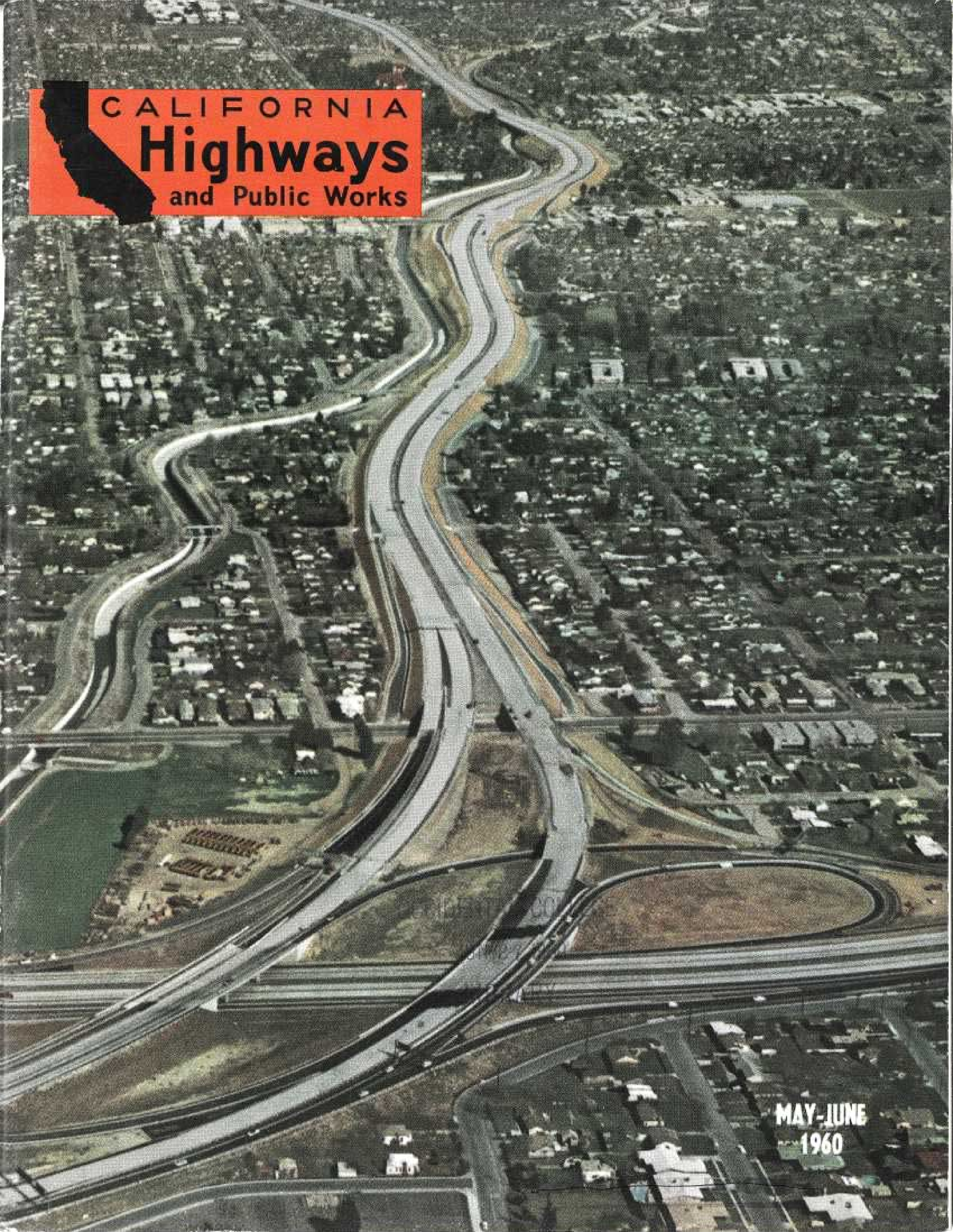
CALIFORNIA Highways and Public Works

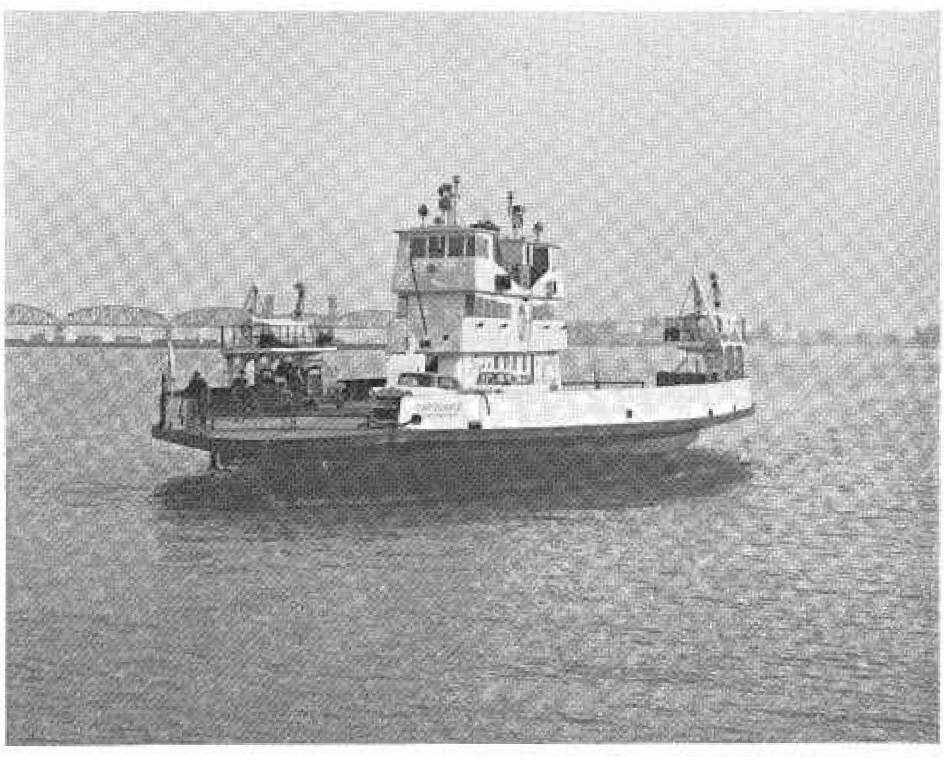


MAY-JUNE 1960

Work has started on the new highway bridge over the upper end of Carquinez Strait to provide a crossing for the San Francisco Bay Area Interstate Loop. The new bridge will cross just downstream (right) from the railroad bridge in the photo above.

The City of Benicia is in the foreground in the picture, with part of the industrial area of Martinez just across the Strait, and in the distance the Clayton and Ygnacio Valleys where the Cities of Concord, Pleasant Hill, and Walnut Creek are growing together into one great residential city at the foot of Mount Diablo. In the upper left of the photo are more of the industrial developments which are gradually taking up the sites along the waterfront between Martinez and Stockton.

At right is Division of Highways ferry MS CARQUINEZ, which will continue to carry traffic between Martinez and Benicia until the bridge is finished. See bridge progress story on page 35.



California Highways and Public Works

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

Vol. 39 May-June Nos. 5-6

CONTENTS

FRONT COVER—The aerial view used as the wrap-around color cover for this issue of the magazine was taken from above the new Ventura Freeway-San Diego Freeway interchange (foreground) looking eastward along the Ventura Freeway in the San Fernando Valley.

—Photo by Robert J. Rose

LESTER S. KORITZ, *Editor*
STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*
HELEN HALSTED, *Assistant Editor*
MERRITT R. NICKERSON, *Chief Photographer*

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

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
SACRAMENTO 7, CALIFORNIA

Ventura Freeway

Last Two Sections in the San Fernando Valley Opened

By F. E. STURGEON and K. P. MOCK, Resident Engineers

GOVERNOR EDMUND G. BROWN, hundreds of sightseers, officials and the general public were on hand on April 5, 1960, to attend ribbon-cutting ceremonies on the Ventura Freeway, marking the completion of two separate contracts together totaling about 8½ miles of new freeway at a construction cost in excess of $14,000,000. Formal opening of these two links completed the Ventura Freeway in the San Fernando Valley.

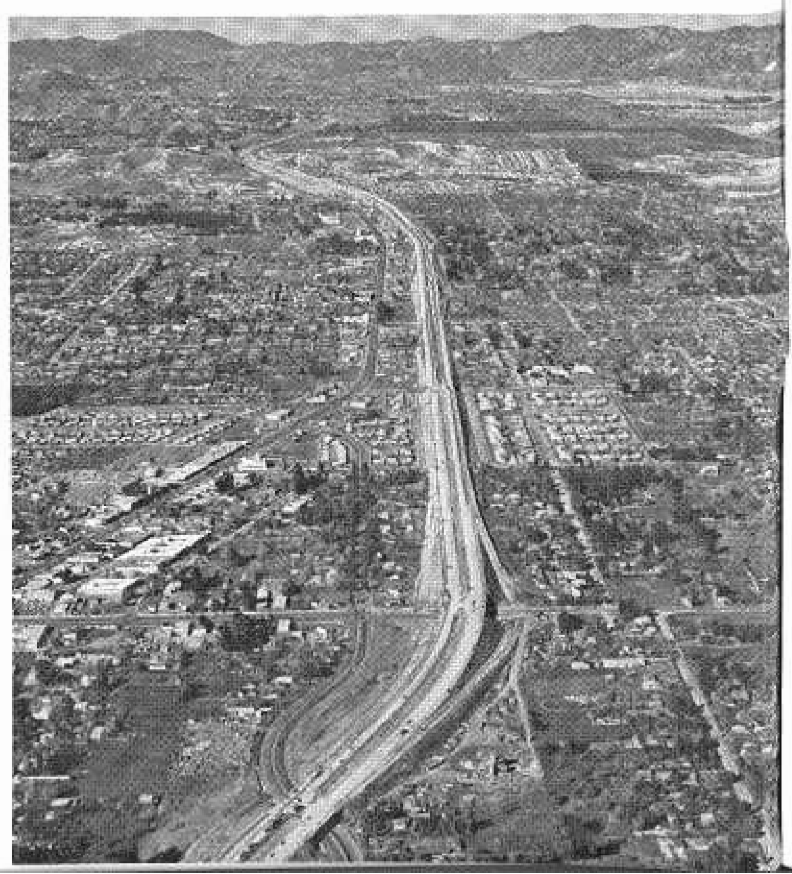
"This fine, modern transportation facility is dedicated to the safe and efficient movement of people and things — within and through — the great San Fernando Valley and to the continued growth and development of the social, economic and recreational well being of the people of the Southern California Empire."

