CALIFORNIA
Highways
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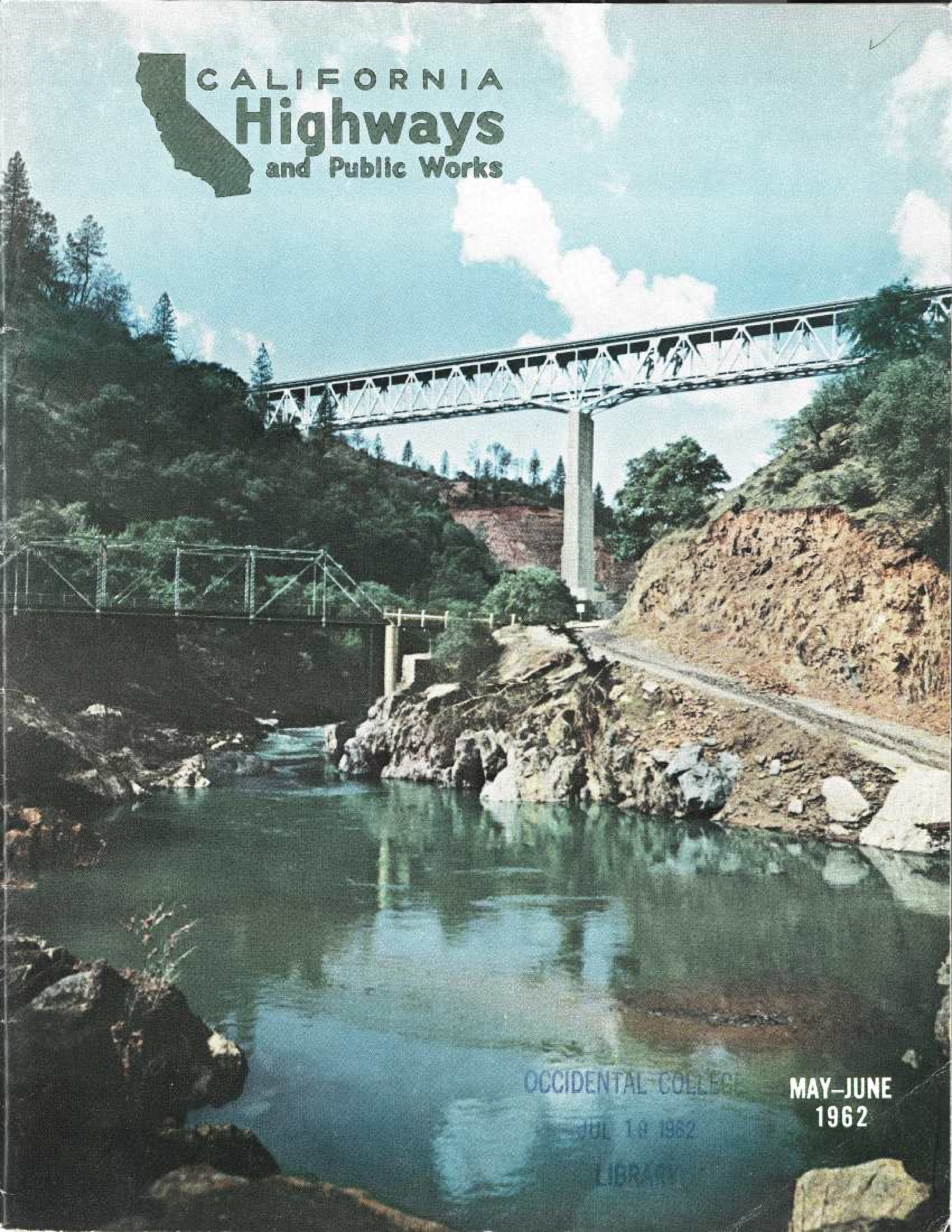

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Vol. 108 WASHINGTON, MONDAY, MAY 21, 1962 No. 80

Appendix

The California Highway Program

EXTENSION OF REMARKS

OF

HON. GEORGE P. MILLER

OF CALIFORNIA

IN THE HOUSE OF REPRESENTATIVES

Tuesday, May 8, 1962

Mr. GEORGE P. MILLER. Mr. Speaker, from time to time, from various parts of the Nation, criticism is leveled at the Federal highway program, particularly as it relates to the development of the new Interstate and National Defense Systems.

The State of California has an outstanding record as far as highway development is concerned. The State highway commission, established in 1911, has been very progressive in planning ahead to meet the manifold problems of efficiently and effectively moving the large amount of traffic between the various points in our State.

I am particularly pleased to say that the California partnership with the Federal Government, in developing the new Interstate System of Highways, is exemplary for other States to follow in our Nation.

I have just received a letter from the Governor of the State of California which sets forth, in detail, the dynamic spirit of California's highway program and, under leave to extend my remarks, I am pleased to insert this letter to me from the Governor which clearly illustrates the above points:

STATE OF CALIFORNIA,
Sacramento, Calif., May 18, 1962.

Hon. GEORGE P. MILLER,
Member of Congress,
House Office Building,
Washington, D.C.

MY DEAR CONGRESSMAN: I understand that concern has been raised in Congress about the handling of the multi-billion-dollar Federal highway program, particularly by the findings of irregularities in some States with respect to the interstate and national defense program for highways.

Without going into statistics or details, I wanted to give you my general comments about the conduct of the highway program in California as I watch it on a day-to-day basis.

First, let me say that the continuation of the present rate of highway construction in California is vital. I think it would be tragic to our economy and to our efforts to remain apace with our population increases if this total highway construction program were seriously curtailed for any reason.

Second, I want to say that I am convinced California's Department of Public Works and Division of Highways cooperate fully, completely, and in honesty with the U.S. Bureau of Public Roads. The regional office of the Bureau of Public Roads for certain Western States is in San Francisco and the State office of the Bureau of Public Roads is right here in Sacramento where there is daily contact between the California highway people and the Federal highway people. Some States, I am told, object to the type of partnership set up between the States and the Federal Government for the interstate program but this is not the case in California, even though California taxpayers send more tax money to Washington for the highway program than they receive back in allocations. Tests and checks applied against the interstate program by the Bureau of Public Roads are cumbersome, costly, and difficult, but we understand that such checks apparently are required and we do not object to them to such a degree that we should like to see any rocking of the boat merely because this working partnership is difficult for both sides to maintain. This Federal-State partnership is carried on in a mutually respectful manner.

Third, the California highway program has been kept free of any irregularities and I am confident this will continue to be the case. We have six different audit groups, Federal and State, looking over the shoulders of the highway people here in California. We have a competent investigating staff here in the State to work with the highway people in pursuing any irregularities which come to light in this big program, and I am confident we have competent and careful direction of the highway program. We take no casual or cavalier attitude toward the huge amount of money which is being spent here in California in the highway program. In addition, I think we have some factors which are not present in some other States. For example, we have a set of laws here in California under the highway program, which I hear are the envy of many other States. We also have a State contract act which I think is the best in the United States. Beyond that, every single individual in our 16,000-man highway division, from the State highway engineer down to the typists, is covered by State civil service law which, at the very least, gives us standards of competence for employment and a rewarding continuity over the years in operations. I know of no allegations of fraud or scandal in the California highway program and, if any such allegations occur, they will be investigated promptly in the hope that we can keep our own house in order without forcing others to do it for us.

Fourth, our State highway commission is composed of dedicated and intelligent men who are appointed for overlapping terms, in order to provide continuity, and they are required by law to take a statewide and not a sectional viewpoint. State law spells out in detail the procedure to be followed by the State highway commission, including the requirement that public hearings be held on a rather heavy schedule. I have insisted, as Governor Knight and Governor Warren insisted, that members of the highway commission be nonpartisan in their conduct of highway policy matters. Our commission is also the envy of other States.

Fifth, we are having the same difficulty some other States are having in locating new routes through built-up areas. This is so because, in a predominantly urban State, there are few perfect corridors still left open through urban areas. Nevertheless, and to my own personal knowledge, these highway routes are being adopted with the public interest and the greatest good for the greatest number in mind. As you know, some persons will be adversely affected by routes through urban areas and it is for this and other reasons that the views of all interested members of the public are sought before freeway routes are established. State law also requires a signed partnership agreement with city councils or county boards of supervisors before any city streets or county roads may be closed in the construction of a freeway.

Sixth, our people in California are trying not only to build an efficient highway system but also a beautiful highway system. We are also cooperating in every way possible to coordinate our program with other forms of transportation.

I attach, for your information, two maps intended to give you a quick status report on work accomplished and work yet to be done (1) on the total State highway system; and (2) on the Interstate Highway System.

This report does not require an answer on your part, but I should always be happy to have any suggestions you might have as to how we may maintain and continue to make improvements in this important program.

I write you because I am fully aware that this program is a joint responsibility between California and the Federal Government. I do not want it hurt or stopped or emasculated because both you and we in the State are looking the other way while others shape its course.

I think you agree that this is a serious piece of business for both of us.

I know you would like me to keep the rest of your colleagues informed on this subject and I will send them the same material.

Sincerely,

EDMUND G. BROWN,
Governor.

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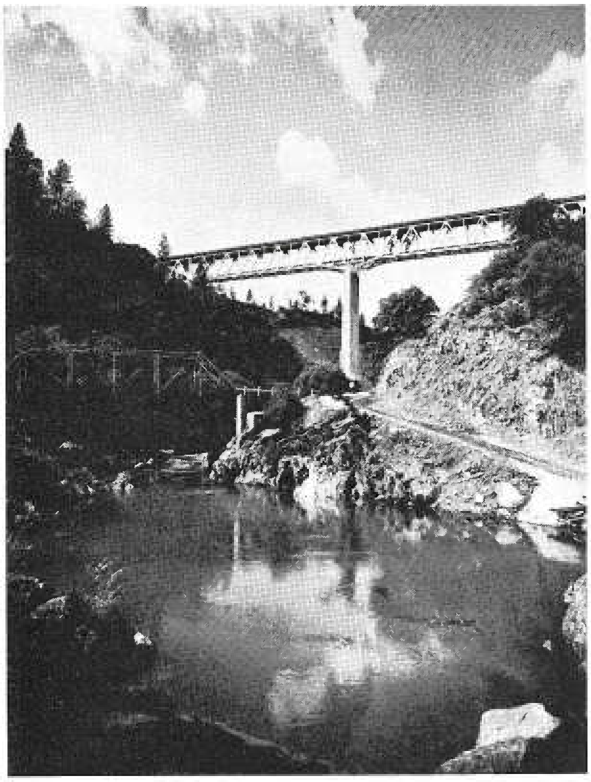

View on front cover is looking upstream along the West Branch of the North Fork of the Feather River with the new West Branch Bridge against the skyline. At present the upper deck which carries relocated Highway U.S. 40 Alternate is 450 feet above the stream, but when the Oroville Dam is completed and the reservoir filled, the water level will be within eight feet of the top of the concrete piers. Old bridge is on county road to Yankee Hill and other foothill mining towns. (See page 2 for story.)

The aerial photograph on the back cover is the Goleta section of U.S. Highway 101, El Camino Real, in Santa Barbara County. Reconstruction and realignment of an eight-mile section of this route as a four-lane divided freeway eliminated the last two-lane section of U.S. 101 in southern Santa Barbara County. The construction in right foreground is work on the future interchange with Ward Memorial Boulevard. (Story on page 34.)

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West Branch Bridge

Feather River Relocation Ready

By P. C. HARRIS, Resident Engineer

MOTORISTS travelling the famed Feather River Highway, US 40 Alternate, soon will be using the new bridge across the West Branch Feather River. This new bridge, recently completed at a total cost of approximately $9,000,000, is a part of the relocation of a portion of the Feather River Highway and the Western Pacific Railroad around the Oroville Dam and Reservoir and will carry four lanes of traffic on the upper deck and a single railroad track on the lower deck.

The bridge is the connecting link at about the middle of a new highway constructed from Wicks Corner, about six miles north of Oroville, to a junction with the present Feather River Highway about two miles west of Jarbo Gap. Construction of the bridge started in November, 1959, and was completed in February of this year. Work on the approaches has continued through the spring.

The main portion of the bridge spanning the deep canyon of the West Branch Feather River consists of four steel truss spans with lengths of 360 feet, 432 feet, 576 feet and 432 feet, respectively, on massive concrete piers towering up from the bottom and sides of the canyon.

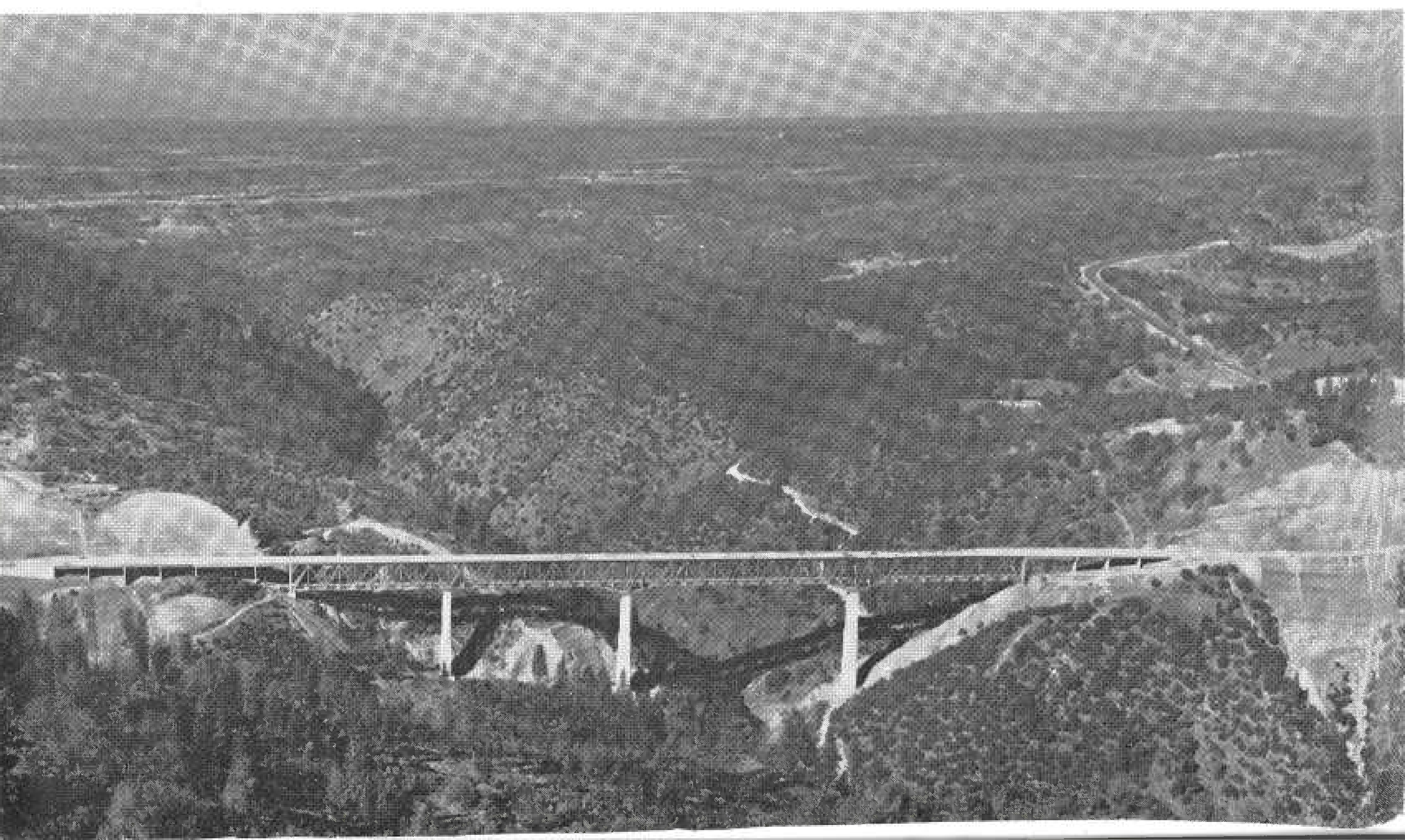
Approach Spans

On the west, or Oroville, end there are five steel girder highway approach spans 80 feet long and one 135 feet long, and on the east end there are one span 135 feet long and three spans 80 feet long. Overall length of the highway portion of the bridge is 2,731 feet; overall length of the railroad portion, including a short approach span at each end, is 1,882 feet. Trusses are spaced 38 feet center to center and are 60 feet deep, except over the two central piers where they are 80 feet deep. Panel lengths are 36 feet.

The highway deck is approximately 450 feet above the stream bed and after Oroville Dam is completed water will be backed up into the canyon to a maximum depth of 350 feet. The two largest piers will extend only about eight feet above maximum high water.

The West Branch Feather Bridge is similar to the Pit River Bridge which carries US 99 across the Pit River arm of Shasta Dam Reservoir. Both carry four lanes of highway traffic on the top deck and railroad on the bottom deck, although the Pit River Bridge carries two railroad tracks instead of one.

General view of the West Branch Feather River Bridge looking north toward the Paradise area in Butte County. (Department of Water Resources photo.)



The Pit River Bridge is longer and has more truss spans, but the layout of spans is similar. Both bridges have unusually high piers. The Pit River Bridge has two piers approximately 355 feet high from foundation base to top of pier which, at the time they were built, were the highest concrete piers in the world. The West Branch Feather River Bridge has two piers approximately 286 feet high from foundation base to top of pier and another one 248 feet high.

Most Massive Pier

Pier 9 on the west side of the stream is the most massive of the three large piers. This pier is located on the end of a spur ridge that branches off from and is roughly parallel to the larger ridge that forms the west side of the canyon.

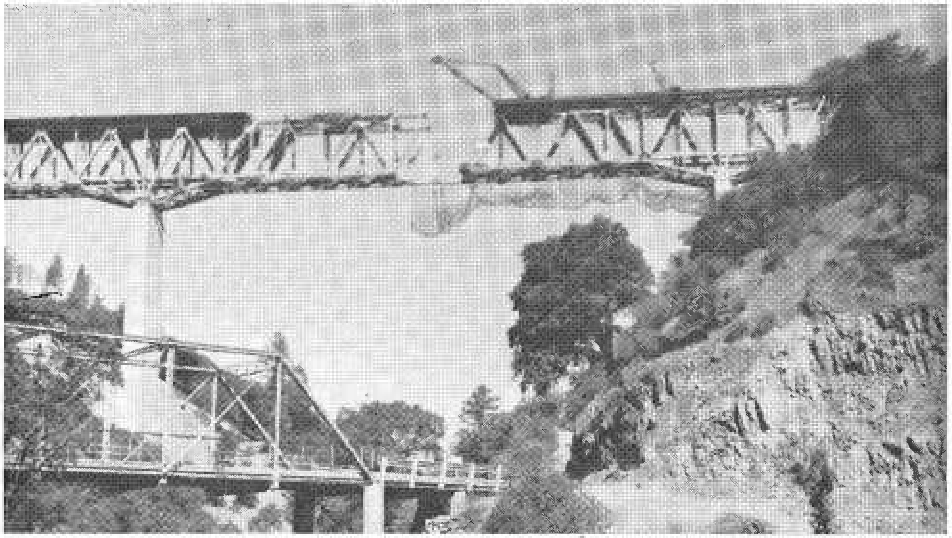
In order to reach the top of the footing of this pier it was necessary to excavate the end of the spur ridge. On the high side this excavation is on a ½:1 slope for approximately 180 feet.

The footing itself was excavated in hard rock to a depth of 18 feet over an area 82 feet long by 68 feet wide and to an additional 16 feet deep over half of that area. This hole, which was filled with over 5,700 cubic yards of concrete, was big enough to hide an average size 6-room house with a large basement under it and a small yard around it. The footings of all the piers are now covered with backfill material and can not be seen.

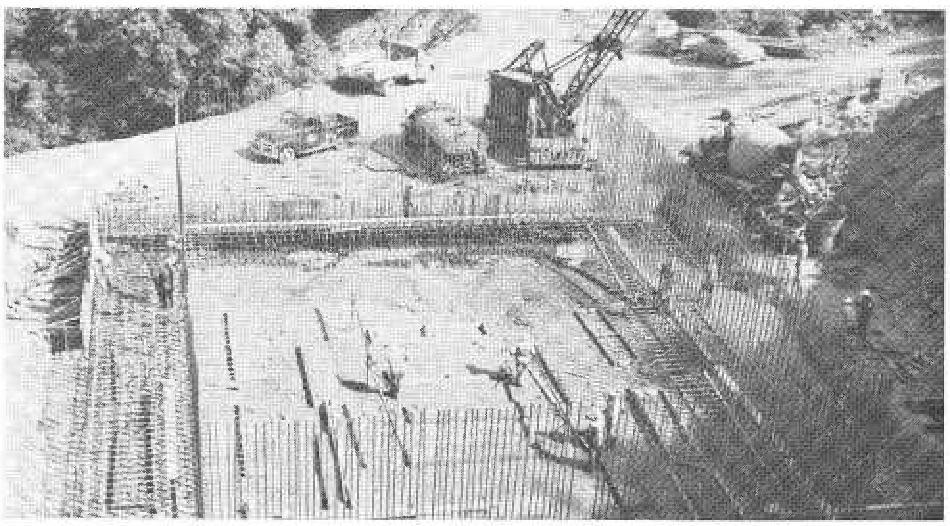
On top of the footing is a pedestal 70 feet long, 50 feet wide and 16 feet high. This pedestal has just over 2,000 cubic yards of concrete in it and appears to the observer to be the base of the pier.

Above the pedestal the shaft of the pier rises in three sections like giant blocks piled one on top of another. The bottom block is 58 feet long, 24 feet wide and 58 feet high; the middle block is 56 feet long, 20 feet wide and 80 feet high; and the top block is 54 feet long, 16 feet wide and 98½ feet high. Four hollow cells, each 11 feet by 12 feet and separated by walls two feet thick, extend from the base of the shaft to within about eight feet of the top. These cells are vented with 12-inch diameter holes to equalize

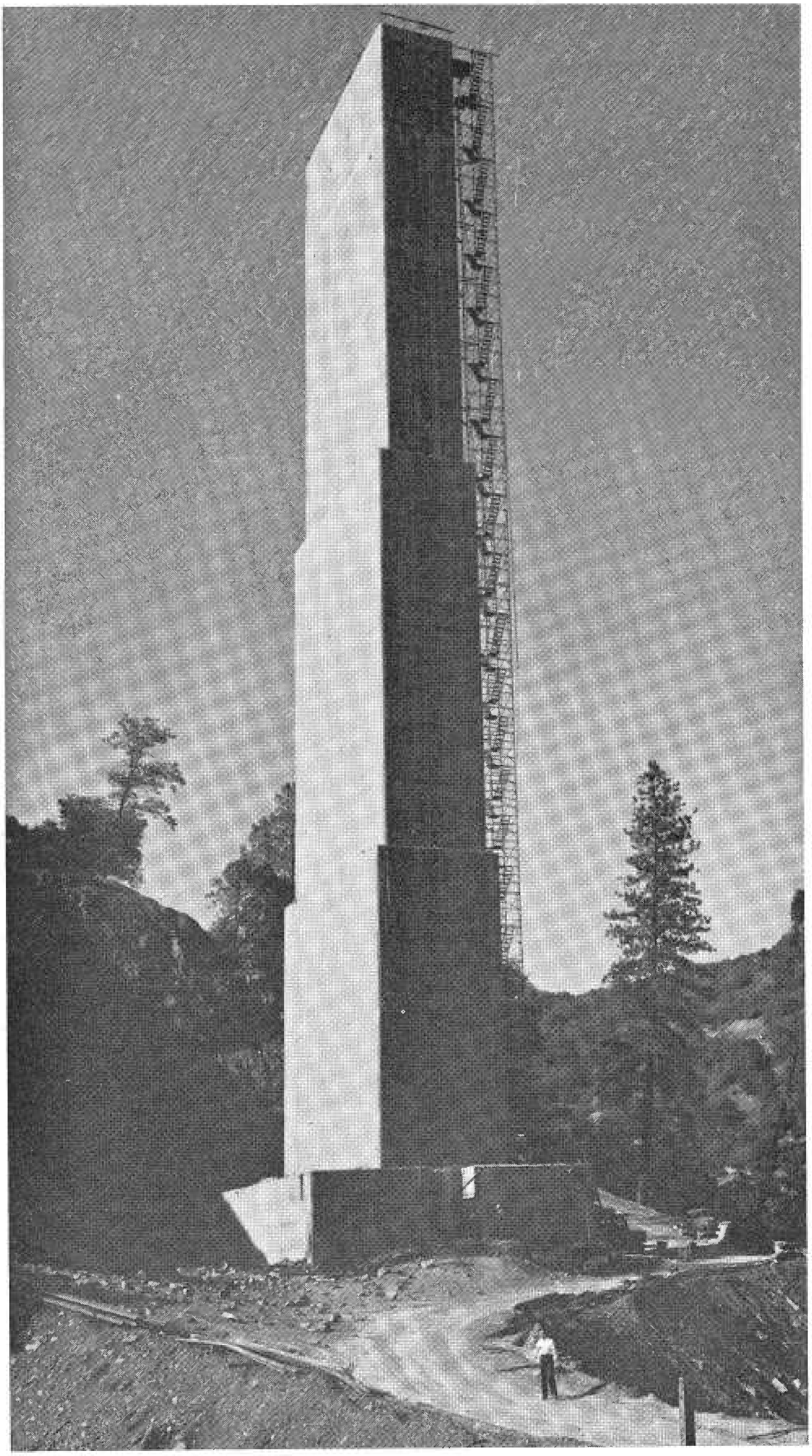
An eastward view of highway deck construction operations. The crane at the far end is filling in secondary structural members.



Placing the connecting steel truss member in Span 9. It was necessary to adjust the opening between the two ends ⅜ of an inch to fit this member in.



Placing concrete for the Pier 9 footing. The footing contains over 5,700 cubic feet of concrete and is large enough to contain an average size six-room house with a small yard around it.



Pier 9 completed. Total height is 252 feet above ground. The footing extends another 34 feet below ground. The temporary access stairway and railing at the top of the pier were removed after the top of the pier was prepared to receive truss bearings.

water pressures inside and outside the pier and to reduce buoyancy.

The overall height of the pier is equivalent to a 25-story building with a three-story basement and an ordinary railroad box car could be placed on top of the pier with room to spare. Total concrete in the footing, pedestal and shaft is 12,900 cubic yards.

Slipform Method Used

The three large piers were constructed by the slipform method which consists of a form four feet high around the outside of the pier and four interior forms for the inside cells, all attached to hydraulically operated jacks which climb steel rods as the concrete is placed. The jacks climb in increments of approximately one inch and on this job the average rate of rise was just over 12 inches per hour, which meant that the concrete was about four hours old when the bottom of the slipform passed over it.

General procedure was to place the main vertical reinforcing steel for the first section of the pier shaft and then slip that section up to six feet below the change in section; stop and place the main vertical reinforcing steel for the next section; slip the six feet to the change in section and stop and move the forms in to the next section; repeat the procedure for the next sections, with stops at 23 feet and 8 feet below the top of the top section to cap off the interior cells.

For the three piers there were eight major slips ranging in height from 52 feet to 90.3 feet and 11 smaller slips ranging from 6 feet to 15 feet. Average rate of rise for all pours was 12.2 inches per hour. Average rate of rise for the eight major pours was 12.9 inches per hour. Highest rate of rise for any one pour was 14.1 inches per hour for the 90.3 foot top section of Pier 8. Maximum rise for any one hour was about 20 inches. Rate of rise was governed mostly by the speed with which the horizontal reinforcing steel could be placed; only on rare occasions did rate of set of the concrete affect the rate of rise.

Steel Bar "Curtains"

The main reinforcing steel in the three large piers consisted primarily of three vertical curtains of 2⅜″

diameter No. 18 bars. Progressing toward the top, successive bars were dropped off or replaced by smaller bars until, at the top of the piers there were only one or two curtains of 1¼″ diameter bars. Prior to the start of placing concrete for each section all main reinforcing steel for that section was placed in position and supported by templates attached to a structural steel tower.

Structural steel towers for supporting the reinforcing steel consisted of six vertical legs placed in 15-foot stories with longitudinal and transverse horizontal and diagonal bracing placed in 7½-foot stories. Outriggers at each end at 30 foot minimum spacing supported the templates for holding the reinforcing steel in place. The vertical legs remained embedded in the concrete, replacing an equivalent amount of reinforcing steel; the horizontal and diagonal braces were removed as the slipform moved up. Towers varied from 60 to 105 feet high; the unsupported length of reinforcing steel above the top of towers varied from 14 to 28 feet. All No. 18 bars were placed full length for each section; maximum length of bar placed was 102′ 9″, weighing approximately 1,400 pounds each.

At the top of the first sections of Piers 9 and 10 where the inside curtain of main reinforcing steel for the bottom section was continuous with the outside curtain of the next section, all the No. 18 bars in this curtain were spliced by butt welding; this required 144 butt welds at Pier 9 and 164 welds at Pier 10. Welding of each joint required from 2 to 3½ hours, with an average of 2½ hours. Welds were radiographed to detect flaws and were repaired when necessary.

All other reinforcing steel, consisting of horizontal bars and ties in the outside walls and interior diaphragms and vertical bars in the interior faces of the outside walls and both faces of the diaphragms, was placed as the slipform moved up. "Chicago" booms, one on each side of the pier, attached to the slipform and operated by winches on the ground, were used to hoist this steel to the working platform and to lower the horizontal and diagonal tower bracing as it was removed.

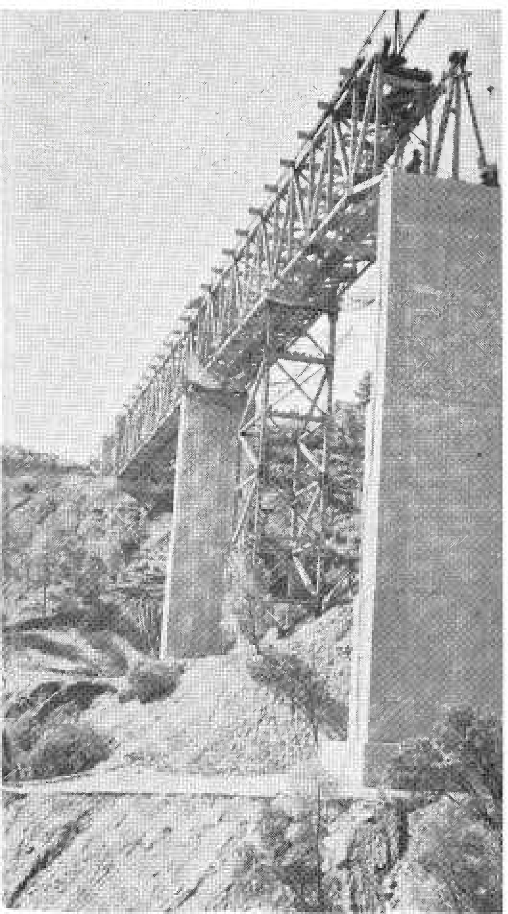
60 Jacks Per Form

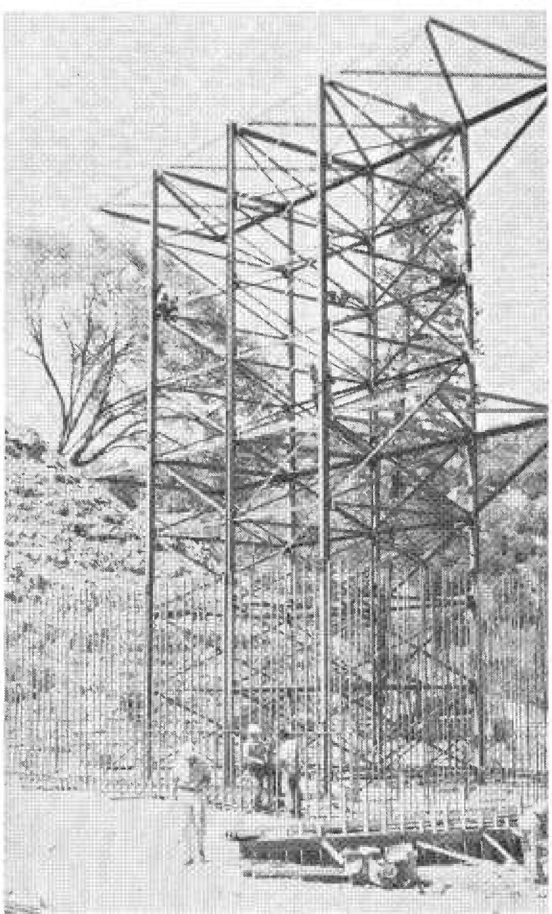
The slipforms were of conventional construction, consisting of four-foot high forms around the outside perimeter and inside the four cells. Sixty jacks were used for each slipform. The jacks climbed one-inch hollow steel rods which were screwed on in increments of about 12 feet as the slipform progressed upward. A small tubular slipform around each rod left a hole around the rod so the rods could be pulled and salvaged; the holes were then filled with grout.

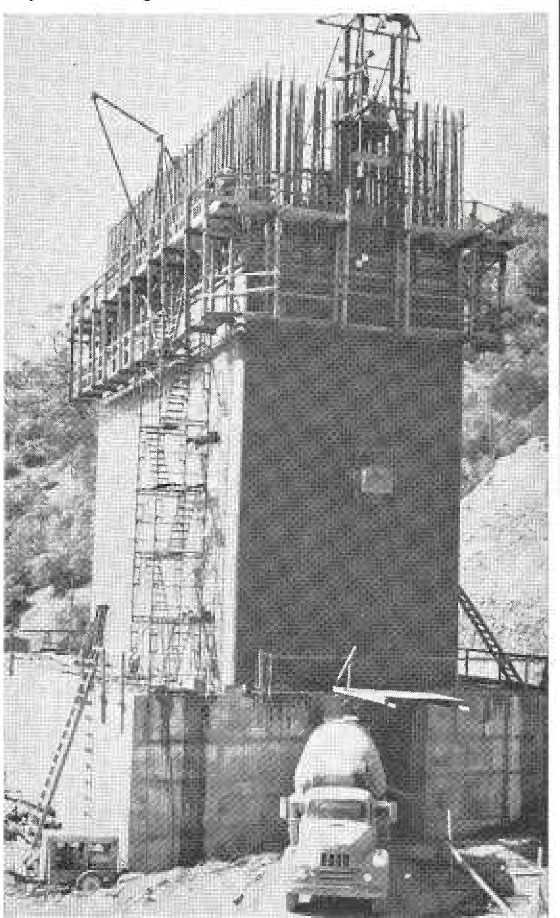
A working platform was constructed over each cell and runways were constructed between the cells over the diaphragms. Another working platform was constructed around the perimeter of the pier outside the reinforcing steel cage. Working platforms for the concrete finishers were constructed under the outside perimeter platform and under the platforms in each cell.

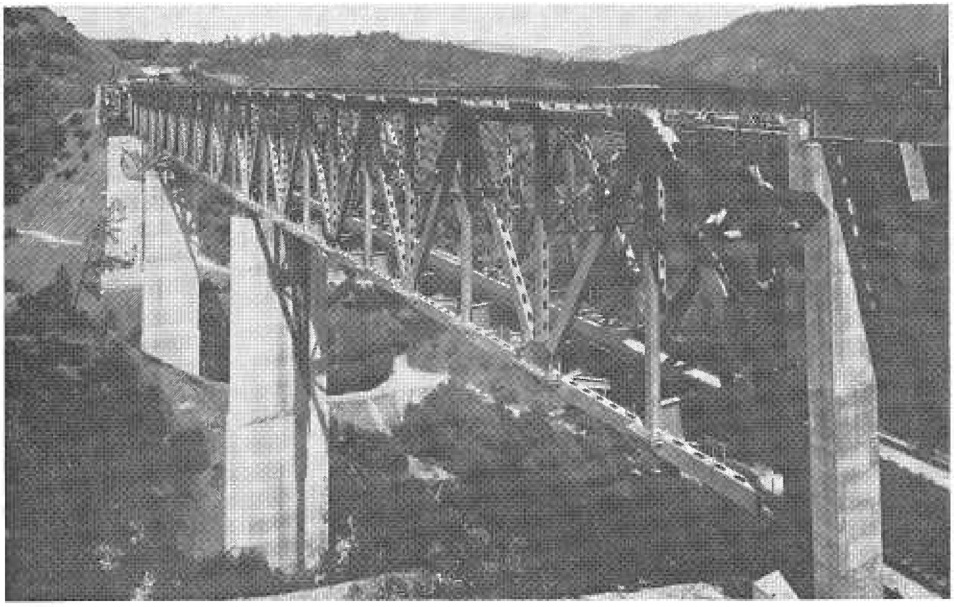
Concrete was delivered to the slipform by means of a skip hoisted on cables to a tower at each end of the slipform. A tripping device dumped the concrete from the skip into a hopper from where it was taken in concrete "buggies" to the pour face around the perimeter of the inside platforms. The skip was operated by a winch on the ground and telephone communication between the winch operator and a man on the skip tower facilitated the operation, particularly

CONSTRUCTION PHOTOS. BELOW LEFT—Steel truss erection being landed on Pier 9. The falsework bent at the middle of Span 8 was built from truss members which later became part of the bridge. Total structural steel in the bridge is 11,000 tons. BELOW CENTER—The main reinforcing steel for the three large piers was supported in place by means of a steel tower. BELOW RIGHT—Slipforming the bottom section of Pier 10. The form itself is four feet high. It moves upward at an average rate of 12 inches an hour propelled by 60 hydraulic jacks climbing on steel rods.









View of the bridge during structural steel erection. The traveller is on the far end. A truck crane over Pier 9 is placing highway deck stringers and secondary truss steel.

at night. The use of a skip suspended from a tower on the slipform was somewhat of an innovation for this type of work. On most other jobs a crane with a long boom or a hoist tower have been used; however, the great height of these piers made either of these methods too costly.

Concrete was cured by means of a series of small spray nozzles suspended about two feet apart below the finishers' platform.

77-Hour Pour

Slipforming is a continuous around-the-clock operation. The longest single pour on these piers required 77 hours.

Structural steel truss erection was started at Pier 7 on the west side of the canyon and proceeded to the middle of Span 9 over the stream, then was started from Pier 11 on the east side of the canyon and proceeded back to a connection in the middle of Span 9. Erection was by the "cantilever" method with a large traveller crane moving along with the end of steel as work progressed. A crawler crane near the end of the bridge loaded steel members onto small rail cars and a small Diesel locomotive pushed the cars over a supply track, installed over one of the truss chords, out to the traveller.

Five falsework bents were used, two each in Spans 7 and 10 and one at the middle of Span 8. The falsework bents under Panel Point 2 in Span 7 and Panel Point 38 in Span 10 were made up of steel members brought to the jobsite for that purpose by the contractor; the other three bents were made up from truss members which were later used in the bridge. At Piers 7 and 11 the ends of the trusses were tied down by means of temporary steel members embedded in the pier concrete to resist the uplift caused by the cantilever erection. At Pier 8 temporary pinned connections were installed between the top chords of Spans 7 and 8 and temporary bearing plates were placed between the bottom chords to make the trusses act continuously over the pier during erection of Span 8. Wire rope tie-downs were installed between the top chords of Span 8 and the bottom chords of Span 7 to resist uplift while cantilevering Span 8 from the falsework bent to Pier 9. Jacks were installed in the top chords at the fixed (west) end of the suspended span in Span 9 and in both top and bottom chords at the expansion end to assist in making the closure at the center of the span. Closure of the downstream chord was perfect; closure of the upstream chord was long by ⅜", but was easily adjusted.

Heaviest Member

Total structural steel in the bridge is 11,000 tons. Members were shop-fabricated using rivets; field connections were made with high strength steel bolts. Many of the individual members weighed in excess of 30 tons each; the heaviest single member weighed 56 tons, the equivalent of about 30 ordinary automobiles.

All of the railroad ballast deck and the highway deck in Span 7 were constructed of lightweight concrete weighing about 105 pounds per cubic foot, compared with about 155 pounds per cubic foot for conventional concrete. Total concrete used in the bridge was over 40,000 cubic yards and nearly 4,000 tons of reinforcing steel was required.

