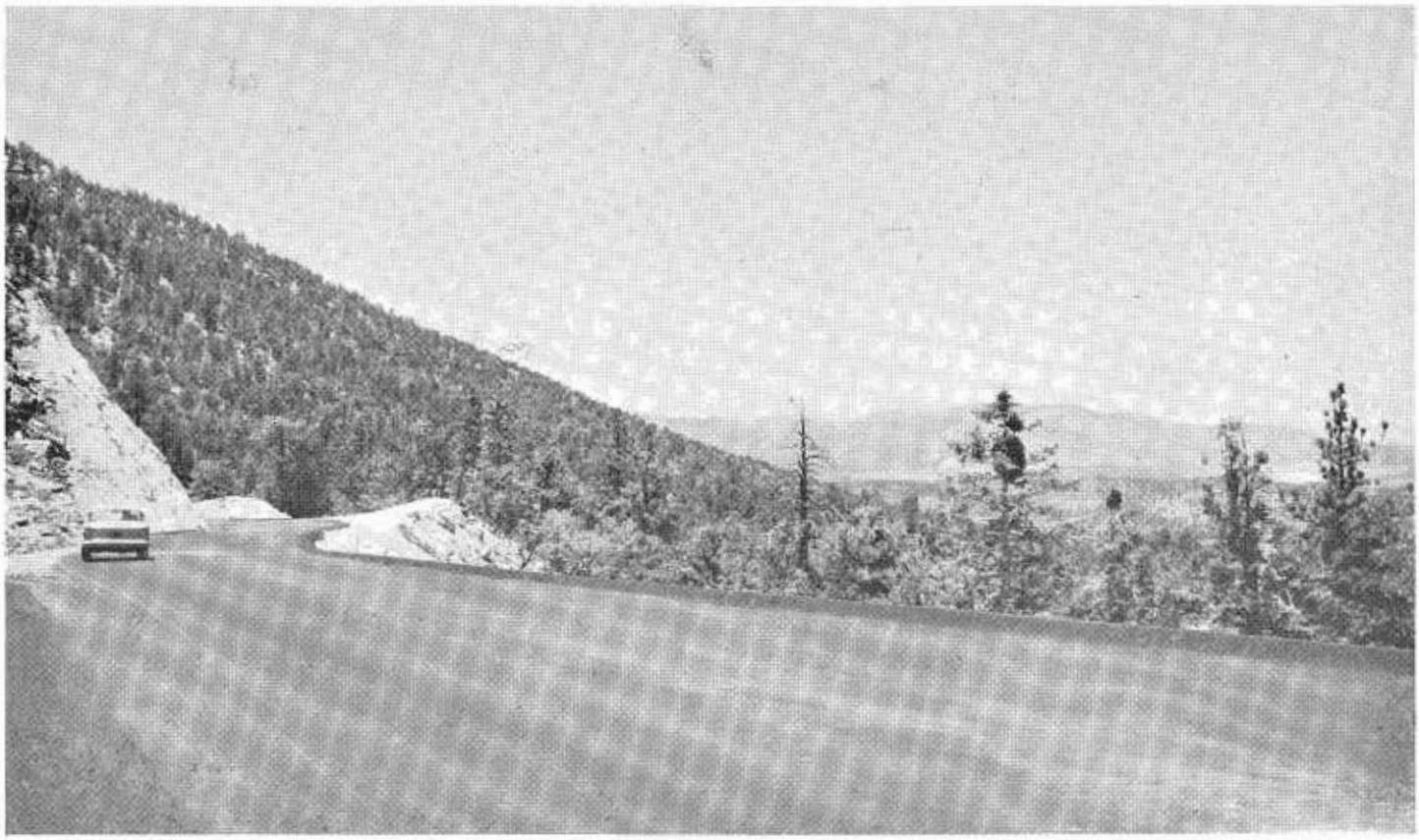


Opening ceremonies for the new section of the Big Bear Loop highway (State Sign Route 38) were held at Onyx Summit on August 12.

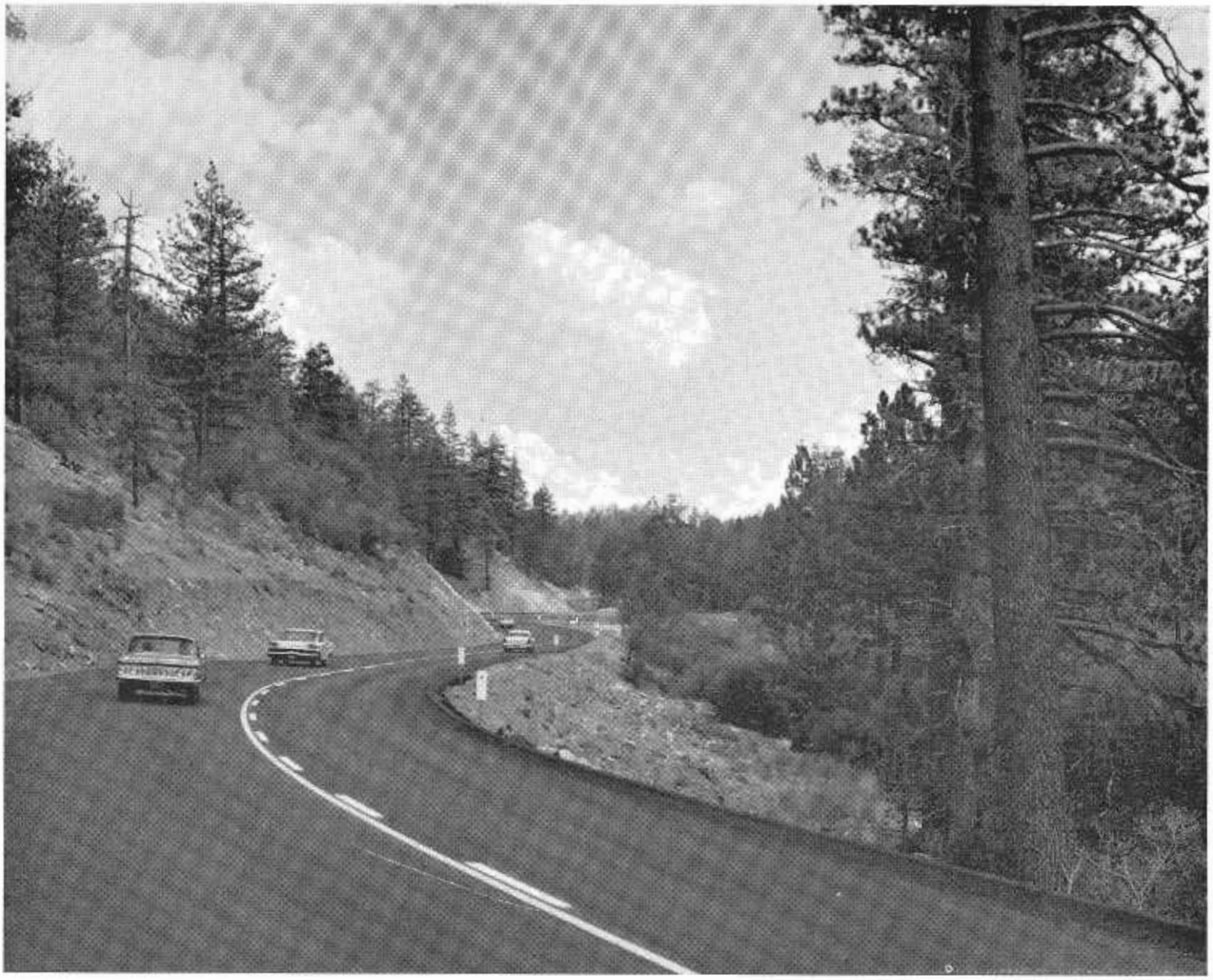


The heavy black line on the above map shows the location of the new section of highway on the Big Bear Loop.

A view of the new highway during construction showing a paving plant in operation to the left of the roadway.



A view of the new highway and surrounding country shortly before it was opened to the public.



Traffic passes over the new section of Sign Route 38 following opening ceremonies on August 8.

Redlands through Camp Angelus and the Barton Flats area, and over the new section to Big Bear City, has been designated State Sign Route 38.

Highway Connections

Motorists desiring a mountain loop trip, mostly above the 6000-foot level, will find connections to Highway 38 at Orange Street in Redlands, or they may make connections with Highway 18 (Rim-of-the-World Highway) in San Bernardino; with Highway 30 (City Creek Road) near Highland; or with Highway 18 in the Apple Valley-Lucerne Valley area. The new Highway 38 will be marked by large signs on the U.S. 70-99 (Interstate 10) freeway now under construction through Redlands.

Construction of the 16-mile link was started in June 1959, with a contract by Spirite and Cohn for grading five miles eastward from South Fork Camp and constructing the Santa Ana River Bridge. R. W. Ellis was Resident Engineer for the U.S. Bureau of Public Roads on this contract. The second unit consisted of grading the remaining 11 miles, under two contracts with J. E. Haddock, Ltd. J. M. Hawkins of the U.S. Bureau of Public Roads was Resident Engineer. The final unit, paving the entire 16 miles, was completed by Osborn Company in July 1961. Resident Engineers on this contract were F. J. Clavert and J. J. O'Neill.

Camps Are Planned

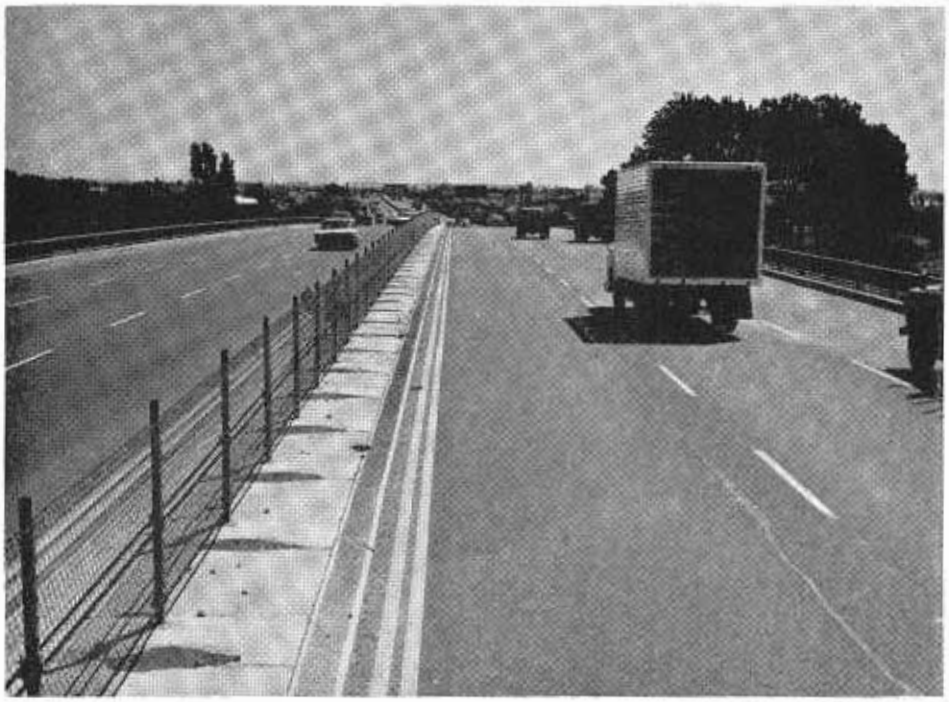
Onyx Summit, where the new road crosses from the Cienega Seca watershed to the Big Bear Lake watershed, is at elevation 8451. Maximum grade rate is 6%, providing a high gear, two-lane mountain road with excellent visibility and alignment. The U.S. Forest Service plans to develop recreational camps and facilities, similar to the Barton Flats area, at several locations along the new highway. This section of highway was declared a freeway by the California Highway Commission and rights of way with controlled access were acquired, which will preserve its ability to move traffic safely and expeditiously.

Barrier Report

Performance of Beam, Cable Types Analyzed

By KARL MOSKOWITZ and WILLIAM E. SCHAEFER, Assistant Traffic Engineers

Beam barrier on a heavily-traveled section of the Nimitz Freeway in Alameda County.



The cable barrier section on the Nimitz Freeway near San Leandro.

In the summer of 1959, two types of median barriers were developed and tested for use on California freeways. These were the cable-chain-link fence barrier, hereafter referred to as "cable", and the double-blocked-out metal beam barrier, hereafter referred to as "beam".

Details of the barriers, and tests leading to their adoption, were reported in "California Highways and Public Works" in July-August, 1959. The photographs on this page show typical installations of both types.

The status of the current barrier construction program is as follows:

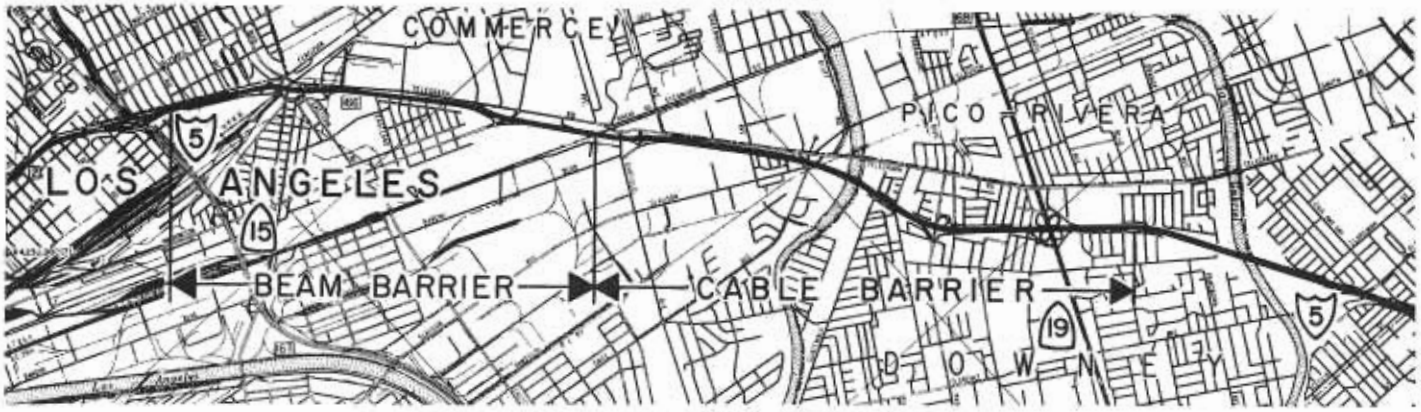
	Net Miles of Barrier-Divided Highway		
	Cable	*Beam*	*Total*
Constructed	31.5	16.8	48.3
Under Construction	47.0	15.1	62.1
Budgeted	38.5	11.6	50.1
Total	117.0	43.5	160.5

The maps, Figures A and B, show the locations of barriers constructed or budgeted.

In order to compare the performance of the two types of barrier, the first contracts were split, with some of each type in each contract. These are referred to as test sections. One test section was on the Santa Ana Freeway in Los Angeles County where 3.17 miles of cable barrier were erected end-to-end with 2.57 miles of beam barrier; the other test section was on the Nimitz Freeway in Alameda County where 3.87 miles of cable barrier were erected end-to-end with 2.87 miles of beam barrier. Before-and-after accident records on these test sections have been examined. The results of the study are given in this report.

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, compared with



A map of the test section on the Santa Ana Freeway in Los Angeles County where 3.17 miles of cable barrier were erected end-to-end with 2.57 miles of beam barrier.

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. (However, there were eight fatal accidents in the after-period as compared with a total of 12 in the before-period.)

(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 impact tests indicated that in high-speed collisions the cable barrier would result in much less severe injury to vehicle occupants and it is believed that in the long run the accidents involving the cable barrier would be less severe.

(4) A sports car has gone through the cable barrier and two vehicles have gone over it. It is expected that the current new series of crash tests will solve the problem of vehicles going over this barrier.

(5) 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.

(6) More accidents involve the cable barrier, but 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.

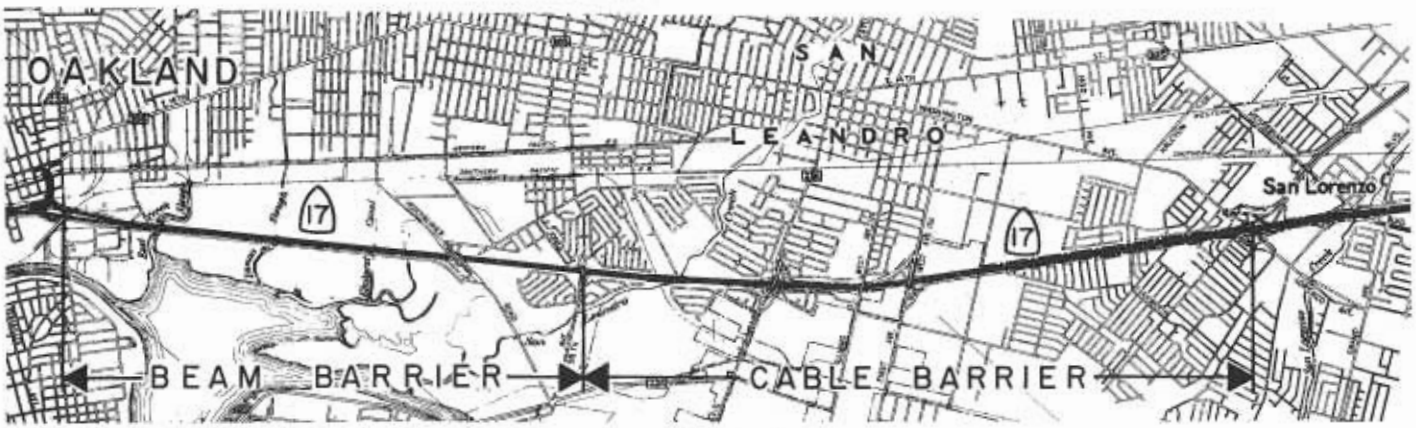
(7) There was little difference in the barrier accident rate between the sections with 12- and 22-foot medians, and the maintenance cost per mile was essentially the same. The crash tests showed that the cable barrier could deflect or give under impact—allowing a vehicle to momentarily enter the opposing lanes. However, nothing in the study indicated this to be a problem.

I. EFFECTIVENESS OF BARRIERS IN PREVENTING CROSS-MEDIAN ACCIDENTS AND FATAL ACCIDENTS

Both types of barrier have proved effective in accomplishing the purpose for which they were designed. They have been struck hundreds of times, and only two headon accidents have occurred at locations where they are in place. Two vehicles climbed or jumped clear over the barrier. A new series of crash tests, using heavier vehicles and 75 mile per hour speeds (instead of the 60 mile speeds used in the original tests) are now under way in an effort to make the design even more fool-proof.

II. EFFECT OF BARRIERS ON OVER-ALL ACCIDENT RECORD, BY TYPE OF BARRIER

As described in the introduction, test sections of both types of barrier were erected on the Santa Ana Freeway and the Nimitiz Freeway for the purpose of comparing the effectiveness of the two types of barrier.



A map of the test section on the Nimitz Freeway in Alameda County where 3.87 miles of cable barrier were erected end-to-end with 2.87 miles of beam barrier.

Although there is no way of being sure that the differences between sections are attributable solely to the difference in type of barrier, it was thought that as many extraneous factors as possible would be eliminated by an end-to-end comparison on the same freeway where traffic volume remains approximately uniform, and where, in fact, the very same vehicles pass by first one type of barrier and then the other.

Comparisons between cable barrier on one freeway and beam barrier on another should be interpreted very cautiously, because there are so many other potential variables which could affect accident rates that the difference owing to type of barrier can be smothered in irrelevancies.

The Santa Ana test sections were between the Long Beach Freeway and Buhman Avenue, and the Nimitz Freeway test sections were between High Street and Washington Avenue. These are both 6-lane freeways with 12-foot medians. The average daily traffic was between 90,000 and 100,000 on all sections. Grades are practically level and alignment is excellent.

Before-and-after statistics, using one year prior to construction as the "before" period, and one year after completion as the "after" period (the period during construction is omitted) are shown in Table 1 for the Santa Ana test sections, Table 2 for the Nimitz test sections, and Table 3 for a section of the Hollywood Freeway.

The following points are noted concerning the Santa Ana test sections:

(1) Before barriers were erected on either section, the section where beam barrier was later erected had a much lower accident rate than the section where the cable barrier was erected.

(2) The total accident rate increased significantly after erection of the barriers, on both sections.

(3) The percentage increase on the section with the beam barrier was very much greater than the percentage increase on the section with the cable barrier.

(4) Although total reported accidents increased where the cable barrier was installed, accidents severe enough to cause injuries did not increase. Where the beam barrier was installed, the injury accident rate increased by 53%. This increase cannot be directly related to cars which crashed into the barrier, however.

The following points are noted concerning the Nimitz test sections:

(1) The over-all accident rates were about equal on both sections before the barriers were erected on either section.

(2) The accident rates increased significantly after erection of the barriers, on both sections.

(3) The increase in accident rate was somewhat greater on the beam section than on the cable section (37% against 26%).

(4) During the "after" period, 42% of the reported accidents on the cable section resulted in injuries, and 44% of the reported accidents on the beam section resulted in injuries. This is about the normal ratio for all freeways.

The following points are noted regarding the Hollywood Freeway beam barrier installation:

(1) The rates were high * before and after. This is probably characteristic of extremely congested freeways.

(2) The barrier did not affect the rates, either over-all or injury.

* While these rates are considered high for urban freeways, they are still only about ⅓ of the rate on urban arterials other than freeways.

TABLE 1

BEFORE AND AFTER RECORD—SANTA ANA FREEWAY TEST SECTIONS

All Reported Accidents

		Before		*After*		*Change*	
	Miles	*No.*	*Rate * per MVM*	*No.*	*Rate per MVM*	*in Rate*	*Percent*
Cable	3.17	120	1.08	153	1.30	+0.22	+20
Beam	2.57	74	0.80	107	1.12	+0.32	+40

Injury-Accidents (Including Fatal)

		Before		*After*		*Change*	
	Miles	*No.*	*Rate per MVM*	*No.*	*Rate per MVM*	*in Rate*	*Percent*
Cable	3.17	55	0.49	56	0.48	−0.01	−2
Beam	2.57	26	0.28	41	0.43	+0.15	+53

* Rate per MVM is the number per million vehicle-miles. An injury-accident rate of 0.49 per MVM shows that more than two million car-miles (the total life of about 30 cars) of travel are accumulated for each accident serious enough to cause minor injuries to the occupants.

TABLE 2

BEFORE AND AFTER RECORD—NIMITZ FREEWAY TEST SECTIONS

All Reported Accidents

		Before		*After*		*Change*	
	Miles	*No.*	*Rate Per MVM*	*No.*	*Rate Per MVM*	*in Rate*	*%*
Cable	3.87	185	1.51	250	1.90	+0.39	+26
Beam	2.87	146	1.55	216	2.13	+0.58	+37

Injury-Accidents (Including Fatal)

		Before		*After*		*Change*	
	Miles	*No.*	*Rate Per MVM*	*No.*	*Rate Per MVM*	*in Rate*	*%*
Cable	3.87	71	0.58	105	0.80	+0.22	+38
Beam	2.87	*	*	95	0.94	*	*

* Where the beam barrier was installed, there was a change in jurisdiction of enforcement agencies between the "before" and "after" periods. Because of a change in methods of reporting, and in definition of "injury", the injury-accident rate in the before period is not known.

TABLE 3

BEFORE AND AFTER RECORD—HOLLYWOOD FREEWAY BETWEEN HARBOR FREEWAY AND BENTON WAY

Beam Barrier 1.68 Miles—ADT = 190,000

	Before		*After*		*Change*	
	No.	*Rate*	*No.*	*Rate*	*Rate*	*%*
All Accidents	242	2.10	266	2.21	+0.11	+5
Injury Accidents	158	1.37	155	1.29	−0.08	−6

(3) The ratio of injury accidents to total accidents, 60%, is very high. It is possible that many non-injury accidents are being overlooked on this section.

Before-and-after studies were also made on four other short installations of beam barrier, two on the Santa Ana Freeway near the East Los Angeles Interchange, and two on the Bayshore in San Francisco.

Because of a change in reporting methods on the Bayshore, and because of construction operations and other modifications of the freeway on this portion of the Santa Ana, reliable before-and-after comparisons cannot be made. Available records on three of the sections showed an apparent increase in accidents, and one section, between Soto Street and the San Bernardino Freeway junction on the Santa Ana, showed a large apparent decrease. The latter section comprised many short sections of barrier intermittent with previously existing retaining walls and other median obstructions.

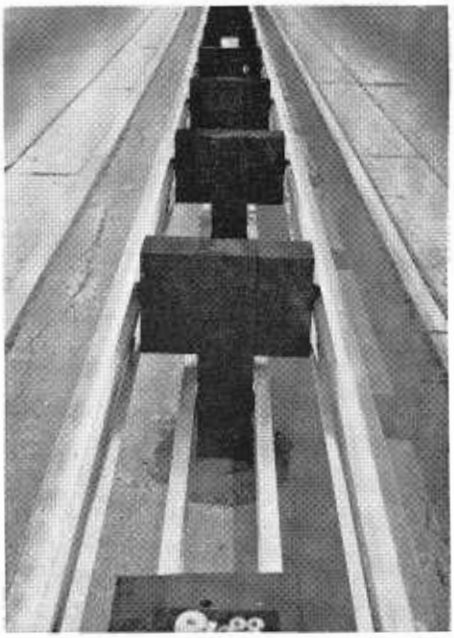
The barriers have generally resulted in an increase in over-all accidents, except on the Hollywood Freeway where the volume is 190,000. An earlier study * had indicated that barriers would increase accidents on roads where the volume is less than 130,000.

The percentage increase in both the all-accident rate and injury-accident rate was greater where the beam barrier was placed than where the cable barrier was placed, although the sample is so small and other unaccounted-for differences in rates are so large that these differences could be due to reasons other than difference in barrier types.

It may be significant that the rise in accidents on the cable barrier section of the Santa Ana was not accompanied by a rise in the injury-accident rate. However, the rise in injury accidents on the Nimitz cable section was just as great as the rise in all-accidents on this section.

The ratio of all-accidents to injury-accidents lies in the expected range of 2.2 to 2.8 in the before and after samples for both types of barrier in the test sections. This is significant in that it shows that the increase in reported accidents is not composed of mere "fender-benders" or "fence-scrapers."

* "Median Study" (Calif. Highways & Public Works, July-Aug. 1959).



A close-up showing construction detail of a blocked-out beam barrier on the Santa Ana Freeway.

III. ACCIDENTS INVOLVING THE MEDIAN

A. Although head-on accidents were virtually eliminated by both types of barrier, it has been seen that in general there was a rise in accident rates where the barriers were installed on freeways having traffic volume less than 130,000 vehicles per day. One explanation, of course, would be that without a barrier many vehicles are able to encroach on the median without suffering a reportable accident, whereas after the barriers are installed, they strike a barrier. Table 4 shows the relation between the number of cars hitting the barrier and the rise in accidents when barriers are installed.

It can be seen in Table 4 that a considerable proportion (57% to 80%) of the increase can be accounted for by collisions with the barrier except in the case of the Santa Ana Beam Section. Before reaching any conclusions, note that the over-all increase in the accident rate on the Santa Ana beam section was 50% greater than the increase on the Santa Ana cable section. The decrease in rate of accidents involving the median on the Santa Ana beam section is one of the inexplicable things that are frequently encountered when making a statistical study involving small numbers.

B. Events associated with barrier collisions: As Table 4 shows, a lot more drivers are getting involved with the median than there were before the barriers were erected. What the table does not show is the number of times the median was violated in the "before" period with no resulting accident.

There has been speculation that people are deliberately driving into the cable barrier on the theory that it is softer than the car ahead. In an effort to explore this possibility, Table 5 was prepared. This table classifies the accidents involving the barrier according to events preceding the collision. There is also a subjective classification in the right-hand two columns as to whether the vehicle was deliberately or involuntarily driven into the barrier. This classification represents the analyzer's judgment, based upon reporting officer's opinions, statements by the drivers, and statements of witnesses, as well as upon the events.

The following points are noted regarding Table 5:

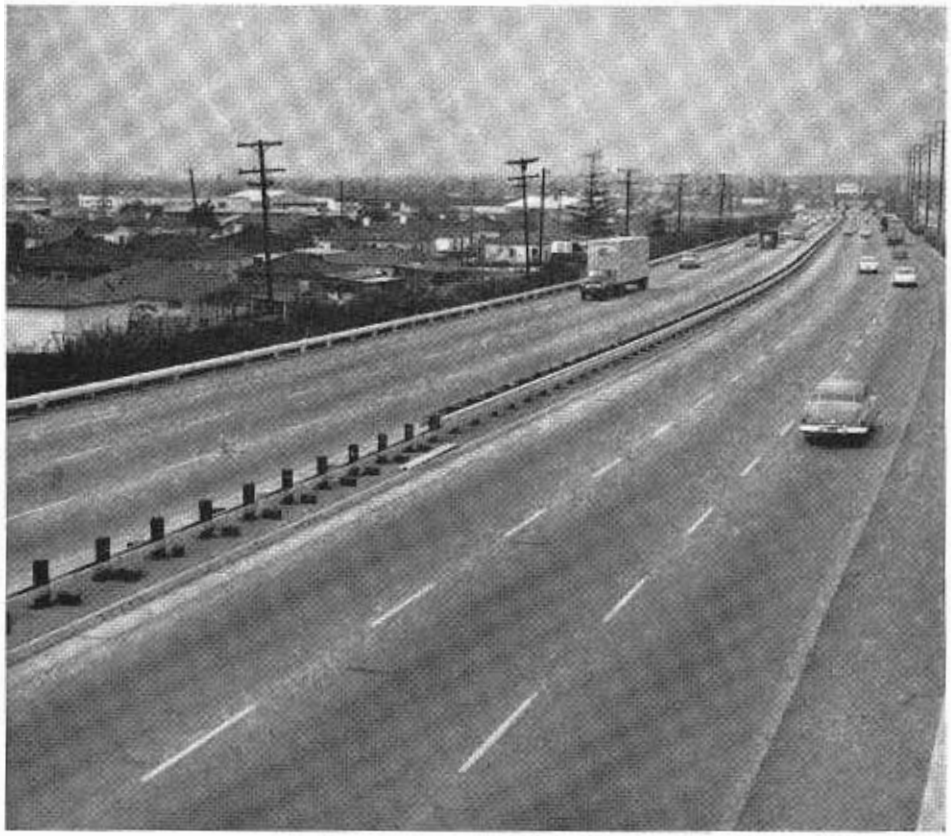
(1) On the test sections, 58 percent of accidents involving the beam bar-

TABLE 4

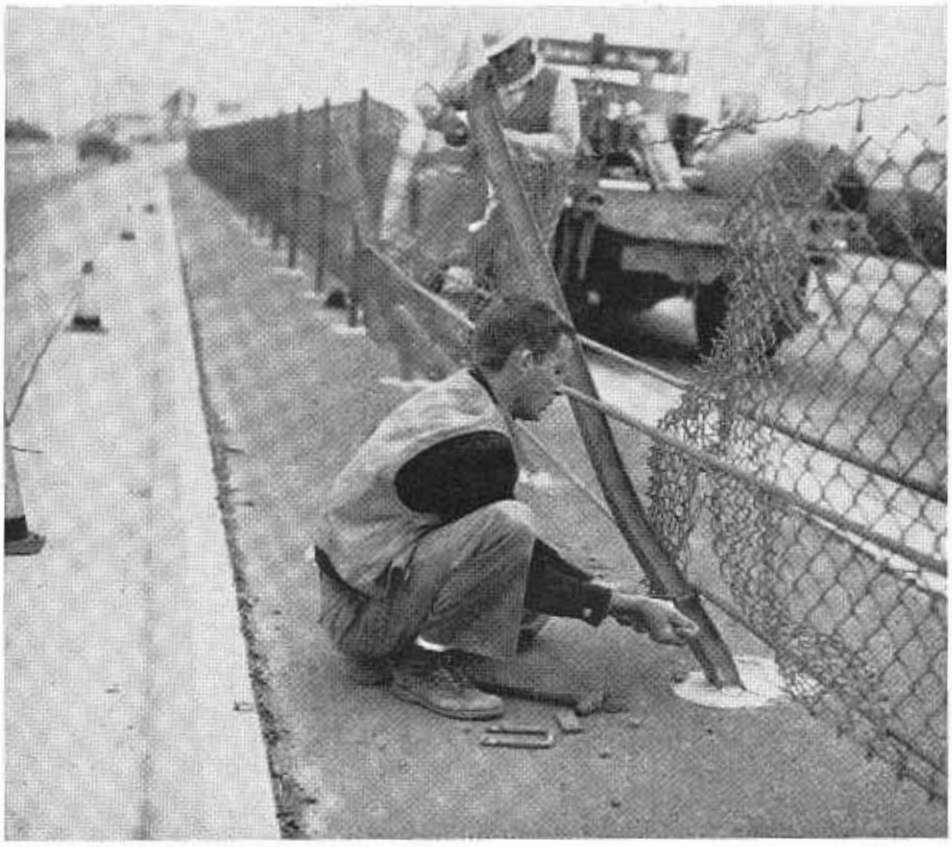
PROPORTION OF INCREASE IN ACCIDENT RATES ACCOUNTED FOR BY ENCROACHMENT IN MEDIAN

	Over-all Increase in Accidents	*Accidents "Involving" Median*			*Portion of Increase Accounted for by Accidents Involving the Median*
		Before	*After*	*Increase*	
	Rate Per MVM	*Rate Per MVM*	*Rate Per MVM*	*Rate Per MVM*	
Santa Ana Cable	0.22	0.17	0.33	0.16	73%
Santa Ana Beam	0.32	0.23	0.15	(0.08)[D]	0
Nimitz Cable	0.39	0.22	0.53	0.31	80%
Nimitz Beam	0.58	0.19	0.52	0.33	57%

( )[D] = Decrease



This photo shows a section of the beam barrier as it was being installed on the Santa Ana Freeway last February. Note the portion of partly completed barrier at the lower left.



Division of Highways maintenance workers repair a damaged cable barrier on the Santa Ana Freeway.

rier were 2-or-more-car accidents, whereas only 39 percent of accidents involving the cable barrier were 2-or-more-car accidents. On the Ventura Freeway, only 20 percent involved more than one vehicle.

(2) About one-fifth of the median barrier collisions were deliberate, a sort of "fielder's choice", in which the driver thought he was choosing the lesser consequence. This ratio was the same for the cable barriers as it was for the beam barriers, although on the Ventura Freeway only two "deliberate" swerves resulted in reported accidents. This freeway has eight-foot paved shoulders in the median, whereas the test sections on the Santa Ana and Nimitz Freeways have curbs and only a six-foot half-width.