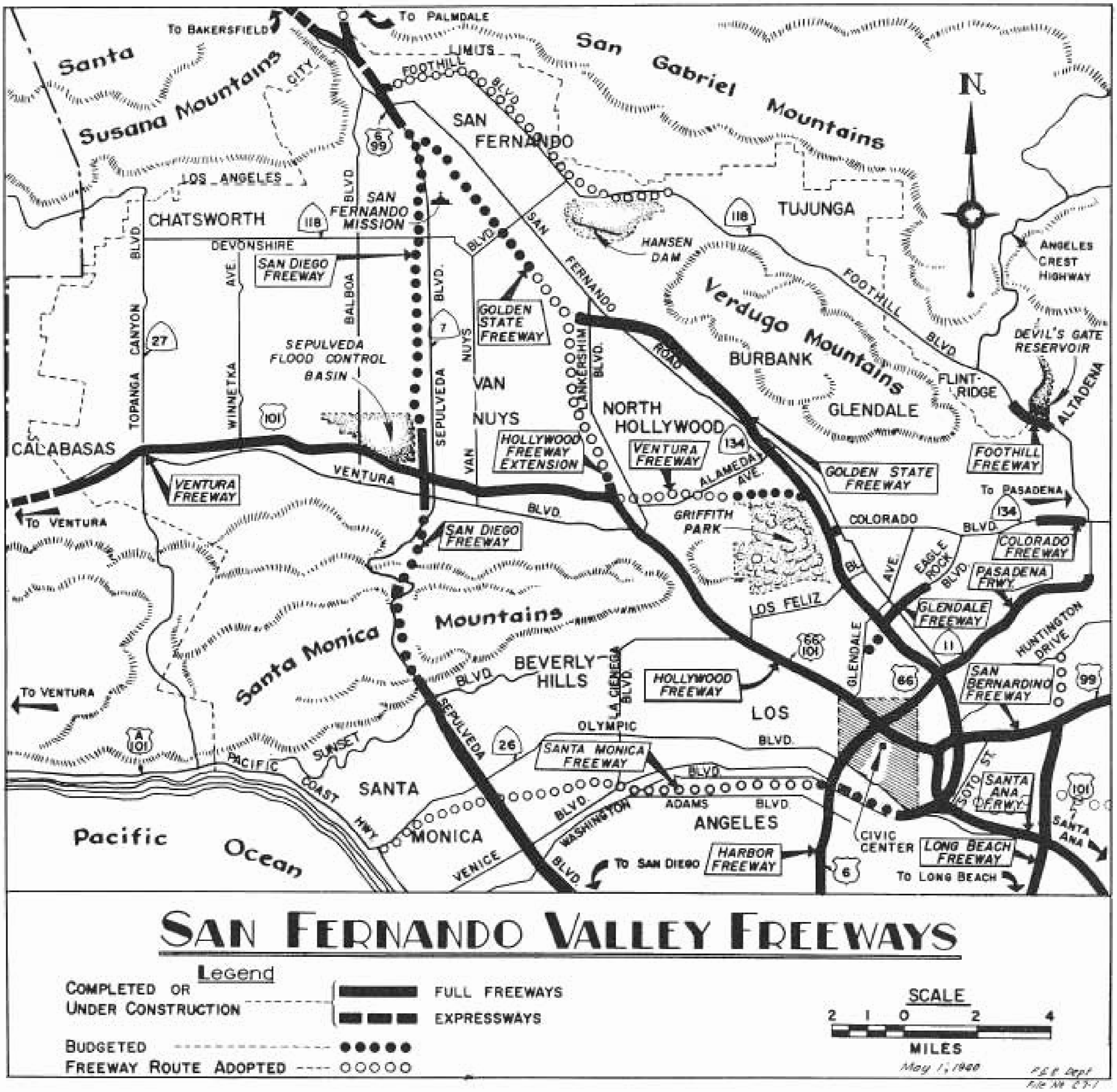
—Governor Edmund G. Brown

Governor Edmund G. Brown officially opens the new freeway as Robert E. McClure (left), of Santa Monica, and Arthur T. Luddy (right), of Sacramento, members of the California Highway Commission, look on.

Governor Brown officially dedicated the freeway as a cavalcade of ancient and modern automobiles, school bands, gaily decked paraders

BELOW LEFT—The Ventura Freeway-San Diego Freeway interchange with the big cut through the Santa Monica Mountains visible in the right background. View is south. BELOW RIGHT—Looking west along construction on the Ventura Freeway between Encino Avenue and Kelvin Avenue. The community of Woodland Hills is in the left background.





and pretty girls formed in a parade at the Coldwater Canyon Avenue Bridge in Studio City. Following brief ceremonies at a "ribbon" symbolized by U.S. Army Hercules and Nike missiles, the motorized cavalcade proceeded in a two-mile-long convoy west to Woodland Hills and Chalk Hill, where it paused for a few words from former Governor Goodwin J. Knight and then doubled back on the eastbound leg of the freeway.

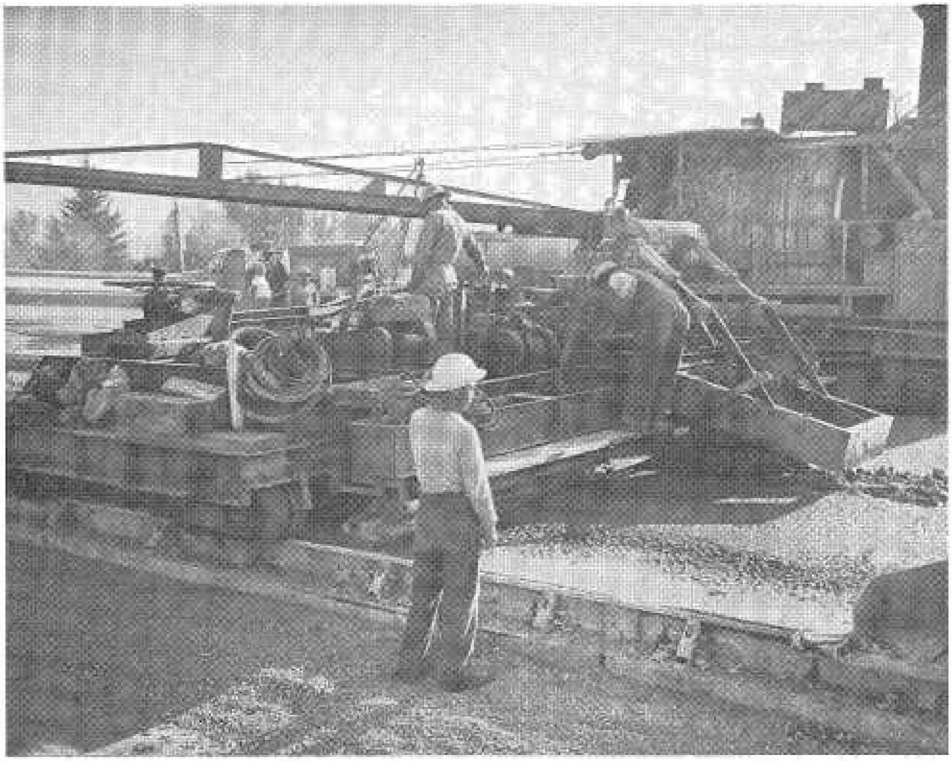
A luncheon attended by more than 300 persons at the Sportsmen's Lodge concluded the day-long festivities. Sponsors of the colorful affair were the Valley-Wide Committee on Streets and Highways and affiliate organizations.

East Contract

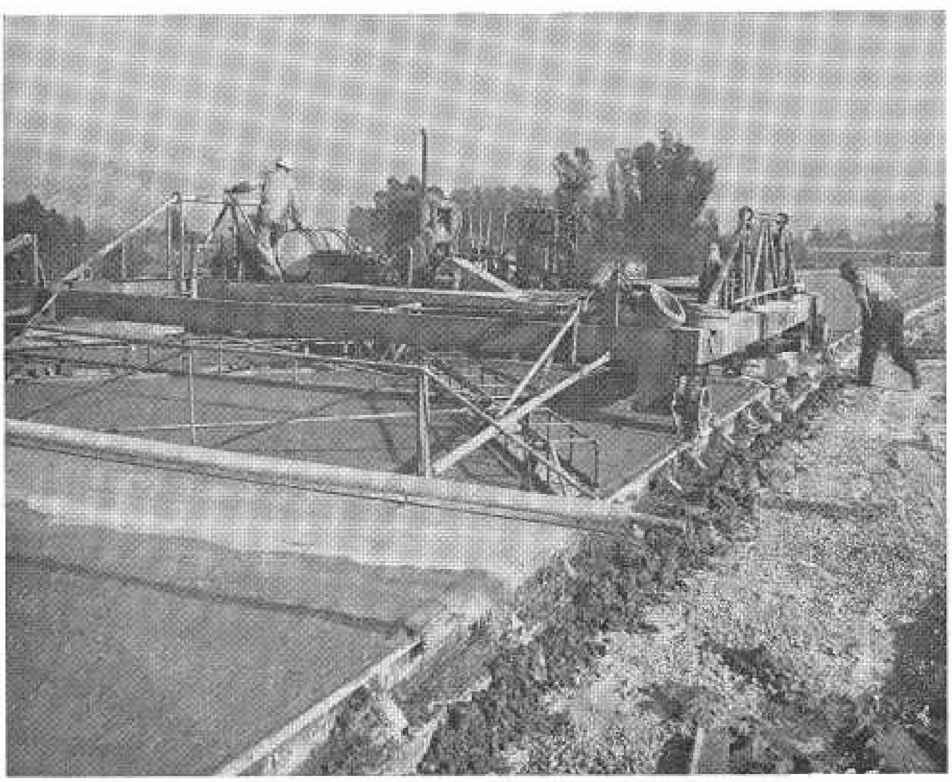
One of the two projects opened simultaneously on the Ventura Freeway was the contract to the east, between Laurel Canyon Boulevard and the San Diego Freeway. Under contract to Peter Kiewit Sons' Company for $8,898,000, it stretches 4.3 miles and has been under construction since July 1958.