The bridge was designed and the construction was administered by the Division of Highways under a service agreement with the State Department of Water Resources. Financing was with Feather River Project funds provided by the Department of Water Resources with some state highway funds being used to the extent of the "betterment," such as the four-lane width. Design and construction were under the general administration of J. E. McMahon, Assistant State Highway Engineer—Bridges. Design was done by a crew headed by R. D. Sunbury and J. R. Stoker. P. C. Harris was resident engineer and D. P. Hopkins was assistant resident engineer during construction. General contractor for the construction was Stolte, Inc. and Morrison-Knudsen Co., Inc., with George Trivitt as project manager and C. W. Young as field engineer. Subcontractor for structural steel was American Bridge Division of United States Steel Corporation. Subcontractor for reinforcing steel was Soulé Steel Co.

At the time of writing this article a contract was under way for paving about a half mile of approaches to the bridge and making the connection to the existing highway near Jarbo Gap. This work is scheduled for completion early this summer, after which highway traffic can be routed over the new highway and bridge. At the same time the relocation of the Western Pacific Railroad line is nearing completion and the first trains should pass over the new bridge in late summer or early fall.

New Intersection

Stanislaus County Constructs F.A.S. Project Near Modesto

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

STANISLAUS County and the State Division of Highways, by means of a co-operative project, have completed construction of a channelized intersection which is a fine example of the spirit of co-operation existing between the two agencies.

The project is at the intersection of Yosemite Boulevard (State Sign Route 132) and El Vista-Snowden Avenue, at the eastern edge of the City of Modesto.

The term "channelized intersection" is somewhat misleading insofar as the size of the project is concerned. The work accomplished involved the reconstruction and widening, from two to four lanes, of almost one-half mile of state highway and one-fourth mile of county road, plus reconstruction only of another one-half mile of county road.

Result of Three Projects

The need for this improvement developed as a direct result of three projects constructed earlier on F.A.S. Route 1226 and described in the September-October 1958 issue of California Highways and Public Works. At the time these projects were programmed, it was estimated that the traffic count, upon completion of the route (known as East Modesto Road), would be approximately 2,000 vehicles per day. Within one year, however, the traffic count was over 5,000 vehicles per day. With traffic on the state highway approaching 7,000 vehicles per day, the congestion at the intersection became critical. The situation was made even worse because of the following existing conditions: (1) the high percentage of turning movements; (2) the north and south legs of East Modesto Road being offset by 40 feet, and (3) the tracks of the Modesto and Empire Traction Company (paralleling Yosemite Boulevard) being two feet above the road.

The project borders one of the industrial areas of the City of Modesto. This particular area contains many food processing plants and related industries, which create a high percentage of truck-type traffic during certain periods of the year. In addition, the Modesto City-County Airport is located one-half mile south of the intersection.

County Handles Construction

After preliminary discussions with Division of Highways personnel, it was decided that the proper approach to the solution of the problem would be to propose a county-constructed project rather than the usual procedure of requesting the State to construct the project, with the county participating only financially. The division's traffic engineers studies the situation and recommended a fully channelized and signalized intersection with left-turn lanes on all four legs. The design was approved in October 1959.

Thereafter, an agreement was negotiated providing for the following: (1) the county to design and supervise the construction of the project with county personnel, acquire all necessary rights-of-way, and pay one-half of the construction cost, and (2) the State to provide plans and speci-

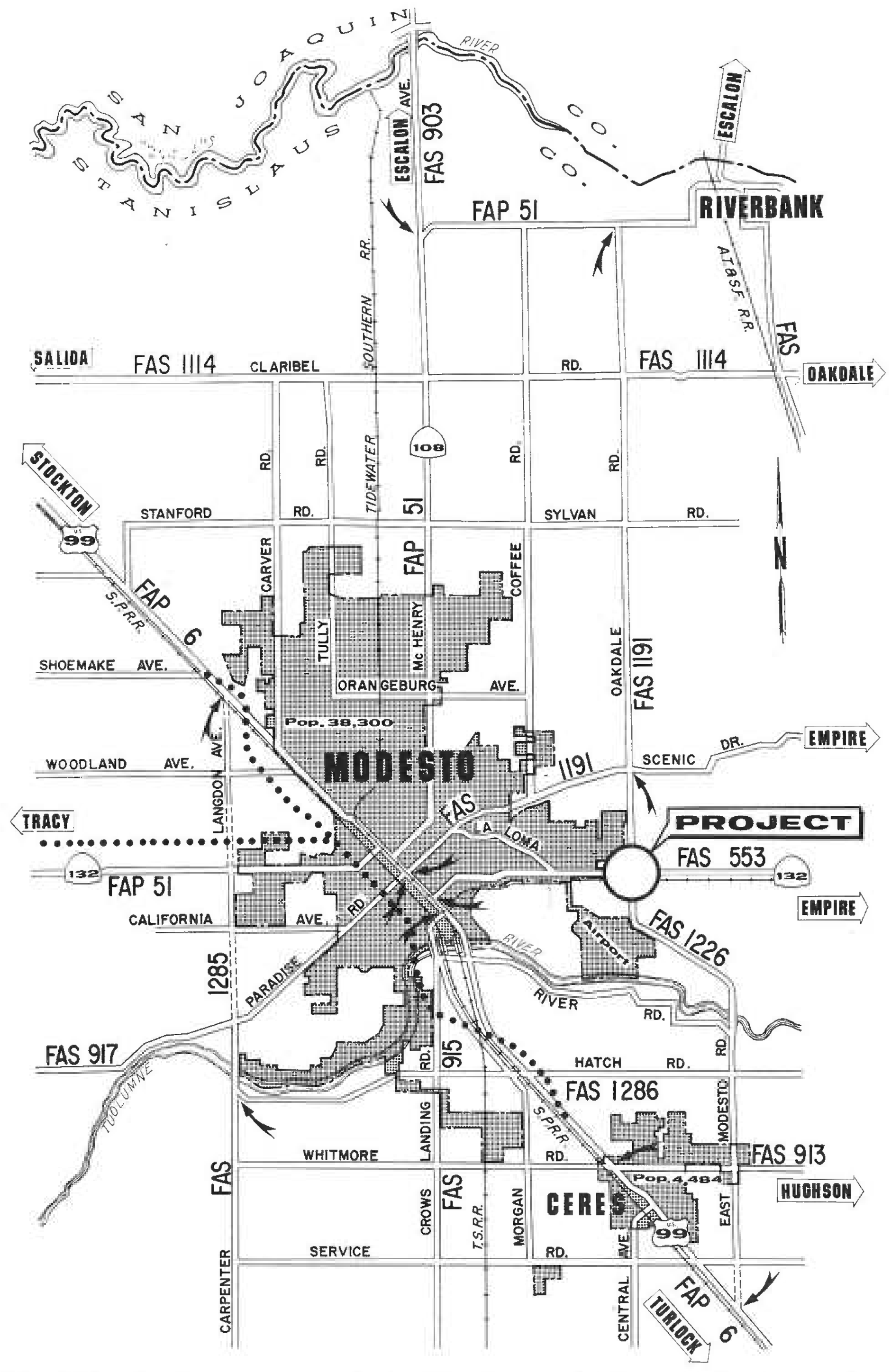
BEFORE—The intersection before it was reconstructed. The view is north along Vista Avenue. *(See photo next page.)*

AFTER—The completed project looking west along Yosemite Boulevard (State Sign Route 132) toward the City of Modesto. (See photo previous page.)

fications for the electrical work and pay one-half of the construction cost. Under a separate agreement, the county and the Modesto and Empire Traction Company installed No. 8 flashing light railroad signals on the south leg of the intersection. The railroad signals were interconnected with the traffic signals to provide preemption for the railroad.

Rights-of-Way Acquired

The county acquired all of the rights-of-way necessary for the project, including those required on the state highway. The City of Modesto assisted in the right-of-way acquisition, since the property in the northwest corner of the intersection is within the Modesto city limits. As a result of excellent co-operation by the



The project is located near the southeast city limits of Modesto (as indicated in the above map) and connects two Federal Aid Secondary County Routes.

City of Modesto, most of the necessary rights-of-way within the city were acquired by dedication.

Bids for the project were opened on February 28, 1961. The contract was awarded to Standard Materials of Modesto for $141,414.10.

Although it was necessary to carry traffic through the project during construction, it was completed with a minimum of inconvenience. The project was completed on July 18, 1961. It is the first signalized intersection in District X with traffic-actuated left-turn signals on all four legs. The final construction cost was $144,657.91. Of this total, the State's share was $54,652.85 and the county's share was $90,005.06.

This project had the fullest co-operation of District X, particularly, City and County Projects Engineer, Al Tschantz-Hahn and his staff. Don Hubbard of Stanislaus County was Resident Engineer; the author supervised both design and construction. The entire project was under the direction of Ellis R. Delbon, Road Commissioner.

Division Issues New Construction Manual

A revised and enlarged edition of its "Construction Manual of Instructions" has been issued by the State Division of Highways.

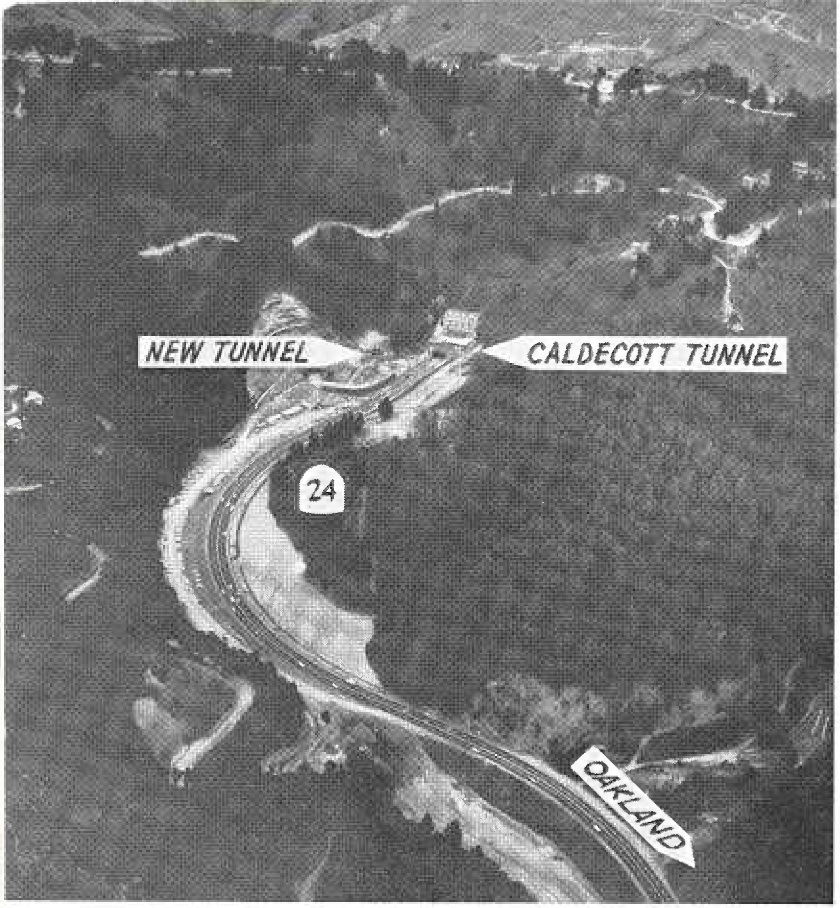
The publication, as in its previous editions, is a continuing attempt to compile in writing the field "know-how" accumulated by experienced resident and construction engineers of the division.

It suggests techniques helpful in completing a construction project in accordance with controlling plans, specifications and other contract documents which will assure proper quality and quantity control.

Under nine main headings, the manual deals with some 70 topics ranging from construction details and the sampling and testing of materials to personnel and public relations problems that may arise in connection with a job.

The manual contains many charts, tables and photos illustrating the points discussed. Copies of the 590-page, paper-covered book, which is in an 8½-by-11-inch format, may be purchased from the Documents Section of the State Printing Division, Sacramento 14, California. The price is $9, plus sales tax of 36 cents for California purchasers.

The Division of Architecture has completed plans on the general, mechanical, electrical, and elevator work for the $14,800,000 Retirement Building in Sacramento. This project will be the first new building under the California State Capitol Plan to become a reality. This plan was approved by the 1961 Legislature.



Construction progresses on the new Caldecott Tunnel Portal at the west end of the existing tunnel. Funds have been budgeted to replace the present four-lane undivided approaches on Sign Route 24 with an eight-lane freeway.

Bay Area Report

By J. P. SINCLAIR
Assistant State Highway Engineer

A CENTURY AGO, waterways were the key to the growth of California. Hundreds of ships coming around the Horn brought people, tools and material to develop the newly discovered goldfields. On the Sacramento and the San Joaquin Rivers, thousands traveled by boat to seek their fortunes in the headwaters of the Sierras.

Today the great waterways handle only a small portion of the total traffic. The railroads, which moved so many people and goods from place to place in the early part of this century, have also assumed a lesser role. Replacing these time-honored modes of travel, the boat and the rail, are miles and miles of concrete and asphalt highways and freeways two, four and eight lanes wide. The Golden Gate, the Carquinez Straits and the San Francisco Bay, have been spanned by mighty bridges to accommodate the ever-expanding tide of automobiles.

The task of the District IV highway engineers in the Bay area, is not only to provide a means of safe and rapid travel for this growing tide of motorists with their cars and trucks, but to insure the same pleasant prospect for the additional thousands who will be driving on Bay area highways in future years.

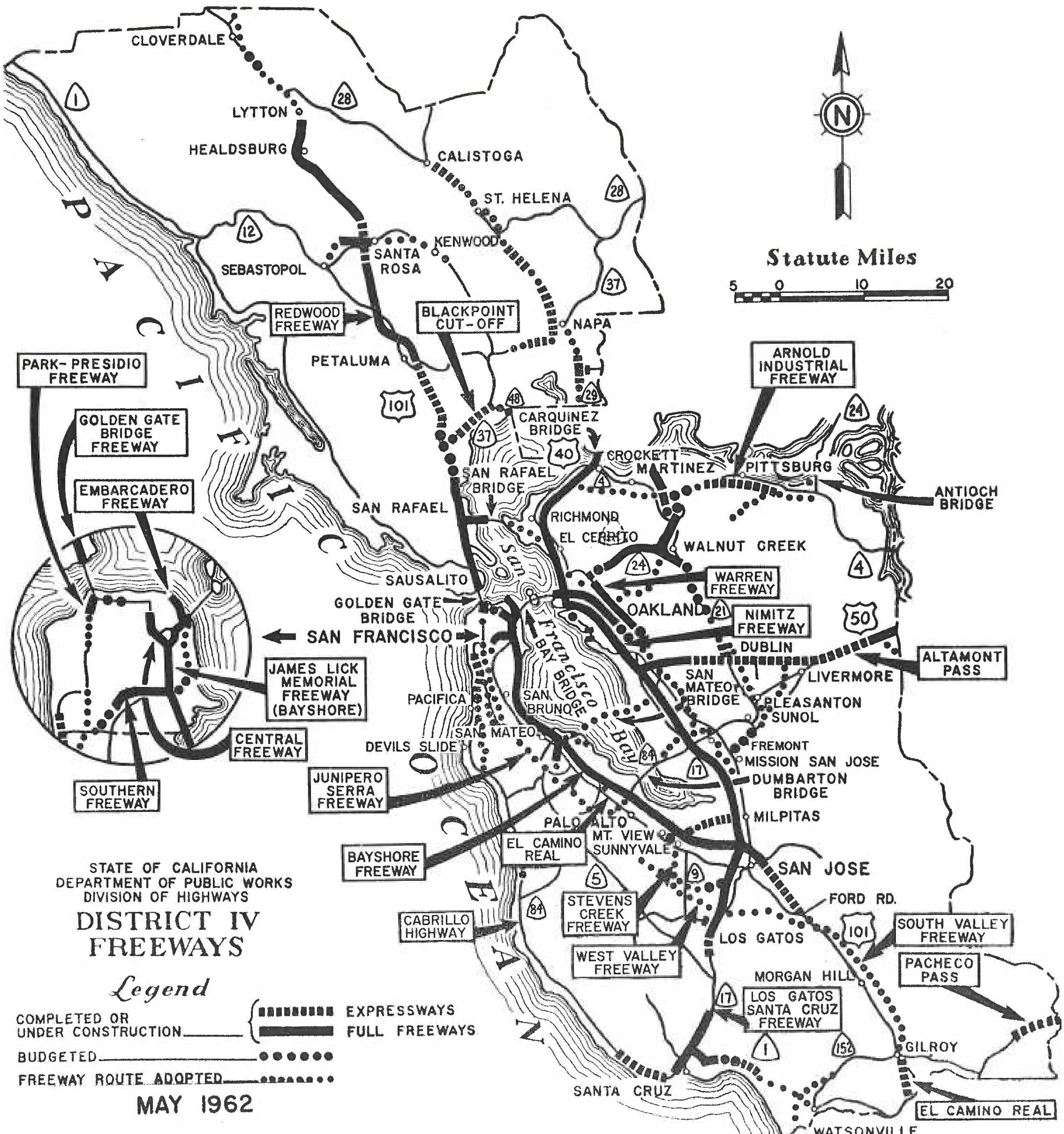
Commuters Increase

Unlike gold rush days, when much of the incoming population left the Bay area seldom to return, many now make a two-way trip daily. They earn their livelihoods in the metropolitan communities of the Bay area, such as San Francisco, Oakland, Richmond, San Jose and Santa Rosa, and often choose suburbs on either side of the Bay or several counties away to join their families in residence or spend their leisure time.

From San Francisco, and Oakland, freeways now provide effortless travel north to Santa Rosa and Sacramento and south to San Jose. More than ever before, the continuity of route development is in evidence.

Completion of the Bayshore Freeway from San Francisco to San Jose, the recent completion of three contracts on the MacArthur Freeway, the Southern Freeway now under contract throughout most of its length, the rapid closing of the gaps on the US 101 Freeway through Marin and Sonoma Counties, all are examples of major route development. One can now drive from Watsonville to the Carquinez Bridge, the entire length of District IV, and not stop for a single traffic signal.

This has not always been accomplished without controversy. That so much has been achieved with little or no controversy is testimony to the willingness of those who build for the future to consider the views of those who would preserve the past. When viewed against the backdrop of Bay area history, beauty, commerce and trade, the achievements listed below become an important part of the growth of not only the Bay area but of California itself.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KENWOOD
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ARNOLD INDUSTRIAL FREEWAY
PARK-PRESIDIO FREEWAY
GOLDEN GATE BRIDGE FREEWAY
EMBARCADERO FREEWAY
CARQUINEZ BRIDGE
CROCKETT
MARTINEZ
PITTSBURG
ANTIOCH BRIDGE
SAN RAFAEL BRIDGE
SAN RAFAEL
RICHMOND
EL CERRITO
WALNUT CREEK
SAUSALITO
GOLDEN GATE BRIDGE
SAN FRANCISCO
WARREN FREEWAY
OAKLAND
NIMITZ FREEWAY
DUBLIN
ALTAMONT PASS
LIVERMORE
JAMES LICK MEMORIAL FREEWAY (BAYSHORE)
SAN MATEO BRIDGE
PLEASANTON
SUNOL
PACIFICA
SAN BRUNO
BAY BRIDGE
San Francisco Bay
CENTRAL FREEWAY
SOUTHERN FREEWAY
DEVILS SLIDE
SAN MATEO
FREMONT
MISSION SAN JOSE
DUMBARTON BRIDGE
JUNIPERO SERRA FREEWAY
MILPITAS
PALO ALTO
MT. VIEW
SUNNYVALE
EL CAMINO REAL
BAYSHORE FREEWAY
SAN JOSE
FORD RD.
STEVENS CREEK FREEWAY
CABRILLO HIGHWAY
WEST VALLEY FREEWAY
LOS GATOS
SOUTH VALLEY FREEWAY
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MORGAN HILL
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WATSONVILLE
PACIFIC OCEAN
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
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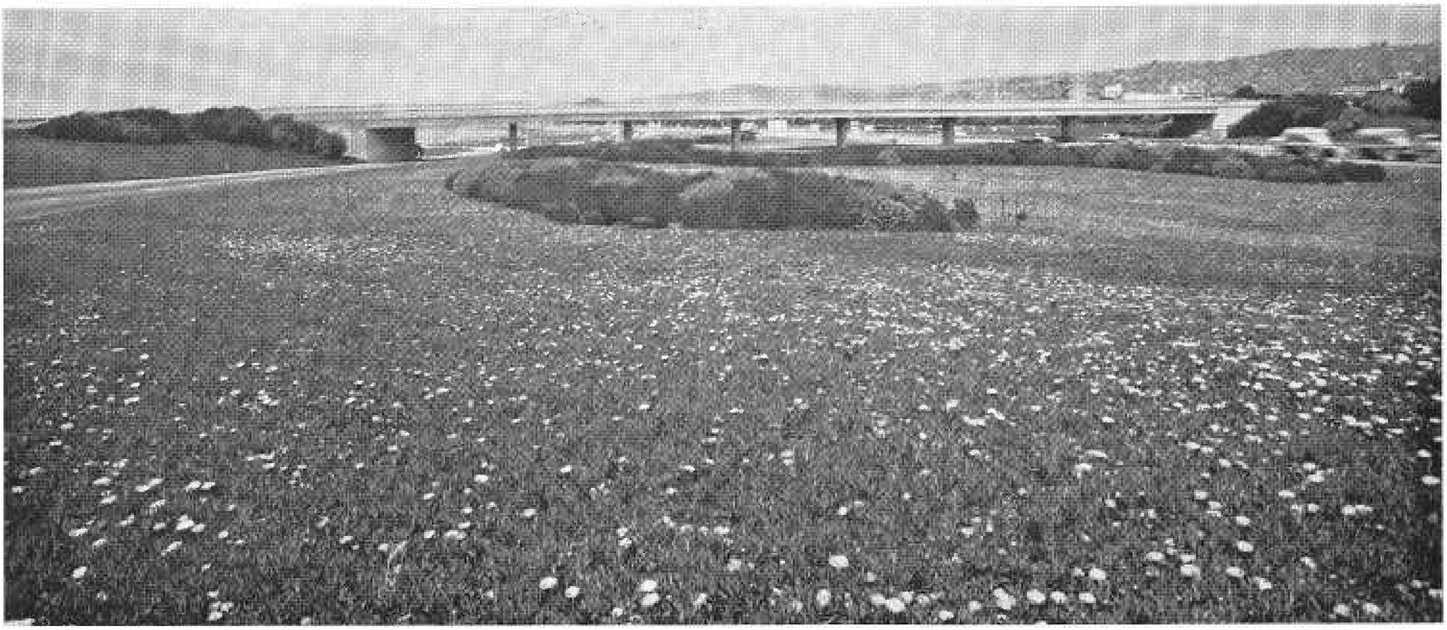
MAY 1962



Freeway landscaping. The Ashby Avenue Interchange on US 40 in Berkeley, looking northeast. Field of flowers in the foreground and beyond is iceplant. Shrub clumps add variety and accentuate the structure.

ALAMEDA COUNTY

The variety of completed, current and budgeted projects within Alameda County ranges from minor projects such as traffic signal modification and widening to major contracts including new freeway alignment, tunnel and tube construction. Some of the most significant developments during the past year were the opening to traffic of three units of MacArthur Freeway (US 50 and Interstate 5W) in May, continued improvement of the Nimitz and Warren Freeways and of State Sign Route 24 between Oakland and the Contra Costa suburban areas.

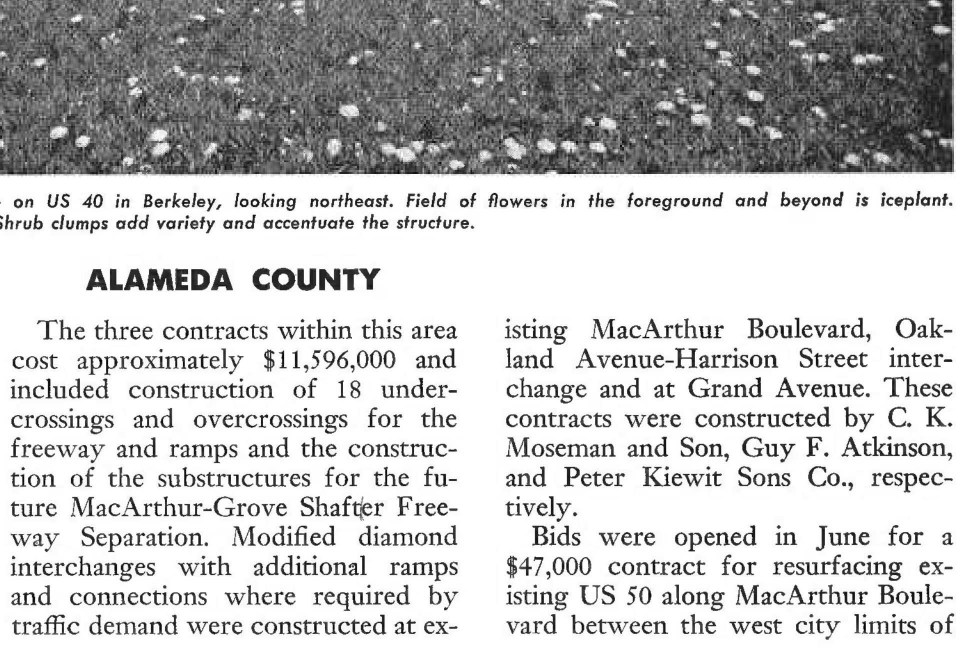
In addition to the above work, funds are budgeted for freeway construction on Interstate 680 (State Sign Route 21) between US 50 and Scotts Corner and for rehabilitation of the existing Posey Tube upon completion of the Webster Street Tube. Numerous other projects were completed or are currently underway on Sign Routes 9 and 84 and State Highway Route 105, in Hayward.

MacArthur Freeway (Interstate 5W)

The opening of the first section of MacArthur Freeway on May 15 provides 2.6 miles of continuous eight-lane interstate freeway between the distribution structure and Grand Avenue in Oakland.

The three contracts within this area cost approximately $11,596,000 and included construction of 18 undercrossings and overcrossings for the freeway and ramps and the construction of the substructures for the future MacArthur-Grove Shaft(e)r Freeway Separation. Modified diamond interchanges with additional ramps and connections where required by traffic demand were constructed at existing MacArthur Boulevard, Oakland Avenue-Harrison Street interchange and at Grand Avenue. These contracts were constructed by C. K. Moseman and Son, Guy F. Atkinson, and Peter Kiewit Sons Co., respectively.

Bids were opened in June for a $47,000 contract for resurfacing existing US 50 along MacArthur Boulevard between the west city limits of



Emeryville and Broadway prior to relinquishment to the City of Oakland.

Units Under Construction

East of Grand Avenue, two units of MacArthur Freeway are currently under way between Grand Avenue and Buell Street. When complete, these contracts together with those just opened to traffic will afford 6.5 miles of eight-lane freeway between the distribution structure and Mills College.

Four traffic separation structures, two pedestrian overcrossings and 11 retaining walls are being built by Peter Kiewit Sons Co. on the 1.7-mile contract between Grand Avenue and 14th Avenue. A modified split diamond interchange with additional ramps and channelization is being constructed in the Grand Avenue-Lakeshore area; at Park Boulevard, a modified half diamond with additional ramps is being constructed. This contract will cost approximately $4,392,000.

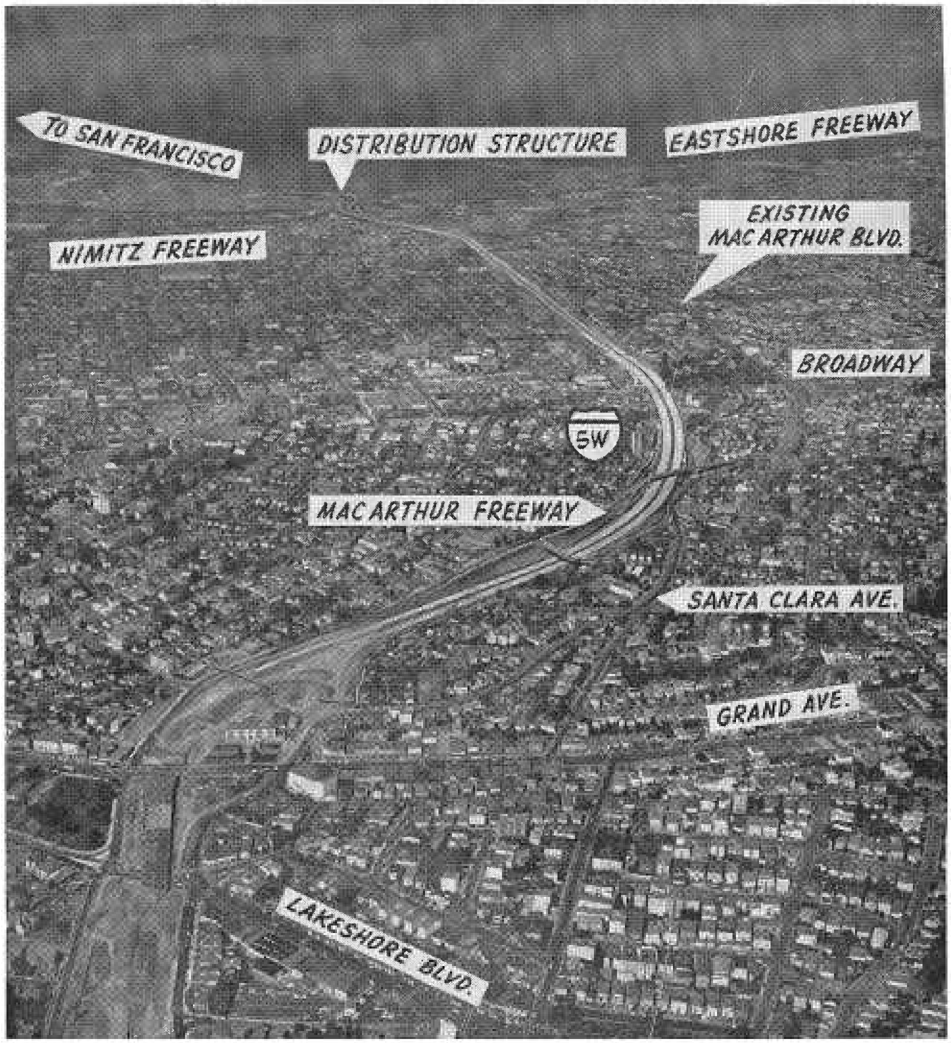
The 2.9-mile contract between Park Boulevard and Buell Street will cost approximately $7,680,000 and is being performed as a joint venture by Stolte Inc. and Morrison-Knudsen Co. Inc. Seven modified diamond interchanges are being constructed and a total of 15 structures are under construction to carry traffic over or under the freeway. A pedestrian separation is being built in the vicinity of Redding Street and 19 retaining walls are required to minimize right-of-way requirements.

Additional MacArthur Projects

Two additional projects are budgeted on MacArthur Freeway. $12,000,000 has been allotted for 4.5 miles of freeway between Buell Street and the east city limits near Durant Avenue. This project includes the connection to Warren Freeway in the vicinity of Calaveras Avenue, where a full directional interchange will be constructed. Modified diamond interchanges will be constructed at five other locations and a total of 12 overcrossings and undercrossings will be built.

South of the above project, $4,500,000 is budgeted for 1.9 miles of freeway between the city limits of Oakland and Sybil Avenue in San Leandro. The major interchange on this unit will be the directional type to be built at the intersection with existing Foothill Boulevard at the northerly end of the project. Seven undercrossings will be built for city streets and ramps in addition to two bridges to be constructed over San Leandro Creek for the freeway and a frontage road.

Funds are also budgeted for two landscaping projects on completed sections of MacArthur Freeway: $170,000 for the 2.3-mile section between the distribution structure and Grand Avenue and $195,000 for the unit between Grand Avenue and Park Boulevard when complete. (A progress report on the MacArthur Freeway will be published in the July-August 1962 issue of *California Highways and Public Works.*)



The MacArthur Freeway in downtown Oakland (Interstate 5W). The portion between the Distribution Structure and Grand Avenue was recently opened to traffic.

US 40 Construction

On US 40 (Interstate 80), $654,800 financed from toll bridge authority bonds was expended to reconstruct the San Francisco-Oakland Bay Bridge eastbound toll plaza and approach roadways. Three collection booths were added and the existing booths were revised to provide for collection from the driver's side. This work, completed in January, will accommodate the planned switch to one-directional traffic on each bridge deck upon completion of the current bridge modifications. Bids were opened May 31 for further revisions on the approaches in order to complete this modification. $119,500 has been budgeted for this work.

Currently under construction is five miles of median barrier, consisting of both cable chain link and blocked-out metal beam guard rail, between El Cerrito Overhead and San Pablo Dam Road. This contract is for $89,000.

Nimitz Freeway

Planned improvements on Nimitz Freeway (State Sign Route 17) continue. In March of last year $276,000 was expended to construct a 164-foot overcrossing at Floresta Boulevard in the City of San Leandro. The city contributed $137,500 to the cost of the contract which included grading and surfacing approach roadways.

Currently in progress is the 5.6 mile widening contract between Fallon Street and Hegenberger Road in Oakland which, when complete, will provide 8 lanes on Nimitz Freeway between El Cerrito Overhead and Hegenberger Road. This $4,441,000 contract, being performed by Dan Caputo and Co. and Cambrian Gateway, includes erection of blocked out metal beam guard rail. The work includes widening the High Street, Fruitvale and 5th Avenue Overheads and modification of inlet and outlet ramps at Hegenberger Road, High Street, 29th Avenue and 23rd Avenue interchanges. The existing left hand off-ramp at 42nd Avenue will be replaced with a right side takeoff.

South of Oakland, funds are budgeted for two additional construction projects on the Nimitz Freeway. Two diagonal ramps will be constructed at First Avenue Interchange and the existing two-lane overcrossing will be widened to four lanes. $482,000 has been allotted for this project. $85,000 has been budgeted for 4.3 miles of cable chain link barrier between Jackson Street in Hayward and Washington Avenue in San Leandro.

A landscaping project was completed between 5th Avenue Overhead and Linden Street in Oakland in March of last year. Presently underway is a 2.3 mile, $87,200 contract for landscaping and installing an irrigation system on the portion of Sign Route 17 between Central and Thornton Avenues, in Fremont.

Warren Freeway (Route 227)

Landscaping was also recently completed on the portion of Warren Freeway between Broadway Terrace and Redwood Road. $48,000 was expended to plant trees and shrubs.

Other improvements on Warren Freeway include the southerly portion included in the budgeted project on MacArthur Freeway and the current contract being built by Dan Caputo Co. for the construction of the Moraga Avenue Interchange at a cost of $1,292,000. This modified diamond, with additional connections and the construction of the Moraga Avenue Undercrossing will replace the existing signalized intersection.

State Sign Route 24

On State Sign Route 24, the current contract for the additional bore at Caldecott Tunnel is underway (see Contra Costa County). Funds are also budgeted for 1.5 miles of 8-lane freeway between Warren Freeway (State Highway Route 227) and the tunnel. Only that portion of the interchange at the westerly end of the tunnel and those frontage roads required to provide access to the tunnel for maintenance forces will be constructed on this $2,715,000 project. The remainder of this interchange and frontage roads, an avercrossing and the Warren Freeway-Highway 24 interchange will be built later.

An interim project at the intersection of Patton Street and Broadway in Oakland was completed on State Sign Route 24 for traffic signals, lighting and channelization at a cost of $49,000.

Webster Street Tube

Between Oakland and Alameda, work is still in progress on the $17,363,000 contract for the Webster Street Tube. The last of the prefabricated sections has been set in place and work is in progress to seal the last two sections. The 3,350 foot long tube is the twelfth underwater tube completed by this method, the adjacent Posey Tube having been the first.

The new tube will provide a two-lane roadway and, upon rehabilitation of the Posey Tube, one-way directional traffic will be accommodated in each tube. The contractor on this work is Pomeroy-Bates and Rogers & Gerwick.

As a part of the Webster Street Tube construction, $450,000 was expended on a contract completed in August to grade and surface a storage area between Mallory Street and Mitchell Avenue in Alameda. Drainage facilities and electrical systems were also installed. The work completed under this contract replaces U.S. Army facilities which were required for construction of the tube.

$1,100,000 has been budgeted for revisions of the existing Posey Tube which will be started as soon as traffic can be diverted to the completed Webster Street Tube. The proposed work includes tunnel entrance revisions, lighting, modification of the ventilation equipment and facing the interior with ceramic tile.

Sign Route 21 (Interstate 680)

Six and one-tenth miles of initial four-lane, ultimate six-lane, freeway is budgeted on State Sign Route 21 between State Sign Route 9 near Mission San Jose and Scotts Corner. This facility is part of the Interstate System (Route 680).

Interchanges and traffic separation structures will be constructed at Mission Boulevard and Vargas, Sheridan, Andrade and Calaveras Roads on this $6,200,000 project. Major structures will also be built over Alameda Creek. North of this project 1.8 miles of resurfacing of existing Sign Route 21 was completed between US 50 and the Alameda-Contra Costa County line at a cost of $62,500.

State Route 105 (Jackson Street)

Currently in progress is a 1.7 mile contract, costing $2,143,000, between Harder Road and Castro Street (Mission Boulevard) in Hayward. This work is being done by Gallagher & Burke. Route 105 (Jackson Street) is being widened to a four-lane divided arterial with parking lanes. The substandard underpass under the Western Pacific Railroad is being replaced. An underpass is also being constructed at Orchard Avenue under the Southern Pacific Railroad. The City of Hayward contributed $74,400 and the Southern Pacific Railroad $73,400 to assist in the financing.

Other Projects

Many other projects were completed on State Sign Routes 9 and 84 in Alameda County during the past year. These included the $761,000 contract for widening 4.0 miles of Mission Boulevard (Sign Route 9) between Sycamore Avenue and Gresel Street in Hayward. An 80-foot roadbed with a 16-foot concrete median island was constructed and highway lighting and traffic signals were installed. The City of Hayward will plant trees in the median strip of this project.

On Sign Route 84, shoulders were reconstructed and some realignment and resurfacing was done on the 6.2-mile portion between Mission Boulevard in Fremont and Sunol at a cost of $79,200. Peralta Boulevard between Fremont Boulevard and State Sign Route 9 was also widened and resurfaced. This 2.5-mile contract was completed in July at a cost of $85,900.

CONTRA COSTA COUNTY

With the completion of US 40 (Interstate 80) to full freeway between the Bay and Carquinez Bridges, construction emphasis has shifted eastward to development of State Sign Route 21 (Interstate 680) north and south of Walnut Creek, and to completion of Sign Route 24 between the metropolitan communities and the rapidly expanding suburban areas east of the Berkeley hills. Several projects on these routes, currently under way or budgeted, when complete will provide approximately 30 miles of continuous freeway from Caldecott Tunnel in Oakland to US 40 north of Vallejo via the Benicia-Martinez Bridge.

Sign Route 21 (Interstate 680)

Bids were opened May 16, 1962, for a 6.8-mile contract on Sign Route 21 between 1.0 mile south of Danville and Walnut Creek. This initial four-lane, ultimate six-lane freeway will connect to the existing Sign Routes 21 and 24 Bypass in the vicinity of Walnut Creek and will cost approximately $12,900,000, representing the largest single contract budgeted in the San Francisco Bay area.