(3) On the test sections, 86 percent of collisions with the beam barrier and 55 percent of collisions with the cable barrier were associated with maneuvers such as rear-end and sideswipe collisions or near-collisions.

(4) On the test sections, 22 percent of the cable barrier collisions and four percent of the beam barrier collisions were due to erratic driving, drifting, and unknown reasons. "Erratic Driving" are cars which were observed by witnesses to be driving erratically for some time before colliding with the barrier.

(5) "Unknown, miscellaneous, drifting, and sleep" accidents (nearly all involving only one car) accounted for 19 of the 26 collisions with the cable barrier on the Ventura Freeway. This relatively high proportion is due more to a lack of other kinds than to an excessive number of these kinds. The fact that there were only 7 accidents associated with rear-end and sideswipe maneuvers is probably attributable to the shoulders and absence of curbs.

It was also determined that 16 of the 26 on the Ventura Freeway were at night.

C. Repeated crash tests demonstrated conclusively that when a car collides with the cable barrier there is far less shock than with the beam barrier and that there should be far fewer injuries for a given number of barrier collisions. The first year's experience on the test sections showed the following:

TABLE 5

MEDIAN BARRIER ACCIDENTS CLASSIFIED BY ASSOCIATED EVENTS

(One Year After Construction)
(Test Sections and Ventura Freeway)

			Avoid Read-end Accidents		*Unsafe Lane Change*		*Knocked Into Barrier by*		*Ran Into Barrier After*			*Drifted Into Barrier (Sleep, Drink, Inat-tention)*			*Delib-erate Action*	*Involuntary Action*	*Total Accidents*
	Single Vehicle	*Multi-Vehicle*	*Delib-erate Action*	*Lost Control*	*Avoid-ing*	*Making*	*Side-swipe*	*Rear-end*	*Side-swipe*	*Rear-end*	*Erratic Driver*		*Misc.*	*Un-known*			
CABLE-CHAIN LINK BARRIER																	
Santa Ana	23	15	8	2	2	1	3	1	1	3	2	2	8	5	11	27	38
Nimitz	37	23	5	12	8	0	2	5	0	1	8	3	14	2	11	49	60
TOTAL No.	60	38	13	14	10	1	5	6	1	4	10	5	22	7	22	76	98
TOTAL %	61	39	13	15	10	1	5	6	1	4	10	5	23	7	22	78	100
Ventura	21	5	2	0	1	0	2	2	0	0	1	5	4	9	2	24	26
BLOCK-OUT METAL BEAM BARRIER																	
Santa Ana	5	7	1	5	2	1	1	0	0	1	0	0	0	1	2	10	12
Nimitz	16	22	7	11	5	0	2	5	0	2	0	1	5	0	10	28	38
TOTAL No.	21	29	8	16	7	1	3	5	0	3	0	1	5	1	12	38	50
TOTAL %	42	58	16	32	14	2	6	10	–	6	–	2	10	2	24	76	100

It is noted that experience of one year does not show conclusively that collisions with the cable barrier are less severe than with the beam. This is contrary to expectation. Observations and actual measurements of test crashes showed that deceleration rates, which are closely related to injury potential, are significantly less with the cable. There were so few serious injuries involving collisions with either type that it is believed that the measured evidence of physical tests outweighs the statistical evidence, in which chance plays a major part.

Maintenance records show that the number of repairs of the cable barrier greatly exceeds the number of reported accidents involving the barrier. On the other hand, there have been reported accidents involving the beam barrier that did not require repairs.

TABLE 7

COMPARISON OF REPORTED ACCIDENTS WITH BARRIER REPAIRS

	Reported accidents involving barrier	*No. of repairs*
Santa Ana Beam	12	25
Santa Ana Cable	38	60
Nimitz Beam	38	37
Nimitz Cable	60	91

TABLE 6

SEVERITY OF REPORTED ACCIDENTS INVOLVING MEDIAN BARRIERS

	Total No. of vehicles colliding with barrier	*Collisions in which occupants were injured*			*Fatal accidents*	
		Seriously	*Minor wounds, contusions*	*Total*	*No.*	*Remarks*
Santa Ana Beam	12	0	3	3	0	
Santa Ana Cable	38	3	9	12	1	x-median, head-on
Nimitz Beam	38	7	11	18	2	1 suicide, 1 truck driver ejected when truck hit barrier
Nimitz Cable	60	8	19	27	2	1 motorcycle, 1 spinning car, occupants ejected

Table 7 shows that collisions were much more likely to damage the cable barrier, and that for a given number of reportable accidents there is more disruption to traffic caused by barrier repairs, as well as additional maintenance cost. It does not necessarily show that there were more "drive-away" or hit-and-run collisions with either type, but it does show definitely that about one-third of the collisions with the cable barrier were so minor that the vehicles were able to drive away.

IV. CONSTRUCTION AND MAINTENANCE COSTS

A. *Initial Cost.* By the end of the 1960-61 fiscal year, approximately 49 miles of barrier had been installed. Average unit prices for the barriers were as follows:

	Per lineal foot	*Per mile*
1. Single Metal Beam	$5.84	$30,700
2. Double Metal Beam	8.31	43,800
3. Double Metal Beam on Steel Posts (Structures)	14.53	
4. Cable-Chain Link	3.25	17,100

The unit price of beam barrier was 2.6 times that of the cable barrier. In later contracts, the unit prices of cable barriers have declined.

Maintenance Costs

Maintenance costs of the two types of barrier during the one-year period after construction are shown in Table 8. The average yearly cost of repair is shown in terms of cost per mile, cost

per accident, and cost per million vehicle-miles of travel or exposure. The unusually large cost per mile for the beam barrier on the Nimitz Freeway was due to the two accidents involving truck-trailer combinations.

The annual cost per mile of $2,078 for the cable barrier was 2.9 times the $720 per-mile cost of the beam barrier. With a $1,358 per-mile difference in the annual cost of barrier repairs, it requires 19½ years for the damage cost of the fence barrier to equal the difference in construction cost between the two barriers. However, it should be noted that approximately 60% of the damage costs have been recovered, hence the actual difference in the maintenance costs to the State was $540 per mile.

At $540 per mile per year, it would require 49½ years to make up the difference of $26,700 per mile in initial cost.

More important than cost is the hazard to both maintenance workers and the traveling public of continual maintenance in the median. There is also a certain amount of congestion caused by such operations. In this regard, comparison of the two types should include the bulkiness of equipment and size of crew required, and the time per job, as well as the number of repairs required. The width of median is also important in this respect.

TABLE 8

COST OF BARRIER REPAIRS FOR ONE YEAR AS REPORTED BY MAINTENANCE DEPARTMENT

Cable Chain Link Barrier

Freeway	*Length*	*Million Vehicle-Miles*	*No. of Repairs*	*Total Cost (One Year)*	*Cost Per Repair*	*Cost Per Mile-Year*	*Cost Per MVM*
Nimitz	3.87	131.65	91	$6,879.53	$75.60	$1,777.66	$52.26
Santa Ana	3.17	117.21	60	7,848.16	130.80	2,475.76	66.96
Sub-Total	7.04	248.86	151	14,727.69	97.53	2,092.00	59.18
Ventura	2.35	78.06	43	4,782.00	111.21	2,034.89	61.26
Total	9.39	326.92	194	$19,509.69[1]	$100.57	$2,077.71	$59.68

Blocked-Out Metal Beam Barrier

Nimitz	2.87	101.30	37	$3,658.41	$98.88	$1,274.71	$36.11
Santa Ana	3.29	127.66	21	1,205.26	57.45	366.20	9.50
Sub-Total	6.16	228.96	58	4,863.67	83.90	780.00	21.25
Bayshore	1.43	53.42	4	599.88	149.97	419.50	11.23
Total	7.59	282.38	62	$5,463.55[1]	$88.10	$720.00	$19.35

[1] Approximately 60% of this was recovered from vehicle owners whose cars damaged the barrier.

Scope of Report

This report covers a limited amount of experience which has been had during the year following initiation of the barrier construction program. Although there are indications regarding the effectiveness of the barriers, both in preventing cross-median head-on collisions and in increasing over-all accident rates, the experience so far should be interpreted with caution and only tentative conclusions should be made at this time. Additional data are being accumulated covering more extensive sections of barriers over a greater period of time. It is planned to continue the investigation. In the meantime, barriers are being installed on all 8-lane freeways and on freeways where the average daily traffic exceeds 60,000 per day. It has been shown in the 1959 study and confirmed by 1960 experience that four-fifths of all the cross-median, head-on fatal accidents occur on these high-volume freeways.

A report on the current series of crash tests which are being made to improve present designs will be published in "California Highways and Public Works" magazine in the near future.

According to law, $5,000,000 in state highway matching funds is made available each year by the Highway Commission to help finance local grade separation projects included on an annual priority list established by the State Public Utilities Commission.

Department Members Win 25-Year Awards

Headquarters Office
Charles Cordero
Amy Aileen Jones

District I
Emery L. Blomquist
Joe O'Connell
Richard H. Ramsey
Howard E. Raymond

District III
Herbert M. V. McAllister

District IV
John A. McCrea

District V
Edwin J. Eggler
John L. Slaughter

District VI
Harry James Gazzola
J. Howard Lang

District VII
Byron L. Green
Lloyd B. Hughes
Ralph Palmer
Lan M. Weir

District VIII
Joe C. Cordery
Henry E. Sandoz
Roscoe Webb

District IX
F. B. Thrailkill

District X
Kenneth N. Hatch
Hazel Laughton
F. J. Leithold
Melvin B. Rowan

Bridge Department
Irwin W. Black
Darwin C. Dinsmoor

Materials and Research Department
William S. Maxwell

Shop 3
George W. Hayes

During August cloudbursts and resulting flash floods closed several sections of state highways in southern California until mud and other debris could be cleared from the roadways.

Watt Avenue

1½-mile F.A.S. Job Includes Bridge, U.S. 50 Connection

By D. W. McKENZIE, Chief, Highways and Bridges Division, and
F. T. WALDECK, Resident Engineer, Sacramento County

Immediately following dedication and ribbon-cutting ceremonies July 21, a major milestone was reached

PROJECT LOCATION
WATT AVE. EXTENSION

SCALE IN MILES
0 1 2 3

in the development of Sacramento County's highway network when traffic for the first time was turned onto the new Watt Avenue Extension two miles east of Sacramento.

A portion of Federal Aid Secondary Route 933, the Extension commences at Fair Oaks Boulevard and travels 1.5 miles south, across the American River, and connects with U.S. 50, as shown on accompanying maps.

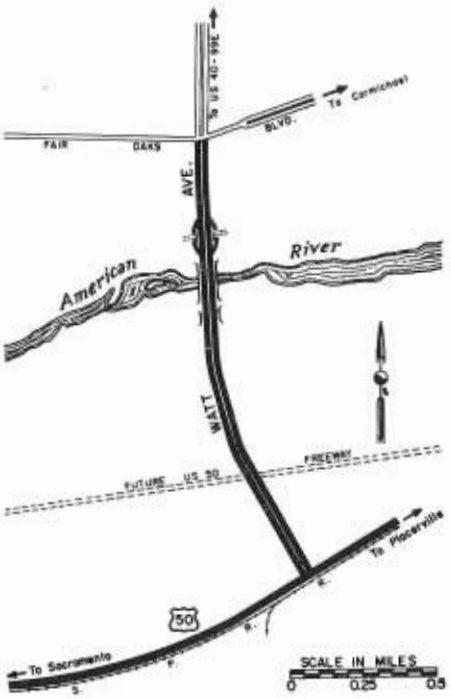
The expressway is an integral part of the official Master Plan of Streets and Highways of Sacramento County, and in this booming metropolitan area is a vital link between the vast residential section north of the river and the industrial and defense on the south.

Following a previously unconstructed route, the four-lane divided facility was built over a period of one year and eight months under four separate contracts totaling nearly $1,500,000. Of this total cost, $742,000 was involved in two FAS projects and $749,500 in two county-financed jobs.

It is the only river crossing between the City of Sacramento and Citrus Road ten miles to the east. Its effectiveness became immediately apparent as predicted. One month after being placed in service, the route was carrying 13,000 vehicles a day—mostly commuters who formerly used the other two widely separated routes.

Crosses Future U.S. 50

The Extension also crosses the adopted alignment of the future U.S. 50 freeway which will run east and west about one-half mile north of the existing state highway.

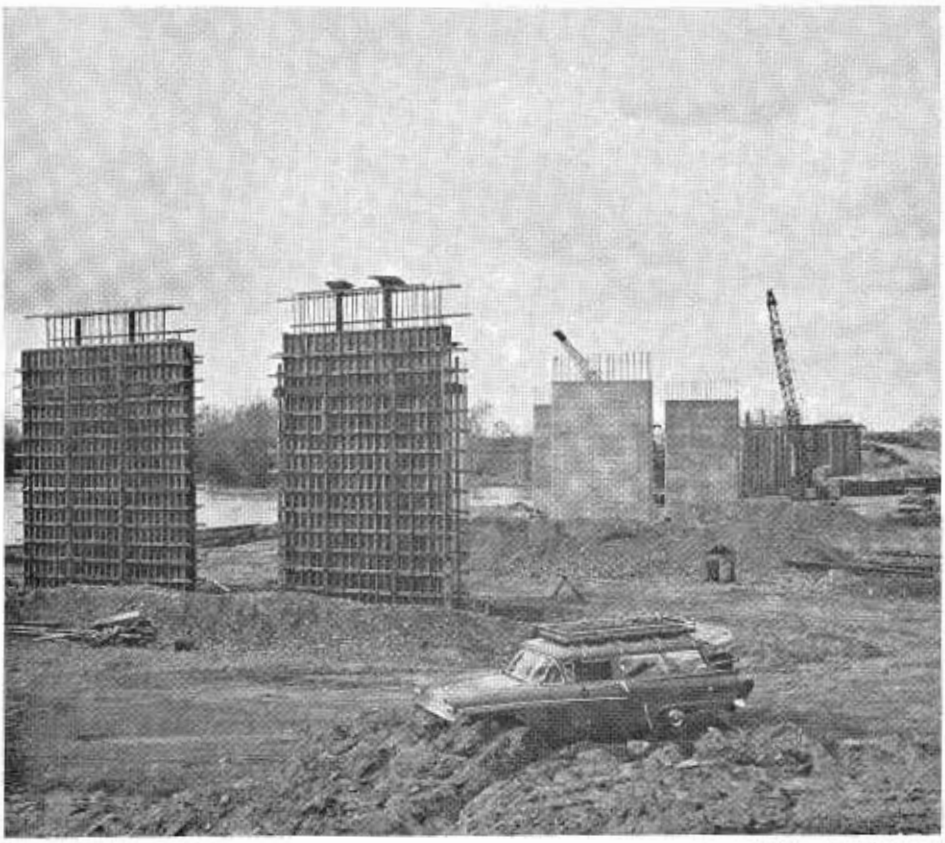


PROJECT LOCATION
WATT AVE. EXTENSION

The overall four-stage improvement included 1) a four-lane divided bridge

The new Watt Avenue Bridge across the American River. The small bridge in front is privately owned.

One set of footings for parallel pier columns on the bridge shown just after stripping the forms.



This photo, taken during the construction of the bridge, shows the re-usable, prefabricated pier forms still in place on the two front piers.

over the river, 2) a four-lane divided grade separation structure with a diamond interchange located 1,000 feet north of the bridge, 3) a similar structure for a future ½-cloverleaf approximately 400 feet south of the bridge, and 4) the four-lane roadway. The final highway project also included 1.5 miles of divided road from Fair Oaks Boulevard north to Arden Way. This final contract was accepted from the contractor August 18.

Terrain through which the Extension passes is flat. However, due to levees and necessary structure clearances, a maximum grade of 4 percent was necessary. Minimum radius of curve on the main line is 1,800 feet. Right of way width is 150 feet, except that within 600 feet of Fair Oaks Boulevard, where no fill exists, width is 100 feet.

Construction of the American River bridge was commenced December 3, 1959 by Lord & Bishop of Sacramento. It is actually two parallel reinforced concrete t-beam structures of 13 spans each and 1,012 feet long, providing clear roadway widths of 28 feet with a six-foot-wide raised divider between, and five-foot sidewalks with steel railings on the outside.

Water Level Low

Luck was with the contractor in the river work. Flow remained at a low elevation throughout construction, making cofferdam work for the piers routine. After foundation work was completed, the pier columns, being identical, were constructed with four sets of prefabricated forms, providing an efficient operation for erection of the 24 columns.

Placement of reinforcement for pier columns, whose height ranged from 18 to 46 feet, was accomplished by tying the required steel into cages and hoisting the cages into position. A similar technique was used in placing steel for the five-foot deep t-beams. The steel in this phase was tied for beams from hinge to hinge and lowered into position.

Placement of concrete was by standard methods. Piers were worked in pairs and brought up at the rate of five feet per hour. For t-beam and deck concreting, pours were monoliths extending from hinge to hinge,

varying in length from 154 to 280 feet, and in volume from 285 to 475 cubic yards. By employing independent screed supports for finish grade and vibratory strike-off for deck finishing, the contractor was able to obtain a smooth-riding surface.

Limitations set up in the Special Provisions, relative to stripping falsework in adjacent spans, made it desirable for the contractor to prefabricate forms for 500 feet of bridge. This method required continuous construction in order to finish the project within the 269-working-days limit.

Quantities Listed

Quantities for major items of work included 2,100 cubic yards structure excavation, including wet excavation; 5,400 cubic yards Class A concrete; 700 tons steel reinforcement; 329 steel piles with a total length of 9,400 feet; and 2,045 lineal feet steel railing.

Total value of the contract was $588,769 of which the Federal government contributed 58 percent, the State 37 percent, and the County 5 percent plus engineering and rights of way.

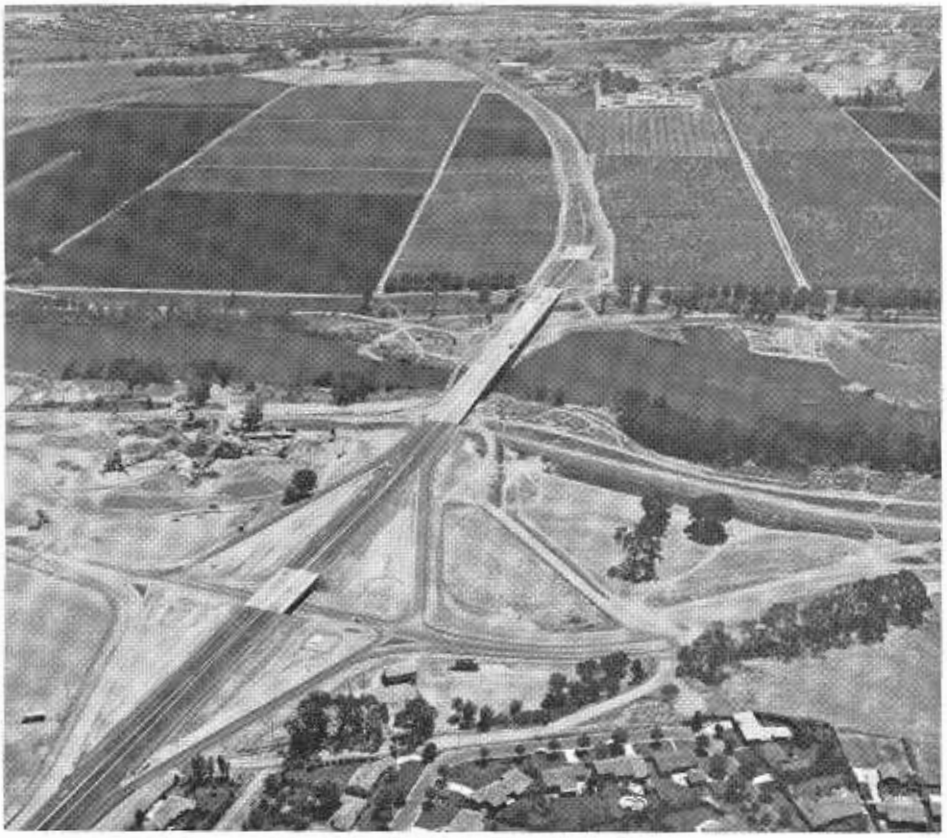
Work on the north Watt Avenue separation began March 23, 1960 under a contract with Thomas Construction Company of Fresno. Because of excellent supervision and scheduling of operations, the project was completed September 14, one month ahead of time.

The separation is an undercrossing for a future highway to serve the Haggin bottom land area. It consists of a pair of similar parallel reinforced concrete slab bridges, each with four spans and an over-all length of 145 feet. Providing clear roadway widths of 34 feet each plus a six-foot raised median, the structures are supported on concrete columns and open abutments which are supported on concrete piles. The four ramps forming the diamond interchange were added later by the County.

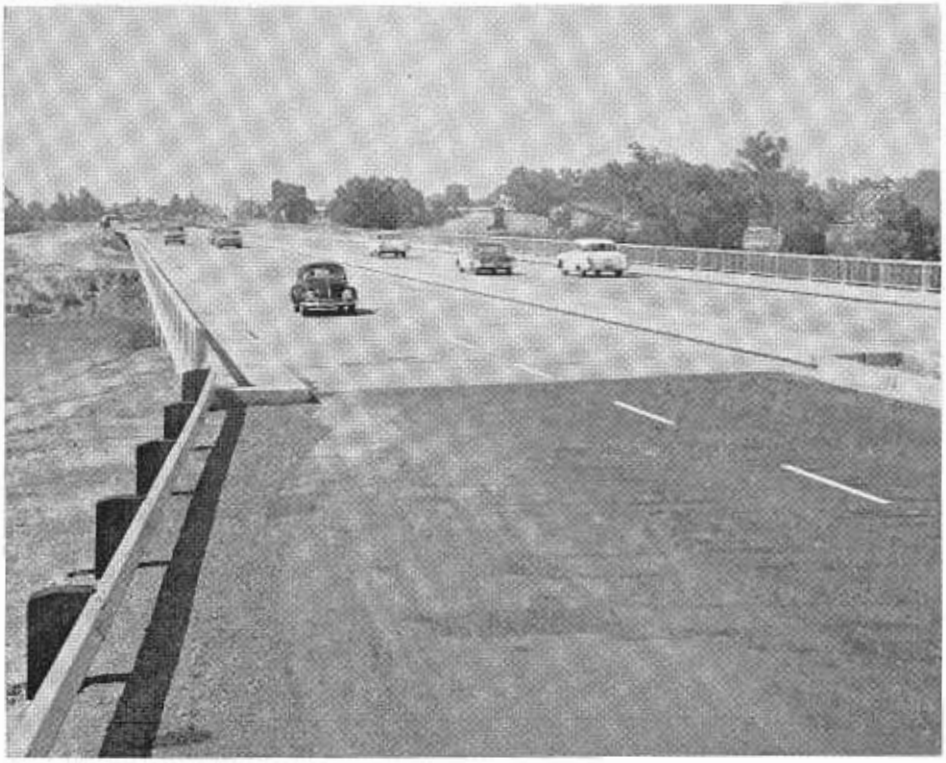
Provides for Future Road

Like the north separation, the south Watt Avenue separation is an undercrossing for a future road and will include a half-cloverleaf interchange. It, too, is a pair of parallel concrete slab bridges. Their location in the

BEFORE—Looking north up Watt Avenue prior to construction. The intersection in the center is with Fair Oaks Boulevard. The bridge (foreground) is privately owned.



AFTER—The completed Watt Avenue Bridge and freeway section looking south toward U.S. 50. The structure immediately beyond the bridge will be part of an interchange to serve a proposed housing development on the south side of the river.



The completed bridge shortly after it was opened to traffic. The view is north toward the Fair Oaks Boulevard intersection.

alignment required that they be constructed on a 2,000-foot radius curve with a 4 percent superelevation—the only variation from the north separation in basic design.

Work was started September 23, 1960 by Leedham & Roebbelen of Sacramento and was completed within the 140 working days allowed. The value of contract work was $152,510 which was totally financed by the County.

This spring, the final operation in the linking of Fair Oaks Boulevard and U.S. 50 got under way when A. Teichert & Son, Inc. of Sacramento began work on the grading and paving contract valued at $596,966. This job, too, was financed entirely by Sacramento County. It also included four-laning Watt Avenue from Fair Oaks Boulevard north to Arden Way, about 1.5 miles.

Prior to the project, Watt Avenue existed from Fair Oaks north as a two-lane road on a right of way varying from 70 to 106 feet. For about 1,300 feet there was a frontage road along the west side; about 3,700 feet on the east side; and another 1,400 feet of frontage road on both sides. These local roads had curb and gutter on the property side, but no sidewalks.

Sidewalks Installed

The County planned to construct the divided four-lane facility within the existing right of way by eliminating these frontage roads. This plan caused considerable opposition from abutting residents who wanted to retain the frontage roads as a refuge for their children from the main stream of traffic.

After several meetings the issue was compromised. The County agreed to install sidewalks for school children's safety to replace the frontage roads.

The highway north of Fair Oaks Boulevard was constructed as four 12-foot lanes with 10- to 16-foot shoulders plus a 14-foot curbed median with left-turn lanes at 11 of the 22 intersections. The median was continued across 11 less important intersections and eliminated many left-turn movements.

As for the new section south of Fair Oaks Boulevard, one 3,300-foot portion between the south separation and U.S. 50 was built four-lane undivided on a "detour" alignment. Although it is not obvious to motorists, this portion is actually located a sufficient distance west of the permanent alignment to permit the State to build a future interchange that will carry Watt Avenue over the ultimate U.S. 50 freeway without interfering with Watt Avenue traffic. Also, the State will save the cost of the detour which would otherwise be necessary—a typical example of the continuing cooperation between the State and County highway departments.

Major Items

Quantities for major items of work included 50,000 cubic yards roadway excavation; 30,000 cubic yards import; 53,600 tons aggregate subbase; 70,900 tons aggregate base; 22,440 tons asphaltic concrete; 8,000 linear feet curb and gutter; 25,000 linear feet curbing; and 27,000 square feet sidewalk.

The roadway excavation and unsuitable excavation figures represent an overrun of 22,000 and 10,000 cubic yards respectively. That was caused by the presence of a large amount of unsuitable material underlying the existing roadway between Fair Oaks Boulevard and Arden Way. It appeared that the muck, undetected prior to the contract award, had been deposited by an ancient slough that once coursed through the project alignment.

This project also included traffic-actuated signals at the U.S. 50 intersection. They were electrically interconnected with the system at U.S. 50 and Manlove Road, about 1,000 feet east. Both were then interconnected by radio to the master traffic control system for U.S. 50 in the vicinity of Mather AFB and Rancho Cordova.

All design construction engineering and inspection, both on the structures and road work, was performed by personnel from the Inspection and Surveys Division, Sacramento County Department of Public Works, A. L. Kiefer, Director. Representatives from the Division of Highways made frequent visits during construction of the two FAS structures.

L.A. Renaissance

Freeway Service Key Factor in Downtown Growth, Renewal

By MILTON STARK, Information Officer, District VII

The decision to remain on 12th Street between Broadway and Olive (in Los Angeles) was predicated on the conviction that this location represents the focal point of a dynamic new urban community that is growing along the axis between the new Civic Center and the cultural-recreational center represented by the University of Southern California, the Coliseum, Sports Arena and museums in Exposition Park.

Of equal significance in our study was the impact new freeways presently under construction will have on the future growth of downtown Los Angeles—especially the area between Olympic and Venice Boulevards. The new Santa Monica Freeway, which parallels Venice Boulevard and will cross the Harbor Freeway, will eventually complete a freeway loop around the downtown district. This loop will permit vehicles to have free and easy access to the southern perimeter of downtown without traveling through the interchange system.

The new freeway system will make Occidental Center immediately accessible from all sections of Greater Los Angeles—both by automobile as well as all forms of public transportation.

Grateful acknowledgments for assistance in the preparation of this article are extended to the Los Angeles Central City Committee, the Los Angeles City Planning Department, the Downtown Business Men's Association, and the architects and public relations departments of the agencies, organizations, businesses and institutions described herein.

BELOW—Looking west from the Harbor Freeway to the Union Oil Center Building. The verdure of the freeway landscaping blends gracefully with modern architecture. Big business planners recognize the utility of locating near a freeway.

The foregoing remarks were made by Horace W. Brower, President of Occidental Life Insurance Company of California, on the eve of groundbreaking ceremonies for the new $25,000,000 Occidental Center scheduled for September of this year. The company, which calculates its total assets in 1960 at $816,536,525 with $10,206,576,348 in policies in force, is expanding its national headquarters in Los Angeles. Occidental's consulting planners spent five years in the determination of the most advantageous location for the company's headquarters.

Implicitly significant in Brower's statement is the changing character of the Central City, a trend outward by business and industry and a trend inward by headquarters agencies and all of the consequent related improvements of new construction, renovation, restoration and slum clearance. It nowise means abandonment of downtown Los Angeles, but is rather a metamorphosis indicating growth and expansion. Termed broadly decentralization, the trend is given general definition and description in the ensuing discussion.

The prime mover in the renaissance of Los Angeles, particularly in the Central City area—which is roughly bounded by the Hollywood Freeway


NEW CONSTRUCTION 1945 – 1960
CENTRAL CITY AREA
CITY PLANNING COMMISSION – LOS ANGELES CALIF

to the north, the Santa Monica Freeway to the south, the Santa Ana Freeway to the east and the Harbor Freeway to the west—has been the trend to decentralization in concentric circles outward from the core of downtown. So that self-sufficient entities or communities are forming along expanding perimeters outside of the heart of the city, partly because of the growing network of freeways, which cut distance and time travel. This emigration, reflected in the general population decline in the old nucleus of the Civic Center and the shift of business and industry to serve further removed metropolitan centers, is also partly owing to a desire for suburban living, away from and independent of the Central City or downtown. Impetus to this movement is given by the steady influx of new residents into this part of Southern California and the problems of living and working space which they inevitably introduce.

Decentralization, then, is giving new character to the Central City. The nature of downtown is undergoing change towards a related net of headquarters offices, administrative and executive centers, forming a nucleus of entirely new developments designed to serve the far-flung metropolitan complexes. In this sense, the outlying communities are not independent but rather a loose federation connected to the administrative headquarters in the Central City.

For the immediate purposes of this discussion, the geographical area described is that of the Central Business District or the 400-acre core area bounded by First Street on the north, Los Angeles Street on the east, Olympic Boulevard on the south and the Harbor Freeway on the west. This, then, is the nucleus of the Central City. The Central City itself exceeds 6 square miles of land area and is framed by the Hollywood, Santa Ana, Santa Monica and Harbor Freeways.

Land Value

An interesting comparison is had in the assessed value of land and improvements in the Central Business District for the sample years 1941-42 and 1959-60. In the former year, land was valued at $72,000,000 and improvements at $47,700,000; in the latter year land was set at $63,038,000 and improvements $85,100,000. A definite relationship is shown in the fall of land value and the rise of improvements over a 20-year period.

Rejuvenation in Los Angeles does not neglect the natural beauty of trees and lawns. This is the new Public Health Building in Civic Center.

Floor Space

The Central Business District, which is largely comprised of office buildings, retail stores, hotels, institutional, governmental and quasi-public, manufacturing and wholesale, services and automobile parking, showed a rentable floor and ground space of 36,800,000 square feet in 1930, 38,200,000 square feet in 1955 and 40,500,000 square feet in 1960. The trend upward in useable space has been most evident in the years since 1945, 3,917,000 square feet having been added in the 15-year interim. In company with new construction during the 29 years spanning 1931 and 1960, a good deal of demolition was accomplished, amounting to 3,626,294 square feet; the net gain resulting from subsequent improvements is calculated at 1,577,000 square feet of floor space.