This contract also called for relocation of Mulholland Drive in the Santa Monica Mountains and construction of a new bridge to carry Mulholland Drive across the future San Diego Freeway.

Among the major structures included on the freeway proper are the following: Tujunga Wash Bridge, Whitsett Avenue Undercrossing, Coldwater Canyon Undercrossing, Ethel Avenue Pedestrian Undercrossing, Fulton Avenue Undercrossing, Sunnyslope Avenue Pedestrian Undercrossing, Woodman Avenue Under-



A crew spreads concrete and places center dowels on the East Contract.



A finishing float with a burlap drag makes a final pass over the pavement on the East Contract.

crossing, Los Angeles River Bridge at Hazeltine Avenue, Hazeltine Avenue Bridge over Los Angeles River, Tyrone Avenue Pedestrian Undercrossing and Los Angeles River Footbridge, Van Nuys Boulevard Undercrossing, Kester Avenue Undercrossing, Noble Avenue Pedestrian Undercrossing and Sepulveda Boulevard Undercrossing.

Plans on the main contract called for grading, structures and paving eight lanes of concrete on cement treated subgrade. Major contract items included 2,450,000 cubic yards of roadway excavation, 7,950,000 mile-yards of haul, 217,500 tons of imported subbase materials, 164,000 tons of untreated base, 51,500 cubic yards of concrete pavement, 32,480 cubic yards of bridge concrete, 66,060 lineal feet of concrete and steel piling, 1,800,000 pounds of structural steel, 1.02 miles of sanitary sewer pipe, and 2.7 miles of storm drain pipe.

The major portion of the material required for the fills was obtained from the Mulholland material site, approximately 3½ miles south of the job. This material was within the roadway prism of the proposed San Diego Freeway. No shooting was necessary in excavating—all material was ripped, and then dozed to a 60-foot belt loader. Tractor trucks equipped with "hydro-tarders" and 20-cubic-yard bottom-dump semitrailers were used for hauling. The same haul road was used from the Mulholland area to the interchange of the Ventura and San Diego Freeways as was used on a previous Ventura Freeway project.

Hauling and Paving

In order to avoid interference with public traffic, the contractor erected additional haul bridges at all but two crossings at which points the right-of-way was of insufficient width to permit building them adjacent to the freeway bridges. Manually controlled signals, synchronized to signals on nearby Riverside Drive, were installed at these two locations.

One of these two grade crossings was later eliminated after the deck of the Kester Avenue Undercrossing had been poured, cured and protected from overstressing by special construction. The contractor erected a haul bridge over the structure by spanning the bridge with steel H-beams supported over the freeway bridge abutments and over a temporary pier under the center of the span. This arrangement transferred zero load to the freeway bridge and thus permitted the overweight loads to cross.

Pouring of the concrete for the roadway was done in 24-foot widths, using two pavers averaging 1,700 cubic yards per 8-hour working day. An unusual feature of the paving operations was the use of double header forms bolted together in 20-foot lengths and spiked fast to supporting 4″ x 10″ planks. This was done to provide an unyielding foundation for the heavy 24-foot paving equipment, including an automatic spray curing rig. Outside lanes were poured to a 9-inch truck-load thickness, the inner lanes being of standard 8-inch dimension.

Concrete finishing operations must be made at the junction with the previous day's run.

Mulholland Bridge

Five different types of bridge construction are represented: welded steel girder, concrete box girder, T-beam and box girder, cored slab, and curved soffit box girder. The Mulholland Drive Overcrossing is the curved soffit box girder bridge, and its center span of 235 feet is the longest of this type ever built in the West. At the piers the arched soffit is 16 feet deep and varies to 7 feet at the center. The bridge provides a 56-foot roadway and two sidewalks 5 feet 8 inches wide.

This photo shows a portion of the scored concrete shoulder strip which is described in more detail in the accompanying article.

The actual construction of this bridge presented some extremely difficult engineering problems. The bridging was to be done over a 125-foot-deep gorge in rough terrain. Because of lack of storage space and working area, the contractor elected to fill the breach with excess excavation from the adjoining Mulholland relocation site, which he did to a height of approximately 12 feet from the soffit of the bridge. Utilizing this earthen falsework fill, he was able to move in his equipment and materials, including 120-foot lengths of 2⅞-inch reinforcing steel, and begin construction operations.

The Mulholland Bridge is supported by end abutments and six central piers; it has one center span 235 feet in length and two connecting spans each 168 feet in length. The vertical distance from the deck of the bridge to the traveled way of the future San Diego Freeway, which will pass beneath the central span, is approximately 85 feet. Another feature of the bridge is walkways with 8-foot-high steel picket railings having tops bent inward as a safeguard for pedestrians.

West Contract

The second Ventura Freeway project, also opened on April 5, extends from Encino Avenue to Kelvin Avenue at Chalk Hill, a distance of approximately four miles. Construction of this section, under $5,312,645 contract to Oberg Construction Corporation and Oberg Bros. Construction Company, was begun on August 26, 1958.

Major structures were built on the West Contract as follows: Encino Avenue Pedestrian Overcrossing, White Oak Avenue Undercrossing, Zelzah Avenue Pedestrian Undercrossing, Lindley Avenue Undercrossing, Etiwanda Avenue Pedestrian Undercrossing, Burbank Boulevard Undercrossing, Reseda Boulevard Undercrossing, Yolanda Avenue Pedestrian Undercrossing, Wilbur Avenue Undercrossing, Van Alden Avenue Pedestrian Undercrossing, Tampa Avenue Undercrossing, Shirley Avenue Pedestrian Undercrossing, Corbin Avenue Undercrossing, Oakdale Avenue Pedestrian Undercrossing and Winnetka Avenue Undercrossing.

Work consisted of grading and surfacing for an 8-lane freeway with Portland cement concrete on cement-treated subgrade. City streets were reconstructed where they join on and off ramps and Burbank Boulevard was reconstructed on new alignment to reduce the skew where the freeway crosses overhead.

In addition to the State's construction cost, $40,000 was contributed by the Los Angeles County Flood Control District under agreement by which the State's contractor built another 9′ x 10′ reinforced concrete box culvert adjacent to the existing double 9′ x 10′ reinforced concrete box to augment the drainage capacity of the Caballero Creek Channel for anticipated future increased storm water flow.

Two Operations

An interesting aspect of this contract was that almost all of the roadway excavation quantity of 1,660,000 cubic yards was located at the westerly end of the project in the Chalk Hill cut, the transportation of which required 3,200,000 mile-yards of overhaul. Two separate earthmoving operations were required. Push cats fed a belt loader which loaded bottom-dump trucks for the long haul and up to 20 scrapers for the shorter haul.

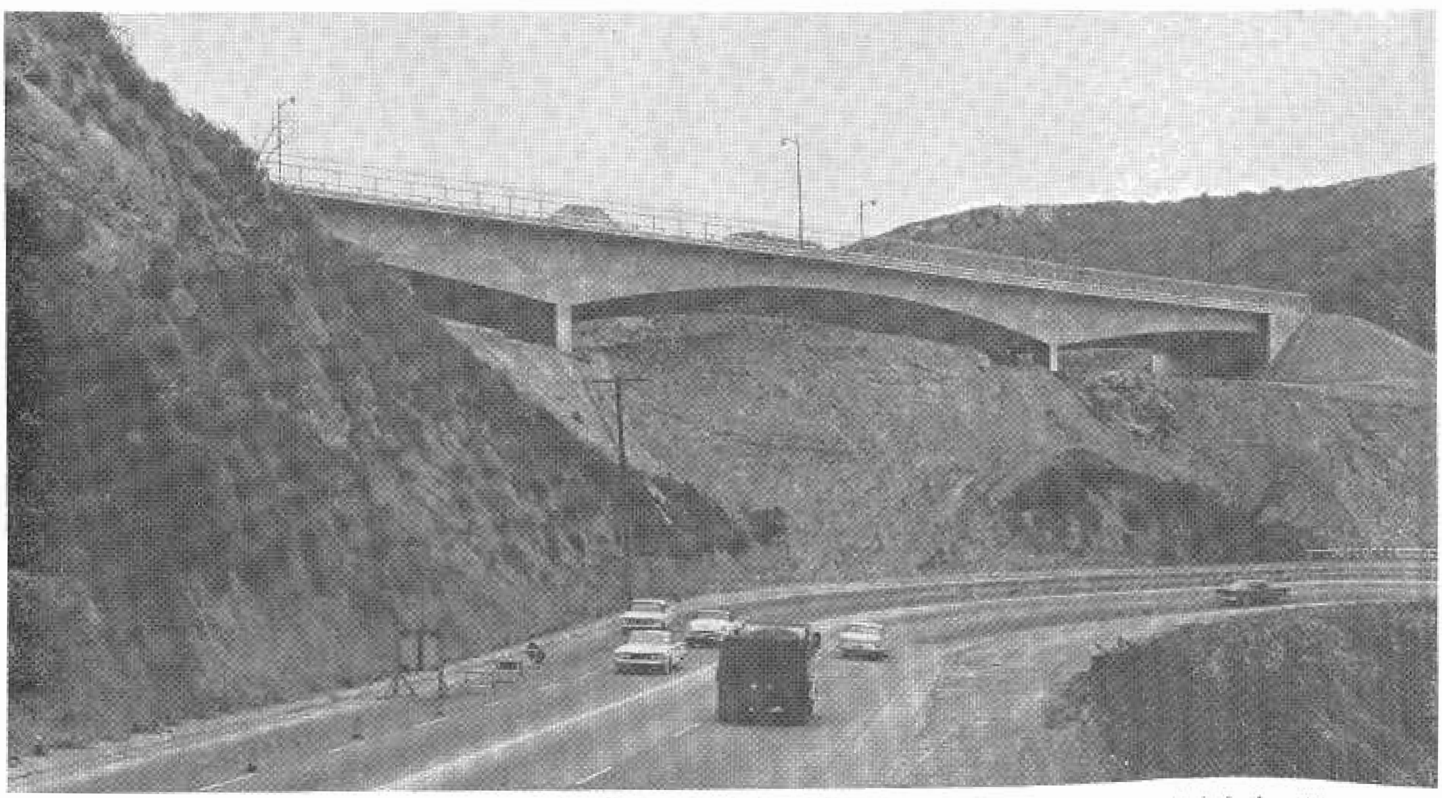
The first order of work was construction of reinforced concrete box culverts at three locations, Caballero Creek, Tampa Channel and Corbin Channel, and completion of two frontage roads for residential traffic circulation; one at the east end, from Etiwanda to Yarmouth Avenues, and the other at the west end, from Calvin to Winnetka Avenues, in order to facilitate the fill operation. The entire project with the exception of the Chalk Hill area is in fill over virtually level ground.