Major Structures

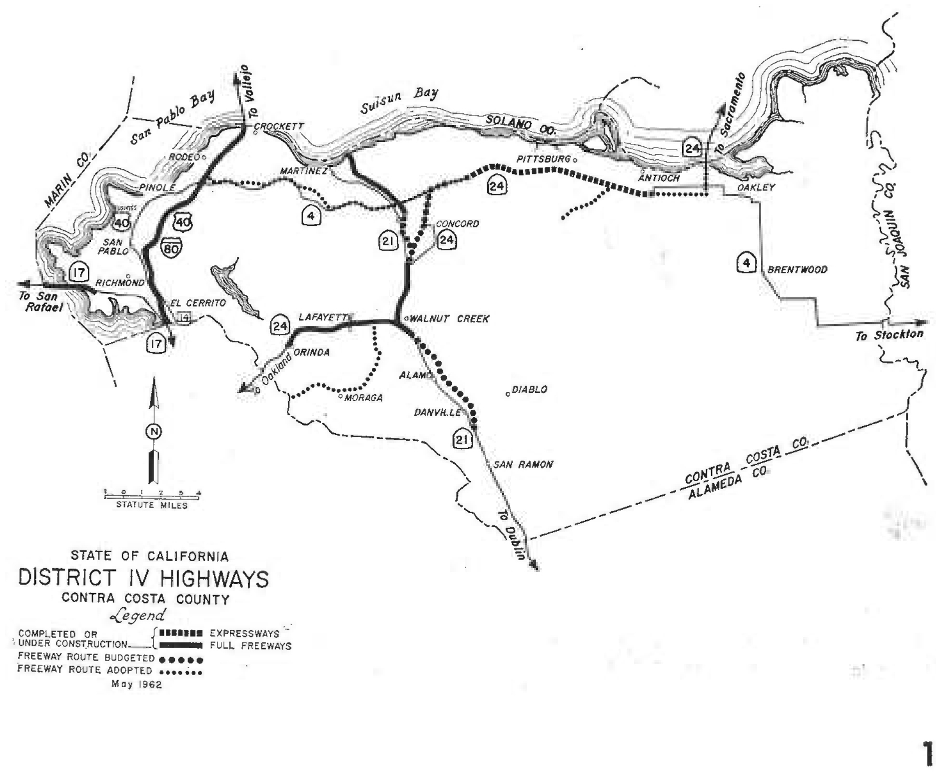
A total of 13 major structures are to be completed, including four separate bridges over San Ramon Creek and an overhead over the Southern Pacific Railroad north of Sycamore Valley Road. Interchanges will be provided at Sycamore Valley, Diablo, El Fintado, El Alamo, Stone Valley, Livorna and Rudgear Roads. Contra Costa County will contribute approximately $343,000 toward the cost of county road construction and local drainage improvements.

Monument Road Area

In the area north of Walnut Creek, a portion of Sign Route 21 between Monument Road and Willow Pass Road is included in the project budgeted on Sign Route 24 between 0.2 miles south of Monument Boulevard to 0.1 mile south of Olivera Road. Bids were opened on May 23 for this 3.8-mile project which will cost approximately $5,450,000. A diamond interchange will be constructed at Monument Boulevard and cloverleaf interchanges will be built at Grant Street and Willow Pass Road. Five undercrossings as well as structures over Walnut and Pine Creeks and an overhead over the Southern Pacific Railroad at Concord Avenue will be constructed.

Four Interchanges

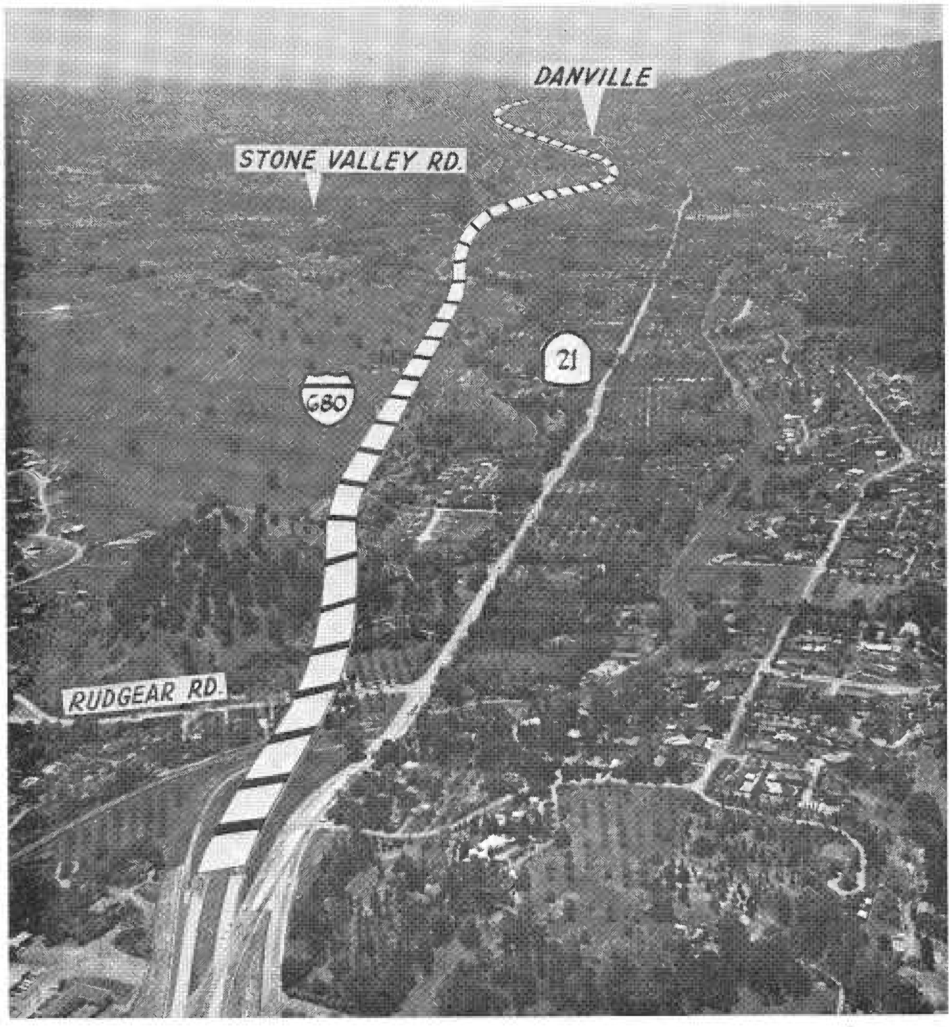
North of the above project, work is under way on a 4.2-mile portion of Sign Route 21 between Willow Pass Road and State Sign Route 4. Four interchanges are being constructed on this $3,984,000 contract; a half cloverleaf at Pacheco Boulevard-Sign Route 4 intersection, a full cloverleaf at the intersection of Sign Routes 4 and 21, a full diamond at Concord Avenue and a half diamond at Willow Pass Road. In addition, structures will be built on both Sign Routes 4 and 21 across Grayson Creek and at Center Street. Contra Costa County is contributing $63,000 for adjacent county road work. This project will complete 2.3 miles of freeway on State Sign Route 21 and approximately 1.2 miles of freeway on Sign Route 4. The contract is being performed as a joint venture by G. H. Ball and G. H. Ball Inc.



Revenue Bond Job

Between Arnold Industrial Highway (State Sign Route 4) and the Benicia-Martinez Bridge, construction is under way by Peter Kiewit Sons Co. to complete 3.9 miles of initial four-lane, future six-lane freeway to Escobar Street in Martinez. This $5,131,000 contract is financed from revenue bonds and calls for overcrossing structures at Blum Road and the East Martinez trumpet interchange. An underpass is being constructed at the Santa Fe Railroad in East Martinez and an overhead structure in the Mococo cloverleaf interchange over Escobar Street and the Southern Pacific Railroad. A half diamond interchange and the Arthur Road Undercrossing are being constructed at the approach to the bridge, which is expected to be completed in November of this year at a cost of $14,-238,000.

During the past year, $474,000 was expended to grade and pave Howard and Escobar Streets between Berrellesa and Laguna Streets to provide a connection to the bridge approach from downtown Martinez and $62,500 was spent for resurfacing State Sign Route 21 between US 50 at Dublin and 0.2 mile north of the Alameda-Contra Costa county line.



Looking south along the future routing of Interstate 680 between Walnut Creek and Danville. Present Sign Route 21 generally parallels the routing to the right. Bids have already been opened on construction of the project.

US 40 (Interstate 80)

On US 40 (Interstate 80) two landscaping projects were completed during the past year. Between 0.3 mile south of El Cerrito Overhead and 0.3 mile south of Jefferson Avenue in Richmond, approximately $191,500 was expended to landscape 2.5 miles. It was completed in March of this year. In October of last year a $27,000 contract was completed for landscaping the Carquinez Bridge approaches and the Crockett Interchange.

Funds are budgeted for a $420,000 project for the construction of the Barrett Avenue offramp in Richmond on US 40. Presently under construction is a $89,000 contract for constructing 4.7 miles of median barrier between El Cerrito Overhead and San Pablo Road in Richmond.

Sign Route 24

In addition to the recently advertised contract between Monument Boulevard and Olivera Road previously discussed, funds are budgeted on State Sign Route 24 for 2.0 miles of eight-lane freeway between the east portal of Caldecott Tunnel and 0.4 mile west of Orinda Highway. Bid opening is June 20, 1962. Two interchanges will be constructed on this $7,500,000 project, a two-quadrant cloverleaf at Gateway Drive and connections to Fish Ranch Road at the east portal of the tunnel.

New Tunnel Bore

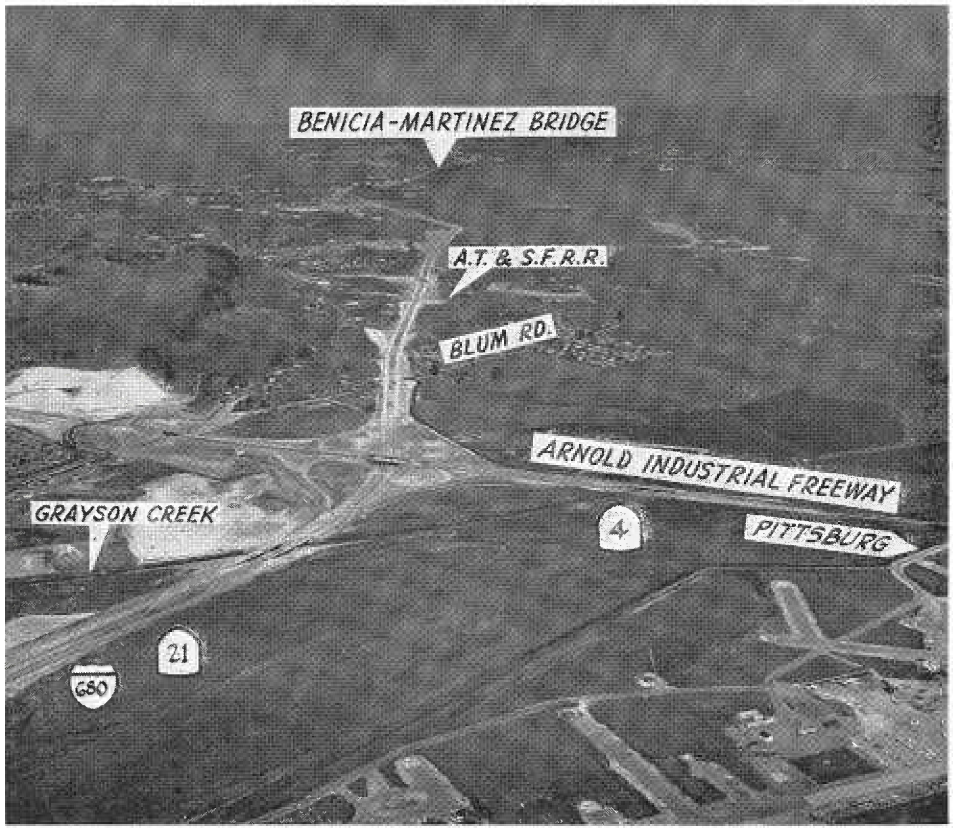
An additional two-lane bore is now under construction paralleling the two existing bores of the Caldecott Tunnel. Completion of this bore in 1964 will permit the use of four lanes for directional peak hour traffic. This 0.7-mile contract, including approaches will cost about $10,897,000 and is being performed as a joint venture by Connelly-Pacific Co., Grafe-Callahan Const., Brayer Electric Co. and Chas. L. Harney Inc.

Landscaping Completed

Two landscaping jobs were completed on the new freeway portions of Sign Route 24 during the past year. In September, a 2.4-mile contract costing approximately $119,000 was completed between Orinda Highway and West Sunnybrook Drive. Between Pleasant Hill Road and Walden Road and Creekside Drive, a landscaping contract was completed in December. This 4.5-mile project cost approximately $232,000.

Other Contracts

On Sign Routes 4 and 24, $13,400 was expended for traffic signals and channelization islands at 18th Street and "A" Street in Antioch. This work was completed in September. $47,000 is budgeted to construct a truck passing lane on Barry Hill and to channelize portions of State Sign Route 4 between 0.3 mile south of McEwen Road and 0.2 mile east of Muir Road. This project includes the channelization at Muir Road at the entrance to the Veterans Administration Hospital.



Interstate 680 north of Concord looking toward the Benicia-Martinez Bridge.

MARIN COUNTY

Conversion of US 101 to full freeway standards between the Golden Gate Bridge and Hamilton Air Force Base is a step closer with the completion of the Sir Francis Drake Boulevard (Greenbrae) and Miller Creek Road interchanges during the past year. In addition to this work, other improvements were completed or budgeted to provide safer traffic service on this heavily traveled thoroughfare. Two additional projects are now budgeted for extending the freeway to State Sign Route 37 with an interchange at Ignacio.

US 101—Greenbrae to Ignacio

South of San Rafael, the third stage of construction on Greenbrae Interchange was completed in September. Peter Kiewit & Sons Company, contractor for this project, removed the old wooden bridge across Corte Madera Creek and erected a new structure for the northbound off-ramp to Sir Francis Drake Boulevard. The Greenbrae structures for freeway traffic were completed on two previous contracts. This last $1,151,000 contract included reconstruction of Sir Francis Drake Boulevard and construction of ramps and frontage roads.

Work is presently under way on the reconstruction of the Auburn Street Railroad Underpass in the San Quentin Wye area south of San Rafael, a portion of the interchange frontage road arrangement. An amount of $115,000 is allotted for this work, which also provides for extending Woodland Avenue under co-operative financing with the County of Marin.

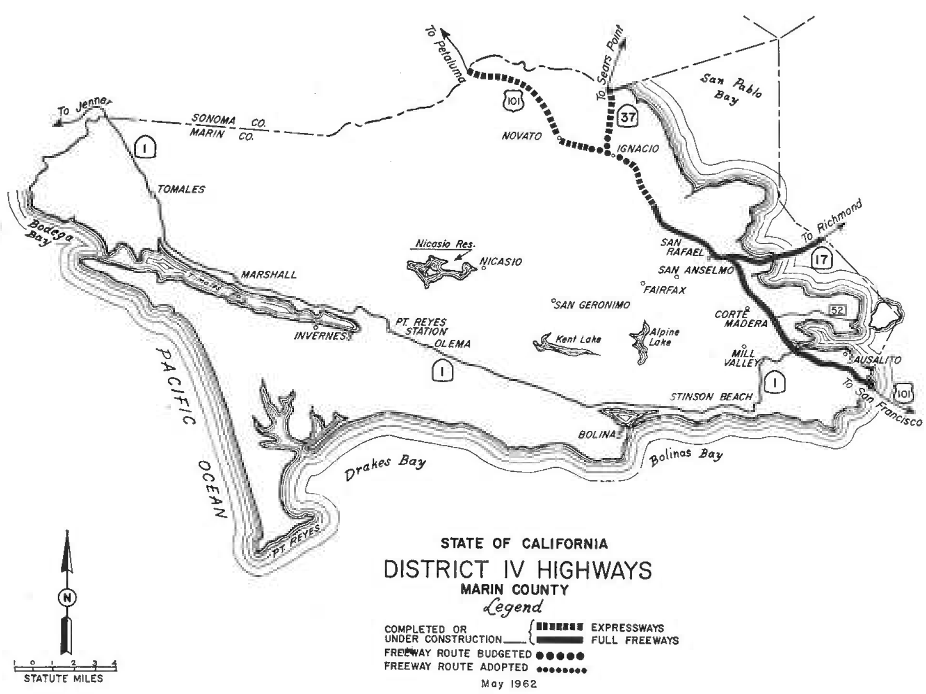
North of San Rafael, a $633,500 construction contract by Charles L. Harney, Inc. provided the initial construction of the Miller Creek Road Interchange. This work included widening and resurfacing approximately 1.3 miles of freeway and the construction of the diagonal ramps of a future four-quadrant cloverleaf and two lanes of the ultimate four-lane overcrossing. This contract was completed in October.

At Gallinas Creek near the north city limits of San Rafael, a $121,000 contract for culvert and channel lining construction was completed in September. This work added additional capacity and provided length to accommodate the ultimate eight-lane freeway width.

US 101—Novato

North of Novato, $139,000 was expended to repair shoulder failures and construct drainage facilities between 2.2 miles north of Atherton Avenue and the Petaluma Creek Bridge. This contract was completed in January 1962.

Two major projects in the Novato area are in the current construction budget. One is the $3,500,000 project from Miller Creek Road to north of Entrada Drive to provide 2.7 miles of initial six-lane, ultimate eight-lane freeway with frontage roads. Inter-



changes at Pacheco Creek and San Jose Boulevard are included. Hamilton Air Force Base will be served from an easterly frontage road connecting the two interchanges. Auxiliary climbing lanes will be constructed over St. Vincents Hill for heavy truck traffic.

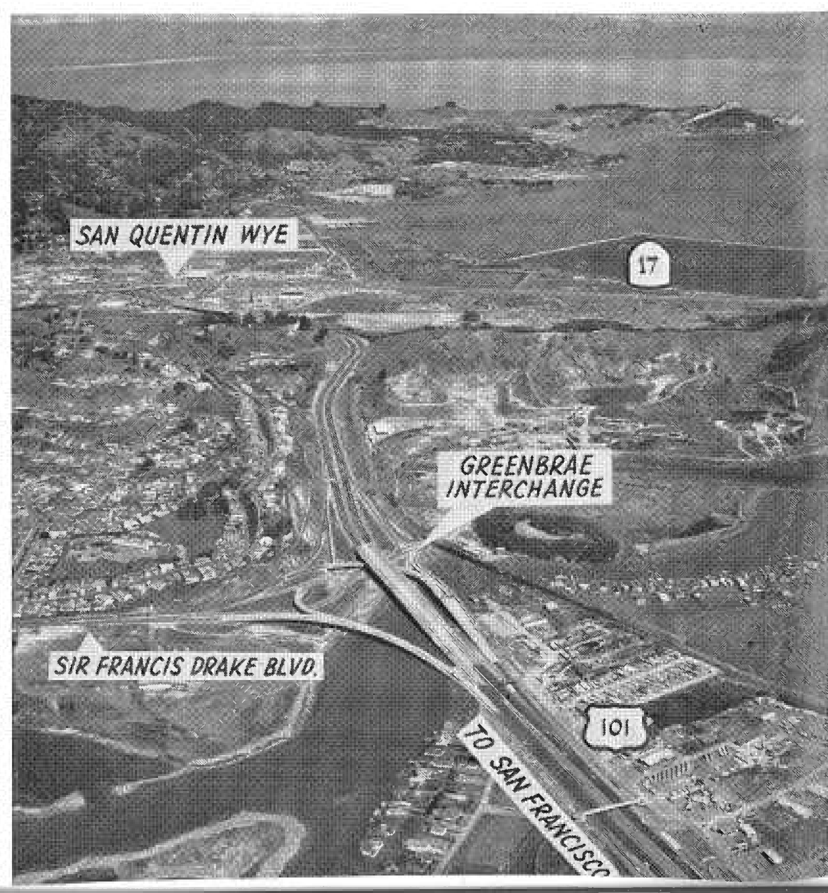
The second project is the $4,000,000 interchange at US 101 and Sign Route 37. Five structures, including the Northwestern Pacific Railroad Overhead, will be constructed. This is a directional type interchange except for the cloverleaf loop to be constructed in the northeast quadrant to serve US 101 northbound traffic to South Novato Boulevard. Considerable congestion now occurs at this signalized intersection caused by commute traffic and also recreational traffic from Sacramento, Russian River and Lake County resorts.

US 101—Golden Gate Bridge Area

One of several improvements programed for the Golden Gate Bridge Freeway (Waldo approach to the bridge) was completed last year with modification of the lighting on the county road connections at the Waldo Interchange. There is also a contract under way to modify the Golden Gate Bridge approaches to meet structure widening being done under Bridge District contract. $225,000 has been allotted for constructing lane transitions, installation of median barrier between the bridge and the Waldo Tunnel, adding a northbound lane from Vista Point to the Sausalito Road Undercrossing and an improved Sausalito Road channelization.

An amount of $200,000 is budgeted for improvement of Vista Point parking area at the northerly end of the Golden Gate Bridge. This project in-

BELOW LEFT—The Freitas Park overcrossing was completed last year. The development of suburban residential areas, such as Terra Linda on the left, warranted the replacement of the former signalized intersection on busy US 101. BELOW RIGHT—Looking north toward San Rafael in Marin County from above the recently completed Greenbrae Interchange.



cludes grading, paving, parking areas, landscaping and directional pointers naming important landmarks. A combination rubble masonry and redwood guard railing on the perimeter of the sidewalk around the parking area is included.

An $80,000 landscaping project for 1.7 miles of the freeway between Waldo Undercrossing and just north of Freitas Parkway and a $33,300 interim project to widen the northbound lanes between Lincoln Avenue Undercrossing and San Pedro Road are included in the budget.

Other Improvements

Construction is under way on State Sign Route 1 between Stinson Beach and Bolinas Road. This $137,600 contract is for re-constructing drainage facilities and resurfacing the existing two-lane conventional highway.

Bids were recently opened on a $540,000 contract near Mill Valley, on Tiburon Boulevard (State Highway Route 52), between US 101 at Alto Wye and 0.4 mile east of Strawberry Drive. The existing two-lane road will be replaced by a four-lane divided section with traffic signals at intersections.

NAPA COUNTY

Major highway development within Napa County in recent years has been generally confined to initial stage construction of two- and four-lane expressways on adopted freeway routes north, south and west of Napa. This steady improvement to modern highway standards continued during the past year with the completion of two contracts on State Sign Route 29 in the vicinity of Imola Avenue in Napa.

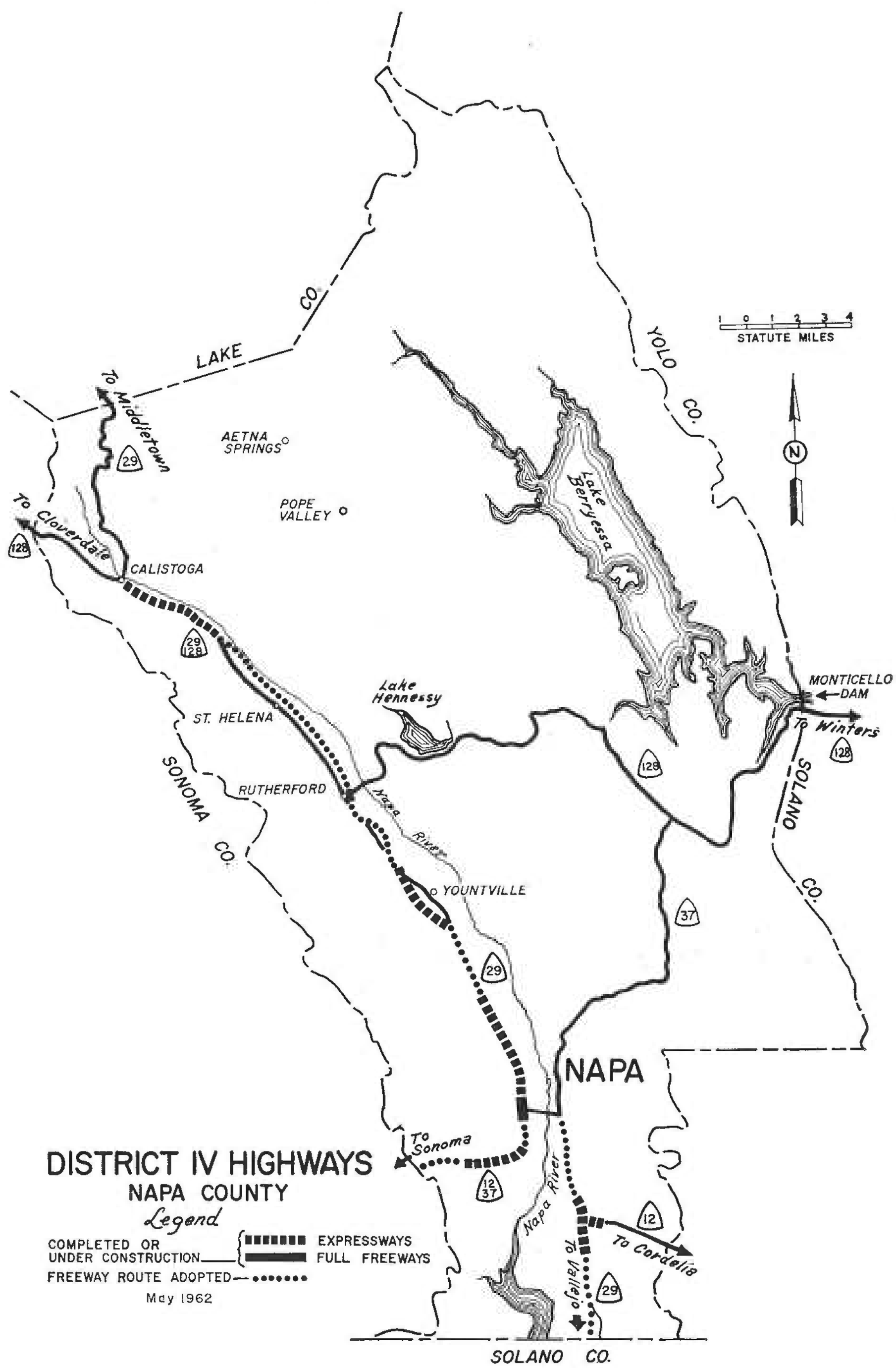
Freeway Construction

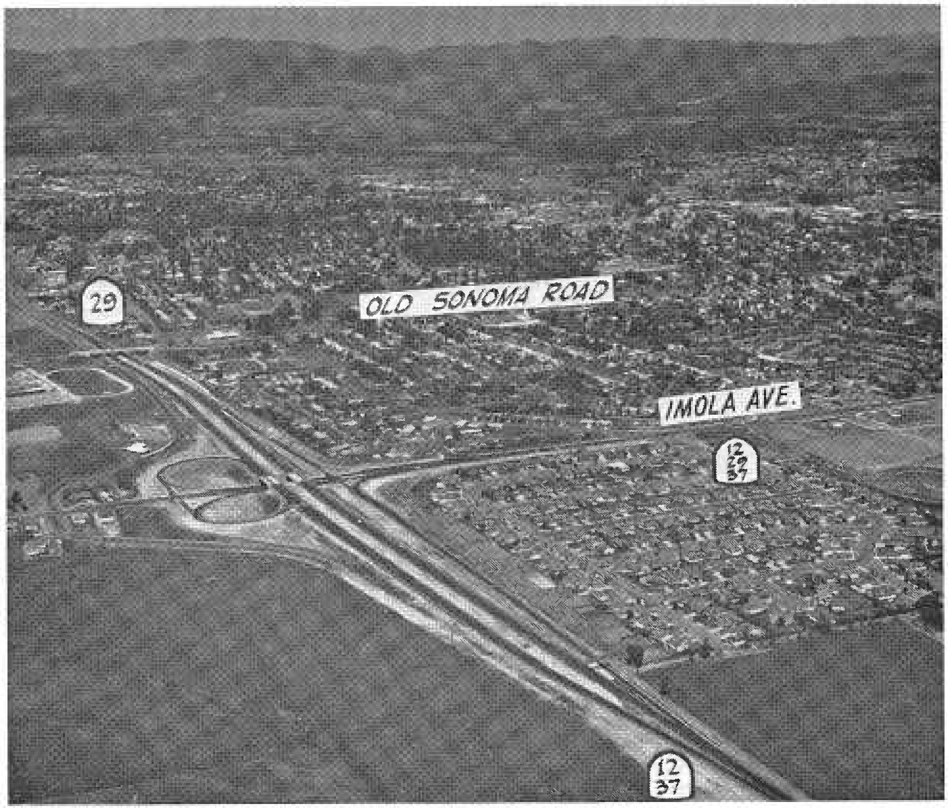
The first of these was completed last June at a cost of approximately $372,000. This contract included the construction of the Old Sonoma Road overcrossing, its approaches and frontage roads between Imola Avenue and 0.1 mile north of Old Sonoma Road. The second contract, completed in February, provided the interchange at Imola Avenue, including one mile of four-lane freeway to Old Sonoma Road. Included in the 1962-63 budget is $60,000 for functional planting within these limits.

Other Work on Sign Route 29

Two other contracts were recently awarded on Sign Route 29 and an additional project is budgeted. South of Napa, a contract has been let to resurface 2.6 miles of the southbound lanes between Imola Avenue and Kelly Road at a cost of $104,000, and construction is currently in progress on a $56,000 contract to construct three truck turnout lanes on Mount Saint Helena between Calistoga and the Lake County line.

Northwest of Napa, a $585,000 contract will be let to widen portions of existing Sign Route 29 to a 40-foot all-paved section between Dry Creek and Oakville. Construction of front-





The Imola Avenue Interchange in Napa where Sign Routes 12, 29 and 37 join.

age roads will be included in the southerly portion between Dry Creek and California Drive. Work will also include improvement of drainage facilities in cooperation with Napa County.

Sign Route 128

Two projects were completed on State Sign Route 128 northeast of Napa during the past year. $18,500 was expended for line changes to avoid slipouts near Lake Berryessa, about 6.1 miles east of the junction with Sign Route 37, and a $38,000 contract was completed in March of this year for reconstruction about 21 miles northeast of Napa. This year, $50,000 is budgeted for grading and paving of an 0.8-mile portion of Sign Route 128 between Pope Valley Road and the Monticello Dam relocation.

Sign Route 37

On Sign Route 37, $72,000 was expended by the State with an additional contribution of $16,000 by Napa County for realignment and widening of the existing two-lane highway between 3 miles and 12 miles northeast of Napa. Bids were opened May 31 for a $160,000 contract to widen this route at seven locations between Vichy Springs and Sign Route 128. A minimum 26-foot all-paved section will be constructed. Upon completion of the project, only about 2.5 remaining miles of the highway between Napa and Route 128 will require widening.

SAN FRANCISCO COUNTY

The major construction effort for the past few years, in the City and County of San Francisco, has been concentrated on the Southern Freeway. When complete, this freeway will connect James Lick Memorial Freeway (Bayshore Freeway) with the future Junipero Serra Freeway in Daly City.

The first unit was opened to traffic in July 1960, with the completion of the $7,565,000 interchange complex at the James Lick Freeway. The $4,273,000 unit between Mission Street and the completed interchange is presently under construction by Charles L. Harney, Incorporated. When completed in 1963, it will provide the first usable portion of the six-lane, ultimate eight-lane, freeway. Two major overcrossing structures, serving local traffic to and from Alemany Boulevard, are included, as well as overcrossings for Mission Street, Justin Drive, and a pedestrian bridge near Gladstone Drive.

Work started in December 1961 on the next unit extending from 1.1 mile west of Mission Street to Ocean Avenue. This $6,080,000 project was also awarded to Charles L. Harney, Inc., and consists in grading and paving for a six-lane freeway, constructing 13 traffic separations, pedestrian crossings and interchange structures, and nine retaining walls. Overcrossings are being constructed at Paulding Street and Baden Street, and pedestrian overcrossings will be provided at Theresa Street and Lamartine Street. The remaining nine structures will be overcrossings and undercrossings in the vicinity of San Jose Avenue, to furnish traffic service to San Jose Avenue, Monterey Boulevard, Bosworth Street and Lyell Street.

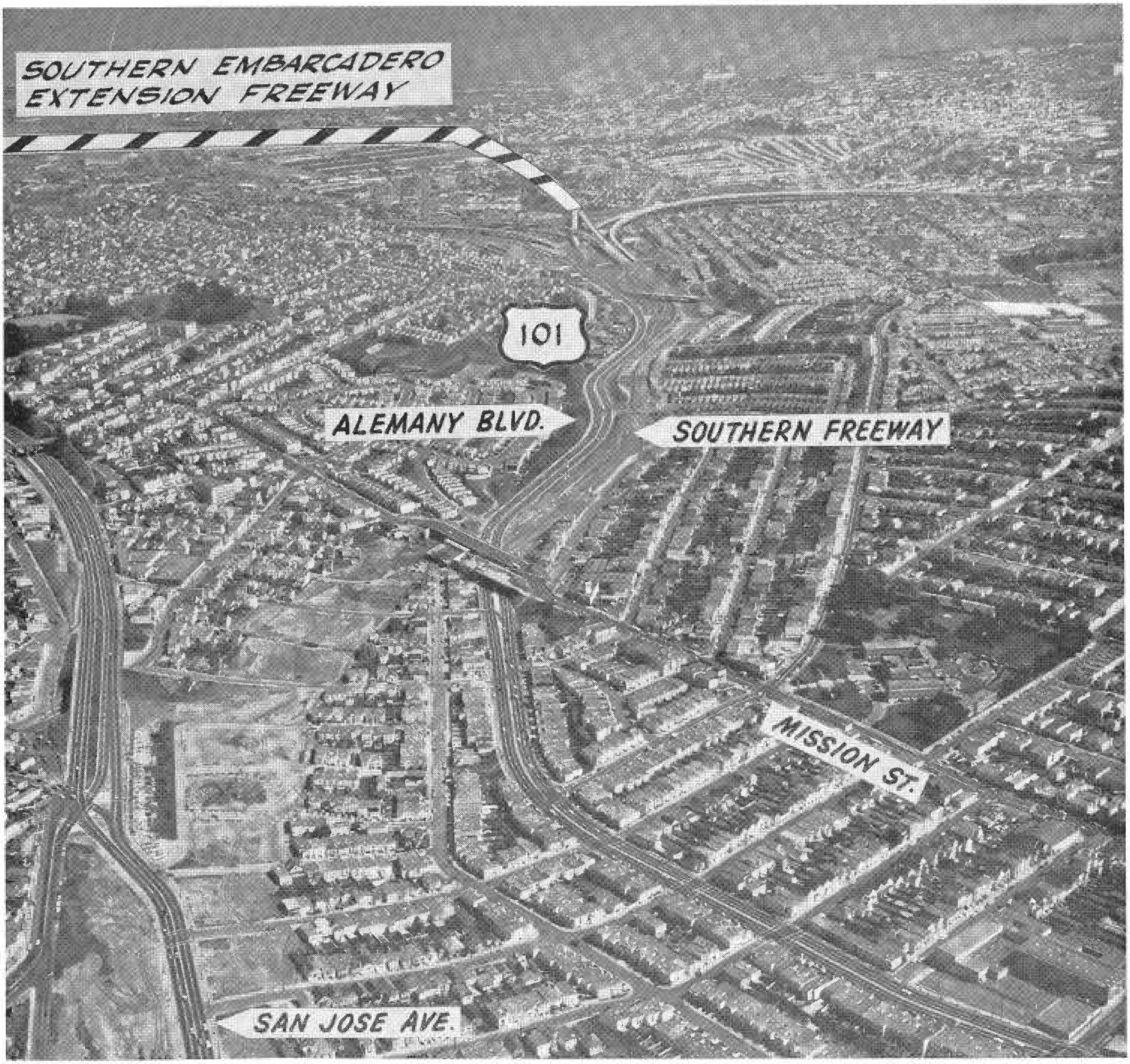
Ocean Avenue

The next project, extending from Ocean Avenue to Orizaba Avenue, will be under construction shortly, and is expected to be completed at about the same time. A total of $4,600,000 has been budgeted for it. Interchange facilities will be constructed at Ocean Avenue and ramps will be provided for traffic to and from San Jose Avenue in the vicinity of Plymouth Avenue. Major structures include overcrossings for San Jose Avenue in the vicinity of Broad Street and Mount Vernon Avenue, Geneva Avenue and Ocean Avenue. Undercrossing structures will be constructed for the freeway and ramps at San Jose Avenue and Sickles Avenue, and pedestrian overcrossings are planned for Whipple Avenue and Havelock Street.

The first two units of the Southern-Embarcadero Extension Freeway have been budgeted. Construction of the double deck viaduct between James Lick Memorial Freeway and Newcomb Street should be underway this summer. A total of $5,500,000 has been budgeted for this construction, which will not provide a useable unit, however, until completion of the second unit between Newcomb Street and Army Street.

This second unit, scheduled for construction in 1963, will provide the transition from the double deck viaduct to a single deck viaduct, and freeway facilities to Evans Street, at a cost of approximately $5,580,000. An on-ramp will be built to Army Street.

During 1961 the route for the Southern-Embarcadero Extension was



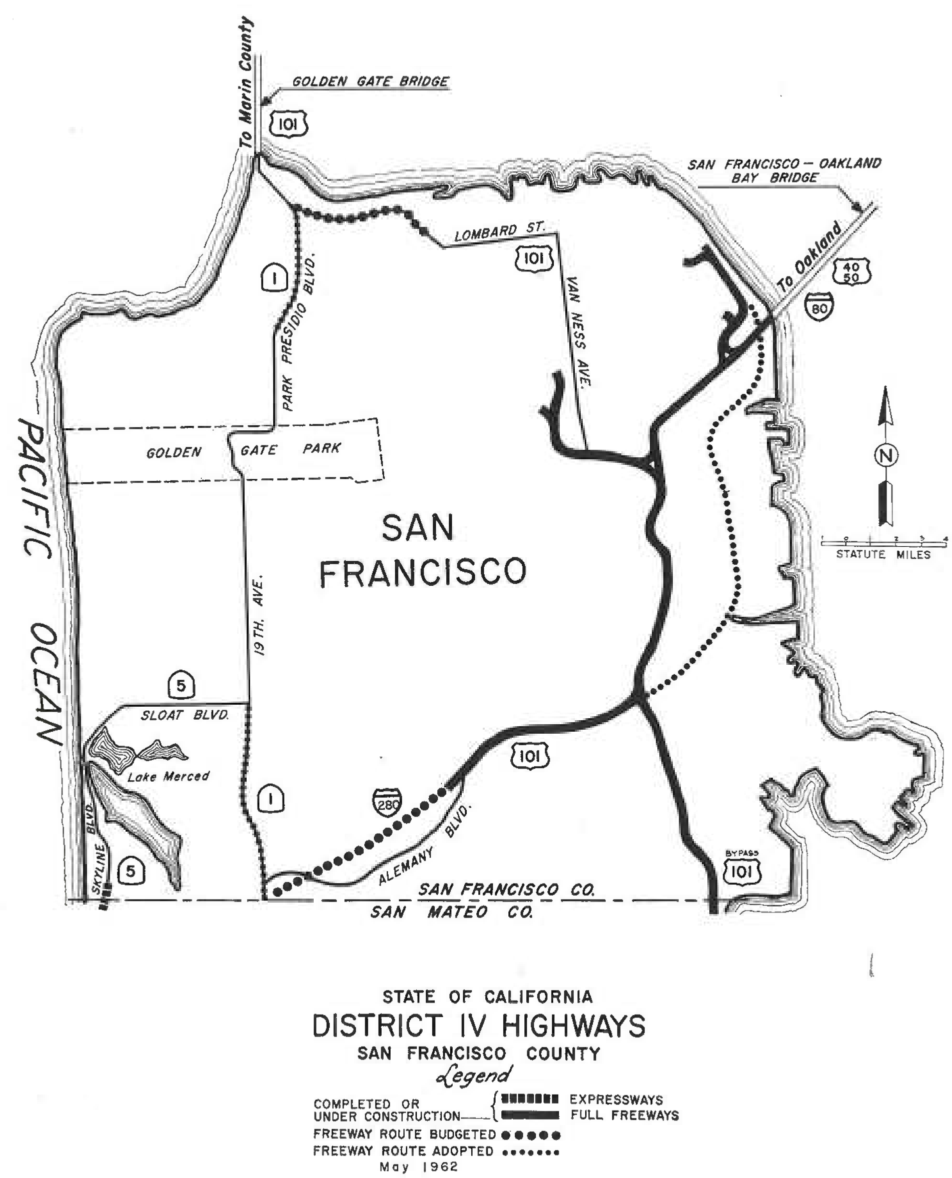
The Southern Freeway on US 101 in San Francisco. The future location of the Southern-Embarcadero Freeway extension is shown in the background. The portion between the James Lick-Southern Freeway Interchange and Mission Street is under construction and the right of way west of Mission Street has been cleared.

adopted by the California Highway Commission. When complete, this freeway will provide much needed relief to the Bayshore Freeway northerly of its interchange with the Southern Freeway.

Ramp Connections

Funds are budgeted in the amount of $1,470,000 and design is underway for additional ramp connections to the Embarcadero Freeway between Howard and Vallejo Street. These ramps will provide service to Clay and Washington Streets within the Golden Gateway Redevelopment area, which is scheduled for clearance early in 1963.