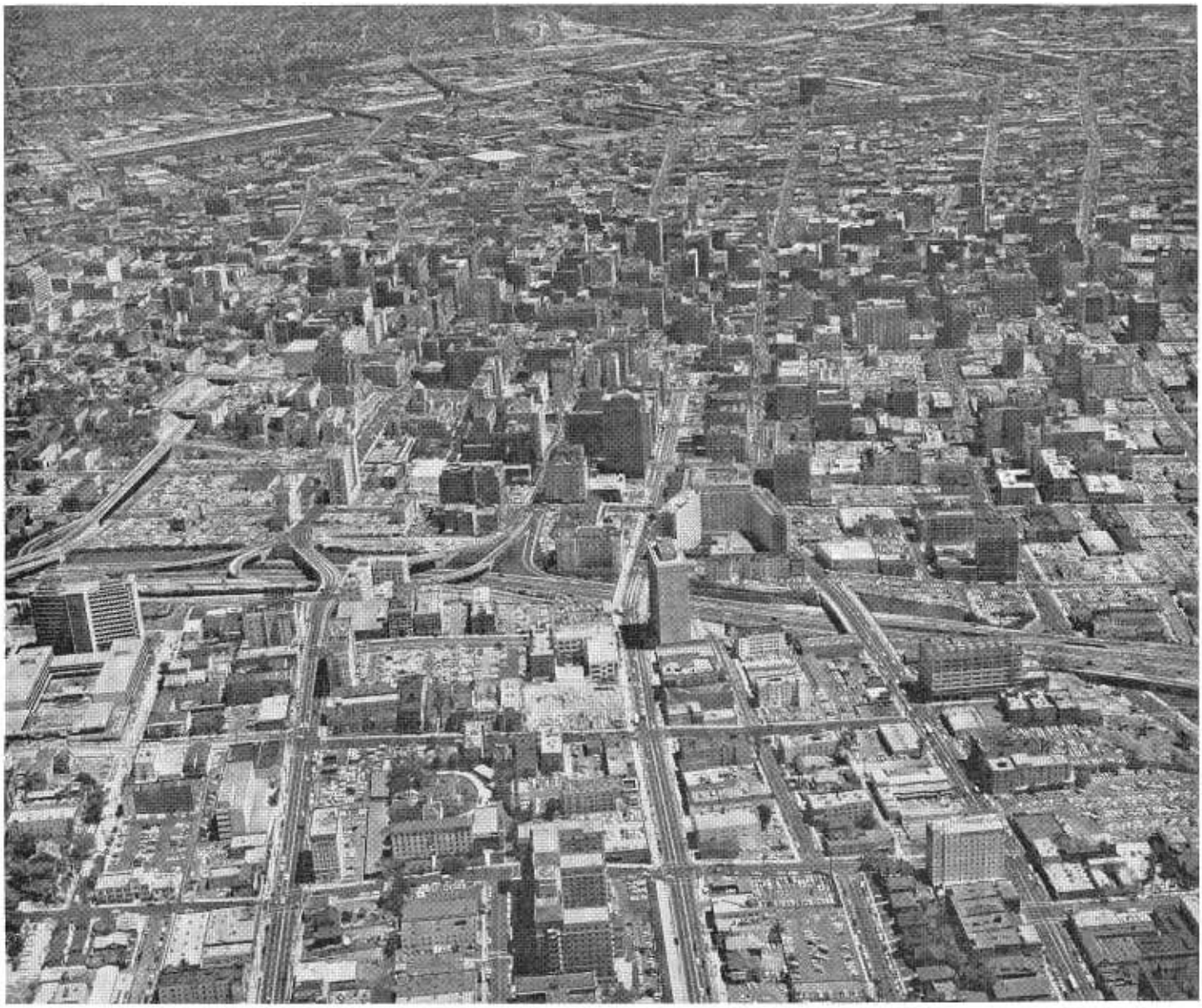
Sales

Retail sales of such diversified items as food, furniture, gasoline, lumber, apparel in the Metropolitan area (Los Angeles and Orange Counties) indicate in the grand total a substantial increase from $3,612,725,000 in 1948

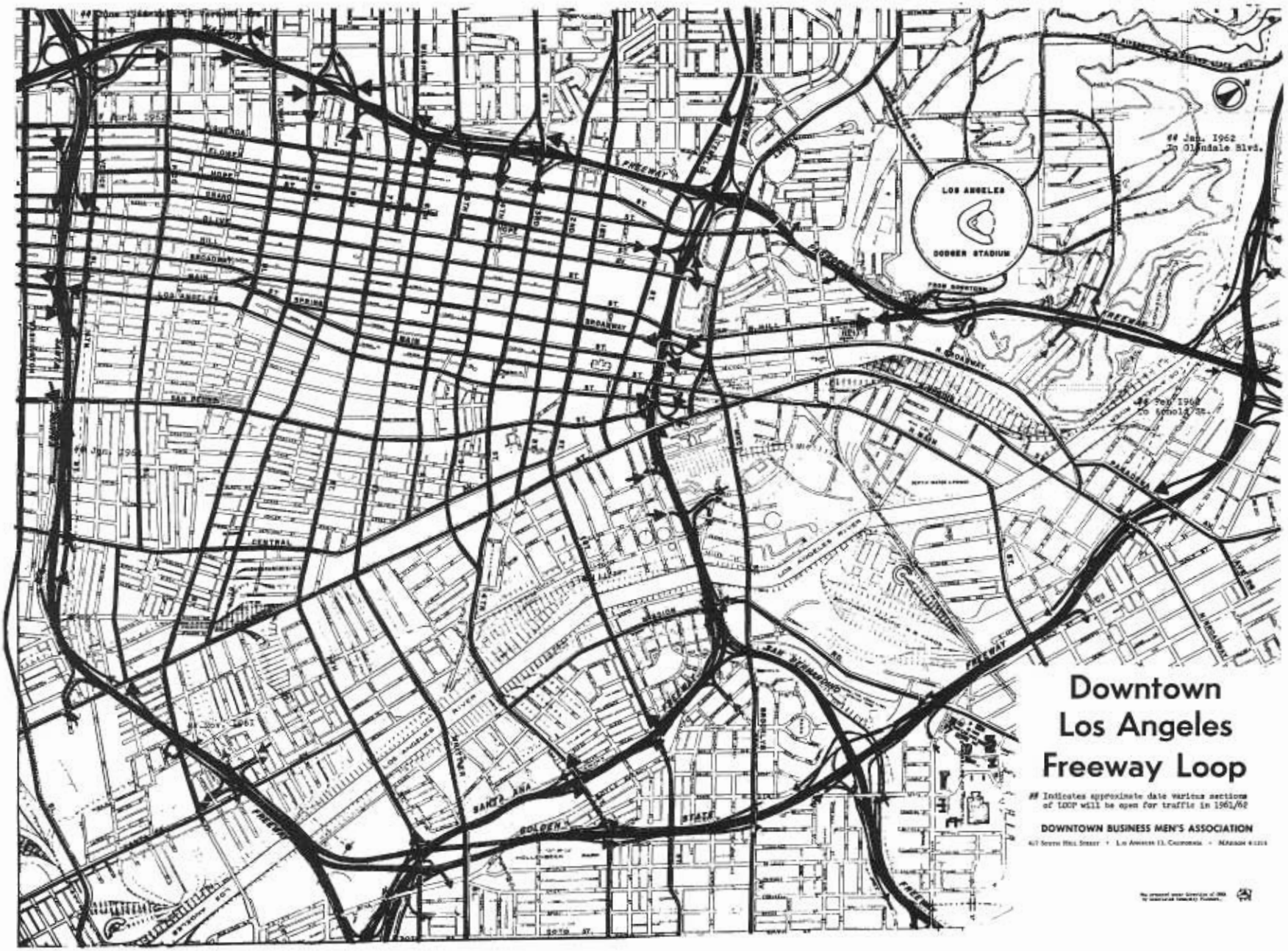
to $6,903,325,000 in 1954. On the other hand, within the Central Business District a decline is evident in total retail sales from $451,009,000 in 1948 to $421,003,000 in 1954. It is clear from these statistics that retail outlets, which in January, 1960 occupied 5,504,000 square feet of floor space, are burgeoning outward into the broader metropolitan area. It is significant that business follows the customer and during the last decade four department stores in the Central Business District opened thirteen branch outlets in the outlying areas. It is felt that with the growth of headquarters functions in downtown and the construction of multiple dwelling units on the periphery of the core area, downtown sales will be given new stimulus, though, certainly, they are substantial as they are.

Office Use

Office use has an important place in the Central Business District, occupying 32% of the available space. New office building construction is above the average for the U.S. as a whole, and the following figures are cited for the larger Los Angeles Metropolitan Area: In 1958 7.7% of total national construction and 29.5% in the West; in office building construction 12% of the nation and 40% in the West. In a four-year period between 1956 and 1959, valuation of new office buildings in the metropolitan area was set at $365,000,000 or equal to half of the New York area and equal to the combined areas of Chicago, San Francisco and Boston. The square footage added for the four years prior to 1960 for the entire Los Angeles Metropolitan Area is estimated at 18-25,000,000, including nearly 3,000,000 in the Central area and 750,000 in the Central Business District. Since 1948 a total of 14,000,000 square feet of office space has been added in Los Angeles City and 1,500,000 in the Central Business District.



An aerial view of the Los Angeles Central Business District looking east across the Harbor Freeway.



The above map shows the area of the city which will be encompassed by the Freeway Loop now under construction.

"Approximately fourteen million square feet of the office space constructed since 1948 has been located outside the Central Business District. However, of this amount an estimated 1,000,000 square feet was erected along the southwesterly and westerly fringe of the Central Business District within the past few years. Included are the structures of the Bank of America, Union Oil Company, Signal Oil Company, the Bar Association and the Pacific Clay Products Company. While directly outside the arbitrary boundaries of the Central Business District, the proximity of this development suggests that it properly should be considered as an integral part of the business district. The current inventory of office space in the Central Business District is approximately 12,424,000 net square feet. Approximately 85% of this space is contained in structures which were constructed before 1930. Many of these older buildings have been remodeled to provide modern accommodations. Many large one-firm buildings in the Central City Area house offices of petroleum companies and financial establishments. In aggregate, professional services regional in scope and other activities directly related to insurance, petroleum, finance, public utility or government administration activities, use the largest amount of Central office space."—Los Angeles Centropolis 1980, The Los Angeles Central City Committee and the Los Angeles City Planning Department.

Hotels

5,389,000 square feet of space is utilized by hotels in the Central Business District or 15% of floor space available in the area. Figures for 1956 show the presence of 26 hotels having a total of 10,000 rooms. More hotel and motel accommodations will be needed to keep pace with population influx and labor force increases in the Central Business District.

Floor Space Uses

An impressive array of statistics relating to other floor space uses and percentages have been compiled by city planners for the Central Business District and may be reduced to tabular form as follows: Manufacturing and Wholesale, 3,175,000 square feet, 8.8% of total floor area; Institutional (Churches, Clubs, Educational Eleemosynary) 2,070,079 square feet, 5.6% of total floor area; Government and Quasi-Public, 3,451,350 square feet, 10% of total floor area; Services (Financial institutions, travel agencies, restaurants, etc.), 2,449,775 square feet, 6.7% of total; Parking Structures, 1,305,229 square feet, Interior Parking, 921,900 square feet, Surface Parking, 3,737,071 square feet or a total of 31,000 parking spaces, 32.8% of total land area. The latter percentage is high and indicative of the popularity of motor vehiclar travel over conventional public transit facilities.

1980 Needs

The population for the Los Angeles Metropolitan Area is estimated to reach 11,800,000 by 1980. As of July 1, 1961 it was 6,251,204.

"Space targets for the larger Central City area will depend in large measure upon the quantity and character of improvements planned for the inner core. The outer fringe will in all probability be devoted primarily to multiple apartment structures, the expansion of light industry, cultural facilities, and some of the smaller types of business services. Space targets for 1980 are predicated upon sweeping changes in the downtown, which will include the elimination of the blighting influences of previous years, and the introduction of a comprehensive improvement program. Should the downtown develop in accordance with its potential, an approximate doubling of the downtown daytime population is anticipated by 1980, a conservative expectation in view of the anticipated population growth and economic development of the region, the metropolitan area, and the corporate city. To achieve the expected doubling of the downtown daytime population, substantial increases in varying degree are anticipated in the downtown labor force, shoppers, business personnel and visitors. It is quite possible that the relative proportion of these several components might change during the process."—Los Angeles Centropolis, 1980, the Los Angeles Central City Committee and the Los Angeles City Planning Department.

Needs for 1980 as expressed by present estimates of future net square footage of floor space in the Central Business District are as follows: Retail, 5,917,000, Office Space, 24,145,000, Hotels, 7,080,000, Manufacturing and Wholesale, 2,500,000, Institutional, 3,658,000, Government and Quasi-Public, 4,000,000, Services, 4,366,000, Parking (interior), 5,500,000, (surface), 1,400,000.

The expected grand total of square feet for 1980 for the inner core of the Central City Area is 58,566,000. The square footage available today (1960) is 40,429,000. This means that new construction in the amount of about 18,000,000 must be added to achieve the goal, a goal which will be reached through reclamation, renewal and removal of outmoded structures.

Buildings—Developments
Occidental Center

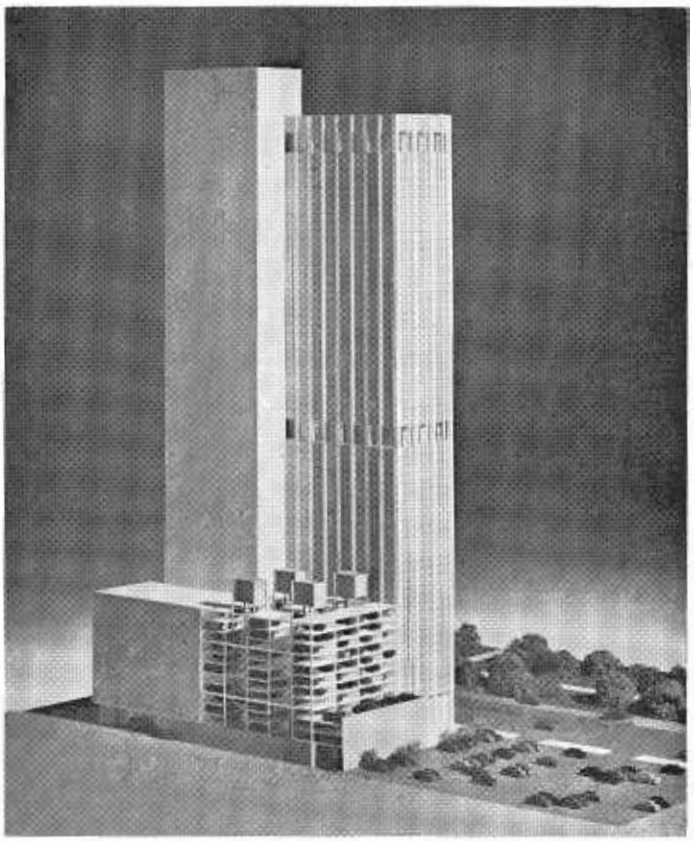
Ground-breaking ceremonies on the $25,000,000 Occidental Center, a complex of buildings including a 25-story tower on 12th Street between Hill and Olive Streets, will be held in September, 1961. Plans call for construction of a 9-story building on the northwest corner of 12th and Hill Streets, a 25-story tower adjunct on the northeast corner of 12th and Olive Streets, a 5-story parking structure with room for 700 vehicles, and remodeling of the present 9-story structure on 12th Street between Broadway and Hill Street. The finished complex will provide over 1,000,000 square feet of office space. Initial construction is scheduled for completion in January, 1963.

333 Building

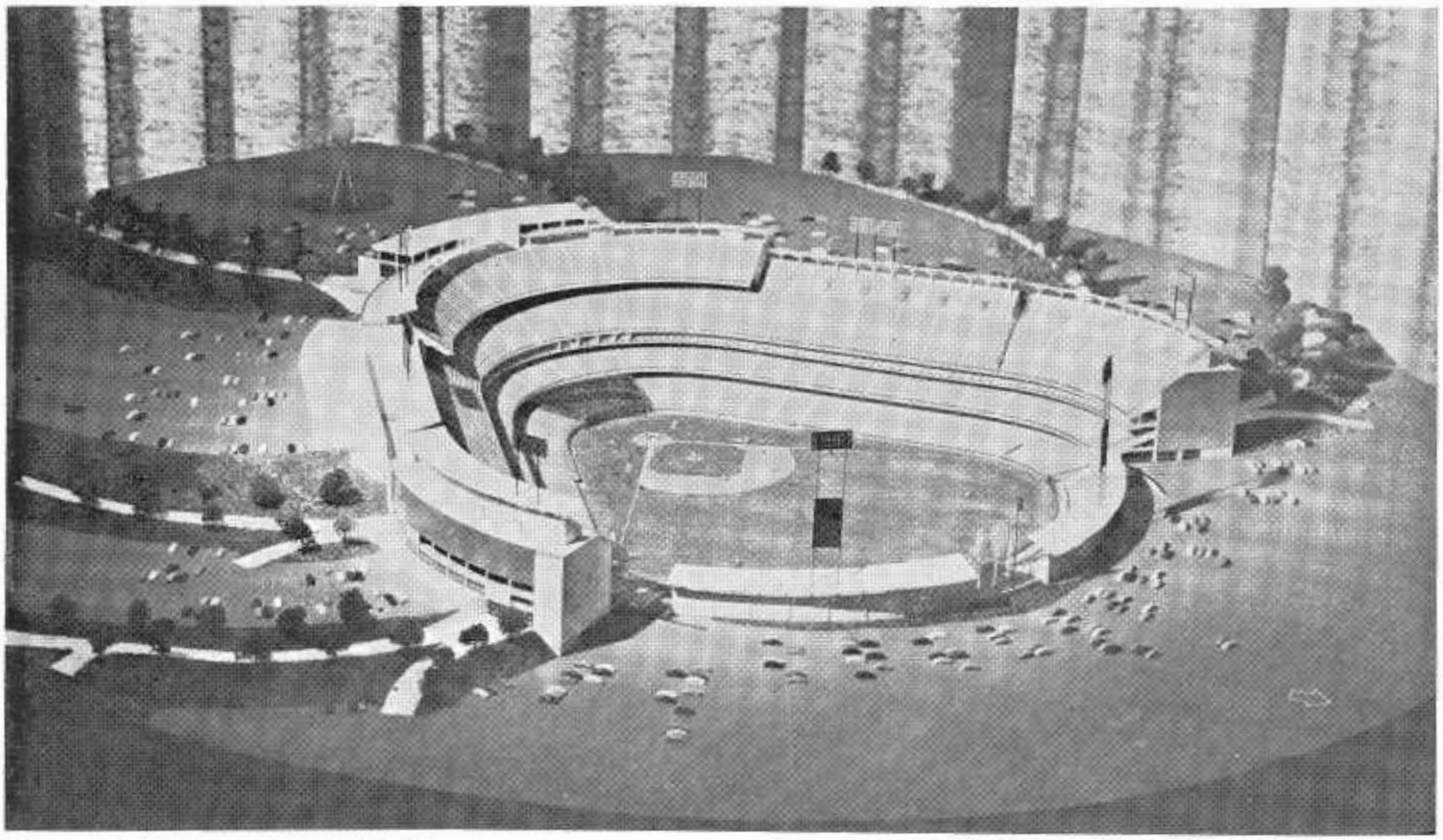
Demolition is in progress to be followed by construction of a 35-story aluminum, glass and marble office skyscraper and 14-level parking structure at Sixth and Hill Streets overlooking Pershing Square. It will be called the 333 West Sixth Street Building, replacing the 40-year old Paramount Theatre Building, and will occupy one acre of land and have an area of 615,000 square feet. Valued at $20,000,000, the new development is scheduled for completion in the fall of 1962.

Construction of a 500-car electronic parking facility will employ a revolu-

A model of the future Occidental Life Building in the downtown area. (Photo by Herbert Bruce Cross.)



The proposed 35-story building at 333 West 6th Street. (Photo by Herbert Bruce Cross.)



A model of the new Los Angeles Dodger Stadium which will be constructed at Chavez Ravine.

tionary parking system consisting of aluminum crane elevator towers to whisk automobiles from ground level stalls to stalls on the highest level in 45 seconds. Fourteen high speed automatic passenger elevators will serve tenants and customers.

California Hospital

In 1962 the Lutheran Hospital Society of Southern California plans expansion of a new $3,000,000 addition to the present facility at 1414 South Hope Street. The new wing will provide 119 beds with enlarged major and minor surgery facilities and a new cancer research and treatment program which will include an extensive tissue culture laboratory for cytological study and research. With the installation of a $250,000 6-megavolt x-ray generator, one of the largest in the world, California Hospital will be the leader in cancer treatment and research in this part of the country.

Pacific Telephone Building

On May 9, 1961 Pacific Telephone dedicated a new communications center at 420 South Grand Avenue. The $31,000,000 8-story center (along with existing buildings on South Grand and Olive) will house the largest concentration of switching apparatus in the world. It is described as being the crossroads of direct dial long distance calls, local and Eastern television programs, microwave radio relay, telephoto, ship-to-shore telephone calls, mobile telephone, teletypewriter, data processing and the new dataphone service. The first-stage improvement amounting to 180,000 square feet of floor space is judged adequate for expansion into 1967, when other floors will be added. An arresting feature of the new building is a 30 x 18 foot mosaic on the building front which pictorially illustrates the scope and breadth of communications in today's shrinking world.

Detention Center

A Los Angeles County Men's Detention Center with facilities for 3,300 inmates and occupying 585,150 square feet of space is under construction at a cost of $13,630,000 on a 17-acre site at Vignes and Bauchet Streets adjacent to the Union Station. Work is on schedule and completion is anticipated by July, 1963. The center will have a 5-floor main building housing administrative offices, service facilities, cell blocks, library, chapel and detention facilities on four floors. Well planned cell block arrangements eliminated the long outmoded two-man cell. To meet the many forms of prison segregation—older prisoners from younger prisoners, first offenders from "repeaters", narcotic addicts from traffic violators—the architects devised several types of inmate housing, varying from dormitories to single cells, according to specific needs.

Water and Power Building

Under contract now is a new general office building for the Los Angeles Department of Water and Power on a 16-acre site in the Civic Center Mall, bounded by Hope, First, Temple and Figueroa Streets. The 17-story structure will have 880,000 gross square feet of space and will cost $26,700,000 to construct. An additional $3,450,000 investment is represented in a 2,400 parking structure and $880,000 in clearing, excavating and landscaping costs. The facility is designed to accommodate 3,200 employees now located in other offices with provision for an estimated ultimate 4,300 employees by 1990. The Department stated that it had in the last ten years invested $619,000,000 in new construction to supply water and electrical service to its customers. Excavation on the new building is in progress and a contract has been entered into with the Division of Highways for the disposal of 480,000 cubic yards of excess excavation on the right of way of the Santa Monica Freeway between Vermont and LaSalle Avenues. This represents a haul of just under 5 miles for the contractor and this phase of the operation—which will save the State of California an estimated $600,000—is scheduled for completion in January, 1962. The Department of Water and Power building will be completed early in 1964.

Dodger Stadium

Los Angeles' own baseball team, the transplanted National League Dodgers of Brooklyn fame, is investing $16,000,000 in a new stadium in the Chavez Ravine area, northern gateway to the Los Angeles Civic Center and the Central Business District adjoining the Pasadena Freeway. The 56,000-capacity stadium, which will also be used by the American League Los Angeles Angels, is designed to be expanded to 65,000 and 85,000 capacity when conditions warrant expansion. Parking for automobiles will be provided in 16,000 individual slots, with ultimate provision for 25,000 parkers. Construction is under way and completion is anticipated in 1962 for the National League opener. The Division of Highways and the City of Los Angeles are expediting plans for early improvements on the Pasadena Freeway which will be a main corridor for attending fans in time for the forthcoming season. Plans call for ramp and street revisions to accommodate traffic and improve access facilities to and from the ball park grounds.

Federal Building

A $27,000,000 appropriation by Congress recently assures construction in the near future of a new Federal Building on a 7-acre site on the east side of Los Angeles Street between Temple Street and the Hollywood-Santa Ana Freeway. This will centralize U.S. Government offices and functions in the Civic Center.

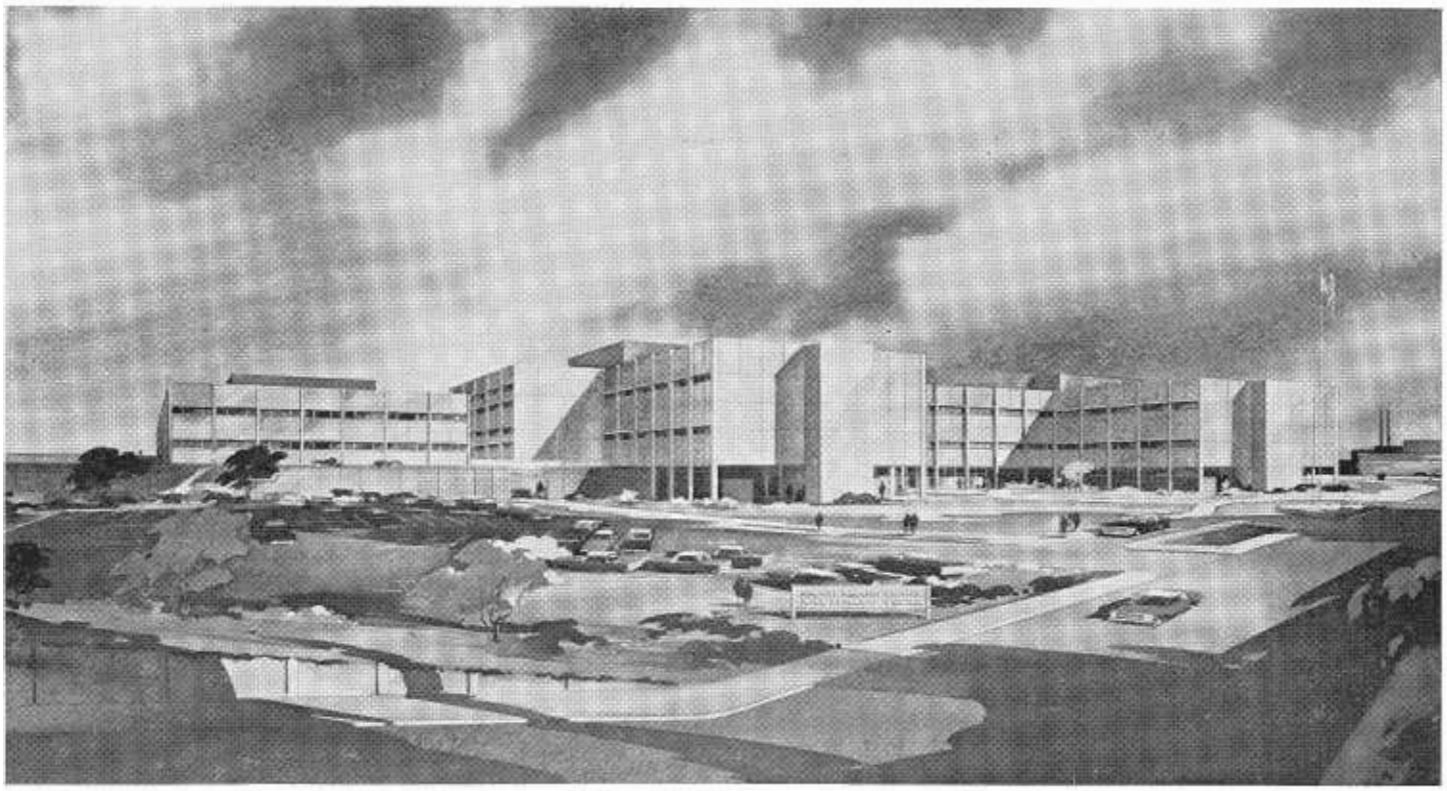
Security-First National Bank

Ground-breaking ceremonies have already been held on an addition to the Farmers and Merchants Branch of the Security-First National Bank at 401 South Main Street. Going up 6 stories and providing 90,000 square feet of office space and an extended parking area, the structure will cost $1,500,000 and will be completed in July, 1962.

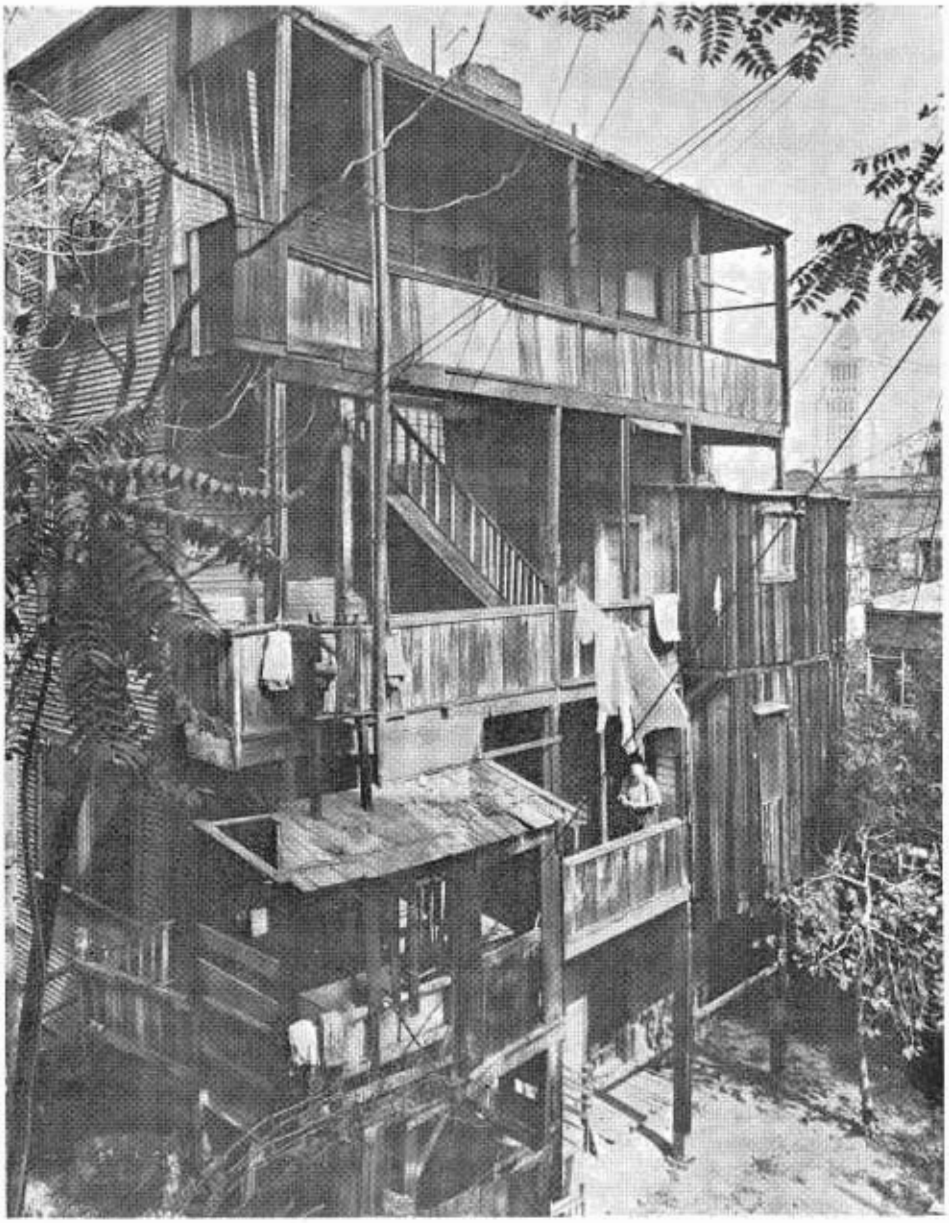
Little Tokyo

Japanese Americans of Southern California, 77,000 strong, with their neighbors and tourists may in the future look at new developments in the Little Tokyo section of downtown Los Angeles, within an area bounded by Jackson Street to the north, Central Avenue to the east, Third Street to the south and Los Angeles Street to the west. New zoning granted to this community will permit renovation and expansion, which the Japa-

Artist's conception of the new Music Center at the Civic Center. (Photo by Welton Becket and Associates.)



Sketch of the future Los Angeles County Men's Detention Center adjacent to the Union Station. (Photo courtesy of Robert M. Garrick.)



The old Bunker Hill section of Los Angeles which will be replaced by the redevelopment (photo next page). Note the tower of the City Hall visible in the right background.

nese Chamber of Commerce and local businessmen are promoting. Investments estimated at approximately $6,000,000 by private enterprise would assure restoration and new construction to provide hotels, motels, and a shop-lined pedestrian way, much like Olvera Street in the Mexican quarter. A civic improvement association and a large corporation would also be formed to spearhead the conversion of the site into a business, residential and tourist attraction.

Bunker Hill

One of the most ambitious developments anywhere in California or the U.S. is the Bunker Hill Urban Renewal Project being planned by The Community Redevelopment Agency of the City of Los Angeles, having been approved by the City Council on March 31, 1959. The great restoration here will cover an area of 136 acres, framed by First Street, Hill Street, Fifth Street and the Harbor Freeway, representing a gross project cost of $65,099,881 when completed. The blighted area will be cleared and converted to the following land uses: Residential, 27.2 acres; Commercial, 40.4 acres; Parking-Commercial, 24.1 acres; and Public, 3.6 acres.

As the planners put it themselves: "Bunker Hill has languished as a blighted area for half a century—deteriorating steadily and blocking growth of the central city. The present pattern of substandard rooming houses and cheap hotels with the inevitable earmarks of crime, disease, fire danger and excessive public costs which characterize such conditions will soon give way to the most modern and attractive core area development in any American city! It is difficult to calculate the total effect this single undertaking will have on the community when it is completed. It will not only compliment the adjacent Civic Center and the whole central business district, in realizing their full potential as an up-to-date Central City, but will also be of great benefit to the entire city by the 1,000% increase in yearly tax revenue that will accrue to the City Treasury. With the consolidation of this rebuilt area, coupled with the network of freeways, the eventual new public transit system and other new developments, in the planning stage, Los Angeles will no longer be 'in search of a city.'"

Restored Bunker Hill will have tower apartments, at a walk-to-work location, for a residential population of 6,000 to 8,000 persons; commercial uses with an emphasis on office buildings for a working population of up to 50,000 persons, and hotels and motor hotels, for the transient residential population; and parking structures to serve the immediate area and the adjacent Central Business District as well as the Civic Center for as many as 20,000 spaces.

The Community Redevelopment Agency commenced its land acquisition program in April of this year. Although it is expected to require about two years to acquire all the land in the Bunker Hill project area, the Agency expects to initiate the first steps in its land disposition program (sales of property to private developers) before the end of this year. Private developers are expected to invest some $250,000,000 in the rebuilding of Bunker Hill, resulting in the addition of $4,000,000 in property tax revenue annually (present yield $400,000). It is reasonable to expect that before the end of 1961 actual construction will

commence on certain sites and the new Bunker Hill will break the skyline in downtown Los Angeles.

Civic Center Development

The Los Angeles Civic Center is generally a square formed by Sunset Boulevard, Figueroa, First and Alameda Streets and contains 228 acres. Within this area are most of the important governmental establishments and their headquarters staffs which have been associated with the downtown. The Center presently has 13 existing major buildings having a gross square footage of space of 6,700,000, accumulated during fifty-one years of construction and representing an aggregate expenditure of approximately $100,000,000. This complex will number at least 19 structures ultimately. Currently one new building is under construction and engineering plans for three others are being completed. Taken together they will represent an addition of 3,500,000 gross square feet of floor space to the existing total in the Civic Center when completed in the next three years.

Music Center

A music center complex of three buildings is planned on a 7-acre site bounded by First, Hope, Temple and Grand Streets in the Los Angeles Civic Center. It is dedicated as a "Living Memorial to Peace" through the joint efforts of the Music Center Building Fund Committee and the County of Los Angeles. The Music Center, estimated to cost $23,000,000, will provide facilities for the performing arts consisting of a 3,200-seat auditorium, the Memorial Pavilion, on the south side of a landscaped central mall; a circular theatre containing 650 seats, the Forum, and an auditorium with 1,700 seats.

The Forum, a circular building 132 feet in diameter set in a sunken garden, will have a round stage that can be raised or lowered, amphitheatre-style seating and a large semicircular lobby reached from the mall by footbridges. The Center Theatre, immediately to the north and joined to the Forum by a graceful colonnade of white marble columns which surrounds both structures, will have its stage and auditorium housed in an 80-foot high envelope of sculptured concrete with the lobby enclosed on three sides by glass.

The Music Fund Committee has full responsibility for raising the estimated $5,000,000 cost of constructing two of the buildings and has also pledged itself to raising $6,000,000 toward the Music Center project. Los Angeles County has agreed to guarantee $9,000,000 toward the construction cost of the Memorial Pavilion as well as providing the site for the Center.