Approximately 250,000 tons of imported subbase material was obtained from the Eden Memorial Cemetery located at Sepulveda Boulevard and Rinaldi Street in the northeast corner of the San Fernando Valley. Approximately 140,000 tons of untreated base material was obtained from a quarry and crushing operation near Bell Canyon in the northwest corner of the San Fernando Valley.

Cement-treated subgrade operations were started on November 19, 1959, and concrete pavement started on November 23, 1959. Approximately 50,000 cubic yards of Portland cement concrete pavement was required; approximately 18,115 cubic yards of concrete and 3,317,000 pounds of reinforcing steel was used in constructing the bridges and pedestrian crossings.

Shoulder Strips

The Reseda Boulevard westbound offramp and the Burbank Boulevard eastbound onramp feature an experimental scored concrete shoulder strip on the right edge of the ramp pavement. Adopted by Sacramento Headquarters design section from a type used on highways in the State of New Jersey, the scored strip is 2 feet wide flush with pavement and with raised projections ½ inch in height. It is designed to discourage vehicular use of shoulder areas on ramps by producing a rumbling, washboard effect on contacting tire treads. Use of the scored strip is limited to locations where suitable drainage conditions exist, and



A view of the new Mulholland Drive Bridge spanning the future San Diego Freeway, taken from the old highway (Sepulveda Boulevard).

the conventional 3-foot rolled gutter can be dispensed with.

Budgeted Projects

East of the Hollywood-Ventura Freeway Interchange the Ventura Freeway is budgeted for construction from Buena Vista Street to the Golden State Freeway at the northeast corner of Griffith Park, a distance of 2.2 miles. The California Highway Commission has allocated $4,400,000 for this project, which is expected to be ready for advertising in the summer of this year. A future allocation will fill in the 2.8-mile gap in the Ventura Freeway from Buena Vista Street to the Hollywood Freeway, making a direct, continuous freeway connection from the Hollywood Freeway to the Golden State Freeway.

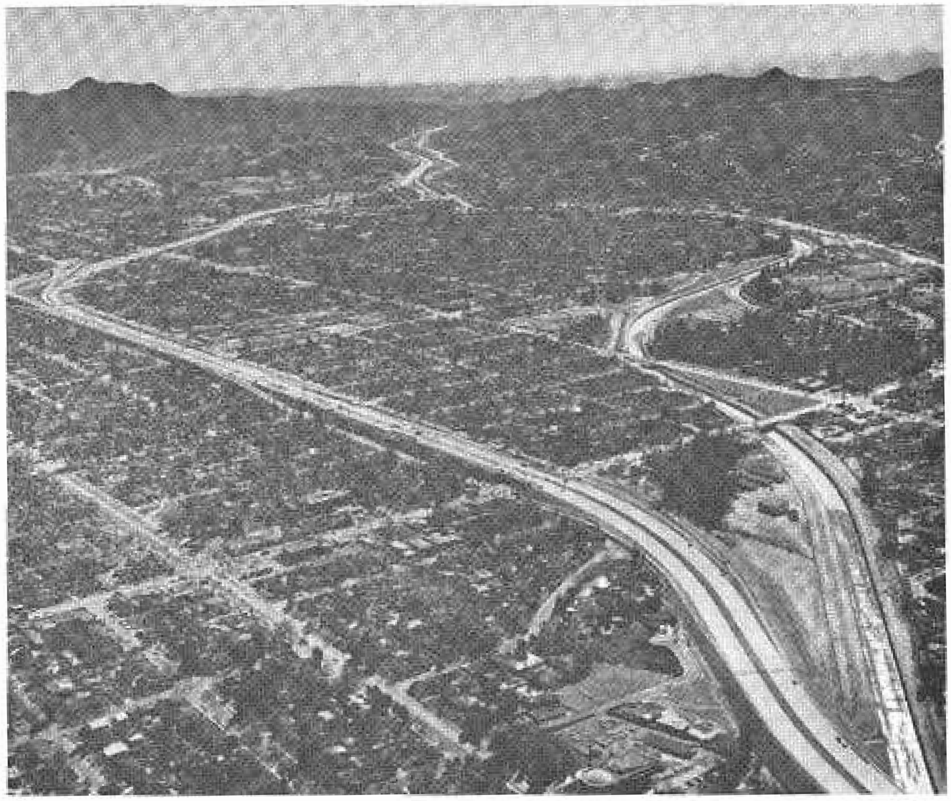
Major structures on the budgeted portion of the freeway include Victory Boulevard Overcrossing, Forest Lawn Drive Undercrossing, Los Angeles River Bridge, Riverside Drive Undercrossing and the following equestrian undercrossings: Victory Boulevard, Roberta Street, Crystal Springs Drive, Forest Lawn Drive, Mariposa Street and in the vicinity of Buena Vista Street.

One other project is financed on the Ventura Freeway in the 1960-61 construction budget. This project is located in the City of Ventura in Ventura County and is two miles in length, extending from Palm Street to the Southern Pacific Railroad Overhead and including some construction on the Ojai Freeway as far as Prospect Street. The State Highway Commission has made $6,500,000 available for this project, which is scheduled for advertising this summer.

Project Under Way

One major contract has been under way in the City of Ventura since March 14, 1960. This project is 4.6 miles in length, extending from Telephone Road to Palm Street. Contractor is the Griffith Company, whose low bid was $8,290,756. The tentative completion date is set for March 1962.

Freeway plans call for construction of the following major structures: Telephone Road Undercrossing, Main Street Undercrossing, Lemon Over-



Construction on the Ventura Freeway near Laurel Canyon Boulevard. The Los Angeles River is to the right and Cahuenga Pass in the background. The view is southeast.

Looking east along Ventura Freeway between Sepulveda Boulevard (center) and Laurel Canyon Boulevard (background). The completed Ventura Freeway-San Diego Freeway interchange is in the foreground.

An aerial taken above the Santa Monica Mountains showing (in foreground) the existing hairpin turn on Sepulveda Boulevard and the new Mulholland Drive Bridge above it. The huge Summit Cut for the San Diego Freeway is in the middleground.

head, Seaward Avenue Overcrossing, Vista Del Mar Undercrossing, Sanjon Creek Bridge, Ventura Underpass, Chestnut Street Overhead, California Street Overcrossing and Ash Street Pedestrian Overcrossing.

Right-of-Way

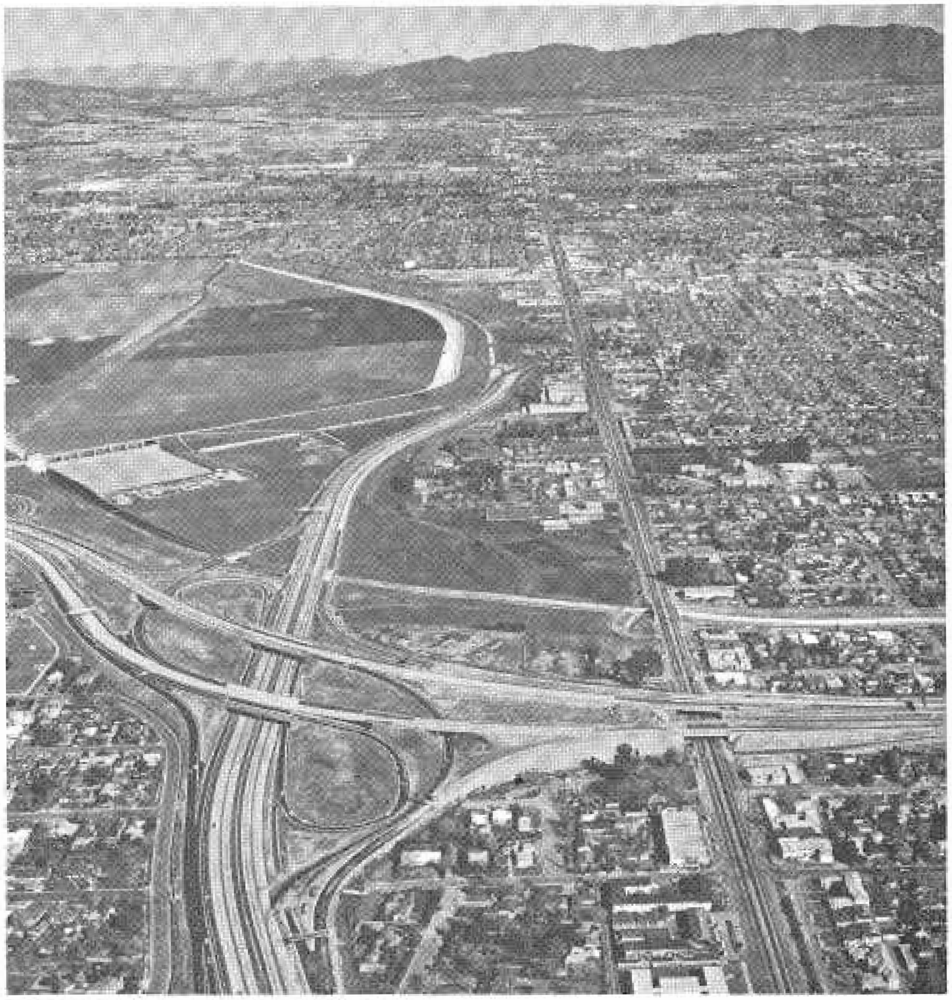
Steps are now being taken to convert the existing Ventura Expressway from Calabasas to the City of Ventura into a full freeway by eliminating grade crossings. Public meetings, design studies and right-of-way acquisition have been in progress for this phase of the conversion.

Right-of-way for the four-lane divided portion of Ventura Boulevard in Ventura County from the Southern Pacific Overhead north of the City of Ventura to Seacliff is presently being acquired. In this seven-mile stretch considerable relocation and reconstruction of the Continental Refining Company facilities must be made. Right-of-way is being acquired as funds become available.