Three landscaping projects were completed during the past year on the James Lick, Southern and Central Freeways, and funds are budgeted for a similar project on the Embarcadero Freeway, between First and Stewart Streets. Eucalyptus trees were planted in the vicinity of the Southern-James Lick Freeway Interchange and acacia, tea trees, and other shrubs, were placed on this contract as well as the other two. Ivy plants and ice plant cuttings were used on these projects for ground cover.



SAN MATEO COUNTY

For many years the major demand for highway facilities was on the easterly side of the Peninsula, connecting the many suburban communities which had grown up along the Bay with San Francisco and San Jose. However, in recent years, a growing need for additional high standard, north-south arteries through the central, hilly portion and along the ocean coast, as well as east-west connections, has become more apparent.

19th Avenue Freeway

The first major step to fill the need for an east-west freeway is the present construction on State Highway Route 105 (19th Avenue Freeway) between West Hillsdale Boulevard and South Delaware Street in San Mateo. Eventually, this freeway will extend from Half Moon Bay to Hayward via the San Mateo-Hayward Bridge.

The unit presently under construction by L. C. Smith and Concar Ranch and Enterprises provides access to the new campus of the College of San Mateo. The 2.6-mile project will cost approximately $4,652,500 including contributions of $100,900 from the County of San Mateo, $76,500 by the Southern Pacific Railroad and $6,000 by the city. Four lanes are under construction between West Hillsdale Boulevard and El Camino Real, easterly of El Camino, a six-lane freeway will be constructed. Traffic separation structures and interchanges are being built at Alameda de las Pulgas, El Camino Real (US 101) and South Delaware Street, and an undercrossing will be constructed at Palm Avenue. This contract also includes an overhead crossing over the main tracks of the Southern Pacific Railroad near Pacific Boulevard.

Cabrillo Highway (Sign Route 1)

On State Sign Route 1, on the west coast, $3,850,000 is budgeted for a 3.2-mile, initial four-lane, ultimate six-lane freeway between 1.1 mile south of Sharp Park Road and 0.4 miles north of Manor Drive in Pacifica. This project includes an interim channelization at Westport.

Overcrossing structures will be built on this contract at Sharp Park Road, Clarendon Avenue, Paloma Avenue and at Manor Drive. A full interchange will be constructed at Sharp Park Road and access ramps will be provided in the vicinities of Clarendon Avenue, Belle Vista Avenue, Milagra Drive and Monterey Road. Pedestrian separations will be built at Fairway and Milagra Drives.

South of Half Moon Bay on Sign Route 1 (Cabrillo Highway), work is under way on a $592,000 contract between 0.5 mile south of and 0.3 mile north of Tunitas Creek. The work includes construction of a new bridge across Tunitas Creek and improving the approaches.

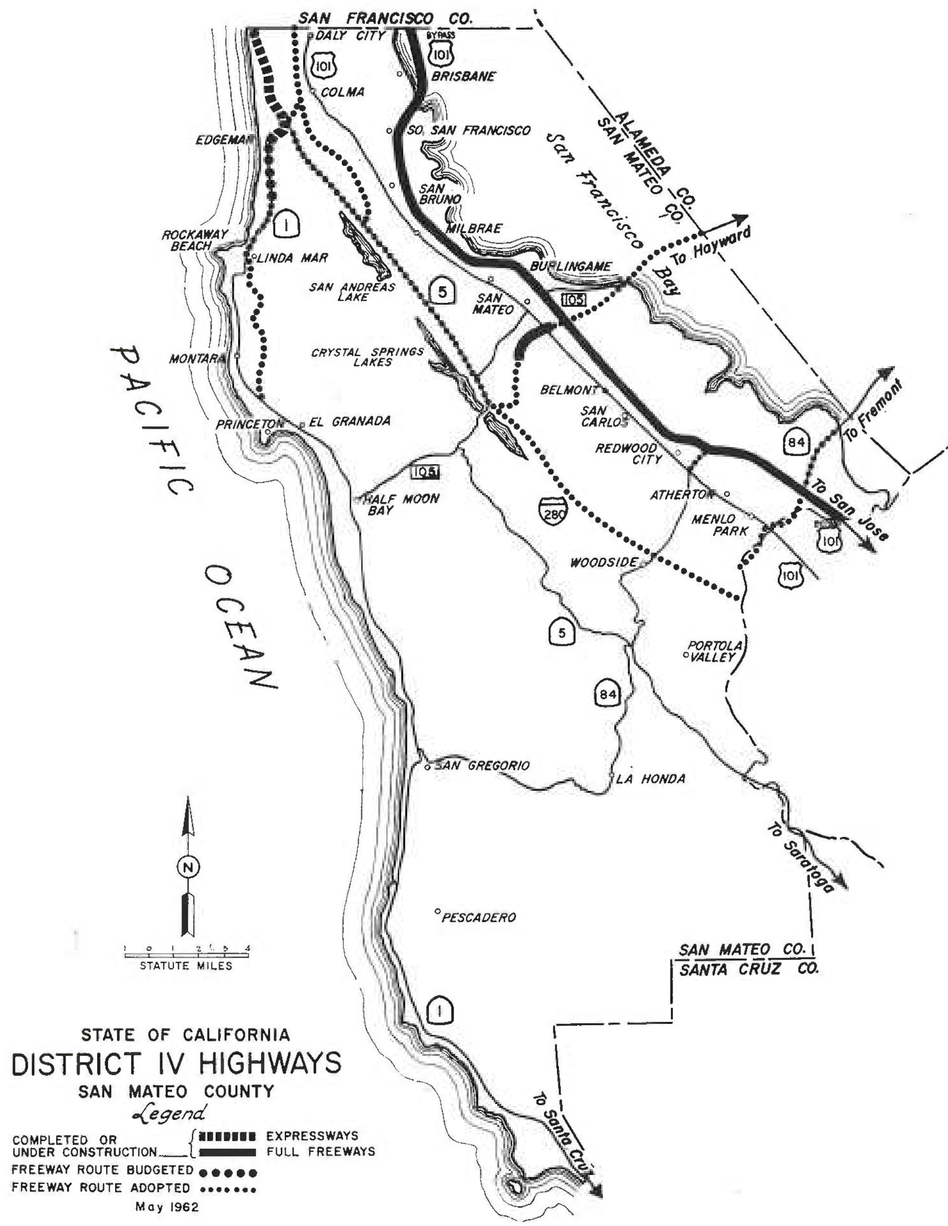
El Camino Real (US 101)

Several contracts were completed on El Camino Real (US 101) during the past year, including major widening between Taylor Boulevard and Santa Helena Avenue in Millbrae. Approximately $254,000 was spent on this 0.8-mile project to widen the existing four-lane conventional roadway to a six-lane divided highway. Elsewhere, traffic signals and lights were installed or modified and channelizations constructed on two separate projects on El Camino Real. One location was at Broadway in Redwood City and the other between Menlo Avenue and Partridge Avenue in Menlo Park.

Funds are budgeted for 1.7 miles of widening on El Camino Real between Millwood Drive in Millbrae and Euclid Avenue in San Bruno. $530,000 has been budgeted for this project to widen the existing four-lane conventional roadway to a six-lane divided highway. $290,000 will be provided by the Cities of Millbrae and San Bruno to construct adjacent parking aprons and sidewalks and install street lighting.

US 101 Bypass (Bayshore Freeway)

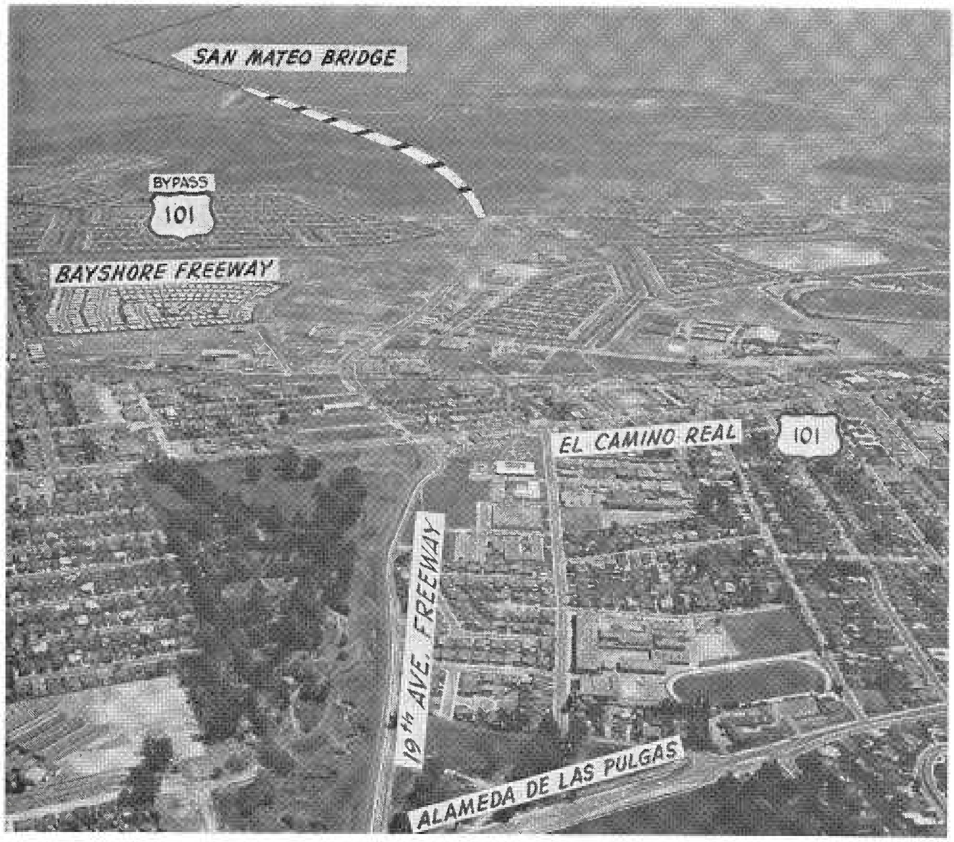
The major improvement on Bayshore Freeway (US 101 Bypass) in San Mateo during this period was the



completion of 7.5 miles of widening to eight lanes between Grand Avenue in South San Francisco and Peninsular Avenue in Burlingame. This $1,662,000 contract eased the severe peak-hour traffic congestion in the vicinity of the San Francisco International Airport. In addition to the widening and resurfacing of the existing traffic lanes to provide a smoother riding surface, the work included the construction of a diagonal ramp in the southwest quadrant of the Millbrae Interchange and improvement of ramps in the other quadrants. Double blocked out metal beam barrier was placed in the median on this project and 19 illuminated signs were installed. L. C. Smith was the contractor.

Presently under way is a contract for $280,000 for placing either cable chain link or blocked-out metal beam barrier on the remaining portions of Bayshore Freeway between Sierra Point Overhead near South San Francisco and Redwood Creek Bridge in Redwood City. Sign structures and sign lighting systems are also to be installed on the 17.4-mile project.

Bids were opened May 2 for resurfacing portions of US 101 Bypass between Buter Road in South San Francisco and Third Street Overcrossing



The 19th Avenue Freeway under construction in San Mateo. The future connection to the new San Mateo-Hayward Bridge, which will be constructed by the State Division of Bay Toll Crossings, is shown in the background.

in San Francisco. $420,000 is allotted for this 3.5-mile contract, which will provide a higher quality riding surface over the existing Candlestick fill cutoff.

Bayshore Landscaping

A $71,000 landscaping contract was completed in April of last year between 16th Avenue in San Mateo and Bransten Road in San Carlos.

Two additional landscaping contracts are under way; between Spruce Avenue in Redwood City and University Avenue in Palo Alto, 4.1 miles of Bayshore is being landscaped at a cost of $84,000. South of University Avenue to Natadero Creek, a 1.9-mile project will cost $61,400.

Projects were also completed or are budgeted on several of the other routes in the county. $42,700 was expended on a 0.2-mile realignment of State Sign Route 84 approximately three miles north of Woodside. Traffic signals and lights were installed and a channelization was constructed at Eastmore Avenue at the south city limits of Daly City on existing Junipero Serra Boulevard at a cost of $18,900.

An amount of $60,000 is budgeted for signals and channelization at the intersections of Sharp Park Road and Westborough Boulevard and Skyline Boulevard (State Sign Route 5). A channelization will also be constructed at the intersection of Skyline with Manor Drive and $28,000 is budgeted for this purpose.

Beaches and Parks

Funds are also budgeted for Division of Highways participation in the development of Thornton Beach State Park by the Division of Parks and Beaches. Bids were opened May 2 on this project for constructing a two-lane access road, parking areas, and a water and sewer system for this newly established metropolitan recreational area for picnicking, fishing, hiking and beach sport. The access road will utilize a large portion of relinquished State Sign Route 1 from Alemany Boulevard and the work includes 1,600 feet of resurfacing and 600 feet of realignment.

The major portion of the work, $85,000, is being paid by the Division of Parks and Beaches, the highway allotment being $25,000.

SANTA CLARA COUNTY

Highway development in rapidly-growing Santa Clara County has recently included completion of two contracts converting Bayshore Freeway (US 101) to full freeway standards and the recent award of the first contract for construction of Junipero Serra Freeway (Interstate 280). Other contracts were completed, are under way or are budgeted on US 101 to the south, the San Jose-Los Gatos Freeway, and on State Sign Route 9 in and near Mountain View.

Bayshore Freeway

Approximately 15 years after the first contract on the Bayshore Freeway was awarded, a continuous freeway extending 49 miles between San Jose and San Francisco has been completed. In December of last year, the first of two contracts on Bayshore was completed between Charleston Road in Mountain View and the Guadalupe River near San Jose. This work, performed by L. C. Smith and Concar Ranch and Enterprises, included construction of a freeway section on State Sign Route 9 from Bayshore Freeway to 0.2 mile east of Borregas Avenue, a $4,518,000 project.

The final gap in the freeway was closed in February as part of the second contract performed by Allan M. Campbell Company on a 6.1-mile section between Brokaw Road and Morse Avenue. This contract, completed in April of this year, cost approximately $5,672,000 and included eleven structures of four interchanges and two grade separations. (For a detailed report on these two projects, see "Bayshore Freeway," by W. G. Remington, March-April 1962 issue of *California Highways and Public Works.*)

US 101—San Jose and South

Also completed during the past year was a contract for $51,500 for constructing a channelization and left turn lane at McKee Road interchange in San Jose.

South of San Jose on US 101 and US 101 Bypass, one contract was completed and two are under way. $896,000 is being expended to construct an overcrossing and interchange at Tully Road on US 101 Bypass. Between El Toro Avenue in Morgan Hill and Ford Road, the junction with US 101 Bypass, an $887,000 contract is in progress to widen and reconstruct existing US 101. This work includes drainage facilities and left turn lanes.

A $103,000 landscaping project is now in progress between Brokaw Road and Coyote Creek, in and near San Jose.

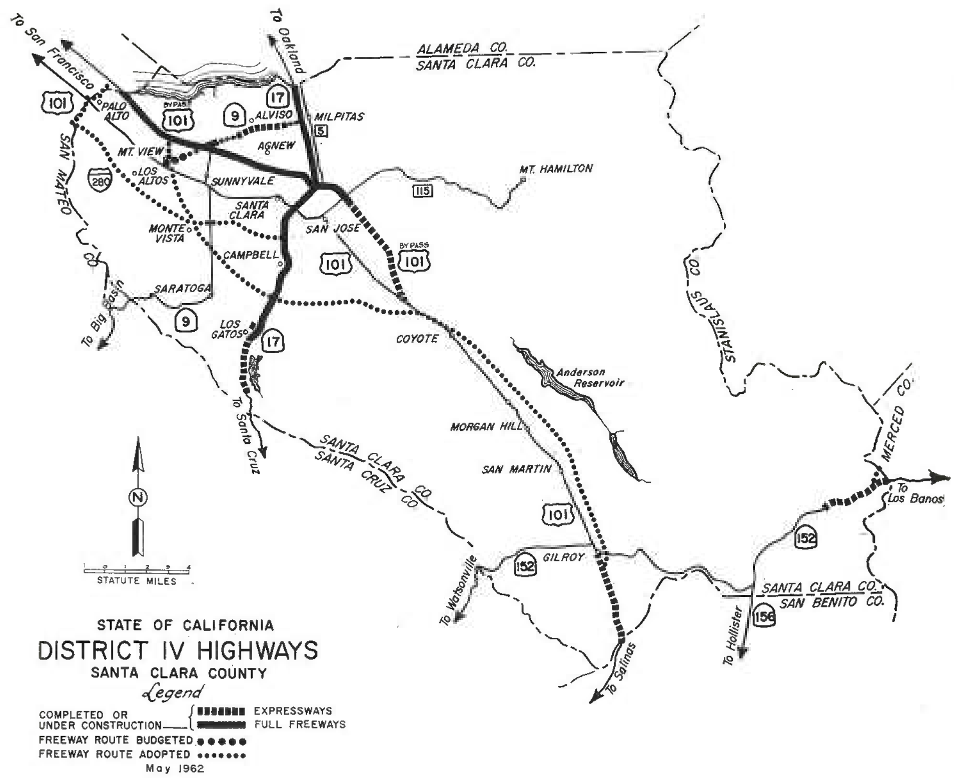
El Camino Real (US 101)

North of San Jose on El Camino Real (US 101), traffic signals and lights were installed and a channelization was constructed at Lincoln Street in Santa Clara. The City contributed approximately one-half of the funds for this $12,850 contract.

Farther north, in Palo Alto, a 2.1-mile project, costing $1,440,000, is under construction by McGuire & Hester, between University Avenue and Matadero Creek. El Camino Real is being widened from four lanes to a six-lane divided city street and the work includes installation of a lighting system, placing longitudinal storm drains, and landscaping median islands. The existing Mayfield Avenue pedestrian undercrossing is being extended.

Junipero Serra Freeway

An amount of $1,200,000 is budgeted to widen existing State Sign Route 17 freeway to six lanes between Forest Avenue and Bayshore Freeway. Coleman Avenue Interchange will be reconstructed as a part of this work.



The first contract on Junipero Serra Freeway (Interstate 280) was recently awarded. It includes grading and paving 4.3 miles of freeway between State Sign Route 17 freeway and west of Saratoga Avenue and adding an additional lane on the inside of existing Sign Route 17 between Moorpark Avenue and Forest Park Avenue. This $4,750,000 contract will modify the existing full cloverleaf interchange at Stevens Creek Road and Sign Route 17 to accommodate collector roads and direct connections to Junipero Serra freeway. Interchanges will also be constructed at Santa Clara-Los Gatos Road and at Saratoga Avenue. Two pumping plants and two pedestrian separations will be built and eleven traffic structures will be constructed or modified. (An extensive account of the planning and design studies for the Junipero Serra Freeway was published in the January-February 1962 issue of *California Highways and Public Works.*)

Sign Route 17

On State Sign Route 17 westerly towards the Santa Cruz county line, $9,700 is to be expended to widen the existing highway and install guard rail. Two other contracts were completed on Sign Route 17 in Campbell. The southbound freeway off-ramp was widened and signals installed at Hamilton Avenue at a cost of $25,300. Lighting, signals and channelization were constructed at Camden Avenue at a cost of $53,800.

In San Jose, a 2.6-mile landscaping contract is under way between Bascom Avenue and Bayshore Freeway. Twelve hundred trees, 5,200 shrubs and 363,000 ground cover plants are being placed on the $176,200 contract; along with an irrigation system.

Sign Route 9

On State Sign Route 9, $408,000 was expended on improvements between 0.2 mile east of San Jose-Alviso Road and Nimitz Freeway. This project, completed in January, included 2.1 miles of widening and realignment to eliminate sharp curves in the former highway. A major portion of the line change will serve as the northerly lanes of a future freeway. As a part of the work, a new bridge was constructed across Coyote Creek. In Sunnyvale, traffic signals and highway lighting were installed and channelizations were constructed at the intersection of State Highway Route 113 with Java Drive-Fair Oaks Avenue and at Caribbean Drive-Lawrence Station Road at a cost of $21,650. West of Saratoga, 3.1 miles of shoulders were reconstructed and resurfacing placed at a cost of $86,100.

Funds are budgeted for two projects on Sign Route 9, one at the Middlefield overcrossing structure and approaches in Mountain View on the route of the future Stevens Creek Freeway. Between El Camino Real (US 101) and 0.4 mile north of the Southern Pacific Railroad near Bernardo Avenue in Mountain View, $1,475,000 is budgeted for a project which will provide a four-lane expressway from El Camino Real to Church Street, a four-lane divided freeway between Church Street and Sylvan Avenue and a two-lane conventional highway between Sylvan and Bernardo Avenues. An interchange will be constructed at Dana Street and structures will be built at Stevens Creek and East Mountain View overhead. The latter will be two-lane and eliminate the present grade crossing. The portion between Stevens Creek and Sylvan Avenue will be depressed.

A contract was recently awarded for widening Sign Route 9 from two to four lanes on the 5.4 miles between the railroad crossing at Azule and El Camino Real in Sunnyvale with signals and left-turn storage lanes at Prospect Avenue, Bollinger Road, Stevens Creek Road, Homestead Road and Fremont Avenue. $740,000 has been allotted for this project.

Other Projects

A little more than four miles of Sign Route 152 was widened and resurfacing was completed in September between San Felipe and Bell's Station at a cost of $200,000. Drainage facilities were also reconstructed east of Prunedale Avenue near Gilroy on this route at a cost of $19,900.

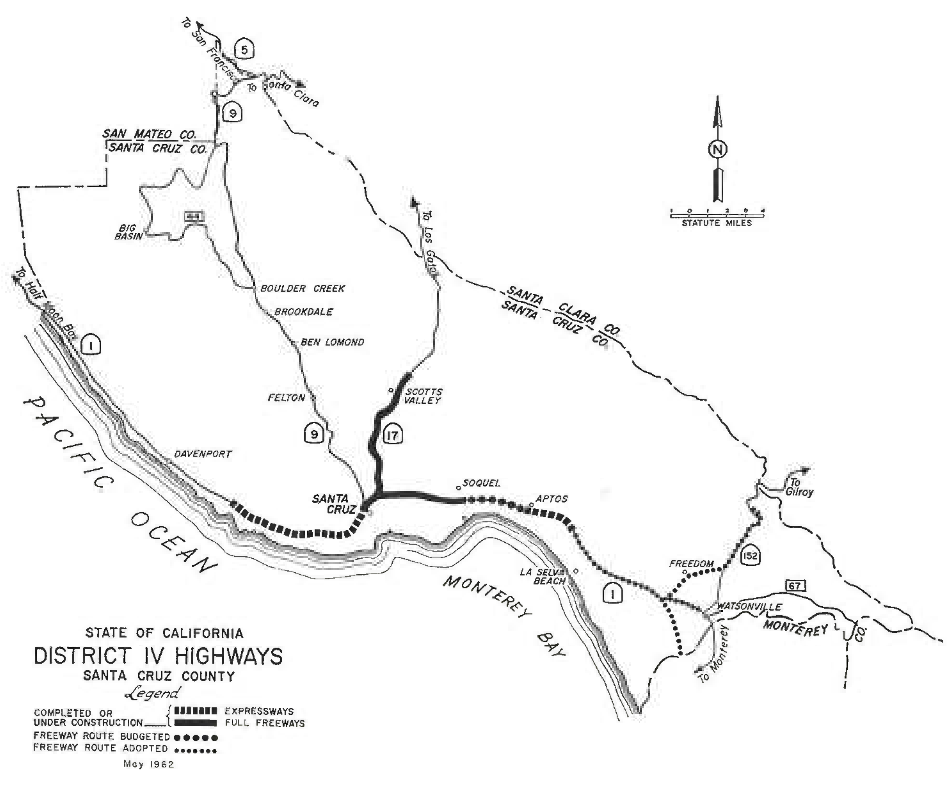
Funds are budgeted for widening Jones Creek Bridge east of Gilroy on Sign Route 152 and bids were opened in May for installing underdrains at a cost of $30,000 between 2.6 miles north of State Highway Route 42 near Saratoga gap and the San Mateo county line on State Sign Route 5.

SANTA CRUZ COUNTY

The first contract to convert the existing State Sign Route 1 expressway between Santa Cruz and Rob Roy Junction to full freeway standards was completed by L. C. Smith in January of this year.

A two-quadrant cloverleaf was constructed at 41st Avenue and a frontage road was built from South Rodeo Gulch Road to 17th Avenue. This 1.5-mile contract between Soquel Wharf Road in Capitola and Soquel Avenue was completed at a cost of about $594,000.

A similar project between 0.2 mile west of Aptos Creek and 0.3 mile east of Soquel Wharf Road is budgeted for early construction. A two-quadrant cloverleaf interchange will be constructed at State Park Drive and a diamond interchange will be built at Park Avenue. This 2.9-mile project will cost approximately $1,250,000 and will include frontage roads.



An amount of $180,000 is budgeted for repaving 7.1 miles of State Sign Route 1 between Rob Roy Junction and Main Street in Watsonville. North of Watsonville, a contract was completed to reconstruct the base and resurface 18 miles between south of Davenport and Princeton. This $448,000 project was required to repair damage to Sign Route 1 resulting from the hauling of large rock for constructing the Pillar Point breakwater.

Sign Route 17

On State Sign Route 17, a three-mile section of four-lane freeway was completed between Granite Creek and Glen Canyon Road by Edw. Keeble Construction Co. The completion of this contract provides a combination freeway-expressway on Sign Route 17 beginning in the vicinity of Santa's Village and terminating in Santa Cruz. This relocation bypasses the former three-lane highway through Scotts Valley, which will continue to serve local traffic. Interchanges were constructed at Granite Creek and Glen Canyon and an over-

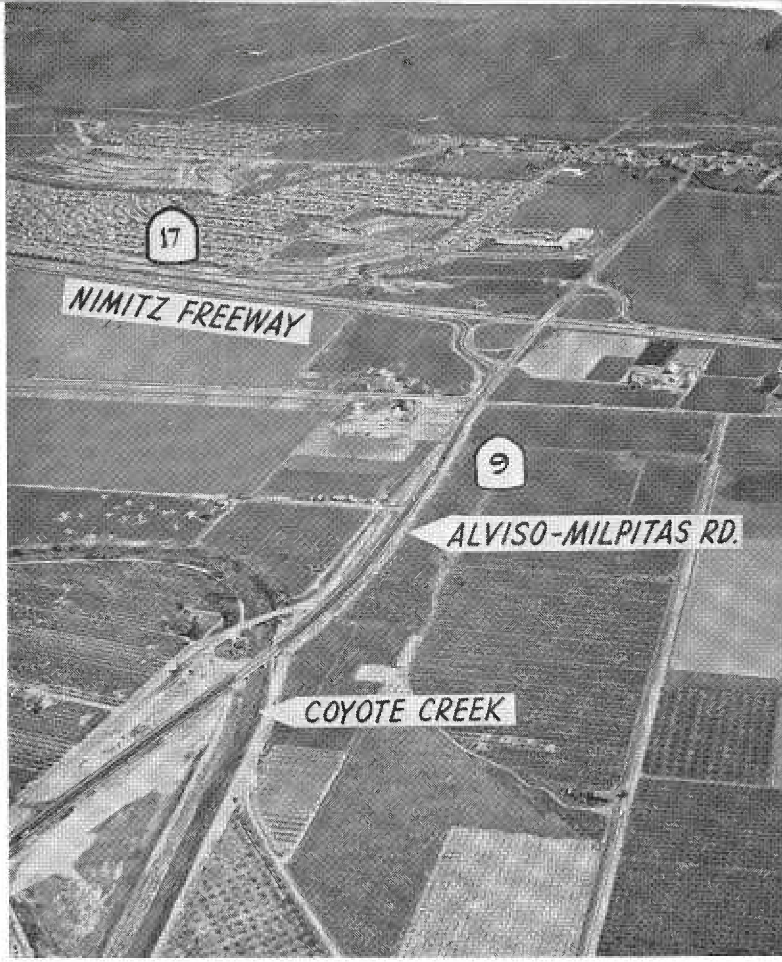
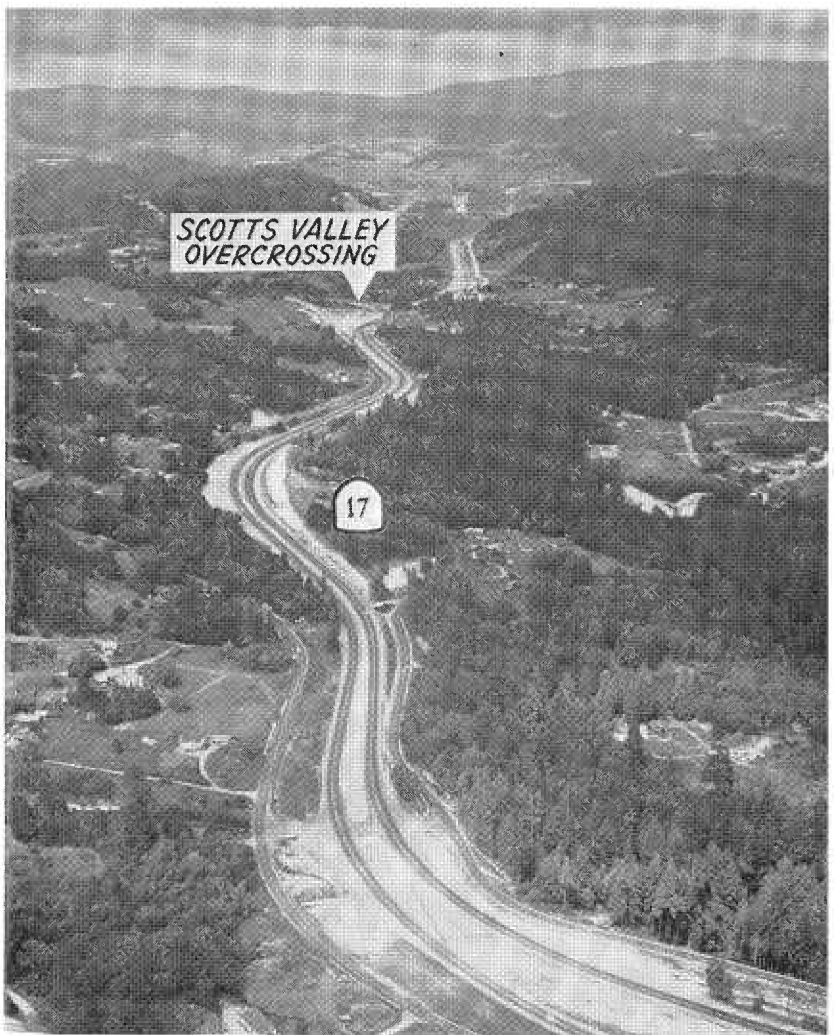
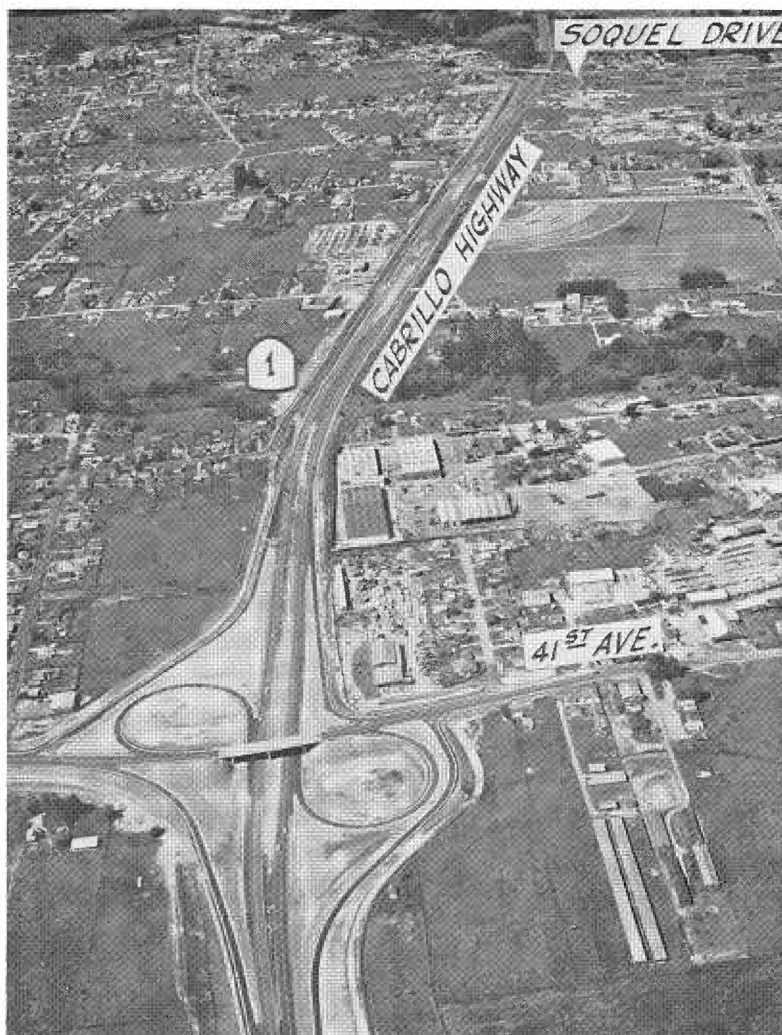


PHOTO ABOVE—The newly completed section of US 101 Bypass (Bayshore Freeway) in Santa Clara County between Morse Avenue and Charleston Road. BELOW—Typical freeway-expressway development through forested foothill terrain on Sign Route 17 between Santa Cruz and Los Gatos.

PHOTO ABOVE—Looking east toward the Nimitz Freeway on Sign Route 9 at the Coyote Creek Bridge in Santa Clara County. BELOW—Looking toward Santa Cruz from the 41st Avenue Interchange near Soquel. This is the first contract for converting Sign Route 1 expressway to full freeway.





crossing was built at Scotts Valley Road. This contract cost $1,288,000.

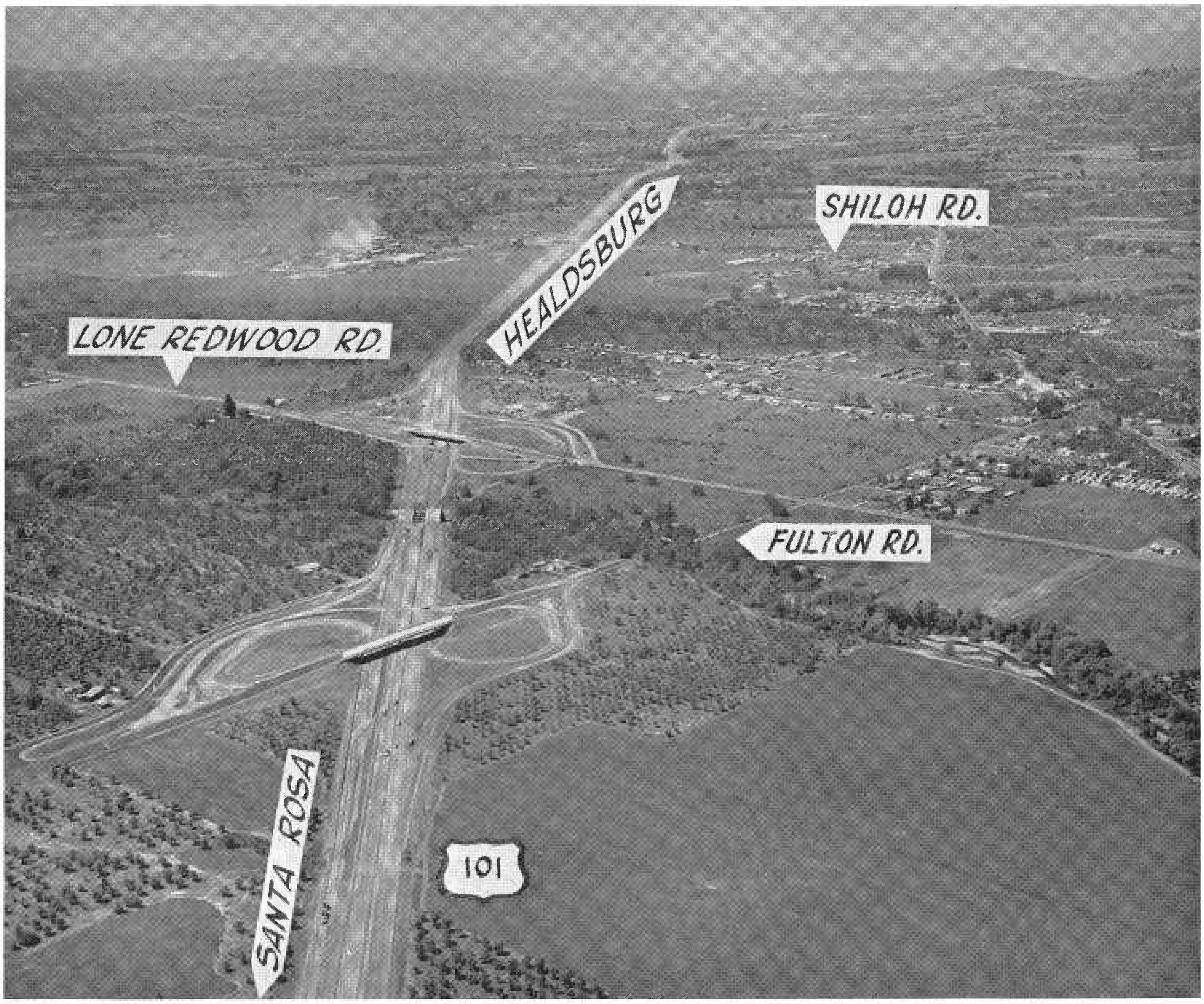
Currently under construction is a contract for replacing base and resurfacing on portions of the 6.4 miles of State Sign Route 17 between Granite Creek and the Santa Clara county line. Drainage improvements are also included in this half-million dollar contract being performed by L. C. Smith Co. Funds amounting to $160,000 are budgeted for functional planting and trees between State Sign Route 1 and Granite Creek Road.

In July a $239,000 contract was completed to realign 1.2 miles of State Highway Route 67 (Chittenden Pass Road), between 1.8 miles and 3.0 miles east of Watsonville. This work included construction of a new bridge across Coward Creek.

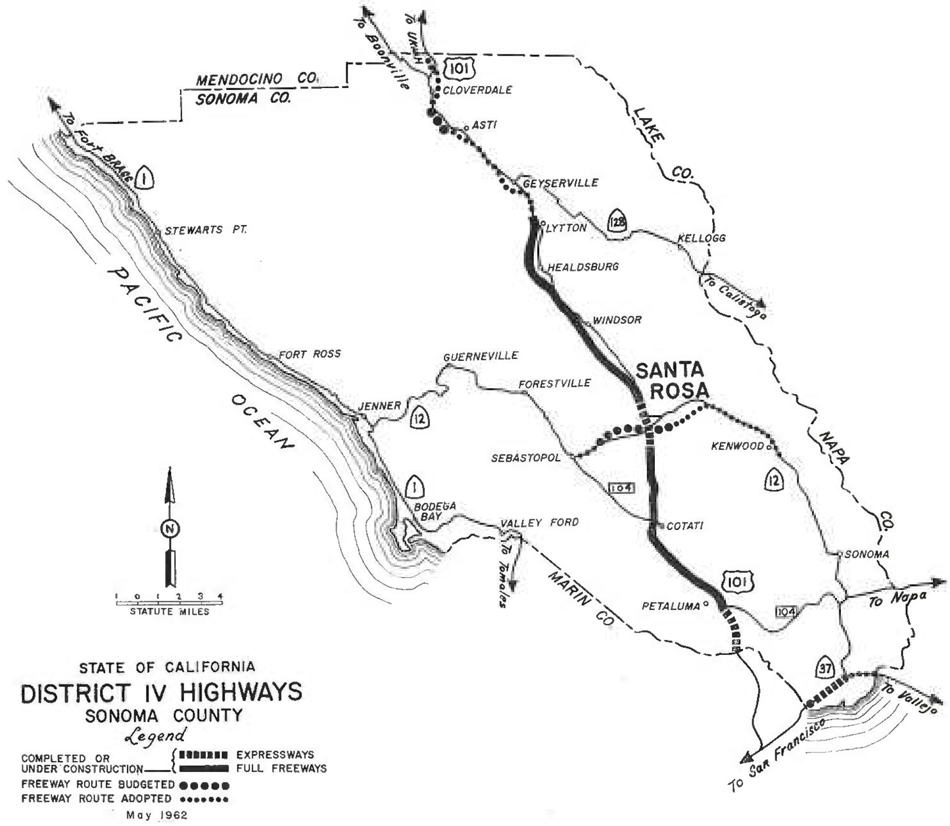
SONOMA COUNTY

The recent award of the 5.5-mile contract for State Sign Route 12 between Occidental Road and South E Street, in and near Santa Rosa, was another important step in the development of major traffic routes within Sonoma County to freeway standards. This project, together with freeway contracts on US 101 recently completed, under construction, or budgeted, will insure improved and safer travel conditions for the motoring public.