A major feature of the new development will be a 1,000-car, four-level garage under the two new structures which will be connected to the 1,000-car subterranean garage already planned beneath the Memorial Pavilion. This combined underground parking area will make available 2,000 parking spaces to Civic Center employees and visitors during the day. The County will assume the cost of constructing the garage portion of the project as a part of the overall plan to meet the parking needs in the Civic Center.

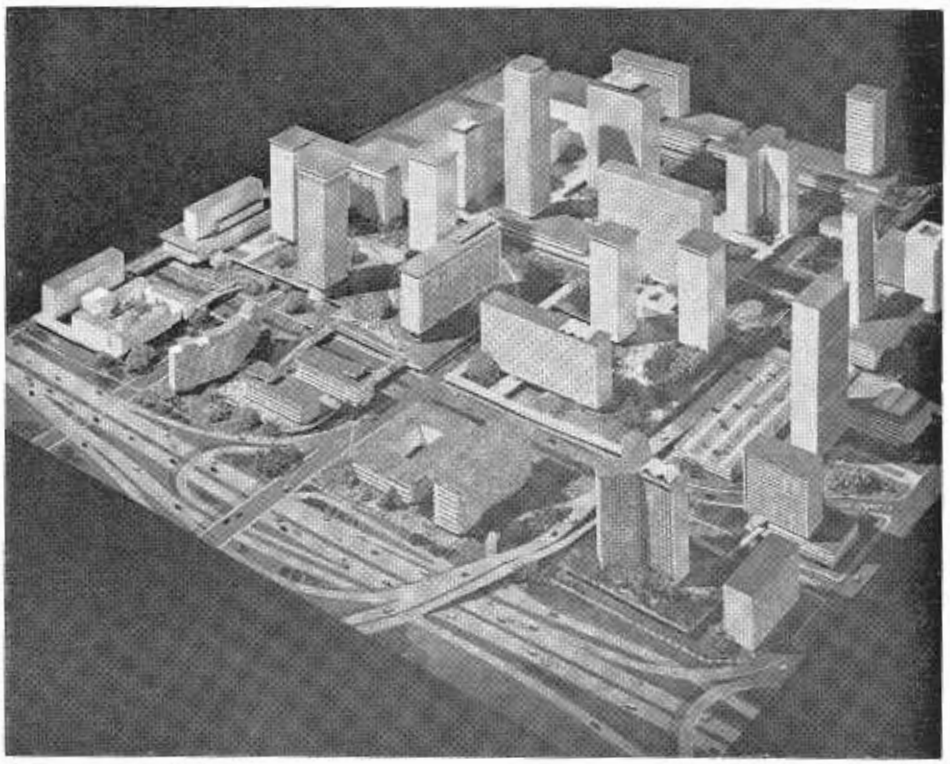
Ground-breaking for the Music Center is planned shortly with the Memorial Pavilion scheduled to open in December of 1962. Construction of the Forum and Center Theatre is expected to be completed in 1963.

Historic Restoration

In the area between the Civic Center and the Union Station, where the city was founded September 4, 1781, its colorful past is coming to life again as buildings in the Old Plaza are being restored. The State, county, city and a private non-profit corporation are working together under a master plan to acquire and rebuild historic buildings and other landmarks. The project is Pueblo de Los Angeles State Historical Monument, a part of the State park system, administered by the City Recreation and Park Department.

The Olvera Street section, long a favorite place for tourists to watch native Mexican craftsmen work, to buy their wares and sample their traditional foods, already has been partially restored. It is operated commercially by El Pueblo de Los Angeles, Inc. The manager is venerable and dynamic Christine Sterling, who conceived the idea of the restoration in 1926.

The main historical buildings in and around Olvera Street, including the



Suggested model for the proposed Bunker Hill Redevelopment Project prepared by the staff of the Community Redevelopment Agency of the City of Los Angeles. (See photo preceding page.) (Photo by Able Photo Service.)

The Police Facilities Building at 150 North Los Angeles Street, typical of new construction in recent years in Civic Center.

ABOVE—The Los Angeles County Hall of Administration in Civic Center. BELOW—Looking east on Wilshire Boulevard toward the new Tishman Building. To the right is the Statler Hilton Hotel.

City Ren

Downtown Los Angeles is an area in metam
business and industry and a trend inward by h
accessibility, the movement involves new constru

Westerly view of the Signal Oil Building on Wilshire Boulevard above the busy Harbor Freeway.

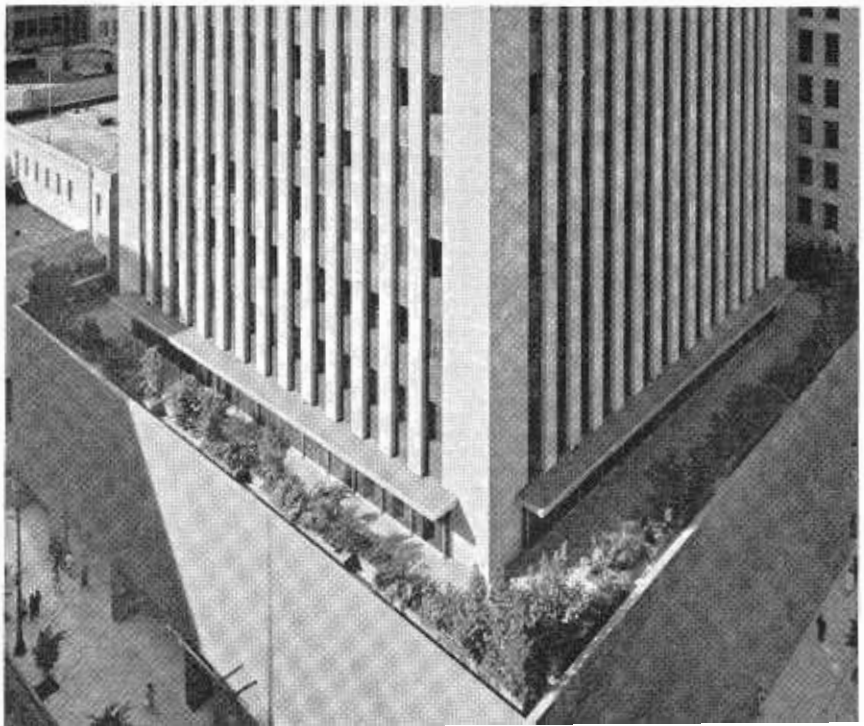
naissance

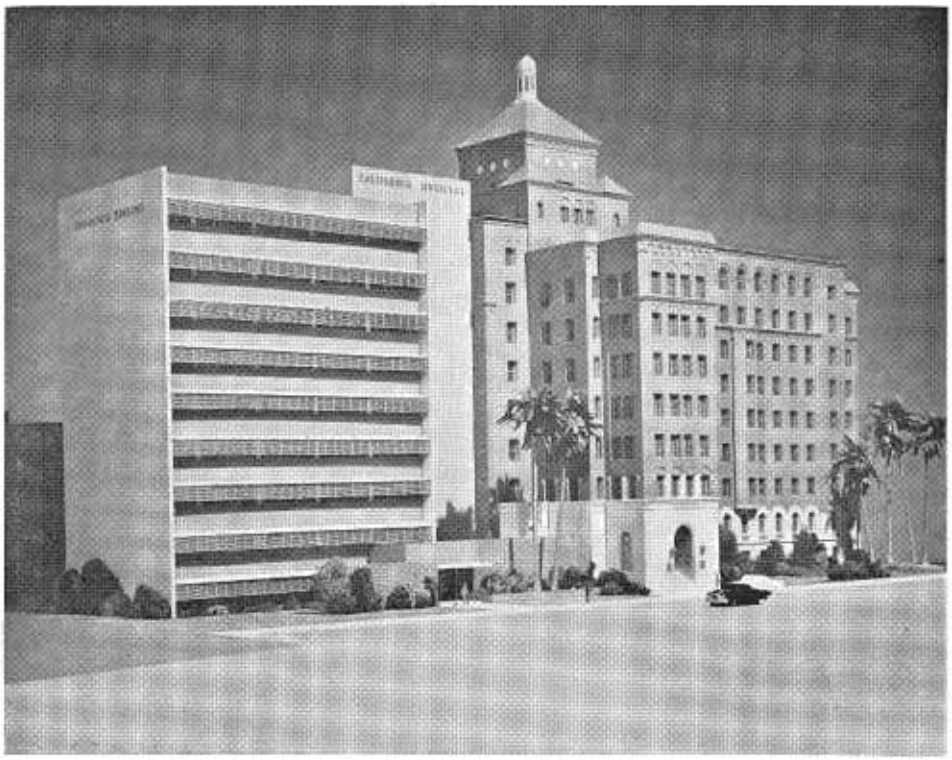
norphosis, characterized by a trend outward of headquarters agencies. Based largely on freeway uction, renovation, restoration and slum clearance.

New functional design is embodied in the Southern Counties Gas Company Building at 8th and Flower Streets.

The Los Angeles County Hall of Records under construction in Civic Center.

ABOVE—The Los Angeles County Courthouse, one of the many "headquarters" type of improvements in Civic Center. BELOW—Looking down upon the angular beauty of the new California Bank Building at 6th and Spring Streets.





Model of the new wing of the California Hospital proposed for construction in 1962. (Photo by Herbert Bruce Cross.)

Avila Adobe, Sepulveda House and Pelanconi House, will be repaired and restored.

The former Methodist Headquarters Building, on the northwest corner of Los Angeles Street and Sunset Boulevard, will be converted into a Latin Amercan Trade Mart. It is contemplated that the consulates and trade offices maintained in Los Angeles by the republics of South and Central America will be housed here in an informal, colorful south-of-the-border atmosphere.

The Simpson Building, at North Main Street and Sunset Boulevard, has been rebuilt, and one part is occupied by a branch of Bank of America. All the furnishings, draperies, brickwork, tile and woodwork were imported from Mexico and combined to create an interior of great beauty and charm.

Across the Plaza in the blocks bounded by North Main, Los Angeles and Plaza Streets, and Arcadia Street (which separates the section from the Santa Ana Freeway), the work of restoration is under way. Already completed is the old Fire House, as it functioned in the 70's, complete with an old city-owned fire engine which has been rebuilt and polished brighter than new.

Principal buildings being restored or planned for work later are the Pico House, the city's first three-story building, erected in 1869, which will again serve as a hotel; The Merced Theatre, first in Los Angeles; Masonic Building, where Los Angeles' first Masonic Lodge met; and a few newer and less historic structures. It is contemplated that operation of the Pico House, its dining room and a number of small ground-floor shops beneath the Merced Theatre will be leased to a concessionaire later.

The original financing for the project in 1953 consisted of $750,000 appropriated by the State Legislature and an equal amount provided by the city and county. Ultimately a great deal more will be spent, including private funds.

California Mart

A $50 million California Mart development is being planned to occupy an entire city block (four acres) bounded by Ninth, Main and Los Angeles Streets and Olympic Boulevard in downtown Los Angeles.

Construction will begin early in 1962. The development consists of A Tower (first unit) 13 stories with 400,000 square feet of display space; branch bank building; auditorium exhibition hall; B Tower, 20-story display offices building; Mart hotels will be a 16-story high-rise structure and a two-story motel built around a swimming pool patio plaza; other features include a three-level subterranean garage, restaurants, night clubs, specialty shops, etc. Development is planned as an international marketing center for all consumer goods and related fashion lines. Charles Shattuck,

The general offices of the Los Angeles Department of Water and Power as they will look when completed.

recognized dean of Southern California realty appraisers, says of the Mart: "Feasibility of the project is increased by its favorable geographical relationship to existing transportation arteries, particularly the central freeway interchanges, the central business district, the retail area and the financial center."

Traffic

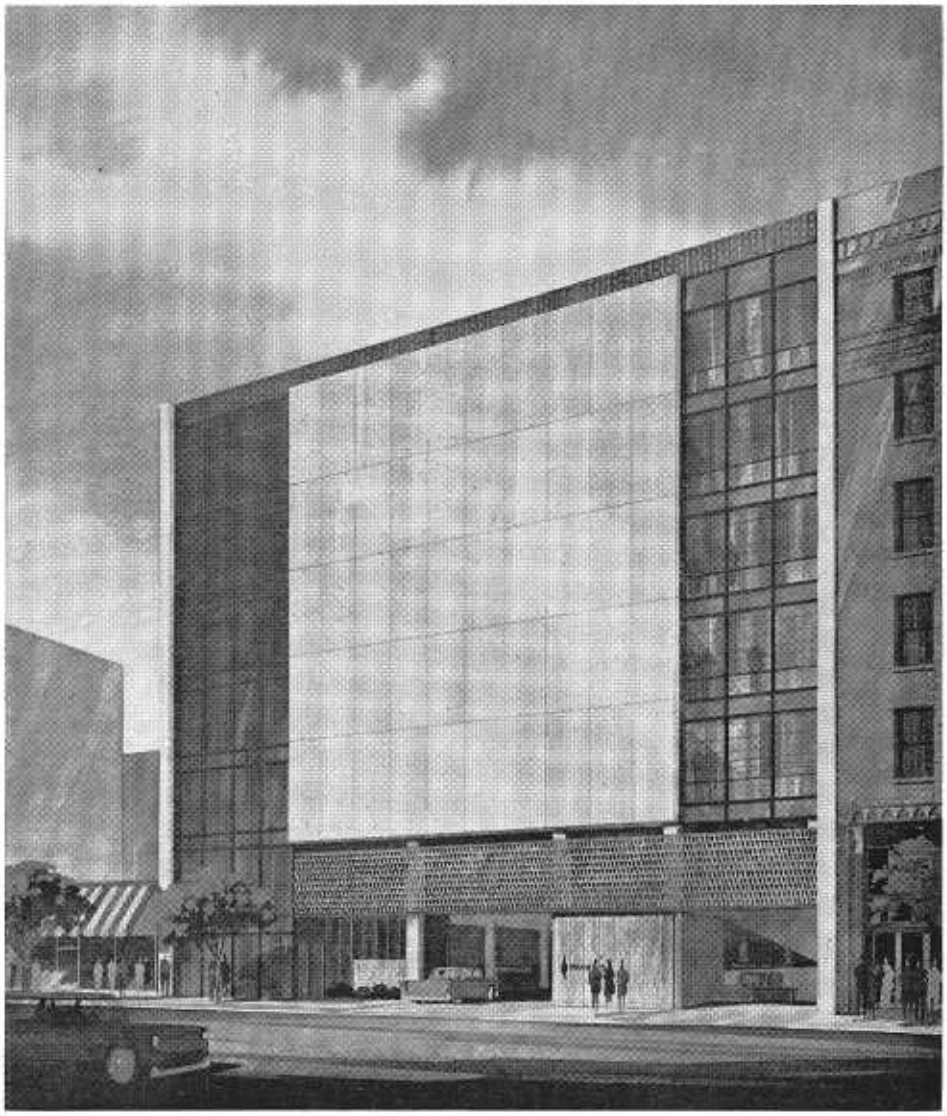
Cordon counts of traffic by the City of Los Angeles Traffic Department within an area somewhat larger than the Central Business District, bounded by the Harbor Freeway, Hollywood Freeway, Los Angeles Street and Pico Boulevard, showed appreciable increases over 1957 in passenger vehicles entering and decreases in persons entering.

A count conducted in May, 1960, during the 16-hour period between 6:00 A.M. and 10:00 P.M., showed 679,000 persons entering, a decrease of 9,000 persons from the 1957 count year. However, the "maximum daytime peak accumulation" showed an increase of 25,000 persons over the accumulation tallied in 1957 in the Central Business District: in 1960 the total was 157,000, in 1957 it was 132,600. Passenger vehicles entering the count area numbered 296,300, a 5,400 increase over the 290,900 in 1957. The high hourly accumulation of passenger vehicles during the count period in 1957 was 36,500, whereas in 1960 it was 51,900.

Vehicular entry into and exit from the Central Business District has been improved by recent freeway construction; it has been improved by projects aimed at easing the traffic flow in the ring of freeways formed by the Hollywood, Santa Ana, Golden State, Santa Monica (under construction) and Harbor; the inner circulation has been relieved through a system of one-way city streets and new pedestrian controls at key intersections. Removal of through traffic from city streets promotes local business patronage and reduces the parking problem.

Metropolitan Transit Authority

The Metropolitan Transit Authority, a self-supporting public corporation of the State of California, has since March, 1958 been operating a major bus and streetcar system in Los Angeles County, serving also areas within Orange, Riverside and San Bernardino Counties. Its 91 lines carry more than 750,000 passengers a day, using 1,591 buses, 89 trolley coaches and 164 streetcars.



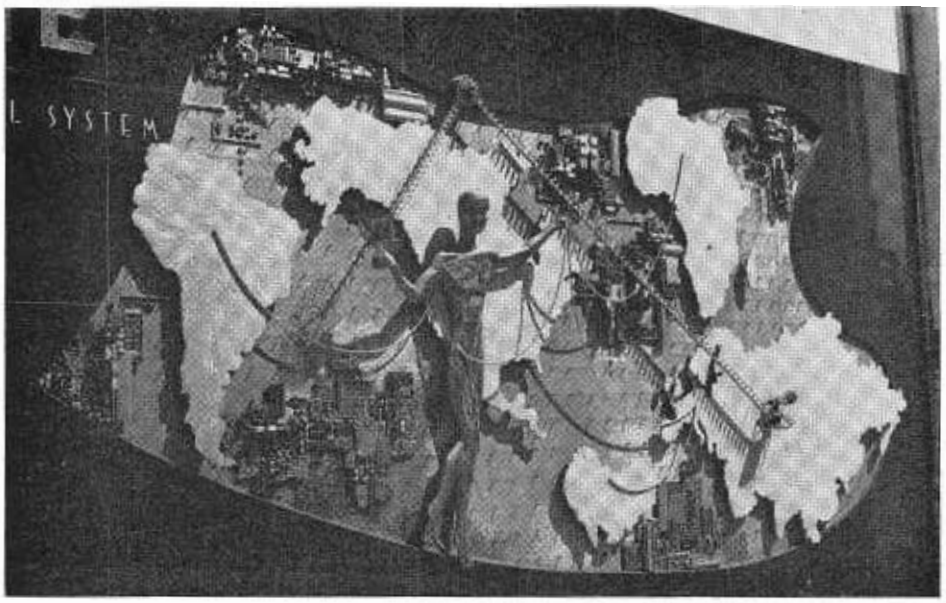
The proposed new addition to the Farmers and Merchants Branch of the Security First National Bank. (Photo by Albert C. Martin and Associates.)

Action by the California Legislature in 1961 allows implementation of a mass rapid transit system by the Metropolitan Transit Authority, studies for which have lately been completed, for an initial route to begin at Century City in West Los Angeles and terminate in the City of El Monte, a distance of 22.7 miles. A 12-mile segment of the route from Century City to Union Station in downtown Los Angeles would be in subway, with the balance above ground. The project, estimated to cost $192,000,000, would require three to four years to complete.

The MTA system as it operates today, serving the Central Business District and extended areas, is a prime mover of large masses of population. This movement, when interrupted as it was in 1960 by a strike, can have a deleterious effect upon other vehicular traffic plying between points in the entire Metropolitan area complex and the Central Business District. As of June 30, 1961 Los Angeles County had 3,145,949 motor vehicle registrations.

Freeway Network

The downtown, the Central Business District, the Civic Center and the Central City Area, are served by a network of freeways, the Hollywood-



The 30 by 18 foot mosaic in front of the Pacific Telephone and Telegraph Building on South Grand Avenue. Tile, rock and pieces of actual telephone equipment are used to explain the role of communications in today's shrinking world. (Photo by Ted Schmidt.)

Santa Ana on the north, the Santa Ana-Golden State on the east, the Santa Monica on the south and the Harbor Freeway on the west. All of the downtown portions are completed with the exception of the Santa Monica Freeway linking the Santa Ana Freeway with the Harbor Freeway and points west. The Santa Monica freeway is under construction in viaduct—approximately 20 feet above existing surface streets—from the Santa Ana Freeway to Hoover Street west of the Harbor Freeway, a net distance of approximately 4 miles. Total cost of this section which will be completed by the summer of 1962, will be approximately $31,000,000.

The eight-lane viaduct structure crosses 38 city streets. Ten streets will be deadended and 4 relocated, although during construction all streets will remain open to traffic. There will be enough space for areas totaling 80 acres beneath the viaduct which will be available to lease for public parking and other approved uses, converting what would otherwise be lost area into a useful, revenue-producing facility.

Recent construction in the vicinity of downtown includes two contracts on the Golden State Freeway, between 6th Street and Pasadena Avenue, 2.4 miles, completed in March, 1960, at a construction cost of $7,778,000 (plus realignment of a section of the San Bernardino Freeway and the interchange, $800,000); the Long Beach Freeway Extension connecting the Santa Ana Freeway with the San Bernardino Freeway, 3.7 miles, completed in April, 1961 at a construction cost of $6,650,000; and the East Los Angeles Interchange between the Golden State, Pomona, Santa Ana and Santa Monica Freeways, 2 miles, completed in June, 1961, at a construction cost of $10,326,600.

The East Los Angeles Interchange, located on the east side of the Central Business District is the critical key in the downtown Los Angeles Freeway Loop. The complex is composed of one "Y" and two "X"-type junctions with numerous access ramps to the local city street system.

The Santa Ana Freeway, built in 1947, angles northwesterly through the area and by 1975 will be carrying an estimated 135,000 vehicles per day. In 1956 at the junction of the San Bernardino Freeway, the Santa Ana Freeway carried 106,000 vehicles; today, in 1960, it carries 103,000, which is the only instance of decrease in vehicular movement in the downtown area and reflects diffusion to newly constructed bypass routes (Golden State, Long Beach Freeway).

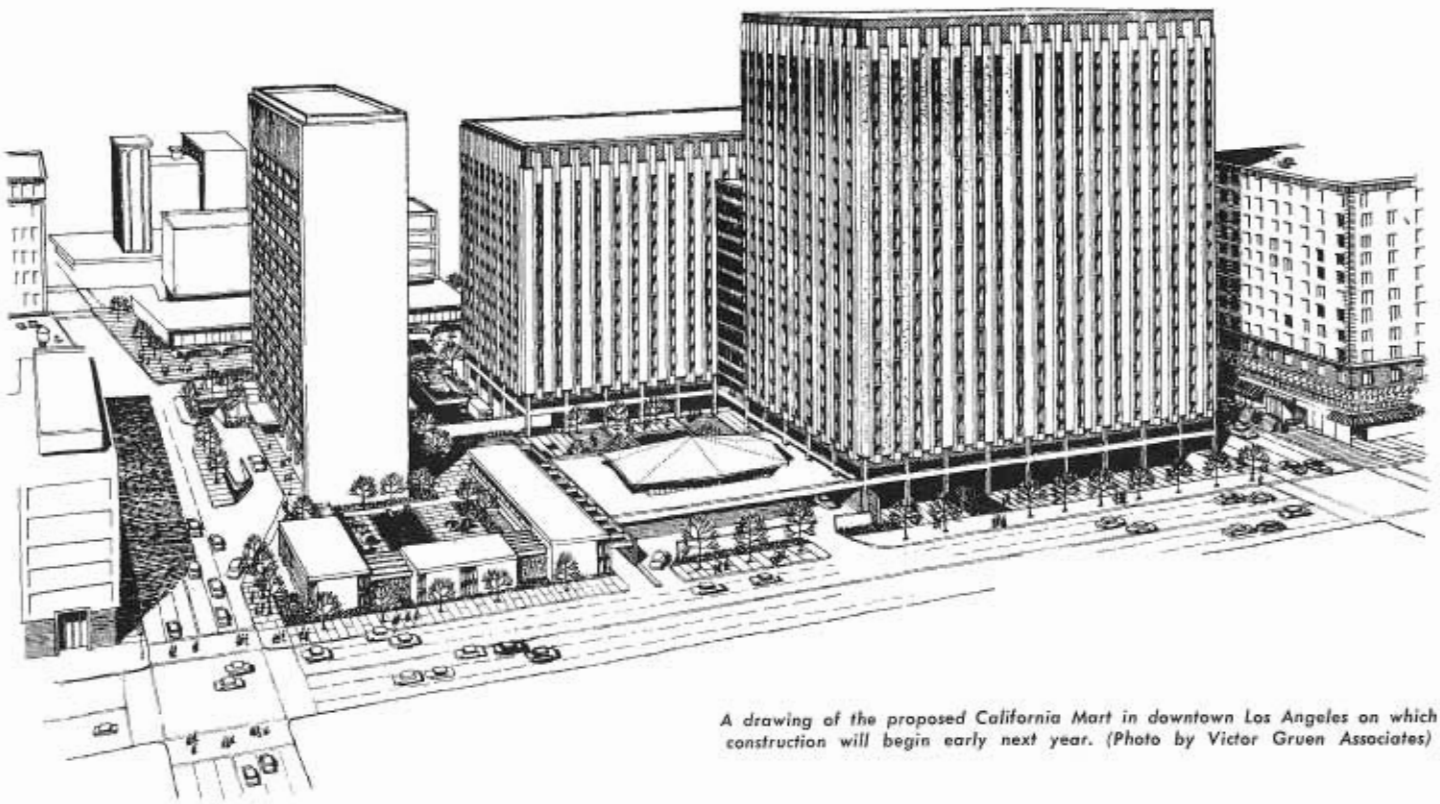
The Santa Monica Freeway, currently under construction, is expected to be carrying 180,000 vehicles per day by 1975. The estimated average daily traffic for this freeway as far west as the Harbor Freeway after construction in 1962 is 70,000. The frontage road system on the Santa Monica Freeway will dissipate 50% or more of the traffic destined for mid-town at Santa Fe Avenue, Alameda Street, Central Avenue and Los Angeles Street connections.

The Golden State Freeway joins the interchange from the north as a portion of the freeway loop around the Central Business District. This freeway will carry an estimated 163,000 vehicles per day in 1980. The portion open to traffic now in the vicinity of downtown carries 30,000 vehicles.

The Pomona Freeway, State Route 172, will be the easterly leg of the complex upon construction and will carry 163,000 vehicles in 1975. Before 1980 the interchange complex is expected to be handling 450,000 vehicles per day, or nearly 600,000 individuals. In comparison, the 4-level structure at the junction of the Harbor-Pasadena Freeways, and the Hollywood-Santa Ana Freeways presently carries 355,000 vehicles per day.

Construction in progress on the Santa Monica and Golden State Freeways will when completed render relief to the "slot" area from the 4-level structure to junction of the Santa Ana-San Bernardino Freeways – in terms of percentages, this relief will amount to a 16 to 19% reduction in traffic from the 185,000 vehicles using this facility now to 150,000 anticipated for the future. On the other hand, changes in travel patterns occasioned by diversion of traffic from the "slot" indicate a slight increase of traffic on the Harbor Freeway or a 20,000 per day gain over the present 210,000. This forecast is based upon mid-town destinations with the bulk of the exits being via 9th and 6th Streets.

Thus another component is added to the growing network of freeways in Metropolitan Los Angeles that will



A drawing of the proposed California Mart in downtown Los Angeles on which construction will begin early next year. (Photo by Victor Gruen Associates)

begin to function as a system, providing alternate routes to accommodate the areawide traffic flow patterns. To 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.

The Division of Highways is meeting the challenge of expanding, changing Los Angeles with a planned network of superhighways for the transportation of people and goods. As of April 25, 1961, the State Division of Highways had expended for rights of way and construction or obligated $730,599,000 on freeways and expressways in Los Angeles County, representing 210 miles.

To properly gauge Los Angeles County's rapid advances in freeway development, it should be pointed out that on April 5, 1951, just 10 years ago, the total expressway-freeway mileage was 63.2 and construction expenditure $41,631,000.

Conclusion

A fitting general conclusion to this discussion of Los Angeles in Renaissance and the meaning of the multiform changes, growth and expansion that are attending it, is contained in *Metro*, a publication of the American Automobile Association.

Far from being a deleterious influence, as critics of the car allege, this development of the suburbs along the pleasanter lines made possible by higher incomes, the auto, and highways, is having a rejuvenating effect on central cities. It is causing them to study the possibility of rebuilding their slums and other congested areas. Without this pressure from the suburbs, the central cities might have continued to be areas of congestion and often of ugliness.

It is now becoming possible to redesign and rebuild downtown areas because the competition of suburban development provides the incentive, and to some extent because the migration to the suburbs provides vacancies, and sets downtown values closer to levels which make redevolpment and renewal possible. The successful use of the auto in the suburbs is therefore spurring a revitalization of downtown. To insure the continuance of urban renewal, expenditures on urban and suburban highways must be increased.

The expansion of urban highway systems, and their growing use has begun to save our larger centers of population from decay. If the central cities are to survive, they must replace some of the business they have lost. The new highway networks are helping to make this possible. They are making it possible for residents of the far-flung suburbs to reach the central city more conveniently for the services it can provide best instead of having to duplicate these services in the peripheries. Instead of facilitating the development of new relatively self-sufficient cities, the highways are tying the suburbs to downtown.

There is every reason to believe that central business districts will continue to undergo change in their character. But examples of some cities have made it clear that through planning, renewal and provision of adequate transportation, our cities can reach new heights of vigorous growth and the provision of pleasant living and working conditions.

Legal Decisions

State Supreme Court Rules On Three Property Valuation Cases

By CHARLES E. SPENCER, JR., Attorney, Division of Contracts and Rights of Way

During the past year, the Supreme Court of California handed down three important decisions relating to the valuation of real property in eminent domain proceedings. These three cases—*People* v. *Ayon*, 54 Cal. (2d) 217; *People* v. *Symons*, 54 Cal. (2d) 855; *People* v. *Murata*, 55 Cal. (2d) 1, were handled by the Los Angeles Office of the Division of Contracts and Rights of Way. The *Ayon* case was decided in May of 1960. The *Symons* case was handed down in December, followed a few days later by the *Murata* decision.

In each instance the Court was required to carefully review all the facts to be assured that the property owners were not being denied their constitutional right of just compensation and at the same time not to transfer an unreasonable burden to the State and taxpayers. The results are equitable decisions which will be of great assistance in the freeway program by eliminating the threat of some of the unreasonable claims for damage for right of way acquisition and yet clearly assuring the property owner payment of the fair market value for his property, and damages for certain losses resulting from freeway construction. In all three cases, the Su-

Looking south at the Yor-Way Market from the center of Azusa Avenue after reconstruction of the highway. (See next photo.)

A southward view of the Yor-Way Market before Azusa Avenue was reconstructed. Photo by Verne Cox. (See previous photo.)

preme Court affirmed the position of the Department. The cases will be discussed in the order in which they were decided.

The Ayon Case

The *Ayon* case presented two basic questions:

(1) Where an owner conducts a business on his property, is he entitled to recover for loss of business which results when part of the property is taken for freeway purposes?

(2) When freeway construction necessitates a temporary interference with access to the property, does the owner have a right to collect damages for this interference?

The property in question was used as a supermarket with an adjoining parking lot. The property fronted on Azusa Avenue and First Street in Azusa, California. Before the improvement by the State which gave rise to this action, traffic traveling both north and south on Azusa Avenue had access to the market parking lot.

The improvement involved widening Azusa Avenue, separating north and south-bound traffic by a divider strip, and turning Azusa Avenue into a one-way street for north-bound traffic a short distance north of the market property. At the same point, traffic would be two-way in a southerly direction with access to the parking lot from Azusa Avenue limited to south-bound traffic by reason of placing the divider strip between the north and south-bound lanes. As a part of the redesigning of Azusa Avenue, the State acquired a 10-foot wide strip of land from the defendants along the entire eastern boundary of the property.

Defendants Agree

The defendants agreed to the Department's appraisal for the value of the part to be acquired from them and for all damages arising from the widening of the street and for the severance damage to the remainder of their property. They did, however, by stipulation, reserve the right to claim additional damages, if any, arising from loss of business, customers and good will because of an alleged impairment of access. The Supreme Court of the State of California ruled that these items—loss of business, customers and good will, were not compensable as such.

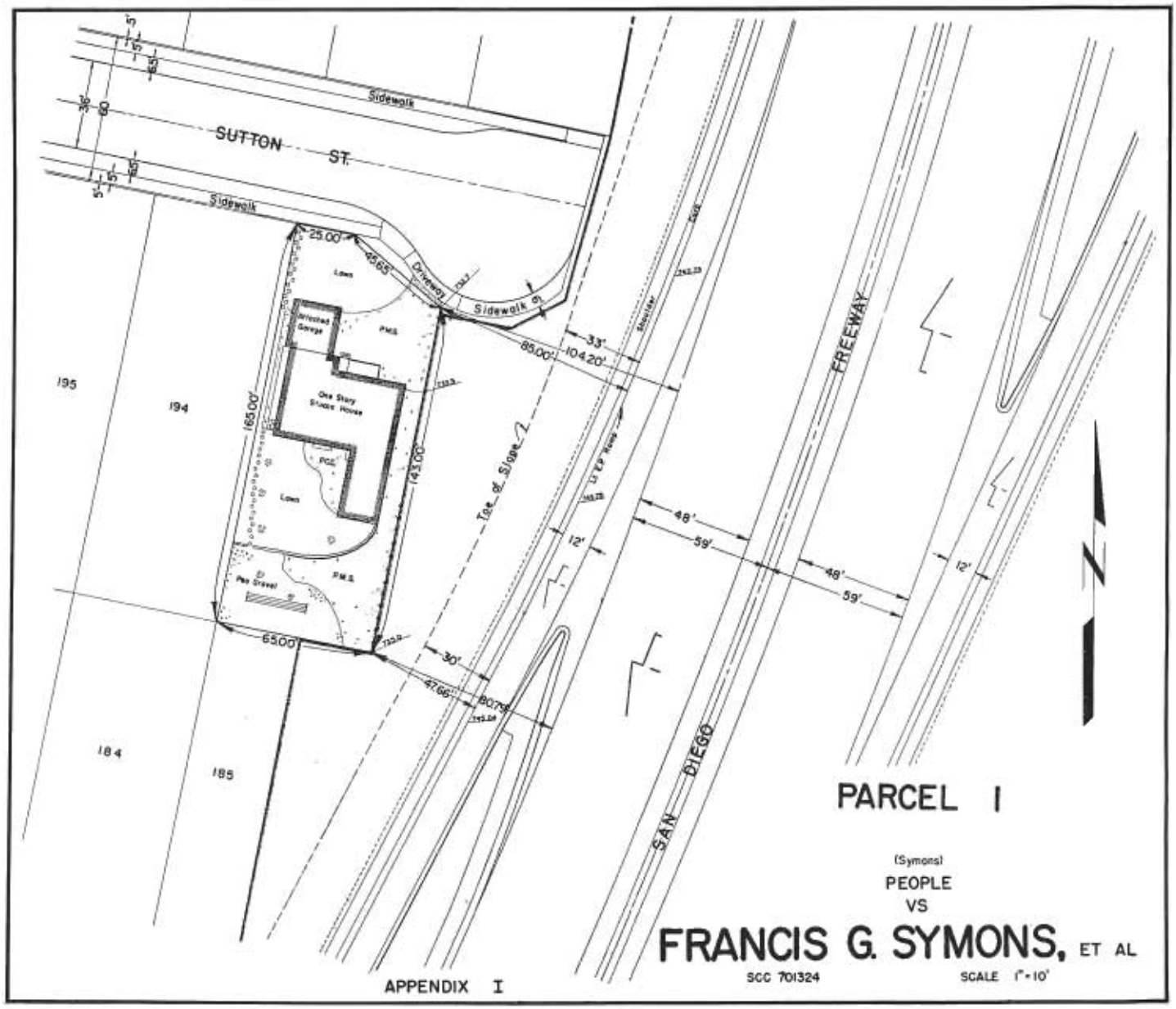
The Court noted that modern transportation requirements necessitate the continual improvement of streets and relocation of traffic and that a property owner has no constitutional right to compensation simply because the streets upon which his property abuts are improved so as to facilitate the traffic flow on such streets.