In acquiring the right-of-way for the bypass of the City of Ventura many difficult and involved problems were encountered. In one case it was necessary to purchase a sizable portion of the main plant of a large lumber company. This property covered a large rectangular area fronting on five streets which included a main office, showroom, parking area, railroad facilities, spur track on property and storage yards. The company supplied eight branches throughout Ventura County with various types of milled lumber, doors and casings. It was necessary to rearrange their entire operation, loading docks, spur tracks and, in addition, provide other areas for their use.

In another case the right-of-way passes diagonally through several large lemon groves operated under lease as one unit, with a large packing and processing plant on the premises. Many problems were involved in rearranging irrigation facilities, wind machines, providing drainage and wind breaks, farm roads and other facilities to keep these properties operating in an efficient and profitable manner.

Also, a large area of State Division Beaches and Parks property along the beach frontage in the City of Ventura was taken and it was necessary for us to replace a similar area for the part taken for freeway purposes. Easy access is now possible to this recreational area, and with a large and expansive development program for this area under way by the Division of Beaches and Parks, and the construction of a small boat harbor in the immediate area, this should prove to be one of the finest recreational spots along the entire coast.



A view northward taken above a completed portion of the San Diego Freeway. The interchange with the Ventura Freeway can be seen in the foreground (left). The arterial to the right is Sepulveda Boulevard. Sepulveda Flood Control Dam is at center left.

The route of the Ventura Freeway as adopted from the Hollywood Freeway to the Golden State Freeway at Griffith Park cut through a picturesque residential area known as Toluca Lake which, of course, housed many individuals employed by the entertainment world as well as such organizations as NBC, Columbia Studios and Walt Disney Productions. The acquisition from the Walt Disney Productions involved the moving of many old movie sets from the part the State acquired. This area was formerly used by Walt Disney as a storage ground for old sets.

Also of interest was the acquisition of a part of Griffith Park, which affected a section of the park known as Travel Town. Travel Town consists of a collection of old steam engines and other antiquated means of transportation. This attraction had to be relocated. Another unique acquisition is a bowling alley (this acquisition as of this date is not complete).

Summary

The Ventura Freeway is officially described as beginning at the Golden State Freeway at Griffith Park and terminating at the Santa Barbara county line 75.4 miles distant. 32.4

miles are located within Los Angeles County, 43 miles within Ventura County. Portions of the route are completed, under construction or budgeted for construction with two exceptions. Gaps yet to be financed include 2.8 miles near the east end from Buena Vista Street to the Hollywood Freeway and 7 miles in Ventura County near the west end from the Southern Pacific Railroad Overhead north of the City of Ventura to Seacliff. The total expenditure of state funds to date for development of the Ventura Freeway, including right-of-way acquisition and construction, amounts to more than $83,000,000.

Revision of Manual On Traffic Devices

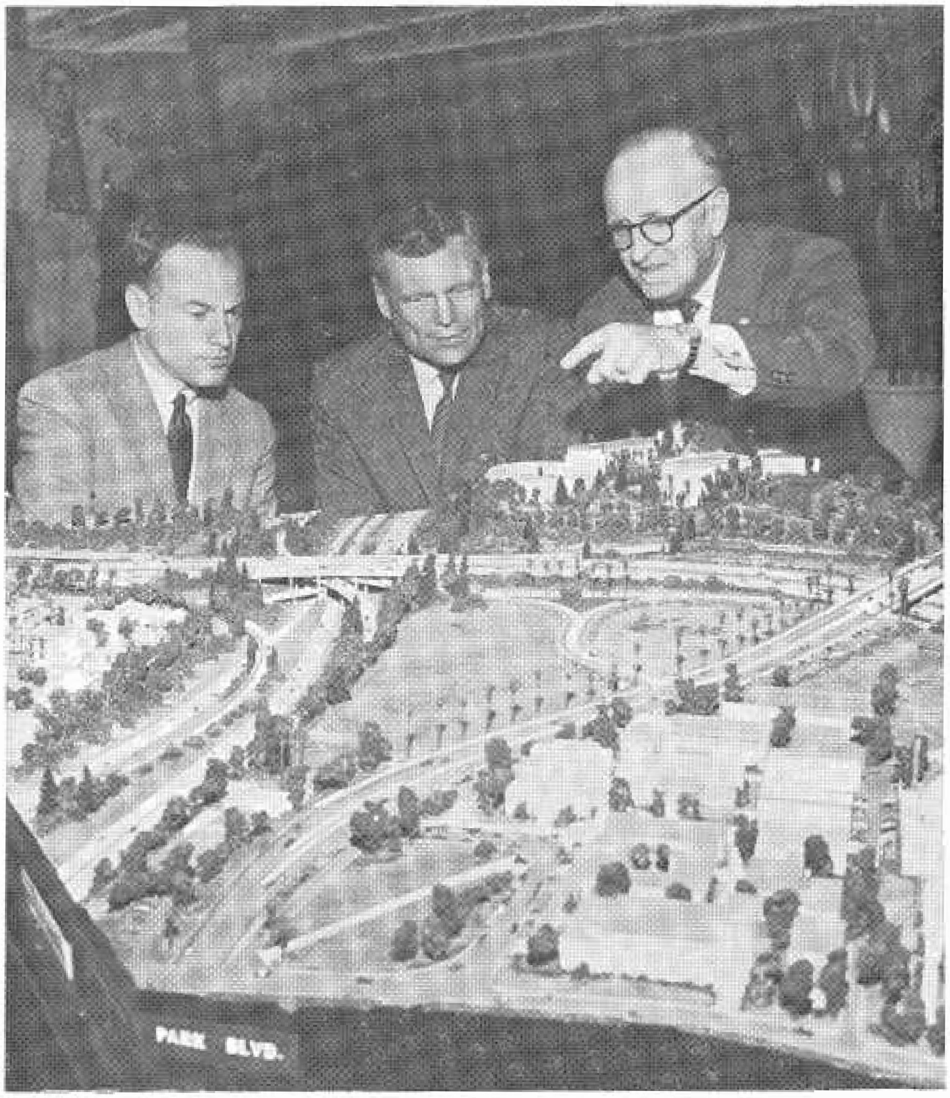
A general revision of the basic manual which for many years has provided the accepted national standards for highway signs, signals, and pavement markings is now under way it was announced by Federal Highway Administrator Bertram D. Tallamy.

Tallamy, who heads the Bureau of Public Roads, U.S. Department of Commerce, said that the revised Manual on Uniform Traffic Control Devices for Streets and Highways is expected to be completed this summer. The last edition of the manual was published in 1948 and limited changes were made in 1954.

The new revision of the manual is being prepared by the National Joint Committee on Uniform Traffic Control Devices, which also developed the previous editions. The joint committee, formerly composed of representatives of the American Association of State Highway Officials, the Institute of Traffic Engineers, and the National Committee on Uniform Traffic Laws and Ordinances, now also includes representatives of the American Municipal Association and the National Association of County Officials.

The general revision now under way will result in a new, up-to-date manual covering modern standards for signs, signals, and pavement markings for all classes of roads and streets. Included for the first time will be standards for modern expressways, including the interstate system.

U.S. 101 RELOCATION THROUGH SAN DIEGO SCHEDULED



Studying a model of the proposed US 101-395 freeway interchange in San Diego are (left to right): Roger S. Woolley, member of the California Highway Commission, Jacob Dekema, engineer in charge of District XI of the State Division of Highways, and Frank G. Forward, chairman of the Highway Committee (Southern Section) of the State Chamber of Commerce.

Bids were opened in Los Angeles on June 2, 1960, for the construction of the first units of the San Diego Freeway between Park Boulevard and Sixth Avenue, which will include the proposed four-level traffic interchange at the junction of US 101 and US 395. Four bridges in addition to the four-level structure will be included in the contract.

This first section to be advertised is one of a series of contracts which when concluded will afford the motorist a full freeway between Balboa Avenue in San Diego and the existing Montgomery Freeway in National City. The new development will eliminate 30 railroad crossings, 15 traffic signals, and numerous intersections existing along the present route.

An indication of the project's magnitude can best be appreciated by noting several of the many contract items. More than a million cubic yards of earth will be excavated in the grading operations, while the bridges will consume 18,000 cubic yards of concrete laced with four and one-half million pounds of reinforcing steel.

Estimated completion date for the project is mid-1962.

Motels

How Essential Are Accessibility And Visibility to Business Success?

A REPORT OF THE LAND ECONOMIC STUDIES SECTION, RIGHT-OF-WAY DEPARTMENT

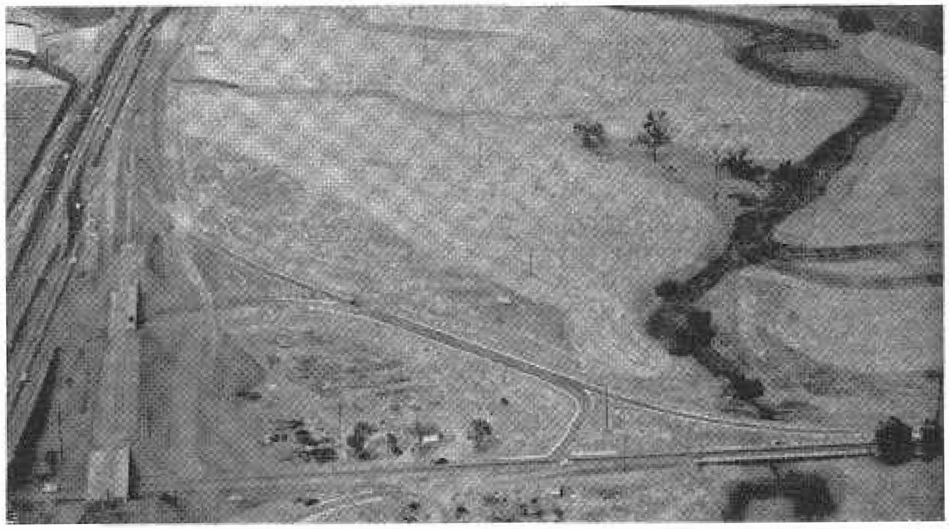
Summation by JAMES R. SMITH, Headquarters Right-of-Way Agent

THE SUCCESS of the modern motor hotel—like any business venture—reflects the successful combination of a great number of factors. Not all of these factors will contribute equally to motel success. In any given instance some will be of extreme importance, while others may be of only passing moment; and to a great extent, their order of importance may reflect only the current opinion and appraisal of the particular expert involved.