State Sign Route 12 will be constructed to a four-lane expressway on new alignment between 0.4 mile west of Occidental Road and the vicinity of Dutton Avenue in Santa Rosa, and as an initial four-lane ultimate six-lane freeway from Dutton Avenue to South E Street plus grading work for



Construction on the Redwood Highway between north of Santa Rosa and Windsor. Completion of this work and another contract immediately to the north will provide a minimum four-lane divided highway for 74 miles on US 101 between the Golden Gate Bridge and Lytton.



another 1.2 miles easterly. In addition to the Northwestern Pacific Railroad, separations are being provided at Olive Street, Santa Rosa Avenue and Dutton Avenue, and a three-level interchange will be constructed at US 101. This $5,200,000 contract is being performed by Peter Kiewit Sons Co.

Completion of this project will eliminate the most congested intersection on US 101 in Sonoma County and will provide the first portion of planned free-flowing traffic facilities for the Santa Rosa area, linking the major east-west and north-south freeways. Projects for extending Sign Route 12 on to Kenwood are under design study and the California Highway Commission in May adopted a freeway route from Kenwood to a junction with Sign Route 37 in the vicinity of Schellville.

Redwood Highway—US 101

Two major projects on US 101 expected to be opened to traffic this fall will complete the Redwood Highway to full freeway standards between the Marin county line and Lytton, northerly of Healdsburg, except for portions south of Petaluma River and within Santa Rosa.

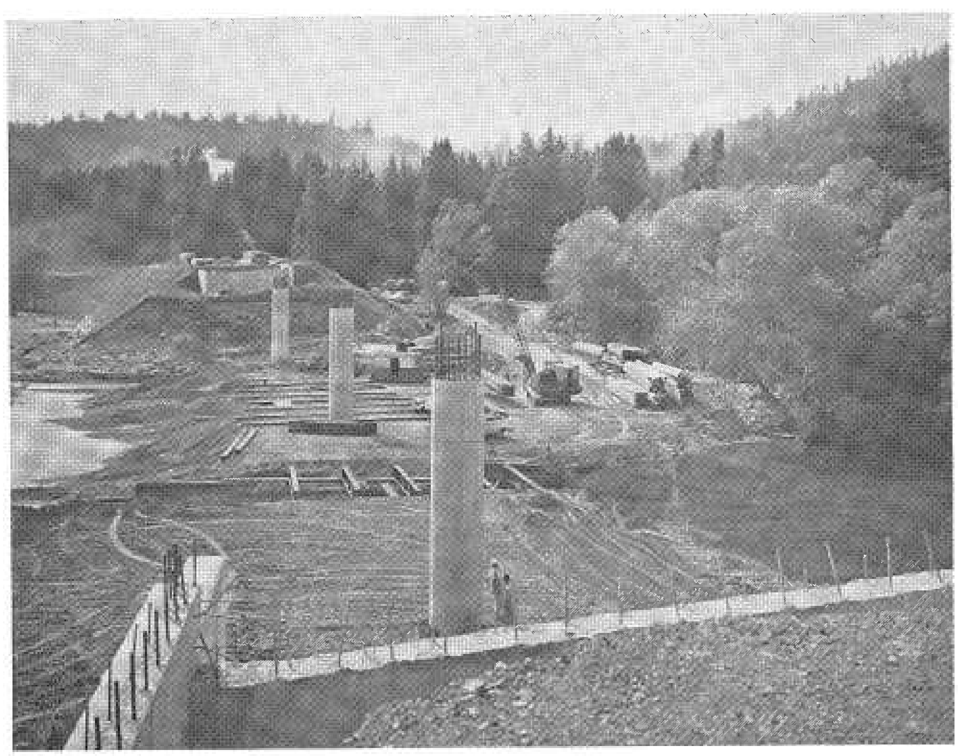
A 9.6-mile contract, costing approximately $4,386,000, from the north city limits of Santa Rosa to Grant Creek includes full interchanges at Mendocino Avenue, East Fulton, Fulton, Lone Redwood and Shiloh Roads, and a partial interchange at Windsor. On this contract, performed by Guy F. Atkinson Company, the freeway is being paved to Windsor and was rough graded from there to Grant Creek.

The second project for constructing five miles of freeway between Windsor and Healdsburg includes paving the aforementioned rough graded section and constructing interchanges or separations at Windsor, Arata Lane, Limerick Lane and south of Healdsburg near Grant Avenue. This work is being done by Ball and Simpson at a cost of $3,020,000.

North of Lytton, almost 10.0 miles of the existing highway has been resurfaced and $2,400,000 has been budgeted for a 3.5-mile freeway project through the Asti area between Washington School Road and north of Hiatt Road.

Interim Project

Bids were opened May 9 for the interim contract to improve 0.8 mile of State Sign Route 12 between Farmers Lane and Brush Creek in Santa



Substructure construction of a cast-in-place, reinforced concrete, box girder bridge over Austin Creek in Sonoma County on the alignment of Sign Route 12 between Austin Creek and Duncan Mills.

Rosa to a four-lane conventional highway. This project will serve traffic until the freeway is completed easterly to Melita. It is a co-operatively financed project with the City of Santa Rosa providing funds for the rights-of-way and contributing $20,000 to construction costs, and Sonoma County Flood Control and Water Conservation District contributing $50,000 and right-of-way for channel improvement in addition to the $175,000 budgeted by the State.

Other Construction

West of Guerneville, construction is under way on Sign Route 12 to provide 1.9 miles of conventional highway on new alignment between Duncans Mills and Austin Creek. This $680,000 project will replace the narrow, steep, tortuous alignment and will provide a new bridge at Austin Creek.

On State Sign Route 1 along the coast three minor projects between Fort Ross and Jenner were completed during the past year for realignment around slipouts, installing culverts and grading and surfacing.

STATUS OF DISTRICT IV FREEWAY AND EXPRESSWAY PROJECTS

Description	Total miles	Completed projects		Under contract		Budgeted		Right of Way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
U.S. 101 AND 101 BYPASS								
Bayshore and James Lick Memorial Freeway, U.S. 101 Bypass; Southern Freeway in San Francisco to Ford Road South of San Jose	52.9	46.8	$53,749,000	6.1	[a]$6,716,000		$855,000	$25,382,341
Southern Freeway	4.7		[b]7,312,000	2.4	10,414,000	1.8	4,600,000	20,132,965
James Lick Memorial Freeway	3.0	3.0	11,438,000					12,870,440
Central Freeway	1.8	1.8	11,653,000					8,531,116
Golden Gate Freeway	1.1					1.1	5,100,000	83,097
Ford Road South of San Jose to San Benito County Line	27.9	5.8	1,093,000					545,839
Southern Freeway Ext. near South City Limits of San Francisco (Rte. 68) to Rte. 224 near the San Francisco-Oakland Bay Bridge	4.4					1.4	11,080,000	3,535,000
Redwood Freeway; Golden Gate Bridge to Mendocino County Line	84.3	58.0	[c]43,841,000	11.0	7,680,000	3.5	10,395,000	17,555,070
U.S. 40								
San Francisco to Carquinez Bridge (portions)	18.2	18.2	[d]61,976,000		89,000		420,000	13,284,971
U.S. 50								
MacArthur Freeway; Distribution Structure to Castro Valley	15.3	1.1	4,115,000	5.7	19,534,000	6.1	17,065,000	53,533,107
Castro Valley to San Joaquin County Line	31.4	31.4	11,647,000					4,250,000
SIGN ROUTE 17								
Nimitz Freeway; Distribution Structure to Bayshore Freeway at San Jose	41.3	41.3	55,688,000	Add lanes	4,487,000		485,000	22,464,786
Santa Cruz to San Jose (portions)	19.9	19.9	17,105,000		176,000		660,000	9,825,985
U.S. 40 near Albany to U.S. 101 near San Rafael (portions)	9.9	2.2	1,973,000					2,614,898
SIGN ROUTE 9 AND 21								
Warm Springs to U.S. 50	17.7					4.7	6,200,000	1,838,913
U.S. 50 to Walnut Creek	16.0	3.5	3,010,000			6.8	12,900,000	10,615,281
Walnut Creek to Monument	3.4	3.4	9,236,000					6,412,772
Monument to Solano County Line	7.4			5.4	[e]11,243,000	2.0	1,800,000	4,732,254
Sign Route 9 North of Route 21 in Fremont	4.4							28,465
GROVE-SHAFTER FREEWAY ANG SIGN ROUTE 24								
Sign Route 17 in Oakland to Warren Boulevard	4.8							12,359,441
Warren Boulevard to Walnut Creek	11.0	6.4	9,725,000	1.1	11,584,000	3.1	10,215,000	5,528,651
North of Monument to Sign Route 4, Concord	3.4		226,000			3.2	3,150,000	1,823,273
EMBARCADERO FREEWAY	1.5	1.5	14,792,000			Add R	amps 1,470,000	12,628,424
PARK-PRESIDIO FREEWAY; GOLDEN GATE BRIDGE TO FULTON STREET	2.1	1.2	1,448,000					70,000
JUNIPERO SERRA FREEWAY								
Sign Route 17 to San Francisco County Line	43.9					4.7	5,950,000	19,417,159
Stevens Creek-West Valley Freeways	23.6							5,921,596
CABRILLO HIGHWAY								
Moss Beach to Lake Merced Boulevard in San Francisco	17.0	5.4	2,766,000			3.2	3,817,000	7,765,051
Watsonville to 4 miles South of Davenport (portions)	22.8	13.9	7,523,000			2.9	1,250,000	3,860,376

STATUS OF DISTRICT IV FREEWAY AND EXPRESSWAY PROJECTS—Continued

Description	Total miles	Completed projects		Under contract		Budgeted		Right of Way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
JUNIPERO SERRA FREEWAY TO NIMITZ FREEWAY								
19th Avenue Freeway, Junipero Serra Freeway to Alameda County Line at San Mateo Bridge (portions)	8.0	------	------------	2.3	4,800,000	------	------------	5,823,518
San Mateo County Line to Nimitz Freeway	6.8	------	------------	------	------------	------	------------	426,000
PACHECO PASS: 1 MILE EAST OF BELL'S STATION TO MERCED COUNTY LINE	5.3	5.3	1,285,000	------	------------	------	------------	12,393
WEST OF U.S. 101 TO BYPASS U.S. 101 IN REDWOOD CITY (ROUTE 214)	1.1	------	------------	------	------------	------	------------	2,513,802
MOUNTAIN VIEW—ALVISO FREEWAY; EL CAMINO TO NIMITZ FREEWAY	10.5	5.5	2,088,000	------	------------	1.5	1,475,000	2,905,050
FREEWAY CONNECTION FROM NIMITZ FREEWAY TO U.S. 50 (ROUTE 228)	2.2	2.2	2,803,000	------	------------	------	------------	2,236,000
BAY FARM ISLAND BRIDGE AND APPROACHES	0.6	0.6	2,062,000	------	------------	------	------------	165,000
WEBSTER STREET TUBE	1.1	------	203,000	1.1	17,363,000	------	1,400,000	2,613,669
WARREN BOULEVARD FREEWAY; SIGN ROUTE 24 NEAR LAKE TEMESCAL TO MACARTHUR FREEWAY	5.6	4.1	[f]5,654,000	------	1,292,000	0.6	600,000	2,255,652
SHEPHERD CANYON FREEWAY; WARREN BOULEVARD FREEWAY TO SIGN ROUTE 24	10.3	------	------------	------	------------	------	------------	689,443
ARNOLD INDUSTRIAL FREEWAY; HERCULES TO ANTIOCH BRIDGE (SIGN ROUTES 4 AND 24)	34.1	14.7	4,694,000	------	------------	------	------------	1,806,073
SIGN ROUTE 12; SEBASTOPOL TO KENWOOD	17.7	------	------------	------	------------	4.1	5,220,000	5,774,394
SIGN ROUTE 29; SOLANO COUNTY LINE TO CALISTOGA	36.9	23.2	4,703,000	------	------------	------	485,000	4,182,514
SIGN ROUTE 37; FROM REDWOOD FREEWAY AT IGNACIO TO NAPA	13.4	7.2	5,900,000	------	------------	------	------------	777,903
Totals	648.7	327.6	$359,708,000	35.1	$95,378,000	50.7	$106,572,000	$319,792,686

(a) Includes $300,000 contributed by co-operating agencies.
(b) Includes total of $1,600,000 by City of San Francisco.
(c) Includes total of $5,000,000 by Golden Gate Bridge and Highway District.
(d) $29,117,000 Toll Bridge Funds in this amount.
(e) $6,833,000 from Toll Bridge Funds.
(f) City of Oakland and Alameda County contributions included in this figure.

DESIGN ENGINEER JOHN CREED RETIRES IN BISHOP

John H. Creed, Design Engineer for District IX (Bishop), retired June 1 after 34 years of service with the Division of Highways. His first engineering job was as chainman on tunnel construction for the Southern California Edison Company in 1922.

JOHN H. CREED

He joined the division in 1928 as a Junior Highway Engineer. He served in various engineering assignments in Districts I (Eureka), II (Redding), and IV (San Francisco).

He was promoted to senior highway engineer in 1949 and assigned as Design Engineer of District IX. He supervised the location and design of the U.S. 395 relocation over Sherwin Grade.

A native Californian, Creed attended grade school at Pescadero, high school in Oakland and studied at Stanford University.

He is a member of the American Society of Civil Engineers and is an Elk and a Mason. He has been active in Boy Scout work.

He is married and has a daughter, Mrs. Margaret Furber, of Klamath Falls.

Creed has accepted an appointment as County Engineer of Klamath County in Oregon with headquarters in Klamath Falls.

MOUNTAIN ROUTES OPENED

The Division of Highways reported the following road openings in April: Fallen Leaf Lake Road, April 10; June Lake Loop, north leg, April 13; Sign Route 89, Emerald Bay Section, April 18; Sign Route 120, Big Oak Flat road in Yosemite National Park, April 20; Sign Route 120, Mono Hills Section, April 24; Sign Route 89, Monitor Pass Section, April 26.

Route Adoptions

March, April Freeway Routings Total 62 Miles

THE CALIFORNIA Highway Commission adopted routings for seven sections of freeway totaling 62 miles in length at its March and April meetings. This brings the total mileage of freeway routes adopted to 6,066, or approximately one-half of the length of the 12,400-mile California Freeway and Expressway System.

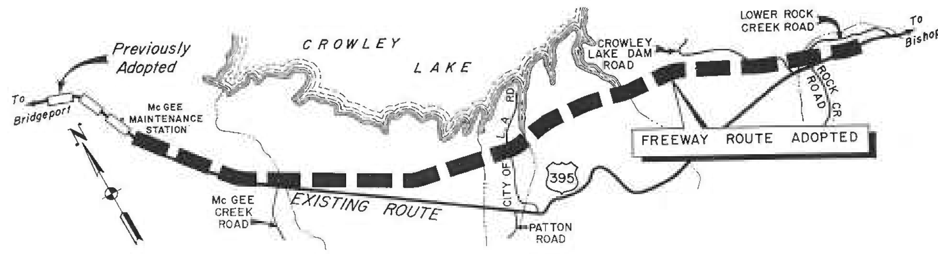
The commission also adopted routings for four sections of conventional highway.

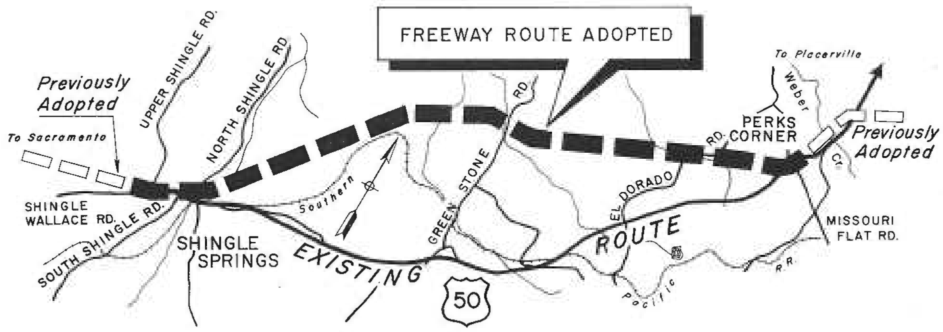
The freeway route adoptions ranged from central California to San Diego, and included two on which the commission had held public hearings in addition to the public hearings held by the Division of Highways.

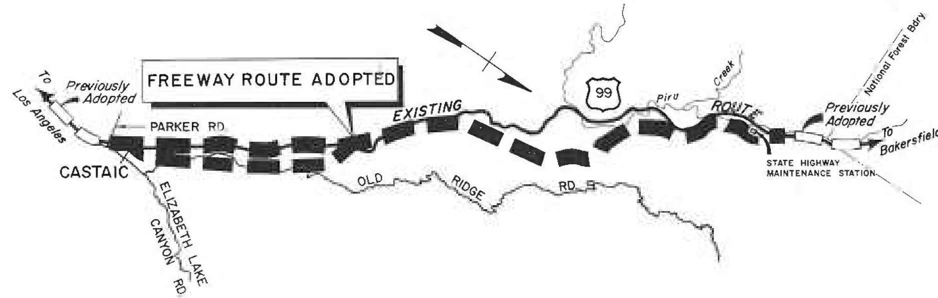
In one of these, a routing for 6.4 miles of State Highway Route 107 in San Mateo and Santa Clara Counties and the cities of Menlo Park and Palo Alto, the commission adopted a route differing in part from that recommended by State Highway Engineer J. C. Womack.

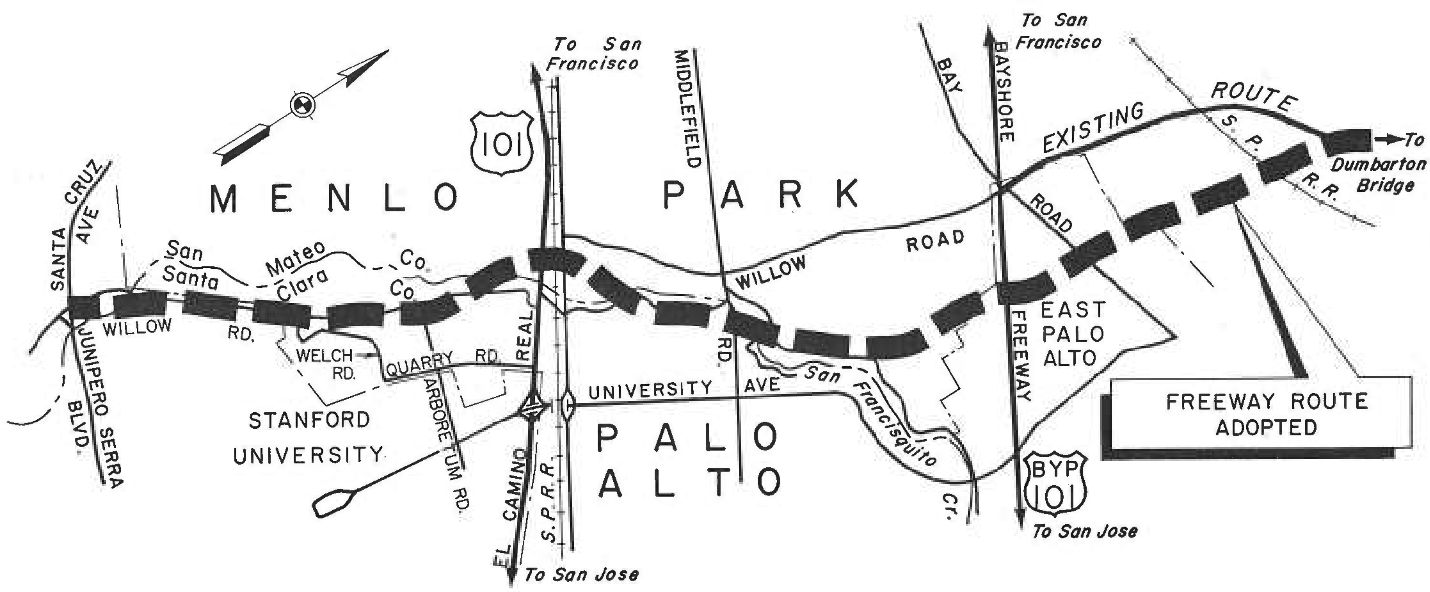
East-West Routing

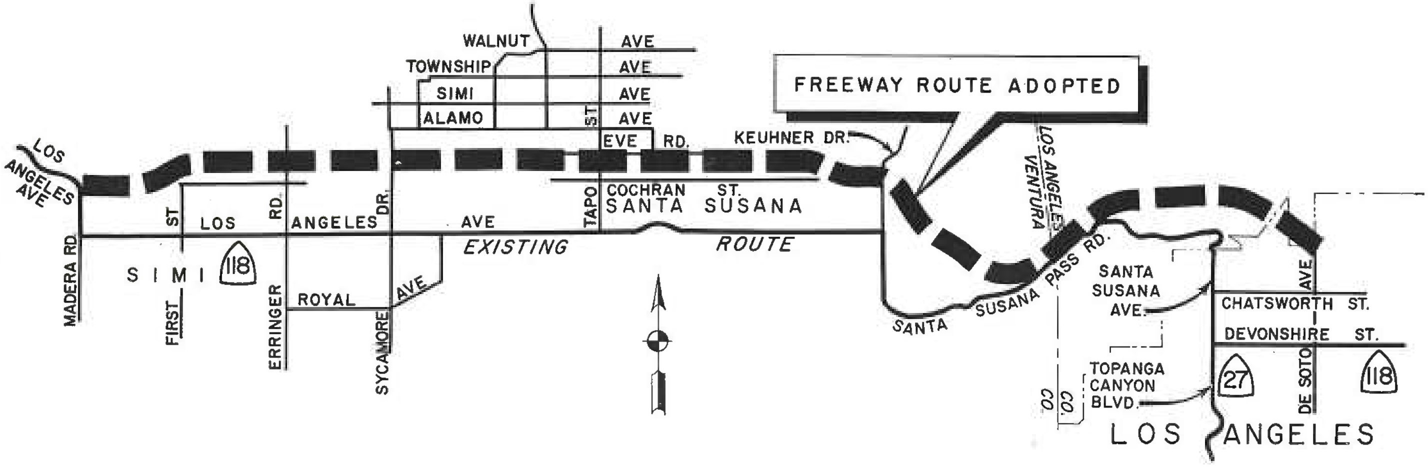
This highway will be an east-west route and the section adopted in March runs from the Dumbarton Bridge to Santa Cruz Avenue, east of Willow Road between the Dumbarton











Bridge and El Camino Real and then generally along the line of Willow Road.

The other route on which the commission held a public hearing is for the relocation of 8.3 miles of US 395 in Mono County in the vicinity of Crowley Lake. The commission adopted the recommended route which runs north of the existing highway on a line which is more direct than the existing highway and about seven-tenths of a mile shorter.

Other freeway routes adopted:

El Dorado County—for the relocation of 6.9 miles of US 50 between 0.8 mile west of Shingle Springs and Missouri Flat Road at Perks Corner.

Los Angeles County—for the relocation of 17.9 miles of US 99 between Parker Road in Castaic and three-fourths of a mile north of the Ridge Route Maintenance Station.

San Diego County—for 2.8 miles of State Highway Route 283 in San Diego on Wabash Boulevard between US 101 and the adopted freeway route for State Highway Route 241 near Nile Street.

Santa Barbara County—for the relocation of 7.5 miles of Sign Route 1 between US Highway 101 near Las Cruces and San Julian Ranch.

Highway Relocation

Ventura and Los Angeles Counties—for the relocation of 12.5 miles of Sign Route 118 (Los Angeles Avenue and Santa Susana Pass Road) in Ventura and Los Angeles Counties and the Chatsworth area of the City of Los Angeles.

The conventional route adoptions include a route for a section of Sign Route 29 in Lake County north of Middletown, a route for a minor relocation of Sign Route 132 at Tarantula Creek in Stanislaus County and for Sign Route 36 in Humboldt County near Carlotta, four miles east of Alton.

District V Loses Mark L. Cardwell

Highway Superintendent Mark L. Cardwell retired June 1 from the Division of Highways district office in San Luis Obispo. He was with the division 34 years.


MARK L. CARDWELL

Promoted to superintendent in 1940, he first served in District VI (Fresno) and later at Buellton, Salinas, Cambria, Paso Robles and finally San Luis Obispo in the District V area.

Cardwell was born in Noblesville, Indiana, where he attended grade school. He went to high school at Westfield and came to California in 1913.

He served in the U.S. Army from 1917 to 1920 and joined the California Division of Highways as a power shovel operator in 1928, working first in the Carmel and Big Sur area. He was promoted to foreman in 1935 and assigned to the Santa Maria area.

The Western Association of State Highway Officials will hold its 11th annual planning conference in San Francisco on July 12th and 13th.

Progress Reported On Bridge Projects

The Division of Highways reports progress on five bridge and tunnel projects as follows:

Webster Street Tube—Eighty-five percent of the work completed; estimated completion date January 1963.

San Pedro-Terminal Island Bridge—Substructure expected to be completed in July. On superstructure the erection of the main steel for the Terminal Island tower has been completed.

Randolph Collier Tunnel—The project is 48 percent complete; estimated completion date is January 1963.

Caldecott Tunnel—The project is 20 percent complete and the estimated completion date is January 1963.

Benicia-Martinez Superstructure—The contract is 92 percent complete and estimated completion date is November 1962. The substructure was completed in January.

The Division of San Francisco Bay Toll Crossings reported that reconstruction work on the upper level of the San Francisco-Oakland Bay Bridge through Yerba Buena Island Tunnel is now 50 percent complete.

Goleta Project

Last Two-lane U.S. 101 Section in South Santa Barbara County is Eliminated

By ROY E. ALDERMAN, District Construction Engineer

WITHOUT fanfare or ceremony, but with considerable public satisfaction, the remaining eight miles of two-lane highway on US 101 in southern Santa Barbara County were eliminated by recent completion of a modern four-lane divided freeway from the west city limits of Santa Barbara westerly to Elwood Station.

The general area surrounding this freeway location, was until recently, principally devoted to citrus and walnut orchards and diversified farming. It is now in a transition stage with the orchards and farms rapidly disappearing, to make way for extensive residential, commercial and light industrial growth. Most of the light industry is concentrated in the vicinity of the Santa Barbara airport at Goleta which is immediately south and toward the ocean from this project. The University of California at Santa Barbara is located in this general vicinity and the campus is expanding at a great rate, further complicating the traffic problems in this area.

The Fairview overcrossing (center front) connects U.S. 101 with the University of California at Santa Barbara. The view is westward.

Two Lanes Inadequate

The existing two-lane highway, although on excellent alignment and grade, was woefully inadequate to handle the increasingly heavy traffic volume in this rapidly expanding area. In addition to the heavy flow of traffic on US 101, there were additional complications arising from the fact that there are a total of 10 heavily-traveled county roads which crossed or terminated with US 101 at inopportune points where interference with through traffic would be a major factor. This problem was also complicated by numerous, often used, private road approaches all along this eight-mile section, and by hazards caused by the presence of numerous railroad crossings of county roads at grade.

A combination of all these factors contributed to a high accident rate, most of which were of a noncollision or rear-end type. The most commonly reported causes of vehicle accidents were speeding, following too closely and improper passing. Also, nearly one-third of the vehicles involved were those either attempting to make a left turn onto the existing two lanes from county and private roads or vehicles making a left turn from the highway to various crossroads. Completion of this four-lane divided freeway has naturally eliminated these most commonly reported types of accidents.

Traffic, Growth Factors

The traffic and area growth factors, plus the increasing high cost of real estate in this area, dictated the selection of the existing route as the logical location for the freeway.

It was possible to salvage most of the existing roadway, which was used as a larger portion of the left or southbound lanes. To accommodate the interchanges, it was necessary to move some of the existing alignment slightly to the north away from the railroad. This provided room for construction of southbound on-off ramps of the interchanges.

Provision was also made for an interchange at US 101 with the Clarence Ward Memorial Freeway leading to the University of California at Santa Barbara campus.

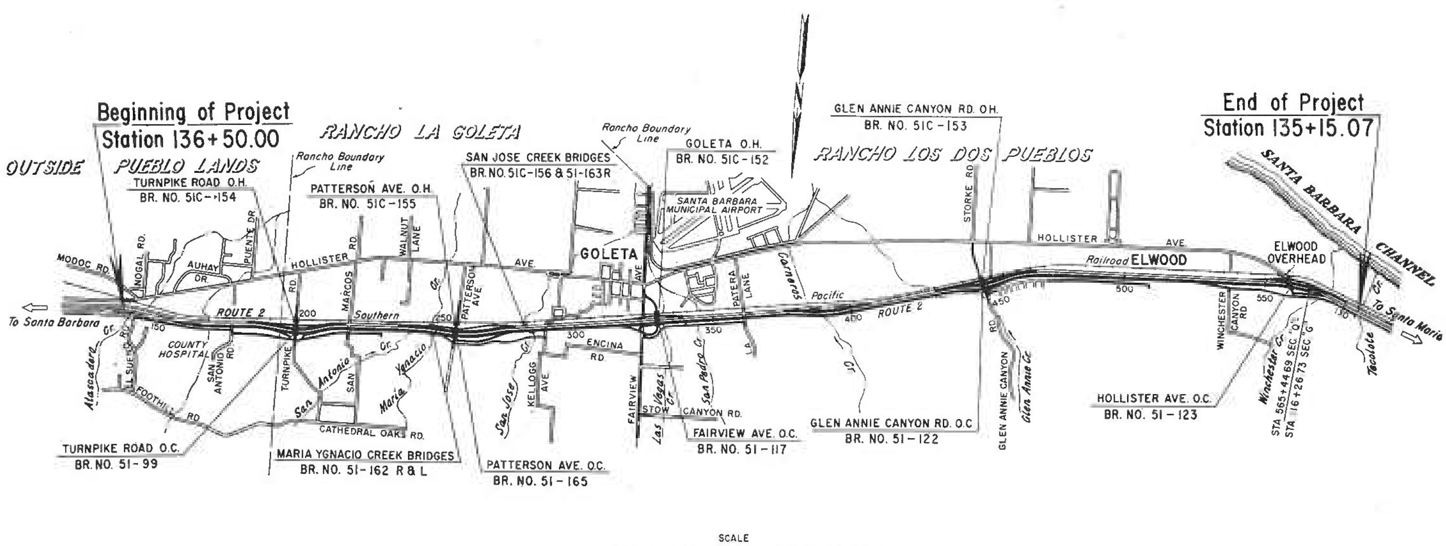
To minimize construction costs and interference with traffic during future construction, the approach fills for the Clarence Ward Memorial Freeway were constructed as an integral part of this freeway project. Initial construction on the Clarence Ward Memorial Freeway began late in August 1961, more than a year after construction of this portion of US 101 freeway, and work on this interchange is proceeding nicely without interference to traffic.

The existing US 101 highway was constructed in 1947 and consisted of an 11-foot and 12-foot traffic lane with 8-foot shoulders. The structural section consisted of three inches of asphalt concrete over six inches of crusher-run base on 9-15 inches of imported borrow. Considerable alligator cracking had developed on the traveled way and maintenance of the highway had become extremely costly.

Roadway Salvaged

In the early design stage, consideration had been given to salvaging the existing roadway by overlaying it with an asphalt concrete blanket.

This westward view toward the ocean shows the Glen Annie overcrossing at the center of the photo. The left or eastbound lane was not completed when this photo was taken.



Length of Project 8.5 miles

Limits of the project, as indicated in the above map, is between El Sueno Road 2.4 miles west of Santa Barbara and 0.5 of a mile northwest of Elwood overhead on U.S. 101 in Santa Barbara County.

However, the maintenance problem soon indicated that more extensive rehabilitation would be required. It was then decided to pulverize the existing asphalt concrete and cement treat the top eight inches of existing roadway using the pulverized asphalt concrete as part of the material to be cement treated.

Pulverizing the existing asphalt concrete was done during construction by ripping it, then breaking it up with a sheepsfoot roller and, finally, by thoroughly granulating it with a mechanized pulverizer. In most cases, three passes of the pulverizer satisfactorily prepared the old asphalt concrete for cement treatment.

The Turnpike Road overcrossing passes over the freeway at the center of the photo with the San Marcos High School to the left of the overcrossing and the Cathedral Oaks Elementary School to the right. Group of buildings in the right foreground is the Santa Barbara County Hospital.

The pulverized asphalt concrete and sufficient underlying base material to make the required eight-inch depth of treated base was then formed into sized windrows and mixed cement and water using a self-propelled road mixer.

The resulting mixture provided an exceptionally high quality base which is expected to give an unusually long service life at approximately one-third the cost of construction with imported aggregate for cement treatment.

Structural elements of the new westbound lanes consisted of 0.67 feet of portland cement concrete pavement over 0.33 feet cement treated base Class B; 0.17 of aggregate base Class 3 all over 0.83 of Class 2 aggregate subbase material. The 0.17-foot-deep layer of aggregate base was provided as a working table for roadmixing the cement treated base because of the expected use of cohesionless sand as subbase.

Base is Extended

The contractor elected the optional slip-form method of placing portland cement concrete pavement. Accordingly, the cement-treated base was extended in width by 12 inches or more at each side during construction to provide greater support and protection at the pavement edges.

The slip-form paver selected by the contractor is a machine mounted on four independent tracks and assemblies grade control is taken from the subgrade in the track paths. Thus the smooth riding quality of the finished pavement is dependent on the accuracy and uniformity of the subgrade, particularly at the track paths. This factor requires an extra effort in making grade on the cement treated base.

In order to insure that the minimum of 0.67 feet specified thickness of concrete was obtained throughout, cross sections of the completed cement treated base were taken to determine the relationship of the pavement subgrade to the track path grade. These cross sections were then used to determine a screed setting for the slip-form machine to insure a minimum pavement thickness obtained at the thinnest point. A scratch template, which also traveled on the track grade, was then set to the same setting and subgrade was further checked to avoid any undetected high spots.

This was only the second time that this make or model of slip-form paver had ever been used on highway construction. At the start of paving, the profile index obtained exceeded the specified maximum. The contractor then made several changes in the equipment and added a special job-built spreader box to uniformly control the amount of concrete placed ahead of the paver by the mixer operators. This spreader box was the chief factor in achieving the proper profile index during the remainder of the paving. This contractor also had some difficulty in forming the longitudinal keyway which provides the shear key for additional lanes when constructed at a later date. However, the use of heavier tie wire and the addition of more guides on the slip-form paver largely eliminated this difficulty. Other than the slip-form paver, the contractor used conventional methods for construction of the freeway.

Aggregate Shortage

Highway construction in this area is complicated by the shortage of suitable mineral aggregate for the various bases. This is true in spite of the proximity of the Santa Ynez Mountains with numerous rock outcroppings. However, tests indicated this rock was too soft to use as aggregate materials for the project.

After much searching, the contractor obtained a source of aggregate subbase near the west end of the project. The subbase was obtained from a sandy cut which was part of the grading plan of a subdivision to be constructed near the freeway location. For aggregate base and mineral aggregate for cement treated base, the contractor elected to blend sandy material from a local source with crushed aggregate hauled from the Santa Clara River near Ventura. The blending was accomplished on the belt loader at the local material site.

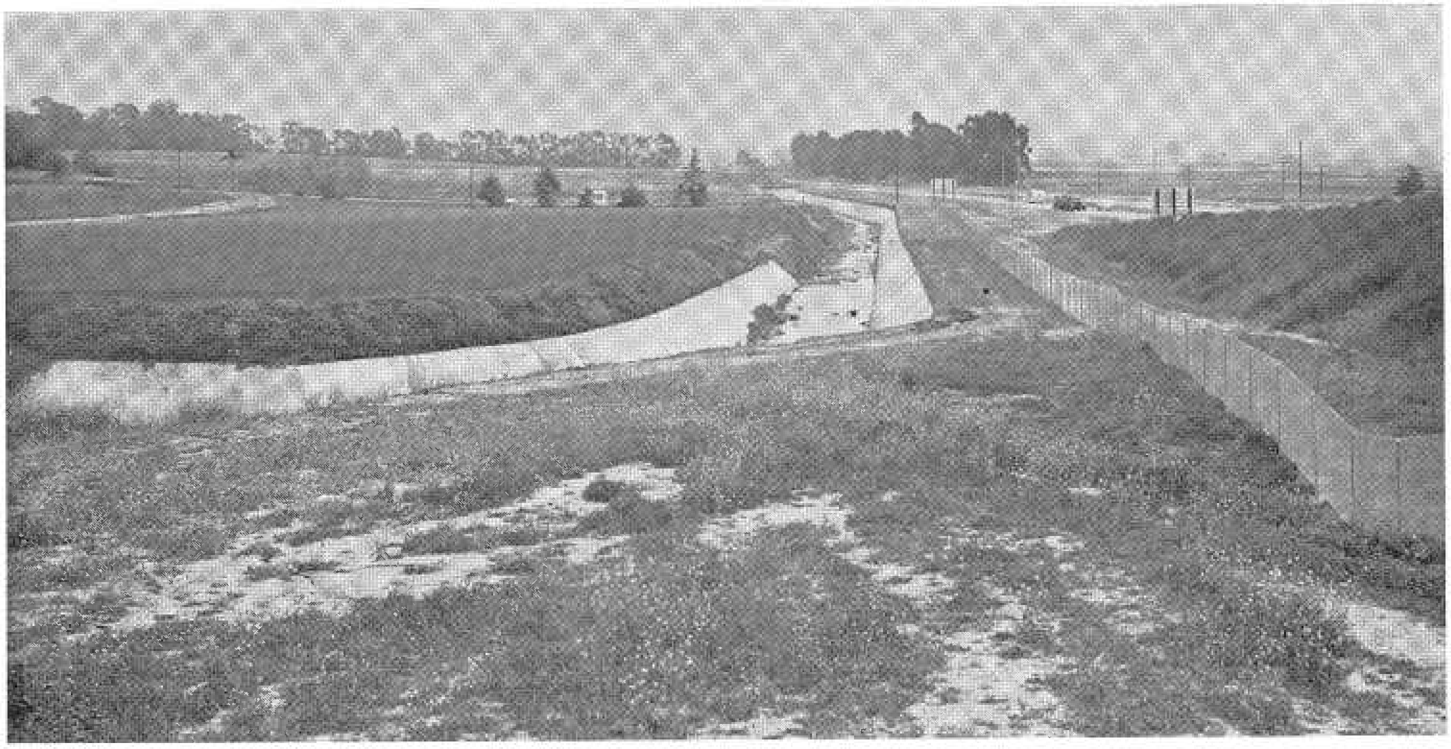
Mineral aggregate for asphaltic concrete and Portland cement pavement were obtained from commercial sources in the Santa Clara River, and involved a 30-mile haul to the project. As an example of the extreme scarcity of suitable materials in this area, Portland cement concrete aggregate for highway construction is produced by the heavy media process. The asphaltic concrete plant and the Portland cement concrete batch plant were owned by the Contractor and set up directly on the job site.

The freeway under construction. A mixer prepares cement-treated base as described in the article.

Traffic Accommodated

The general plan of construction for this project was to leave traffic on the existing lanes, construct necessary short sections of the new southbound lanes at each interchange and complete all grading and paving for the new northbound lanes. Then after the northbound lanes were completed, traffic was shifted and the existing roadbed reconstructed.

Five interchanges were constructed as a part of the project with provision made for construction of a sixth at Carneros Creek when necessary to



The Glen Annie Creek channel change. The channel is flared (extreme left) to catch the maximum water flow and is concrete lined where water erosion will be greatest. Note the middle section on the left where only grass planting is needed for sufficient erosion control. The view is south with portions of Goleta visible in the right background.

serve the anticipated growth in this area. All interchanges were of the overcrossing type combined with a railroad overhead. On and off ramps on the south side were located between the freeway and the railroad without complication. The overcrossing structures are all four span with total lengths ranging from 196′ to 241′. Precast, prestressed girders now in extensive use on freeways throughout the State were used in the two center spans over the freeway lanes. The end spans are cast-in-place "T" beam construction. The railroad overheads all have three spans with the center spans over the railroad of precast, prestressed girder construction. The length of the overheads varies from 163′ to 168′. Other bridge structures of importance include parallel bridges over Maria Ignacio Creek, east of Patterson Avenue and twin bridges over San Jose Creek west of Patterson Avenue.