The Court reached the obvious conclusion that the true test was not whether or not there had been a loss of business but whether there had been an actual diminution in the market value of the property. The Court further found that the access to the property from Azusa Avenue had not been substantially impaired by the construction.

The other question raised was whether or not an owner can collect damages for temporary interference for access to the property during construction. The engineer for the State testified that the entire improvement would be completed within 90 days and that during this period access would at all times be maintained to the parking lot from Azusa Avenue. Although the improvement had not yet been constructed, the defendants attempted to prove that construction would take at least six months instead of 90 days, and that the attempt to maintain access would not succeed.

Ingress, Egress Necessary

The Court observed that it is often necessary to break up pavement, narrow streets and provide other temporary modes of ingress and egress to abutting property during the period streets and highways are being improved, and that reasonable and temporary interference with the property owner's right of access is therefore not compensable. In further defining the rights that a property owner has, the



A map showing the location of the Symons property in relation to the San Diego Freeway and Sutton Street.

Court pointed out that whether or not there will be any further and improper interference with defendant's right at that time is uncertain and highly conjectural. If the improvement is not carried out as proposed, and if, as a result, unnecessary or unreasonable interference with defendant's rights of possession and rights of access occur, then they have a right to bring an action for such damages.

The Court, in restating the rights of property owners, considered the burden on the public by emphasizing that it would unduly hinder and delay, or even prevent the construction of public improvements, to hold compensable every minor item of inconvenience or interference.

The second of the trio of cases considered is *People* v. *Symons*. In this case the State constructed a freeway on the property adjacent to the Symons' property. The defendant's property was a single family home on a residential lot on the south side of a city street which was *cul de saced* at the freeway boundary. The only property acquired from the Symons was for the purpose of constructing a *cul de sac* on the city street.

The Symons and the State agreed as to the market value of the property actually acquired and, in addition, the State agreed to reconstruct the driveway and to reinstall the lawn and sprinkler system.

Damages Sought

The Court was faced with the basic problem that the defendants were seeking damages for the construction of an improvement, not on their land, but on adjacent property. The defendants sought to introduce evidence of an alleged change from a quiet residential area; loss of privacy; loss of view to the east; noise, fumes and dust from the freeway; loss of access over the area now occupied by the freeway, and a misorientation of the house on its lot after the freeway construction.

The California Supreme Court held that the only items of damage which could arise would be those resulting from the *cul de sac* itself, and not from the freeway. The rationale of the Court was that the *cul de sac* had no direct relationship to the freeway inasmuch as any damages arising from the construction of the freeway would have occurred whether or not the *cul de sac* was constructed.

The Court pointed out that it has long been recognized that there is no right to recover for all elements of damage caused by the construction of a public improvement. There are many things which might make a property less desirable but this is not necessarily an injury to the property itself, as much as an influence affecting its use for certain purposes.

Adjacent Improvements

There are many instances where improvements are constructed on lands of another and which influence adjacent property, but this does not entitle an owner of the affected land to damages. For example if a private citizen were to acquire property next door and were to construct, let us say, a factory with a change of zoning to such use, there could be no claim for damages arising therefrom. The Court concluded, since it is not proper to allow damages against a private citizen under these circumstances, it certainly would not be fair to enlarge the State's scope of liability under similar circumstances, which is exactly what the defendants were attempting to do.

The Court pointed out its responsibility in these instances by stating that it has assumed the burden of defining the rights of property owners because of the necessity to safeguard constitutional rights and to see that the cost of public improvements are not unduly enhanced. Thus, if the Court had defined the rights of the property owner other than it did in this case, it would have, as it stated, "imposed a severe burden on the public treasury and in effect placed 'an embargo upon the creation of new and desirable roads' ".

The third case previously referred to is *People* v. *Murata*. This case involved the question of what date of valuation was to be used on the retrial of a freeway condemnation case.

Property Valuation

A California statute provides that the property is valued at the date of issuance of summons unless the trial is not held within a year of such time, and then the date of valuation shifts to the date of trial unless the delay is caused by the property owners. For all intents and purposes, the first trial was held within a year after the issuance of summons, but because of certain errors caused by the defendants in the first trial, a retrial was granted. The second trial was held more than a year after the original issuance of summons. The Court, in summing up the proper interpretation of the statute, determined that the valuation date should remain the same as that of the original trial. The Legislature in enacting the code section involved could have easily provided for a change of valuation date upon successive trials or retrials. It was obvious, the Court said, that the Legislature had in mind only the first trial of the action and to hold otherwise would mean that the Legislature had deliberately deprived the State of an effective appeal. Likewise, any other interpretation would also deprive the property owner of an effective appeal if his property was involved in an adverse market.

Again, the Supreme Court of the State of California was faced with a situation where due consideration had to be given to a judicial determination which would clearly provide just compensation to the property owner and yet not unjustly penalize the public.

Interstate Highway Progress Reported

A compilation released in August by the Bureau of Public Roads showed that California is making good progress on the Interstate highways within its borders. The report, giving figures as of June 30, showed that of the 2,177.4 miles of Interstate highways in California, 183.6 miles are completed to full or acceptable standards, and that another 223.6 miles are improved to standards adequate for present traffic.

A total of 596.8 miles were open to traffic, 159.7 miles under construction and 1,067 miles in the engineering or right of way phases.

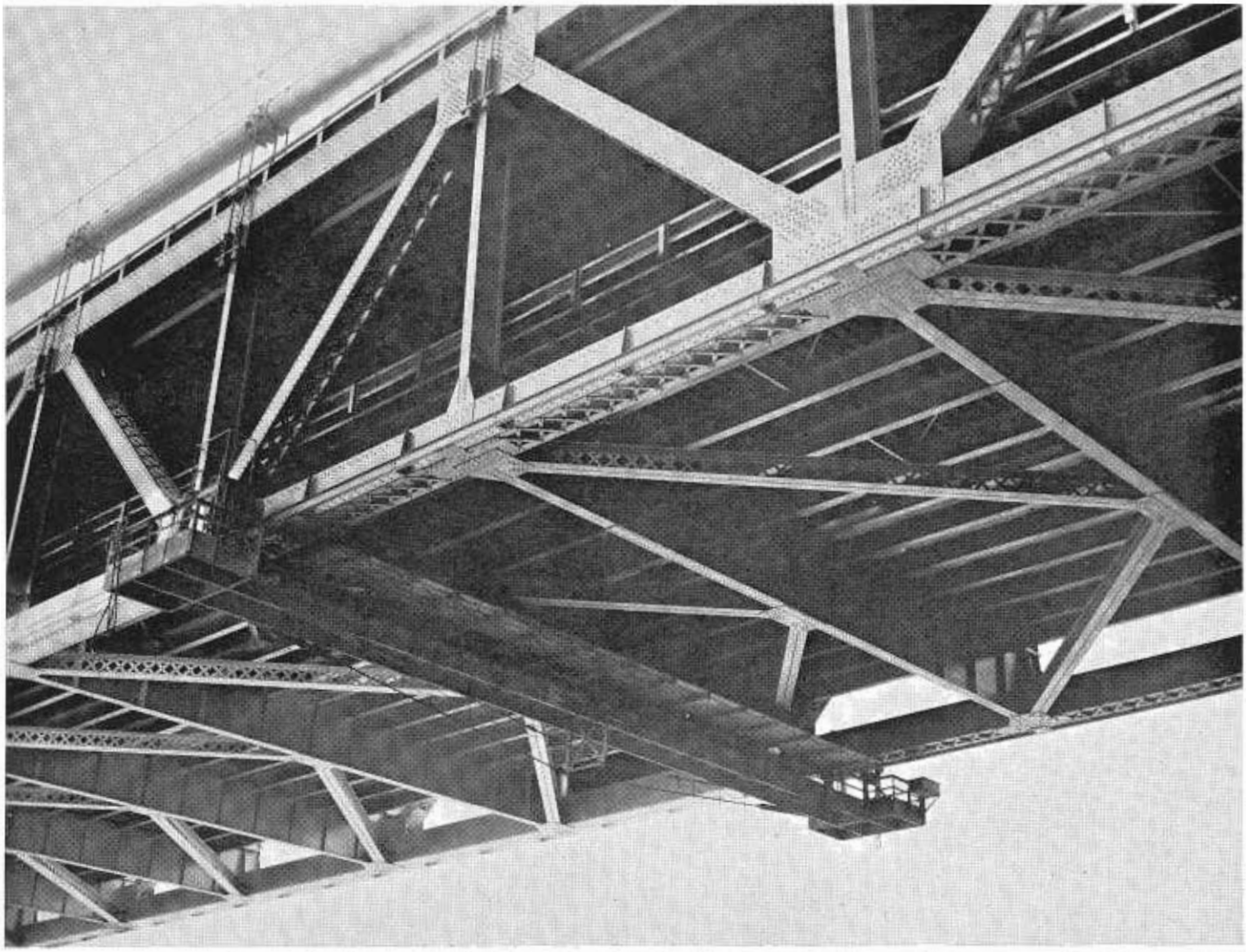
Painting the Bridge—2

Gantries Aid Bridge Repair

By D. EWING MARSH, Maintenance Superintendent, San Francisco-Oakland Bay Bridge

ALTHOUGH the San Francisco-Oakland Bay Bridge is mostly built of heavy steel, there are locations such as the sidewalks and the overhead structure in the cantilever and 504-foot through truss spans where the steel is comparatively light and the steel temperature changes more rapidly than in other locations. This rapid temperature change causes a breakdown of the paint film on seams. In this portion of the bridge, we begin repainting at intervals of 3½ to 4 years. It is necessary to keep these seams well sealed because of their awkward position on the bridge directly above upper-deck traffic, and the fact that it would be extremely difficult to repair them if rust became extensive or heavy between the parts of built-up members.

The sidewalk and chord soffits on the bridge are what we call condensation surfaces. Walks are very light compared to other bridge steel, being only ⅜-inch plate, and flat on the bottom so that dew or condensation forms and hangs there. This cannot run off but remains in droplets absorbing contaminants from motor vehicle exhaust. Paint on these surfaces has a very short life. Sidewalks are non-stress carrying members and do not give too much concern. Various methods have



Inspection bridges such as the one in the photo were used originally as crossovers between catwalks during the cable spinning. Later 14-by-62-foot platforms were added so that they could be used in painting the floor system.

been tried on these walks to make the paint last longer, but the condition is so severe compared to other conditions on the bridge that nothing has proven completely effective in lengthening the life of the paint film to equal that on other portions of the bridge.

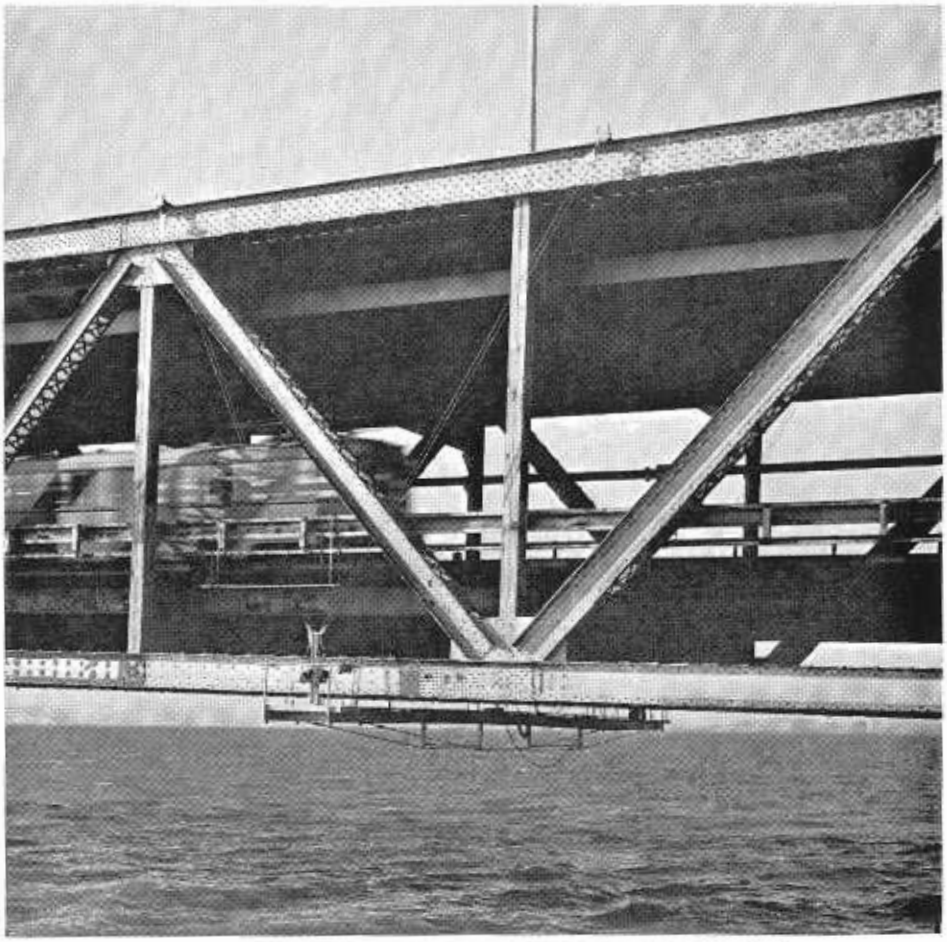
Effect of Rain

Surfaces on the bridge steel which receive rain and are washed clean have a minimum of rust, except as noted under "temperature change". Prevailing winds normally come from the northwest side of the bridge, but not in the rainy season. The heaviest rains come from the southwest, are not accompanied by high winds and consequently do little *good* beneath the decks. High velocity windstorms from the southeast accompanied by rain blow a large amount of water through the trusses on the south side of the bridge, and the effect of this water is very noticeable. The ends of floor beams, exposed to this rain water blowing in, will have little or no rust, while the opposite end of the same beams, subject to motor vehicle exhaust and generally unwashed, may have the entire surface rusted and require 100-percent sandblasting.

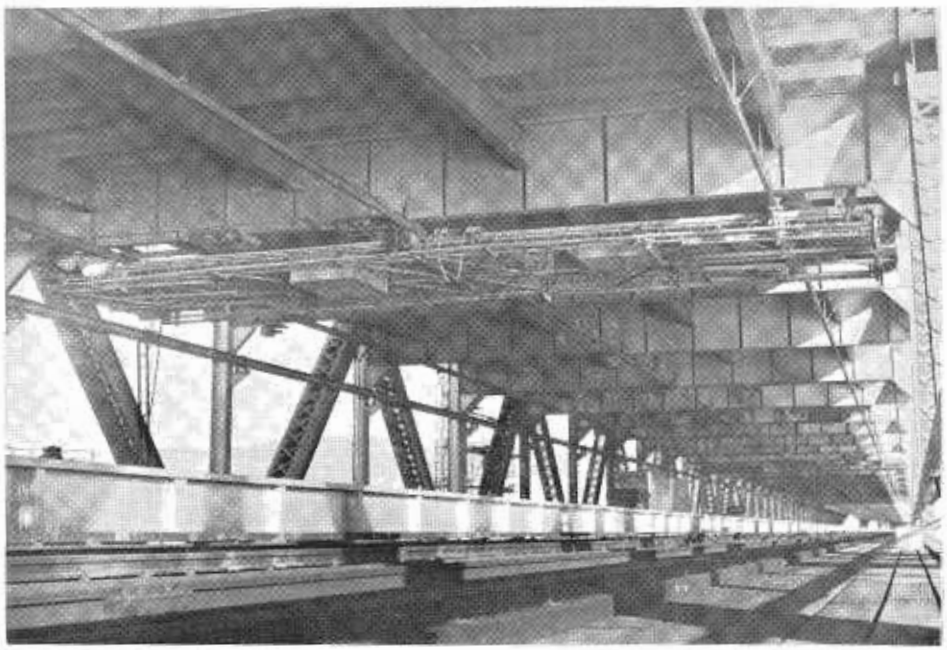
Paints in Use

Between 1940 and 1945, the formula for the aluminum vehicle was changed from a long tung oil varnish to a phenol formaldehyde type. The present varnish is known as California State Specification 58-I-04, and is a 100 percent phenol formaldehyde type. The resin used is CKR2432, or equal, corresponding to Federal Specification MIL-R-15189A. Aluminum paste used is Specification TT-A-468, Type II, Class B leafing type, except that nonvolatile is 74 percent minimum. Two pounds of this paste are used per gallon of aluminum vehicle.

Several years ago, we began using a semi-quick drying red lead paint which weighs 21.7 pounds per gallon. This paint dries satisfactorily for recoating in 16 hours. We have not abandoned the use of slow drying paint, but use these quicker drying paints in locations where we can get at the surfaces for repainting more rapidly, thereby reducing contamination between coats during the repainting operation. Semi-quick drying paint



The Magic Carpets, 6 feet wide by 85 feet long, are suspended from the upper chord. For many years they have provided a platform for repainting the lower deck floor system. They are now being replaced with power-operated travelers (see photo next page).



The gantries or upper deck travelers run on a three-rail overhead track with air-powered drive. The working platform is 17 feet wide and 59 feet long.

Lower deck travelers used on the East Bay section provide a 19-by-73-foot platform for painting the lower deck floor system. They are hung from air motor-driven trolleys. Folding ends allow clearance when passing through the bridge piers. These are replacing the older Magic Carpets (see photo previous page).

is compatible with our linseed oil paints, and they are frequently mixed together in equal portions for color differences between coats, or some of this quick drying is added to the regular paints to speed the drying.

Another item of interest which is frequently used to our advantage is leafed metallic lead paste. This is added to the lead coats to reduce or speed the drying time and provide a better tooth or bond between coats. We add approximately 1½ pounds per gallon in our mixing tubs. It is not practical for us to buy paint with this mixed in at the factory. Our use is not continuous, but varies with the locations where we are working as well as with the weather conditions.

State Specification items used at San Francisco-Oakland Bay Bridge during 1960:

1. First coat paint
   a. Red lead linseed oil—27.8 lbs./gal. Specification 58-G-60
   b. Semi-quick drying red lead—21.7 lbs./gal. Specification 58-G-53
   c. Phosphoric acid wash (Mil-C-15328A) Specification 52-I-05
2. Second coat paint—24.4 lbs./gal. Specification 58-G-61
3. Aluminum finish coat—Specification 54-G-80
4. Steam cleaning compound—medium duty (Bay Bridge formula) Specification 59-A-77

Over the years, coal tar coatings have been used in some areas. The quantities have been small, but the results in these specific areas have been excellent.

The following quantities of our regular paints were used during the fiscal year ending June 30, 1960.

First coats	
Red lead linseed oil	1,472 gallons
Semi-quick drying red lead	4,945 gallons
Second coat red lead	2,890 gallons
Finish coat aluminum	5,945 gallons
Total	15,252 gallons

Everything practical is done to shorten the time between coats, thereby reducing contamination between coats. This is particularly important between the first and second coat. One coat of red lead paint has a very short life in our exposure and it is not satisfactory to leave unrecoated for more than two months and in some locations for only three weeks. At times,

we have had two coats of red lead paint go for nearly a year with very few bad results. This was not done intentionally, but because of accidents where surfaces had to be left until access could be had at a later date.

Surface Preparation

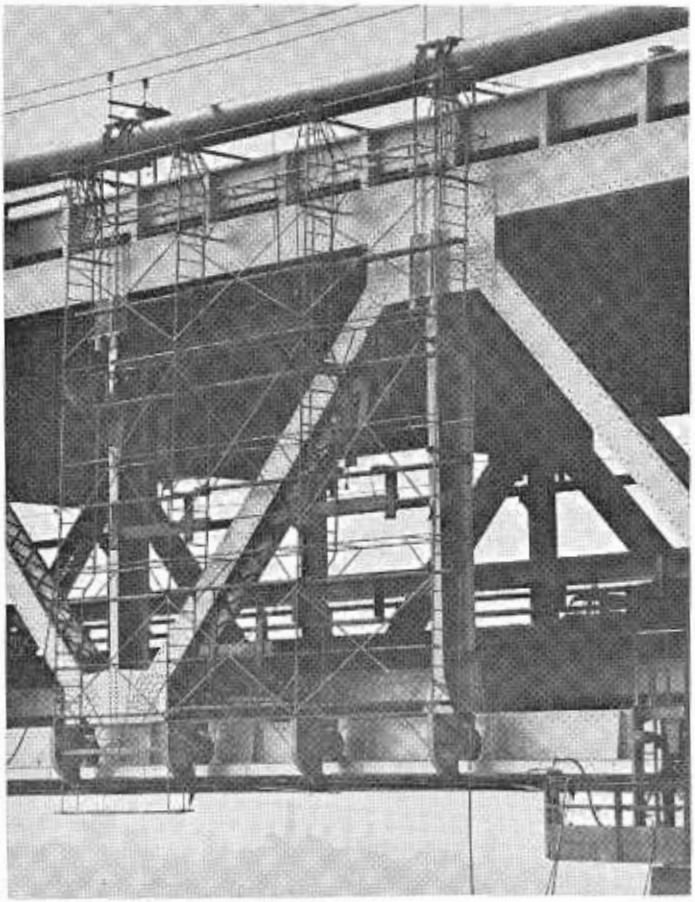
Our present policy is to steam clean all surfaces which can be cleaned without serious inconvenience to traffic. Under this plan, we have steam cleaned to the tops of the suspension bridge towers 275 feet above the upper deck with the steam cleaners on the lower deck of the bridge adjacent to the tower legs. This is followed by sandblasting to remove rust. The steam cleaning reduces the amount of sandblasting by removing dirt and other stains which might be mistaken for rust. Another advantage is the reduction in cost over that of blasting, and we do not wish to remove good paint unnecessarily.

We only do spot sandblasting except in rare instances, and no blasted surfaces are left overnight. They are all painted the same day they are blasted and receive two spot coats of lead paint, one of which is a spot coat on all seams, rivet heads, and edges in addition to the blasted areas. This is followed by a third coat of lead paint over the entire surface, which in turn is followed by the finish coat of aluminum. This brings all blasted surfaces to the same standard of protection which was originally used at the time of construction.

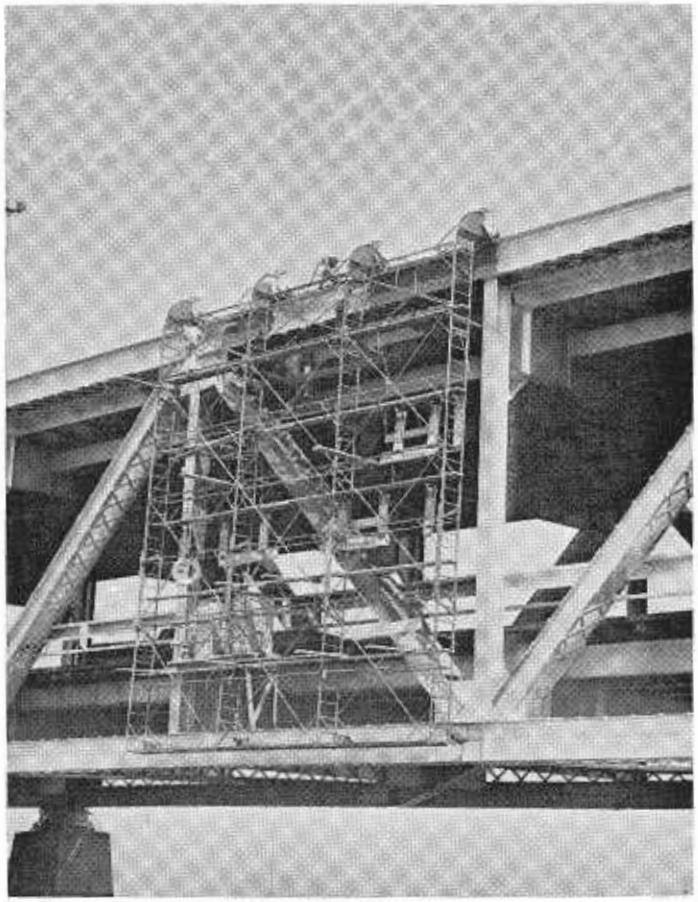
Another routine which we have adopted is that in many places where we are unable to clean out cracks which show indication of rust, we pour into that crack the phosphoric acid diluent of vinyl wash primer. This acid treatment is compatible with any water which may be in the crack, creates an inert surface on the steel it touches, and has a tendency to inhibit any rust which it touches or which absorbs it. After this has had a chance to dry, the open edge of the crack is given a treatment of a surface preparation oil, of which there are several on the market. These do not contain driers and are compatible with paint. Following this, the cracks are filled with caulking compound and sealed over with the usual several coats of paint.

Mechanized Scaffolds

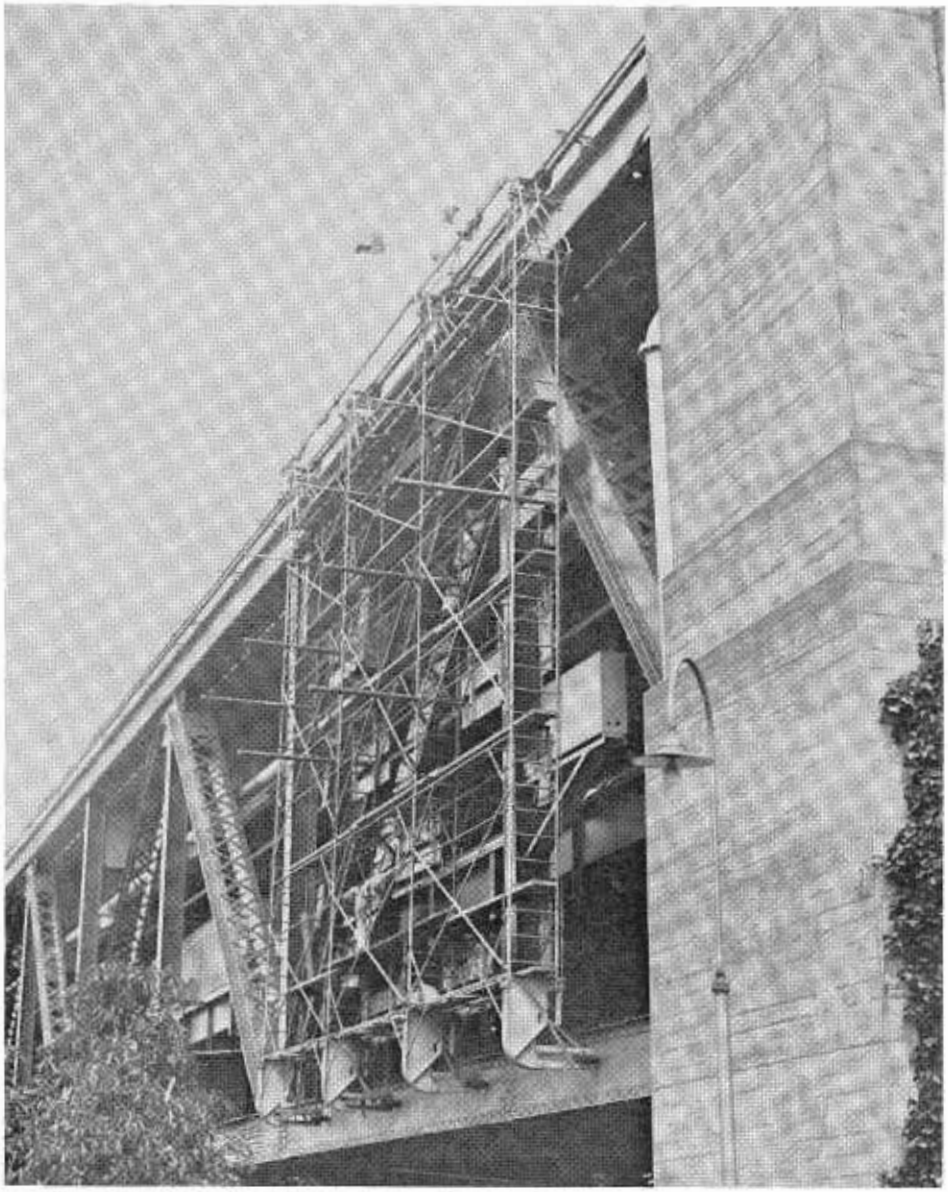
We attempt to have all our scaffolding in as large units as possible and mechanized to reduce human effort in moving the scaffold and thereby wasting time. At present, we have eight scaffolds covering an entire truss panel running on the outside of the bridge trusses for painting the truss web system. The first of these truss web scaffolds was built in our own shop in 1946 and others built to our design



The Bird Cages or truss web scaffolds on the West Bay suspension spans run on the inspection bridge track on the lower chord. These scaffolds are 40 feet high and 36 feet wide and support platforms for painting truss members. They are mounted outside the bridge to keep painters away from adjacent traffic.



The East Bay Bird Cage or truss web scaffold, also 40 feet high and 36 feet wide, is suspended from a portable truck on the top bridge chord. All Bird Cages have folding platforms providing access to truss diagonals sloping either to right or left.



This West Bay truss web scaffold was temporarily mounted on overhead track for work on the Yerba Buena Island Spans.

later that year. Two covering a half a panel were erected at the curved spans in February, 1961. These enable the men to paint the trusses without being on the narrow sidewalk adjacent to the highway and increase safety by keeping the men as far as possible away from traffic. There are currently five travelers running underneath the upper deck suspended on overhead rails.

These platforms are approximately 15′ x 60′ and cover half of a floor system panel providing easy access and a minimum amount of rigging time moving from panel to panel. In 1948, we built and erected the first of these and a half mile of track with our own crew. A new scaffold was installed in 1960 underneath the lower deck for painting approximately 3,000 feet of bridge on the east end. This platform is also approximately 15′ x 75′. Three more are in the design stage nearly ready for contract.

Run On Tracks

Seven inspection bridges running on track were provided with the bridge originally. These were 4 feet wide by 76 feet long, powered by hand, and were for inspecting the lower-deck floor system on the suspension bridge and the main span of the cantilever. Wider platforms, 14 to 15 feet wide, have been placed on these scaffolds and power drive has been installed.

Special scaffolds to run on the main cable hand ropes were built in 1947. These are adjustable so they may be kept level as the cable changes slope. Special elevator-type platforms are used for painting the suspender ropes. For painting the suspension bridge towers, an articulated scaffold was built in 1939 which completely encircled a tower. When not in use on the big towers, sections were used elsewhere. This was operated by hand-powered jack machines. It is now old and has deteriorated to such an extent that when the towers are painted again, we anticipate designing a new scaffold with power drive. For vertical transportation several different commercial makes of air-powered scaffold machines are used. We have learned that no one commercial machine answers all our problems, but that each type of machine which we have works better in some places than any of the others.

There is currently being installed on the Bay Bridge a 4-inch air line the full length of the bridge for conveying compressed air to working locations. Compressed air driven tools have proven to be the most adaptable to the variety of conditions encountered on this bridge. Originally, electric-driven tools were tried, but because of operating conditions, they were not satisfactory, although they might be on a bridge where power is more accessible and other conditions are different.

Areas Repainted

At the present time, January, 1961, the West Bay suspension bridge towers have been painted twice under maintenance at intervals of 12 years. The same applies to the main cables and suspender ropes. The suspension bridge trusses are now being painted for the second time under maintenance. The upper and lower-deck floor system painting is a continuous process which never ends and is carried on from the center of the suspension bridge toward the ends, or in other words, downhill from the center. This floor system has been painted at an average of eight-year intervals,

although on the first time over portions went as long as 20 years.

On the East Bay as on the West Bay, painting of the floor system is a continuous process. The average time between coats being eight years, with portions on the East Bay having gone as long as 18 years. The trusses on the East Bay 288-foot truss spans are now being repainted for the second time under maintenance. All bents supporting the East Bay portion of the bridge are now being repainted for the third time. The 288-foot Yerba Buena Island spans have just been completed for the second time on the lower-deck floor system and the third time on the upper-deck floor system. The trusses are about to be repainted for the second time under maintenance.

Four-Year Intervals

In the 504-foot through truss spans and the cantilever section, which are roughly 2,500 feet long each, we find it necessary, because rapid temperature change causes paint failure on cracks and seams, to start a paint crew through the overhead structure (struts, bracing connecting the trusses, and the trusses themselves) at intervals not exceeding four years. Luminaire standards throughout the bridge have a very long life, the principal deterioration on them being abrasion caused by the use of the tower or ladder trucks.

Although large quantities of lead and aluminum paint are sprayed, it is a very small percentage of the total paint applied here. We have observed, however, that the speed gained is not always to our advantage, it having been found that paint which is applied to a surface with pressure, that is, by friction, is worked into the surface with a better bond and gives us a longer life and a better coat of paint. This undoubtedly is because any surface contaminants are worked up into the paint film and do not lie undisturbed between the old paint and the newly-applied coat.

The general order of painting is determined by:

1. Policy of preventive maintenance.
2. Anticipated life of paint coatings under local conditions on the structure.
3. Techniques required for specific locations.
4. Accessibility.

Routines vary between the suspension bridge between San Francisco to Yerba Buena Island and the cantilever and truss spans from the island east to Oakland. They are thus listed in the general order of their frequency. Groups are generally determined by the type of scaffold or rigging used.