Almost without exception, however, motel experts collectively have unequivocally cited "location" as *the* most critical of the various motel success elements. With similar unanimity, motel planners have proceeded from this base to a simple, three-phase admonition: If you wish your motel to be a success, locate it (1) directly adjacent to a highway; (2) on a directly accessible site that is (3) clearly visible to passing traffic. And with this sequence, location and its two major elements—direct access and unlimited visibility—are correspondingly established quite firmly in motel locational theory.

Yesterday—a "prefreeway" yesterday—one needed only to tour the nation's highways to confirm that motel developers were—again almost without exception—heeding all three elements to the letter, and with apparent success. Today, however, the picture is not nearly so clear. A tour of California's expanding freeway network, at least, reveals more than enough examples of de luxe motels—seemingly in successful violation of the traditional locational criteria—to prompt the new admonition-producing question:

How important to the success of the modern motel are the locational elements, direct access and unlimited visibility?

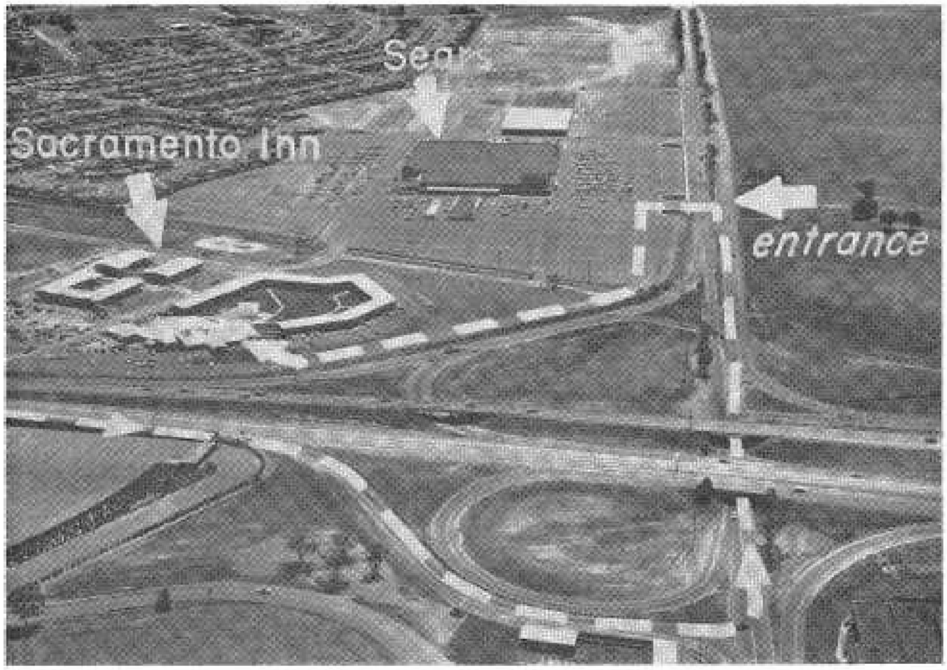


BEFORE: Large undeveloped land parcel adjacent to US 40 near Sacramento, California, in 1953. As a result of the construction shown in the left and lower center (to allow for both the merging of two freeways and the separation of local traffic), the direct access and unlimited visibility aspects of this property are to be significantly altered.

AFTER: Deluxe modern motel constructed on the property after completion of the freeway and after the access and visibility restrictions were clearly evident.

Valuable Answer

While there are many people to whom the answer to this question would be of general interest, there are three people to whom the answer would be of extreme importance, the main basis, perhaps, for decisions involving substantial sums of money.



Aerial photograph showing the circuitous route motorists traveling toward Sacramento must follow to reach the motel. Distance from freeway turnoff to motel parking lot is 1 mile.

These three are the motel investor, the motel lending agency, and the highway right-of-way agent.

The basis of current lender and investor interest in the visibility and access facets of motel location is readily apparent. They are concerned with anything which might significantly influence the success of a proposed motel venture.

Modern motels—in the one-hundred-and-up room sizes which are fast becoming the standard—are constructed in many instances at overall costs which approach $12,000 per unit. Thus the total investment upon which an adequate return must subsequently be generated is clearly substantial, and such ventures can therefore little afford to be based upon any untimely or ill-advised planning. What are the ingredients of success; which are most critical and most important; and how they are reflected in a given site—the answers to these questions become the basic factors on which both investor and lender commitments are likely to turn.

Right-of-Way Concern

The right-of-way agent's interest in the problem is also a direct one, and only slightly less apparent than is the connection between motel investors and lenders.

Motels have traditionally been "roadside" businesses, and as a result of the process of improving highways throughout California, all or portions of both existing motels and potential motel sites have frequently been directly affected by right-of-way acquisition. A continuing study of pertinent aspects of the motel business by the right-of-way profession thus became necessary for several significant reasons.

When acquiring a going motel in its entirety, the right-of-way agent—in order to pay a complete and well documented "just compensation"—simply must know all there is to know about both the specific operation under acquisition and the overall field in general. In short, his position must be that of a well-informed buyer, and it follows that timely, accurate knowledge of such fundamentals as the elements of motel success will clearly be a basic part of his motel data fund.

When right-of-way acquisition is affecting only a portion of either an existing motel operation, or a potential motel site, complete knowledge of the various success factors and their relationships becomes even more critically important. In these instances, the effect of the right-of-way taking and the construction of the new access controlled facility upon both the property and the operation remaining, are the issues of prime moment. Clearly, factual knowledge of the motel success factors which are being effected, and the extent to which any impairment of them is likely to be reflected in the overall success of the operation (and hence its market value) would be vitally necessary.

It is true, however, that because highway needs and concepts have changed over the years, right-of-way acquisition currently is not directly affecting *existing* motel properties as frequently as in the past. Moreover, the expectation that right-of-way purchases will involve even fewer such parcels in the future is a reasonable and logical one and may be readily documented. The preponderance of recent freeway right-of-way acquisition is on new alignment, generally through areas where existing "roadside" businesses are not as yet in existence. It follows, then, that fewer existing streets and highways are currently being improved to full freeway standards than was formerly the case, and thus even fewer future acquisitions of all or portions of established "roadside" businesses are likely.

It is therefore apparent to the right-of-way agent that keeping abreast of changing motel locational concepts is not altogether "operations research" on an increasingly recurring right of way problem, insofar as the acquisition of *existing* motels is concerned. With respect to the effects of right-of-way acquisition upon the *potential* motel site, however, the situation is somewhat reversed, and continuing study of locational theory can be expected to reveal much useful information of value in accurately appraising and fairly acquiring these types of sites.

Location and Success: A Case Study Approach

With motels, as with any other business, the earning of a fair return will depend not on one but on many factors, with each factor contributing proportionally to the final total. A grouping of the major elements of motel success, for example, would certainly include such factors as management, location, competition, age, size, etc.—all necessary ingredients of profitable motel operations.

It is, moreover, evident that in each particular instance, the contribution and individual importance of the various factors will differ. For example, a good manager can, up to a certain point, overcome many of the disadvantages of competition, motel age, etc. Just as clearly, however, all of the success ingredients must be present in relatively harmonious proportions, or the entire motel operation will not have a fair economic chance.

Of all the success factors, the locational element is undoubtedly most critical. It is also probably the most difficult to pin down. A review of the literature—much of which is noted in the "References" at the end of this article—reveals that, over the years, a good motel location has apparently come to mean *proximity to a highway, visibility from a highway*, and *access to and from a highway*. Thus premised, an inflexible, "either-or" kind of sequence has developed, and the emphasis on location has tended to move to the extreme—success has meant location *on* a highway, *unlimited* visibility in all directions from a highway, and *direct* access to and from the premises. All of the other success factors have taken a back seat to these locational criteria, and many a motel business failure has been blamed entirely upon inadequacies in the locational "big three" without any attempt to see if nonsuccess might not be more accurately related to some of the other factors as well.

Inexorably, as seems to come to all "black and white" dichotomies, the "shades of gray" examples have recently begun to appear upon the motel scene. Successful instances of motel operations without direct highway access and with only relatively limited highway visibility, can be found here and there throughout the State. Today they are becoming fairly numerous, and they seem still to be on the increase. A sound, case study kind of analysis has thus become available, and a direct, uncomplicated approach can now be taken. One such approach follows:

1. Find an outlying motel in *profitable operation* which has only *limited visibility* and markedly *indirect access* from an adjoining freeway facility.
2. Determine just how important "location's" various subelements have been to that motel's success, by determining where they fit into its particular picture.

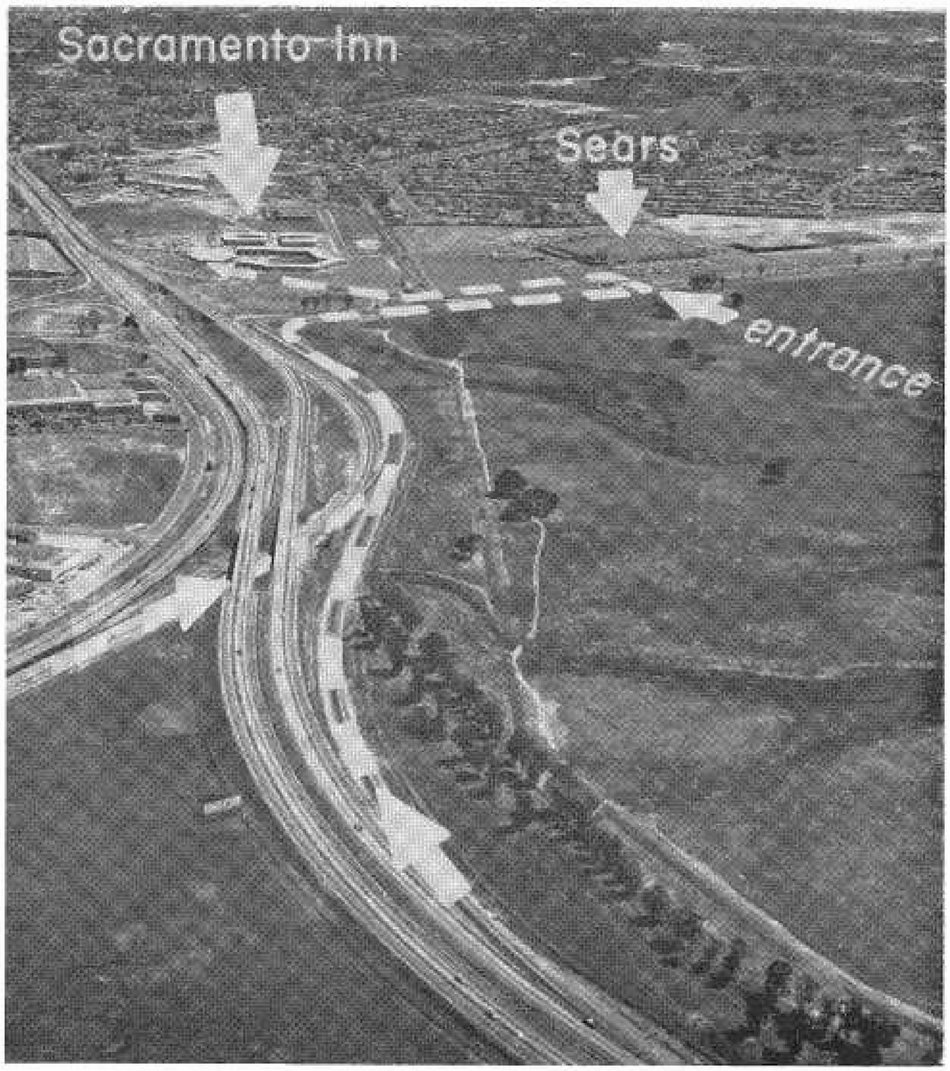
A modern, de luxe motel which clearly meets all of the conditions noted in (1) above, has been chosen as the first of a continuing motel case study series. (From time to time other case studies will also be summarized in future issues of *California Highways and Public Works*.)