Drainage Channels

Drainage channels of considerable magnitude were also included as part of this freeway project. Channel changes were built at San Antonio Creek and Glen Annie Creek with appurtenant channels controlling Maria Ignacio Creek and San Jose Creek. In construction of these channel changes, approximately 2,000 cubic yards of Class B Portland cement concrete slope paving was placed. At Las Vegas Creek an existing double 12′ x 5′ reinforced concrete box was extended, right and left, a total of 208′. At Caneros Creek, where provision has been made for a future interchange, a box culvert was extended 253′ with a special 18′ x 7′ reinforced concrete box. These considerable channel change structures were essential because native soil in this area is mostly a sandy silt and is easily eroded. In addition to the concrete slope paving, all remaining slopes were treated with straw, hardy grass seeds, and fertilizer to prevent erosion. Nearly all open drainage ditches were lined with air-blown mortar.

This work, along with installation of lighting and signs, completed the freeway project as previously planned; however, provisions have been made through location of the alignment, acquisition of right-of-way, and by methods of construction to provide for construction of an additional two lanes when future traffic volumes require, and when funds become available.

Future Construction Plans

Supplemental contracts will, no doubt, be let at a later date when the Clarence Ward Memorial freeway is completed, as directional signs will be needed on US 101. Also, when the funds become available and, in keeping with Division of Highways policy, it is anticipated that considerable landscaping for functional benefit and general beautification of the area will be provided as has been done with other freeway sections in the southern Santa Barbara County area.

This project got underway April 4, 1960, and was completed May 4, 1962, at a cost of approximately $3,-910,000. The contractor was Silva and Hill and Jack L. Adams, acting as a joint venture. The Resident Engineer was G. G. Puder. The Bridge Representative was Walt Bedell. The entire operation was under the supervision of E. R. Foley, District Engineer.

Tunnel Lights

New Fluorescent Lamp Fixtures Are Brighter, Vandal-Resistant

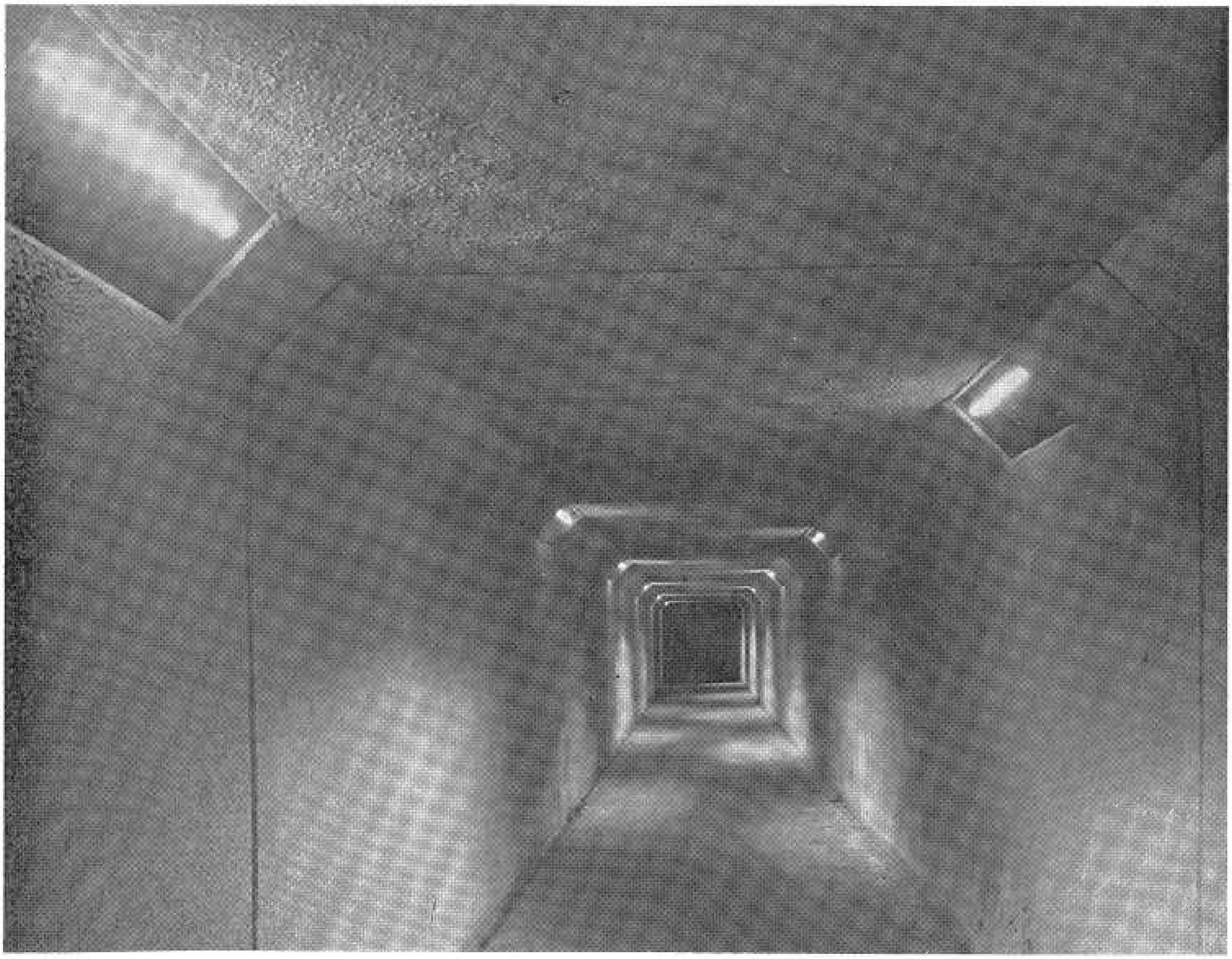
By T. N. KREIBERG, Senior Highway Electrical Engineer

ONE OF THE major objections to the installation of pedestrian tunnels under elevated embankment sections of freeways has been the problem of illumination. At best, in daytime the tunnel presents the aspects of a long dark hole that is uninviting to enter. For many years the only fixtures available for the illumination of these structures were small incandescent fixtures embedded in the concrete of the structure.

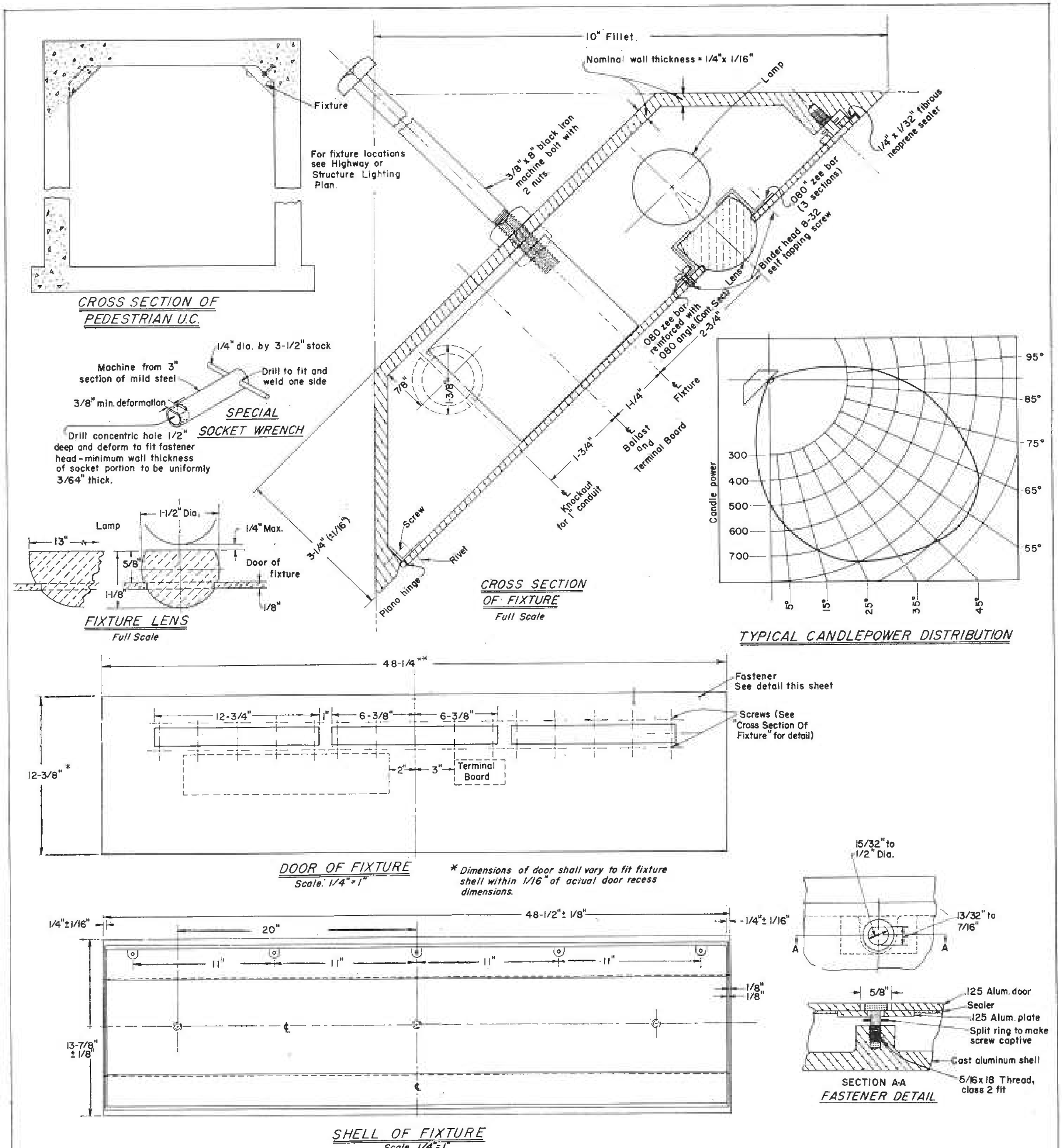
These fixtures are grossly inadequate from the standpoints of light output and susceptibility to damage from vandalism. The unit consists of a fixture shell embedded in the roof of the pedestrian tunnel which contains a 150-watt incandescent lamp with an acrylic plastic lens and covered by a heavy metal guard. The guard is added in an attempt to minimize vandalism from objects being thrust into the fixture.

Heat Limits Size

This protection is not only inadequate, it also greatly reduces the light output from the fixture. Furthermore, the size of the incandescent lamp that can be used in this fixture is limited by the heat produced which can be dissipated from the fixture. Otherwise the lamp temperature will rise sufficiently to shorten the life of the lamp and cause premature burnout. The necessity for embedding the fixtures



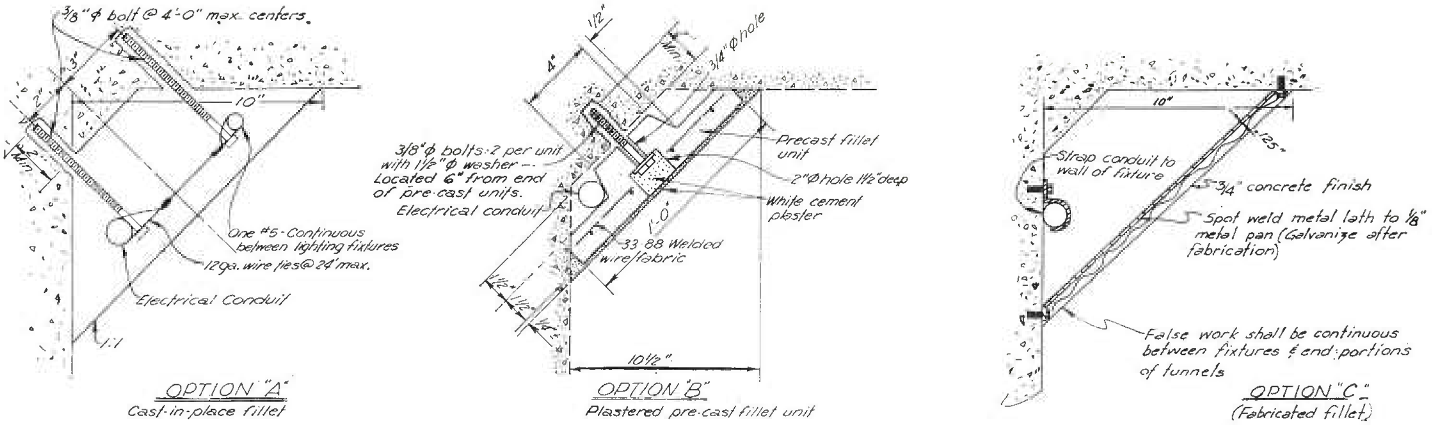
A night view inside the East Third Street Pedestrian Undercrossing in the City of Benicia following installation of the new fluorescent lights.



A diagram showing some of the detail of the new fluorescent light fixtures being installed in pedestrian undercrossings.

in the concrete of the tunnel to protect them from acts of vandalism further decreases the ability of the fixture to dissipate the heat from the lamp. The resulting illumination in the tunnels consists of a few dim patches of light in an otherwise long, dark area and constitutes a policing problem to the local agencies.

The ideal type of lighting for these structures would be that provided by fluorescent fixtures. A fluorescent fixture would provide 52 lumens of light for every watt of electrical power used as compared to about 18 lumens



The Division of Highways has developed several means of surface-mounting the new fixtures and providing 10-inch gunited cast-in-place or prefabricated fillet units to fill the corners between the fixtures.

per watt produced by an incandescent fixture. Thus, a fluorescent lamp is not only about three times as efficient in producing light as an incandescent lamp; its life is also several times longer. A fluorescent light fixture will also produce a long-line source of light that is more appropriate in a tunnel.

Complications Listed

The development of a fluorescent fixture for pedestrian tunnels has been complicated by the following considerations:

1. Resistance to vandalism,
2. Adequate light provision and distribution,
3. Adequate provision for heat dissipation,
4. Accessibility for relamping and other maintenance,
5. Ease of installation during the construction of the tunnel and simplicity of wiring afterwards.

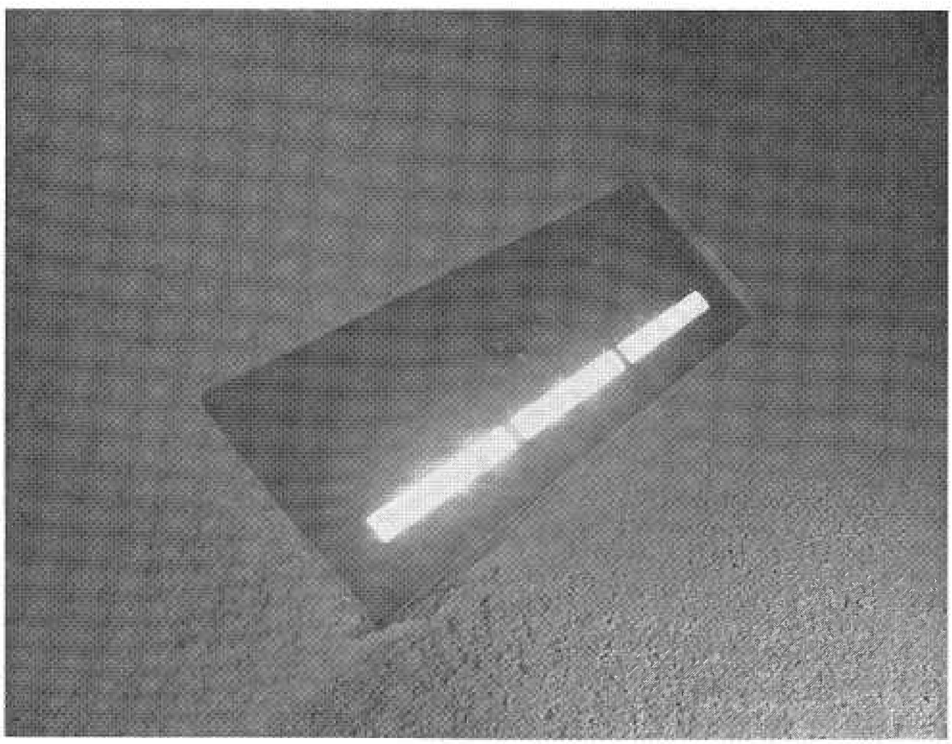
The advent of a fluorescent lamp with a half-inch wide slit in the phosphor coating along the full length of the glass tube has simplified the design of an appropriate fixture. The lamp is known as a 30-degree aperture, very high output fluorescent lamp. The aperture and the special phosphors applied to the lamp provide an extremely bright, and what is essentially a half-inch wide, source nearly four feet long.

The fixture that was designed around this lamp consists of two main parts: A fixture shell embedded in the tunnel concrete and a fixture door. All of the electrical components for the fixtures are mounted on the door, which consists of an ⅛-inch thick panel of plate aluminum of size necessary to fit the door opening in the fixture shell. The use of a cast aluminum door would be undesirable since such large thin castings would be brittle and subject to cracking from vandalism attacks. The ballast is mounted on the door in order to provide adequate radiation to dissipate the heat generated by it.

Lenses Mounted in Door

The door also contains three slots in which the fixture lenses are mounted. The lenses consist of inch-and-a-half sections of clear methyl-methacylate plastic resin rods which have been beveled on the ends and a flat surface provided along the length of the rod. These are mounted in the door with zee bars in such a manner as to place the side of the lenses parallel to the door surface. The lamp is then mounted approximately one-fourth inch behind this flat surface of the lens.

The sockets are a special bi-pin type designed for the lamp and are



A close-up of one of the new fluorescent fixtures in the East Third Street Pedestrian Undercrossing in Benicia (see previous page).

rotatable so that the aperture can be positioned directly behind the lenses. The sockets are rated at 1,000 volts and are approved by the Underwriters Laboratory for outdoor use. An unusual feature of these sockets is the neoprene "O" ring which bears against the end of the tubes to exclude moisture. Fluorescent lamps immersed in water have been successfully illuminated while using these sockets. The attachment of the lamp, lenses, ballast and terminal block to the fixture door, which is provided with a full piano hinge and four specially designed vandal resistant fasteners, provides an easy means of attaching the unit to the shell.

The fixture shell is an aluminum casting about 14 inches wide, somewhat over four feet long and about four inches deep. The fixture shell is designed to be embedded in the corner fillet of the pedestrian tunnel. The Division of Highways Bridge Department has modified standard drawings for pedestrian tunnels to provide a 10-inch fillet into which the fixture casting can be embedded. This design contemplates that the contractor will construct the inside form of the pedestrian tunnel with a constant cross section having the 10-inch fillet throughout. The fixture shell and the conduit can then be quite simply mounted on the 45 degree slope of the fillet prior to the placing of concrete. After the contractor has stripped the inside forms of the tunnel and pulled the electrical conductors, he mounts the fixture door on the embedded fixture shell and connects the conductors to the terminal blocks. The insertion of the lamps and their positioning concludes the necessary electrical work in the tunnel.

BEFORE—A night photo of lighting inside the Miner Avenue Pedestrian Undercrossing in Stockton prior to the experimental installation of the fluorescent fixtures.

Socket Wrenches Provided

The vandal-resistant fasteners are provided with special socket wrenches and are in conformity with the requirements of the Los Angeles Bureau of Street Lighting which has the responsibility of maintaining a majority of the pedestrian tunnels in the State.

The first installation utilizing these fixtures was in the East Third Street Pedestrian Undercrossing in the City of Benicia (see photograph). The unlighted fixtures have been in this tunnel for a period of approximately nine months. During this time, evidence indicates that they have been subjected to hammering from large rocks and numerous heavy objects thrown at them. The testing of these fixtures by vandalism has been evidenced by the numerous nicks on the doors and the presence of rocks in the tunnel. These tests indicated that the doors were too susceptible to flexure and as a result, it has been necessary to provide additional reinforcing to stiffen the doors and prevent the bending which has broken several lamps.

A fluorescent fixture manufacturer in Stockton has been most co-operative in assisting in the development of this fixture.

Model Is Tested

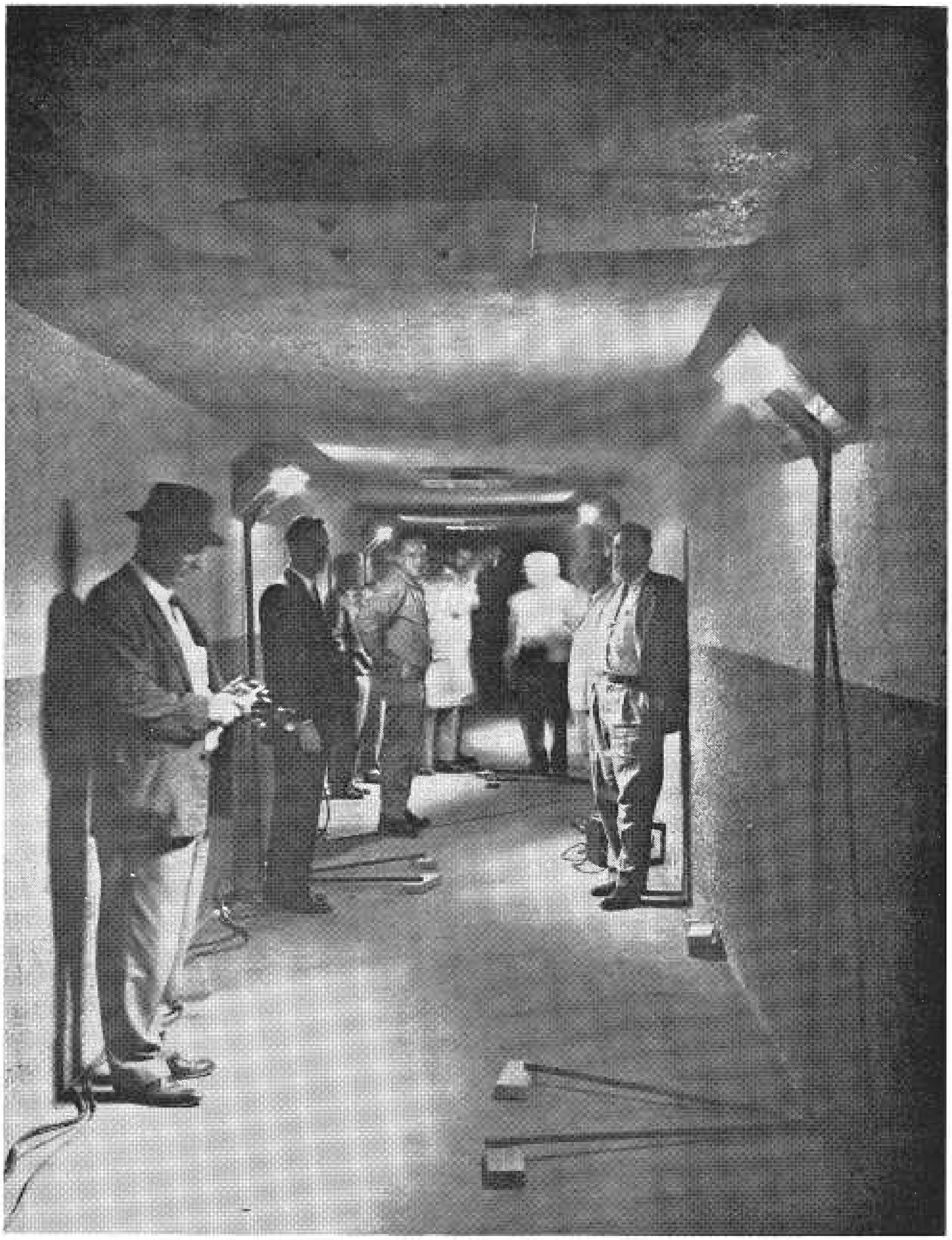
The company constructed and helped test a preliminary model of the fixture. After the preliminary unit was tested and modified, five experimental fixtures were purchased from this company. These fixtures were mounted on temporary pipe supports and placed in the Miner Avenue Pedestrian Undercrossing in Stockton for evaluation. The accompanying photographs, which were taken by a camera using identical film and exposure, graphically indicate the contrast in lighting obtained from the new fixtures compared to those fixtures presently installed in the structure. The seriousness of the vandalism problem is attested by the heavy steel plates which can be seen covering the incandescent fixtures in the ceilings of the structure.

It was concluded from this test that the fluorescent fixtures would provide an acceptable level of illumination when staggered on both sides of the tunnel at a spacing between fixtures of approximately 20 feet. At the time of this writing, the cost of these fixtures is in the neighborhood of $175. It is expected that increased use and competition will serve to reduce this cost.

No Louvers Necessary

The original design of the fixture included a number of louvered openings in the doors to provide some convection movement of air since it was feared that the ambient temperature inside the fixture due to heat from the ballast and the lamp would become unreasonably high. As a result of tests by the manufacturer, it appears that the fixture will operate satisfactorily without these louvers. Experience with other equipment having similar openings has included having vandals filling the openings with paper and lighting the paper. Because of this, louvers were omitted from the final design. With minor modifications, the unit has been found acceptable by the Los Angeles Bureau of Street Lighting.

The design of this fixture was influenced by the possibility that it would be used for relighting existing pedestrian structures in the event that it was successful. Consequently, the back of the fixture was designed to clear the five-inch fillets which had been standard on previous pedestrian tunnels. The Bridge Department has developed several acceptable means of surface-mounting the fixtures and providing 10-inch gunited cast-in-place or prefabricated fillet units to fill the corners between the fixtures. The first such installation of relighting a pedestrian tunnel is in the Jackson Street Pedestrian Undercrossing under the San Bernardino Freeway, about one-quarter mile easterly of the east city limits of Monterey Park.



AFTER—A night photo of the interior of the Minor Avenue Pedestrian Undercrossing in Stockton following experimental installation of the fluorescent fixtures.

The development of this fixture was financed in part out of the State annual apportionment of Federal-Aid highway funds for research, with the approval of the Bureau of Public Roads.

CITIES GET $34,948,755 STREET APPORTIONMENT

A record total of $34,948,755 in state gasoline tax revenues has been apportioned to the 377 incorporated cities in California for city street work during the past fiscal year, the State Division of Highways has announced.

This is $1,136,290 more than last year's record $33,812,485.

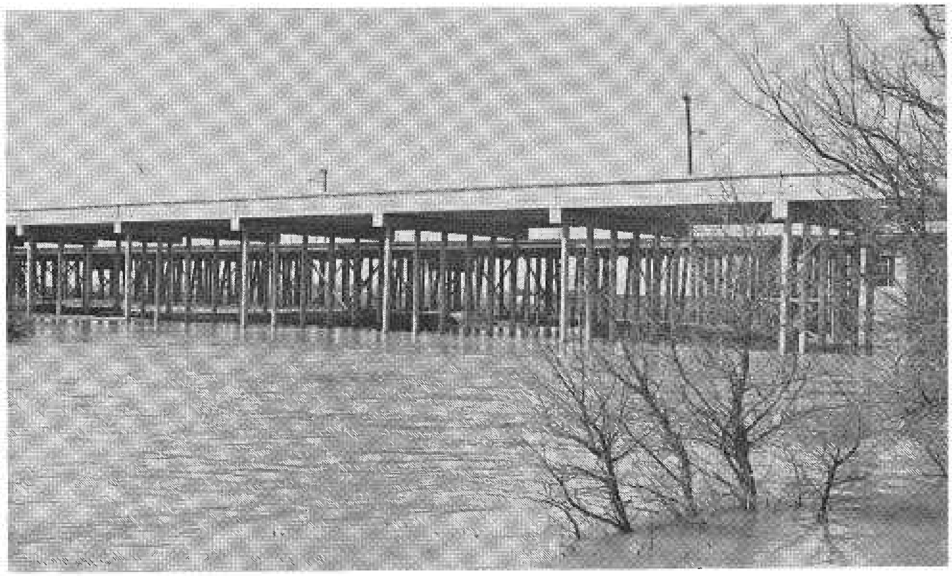
This amount is the revenue from the five-eighths of a cent per gallon out of the state gasoline taxes paid by highway users.

Yolo Causeway

New Crossing Is Scheduled For Early 1963 Completion

By R. F. COLLEY, Resident Engineer and M. CHAPMAN, District Representative

AFTER 46 years of service the existing Yolo Causeway is being replaced by a new crossing which is at present more than two-thirds complete. Elimination of this narrow old structure will be a great improvement in the highway system between Sacramento and Davis which is a part of US 40, US 99W and Interstate 80. This new crossing of the Yolo Bypass (a strip of lowland that is flooded when relief from high water on the Sacramento River is needed) is the major objective of a $6.9 million contract for realignment of 5.7 miles of



The new eastbound Yolo Causeway structure at its east end. The old causeway is in the background.

"GREAT YOLO BASIN CONCRETE TRESTLE" WAS COMPLETED IN MARCH, 1916

(Condensed from articles in the July 1914, July 1916 and December 1932 issues of *California Highways and Public Works*).

The Yolo Causeway across the bypass of the Sacramento River west of Sacramento was a feature of special importance in the early planning of the State Highway System, one of the objectives of which was the shortening of routes between sections of the State.

South of the bridge at Meridian, Sutter County, there was no way, during flood periods, for vehicles to cross the lowlands that extended from some 15 miles north of Marysville to Rio Vista, a distance of 120 miles. Thus the east and west sides of the Sacramento Valley had no highway communication at flood times, which lasted from six to eight months annually, and highway travelers to San Francisco and the Bay area had to go by way of Stockton and Altamont.

For a few months during summer and fall, when the flood waters of the Sacramento River had subsided and the marsh lands had dried out, a precariously passable road, known as the "Tule Jake" Road, was the only means of crossing the basin.

The route of the "Great Yolo Basin Concrete Trestle," crossing the lowlands between Sacramento and Davis, was laid out as a state highway April 22, 1914. Bids for construction were received June 8, 1914. The length, 3.1 miles—a wooden trestle for about 0.4 mile and reinforced concrete trestle with a draw span for about 2.7 miles. It provided a clear driveway of 21 feet in width. The contract was let July 21, and driving piles on the west end began November 1, 1914.

The causeway was opened to traffic on March 18, 1916, having been under construction for a period of about a year and a half, and costing about $400,000. Over 2,000 automobiles used the trestle on the day following its opening.

It was formally opened and dedicated with a gala four-day celebration May 11 to 14, 1916, with practically the entire Sacramento Valley participating.

As an emergency unemployment relief measure, funds for widening the causeway were advanced from federal aid allotments in the fall of 1932.

For weeks hundreds of men in the mills and woods of the Redwood Empire were employed in getting out redwood piling and timbers for an additional 20-foot width on the three-mile trestle.

While the labor required at the bridge site and the direct labor benefit in the adjacent territory was relatively small, the project provided a tremendous stimulus to the timber industry in the northern counties in providing the six million feet of structural lumber to be used on the causeway. Thousands of workers in the mills, the woods and on the logging railroads were employed in producing this order, thus spreading unemployment relief to the entire redwood belt.

highway, beginning at Swingle at the west terminus and joining the existing four-lane divided highway at about one-half mile east of the Yolo Bypass.

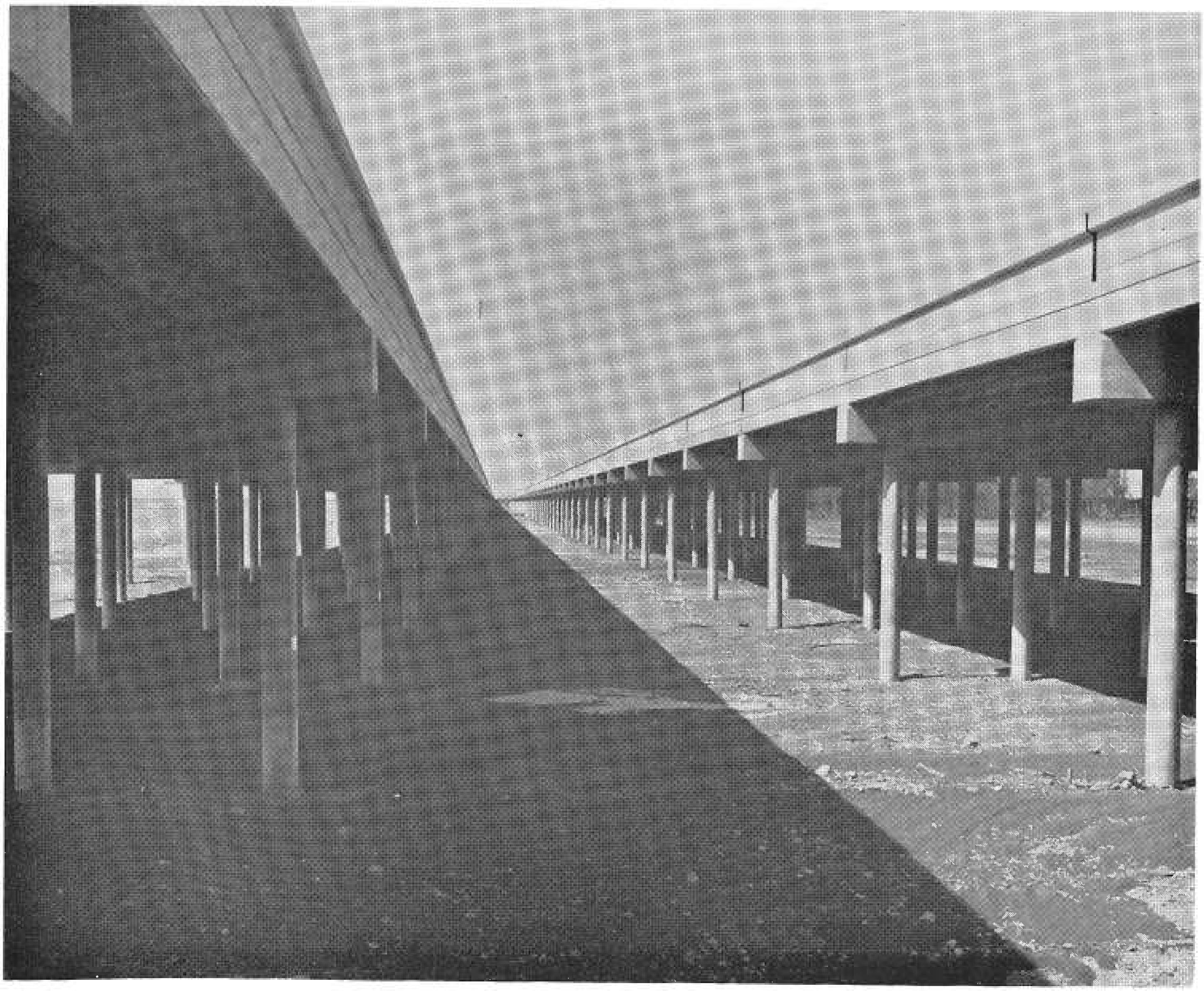
The new alignment will be to the south of the existing highway, and will consist of a six-lane divided highway with provisions for widening to eight lanes. Besides the crossing of the bypass the contract includes: an undercrossing structure adjacent to the west levee of the bypass, the widening of the existing Yolo Causeway Undercrossing to six lanes at the east end of the project, 2.6 miles of six-lane divided highway, ramps, connections, frontage roads and appurtenances. The contract was awarded to a joint venture of Fredrickson and Watson Construction Co. and Lew Jones Construction Company.

Part Is Earth Fill

An earth fill makes up about 4,700 feet of highway inside the Yolo Bypass, with the remainder of the 3.1 miles of bypass divided into two pairs of parallel structures. The length of the west structures will be 2,880 feet and that of the east structures will be 8,800 feet. Eastbound and westbound traffic will be carried on structures completely independent of each other. Each structure will have a curb-to-curb width of 46 feet, consisting of three 12-foot traffic lanes with an eight-foot shoulder on the right and a two-foot shoulder on the left.

When the north half of the existing causeway was completed in 1916 the width between wheelguards was only 21 feet. The substructure consisted of about 2,500 feet of timber-pile trestle and 14,000 feet of concrete-pile trestle with an 80-foot bascule span at the east end. In 1933 the causeway was widened to its present width of 42 feet by adding a timber-pile trestle on the south side, and the east end was revamped to a 104-foot double-leaf bascule.

The new causeway structures will provide two roadway widths of 46 feet each as compared to a single



Looking west between the new twin parallel structures. A portion of the old structure can be seen in the distance far right.

Looking west over the Yolo Causeway project. The 4,700-foot-long fill and pavement is completed. The two 2,800-foot-long structures at the west end are nearly complete. The eastbound lanes of the two 8,800-foot-long structures (broken white line left center) will be completed late this summer and traffic will be detoured over it while the westbound structure is being completed.

width of 42 feet which now exists. The entire existing causeway structure will be removed under this contract.

Bidding Alternatives

To intensify competitive bidding five acceptable superstructure alternatives for the Yolo Causeway were designed from which the contractor could choose. The alternatives were: (1) precast pretensioned double channel deck units with an asphalt concrete wearing surface; (2) precast pretensioned "I" girders with a cast in place concrete deck; (3) precast pretensioned "T" girders with a cast in place deck; (4) precast rectangular reinforced concrete girders with a cast in place concrete deck; (5) a conventional cast in place reinforced concrete "T" beam. All alternatives to be supported on concrete pile bents spaced at 40-foot centers. The pile bents to consist of six concrete piles and a reinforced concrete cap.

From the five alternatives the contractor chose alternative (1) and used cast in drilled hole piles for support. For fabrication of the prestressed double channel deck units, the contractor constructed a casting yard at the jobsite. The casting yard consists of four casting beds each approximately 500 feet long with 12 steel deck unit forms for each casting bed. The contractor is able to cast 24 deck units every day. The pretensioning force of 379,000 pounds required for the deck units is obtained by stressing 24 high-strength 7/16-inch steel strands which are anchored at each end of the casting bed. This force is held by bed anchorage until the concrete reaches the required design strength of 4,000 psi, at which time the force is transferred from the anchors to the concrete. To attain this design strength, a steam cure is applied at 140 degree Fahrenheit for 12-14 hours.

5,256 Deck Units

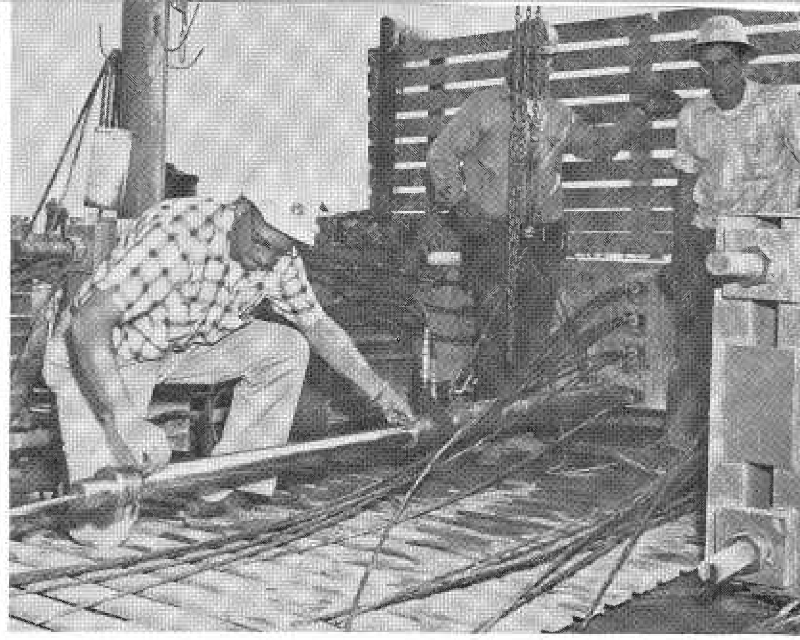
Each deck unit is 39 feet 4 inches long, 5 feet 8 inches wide, 2 feet deep, and weighs about 15 tons. A total of 5,256 of these deck units will be required for this project. There is enough prestressing strand in these units to reach from Mexico to Oregon.

Grading consisted of about 100,000 cubic yards of roadway excavation and nearly 1,050,000 cubic yards of imported borrow. Approximately 757,000 cubic yards of the borrow was placed as embankment for the 4,700-foot earth fill section inside the bypass.