West Bay Crossing

Parts of the suspension bridge done in units are:

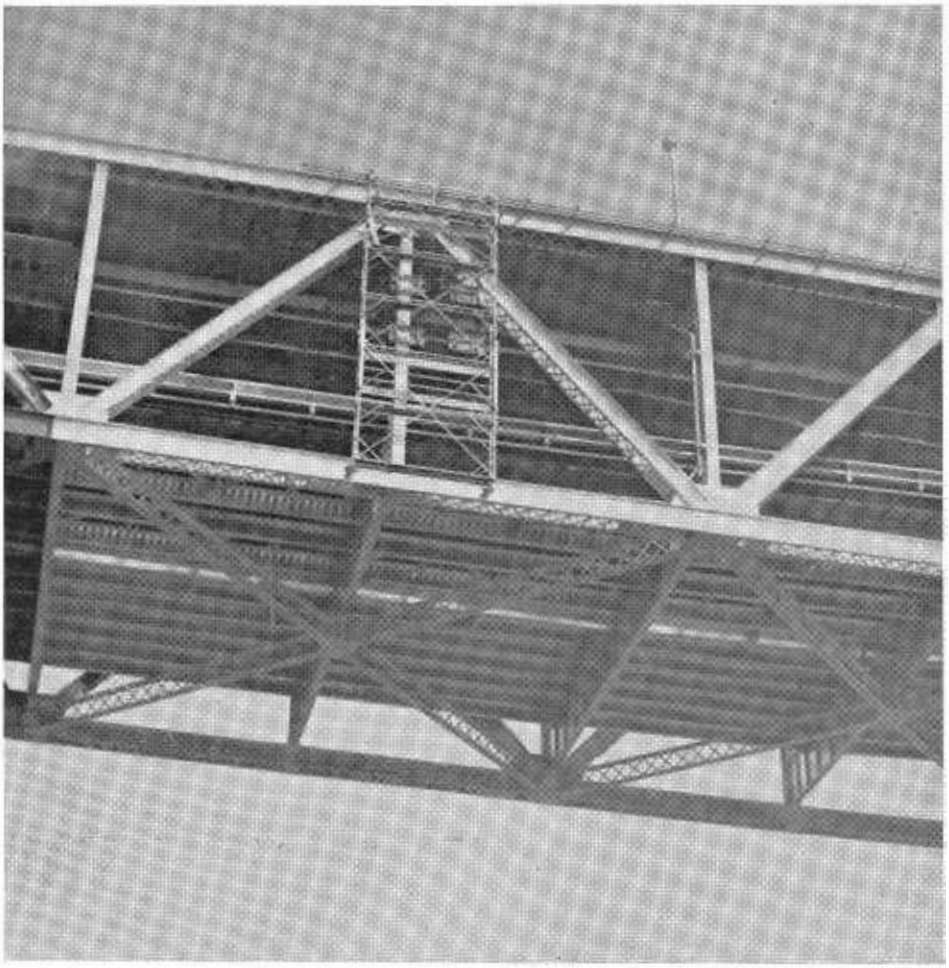
1. Floor systems—upper and lower deck.
2. Truss web members and rocker posts.
3. Tower and bent bases.
4. Towers and bents outside, suspender ropes, main cables.
5. Main cables in saddles and anchorage splays.
6. Roadway faces of walks and skid girders.
7. Bents and towers inside.

Truss web painting also includes inside the upper box chord, suspender rope connections and back of upper walks.

Inside the lower box chords and back of the lower deck walks are done with the lower-deck floor system. At this time, lower chord gusset pockets receive an extra treatment.

Upper-deck floor system includes the upper deck road strut and expansion details at the towers. Because of rapid paint failure on condensation surfaces, the bottom of the upper chord and the attached gusset pockets also receive an extra treatment.

Lower-deck road struts and expansion details on the main towers are painted from the lower tower scaffold.



A special narrow 15-foot wide Bird Cage mounted on overhead tracks is used on the curved spans on the East Bay section.

East Bay Crossing

Policy on this section of the bridge has been to maintain the many large connecting points separately because of the special tools and techniques necessary for working in such very inaccessible places. To keep scaffolding and gear at a minimum when painting the cantilever and 504-foot through truss spans above traffic, laterals, struts, portals, and sway frames are completed as the first operation; truss verticals and diagonals second; and top and batter chords last.

Parts of the East Bay structure done in units are:

1. Above decks or top side.
2. Upper-deck floor system.
3. Lower-deck floor system.
4. Truss web.
5. Bents and towers outside.
6. Large connecting points.
7. Inside of box chords, bents, and towers.
8. Roadway faces of walks and skid girders.

Conclusions

In drawing some very general conclusions based on our experience of painting the Bay Bridge since 1937, we feel that ease of accessibility which includes the use of large power-driven scaffold units is of primary importance. When we have had the opportunity to make suggestions to the designers of other bridges, we have recommended strongly that scaffolding or its supporting track, generous compressed air facilities and access walks be installed at the time of construction. We know from our own experience that film thickness of paint is the life of the job. Experiences also indicate that one or two additional coats of paint shortly after the completion of the original job gave us, with our exposure and under our other conditions, greatly extended life on the original paint job. It is probably not necessary to say that the detail work of sealing cracks, seams, crevices, and other construction details and erection clearances is done better and with a minimum of disagreement and argument by our own forces than it could be done under a contract. We are not implying that a contractor would not do it, but realize the great difficulties which would be encountered in writing a contract to cover the multitude of details and the methods of payment for handling them.

The San Francisco - Oakland Bay Bridge is the headquarters of the State-Owned Toll Bridges organization which is under the general direction of James E. McMahon, Assistant State Highway Engineer, Bridges.

Howard C. Wood, Bridge Engineer, State-Owned Toll Bridges, has direct supervision of the toll bridge organization and is assisted by Thomas J. Dunn, Supervising Bridge Engineer. Edwin F. Levy, Senior Bridge Engineer, is in direct charge of maintenance operations. D. Ewing Marsh is Maintenance Superintendent, Painting. He is assisted by Clair Gibson and Roy H. Proffer, Structural Steel Painter Foremen, who have been with the organization since 1937, and to whom much credit must be given for the establishment of many of our routines and for the successful conduct of our program of preventive maintenance.

Dwight Wonacott

Dwight Wonacott, 62, Highway Maintenance Superintendent for the State Division of Highways in Fresno, died of a heart attack on September 19 while on vacation in Long Beach with his wife Georgia Ann.

A veteran of over 42 years with the Division of Highways, Wonacott began his career as a truck driver for the division in his home town of Bishop. He was promoted to superintendent while in Bishop more than 30 years ago, and had been with the Fresno office nearly 20 years.

He was a member of the Inyo Masonic Lodge No. 221 in Independence, Inyo County, the Order of the Eastern Star, the California State Employees Association, and the Quarter Century Club.

Besides his widow, he is survived by his brother, A. W. Wonacott of Bishop, and a sister, Mrs. Evangeline Troxel of Livermore.

Interstate Funds Total $228 Million

Apportionment of Federal-Aid Interstate Highway funds to the states for the fiscal year 1962-63 as made in August by Secretary of Commerce Luther H. Hodges provides a total of $2,400,000,000 to continue the program. This is the full amount authorized for the period by the Federal-Aid Highway Act of 1961.

California's share is $228,847,200. Last year it was $220,070,812.

The Federal-Aid Highway Act of 1961 authorized the appropriation of additional amounts for the Interstate System through the fiscal year 1971. The total additional funds authorized over the entire period, compared to existing authorizations, amount to $11,560,000,000. No changes were made in the amounts authorized (and already apportioned) for the fiscal years through 1961-62.

The latest cost estimate, approved by Section 102 of the 1961 Act, indicates that the total cost of completing the Interstate System will be $41,000,000,000, of which $37,000,000,000 is the estimated Federal share. This section increases the total amount authorized to be appropriated for this system from $25,440,000,000 to $37,000,000,000, adjusted to the fiscal years in which the estimated funds will be available in the Highway Trust Fund to cover the necessary disbursements. Under the present estimates, the amounts will be sufficient to complete the Interstate System by 1972.

Additional revenues were provided by the 1961 Act. A tax of 5 percent of the manufacturer's sales price of trucks, buses and trailers was increased to 10 percent, effective July 1, 1962. The tax on highway tires was raised from 8 cents to 10 cents per pound; on inner tubes from 9 cents per pound to 10 cents and on tread rubber from 3 cents per found to five cents.

A truck use tax on vehicles over 26,000 pounds was increased from $1.50 per thousand pounds to $3. An excise tax of 5 percent of the manufacturer's sales price of autobobiles and automobile accessories was repealed effective July 1, 1961.

Barstow Bypass

U.S. 66-91 Freeway Extended Nine Miles

By C. G. BEER, Assistant District Engineer and L. M. BARNETT, District Construction Engineer

ON July 5, nine miles of the Barstow Freeway, known locally as the "Barstow By-Pass", were opened to traffic by construction contractors Gordon H. Ball and Ball & Simpson. The project is an extension of the 24-mile freeway from Victorville to Barstow which was opened in January, 1959. It makes available the improvement to full freeway standards of an important link of Federal Interstate Route 15 (U.S. 91) and the first step of freeway improvement of Interstate Route 40 (U.S. 66) toward Needles.

Construction of this $5,650,000 project was started in December, 1959, following a number of years of planning, design and right of way acquisition. Traffic surveys used in determining the route location had been started in 1953.

Noteworthy Changes

With completion of the "Barstow By-Pass", there are noteworthy changes in the routes to be followed by drivers on the several major transcontinental routes which cross in this area. The new pattern is indicated by shields on the map. U.S. 466, pending future connection to Interstate 15 on the west side of Barstow, now will make connections with U.S. 66 (Interstate 40) by way of the new Mojave River Bridge on U.S. 91 (Interstate 15).

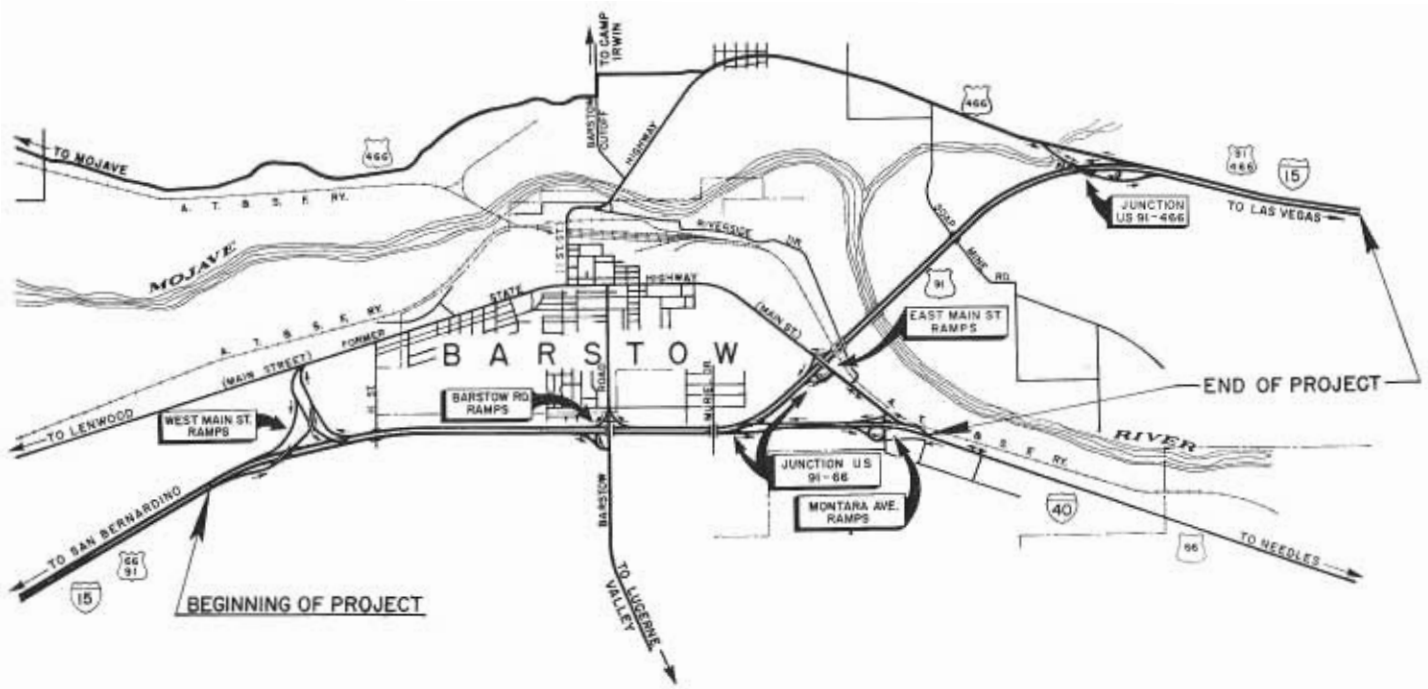
The Mojave River Bridge was the major structure on the project. Although a dry-bed stream most of the time, the Mojave can carry considerable volumes. The photographs show flow in the 1938 flood, estimated to have reached 64,000 second feet; and in a tributary channel during a cloudburst storm in July, 1958. This tributary channel now crosses under the freeway east of Riverside Drive and can be seen in one of the aerial photographs.

Main and First Streets in the City of Barstow, junction of old U.S. Highways 66 and 91.

The junction of U.S. 66 and 91 on the new freeway. Muriel Avenue Overcrossing is in the immediate foreground.

Population Has Doubled

The City of Barstow now has a population of about 12,000, having approximately doubled in the ten years between 1950 and 1960. An official business route has been designated over the former State highway, with signs directing freeway traffic to the business section at the East and West



As indicated by the above map, the new freeway bypasses the downtown section of the City of Barstow.

U.S. 91 and 466 crosses the Mojave River to the City of Barstow in the background. U.S. 466 separates to the right in the lower left portion of the photo.

The Mojave River at Barstow during the storm of March, 1938.

Looking west from the junction of U.S. 66 and 91. A portion of the City of Barstow is to the right. The highway to Needles is lower left; highway to Las Vegas lower right.

Main Street Interchanges, and at the U.S. 91-466 junction north of the river. Concurrently with the freeway construction, the City of Barstow improved Barstow Road, the central north-south cross street, to provide a wide, illuminated arterial for easy access to the freeway from the center of the City.

Traffic surveys made prior to adoption of the freeway route showed that about 43 percent of the motor vehicles going through the City on the main line highways desired to make stopovers. Consequently, the location and design of the freeway was based upon providing direct connections to the central district as well as by-pass facilities for nonstop travelers. Other facts established by the traffic surveys were that U.S. 466 west of the City carried only about half as much total traffic and one-fourth as much through traffic as any of the other three legs. Consequently, the U.S. 466 freeway improvement was not included in the first stage project, but will be constructed later as traffic needs develop and funds become available.

George W. Savage

George W. Savage, newspaperman and former secretary of the California Highway Commission, died September 15 following a heart attack.

A native of Dennison, Iowa, Savage came to California in 1916. He attended high school in Pomona and was a graduate of Pomona College.

He served as managing editor of the Claremont *Courier* beginning in 1928; was co-publisher of the *Inyo Register* at Bishop and other Chalfant Press publications from 1933 to 1946; and published the South Pasadena *Foothill Review* from 1946 until he became secretary of the Highway Commission in January, 1948.

In September, 1949, Savage resigned from the Commission post to join the staff of James A. Guthrie, long-time Commission member and publisher of the San Bernardino *Sun and Telegram*, as manager of the Sun Printing and Publishing House.

He was active in the California Newspaper Publishers Association and various civic and fraternal organizations for many years, and at the time of his death had just completed his term as president of the San Bernardino Chamber of Commerce.

He is survived by his wife, Mary.

Contra Costa F.A.S. *Cummings Skyway, Taylor Boulevard Jobs Completed*

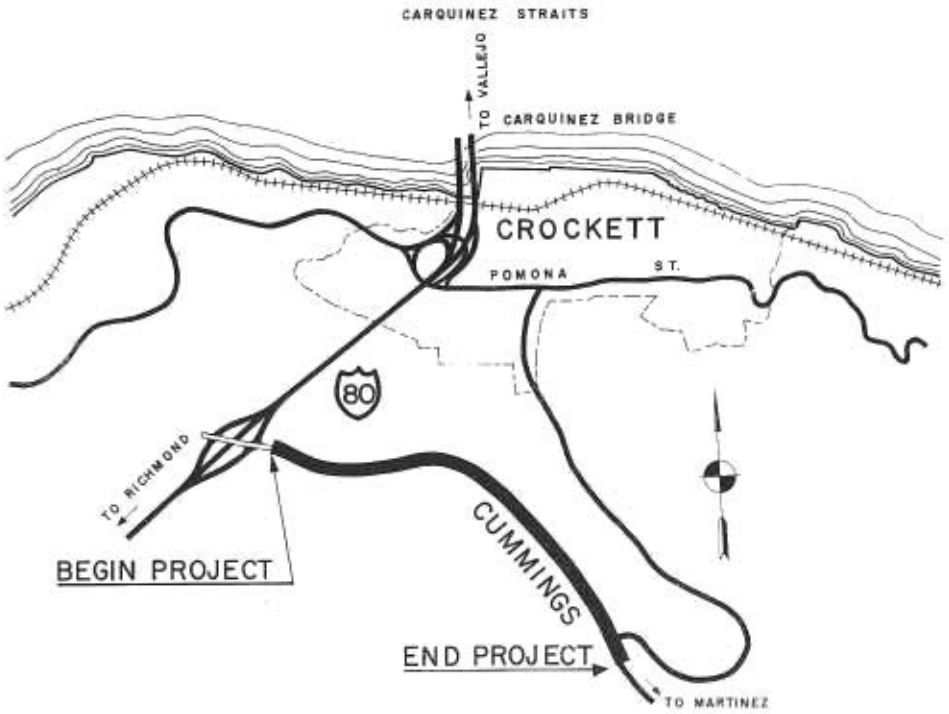
By ROBERT LATCHAW, Assistant Public Works Director, Contra Costa County

Contra Costa County's Federal-aid Secondary Program for 1961 included two major projects making the final connections in two routes designed to furnish collector service to the State Freeway System.

The first included a route through semi-mountainous terrain between Crockett Boulevard, located on high ground overlooking Carquinez Straits, and U.S. 40. Named in honor of former Supervisor H. L. Cummings of Contra Costa County, the new route (FAS Route 1256) now provides a short-cut line between Franklin Canyon Road (State Sign Route 4) and the U.S. 40 interchange and the approaches to the Carquinez Bridge.

The new facility provides two 12-foot traffic lanes and two 8-foot shoulders on one side of a roadbed graded for an ultimate four-lane divided highway for a distance of 1.96 miles and connects to a previous proj-

Looking eastward along the new section of the Cummings Skyway in Contra Costa County above the interchange connecting it with U.S. 40. Part of the "Big Cut" located just south of the twin Carquinez bridges can be seen to the left.



The heavy line on the above map shows the location of the new section of the Cummings Skyway.

ect 1.55 miles long completed by the County without Federal or State funds between State Sign Route 4 and Crockett Boulevard. The grade between U.S. 40 and Crockett Boulevard is continuously upward and the uneven topography required cuts and fills to 75 and 86 feet respectively.

Complex Drainage System

The project features a complex drainage and subdrainage system designed to cope with the problems created by highway construction in an area of extreme geological faulting and overturning. Preliminary soils investigations indicated that water would be found flowing or standing on hillsides, on ridge tops, and occasionally in the creeks.

To correct known drainage problems and to minimize the possible damage from undiscovered drainage situations, the project used about 17,000 feet of underdrains and about 24,500 tons of filter material. Over 6,700 feet of hydraugers were installed to drain wet cut slopes. Future slide probabilities were guarded against by eliminating sidehill cuts, and by using a combination of embankments buttressed against canyon walls and through cuts whose tops fell on the back slopes of the ridges. Nearly all surface drainage is carried in lined ditches or pipes to minimize erosion and reduce slope maintenance costs.

The construction contract awarded by the Division of Highways on December 3, 1959, to Parish Brothers, Benicia, California, was accepted as completed on January 19, 1961. Construction engineering was performed by the County personnel with continuous State and County Cooperation. A. S. Betts of Contra Costa County was the Resident Engineer.

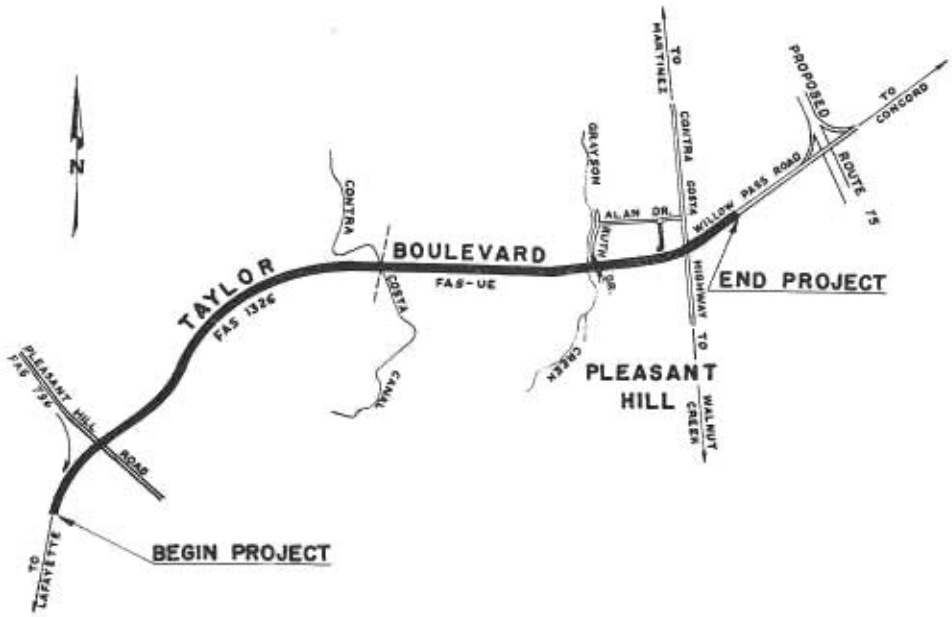
Cost Breakdown

Final cost distribution has not been completed but the preliminary cost breakdown will include Federal funds in the amount of $325,256 and State funds in the amount of $232,544 of a total estimated final cost of approximately $697,800.

The second project completed this year was Taylor Boulevard (FAS Route 1326) between Pleasant Hill Road and State Sign Route 21 at Willow Pass Road.

This is the second FAS Project on this County Thoroughfare and it completes the connection between State Sign Route 24 near Lafayette and State Sign Route 21 near Concord. Since the completion, in June, 1957, of the first unit of Taylor Boulevard which ended at Pleasant Hill Road, the need for the extension became more urgent each year. The new highway, which is an important part of the City-County Thoroughfare System, will provide a more direct route for local traffic and serve as a feeder for the State Freeways in the area.

Ultimately, when the traffic load justifies it, Taylor Boulevard will be



The new Taylor Boulevard project is indicated on the above map by the heavy line.

This westward view shows the intersection of Taylor Boulevard and State Sign Route 21.

a four-lane, divided highway for its full length between Pleasant Hill Road and Contra Costa Highway. The initial phase just completed provides two divided four-lane sections—a 0.41 mile section on the west end between Pleasant Hill Road and Apollo Way, and a 0.32 mile section from Grayson Creek to Contra Costa Highway on the east end. The intervening 0.55 mile section was paved for two lanes, but grading was done to provide for the eventual four-lane section.

Bridges Constructed

Two bridges and a reinforced concrete box culvert were constructed on this contract. The double 10-foot by 6-foot culvert on the north fork of Grayson Creek near Pleasant Hill Road, and the 50-foot span, prestressed concrete bridge across Grayson Creek near Ruth Drive, were built to carry four lanes of traffic. The third structure, a pre-cast, pre-stressed concrete bridge 45 feet in length across the Contra Costa Canal, provided a two-lane superstructure on abutments which were built to accommodate the four-lane bridge which will be required when the road is widened. Both bridges are supported by steel piles.

Three traffic signal installations were included in the contract. The original signals at Contra Costa Highway were replaced by a system designed to handle more directions of traffic movement. This intersection was reconstructed and traffic islands were built to channelize and separate all turning movements. New signals were installed at Ruth Drive to control pedestrian traffic at the school crossing and traffic entering the residential area. At Pleasant Hill Road, a fully channelized intersection, with signals, was constructed to distribute traffic smoothly through this juncture of two major County roads. All three signal installations have automatic, traffic-actuated controllers which proportion the amount of green time in relation to the volume of traffic approaching the intersection. Push buttons are also provided to control the "Walk"—"Don't Walk" pedestrian signals.

Total Cost

The total contract cost of constructing this project is estimated to be $779,332. Federal and State highway aid funds will provide approximately $445,500, while the County's share of the cost is $333,849. This was the first County road project in California to receive funds from the State Highway Commission under the new program for Federal Aid Urban Extensions.

The accompanying photographs show Taylor Boulevard intersecting Pleasant Hill Boulevard and its extension crossing State Sign Route 21 in the Urban Area west of the City of Concord.

Cooperation in the planning and design phases of the project was received from the City of Concord and the State Division of Highways. The firm of Gallagher and Burk, Inc., of Walnut Creek was the contractor with Larry Ashworth as Project Superintendent. The project was completed two months ahead of schedule.

The County Public Works Department, directed by Victor W. Sauer, was represented on this project by Resident Engineer John L. Shotwell.

Talking About Highways — *Comments from Here and There*

Progress on Interstate

The following editorial appeared in the *Hayward Daily Review:*

"California receives a nice compliment in the current issue of *The Saturday Evening Post* which carries an article on the nation's 41,000-mile interstate highway system.

"Although California lags far behind Oregon and Washington in completed mileage on the new I-5 inland coast route from Canada to Mexico, there is a good reason for it.

"In the first place, as the article points out, the two northern states tackled the rural stretches at the outset. California chose to work first on the urban sections.

"With the rapid expansion of California's metropolitan areas, it makes good sense to move as quickly as possible to minimize conflicts between city growth and highway progress.

"In addition, the *Post* article points out that California has acquired more right of way mileage ahead of need than any other of the states.

"The acquisition of rights of way can be one of the most delaying factors in a highway program. California's early attention to that detail could prove a spur to more rapid construction later.

"This state has been remarkably free of highway scandals, with no charges of graft or corruption regardless of whether Democrats or Republicans were in power in Sacramento. Some sections of the east and midwest have not been so fortunate, but it is good to read that the charges are broadly untrue.

"A number of predictions are made in connection with the interstate system. It will save lives. It will save time. It will save money. As residents of a state noted for its mobile population, Californians can appreciate all of those."

Balanced Transportation Network

This statement was included in the final report of consulting engineers hired by the San Francisco Bay Area Rapid Transit District to prepare proposals for a regional transit system:

"No one mode of transportation by itself can provide completely and economically for the movement of people. A balanced network of transportation facilities is essential.

"The (proposed) regional rapid transit system will form an important and integral part of the total transportation facilities of the San Francisco Bay Area.

"The networks of freeways, local streets and local transit routes are all essential elements. By themselves, however, they cannot carry the entire mounting burden of traffic, particularly in the periods of peak demand.

"Together, these networks and the rapid transit system mutually complement each other and afford the Bay Area the best prospect for a balanced and economical combination of circulation facilities."

Freeway At Dunsmuir

"Wonderful! Beautiful! Real Choice! . . . are only a few of the superlatives that can be overheard on the streets of Dunsmuir when the tourists and vacationers are in town shopping, eating, enjoying the several beautiful fountains on our streets.

"About a year ago the hue and cry seemed to be that of dismay and anticipation . . . what would happen to Dunsmuir when it goes off the Freeway.

"Up the canyon we would even hear some of the people say 'poor Dunsmuir' is about done, and 'looks like Dunsmuir is about washed up.'

"Well here it is July, 1961, and for the most part the merchants, townspeople, out-of-towners and our visiting friends are mighty happy with the 'change' in Dunsmuir with the disappearance of the thundering traffic on Florence Avenue.

"In fact, say so many, you can talk on the street now and not be afraid of being murdered by a 40-ton logging or transport truck.

"Merchants are almost unanimous that their business is going on, and a number are very happy with the new and increased volume of business this year."—"Strolling Down the Canyon" column in the *Dunsmuir News.*

William T. Rhodes

William T. Rhodes, Division of Highways engineer who retired in February, 1960, died in San Diego on July 5.

Rhodes had been with the Division 39 years prior to his retirement and had served as resident engineer on numerous construction projects in central and southern California. His career covered a period in highway development which saw some of its greatest change and growth. He served as resident on projects ranging from two-lane desert highways to complex full freeway sections in the San Diego area.

Rhodes developed several aids to highway engineering during his career. These include the "Rhodes Arc" for rapidly calculating the relationship of horizontal to slope distance for surveyors; the "Ready Reckoner" for determining pavement depth during construction; and a type of temporary striping which can be glued to new paving with asphalt binder to delineate traffic lanes through new construction.

Rhodes was a native of Texas. He was a member of the Masonic Lodge at Mariposa.

He is survived by his wife, Marguerite; a daughter, Mrs. Ione Higgins; a son, William T., Jr., all of San Diego, a brother and four grandchildren.

U.S. 80 at El Cajon

Two New Freeway Sections Opened This Year

By J. A. JESPERSON and V. LEFTWICH, Resident Engineers

The completion this year of two three-mile projects in El Cajon, both by the Griffith Company, and the completion early next year of a 2.3-mile contract in La Mesa, will provide the missing links to 17 miles of full freeway on U.S. 80 extending from U.S. 101 in San Diego to the easterly limits of the city of El Cajon. This stretch of freeway ends at westerly terminus of U.S. Interstate Route 8 and in fact, is only the beginning of a major construction program in District XI that ultimately will see this route improved to freeway standards as far as the Arizona border, 160 miles east.

The first work by the Division of Highways through El Cajon Valley was done in 1915. A strip of concrete pavement 30 feet wide by several blocks long was laid through the busiest section of the little town. Some years later in the '20's an 18-foot-wide strip was continued easterly across the valley and westerly to La Mesa. Along this route the city's business developed.

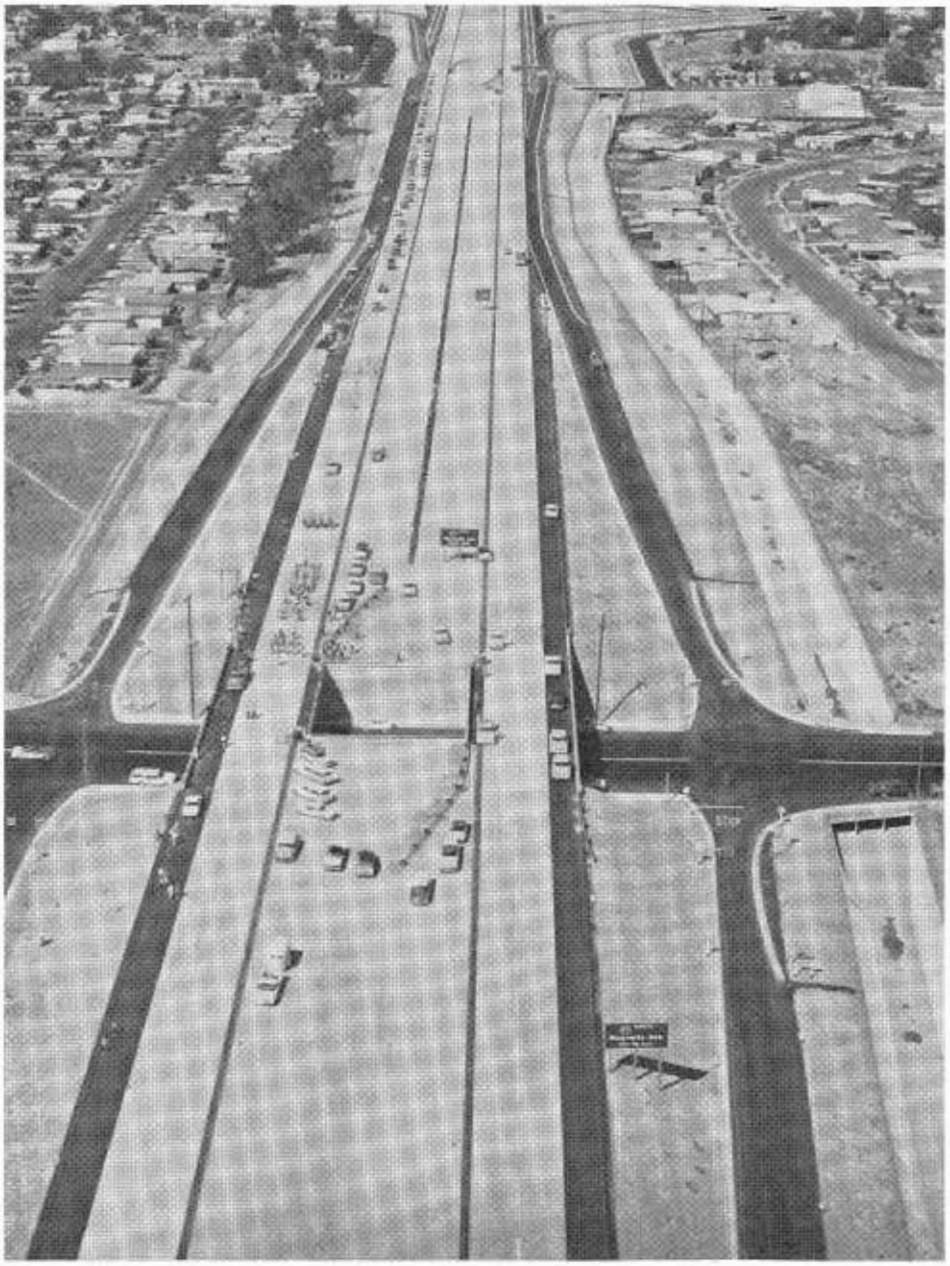
Last Improved 1935

It was not until 1935 that traffic had increased enough to justify further improvements of the route and in that year, within the then city limits, U.S. 80 was widened to a total of 76 feet, providing diagonal parking on both sides.

During the late '40's and the fabulous '50's, El Cajon city sprang from a sleepy little town of 3,000 people to a bustling traffic-congested city of 35,000. Main Street and Magnolia Avenue, the junction of U.S. 80 and State Route 67, became a major traffic bottleneck. Local San Diego commuters, tourists from the east, and heavy truck traffic from the rich farms of Imperial County were funneling through this intersection compounding the city's traffic problems. The opening to traffic in May of this year of the first of the two El Cajon contracts already has relieved considerably the city's congested traffic.