In the following sections, the location of the motel selected with respect to a major freeway will be described and subsequently related to the entire operation's initial and continued success.

Sacramento Inn

"If you can find it, you'll love it." This is the way a Northern California businessman summed up his impressions of the case study, "Sacramento Inn," after returning home from a convention at that California motel located adjacent to U.S. Highway 40 near Sacramento.

And apparently more than enough patrons are both making the discovery and finding their way back again to keep this motor hotel's owners and manager busy providing suitable accommodations. Although only some 2½ years old, the Sacramento Inn has already expanded twice. Currently, a



Aerial photograph showing circuitous route motorists traveling from Sacramento must follow to reach the motel. Total distance involved in this approach is 1.3 miles.

The Sacramento Inn as it appears to the motorist as he passes directly opposite, the only point where a relatively clear view of the premises is possible. According to traditional motel locational theory, this is too late—the motorist is not likely to turn back, even if it can be assumed he knows where to turn off and how to return. The implied correlation between visibility and motel success is not borne out in the case studied, however.

total of 205 modern units are available for the inn's guests, boosting the total investment in land and buildings into the $2,000,000 class.

The 55-year lease which made possible the entire project started on January 15, 1957. Construction on the initial segment—office, dining facilities, and 100 units—commenced four months later, and was completed in November of the same year. From its opening, the inn has more than fulfilled its owners' expectations. In this respect, the subsequent expansions—which in a sense are empirical evidence of both initial and continued customer acceptance—have already been noted.

This case study is an example, then, of motel success. And actually it is largely for this very reason that the Sacramento Inn is of interest; *it has achieved success in spite of the fact that the site on which it is located violates every one of the success criteria of the "direct access-unlimited visibility" school of motel developers.* As is clearly evident from the aerial and other accompanying photographs, access from adjoining freeway US 40 is neither direct nor short, and visibility is clearly restricted.

Approaching from the southwest—driving from Sacramento—one must leave the freeway at a point 1.3 miles away from the inn itself, measured along the very route which patrons are required to follow. The sequence is as follows: From the long offramp to and along a county road; thence turning into a "Sears Roebuck" parking lot entrance; thence through that parking lot and along the freeway fence to the inn.

Driving *into* Sacramento—approaching from the northeast—the trip from the freeway to the inn is an even one mile. And from both directions, a relatively complete view of the motel from the freeway is first possible only when one is almost directly opposite the inn itself. (This, according to traditional motel planners, is not at all soon enough. The customer has been lost, it is said, as he will never bother to subsequently leave the freeway and find his way back, even if it could be safely assumed he knew how!)

It is well to note that this site was selected and the motel built *after the adjoining freeway had been constructed and opened to travel.* There was in this instance no "before the highway" situation—there was no compulsion or commitment of any kind to choose or utilize the site in the pre-freeway period when such things as visibility and access might have been difficult to visualize. All of the locational advantages and disadvantages were clearly apparent upon the ground and were available for careful study, analysis, and comparison with similar elements for other sites. *The freeway, and any particular locational problems it seemed to present, were known quantities, and had the initial analysis indicated that a million-dollar investment was not advisable, no moneys need have been subsequently committed.*

Investor's Analysis

Why, then, would an informed investor choose such a location, particularly an investor who had other sites available which would have allowed short, direct access and considerably more visibility from passing traffic? And why has success blessed this investment in such a presumably "paradoxical" spot? Mr. Elwood F. Maleville, the Sacramento Inn's vice president and general manager, sums it up this way:

"There are many factors which contribute to motel success or failure; among them, site access and visibility certainly have their place.

"However, so definitely do such things as recognizing a need for a motel within any general area; determining the overall type and standard of facility which such a need may indicate; and, of course, after establishing just this very kind of motel, seeing to it that a top level of service is subsequently provided.

"In any given situation, just how these and other success factors will be arrayed can only be determined by an individual, on-the-spot survey. Quite often, what holds true for one situation will only rarely hold precisely true for any other.

"I think it is quite clear, however, that the old good-location formula—direct access and unlimited visibility equal motel success—no longer states the case as correctly as it may once have, and certainly all the 'Sacramento Inns' which are being built these days would seem to support this view."

Conclusion

Motels have been traditionally both highway and traffic oriented. This roadside-motorist-service orientation has largely been responsible for certain "success" concepts which have persisted relatively unchanged over the years as the basis of motel locational theory. The basic admonition to locate first and foremost on a site adjacent to a highway is excellently illustrative.

Locational theory has not come down through the years altogether unmodified, however, and outward evidences of certain evolutionary changes have recently become both apparent and numerous. The recent tendency, for example, to locate motels in various parts of the "downtown" section—many times on the more traditional hotel sites—raises some doubt as to the relative importance of "highway" locations to motel success. And the construction of successful "motel rows" along former highway routes which have been "bypassed" by new freeway alignments would seem to suggest that less emphasis upon *new* highway location might also be reasonably premised. (See "Roadside Merchandising," *California Highways and Public Works* magazine, July-August 1957.)

Even during this changing era, however, certain "success" criteria have persisted relatively *unchanged* and *unchallenged*. Among these, that which emphasizes *unlimited visibility* from passing traffic as *the* locational "must" undoubtedly has undergone the least modification; and *direct access* from adjacent traffic lanes has probably run a close second.

Until recently, there seemed little need to question or re-examine these two key concepts. Now, however, the results of changing highway concepts—controlled-access freeways, notably—have been directly responsible for new motel developments which seemingly discount traditional theory. Uncritical acceptance of these key elements—and indeed yesterday's entire location formula itself—may no longer be entirely realistic. A reappraisal of the relative position and importance of *all* motel locational factors seems now to be clearly required, and quite apparently it is the "unorthodox" but successful freeway-oriented entrepreneurs who are forcing a second look at traditional theory.

The motel owner and investor, the highway right-of-way specialist, and the motel lending institution may find, in just these recent developments, significant indications of change in what may well be termed the last of the motel locational theory "holdouts."

The motel noted—The Sacramento Inn—is of particular interest as a case study example in point. Clearly *in this instance, circuitous access and limited visibility have not restricted successful motel operation.*

REFERENCES

American Automobile Association, "Americans on the Highway," A Report on Habits and Patterns in Vacation Travel, Washington, D.C., Sixth Edition (1956).

Baker, Geoffrey, and Funaro, Bruno, *Motels*. Progressive Architecture Library, New York: Reinhold Publishing Corporation, 1955.

Eckert, Fred W., "Objective Comparisons — The Hotel vs. the Motel," *The Appraisal Journal*, XXV, No. 3, Part 1, (1957), 356-372.

Glassburner, Fred R., *Factors Affecting the Success of Motel Operation in Bakersfield, California*, Bakersfield Savings and Loan Assn., Bakersfield, California, April 17, 1959.

Haverkorn, Thomas W., "America's Vigorous Postwar Enterprises: The Roadside Motels," *Traffic Quarterly*, April 1958.

Kane, C. Vernon, *Motor Courts—From Planning to Profits*. New York: Ahrens Publishing Co., Inc., 1954.

Kane, C. Vernon, "Motor Trends—Bigger and better, but at what kind of a risk?", *Architectural Forum*, February 1954.

Kelly, John F., "Motels and Freeways." Reprinted from *California Highways and Public Works* magazine, January-February, 1954.

"Location Is The First Consideration," *Motels, The Money Maker*, Chicago: Patterson Publishing Company. (No date.)

Lundberg, Donald E., and C. Vernon Kane, *Business Management: Hotels, Motels and Restaurants*, Peninsular Publishing Company, Tallahassee, Florida, 1952.

Miller, Richard A., "The Odds on Motels," *Architectural Forum*, August 1957.

Motels, Hotels, Restaurants and Bars. An Architectural Record Book. New York: F. W. Dodge Corp., 1953.

Podd, George O. "Significant Postwar Trends in Hotel Operation," *The Appraisal Journal*, XXV, No. 4 (1957), 603-617.

Smith, James R., "Roadside Merchandising." Reprinted from *California Highways and Public Works* (July-August, 1957).

U.S. Bureau of Foreign and Domestic Commerce. *Establishing and Operating a Year-Round Motor Court*. By Harry Barclay Love. Washington: U.S. Government Printing Office, 1946.

U.S. Department of Commerce. *Motel Planning. Business Service Bulletin*. Washington: U.S. Government Printing Office, 1954.

Old Roads Recalled, New Ones Praised

Following is an excerpt from a recent letter received by the Editor from Mr. Van Arsdale Smith of 620 Terrace Way, Bakersfield, who obviously qualifies as a veteran California motorist:

"As an 'old timer' who began driving at the ripe old age of 10 years in a 'one lung' Oldsmobile, model 1902, when we had mostly just dirt roads, I have had the good fortune to witness the whole gamut of highway development culminating in the system of magnificently engineered freeways now being built.