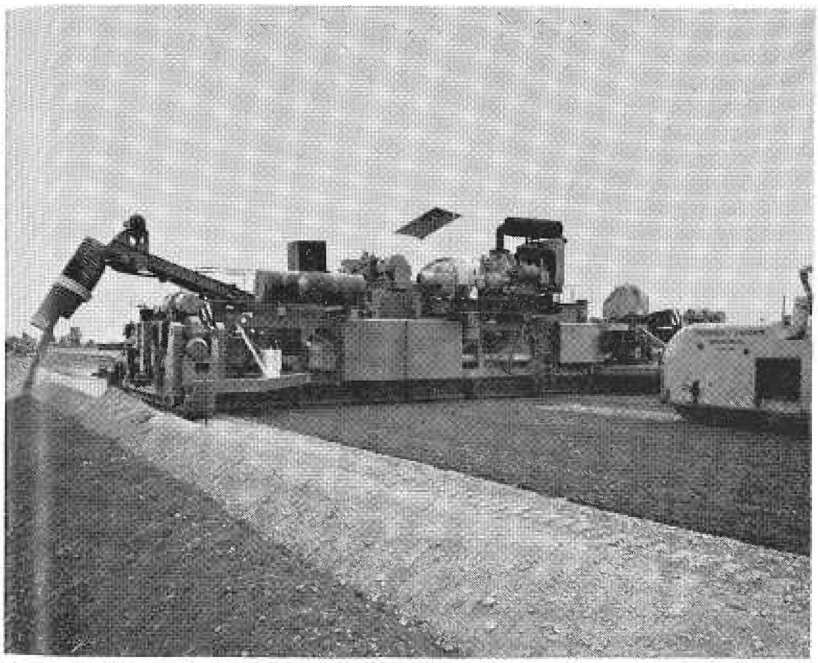
The two state-owned material sites for borrow were located within the bypass north of and parallel to the new alignment and lying on either side of the existing causeway.

For the embankment inside the bypass, loading and hauling equipment consisted of a tractor with bulldozer attachment which was kept continually busy pushing the 24-cubic-yard scrapers used to haul the material. Compaction equipment consisted of a tractor with bulldozer and heavy-

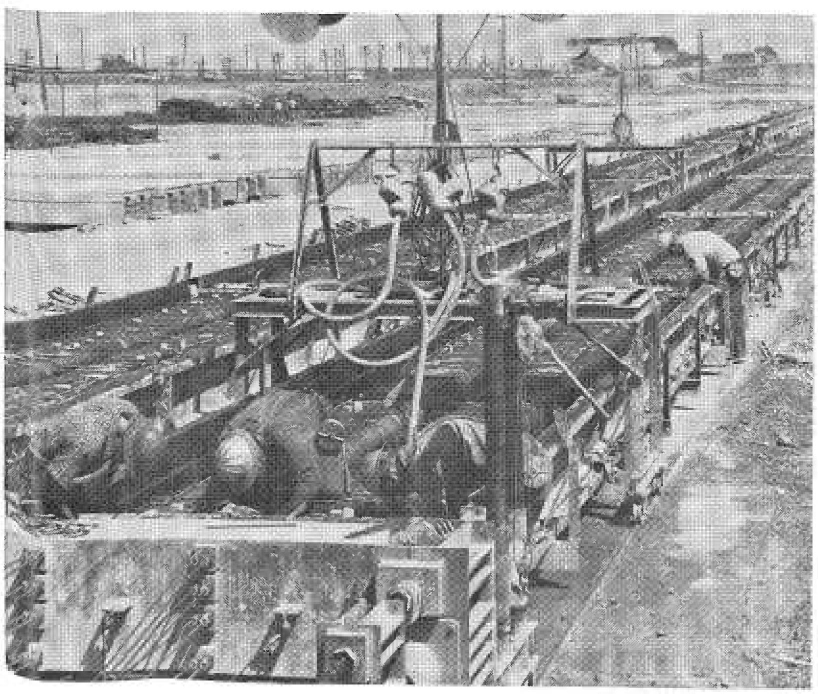
Erecting the deck units on the west Yolo Causeway.

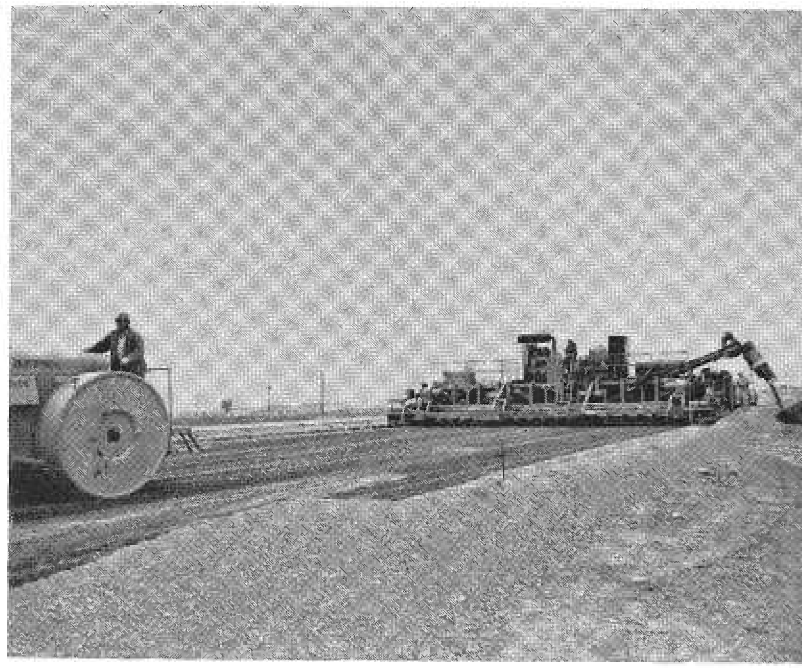


Pretensioning deck unit strands. An inspector is checking elongation.

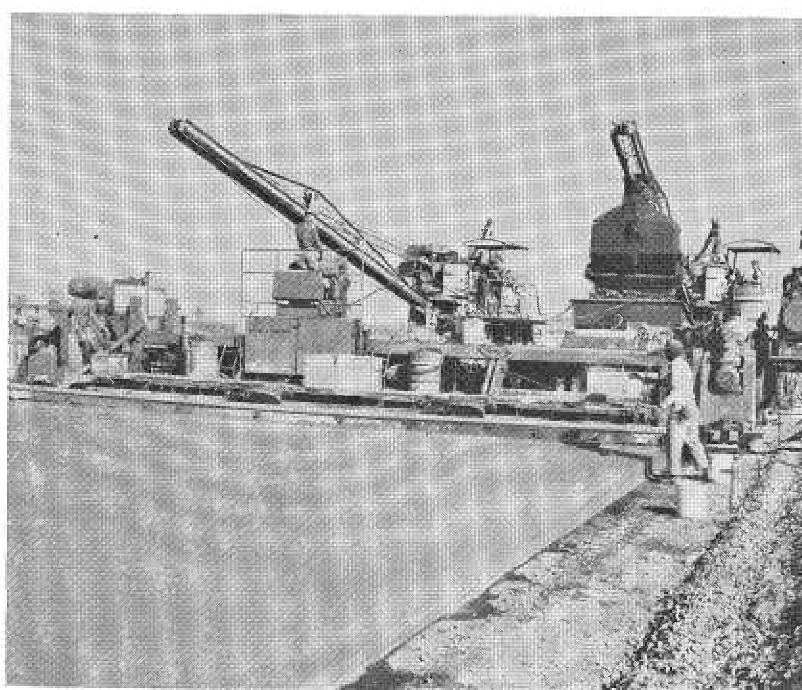


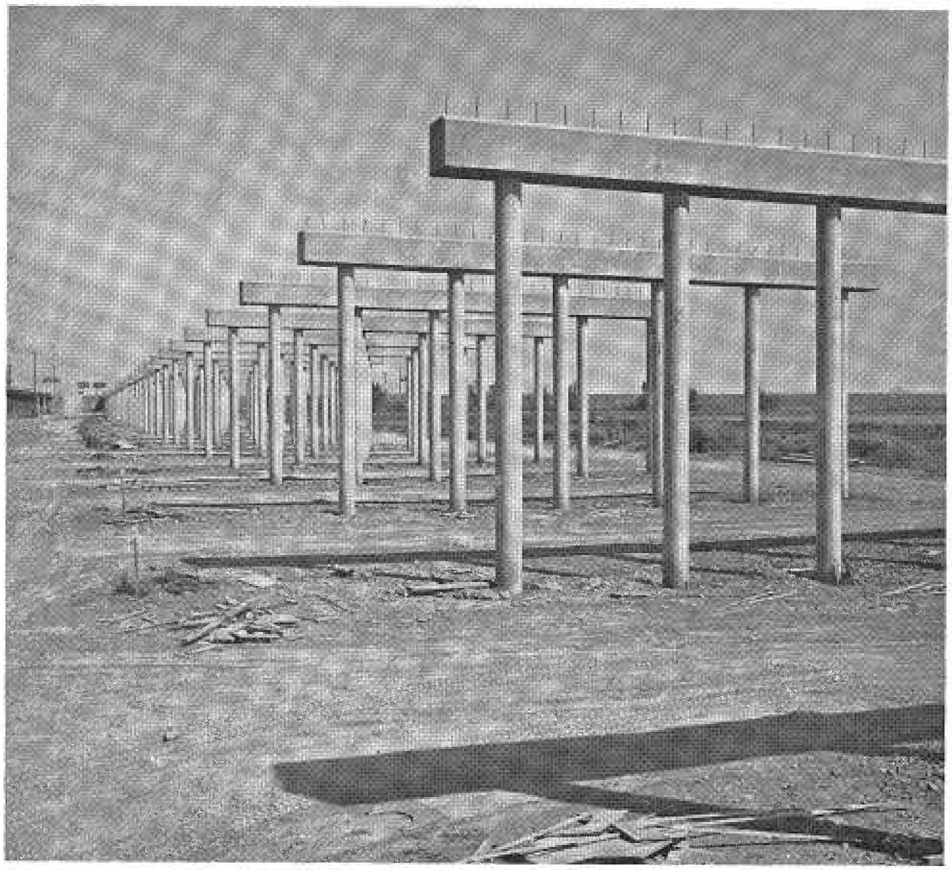
ABOVE—Rear view of the "Road Builder" trimming cement treated base.
BELOW—Steel deck unit forms being prepared for concrete pour.



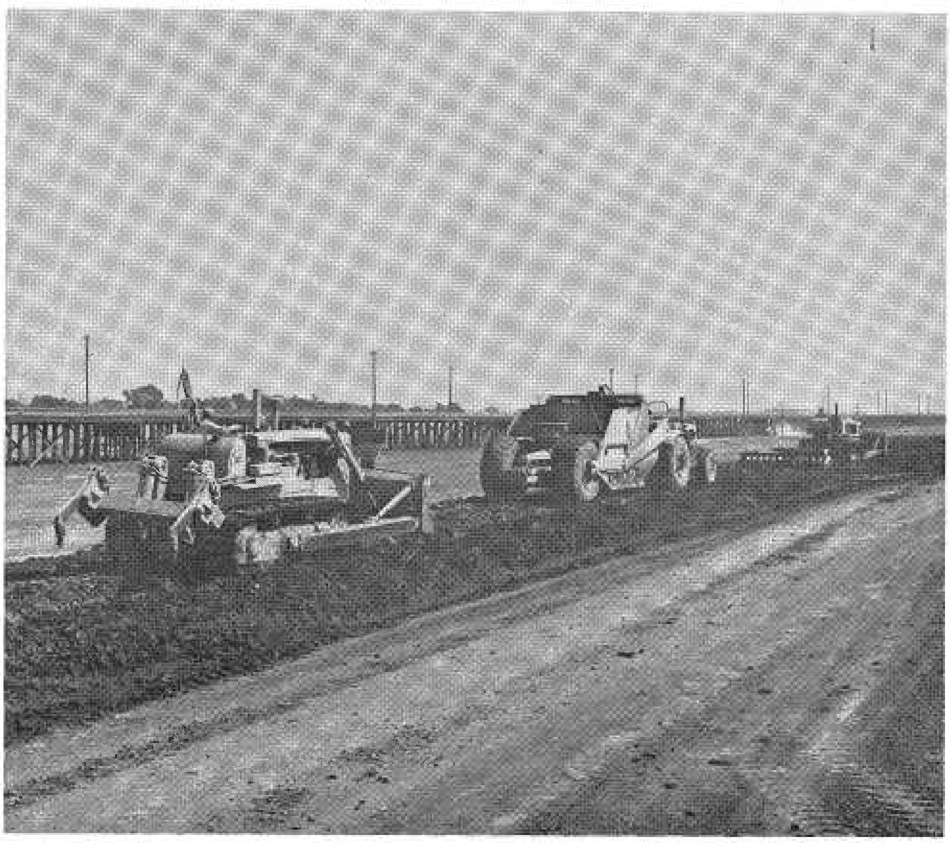


ABOVE—Front view of the "Road Builder" trimming cement treated base.
BELOW—Rear view of the slipform paver in operation.





The substructure of the Yolo Causeway ready for deck units.



Constructing choker on the embankment inside the Yolo Bypass.

duty disc, a large motor grader with disc, and a tractor with bulldozer and sheepsfoot attachments. To maintain an average daily production, the haul distance could be varied from 200 to 5,000 feet.

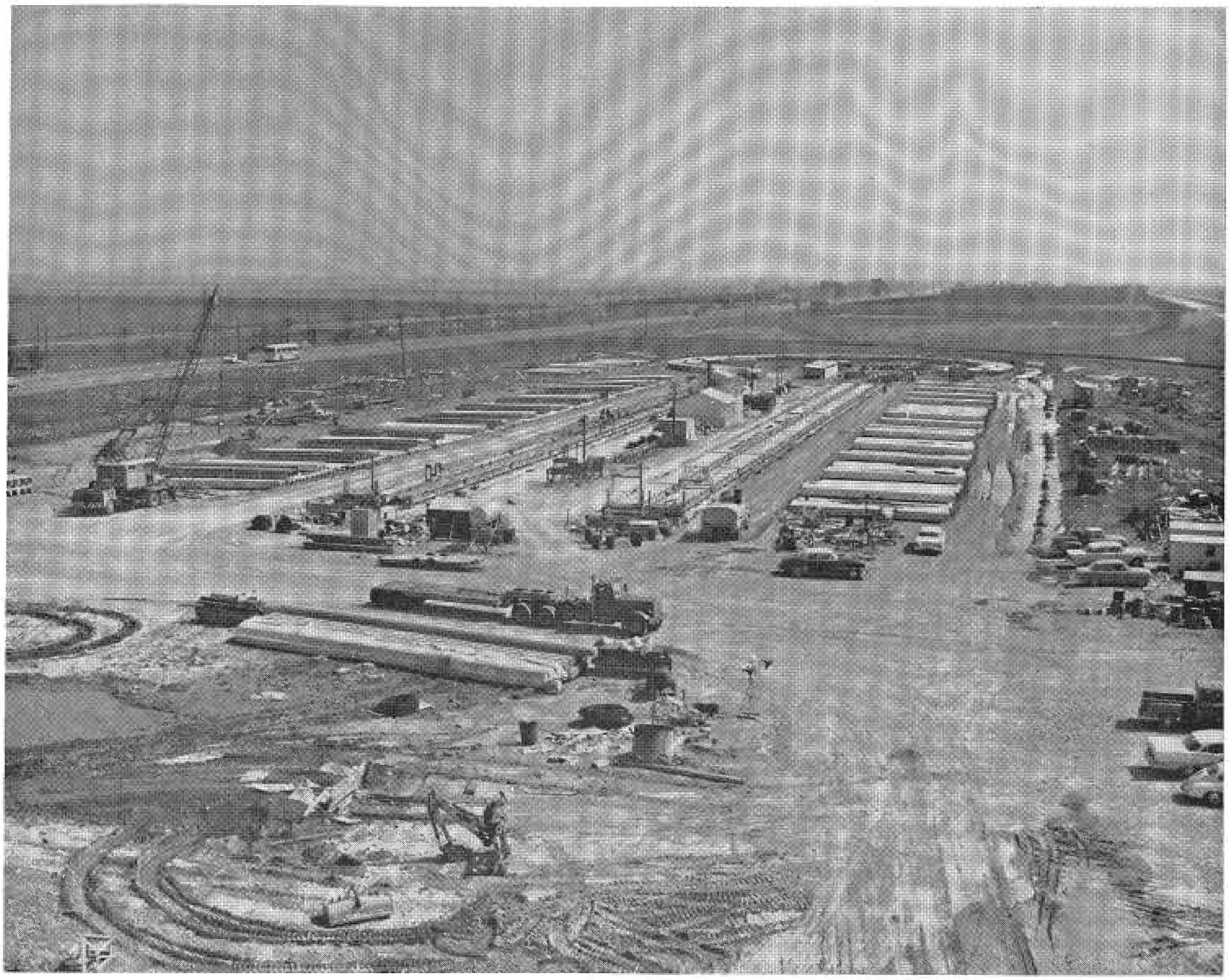
Cohesionless Sand

The portland cement concrete pavement is supported by aggregate base over aggregate subbase. The subbase is a cohesionless sand previously dredged from the Sacramento River and stored in a state-owned site by the U.S. Corps of Engineers. It was placed and watered in full thickness in lieu of layers, because of lost traction to hauling equipment. Four to five passes of a vibratory compactor obtained the required 95 percent compaction. Grade was made with a motor grader.

Aggregate base, obtained from a commercial source, was hauled to the job in bottom-dump trucks and spread on stable base in windrows. It was then picked up with a self-loading scraper and spread on one side of the subbase to form a stable base for further windrowing. This base material was then bladed laterally across the subbase and compacted. Grade was left between 0.03-foot and 0.05-foot high. Final trimming was made by the new Guntert and Zimmerman "Road Builder" in a single pass, allowing for the one-inch difference in pavement thickness between the inside and middle lanes. This new "Road Builder" is built on the same principle as the same firm's slipform paver and was used for the first time on this project. It is guided electronically by taut, horizontal wires set with reference to line and grade. The machine weighs about 80 tons and is driven by electric motors which are supplied by a 20-kilowatt diesel-powered generator.

Self-Propelled Device

The huge device is self-propelled on two sets of tracks, each driven by individual electric motors. Reversible augers across the front, also powered by electric motors, distribute the material laterally in front of the machine. Following these is a row of vibrating compactors, each two feet wide and operated by a battery of electric mo-



A view of the contractor's yard for casting deck units. The boiler for furnishing steam to cure the deck units is housed in the building (center). On each side of the boiler house are casting beds, each with 12 steel forms in which the units are cast. Paralleling the casting beds are storage areas for completed units. At the far edge of the yard is the circular storage track for steam hoods which are used to enclose deck units during the steam curing period. This yard can produce 24 units a day.

tors. Behind the compaction units is another set of augers which trims the material to grade and brings the excess to the center of the machine where it is scooped onto a conveyor and disposed of along the edge of the subgrade, to be used in the shoulders. A strikeoff plate on the rear trims off any minor high spots.

The top four inches of the aggregate base was cement treated to Class A requirements for the middle and outside lanes, and to Class B requirements for inside lanes. Cement was added in proper proportions to the three windrows, two being 13 feet wide and one 12 feet. A road mixer was used to partly spread the material, and initial compaction was made by a 12-ton, three wheel roller.

The "Road Builder" trimmed and compacted the CTB to grade. Finish rolling was done with a pneumatic-tired roller. Minor adjustments up to 0.03-foot were made in the grade line to insure minimum design pavement thickness.

Paver Used for Surfacing

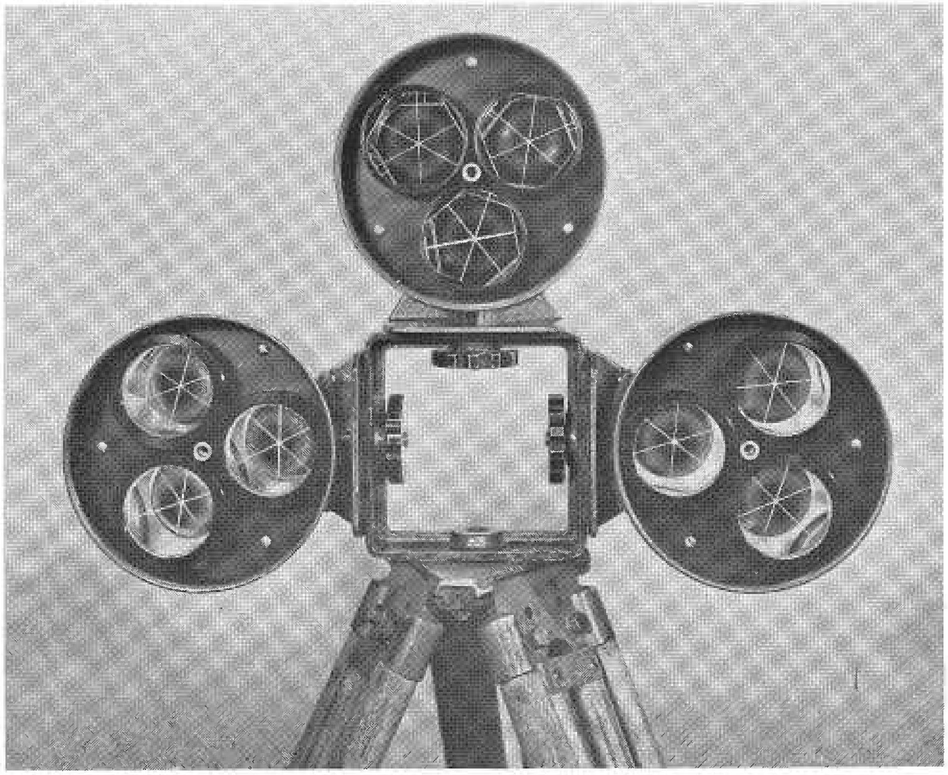
A slipform paver was used for concrete surfacing. A total of 0.035-foot average excessive thickness resulted from the paving operation. Stabbed subgrade accounted for 0.018-foot and the remainder is assumed to be in the high finished grade and waste.

Smoothness of the pavement was affected primarily by the number and duration of paver stops. A high, constant production contributed to a smooth finished pavement.

Since a portion of the existing Causeway must be removed before the westbound structure can be completed, all traffic will be detoured over the eastbound roadway and structures in the late summer of 1962. The existing Causeway will then be removed and the westbound lanes can be completed. The project is scheduled for completion in the spring of 1963.

Meet the Geodimeter

By GEORGE P. KATIBAH, Supervising Photogrammetrist, and
DAN RADMANOVICH, Geodimeter Party Chief



Nine prism reflecting unit obtained by combining 3 three-prism units on special tripod bracket.

In the fall of 1957 the Headquarters Photogrammetry Section acquired a Model 3 Geodimeter, an instrument of Swedish manufacture, for the purpose of measuring basic control survey distances. The range and accuracy of the Model 3 made it possible to make direct survey ties to U.S. Coast and Geodetic Survey triangulation stations by traverse procedures. In this manner the California Coordinate System could be established in the immediate vicinity of a highway mapping project without resorting to costly and time consuming conventional survey methods. This approach was particularly practical in those portions of the State which presented difficult survey problems because of the remoteness of the triangulation stations or the ruggedness of the terrain.

Value Established

The Geodimeter has demonstrated its reliability and value in the complement of precise surveying equipment. Since the advent of the Model 3, a Model 4 instrument was introduced which has proven to be of even greater value for many types of highway survey problems. The latter intrument is now part of the survey equipment in 7 of the 11 district offices as well as in the Headquarters Office.

It is the intent of this article to acquaint the reader with the Geodimeter. This and other electronic distance measuring instruments have indeed precipitated a technological revolution which promises to completely alter the concept of precise surveying procedures and their application to the more routine surveying problems.

Geodimeter System

The rapid development of electronic technology since World War II has provided an extremely flexible series of instrumentation components applicable in all phases of science and industry.

The combination of electronics and accurate timing devices such as the crystal clock has enabled scientists to make a more precise determination of the velocity of light and investigate the effect of meteorological conditions upon its propagation. These studies led to the use of light velocity determinations as a basis for distance measurement.

One of the results of these experiments was the design of the Geodimeter, which is an electro-optical instrument that measures distances with rapidity and accuracy. Observations are normally made during the night hours.

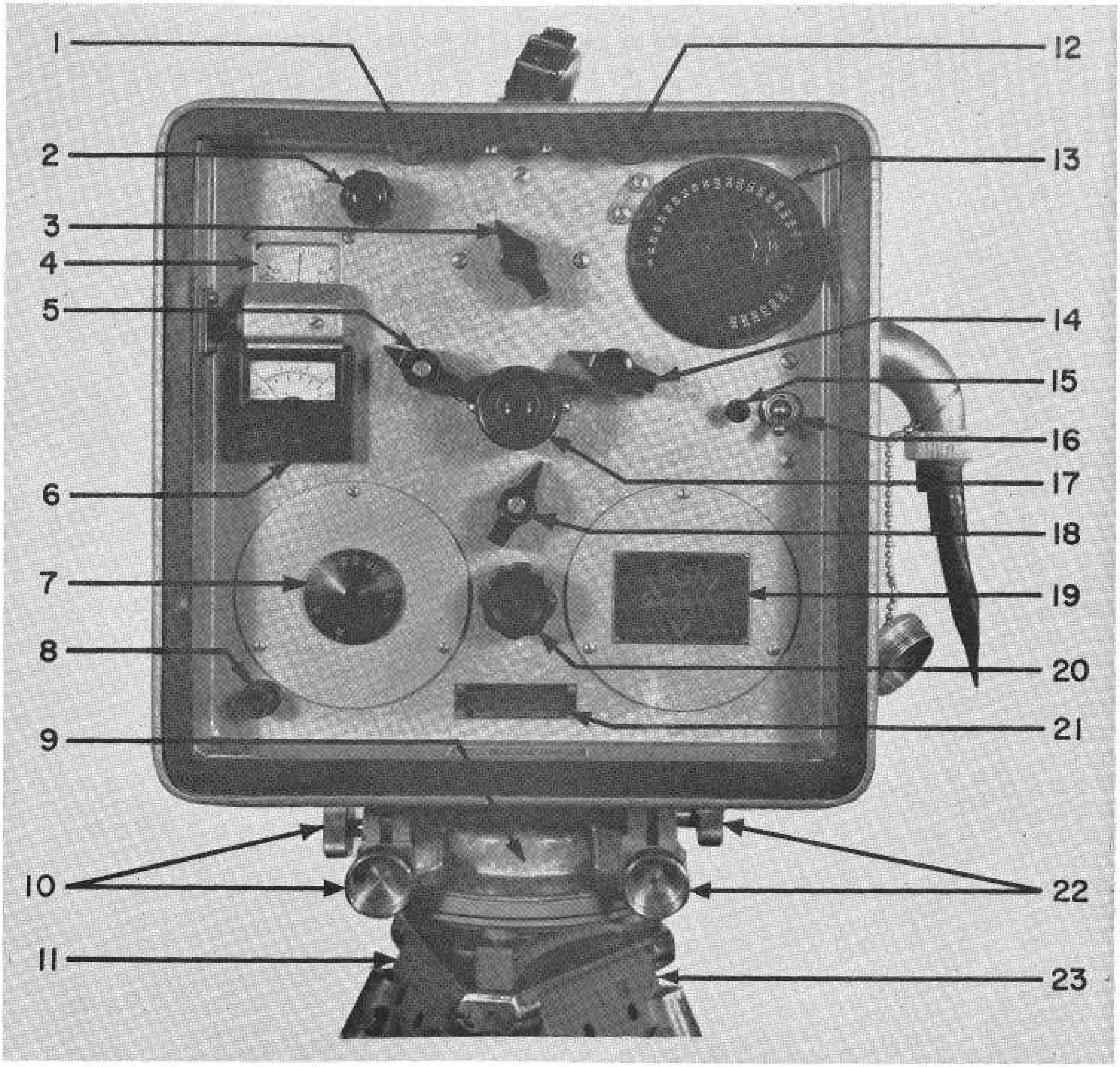
The Geodimeter was invented by the noted Swedish geodesist and physicist Dr. Erik Bergstrand. At the present time, three models are available, of which the Model 4 is the one best applicable to highway surveys.

Operating Principles

The basic principle of all models of the Geodimeter system of distance measurement is the indirect determination of the time required for a pulsed light beam to travel between two stations.

A modulated beam of light is emitted from the Geodimeter to a passive reflector placed at the other end of the line being measured. The reflector returns the light pulses back to the instrument where a phase comparison is made between the projected and reflected light pulses.

The design theory of the various models is essentially the same; how-



Geodimeter Unit, panel view

1. *Panel light and crystal oven signal*
2. *Zero adjustment control*
3. *Frequency selector*
4. *Null indicator instrument*
5. *Control instrument switch*
6. *Control instrument*
7. *Focusing dial*
8. *Coarse sighting eyepiece*
9. *Geodimeter head*
10. *Horizontal tangent screws*
11. *Star plate*
12. *Panel light*
13. *Delay line dial with index*
14. *Phase selector*
15. *Light sensitivity control*
16. *Projection lamp switch*
17. *Fine sighting eyepiece*
18. *Fine sighting switch*
19. *Name plate*
20. *Focusing knob*
21. *Type and serial number plate*
22. *Vertical tangent screws*
23. *Wild T2 Tripod*

Typical operational set-up at night; Dan Radmanovich at the Geodimeter, Lee Winn measuring the vertical angle with theodolite.

ever, the size of the optics, the type of delay line, and the number and frequencies of the crystal oscillators differ in each model.

To illustrate the operation of the Geodimeter, the Model 4 is described as follows with reference to schematic diagram on page 53.

The randomly polarized light from the projection lamp (1) passes through a condensing lens (2) and a polaroid filter (3) to a focus point between the Kerr-cell electrodes (4). The light rays pass through the Kerr-cell to the second polaroid filter (5) which is oriented 90° to the first filter. Since the two polaroid filters are crossed no light can pass through the second polaroid.

The Kerr-cell consists of two parallel electrodes in a glass container. The electrodes are immersed in a fluid of highly purified nitrobenzene. When a high voltage is applied across the electrodes the nitrobenzene becomes doubly refractive and rotates the beam of light so that it can pass through the second filter to the optical transmitter (6). As soon as the voltage is discontinued no light will be transmitted. In effect, the Kerr-cell acts as an extremely rapid electronic shutter and has no moving parts.

Voltage Applied

The high voltage applied to the Kerr-cell is generated by a highly stable radio frequency (RF) oscillator and amplifier (7) as a pulse with a frequency of about 30 million cycles per second (30 Mc/s). The resultant emitted light will flash at the same frequency.

The pickup coil (8) in the Kerr-cell circuit retains a minute portion of the RF power to serve as a reference point of the time when a light pulse leaves the Kerr-cell. This small RF pulse passes through the delay line (9) and into the receiver circuit (13).

The emitted light is returned to the Geodimeter by a prismatic reflector and is collected by the optical receiver (10), transformed into a line image by an astigmatic condenser system (11) to a point on the cathode of the photo-multiplier cell (12). The light is then converted to electrical signals by the photo-multiplier cell and conducted to the receiver circuit (13).

The phase relationship between the transmitted and received pulses is determined by adjusting the delay line until a zero condition is read on the null meter (14). The adjustment of the delay line is controlled by a dial which is graduated into 300 parts corresponding to approximately 1 centimeter of distance per part. The delay line dial readings are used for the computation of the observed distance.

The cathode of the photo-multiplier cell is modulated by the same RF frequency as the Kerr-cell, and therefore the sensitivity of the receiver varies in synchronization with the transmitted light.

Receiver Sensitivity

A reflector can be placed at a point where the maximum sensitivity of the receiver coincides with maximum light received by the photo-multiplier cell. At this point the photo-currents will be of equal amplitude, the null meter will read zero, and the delay line dial will also be at its zero point. If the reflector is then moved a few feet farther away, the synchronization will be lost and the null meter will read off zero. If, however, the reflector is moved further, another zero point will be found. The distance between zero points is called a "unit length," and corresponds to a change in reflector distance movement equal to a time interval of half a cycle of the modulation frequency. The zero readings are obtained at fixed intervals and are determined by the values for the velocity of light and the modulating frequencies.

Three Separate Frequencies

The Model 4 incorporates three separate frequencies in the 30 megacycle range, each producing a specific unit length. Because of the design of the instrument, and since the mathematical relationship between these three frequencies is held constant, distances up to 1000 meters can be calculated from the delay line dial readings.

The instrument is unable to measure distance in terms of total length, but it does indicate that the distance consists of even or odd 1000 meter intervals; i.e., the even intervals are 0-1000, 2000-3000, 4000-5000 meters, etc., and the odd intervals are 1000-2000, 3000-4000, 5000-6000 meters, etc. Since the Geodimeter does not identify the proper 1000 meter interval, it is necessary to obtain from maps or by other methods the approximate distance to within ± 1000 meters to calculate the observed distance.

The precision of the Geodimeter relies upon the fact that the velocity of light and the frequencies of the crystal oscillator are very accurately known and that they remain almost constant.

Changes in atmospheric temperature and barometric pressure produce a small known variation in the value of the velocity of light. Temperature and pressure data are noted for each observed line and the resultant corrections are applied to the computed distance.

Variations in frequency constants are caused by ambient temperature. In order to maintain fixed frequencies, the crystals are enclosed in an electrical oven where a constant temperature is maintained.

The Reflector

The simplest type of reflecting surface that could be employed is a plane mirror. However, such a reflector requires horizontal and vertical fine-adjustment motions since the reflected beam must be accurately directed toward the instrument. Any atmospheric refraction changes or tripod vibrations would make the reflected light unusable.

A special retrodirective reflector system which does not require accurate pointing was developed. The reflector is a two-inch diameter solid glass prism mounted in a metal case. This prism is actually a corner section of a cube. The 90 degree corner angles are ground to a tolerance of $\pm$ one second of arc. An exact corner prism, i.e., with corner angles being perfect right angles, is not desirable because it will reflect incident light directly back to the light source. Since the transmitter and receiver optics of the Geodimeter are laterally displaced, an exact corner prism would not be practical at short ranges. However, this deliberate deviation of the corner angles becomes less important as the range increases, and at ranges over a mile small optical imperfections in the prisms and turbulence in the air will spread the light sufficiently to account for the displacement of the transmitter and receiver optics.

Short Range Operation

Two methods have been devised for short range operation. The first is the insertion of a defined deviation in one of the 90 degree angles of the prism which causes the reflected light to return in two symmetrical light bundles at an angle with each other. One bundle will be centered on the receiver optics and the other bundle will be centered on a point symmetrically located on the other side of the transmitter optics.

The second method utilizes a thin glass wedge which covers half of a corner prism. A light beam entering the uncovered portion will be internally reflected in the normal way but will be deviated by the wedge when leaving the prism.

The development of the retrodirective prism system for use with the Geodimeter effected a huge increase in the number of observations that could be made each night. The prisms are easily portable and can be left unattended. In addition, light will be reflected to the instrument even though the axis of the prism is offset in its pointing by as much as 20 degrees.

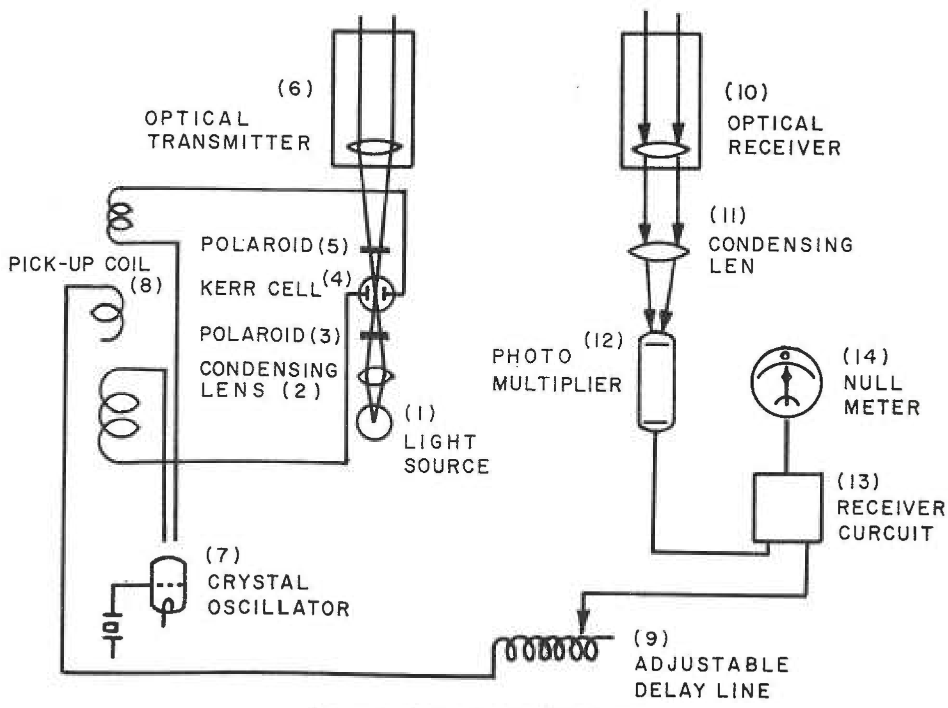
In order to afford the greatest flexibility and economy in operation each prism is mounted in individual shockproof casings which can be placed in housings that will hold 1, 3 or 7 prisms. The housings will mount on any Wild theodolite tripod, and with a special bracket a maximum of 21 prisms may be utilized. Plastic reflectors, similar to those used on highway guide posts, may be substituted for distances up to 0.5 mile. It is possible, therefore, to select the suitable reflector combination for the distance being observed.

The Model-2

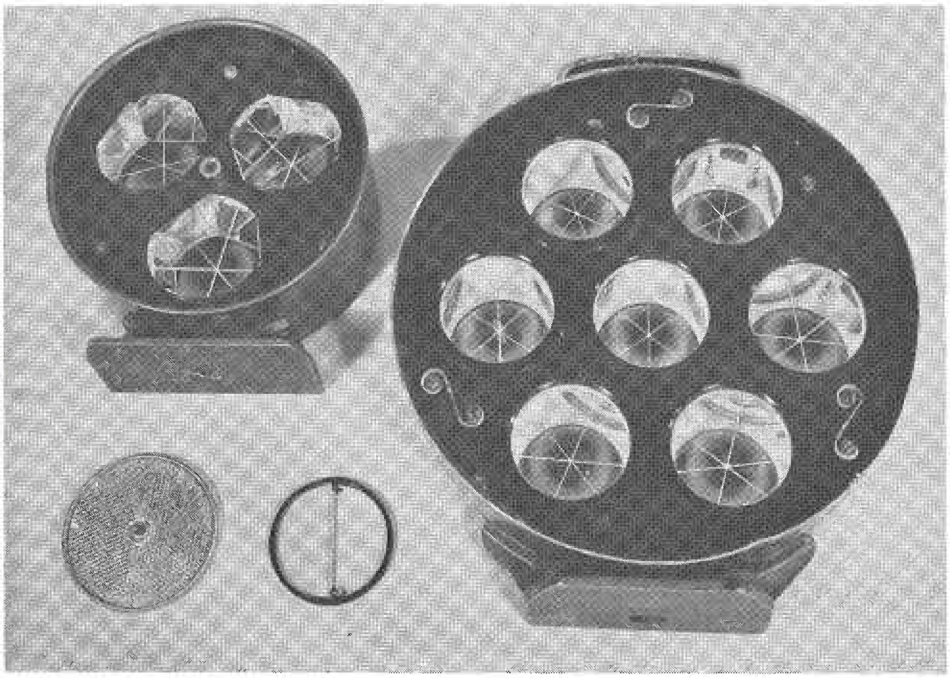
The initial model of the Geodimeter was developed for extreme accuracy at ranges from 5 to 40 miles. The Model-1 instrument was introduced in early 1953, and was superseded by a refined version, the Model-2 in 1955. The Model-2 Geodimeter gives results which are as accurate as the highest-precision taped distances. At the present time this instrument is being used by other agencies to establish first order base lines, and for determining the magnitude of the shift of the earth's crust in earthquake fault areas.

The Model-3

Many users of the Model-2 requested that a more portable unit be developed that would be useful in surveys that did not require utmost accuracy. Subsequent refinements of design, at the expense of range and accuracy, resulted in the production of the Model-3 Geodimeter. This model is designed to operate in the 1



Schematic diagram of the Geodimeter.