Beautiful Panoramic View

El Cajon, named by the early Spanish settlers, signifies "the box" and is



An aerial view of a portion of the U.S. 80 freeway in El Cajon, taken during the ribbon-cutting ceremonies on September 6. View is west, toward San Diego, with four-quadrant interchange at Magnolia Avenue (State Sign Route 67) in distance. Cars and marching units for ceremony are shown near Mollison Avenue interchange. Drainage channel at right was constructed as part of freeway contract through cooperative agreement with city of El Cajon.

descriptive because the valley is boxed in by mountains and hills. The section of freeway completed in May, from Chase Avenue to Ballantyne Lane, enters the valley along the slopes of the westerly hills and for a distance of approximately two miles provides the motorist with a beautiful panoramic view of the entire valley. At night when the city is ablaze with colorful neon lights the view is tremendous.

The new alignment of U.S. 80 bypasses the city's business district to the north about five blocks, and through the heart of the city parallels old U.S. 80.

Contract Began 1959

Work began on the first freeway contract in El Cajon in December 1959 and was completed in May 1961 at a cost of $2,770,000. The second contract got under way in May of 1960, and was completed in September 1961, at a cost of approximately $3,000,000.

Both contracts consisted of grading, placing selected bases, surfacing with concrete pavement, and constructing drainage facilities and reinforced concrete bridges. Both were designed and constructed for ultimate 8-lane developments. However, on the first contract only six lanes were paved and on the second contract only four.

Over 2,000,000 Yards of Fill

Roadway embankment for the contracts was obtained from three sources. First, some 500,000 cubic yards of excess roadway excavation came from the so called "Grossmont Summit" job and were placed on portions of both the contracts before either of them was let. Second, 410,000 cubic yards of roadway excavation were developed from cuts within the limits of the work. And third, 1,250,000 cubic yards of Imported Borrow were taken from a privately owned borrow site located near the center of the first contract on a hill overlooking the valley.

In order to schedule the Imported Borrow of the two contracts in a work-wise manner, the Division of Highways made available to the contractor a haul road on private property, over which it was permissible for him to haul over-legal loads. Along the route, as many as nine city streets had to be crossed, which presented to the contractor a major traffic handling problem. The volume of his own traffic was high. As many as 26 rubber-tired earthmovers, some of 40 cubic yards capacity, were hauling an average of 12,000 cubic yards of imported borrow to the job in an eight-hour shift.

An aerial view looking northeasterly along realignment from Grossmont Summit where new freeway gradually drops to valley floor. Black road is old highway which goes through center of city.

A ground level view showing same section as in aerial above, at later stage in construction. Old road gives access to business section. This portion of freeway was opened in May of this year.

Traffic Safety Precautions

To protect the traveling public, at least one, and often two flagmen were stationed at each crossing. Flagmen were equipped with two hand-operated, battery-powered, flashing, eight-inch stop lights, for each direction of public traffic. The lights were mounted on 4' x 5' warning signs that were placed near the edge of the traveled way during hauling hours. At one major street crossing, State Route 67, a full sized traffic signal system was installed.

In addition to protecting the motorist, there was the problem of protect-

ing children that crossed the haul road to attend the Johnson Avenue, Naranca, and Bostonia grade schools. Meetings were held with the superintendent of schools, principals, and parents. As a result, the children were made aware of the dangers, special signs, barricades and barriers were placed to define crossing points, and flagmen, whose sole duty was to watch after the children, were stationed at each school crossing.

Water a Problem

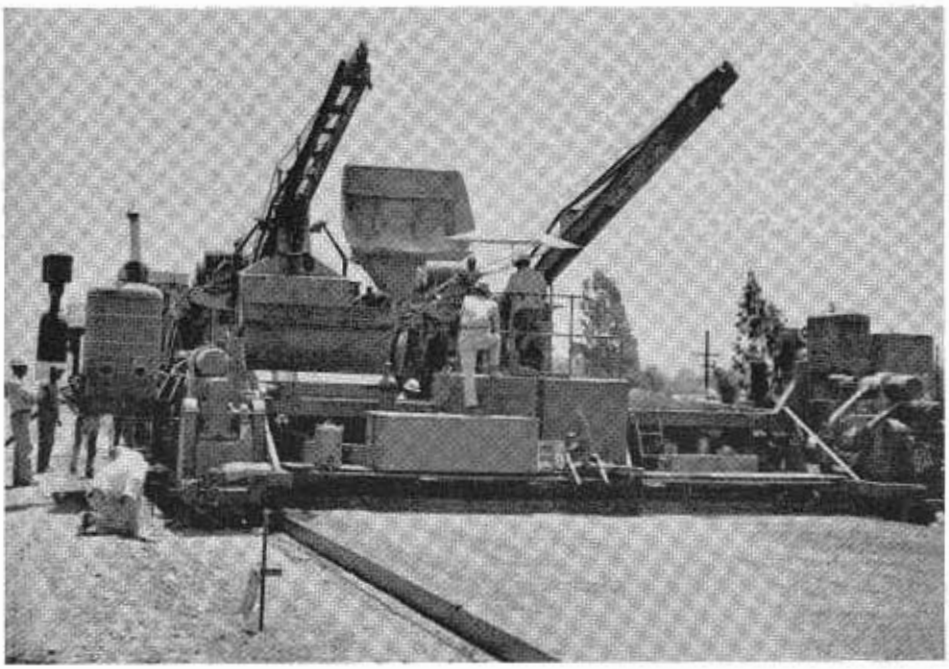
Obtaining an adequate water supply for compacting earthwork presented somewhat of a challenge to the contractor. Water mains, overtaxed by the city's mushroom growth, plus subnormal rainfall for many years, created a real water shortage. The problem was finally solved, however, by pumping reclaimed water from the El Cajon sewage plant located about three miles from the junction of the two contracts.

Construction of drainage facilities constituted a considerable portion of the contract, due largely to the fact, that across the floor of the valley the freeway coincides with the valley's natural drainage, Forester Creek. Thru a cooperative effort of the City of El Cajon and the Division of Highways, drainage facilities were included in the contracts to accommodate not only the freeway needs, but also the city's master plan for future drainage. A concrete-lined channel, averaging ten feet deep by thirty feet wide and three miles long, was constructed adjacent to portions of the freeway. Thirteen large box culverts were constructed. Eight carry channel water under the cross streets. The other five take water under the freeway from the City's drainage system to the channel.

Ten Bridges

Ten twin box girder bridges were built on the two contracts. Four are diamond type interchanges that were located at West Main, Mollison, Second and East Main Streets. Five simply span cross streets and two railroads, with no ramp connections. The largest bridge is a full four leaf clover design with collector roads crossing State Sign Route 67, Magnolia Avenue.

Base materials were obtained from decomposed granite deposits located in the nearby hills to the northwest and were hauled to both contracts by Asbury Contractors Inc. of Los Angeles. An average of 14 bottom-dump trucks and trailers were used to deliver approximately 4500 tons per eight hour shift. The top four inches of the base was treated with cement.



A slip-form paver in use on recently completed section of freeway in El Cajon.

Slip-Form Paving

On the second contract the contractor used the new Guntert-Zimmerman machine to trim the CTB and to slip-form pave the concrete pavement. Since an excellent description of this machine was given by Mr. Leigh S. Spickelmire in the January-February 1960 issue of this magazine, no attempt is made here to describe it. Noted, however, are certain modifications that were made recently which have greatly improved the machine's ability to lay an acceptable slab.

On previous paving jobs this machine has not been able to consistently lay a pavement slab, smooth enough to meet our requirements, without a considerable amount of expensive grinding. The cause of roughness was attributed to at least two factors. First, the fresh concrete, as it went through the machine, tended to surge at the back of the screed and occasionally caused the screed and floating section of the machine to be lifted far above grade. And second, the fresh concrete was not being thoroughly compacted, which resulted in differential settlement of the concrete.

To correct these problems three steps were taken. First, the feed hopper was lowered about two feet, which decreased the concrete head and consequently the upward pressure of the concrete on the screed. Second, in order to increase consolidation of the concrete, a row of eleven equally spaced, longitudinal internal vibrators was installed at a point ten inches in front of the screed. And third, to further assist consolidation a metal plate, extending the full width of the screed, was placed in the feed hopper just in front of the external vibrator in such a position as to form an escape hatch for entrapped air that formerly was causing problems under the screed.

Changes Improve Profile

The results of these changes are very encouraging. Since they were made, approximately six miles of 24 ft. wide pavement have been laid with no

ABOVE—Looking southerly along U.S. 80 fill section in El Cajon residential area. Photo made in February, 1961. Overcrossing in middle distance is Second Street, with Grape Street pedestrian overhead just beyond. Primary purpose of this overhead is to serve school children.

RIGHT—Magnolia Avenue interchange here shown during construction period is designed for heavy traffic. Magnolia Avenue north of U.S. 80 is State Sign Route 67 which eventually will be rebuilt as full freeway to carry traffic northward to Ramona area.

daily average of the profile indexes exceeding the rate of 7.0 inches per mile. The average daily index for the entire job was 2.8 inches per mile. The lowest reading for one day's run was 0.7 inches per mile.

In order to meet the smoothness requirements a small amount of grinding will be necessary at fourteen locations. However, at ten of these spots the cause of roughness is not directly attributable to the slip-form paver.

One other interesting change that developed during the paving operation was the complete elimination of trailing slip-forms. When paving began 45 feet of trailing forms were attached to the machine. Edges were slumping badly. As an experiment 15 feet of these forms were removed. Immediate improvement was noticed. It was then decided to remove the remaining 30 feet to see what would happen. The results were phenomenal. Edge slump was completely eliminated. Where four men were needed to finish the edges now the work could be done easily by two. It then became apparent that with a slight modification of the machine's side forms, or the addition of special edging tools attached to each side form, hand work on the edges could be eliminated.

Trailing "V" Float Eliminated

One additional change, the elimination of the trailing "V" float, is noted. With the trailing forms gone nothing remained to hold this float in correct position. Consequently, it was decided to experiment further by removing the float. No appreciable change was noted in the amount of hand work required to obtain a comparable finish. Accordingly, the float was discontinued permanently.

With the removal of the "V" float, the finishing effort behind the paver, except for edging, was accomplished by two men pulling a 4″ by 40′ aluminum pipe. Minor surface deviations were removed with this pipe by placing it across the concrete at about a 45° skew and floating it back and forth longitudinally on the surface of the concrete.

Texturing of the surface was accomplished in the conventional way by pulling two burlap drags over the freshly finished concrete.

Griffith Company's superintendent on the Chase Avenue to Ballantyne Lane contract was Frank Moody. Victor Leftwich was Resident Engineer for the Division of Highways. On the contract between Magnolia Avenue and 0.7 mile east of Third Street the Griffith Company was represented by two superintendents, Lloyd Leonard and Frank Moody. J. Avril Jesperson was Resident Engineer for the Division of Highways.

Routes Adopted

Highway Commission Acts On Rural, Metropolitan Routings

Thirteen freeway routes in areas ranging from Humboldt to San Diego Counties and embracing both rural and metropolitan areas were adopted by the California Highway Commission in July and August.

The future freeway complex in the Sacramento metropolitan area was further delineated by the adoption of a route for 19.3 miles of State Highway Route 247 (Arcade Freeway) between U. S. Highway 99-50 near the Cosumnes River and Engle Road in the northeast area.

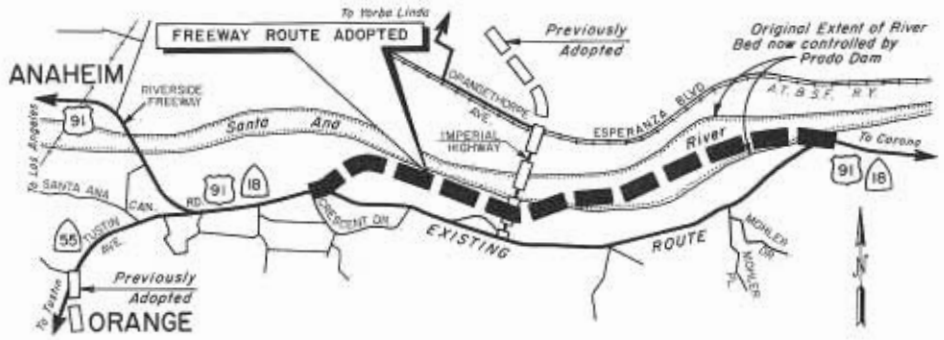
Orange County

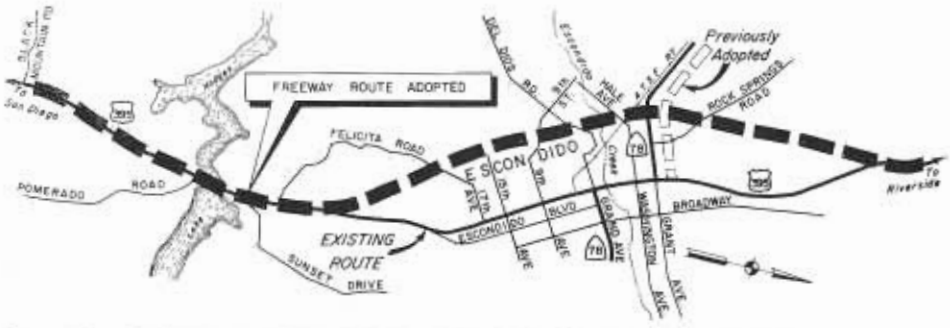
In Orange County, a route for the relocation of 3.7 miles of U. S. Highway 91 (Riverside Freeway-Santa Ana Canyon Road) was adopted, based on the recommendation of State Highway Engineer J. C. Womack and the results of a public hearing held by the Commission in Santa Ana on July 26. The route runs north of the existing highway eastward from Crescent Drive to a junction with the existing highway eastward from Cresent Drive to the existing highway 2.3 miles east of Imperial Highway.

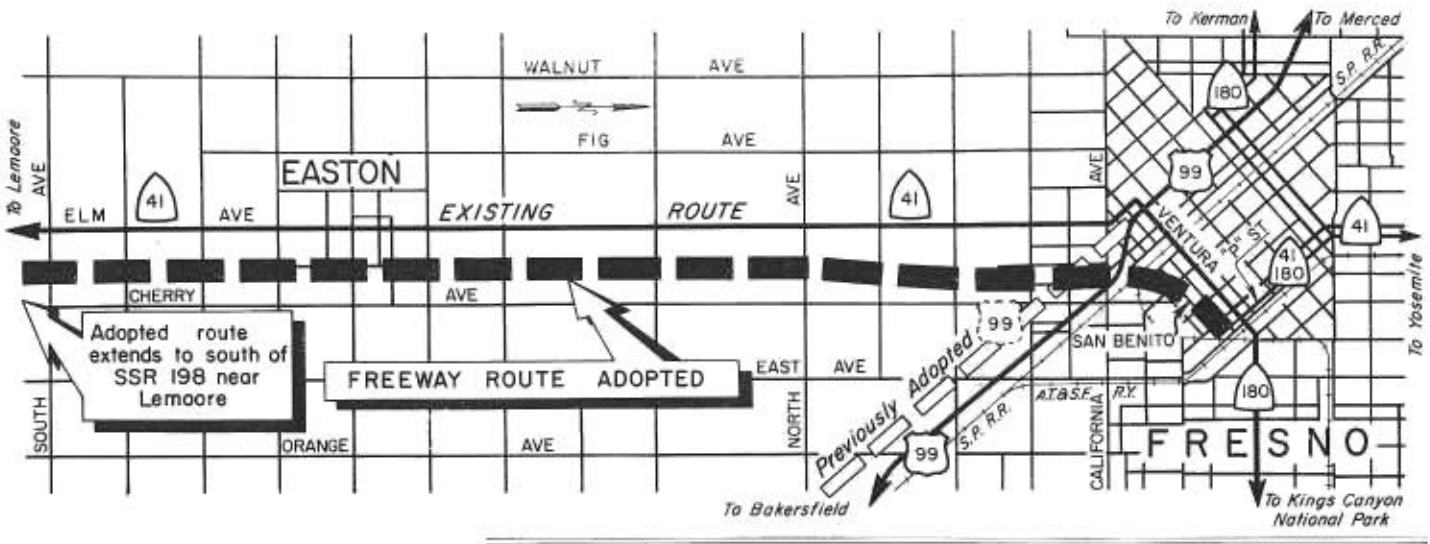
A route was adopted for the relocation of 10.6 miles of U.S. 395 in the vicinity of Escondido extending from 2.2 miles south of Lake Hodges to 3.3 miles north of Grant Avenue in Escondido. The adopted route follows the existing highway to about a mile north of Lake Hodges, then swings about four-fifths of a mile west to bypass the main section of Escondido.

South of Fresno

In and south of Fresno the Commission adopted a route providing for a future 34 miles of freeway on State Sign Route 41 in Kings and Fresno Counties. It extends between Jersey Avenue south of Lemoore in Kings County and P Street in the City of Fresno. The adopted route follows the existing road in Kings County with the exception of a relocation between Jersey and Jackson Avenues to elimi-







nate two right-angle turns. In Fresno County the route is on new location generally about a quarter of a mile east of the present highway. It enters the City of Fresno between Kirk and Rose avenues, swings northeasterly and occupies the block between San Benito and Santa Clara Streets.

Other adoptions:

State Highway Route 56 in Humboldt County between Van Ness Avenue in Ferndale and the west end of the Eel River Bridge at Fernbridge.

U.S. Highway 66 in San Bernardino County between Barstow and Newberry.

Sign Route 4 in Calaveras County in the vicinity of Arnold and between west of Dorrington and Camp Connell.

Sign Route 36 in Plumas County between 1.5 miles east of Chester and the Plumas-Lassen County line.

U.S. 99 in Shasta County, minor changes in the previously adopted route just south of O'Brien and between Black Oak Summit and Antler Summit.

Sign Route 154 in Santa Barbara County between Surf and the west city limit of Lompoc.

Sign Route 198, along the existing highway east of Visalia.

U.S. 6 in Los Angeles County between U.S. 99 and 0.8 mile west of Sand Canyon Road.

U.S. 395 in Mono County between Bridgeport Ranger Station and Devil's Gate.

BRITISH RESEARCH HEAD VISITS LAB

During his visit to the United States for various technical meetings, Sir William Henry Glanville, Director of Road Research for Great Britain, made a special trip to Sacramento on September 8 to inspect the Materials and Research Laboratory of the Division of Highways. He is shown above, at right, examining the Division's marking profilograph. Others in the photo, left to right, are George B. Sherman of the Materials and Research Department; Materials and Research Engineer Francis N. Hveem; and J. O. Grasberger of District IV. Sir William was accompanied to Sacramento by John F. A. Baker, Chief Highway Engineer for the British Ministry of Transport and Civil Aviation. Mr. Baker spent the day conferring with planning officials of the Division of Highways.

The California Highway Commission approved ten projects on Federal Aid Secondary County Roads with a total estimated cost of $2,482,000 at its September meeting.

The California Highway Commission has allocated $2,313,150 in state highway funds toward the cost of railroad grade separation projects on local city streets and roads.

CONSTRUCTION PROBLEMS TACKLED AT 2-DAY MEET

The volume and assortment of documents on the conference table give some idea of the size of the agenda for a two-day meeting of district engineers and assistant district engineers held in Sacramento in July. Contract and inspection procedures, specifications and other problems were intensively discussed. Those participating (Assistant District Engineer for Operations unless otherwise identified) were:

Seated around table, reading clockwise: G. L. Richardson, District XI; W. Z. Hegy, District I; C. C. Winter, Construction Engineer (North), Bridge Department; E. L. Miller, District III; Haig Ayanian, Assistant District Engineer—Construction, District IV; W. M. Nett, District II; Milton Harris, Construction Engineer, Division of Highways, Sacramento; L. R. Gillis, Assistant State Highway Engineer—Operations, Sacramento; C. A. Shervington, District Engineer, District IX; George Wofford, District V; F. M. Roush, District VI; L. A. Weymouth, District Engineer—Operations, District IV; A. L. Himelhoch, District Engineer—Operations, District VII; F. B. Cressy, Assistant District Engineer—Construction, District VII; E. G. Bower, District VIII.

Standing, rear, E. L. Tinney, District X (left) and State Highway Engineer J. C. Womack. Seated, rear, M. H. Mitchell, Assistant Construction Engineer, Sacramento (left), and Deputy State Highway Engineer J. P. Murphy.

John M. Paley

John M. Paley, 63, Chief Clerk for the Division of Highways in Shop 6 at Fresno died suddenly of a heart attack on July 9th.

Paley started with the State in 1934 as a Senior Account Clerk in District VI in Fresno and was promoted in 1938 to Supervising Account Clerk I, and in 1944 to Supervising Account Clerk II while serving as Chief Clerk of Shop 6.

Paley was born in Bristol, Rhode Island. His family soon moved to Tacoma, Washington. He later graduated with a B.A. degree in Business Administration from the University of California in Berkeley.

Paley served for four years in the U. S. Navy during World War I. He was a member of Sun Garden Masonic Lodge No. 530, Royal Arch Masons, the Quarter Century Club and the First Presbyterian Church.

His survivors include a son John E. Paley, a daughter Mrs. Ruth Ann Darter and one grandchild, all of Fresno. His wife recently died after a long illness.

Department Announces Recent Retirements

Headquarters Office

Lessley D. Wanee, Supervising Highway Engineer, 32 years.

District I

William G. Grauman, Groundsman, 12 years; Elvin Houx, Laborer, 27 years.

District II

Bertha Garrison, Intermediate Stenographer, 13 years; Manuel V. Salvador, Light Power Shovel Operator, 37 years.

District VII

Edward F. King, Senior Right of Way Agent, 23 years; Wm. D. Sedgwick, Supervising Highway Engineer, 32 years; Harold S. Throckmorton, Associate Right of Way Agent, 32 years; Ralph Truesdale, Senior Highway Foreman, 27 years.

District IX

Clarence H. Haus, Laborer, 21 years.

District X

Fred Narcisso, Highway Equipment Operator Laborer, 36 years.

Chamber Submits Highway Recommendations

The Statewide Highway Committee of the California State Chamber of Commerce appeared before the California Highway Commission in San Francisco on August 24 to submit for the thirtieth time its annual list of state highway project recommendations for consideration in budgeting and future planning.

The list, compiled after a series of local meetings all over the state, encompassed 783 projects, grouped into three categories. Those in the "A" category included projects on which engineering had been completed to the extent necessary to qualify them for right of way or construction funds. The "B" category included projects recommended for surveys, design or initial right of way acquisition, and the "C" category covered projects recommended for long-term planning.

In introducing the six regional chairmen and vice-chairmen who presented the recommendations for their respective areas of the state, Vice-Chairman Joseph A. Moore of the statewide committee called particular attention to the unique character of the State Chamber's program in the highway field.

"It is the only program we know of in the United States," he said, "where any organization in any state, private or otherwise, goes into counties or areas throughout the state and holds meetings to determine the viewpoints of the people of business, agriculture and industry on what they desire to see done to improve their highway transportation program."

An exhibit displayed to the Highway Commission showed that in 1961 the list of project recommendations was distilled out of a total of 50 local meetings, attended by a total of more than 3,000 persons.

The meetings, planned by the Chamber's district managers, required coordination with some 500 official and civic bodies. They were attended by not only the local and regional organizations, but also by Assistant Director of Public Works T. F. Bagshaw, by the local District Engineer of the Division of Highways and by a representative of the Sacramento headquarters of the Division. C. Clarke Williams, manager of the Highway and Transportation Department of the State Chamber, also attended all the meetings.

Moore also pointed out that the State Chamber's program, in addition to providing a "common meeting ground" at which community leaders can "get together on a unified and solid State highway program," also serves to keep the local groups informed and aware of the highway problems and needs of the entire State.

Members of the Commission and State Highway Engineer J. C. Womack commended the State Chamber group on the thoroughness of the program and the work which went into it.

IN MEMORIAM

Headquarters Office

James R. Smith, Senior Right of Way Agent

District III

Richard W. Thornburg, Highway Engineering Technician I

District IV

Ernest P. Prielipp, Highway Leadingman

District VI

Cecil R. Smith, Highway Foreman

District VII

Abram N. George, Jr., Senior Highway Engineer

Bridge Department

Edgar G. Tuck, Assistant Bridge Engineer

Frederick M. Wilhite, Bridge Painting Inspector I

Shop 6

John M. Paley, Supervising Account Clerk II

Shop 8

Miles H. Lawrence, Automobile Mechanic

State Takes Over Former County Roads

The California Highway Commission has accepted six former county roads for maintenance as part of the State Highway System.

According to law, the State assumes responsibility for maintaining such roads when acceptable design and construction standards have been met.

The new state-maintained routes are:

Shasta and Lassen Counties—Feather Lake Highway (State Highway Route 20) between Sign Route 89 at Old Station, Shasta County, and Sign Route 36 west of Susanville. This 46.1-mile route is included in California Freeway-Expressway System.

Plumas and Lassen Counties—Lake Almanor East Side and Clear Creek Roads (State Highway Route 183) between Sign Route 89 at Canyon Dam, Plumas County, and Sign Route 36 west of Westwood. This former county highway is nine miles long, and generally follows the east shore of Lake Almanor. It was added to the state highway system by the 1961 Legislature.

Kings County—Central Valley Highway and 10th Avenue (State Highway Route 135) between Sign Route 198 east of Hanford and the Fresno County line, a distance of nine miles. This route was added to the state highway system by the 1961 Legislature.

San Bernardino County—Two sections of Twentynine Palms Highway —10.5 miles (State Highway Route 187) between East Road in Morongo Valley and Old Woman Springs Road near Yucca Valley, part of the California Freeway-Expressway System; and 21.7 miles (State Highway Route 218) between Old Woman Springs Road near Yucca Valley and Utah Trail Road in Twentynine Palms, added to the state highway system by the 1961 Legislature.

Riverside County – Cahuilla Road (State Highway Route 277) between Sign Route 79 near Aguanga and Sign Route 74 east of Anza, 21 miles, included in California Freeway-Expressway System.

HIGHWAYS STATE FAIR EXHIBIT IS AWARD WINNER

The Division of Highways exhibit at the 1961 California State Fair in Sacramento was devoted to various aspects of highway planting. It occupied a 30-foot-wide space in the educational area, opposite the Hall of Flowers, and featured nursery specimens of plants frequently used on highway planting projects. Streamers led from the plants to large photographs showing how each plant fitted into an actual planting situation.

Also included in the exhibit was an eight-foot Bridge Department model of a typical landscaped section of elevated urban freeway. In the above picture, Dick Roberts of the Headquarters Roadside Development Section, is shown pointing out features of the model to a young fairgoer. Roberts and other members of the Roadside Development Section and the Maintenance Department took turns manning the exhibit and answering questions.

The display was designed by J. J. Ralph of the Audio-Visual Section and constructed by William Van Sherman and Angelo Venturini of the Service and Supply Department. Judges awarded the booth a plaque for "structural beauty and outstanding educational exhibit."

Copies of the reprint booklet "California Roadsides," containing the four articles on this subject which appeared in this magazine earlier this year, were distributed at the exhibit to interested persons.

Legislation Includes New Highway Fund Formula

Several significant measures affecting State highway expenditures, route adoption procedure and toll bridges were passed by the State Legislature during its 1961 session and signed into law by Governor Edmund G. Brown.

Allocation of Funds—The "Mayo formula" governing minimum State highway construction expenditures within the respective counties will expire on June 30, 1953. It was originally enacted in 1947 as part of the Collier-Burns Highway Act. Senate Bill 1412 (Chapter 1376) of the 1961 session provided a more flexible formula, based on the eleven State highway districts rather than individual counties; however, the expenditures in each county must amount to at least $4,000,000 in each four-year period (except in Alpine and Sierra Counties, where this minimum is $1,000,000). The "north-south split", requiring that 55 percent of the construction monies be spent in the southern group of 13 counties and 45 percent in the 45-county northern group, was not changed.

Right of Way—The revolving fund for advance acquisition of rights of way, established by the Legislature in 1952 and scheduled to terminate in 1962, has been extended by Senate Bill 557 (Chapter 1637) for another ten years. This fund enables the Division of Highways, upon approval of the Highway Commission, to purchase property far in advance of future freeway construction if improvement of the property, making it more costly, is imminent.

Route Adoption Procedure—The Highway Commission's long-established policy of advance public discussion and information and cooperation with local officials in connection with freeway route location matters is expressed and recognized as a part of the Streets and Highways Code (Article 6, Section 210). This is covered in Senate Bill 1335 (Chapter 1371), which also provides for inclusion of the Commission's procedural resolution of February, 1958, (and any future revisions of it) in the California Administrative Register.

Coronado-San Diego Crossing—Included in the Budget Act of 1961 is an appropriation of $525,000 of State Highway Fund monies for traffic, revenue and design studies for a toll crossing between Coronado and San Diego.

San Francisco-Marin Crossing—The Department of Public Works is required by Senate Bill 1273 (Chapter 2142) to study a proposed crossing between San Francisco and Marin County by way of either Angel or Alcatraz Island. The measure makes $500,000 available from the State Highway Fund for the study.

San Mateo-Hayward Bridge—Previous legislation permitting the use of San Francisco-Oakland Bay Bridge revenues to finance the four-laning of the San Mateo-Hayward Bridge is extended for another 18 months to June 30, 1964 by Senate Bill 1016 (Chapter 2076), to make possible the construction of a high-level fixed span over navigable waters rather than a low-level movable span if such a change is found permissible and feasible.

Safety Study—Senate Bill 1217 (Chapter 2110) appropriate $100,000 from the Motor Vehicle Fund for research on highway safety, to be conducted jointly by the Division of Highways, the Highway Patrol and the Department of Motor Vehicles.

Open House

Public Inspects New Highways Building in San Bernardino

The District VIII Office held Open House in San Bernardino on August 8 to acquaint the public with its newly expanded facilities.

The extensive areas involved precluded conducting guided tours; hence, the affair was planned on the basis of making it convenient for guests to readily locate any department or office desired. This was effected by means of temporary signs in the corridors, presentation to each guest as he registered of a brochure including labeled plans of the buildings, and the cooperation of hostesses handling information centers at various locations.

A view of the front entrance of the new Highways building in San Bernardino. Tiled-roof section to the left was constructed in 1952.

Guests register in the lobby prior to touring the new Highways building.

Department Displays

Each department planned and handled its own displays, which were generally designed to picture the department's contribution to the over-all efforts involved in planning, construction, and maintenance of State highways.

Motion pictures and film strips were run continuously on a scheduled basis, providing a general outline of the functions and problems of the Division of Highways.

Displays of surveying methods and equipment, landscaping plants, interchange models, utilities clearance of Right of Way and the Reproduction Section's equipment and methods seemed to evoke special interest among visitors.

More Than 800 Guests

Refreshments were served to both guests and employees in the new cafeteria through the courtesy of Chapter 7 of CSEA and the Highway Engineers' Club.

Approximately 800 guests visited the building during the 1-6 p.m. period. The enthusiasm evidenced by the employees in planing and executing their displays was reflected by obvious appreciation of the guests and a number of favorable newspaper reports.

Marsh Area Fill

Sand Drains Aid in Soil Stabilization

By L. E. DANIEL, Resident Engineer and W. G. WEBER, Associate Materials and Research Engineer

Numerous sand drain projects have been constructed throughout the world since the vertical sand drain method of treatment for soft foundation soils was patented by Daniel E. Moran in 1925. The complete mathematical analysis for theoretical solution of the consolidation of soils by sand drains was published in 1947 by Reginald A. Barron. There are still uncertainties in calculating the rate of consolidation and the resulting increase in strength of the foundation soil when using sand drains; that has resulted in some unsuccessful sand drain projects. It was desired to obtain additional information on the operation of sand drains to decrease some of the uncertainties in the use of sand drains by building a full-scale fill as a test section.

How Sand Drains Operate

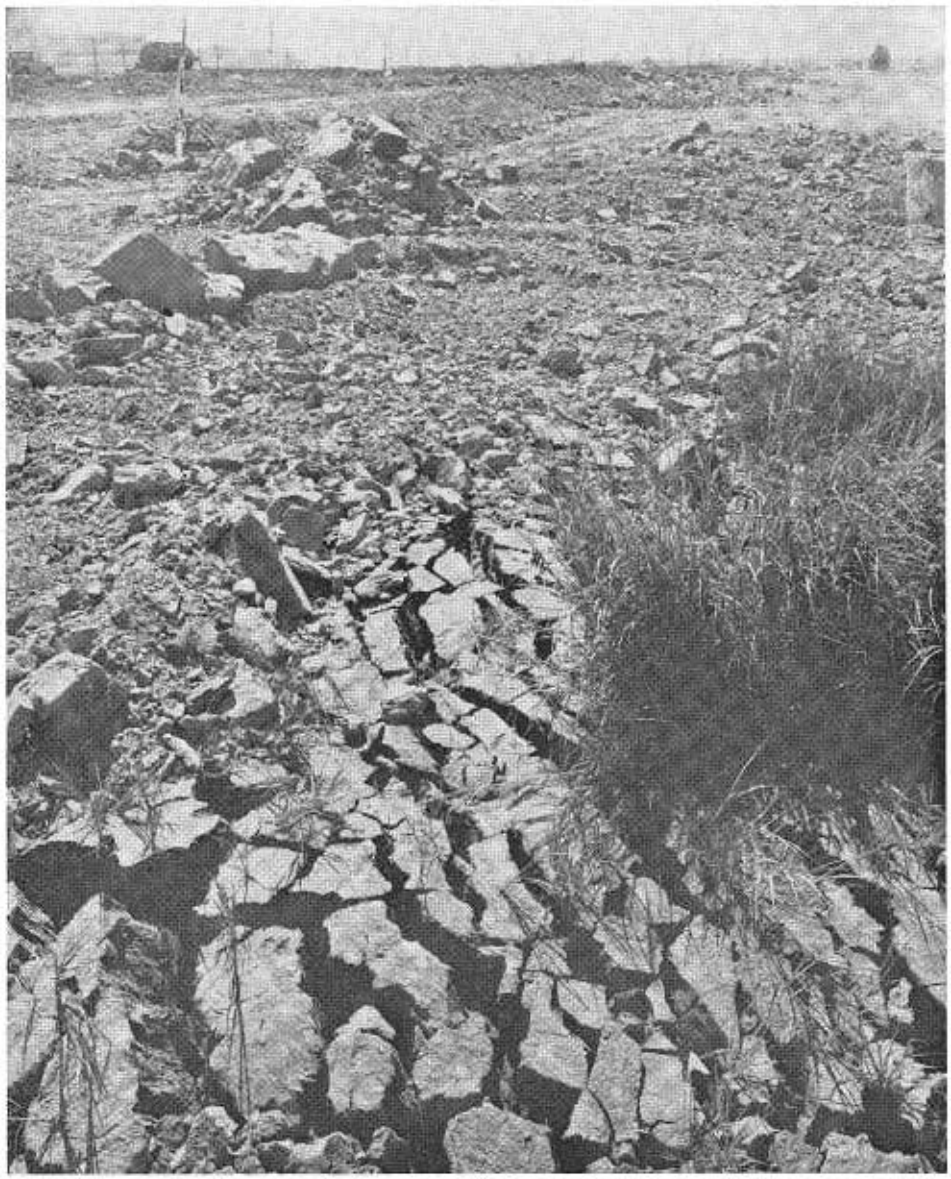
Saturated soft soils and peats are usually so weak that even small fills or other loads sink considerably while the soft soils are being pressed somewhat like a sponge. As with a sponge that is saturated with water, pressing or squeezing forces the water out. The soil has pores so fine that they can scarcely be seen under a powerful microscope. These small pores offer so much resistance to the flow of water that it may take 50 or 100 years depending upon the length of drainage path, to squeeze the small amount of water out of the soil by the applied load. The rate at which water is pressed out of the soil varies with the square of the drainage path. As the water content of the soil decreases the shearing strength of the soil is increased.

Sand drains are vertical columns of sand placed at regular spacing through the soft compressible layer. A pervious blanket is placed over the sand drains so that the water is removed from the fill area. Sand drains shorten the drainage path, thus greatly increasing the rate at which consolidation occurs.

Sand drains thus perform two related functions: (1) increase the rate of consolidation of the foundation soil, thus decreasing the settlement after construction of the fill, (2) increase the height of fill that can be built by increasing the strength of the foundation soil.

Design of Sand Drain

The foundation soil in the area of the west approach to the Napa River Bridge on State Sign Route 48 in Solano County consisted of "soft bay mud" to a depth of 60 or 70 feet, with a firm silty clay underlying the soft bay mud. The natural water contents



A general view of the project looking west. The mud "wave" in the foreground was caused by the placing of the strut.

This photo shows the temporary detour being constructed to the right of the existing highway. The main portion of the fill can be seen to the left.

average above 90 percent and the in-place strength varied from about 100 pounds per square foot at a depth of 10 feet to 400 to 500 pounds per square foot at a depth of 40 feet. Without any special treatment this soil will support fills of about 6 feet in height. With the use of struts it is possible to build somewhat higher fills.

The height of fill required to produce the planned profile grade at the west approach to the Napa River Bridge varied from less than five feet to over 50 feet above the mud flats. With normal construction the fill would end and the structure begin where the profile grade was about five feet above the mud flats. The cost of sand drain treatment and fill construction was estimated at about $120,000 per station less than a structure. The uses of special treatment of the foundation soil thus results in definite savings.

The new alignment was adjacent to the existing roadway, thus avoiding interference with existing traffic. The west approach fill could be constructed prior to the structure under a separate contract, allowing sufficient time to construct and observe the fill.

Frequently Used

Sand drains had been frequently used to stabilize the soft bay mud similar to the soft soils at the west approach to the Napa River Bridge, with questionable benefits being obtained. Only a slight increase in strength of the soft bay mud was observed at the previous locations during construction. Areas with sand drains consolidated at a slightly more rapid rate than areas without sand drains during construction. A large amount of new construction is planned on similar types of soft soil where special foundation treatment would be advantageous.

The soft bay mud was very impervious, having a permeability of 10^{-5} feet per hour. Theoretical calculations indicated that sand drains on an eight-foot spacing would consolidate the soil at a rate that would increase the strength sufficiently to allow a rate of loading of one and one-half feet of fill per week. In previous sand drain construction on similar soils a spacing of ten feet had been used with a rate of loading of three feet of fill per week. With fills above 15 feet in height

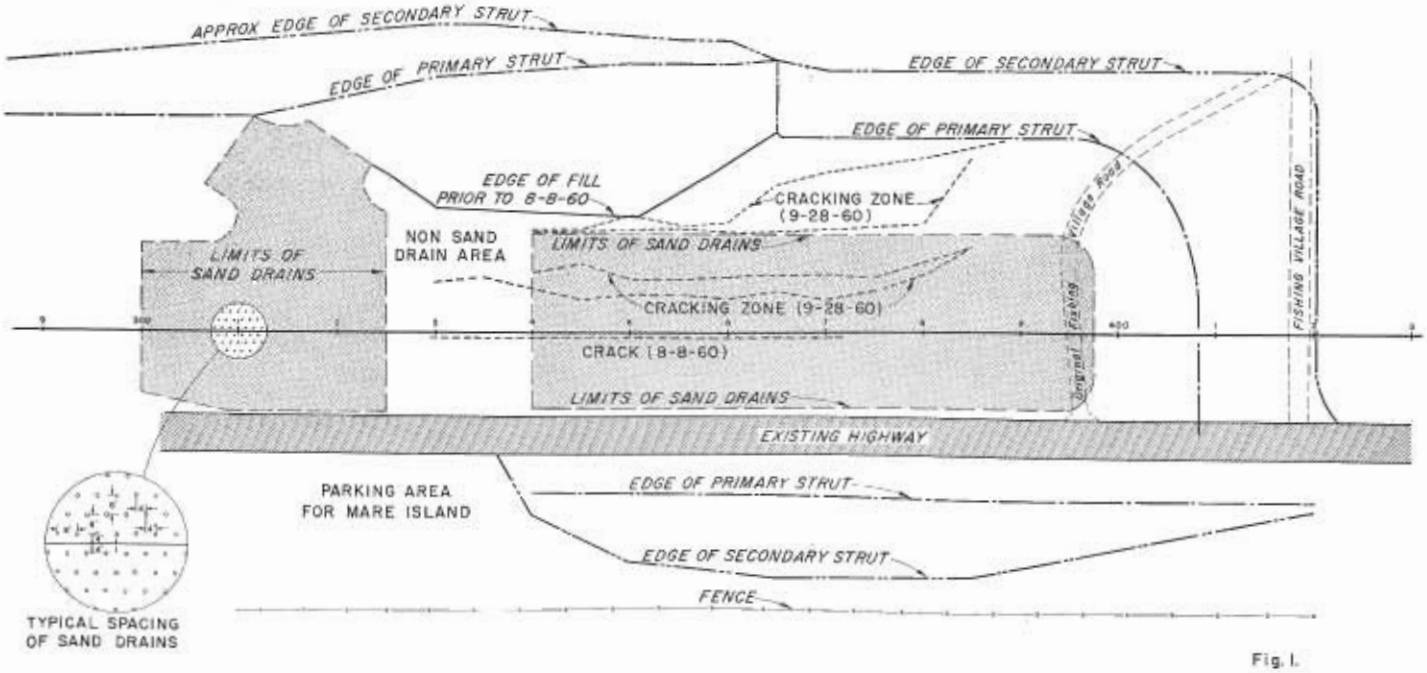


Fig. I.

This map of the area shows the location of the sand drain areas in relation to the existing highway.

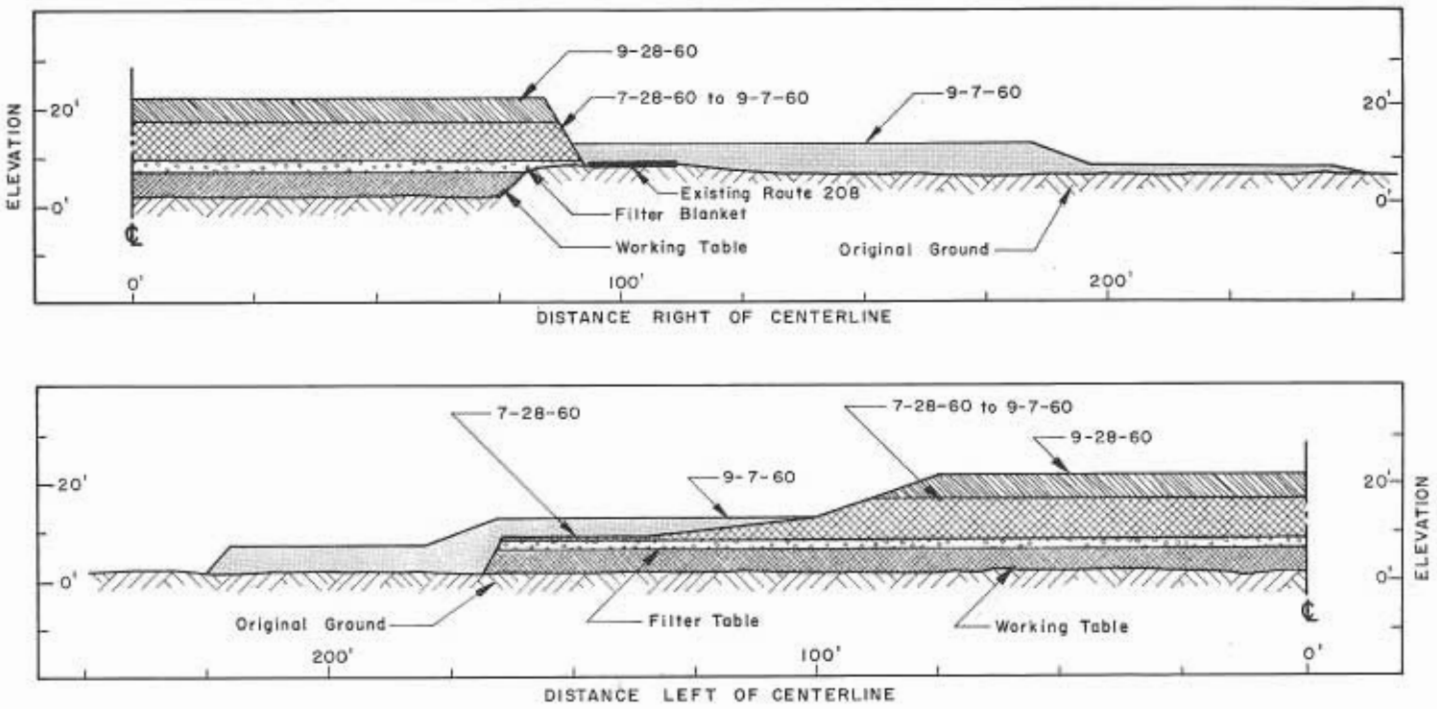


Fig 2.

berms 100 feet wide and eight feet high were planned on the left side of the fill and the existing roadway acted as a berm on the right side. Sand drains were installed under the main fill only.

Test Section

It was desired to conduct a test section to attempt to determine why sand drains have frequently not strengthened the foundation soil as anticipated. A comparison of areas with and without sand drains was desired to determine the amount that sand drains accelerate the consolidation of the foundation soil.

The following prerequisites were considered necessary for this experimental fill:

1. The test section should be part of a future construction.
2. Sufficient time should be available to construct the test fill and to have time to observe its behavior prior to completion of the project.
3. The height of required fill should vary from low enough to be stable without foundation treatment to high enough that it was questionable whether a stable fill could be constructed with sand drains.
4. The soil conditions should be sufficiently uniform so as not to present a variable.
5. The project should be in an area where construction would cause the minimum interference with traffic.
6. The site should be one where stabilization of the foundation soil would result in an economic savings.

The above conditions existed at the west approach to the Napa River on State Sign Route 48.

To accomplish the objectives of the test, the cross-section and profile were varied in increments as shown in Figures 1 and 2. Design details are shown on the drawings, and summarized in the accompanying table.

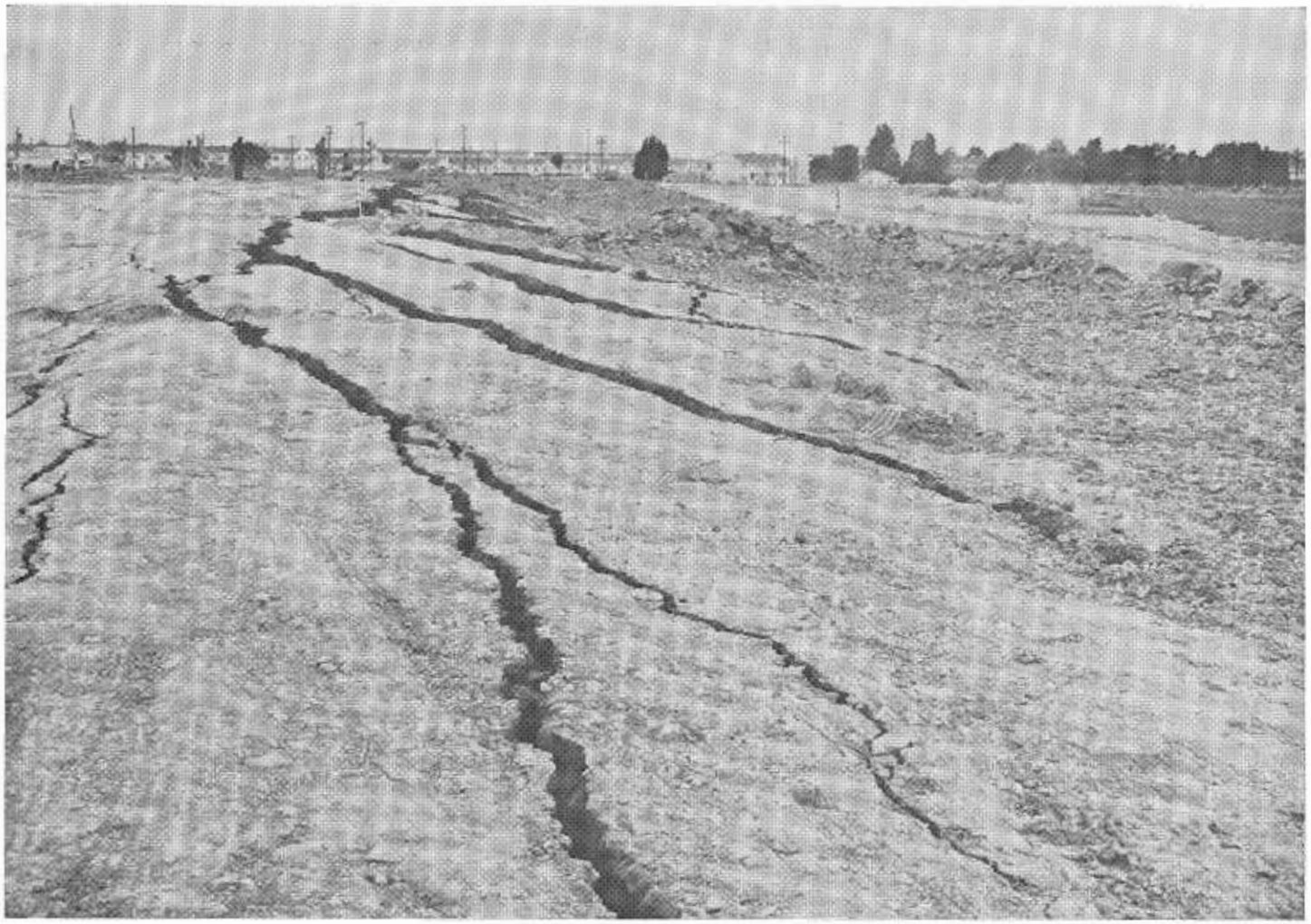
DESIGN DETAILS

Approximate station	*Elev. top of fill*	*Avg. Ht. of fill*	*Drainage features*	*Struts*
388+50–390+00	11.5	8'	None	no
390+00–391+25	11.5	10'	Sand drains under main fill and filter blanket	no
391+30–392+50	16.5	15'	Sand drains and filter blanket	no
392+50–394+00	16.5	15'	No drains; filter blanket	no
394+10–395+75	24.0	22.5'	Sand drains and filter blanket	yes
395+90–397+50	34.0	32.5'	Sand drains and filter blanket	yes
397+65–399+25	44.0	41.5'	Sand drains and filter blanket	yes

Construction

On February 11, 1960, the Attorney General approved the award of a contract to Fredrickson & Watson Construction Co. of Oakland for the construction of 1,200 feet of fill as a bridge approach on the west side of the Napa River.

This was an experimental project and was to be a step-type, surcharged design with struts 100 feet wide to be placed adjacent to the main portion of the fill on the left. The right edge was not to be strutted because of the existing traveled way of Route 208. After the desired height was reached, a waiting period would begin to allow the fill to stabilize itself.



This photo shows the failure of the left side of the main fill which occurred on September 27, 1960.

A material site for the imported borrow was available east of the river and after scales were set up, trucks were weighed prior to crossing the existing Napa River Bridge and loads kept to within the legal limit.

The main portion of the fill was to have been stepped up from 11 to 44 feet in elevation and was placed at a controlled rate of 1½ feet per week after sand drains had been driven and a two-foot blanket of filter material placed.

Due to the extremely swampy nature of the original ground, a working platform of import was constructed over the tules and swamp grass. With the exception of a few large timbers, no clearing was performed. Some care was taken not to place large rocks in the working platform because of the anticipated difficulty in driving of sand drains through this part of the fill.

The platform was kept as thin as possible to obtain deeper penetration of the drains and to keep from creating a "mud" wave at the front edge of the fill. However, if the working platform was too thin, equipment broke through and overturned. If it was too thick, the "wave" in front became higher and higher until it became impossible to cover with import. At such times, the fill would be "split" and the bulge of mud surrounded with import. By working from the outside toward the center of the area, it was possible to construct the platform without increasing the size of the "wave." However, the platform had to be reinforced at several spots during pile driving operations despite the fact mats of 12″ x 12″ timbers were used.

Compressed Air Applied

Raymond Concrete Pile Company subcontracted the placing of the sand drains. Approximately 2,500 drains (154,500 l.f.) varying in depth from 42 to 72 feet were driven, using an 18-inch I.D. hollow mandrel with a hinged bottom. After the mandrel had been driven and the sand placed inside, compressed air was applied at the top, forcing the sand out of the bottom as the steel shell was withdrawn. It was found that if the sand was too wet, it would compact within the mandrel and not flow out until the bottom of the tube was above the platform. In such cases, the pile was redriven.

Some drains brought swamp gas to the surface which caught fire occasionally. This gas burned with such a colorless, odorless flame that it would go unnoticed until the timber mats began to smoke and blaze. A steam hose would then be used to put out the fire.

After the drains were completed, a two-foot blanket of filter material was

placed at the prescribed locations. To aid drainage of water from the filter blanket an 8-inch PMP was placed along centerline. Construction of the main portion of the fill was then started. Despite the controlled elevation, edge failures occurred from time to time and the outside strut was widened and increased in height. After placing sixteen feet of fill and an elevation of 17 feet was reached, cracks began to appear on the right side in the existing traveled way.

Traffic Is Detoured

Placing of fill was immediately suspended and a strut built on the right. Traffic was temporarily detoured to the right until additional fill could be placed on top of the existing pavement. After this fill was brought to an elevation of 14 feet, traffic was rerouted to the original pattern and the far right strut reinforced.

On September 27th, at an elevation of 22 feet, the left edge of the fill began to fail. Numerous cracks from two to seven feet in width and as much as sixteen feet in depth appeared. The strut on the left was widened and the height increased. A waiting period was begun.

On December 7th, it was decided to curtail all further operations until a later date. The top of the fill was dressed up and the cracks filled.

At the time, 329,300 tons of imported borrow and 54,000 tons of filter material were in place.

The contract was closed on January 15, 1961.

The present elevation of the fill in the vicinity of Station 396+00 is about 17. Fill will be placed in the near future to bring the fill surface to elevation 23 between Station 395+90 and 396+80. The fill will be placed at a rate of one foot per week. The structure will then begin at Station 396+00.

Considerable instrumentation was incorporated in the test section during construction to furnish observational data that would give a record of the behavior of the foundation soil during and after filling operations. The following instruments and devices were installed in the test section.

1. Settlement platforms
2. Heave stakes
3. Slope indicators
4. Piezometers.

Results of Studies

It had been anticipated that the 41-foot fill would be of marginal stability and the 32-foot fill completely stable. The failures of the fill at a height of 22 feet was rather startling. This failure was due to the drainage of water from the foundation soil occurring at a slower rate than had been anticipated.

Minor cracking appeared along centerline on August 8, 1960, that indicated a movement was occurring to the right of centerline. The existing roadway failed to give the support anticipated despite the fact that the foundation soil had consolidated and increased in strength under the existing roadway. Increasing the height and width of the roadway fill stabilized the right side.

The final failure on September 27, 1960, was principally movement to the left. This failure consisted of movement to a depth of about 20 feet below original ground. This was a very shallow type of movement. In the design it was felt that the 100-foot wide berm would force the failure to a greater depth where the strength of the soil was greater. This shallow failure indicated that very wide berms would have been required to support the fill. An alternative to such a wide berm would be the stabilization of the foundation soil under the berm by means of sand drains.

Faster Rate

Figure No. 3 shows the centerline settlement profile. The settlement in the sand drain areas occurred at a faster rate than in the non-sand drain areas. The piezometric pressures indi-

PROFILE ALONG ℄ OF ROAD X-SOL-208-A, WEST APPROACH TO NAPA RIVER
SHOWING
SETTLEMENT OF GROUND IN SAND DRAIN AREAS & NON SAND DRAIN AREAS AS FILL WAS PLACED

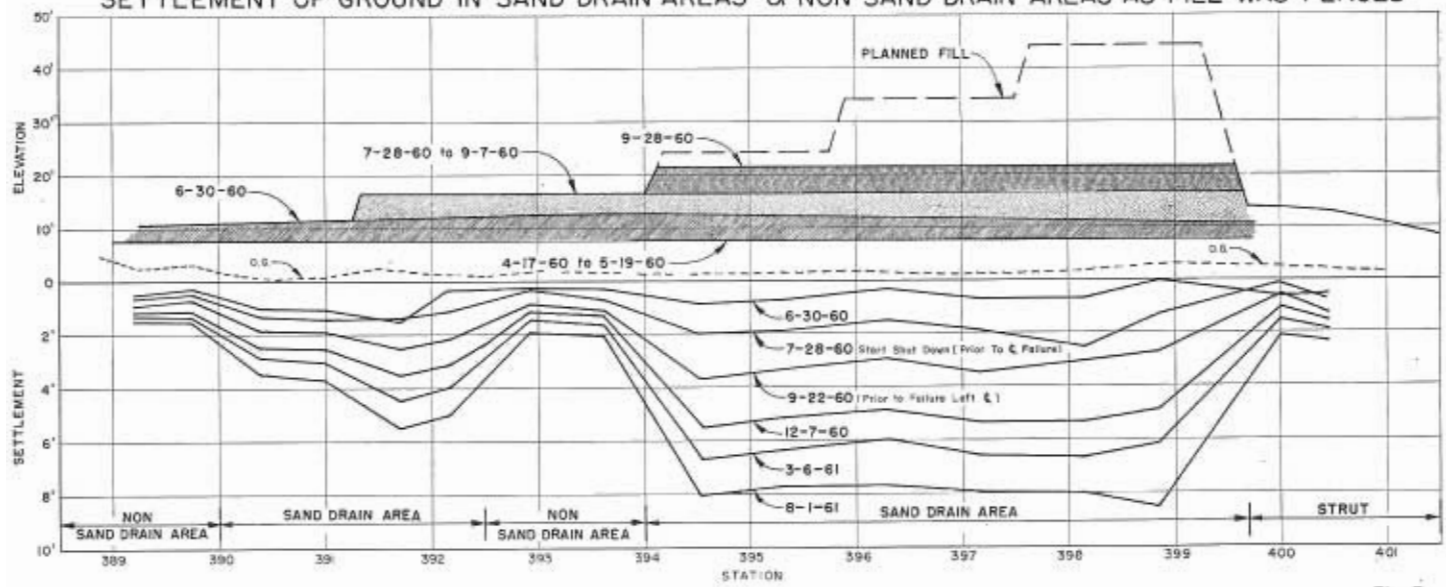


Fig. 3.

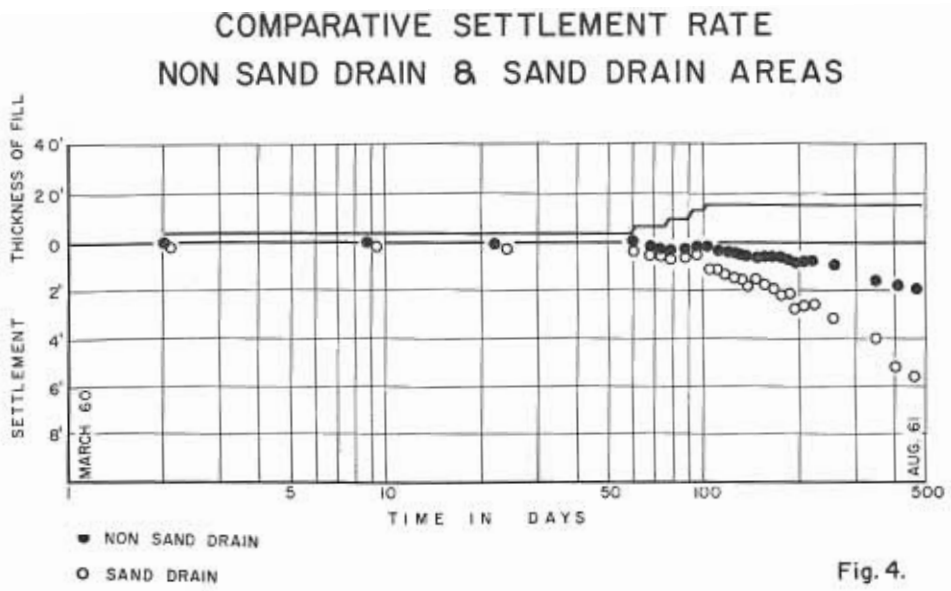


Fig. 4.

cated a very small consolidation occurred in the non-sand drain areas; the consolidation in the sand drain areas was about four times greater. This all indicates that sand drains did increase the rate of consolidation (See Figure No. 4). However, the rate of consolidation of the soft bay mud in the sand drain areas was about one-third the rate that was indicated by the theoretical studies. This slower rate of consolidation may have been due to such items as well resistance, periferial smear, remolding, etc. No attempts were made to study these items in this test section.

The data indicate that on future sand drain design studies on projects to be constructed on soft bay mud, with construction methods the same as at the test section, the rate of consolidation used will have to be considerably smaller than the estimated theoretical rate of consolidation. This should increase the dependability of design calculation for future sand drain projects.

The effect of the berm was somewhat different than had been estimated. It was expected that the existing roadway on the right would provide adequate strength to support the planned fills; however, it failed to do this. After the width and height of the roadway fill was doubled stability on the right was achieved. On the left side a width of berm of 100 feet was planned. This berm was widened to about 160 feet, including a secondary berm used to support the height of fill in the primary berm. The need of such wide berms had not been previously expected.

The end of the bridge would be at Section 391+50 without special foundation soil treatment. With the utilization of the fill constructed under this contract the structure will begin at Station 396+00, shortening the structure about 450 feet. The resulting savings will be in excess of $600,000 by using the fill instead of a structure.

Conclusions

This experimental sand drain project produced several items of information of benefit to the design and construction of future sand drain projects.

1. The consolidation of the foundation soil in sand drain areas will occur at a slower rate than estimated from theoretical studies.
2. Sufficient time must be available to construct fills on soft soils at a slow rate. It may be necessary to construct fills on soft soils under separate contracts and utilize stage construction.
3. Wider struts will be required than had generally been used in the past.
4. With the slow rate of consolidation of the foundation soil sand drains may be required under struts as well as under the main fill.

Marion Bradshaw Retirement Marked

Marion Bradshaw, hearing reporter for the State Department of Public Works, has retired after more than 20 years of state service.

Mrs. Bradshaw came to work for the Division of Contracts and Rights of Way, State Department of Public Works, in the capacity of senior legal stenographer in February, 1940.

She was certified to the position of hearing reporter in November, 1943, and has reported the Commission meetings since 1944. She also reported the California Toll Bridge Authority meetings.

Mrs. Bradshaw also organized the law library for the department.

Born in Grand Junction, Colorado, she was graduated from high school in Goldfield, Nevada, and attended college at Reno.

She is a member of the National Shorthand Reporters Association.

Albert McCarton

Albert P. McCarton, who retired in 1950 as Chief Draftsman and Safety Engineer in District IX of the Division of Highways, died August 31, 1961, in Yucaipa. He was 81 years old.

McCarton was born in Klamath Falls, Oregon, and came to California when he was five years old.

He began his engineering career in 1902 and worked on projects in Arizona, New Mexico, Colorado and California. He held his first job with the State in 1915 in Dunsmuir, but left in 1916 to be resident engineer for the Pacific Power Co. on the construction of three dams at Huntington Lake. He worked for the State from 1919 to 1921, and again from 1933 until his retirement.

McCarton, at the age of 17, served in the Spanish-American War; in World War I he was a lieutenant with the 23rd Engineers.

He is survived by his wife.

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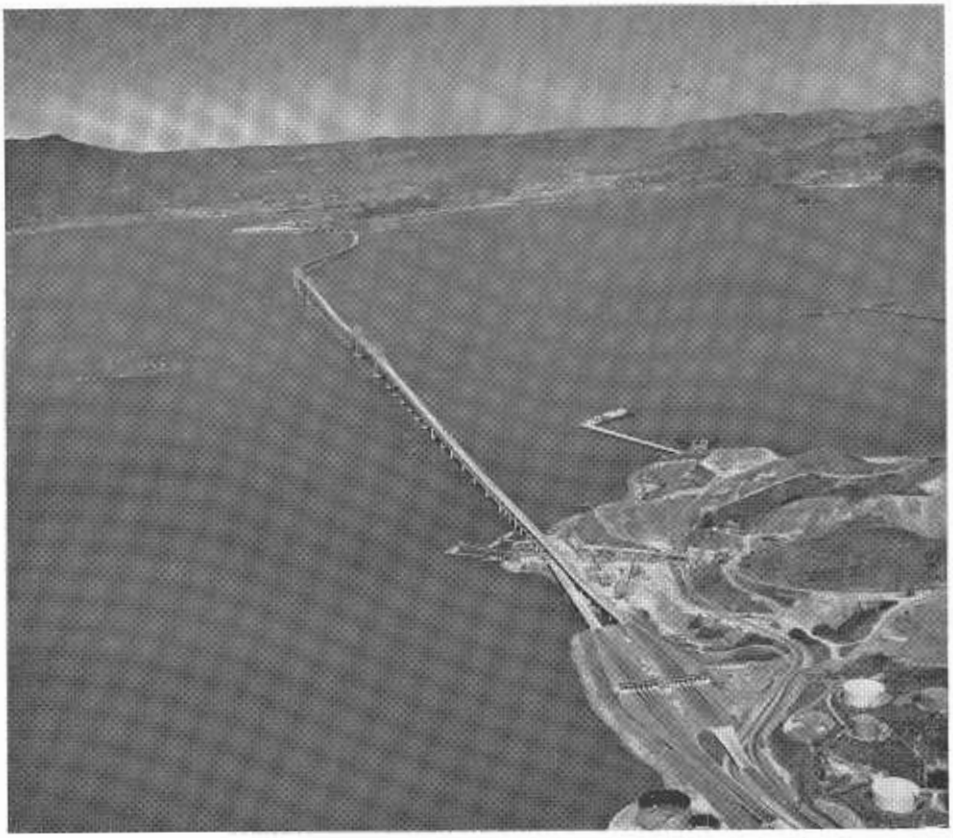
Richmond-San Rafael Bridge Is 5 Years Old

The Richmond-San Rafael Bridge over San Francisco Bay was five years old on September 1, and the anniversary will mark the close of the most successful year for the state-owned toll facility.

Steadily increasing traffic on the bridge in the past year continued to produce sufficient toll revenue to pay all bond interest and operating expense.

State Highway Engineer J. C. Womack said the bridge is now "a definite financial success and an important asset to state highway users."

Construction of the $66,000,000 span by the State Division of San Francisco Bay Toll Crossings began February 26, 1953, after the California Toll Bridge Authority in December, 1952, authorized the sale of revenue bonds to finance the project.



Replaced Ferry

The upper deck was opened to traffic September 1, 1956, and the lower deck was placed in operation August 20, 1957. The bridge replaced a privately operated ferry service.

Since the bridge was opened, there has been a steady upward trend in traffic figures and toll revenue. Traffic has been increasing at a rate of about 10 per cent a year, and toll collections have been up about seven per cent annually.

In the first year of operation (September 1956-September 1957), the bridge carried 2,588,000 vehicles as compared to 3,519,000 in the past 12 months. Average daily traffic has climbed from 7,100 in 1956-57 to 9,400 in 1960-61.

Total Revenue

A total of 15,068,000 vehicles passed through the toll gates during the first five years. Toll revenue for the five-year period was approximately $12,700,000.

Bridge toll collectors had their busiest day on Sunday, September 2, 1956, when 18,743 vehicles used the then brand new structure. The highest single-day traffic total in the past 12 months was 16,464 vehicles on Easter Sunday, April 2, 1961.

The bridge carries State Sign Route 17, providing a connection between U.S. Highway 40 in Richmond and U.S. 101 in Marin County.

It is one of the world's largest bridges. Total length of the bridge and approaches is five and one-half miles. The bridge structure itself is slightly more than four miles long. Roadways on both decks are 36 feet wide, providing three westbound lanes on the upper deck and three lanes for eastbound vehicles on the lower level.

185-Foot Clearance

The two main spans, both cantilever type, are 1,000 feet long. Clearance above the main channel is 185 feet at mean high water, 135 feet above the secondary channel. The deepest piers extend 222 feet below the surface of the bay. The highest towers are 325 feet above the water.

Toll rates for the bridge range from 75 cents for passenger cars and similar vehicles to four dollars for a seven-axle truck.

The bridge is operated and maintained by the Division of Highways and has a full-time staff of 75 persons including 18 toll collectors and 35 painters, as well as emergency road service crews, electricians, and supervisory personnel.

As is the case with other San Francisco Bay bridges, the Richmond-San Rafael Bridge requires constant painting to protect it from the elements. It will be another two to five years before paint crews finish painting the entire structure for the first time.

The infinite variety of California's landscape is suggested in these two highway scenes photographed by Robert Dunn. The front cover shows a section of the Harbor Freeway in Los Angeles, with its many crossings and ramps serving the downtown area (see "L.A. Renaissance," beginning on page 29). The highway on the back cover is a portion of U.S. 101, the Redwood Highway, newly widened and realigned on a freeway basis, alongside Outlet Creek between Willits and Laytonville in Mendocino County.