Various elements of reflecting unit, including 3- and 7-prism reflectors, plastic reflector, and glass wedge.

to 20 mile range, within a possible error range of ± 0.40 feet.

The Headquarters Model 3 instrument was used continuously for a 2½ year period during which time about 930 lines were measured. Although the instrument is still available for use it has been virtually replaced by the Model 4.

The Model-4

The Model-4 Geodimeter is designed primarily to meet the requirements for an instrument of high accuracy in the range of 1,000 feet to 4 miles. In clear air, distances up to 12 miles have been measured. At distances from 400 to 1,000 feet the accuracy is in excess of 1 part in 10,000, and the proportional accuracy increases as the distance measured increases. The maximum error for a single observation at any distance is ± 0.04 foot plus 5 millionths of the distance. Experiments conducted by the Headquarters staff indicate that the accuracy will normally be in the range of ± 0.02 foot using conventional operating techniques.

The components of this instrument consist of the Geodimeter, the head, power converter, and a Wild T2 theodolite tripod.

The instrument weighs 34 pounds and is 11 x 13 x 12 inches in size. The base, which is affixed to the tripod, weighs 10 pounds and is 5 x 7 x 7 inches in size. The power converter weighs 18 pounds and is 10 x 5 x 7 inches in size.

The power source may be either a small generator which supplies 110V at 60 c/s or a 6, 12, or 24 volt battery and inverter. The power consumption is 60 watts.

Approximately 1,500 lines were measured by the Headquarters party alone during the first year of operation of this model.

Need for the Geodimeter

As previously indicated the Geodimeter has proven to be especially useful in establishing the California Coordinate System in the immediate vicinity of highway mapping projects. While the instrument is now being used for a variety of survey problems, the initial interest in it was directly associated with the extension of the U.S. Coast and Geodetic Survey control network for the specific purpose of providing strong tie-points for the highway survey system.

This approach to control surveys was originally stimulated by the legislative enactment of 1947 which legally established the California Coordinate System. Following this, instructions were issued by Headquarters on July 21, 1948, requesting the districts to plan a gradual conversion of highway surveys into a coordinate system tied into the California Coordinate System. The cautious wording of the instructions signified that the task was expected to extend over a period of time.

There were at the outset two main difficulties which soon became apparent. The first centered around the lack of understanding of the California Coordinate System. While the federal government published information regarding the theory and use of plane co-ordinate systems derived from geodetic data, education and training were not readily available. Advancement of the Headquarters instructions of July, 1948, was inevitably slow, and depended upon the interest and effort of those intimately concerned with surveys. In 1951, the University of California Extension developed a course on the application of the California Coordinate System. This course, sponsored jointly by the Institute of Transportation and Traffic Engineering and the Division of Highways, and presented in different areas of the State, reached a wider cross-section of personnel and created greater general interest in the program.

Coast and Geodetic Survey

The second difficulty involved the practical problems associated with the field work necessary to use the U.S. Coast and Geodetic Survey network of triangulation stations. (The network has been developed for basically geodetic reasons and its use by other organizations has been, until fairly recently, of incidental consideration.) Because of the wide-spacing of the stations together with their remoteness throughout most of the State, routine surveying procedures familiar to highway personnel were not applicable. At that time personnel trained in geodetic surveying were not available, although attempts were made by different districts to organize specialized parties for this type of work. Varying degrees of success were achieved by highway survey parties, some showing disappointing results after completion of final computations.

The expanding use of aerial surveys and photogrammetric mapping emphasized the need to place the surveys on the California Coordinate System. In order to satisfy stereomodel scale requirements, especially for mapping large areas, horizontal control should be established on a suitable coordinate grid system. It seemed logical therefore, to specify in mapping contracts with private firms that horizontal control surveys be made on the California Coordinate System, and furthermore, that reasonably permanent monuments be located at sufficient intervals to make the surveys usable at a later date for locating and staking the final line and for right of way surveys.

Limited Progress

In this manner, progress was made in furthering the ultimate objective. However, where the U.S. Coast and Geodetic Survey triangulation stations were spaced more than five miles apart, which seemed to be the rule rather than the exception, the results were frequently dubious. The problem of establishing the California Coordinate System on all highway projects continued to be difficult to resolve.

With the advent of the Model 3 Geodimeter in 1957, instrumentation was at last available to extend the U.S. Coast and Geodetic Survey network into any area without resorting to complicated surveying procedures. Virtually all photogrammetric mapping projects are now placed on the California Coordinate System, and the surveys for design, location, and right of way, subsequent to the mapping, are also placed on the system. For all practical purposes the original instructions of July, 1948 have been carried out, and the conversion of highway surveys into a co-ordinate system tied into the California Coordinate System is rapidly becoming a reality.

Geodimeter Survey Operations

At the time the Headquarters' party was organized in September, 1957, surveying with electro-optical equipment was being done by a few federal agencies. These surveys were generally restricted to base line determinations. The use of electro-optical equipment for other phases of control surveying had been relegated to discussions of probable uses until such time as an economically feasible model was produced for short range measurements.

Thus, when the Model 3 became available a major pioneering effort was a necessity for much had to be learned about personnel requirements, auxiliary equipment, reconnaissance and preparation for the survey, and of course operation and maintenance of the instrument. In other words, the entire operational approach had to be investigated to establish practical procedures.

J. D. Carter, who was largely responsible for the intial interest in and for the ultimate success of Geodimeter surveys, was the first Chief of Party. Carter left state service in the spring of 1959 and his duties were assumed by Dan Radmanovich. Until recently this party operated on a statewide basis as a service to district offices, but it is currently being used for only four districts since the remaining seven now have their own facilities.

U.S. Coast and Geodetic Survey

As previously stated, the Geodimeter was initially acquired for the express purposes of extending the basic control of the U.S. Coast and Geodetic Survey into the project area. This extension of basic control provided strong check points for originating and terminating primary control surveys, that is, the establishment of co-ordinated monuments at intervals of 1,000 feet to 2,000 feet through the length of the project by conventional traverse procedures. Surveys have also been completed for special projects, an example being the Benicia-Martinez Bridge, which require very high order accuracies.

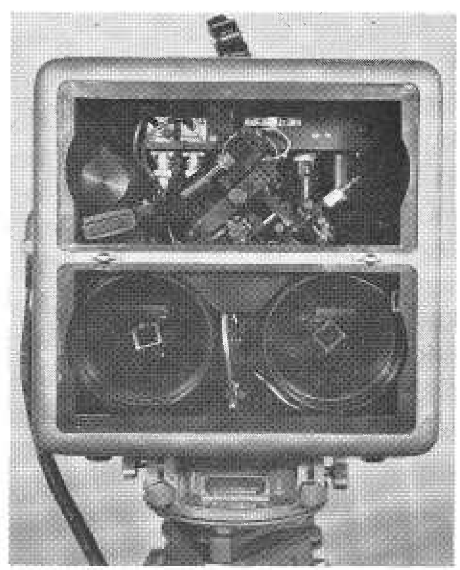
Of special interest was the co-operative work with the U.S. Coast and Geodetic Survey for establishing horizontal control along most of the length of the Westside Freeway from Wheeler Ridge in Kern County, north through Sacramento to Orland in Glenn County. (The section from 31 miles north of Kettleman City to Tracy was accomplished entirely with state forces.) The service agreement * required that geodetic markers be located at intervals of 2.5 to 5 miles along the length of the route. The U.S. Coast and Geodetic Survey was responsible for the entire survey, and they accordingly made the reconnaissance, located the monuments, erected observation towers, observed all horizontal angles, and completed all the geodetic position and adjustment calculations. All distances were measured with the Model 3 instrument by our own party, a deviation from usual procedures especially since the U.S. Coast and Geodetic Survey resorted to traverse rather than to triangulation methods for making the survey, mainly because of the reliability of the equipment.

The overall operational approach has been in practice for several years, although refinements continue to be developed to increase productivity. The following remarks apply in general to present practice by Headquarters using the Model 4.

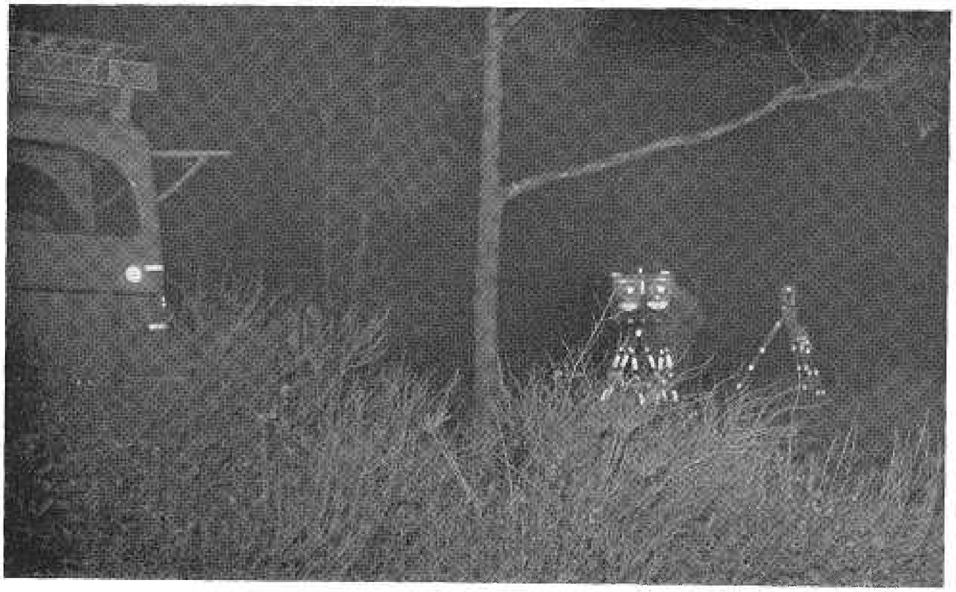
Personnel

Personnel requirements are flexible, depending mainly upon the type of survey, its extent, and the nature of the terrain. The basic party may con-

* Under the procedures prescribed in the U.S. Bureau of Public Roads, Policy and Procedure Memorandum 20-9, co-ordination of this work with the U.S. Coast and Geodetic Survey was authorized, with participating federal funds.



Front of Model 4 Geodimeter, showing transmitting and receiving optics in lower half. The upper half, cover removed, shows light source and Kerr-cell in sloping position.



Night set-up showing value of reflectors and reflector tape in keeping track of equipment in dark.

sist of two men, the operator and a reflector attendant. For traverse-type surveys, the party usually required consists of the operator and his assistant and two reflector attendants. In areas of hazardous terrain, or where long packs to the stations are necessary, additional men are used with each reflector to provide a greater safety factor.

Equipment

The auxiliary equipment is generally divided into the following categories: electric power, vehicles, communications, survey instruments, and miscellaneous items.

Electric power is furnished by either a generator or a storage battery. The generator is a portable type, driven by a two-cycle gasoline engine, specially designed to produce a smooth current of uniform voltage. This generator is normally reserved for pack stations. The storage battery in the vehicle is suitable for nearby set-ups, but an inverter must be connected into the line to transform the current from DC to AC. Vehicles equipped with alternators permit rapid battery recharge when moving between set-ups.

Two four-wheel drive station wagon-type vehicles are used to transport the complete assembly of equipment and to provide transportation during operations. These vehicles are equipped with front end winches, tow hooks, and flashing red lights for obvious safety reasons. On the job, one vehicle is retained by the observing party and the other is used by the reflector attendants.

Communication equipment consists of two-way mobile radios in each of the vehicles, supplemented with handie-talkie radios for pack stations.

Other Equipment

Instruments, such as a one-second directional theodolite for measuring vertical angles, and a steel tape for measuring offsets and height of instrument, barometers and thermometers for atmospheric corrections, are necessary for the complete distance measuring operation.

Miscellaneous items are comprised of tools and spare parts to repair the Geodimeter and generator, and the usual surveying paraphernalia of axes, saws, machetes, flagging, etc. Special consideration is given to safety equipment for night surveying, such as fusees, blinking lights, cones and signs.

Reconnaissance

The fundamental requirement for Geodimeter observations is a clear line of sight, just as is required for theodolite observations. It is especially important that a thorough reconnaissance verify the feasibility of office planning, finalize the layout of the survey, and routes to stations chosen and marked adequately so that a minimum amount of time will be necessary to locate the stations in the dark.

Since the accuracy of the Model 4 is high at both short and long distances, any combination of lengths of courses may be utilized which greatly simplifies setting a random control traverse. However, the daytime planning of monument location, trail marking to the stations, and notices to law enforcement agencies and property owners that night surveys are being conducted is critical. The speed with which observations can be made is of no value if stations cannot be easily located and occupied at night.

Monuments are set on ridges or at some predetermined approximate interval to eliminate the need for chaining on control traverse lines and to reduce the need for chaining on final location centerlines. Observations are made to basic control points and to property corners or other points as may be required by the location and planning staffs. In extremely difficult terrain, the accuracy of the Geodimeter permits its use on courses of 400 to 600 feet which can eliminate many survey problems associated with single point ties.

Observation Procedure

At the Geodimeter station the initial setup is made in approximately five minutes. The assistant operator connects the power pack and voltage regulator to the source of electrical supply. He then sets up the theodolite at a convenient distance away from the instrument for measuring the vertical angle between stations during the observation.

The operator sets the tripod over the station, attaches the head to the tripod, and checks the plumb. The Geodimeter is then locked to the head and the power pack is connected to it. The power is switched on and while the instrument is warming up, observation sheets are prepared and the height of the instrument is recorded.

The reflector attendant plumbs a tripod over his station, attaches a reflector to the tripod and points the reflector toward the Geodimeter.

Communications between the stations are accomplished by utilizing mobile and handie-talkie radio equipment.

When the instrument and reflector are set up the operator may locate the reflector by simply scanning the area, in which it is located, with a flashlight. The reflector will return the light beam and positive identification is made by blinking the light and observing and answering flash from the reflector.

Once the reflector is located, the flashlight is held alongside the Geodimeter and the instrument is pointed and focused with the aid of a high powered telescope which is part of the transmitter-optical system. Fine pointing is accomplished using conventional tangent screws.

A series of 12 to 24 readings are made for each distance determination, requiring 5 to 15 minutes. Midway through the readings temperature, pressure and offset data at both the instrument and reflector stations are noted.

The observation time is completely independent of the length of line being measured. The skill of the operator and the degree of accuracy desired are the governing factors in read-out time.

The usual production in a traverse-type survey will range from 14 to 20 lines, although under ideal conditions as many as 40 lines have been observed in a single night. The largest time-consuming factor in Model 4 surveys is the interval needed to move from station to station. The length of this interval depends on the ease with which stations can be located and occupied. It is therefore evident that the production of a Geodimeter survey party is directly proportional to the effort expended in the daytime planning and preparation of the survey.

Computations

The Geodimeter measures a line-of-sight, or airline distance, which is seldom truly horizontal. Reduction of the slope distance to horizontal distance is based upon either the observed vertical angle or the measured difference in elevation between the Geodimeter station and the reflector station. For a long line the earth's curvature and atmospheric refraction must be accounted for in the computation of horizontal distance. Further reductions of this distance to sea level and to grid are required for survey computations on the California Coordinate System.

Computation of distances are routine but time consuming, especially if attempted in the field. A computer program has been developed by the Highway Planning Survey Tabulation Section for electronic machine computation of the slope and horizontal distances.

Advantages

One of the most significant benefits achieved by the Model 4 occurs in surveys in urban areas. With its great flexibility it is possible to observe from street to street or through residential areas without having to enter upon private property as is necessary in ordinary chaining procedures. In short, the elimination of chaining effects the greatest savings in time and money.

The primary advantage of the instrument lies in the fact that the results achieved are positive. The validity of the raw data is established by the operator during the observation. The computations are also self-checking, and any incorrect solutions are, in almost every case, the result of blunders made in reducing the field notes and transcribing the data to the computation forms. However, experienced computers can resolve virtually every possible field or office error. As an illustration, the Headquarters' party has had to reobserve only three lines in over five thousand Geodimeter measurements.

Expanded Use of the Model 4

The apparent advantages of the Model 4 created greater interest in its application to a variety of surveys, examples of which are, as follows:

- (1) Bridge surveys requiring high order of accuracy.
- (2) Primary control surveys establishing monumented positions at intervals of 1,000 to 2,000 feet in flat to rolling terrain prior to mapping.

Dan Radmanovich, Instructor, at lectern, conducting Geodimeter course for Division of Highways employees. Around table, from left foreground, men are (number indicates district) John Linn, III; Frank Leithold, X; Dave Olson, X; Jim Bell, VI; Wally Greenwood, VII; Jim Westling, VII; Ralph Swingle, VII; Harold Fisher, VI; Don Goodman, III; Bob McClary, I; Larry Mohr, Headquarters; Barry Rockwell, Headquarters; Gary Alkire, I.

- (3) Primary control surveys establishing monumented positions at intervals of 400 to 500 feet in very rugged terrain prior to mapping.
- (4) Right of way surveys.

The demand for Geodimeter surveys continued to increase. Because of heavy workloads, Model 4 equipment had been purchased by the District IV Office in September 1959 and by the District XI Office in January 1961.

By the spring of 1961 it was evident that the Headquarters party did not have the capacity to continue its service to the nine remaining districts. In order to properly assess need versus capacity, a circular letter was issued in May 1961, requesting the districts to submit data regarding past experiences with and proposed future uses of the Geodimeter. The resultant evaluation of the answers to the circular letter revealed that certain districts would be better served if they possessed their own equipment.

It was subsequently recommended that Districts I, III, VI, VII, and X purchase separate Model 4 equipment to fullfill their own requirements. A training program for personnel assigned by each of the five districts was conducted by the Headquarters Photogrammetry Section in late September 1961. The program covered all phases of Geodimeter operations, calculations, repair and maintenance.

Districts II, V, VIII, and IX continue to be served by the Headquarters Party.

New Developments and Conclusions

The use of the Model 4 Geodimeter for daylight surveying, using existing equipment, has been limited to distances up to one mile. The problems encountered in current daylight operation results in a productivity loss of approximately 50 percent and has been considered economically unfeasible.

The manufacturer has recently developed a new light source which can be incorporated into the existing Model 4 to convert it to a daylight-operating instrument. It is reported that under normal conditions distances up to 5 miles can be measured in daylight and that the night range is extended to 20 miles. The daytime productivity is anticipated to be approximately the same as for nighttime observations.

As a daylight instrument the Model 4 will be applicable for many routine surveying jobs which cannot be safely or conveniently accomplished at night. However, actual operational results are not currently available, but they will be reported as soon as users have had the opportunity to test and evaluate the new version of the equipment. Obviously all users are hopeful the new version proves completely successful.

Another development hopefully anticipated is electronic equipment which will be capable of measuring distances directly, without the need for computation other than unavoidable atmospheric corrections similar to temperature corrections applied to taped lines. The ultimate goal is to eliminate the tape where ever possible, or at least to greatly reduce the need for a tape.

James E. Martin

James E. Martin, Executive Assistant to Edward T. Telford, Assistant State Highway Engineer in charges of District VIII, died as a result of a heart attack at his home in Whittier on March 24. He was 42 years old. His state career began in June 1948, when he went to work in District VII as a Junior Civil Engineer. He rose rapidly through the engineering grades while carrying out assignments in Construction, Design and Programs and Budgets. He became a Senior Highway Engineer in November 1955, and was promoted to Supervising Highway Engineer January 1, 1961.

A native of Prosser, Nebraska, Martin came to California as a boy. He attended Whittier High School, studied at Fullerton Junior College, and then at California Institute of Technology where he received his degree of bachelor of science in civil engineering.

Martin is survived by his wife, Alberta, a daughter and two sons, and his mother, Mrs. Thomas Kiley of Lakewood.

Foundations Expert Arthur Root Retires

Arthur W. Root, Supervising Materials and Research Engineer with the Division of Highways in Sacramento, retired on May 1, ending a career of nearly 34 years with the State.


ARTHUR W. ROOT

Root had been head of the Foundation Section of Divisions' Materials and Research Laboratory since 1947. He is an authority in the field of highway foundations, cut slope design and landslide analysis and treatment. He is coauthor of the Highway Research Board book "Landslides and Engineering Practice" and is a member of several national committees of the board.

He also played an important part in the development of the first specialized drill rig used for installing horizontal drains, a machine that has been widely copied by manufacturers of drilling equipment.

Root is a native of Valley City, North Dakota, where he attended grade and high school. He studied engineering at the University of Oregon and the California Institute of Technology.

Root joined the Division of Highways in 1928 as an axeman on construction surveys. Later he served as assistant resident and resident engineer on highway construction in Districts IV (San Francisco), III (Marysville), IX (Bishop), and I (Eureka).

He was appointed District Materials Engineer of District I in 1938. He transferred to the Materials and Research Department in Sacramento as head of the Foundation Section in 1947 and was promoted to Supervising Engineer in 1950.

Root is a member of the American Society of Civil Engineers, the Masonic Lodge and the Toastmasters Club.

Root and his wife, Clarene Ida, plan to move to Sebastopol on the Russian River following his retirement, where he will spend much of his time boating, fishing and training dogs.

Span Lift

Novel Method Used to Raise San Gabriel River Bridge

By G. C. SMITH, Senior Bridge Engineer

THERE are two ways to raise an object—pull it up or push it up. The usual way to lift very heavy structures such as buildings or bridges is to push them up using hydraulic, screw or ratchet jacks.

Flood control work in the San Gabriel River channel required raising the State Highway Bridge across the channel on US Route 101 near Long Beach about 5½ feet. The bridge, which is on 2,000 foot radius, consists of seven, 57′ simple spans of T-beam design resting on concrete piers supported on piles; it is divided along center line by an expansion joint.

Novel Raising Method

In order to raise the bridge, the contractor decided to depart from the conventional and pull it up. Several factors influenced this decision. First, jacking from the bent caps was not possible, since the end diaphragms were not of adequate strength, and jacks could not be placed under the girders because of space limitations. Second, the channel at this point is in tidewater range, making cribbing from the ground impracticable. Consideration was also given to driving piles through holes in the deck, and constructing falsework on these piles to furnish the necessary jacking reaction.

Jacking Unit Described

Lifting was done using equipment originally developed to raise pre-cast floor slabs in building construction. Each jacking unit consists of two high-strength threaded steel rods, threaded sleeves, and a hydraulic motor (Fig. 2). The rods extend through the threaded sleeves and down to the load to be raised. The sleeves are turned by the hydraulic motor, thus

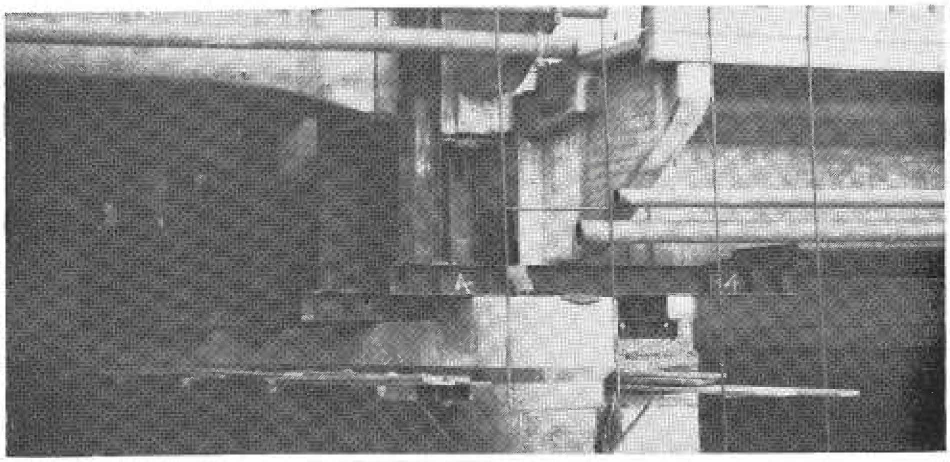


Figure 1. Steel bent in place on horizontal beams. The span to the left is fully raised. The permanent steel frame is in place.

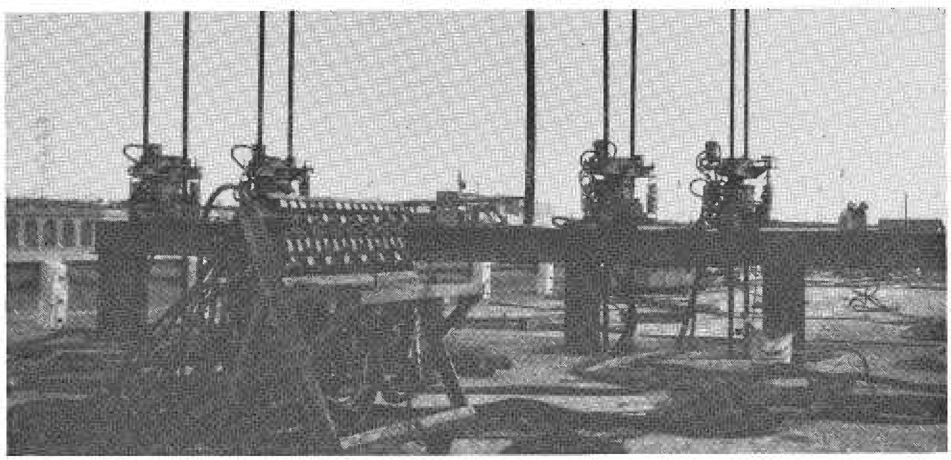


Figure 2. Jacks in place on the steel bent after the span has been raised. The operating console is in the foreground.

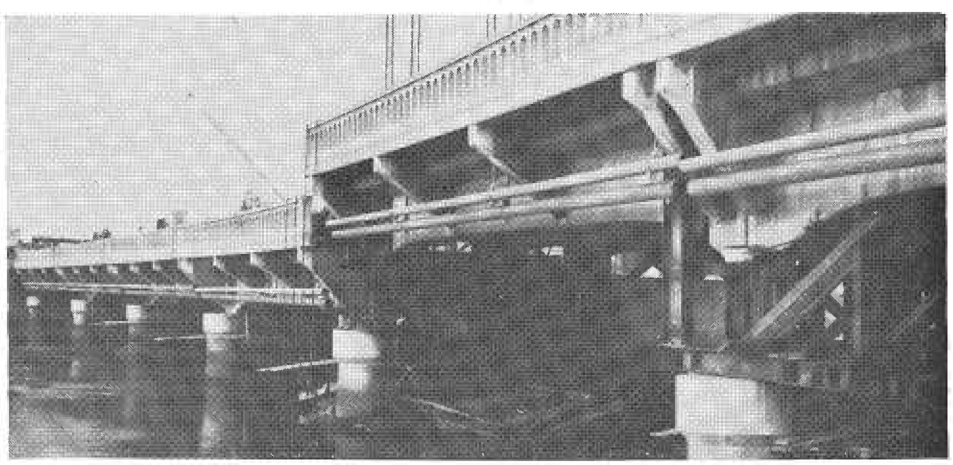


Figure 3. A general view of the bridge partly raised. The lifting jacks are still in place at the span in the center. At the bent in the foreground the reaction is shown carried to a raised span.

raising or lowering the rods, which do not turn. An electric revolution counter is connected to the sleeves in each jack. All operation of the jacks is done from a central console (Fig. 2); the revolution counters feed to this console enabling the operator to maintain uniform travel of the lifting rods at all units.

Steel Bent Used

Jacking reaction was furnished by a steel bent made up of wide-flange beams welded and braced, the legs of which extended, through holes in the deck (Fig. 2) to beams resting on the existing concrete bent cap (Fig. 1). As can be seen in Figs. 1 and 3, these horizontal beams were extended to blocking in the adjacent span. The ratio of length of beam under the adjacent span to that under the moving span was about 2:1, thus insuring adequate reaction.

After lifting the span into place, prefabricated steel posts (Fig. 1) were set under each end of the span, cross-braced with welded members, and the jacks released. These frames became a permanent part of the structure; Class "A" concrete was placed around them to extend the existing cap up to the new bearing elevation.

Lifting Time Reduced

It may seem that the amount of preparatory work to lift a span by this method is considerable. Compared to jacking from the existing caps, or from crib stacks on the ground, the device used cannot compete. It will, probably, about equal falsework on driven piles. The outstanding feature of the system employed, however, is that the actual lifting time, instead of several hours as would be required with jacks, was about 45 minutes.

Work was done by Peter Kiewit Sons Co. under contract with the U.S. Engineering Dept. as part of a project to improve the lower San Gabriel River channel. Plans for the method and equipment utilized in raising the bridge were reviewed by the Bridge Department under the direction of J. E. McMahon, Assistant State Highway Engineer.

ASSISTANT F.A.S. CHIEF TOM REYNOLDS RETIRES

Thomas W. Reynolds, Senior Highway Engineer in the Federal Aid Section of the State Division of Highways in Sacramento, retired on April 30. He had been with the State 31 years.

T. W. REYNOLDS

As assistant chief of the Federal Aid Section, Reynolds has been concerned with the federal approval and co-operative state-federal financing of construction projects on California highways included in the federal road system. More than $273,000,000 in federal aid funds has been apportioned to California for highway improvements during the current fiscal year.

Reynolds joined the Division of Highways as a draftsman in 1931. Prior to that time he had worked as surveyor and draftsman for the Cities of San Diego and Oceanside and several private power and land companies.

Reynolds was transferred to the division's Financial Control Section in 1941 and to the Federal Aid Section in 1949.

He served as a lieutenant in the Navy Seabees during World War II.

Reynolds was born in Lexington, Kentucky, and attended grade and high school at Amsterdam, New York. He studied at Union College, Schenectady, graduating with a B.S. degree in civil engineering in 1922.

Reynolds and his wife, Madge, have a son, Thomas S., of Sacramento.

EXPRESSWAY TO FREEWAY

The State Department of Public Works has awarded a $781,771.30 contract for constructing an interchange at Madonna Road and surfacing 2.7 miles to convert from expressway to four-lane freeway on US 101, between two-tenths mile south of Los Osos Road and four-tenths mile north of Marsh Street in San Luis Obispo.

This is one of a series of budgeted expressway - to - freeway conversion projects which will provide 19 miles of continuous full freeway from north of San Luis Obispo to Arroyo Grande.

Giles H. Lamb

Giles H. Lamb, Materials Engineer for the Division of Highways District Office in Los Angeles, died on April 14. He was 62.

A native of Yates Center, Kansas, Lamb studied at the University of Kansas where he was awarded a B.S. in civil engineering in 1922.

After graduation, he was first Assistant County Engineer of Douglas County, Kansas, and then County Engineer of Chase County.

He joined the California Division of Highways in 1930. Prior to his appointment as District Materials Engineer of the Los Angeles District in 1945, Lamb served as resident engineer on construction projects and carried out special studies on construction methods and materials.

He was the developer of the "tow float" method of finishing portland cement concrete paving. Between 1936 and 1941 he conducted a study of the cost and efficiency of seawall protection at Point Mugu and Little Sycamore Creek in Ventura County.

As Materials Engineer he has conducted studies on slope stability, slides, sources of mineral aggregate, quality control tests, settlement and seepage on state highway construction projects in Los Angeles, Orange and Ventura Counties.

Lamb was promoted to Senior Highway Engineer in 1950.

He was a member of the American Society of Civil Engineers and the American Society for Testing Materials. He was a Mason and served in the U.S. Army during World War I.

He is survived by his wife, Eva May, and a son and daughter.

MONTEREY BUILDING ADVERTISED

The Division of Architecture has advertised for bids on construction of permanent headquarters facilities for the Division of Forestry and the Division of Beaches and Parks at Monterey. Five buildings, mainly of frame construction, with an aggregate floor area of 46,000 square feet, are involved. Approximate cost of construction is $500,000.

Thomas E. Stanton

Thomas E. Stanton, former Division of Highways employee, died at his home in Belvedere on April 30. He was 81.

A man widely known in engineering circles, Stanton served as Materials and Research Engineer for the division for 23 years prior to his retirement in 1961.

During his professional career, Stanton was an active member of virtually all American technical societies. He was a director of the American Society of Civil Engineers, 1937-1939, and vice president in 1942-1943. He served on the board of directors of the American Concrete Institute in 1943-1944 and was elected an honorary member in 1955. Together with other honors for notable contribution, he was awarded the Wason Medal by the American Concrete Institute in 1934, and the Norman Medal by the American Society of Civil Engineers in 1943; both for outstanding work on portland cement concrete, especially for the discovery of the alkali-aggregate reaction.

He was one of the leaders in organizing the California State Employees Association and the State Employees' Retirement System and served as the system's first president.

Stanton was born in Los Angeles where he grew up and attended school. His higher education was obtained at Saint Vincent's College from which he was graduated in 1899 with an A.B. degree. He then attended the University of California at Berkeley where he received a B.S. degree in mining.

He was with the Los Angeles City Engineer's Office for seven years. He started his career with the State Division of Highways in 1912. Stanton was appointed in 1914 to the position of principal assistant division engineer in Sacramento. In 1920, he was made assistant highway engineer in charge of general inspection throughout the southern portion of the State. In 1921, when the Department of Public Works was formed, Stanton was appointed assistant state highway engineer in which capacity he served until his appointment as materials and research engineer in 1928. He held this position for the succeeding 23 years until his retirement in 1951.

Following his retirement in 1951 he piloted the formation of a local Olive Growers' Association, and became its first president in 1951. While serving as the association's president, Mr. Stanton also served concurrently as president of the board of directors until March 1958. He also was active in the Rotary Club, the Del Paso Country Club and the Sutter Club.

He is survived by his son, Thomas E. Stanton, Jr., of Belvedere, and two daughters, Mrs. Henry F. Zacharias of Sacramento and Mrs. John F. Madden of Tiburon, as well as six grandchildren and one great-grandchild. He is also survived by a brother, Joseph E. Stanton, of Pasadena, and two sisters, Anna Stanton of Los Angeles and Mary Megan of Wilmington.

RECENT RETIREMENTS FROM DEPARTMENT LISTED

Headquarters Office

Paul M. Paine, Associate Highway Engineer, 18 years.

District I

James H. Trapier, Highway Maintenance Man II, 32 years.

District II

Herbert E. McCann, Senior Highway Foreman, 29 years.

District III

Edwin E. Robinson, Highway Maintenance Man II, 29 years; Earl H. White, Janitor, 9 years.

District IV

Pete Galli, Highway Maintenance Man I, 18 years; W. G. Remington, Associate Highway Engineer, 41 years; Thelma C. Rock, Senior Account Clerk, 10 years; Frances E. Smith, Intermediate Account Clerk, 17 years; Joseph E. Toohig, Heavy Power Shovel Operator, 30 years; Otis L. Watts, Engineering Aid II, 7 years; Wesley W. Wiltsee, Highway Engineering Technician, 15 years.

District V

Harold N. Albaugh, Intermediate Clerk, 13 years.

District VII

Herbert E. Belford, Senior Highway Engineer, 40 years; Ralph V. Chase, Supervising Highway Engineer, 27 years; Leo C. Cunniff, Heavy Power Shovel Operator, 37 years; Harold J. Downs, Assistant Highway Engineer, 37 years; Mearl F. Evans, Building Maintenance Man, 19 years; Vladimir Fielder, Drafting Aid II, 7 years; Henry Hawthorne, Senior Highway Engineer, 40 years; J. Walter Trumpy, Assistant Highway Engineer, 15 years; Loral Wiley, Highway Maintenance Man II, 28 years.

District VIII

Frances V. Black, Supervising Clerk I, 15 years.

District IX

Carl D. Cleland, Highway Foreman, 35 years.

District X

Henry L. Pleau, Highway Foreman, 31 years; Orvis F. Roberts, Highway Maintenance Man I, 11 years.

State-Owned Toll Bridges

Mary M. Corbett, Senior Typist-Clerk, 30 years.

Materials and Research Department

Mary G. Forbes, Intermediate Clerk, 13 years.

Shop 2

John R. Foster, Machinist, 2 years.

Shop 4

Herbert V. Daugherty, Automobile Mechanic, 25 years; Albert J. Montijo, Automobile Mechanic, 36 years.

Shop 5

Walter H. Gaskin, Machinist, 28 years.

Shop 8

George C. Ulrich, Machine Parts Storekeeper, 26 years.

Shop 11

James R. Leisure, Mechanic's Helper, 25 years.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

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FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . Comptroller
C. G. BEER . . Engineer of Federal Secondary Roads
L. L. FUNK . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . Office Engineer
A. M. NASH . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . . Assistant Chief

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . District I, Eureka
H. S. MILES . . . . District II, Redding
ALAN S. HART . . . . District III, Marysville
L. A. WEYMOUTH . . . . District IV, San Francisco
R. A. HAYLER . . . . . District IV, San Francisco
HAIG AYANIAN . . . . District IV, San Francisco
E. R. FOLEY . . . . . District V, San Luis Obispo
W. L. WELCH . . . . District VI, Fresno
A. L. HIMELHOCH . . . . . District VII, Los Angeles
GEORGE A. HILL . . . . District VII, Los Angeles
A. C. BIRNIE . . . . . District VII, Los Angeles
A. W. HOY . . . . . . District VII, Los Angeles
C. V. KANE . . . . . . District VIII, San Bernardino
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ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . . Assistant Chief
HOLLOWAY JONES . . . . Assistant Chief
HARRY S. FENTON . . . . Assistant Chief

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . Assistant State Architect (North)
TOM MERET . . . . Assistant State Architect (South)
CHARLES M. HERD . . . . Chief Construction Engineer

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DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . . Director, Chief of Division

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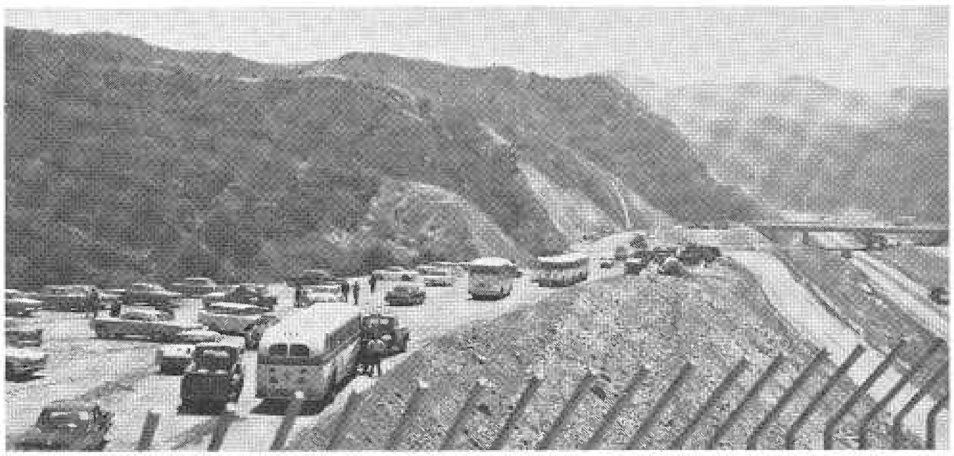
Above: Federal Highway Administrator Rex M. Whitton is shown addressing a group of about 200 highway-minded community leaders from Southern California at a luncheon served overlooking the construction area of the San Diego Freeway where it is being cut through the Santa Monica Mountains. The luncheon was the highlight of a National Highway Week tour on May 22.

Below: Some of the buses and cars used to transport the tour participants. View is south in the cut area from Mulholland Drive Overcrossing. Bridge in middle distance is Rimerton Road Overcrossing.



The observance of the second annual National Highway Week, May 20-26, 1962, was highlighted in California by widespread newspaper publicity about freeway progress and freeway advantages in many areas of the State; by a construction tour and jobsite luncheon on the huge San Diego Freeway construction project in the Santa Monica Mountains in Los Angeles; by exhibits and "open house," particularly in the Los Angeles, Ventura, and San Bernardino areas; and by special radio and television programs.

National Highway Week May 20-26, 1962

Below: Typical of exhibits at State Highway Maintenance stations and other public buildings during National Highway Week was this display of a model and enlarged charts and photographs at Santa Ana. Assistant Highway Engineer James LaBrie, at left, was on hand to explain details, answer questions, and give out maps showing freeway progress.

These were some of the methods by which Californians had the opportunity, in accordance with Governor Edmund G. Brown's recent statement calling attention to National Highway Week, to "inform themselves fully concerning the progress of our State Highway Program and its importance to our safety and prosperity."

In the San Francisco Bay area, newspapers published freeway progress maps for each of nine counties along with a detailed report of current projects. In Southern California the releases, issued by a special committee of highway-minded civic leaders, covered not only county-by-county progress but also the safety and economic benefits of freeways.

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