"For many years I have received the magazine *California Highways and Public Works* and have marveled at the ingenuity of the Division of Highways in designing these freeways.

"One thing I am sure of, is the fact that freeways are indispensable in California or any other area of mass travel by automobile, truck and bus."

Sierra Highway

Geodimeter Speeds Relocation Survey

By IRA H. ALEXANDER, Chief of the Geodetic Section, Los Angeles County Engineer Department, and A. K. GOLDIN, Chief of Survey

THE ANTELOPE VALLEY, located in the northeasterly region of Los Angeles County and of District VII, is a lightly settled, relatively flat, desert terrain covering an immense area. During the last few years industrial, business and residential development of the area has increased at a very rapid rate due to the aircraft facilities that have been established there.

Increase in population and resultant increases in land values of the area require that plans for design, drainage and right-of-way acquisition for the Antelope Valley Freeway be based upon surveys of a more precise order than were previously available.

The adoption of the Antelope Valley Freeway on a location at some distance from the present Sierra Highway places it in an area not covered by the district's survey Control Systems, and precise horizontal control was urgently needed for that area.

The use of the Model 3 Geodimeter gave the district survey staff a method that was fast, accurate and economical to accomplish this task in the shortest possible period of time. It also will serve as a check in establishing new controls on our older Control Systems on the Sierra Highway.

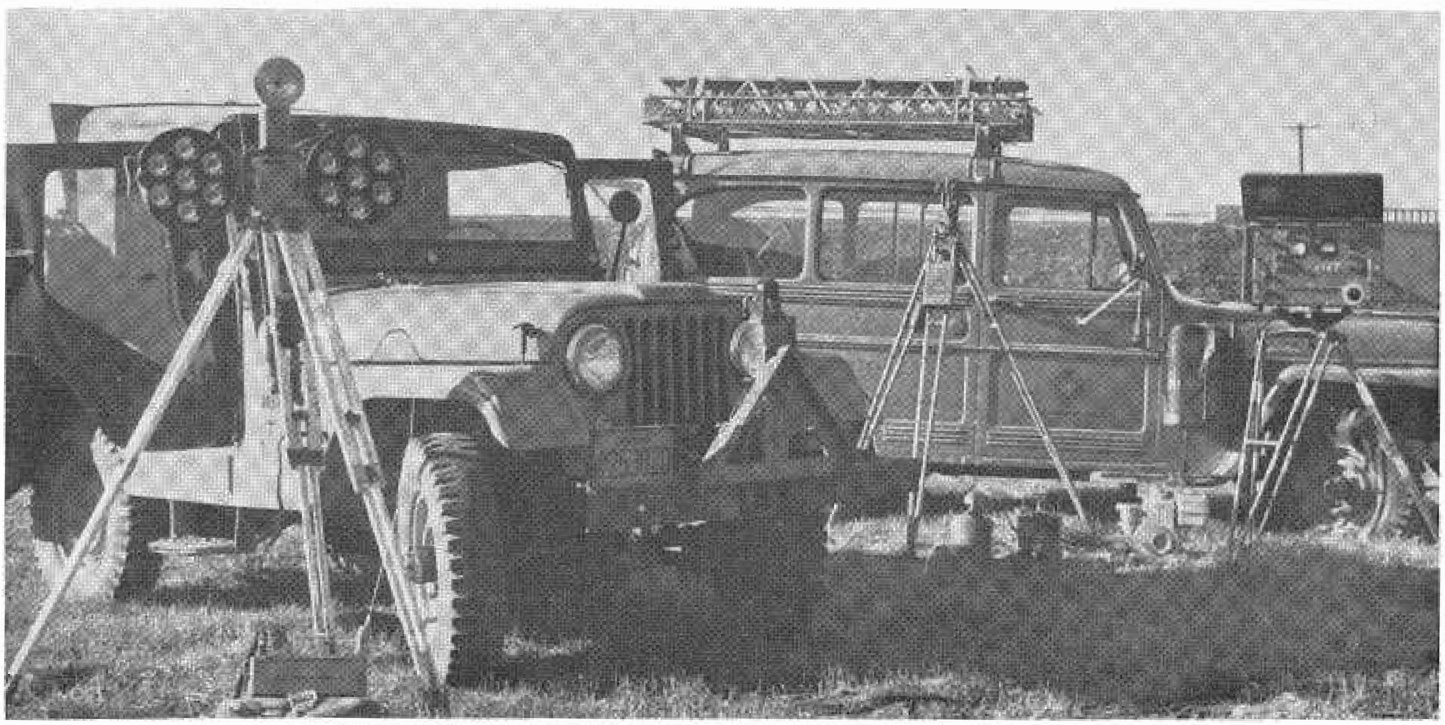
Control Brought North

Horizontal survey control for the Co-ordinate Control Maps of the district had been brought northerly from the Golden State Freeway along US 6 (Sierra Highway) and into Palmdale, a distance of over 40 miles. The control for this consisted of section line ties and dubious triangulation stations whose values have been questioned, due to earth movements since their establishment. The situation was considered critical and a check on the Control System was required.

The assistance of the Sacramento Headquarters Geodimeter Crew was enlisted and a horizontal control network was established terminating on the Llano Base Line, that had previously been established near the Pearblossom Highway by Los Angeles County.

In 1954 the Los Angeles County Engineer's Geodetic Crews had produced an arc of first order triangulation over the San Gabriel Mountains which included their Llano Base Line.

... Continued on page 69



With the jeep on the left is shown the slave or reflector unit and the walkie-talkie radio used to communicate with the master station. With the jeep on the right is shown the master geodimeter unit, the theodolite, the portable generator for electric current to operate both the master unit and its lights and the radio receiving set for the master unit.

Seismic Tests

Portable Equipment Aids Excavation Study on US 6

By A. D. MAYFIELD, Assistant District Engineer, G. H. LAMB, Materials Engineer and DEWEY KNITTLE, Project Engineer

The use of portable, refraction type seismic equipment for selection of excavation methods at sites encountering rock is occurring more frequently in the construction industry. Increasing use of seismic data in the industry has prompted our efforts to secure closer determination of earthwork cost by using a refraction seismograph to investigate subsurface rock formations at large cut sites.

Initial construction on the Antelope Valley Freeway, U.S. Highway 6 relocation, will consist of major grading operations southwest of Palmdale. This portion of the freeway is situated in the rough foothills northerly of the San Gabriel Mountains. Erosion has produced deep incised canyons and numerous exposed beds of sandstone, conglomerate and fractured basalt which have been uplifted by geologic forces.

During the preliminary materials investigation, it was estimated approximately 3,000,000 cubic yards of indurated sandstones, conglomerates and fractured basalts could not be excavated entirely by rippers and scrapers. It was evident that some blasting and shovel work would probably be necessary. A more accurate estimate of the amount of excavation that could be done by scrapers and ripping was needed. Boring with rock bits was considered too costly. A great number of holes would be needed and very expensive pioneer roads would have to be cut in to the drilling sites over relatively inaccessible terrain.

Core Method Inadequate

The geology of the area was well exposed. Because of the difficulty in attaining a direct correlation between the rate of drilling and ability to rip the rock, it was determined drilling and coring would not provide the needed additional information for selection of the most suitable excavation method. A refraction seismograph survey appeared to be capable of obtaining the desired information at materially reduced cost. The seismic type

Marvin McCauley sets off a shot point for a seismic record.

Looking westerly along location of Antelope Valley Freeway with Bee Canyon in foreground and Santa Clara River in background.

survey also would indicate the amount of fracturing within an excavation site. For purposes of correlation, tests were made on the extensive outcrops and compared with results obtained in the refraction tests on the roadway sections.

The refraction seismograph has been used as a basic tool in shallow subsurface investigations for 20 years or more. It has been widely used in geologic studies by the petroleum and mining industries and has been successfully used in several engineering projects, such as dams, highways, tunnels and bridges. Until recently, the refraction seismograph has not been fully used in engineering projects because of complicated and bulky equipment. However, with the recent technological advances in electronics and miniaturization of the past decade, smaller, more compact, and less complicated equipment is available and the portable refraction seismograph is now becoming a standardized tool for use on engineering projects. This equipment operates on the theory that a sharp blow or a dynamite blast at a point of origin called the "shot point" causes sound waves moving outward and downward, the velocity of which can be measured.

Sound Velocity Used

The velocity of a sound wave-front is used in the seismic method to determine depths and differences in degree of consolidation of the underlying material. Wave-front velocities range from 600 feet per second in loosely consolidated soil to 20,000 feet per second in hard crystalline rock. An analogy to sound wave-front travel would be highway travel on a longer detour of smooth roadway at high speed to reach a destination sooner than going more slowly on a muddy direct route in low gear.

As the wave-front progresses outward and downward from the shot point, it is bent along the interface of each higher speed layer surface. This starts wavelets upward toward the surface during the progress of the main front. Beyond a certain distance from the shot point, the wavelet front

Nick Silken and Marvin McCauley review a photographic record from the seismograph like the one shown in Figure 1.

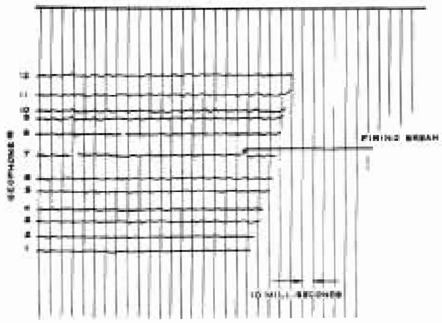
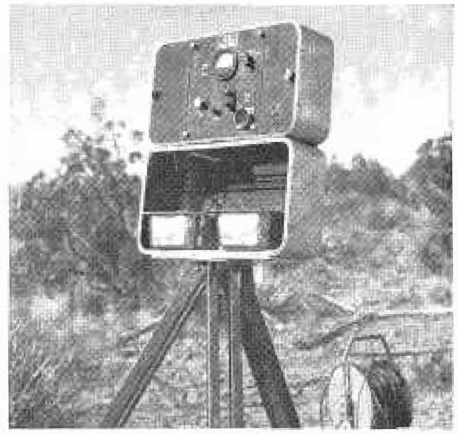


Figure 1. Enlargement of type of seismogram being studied by engineers in photo to the left.



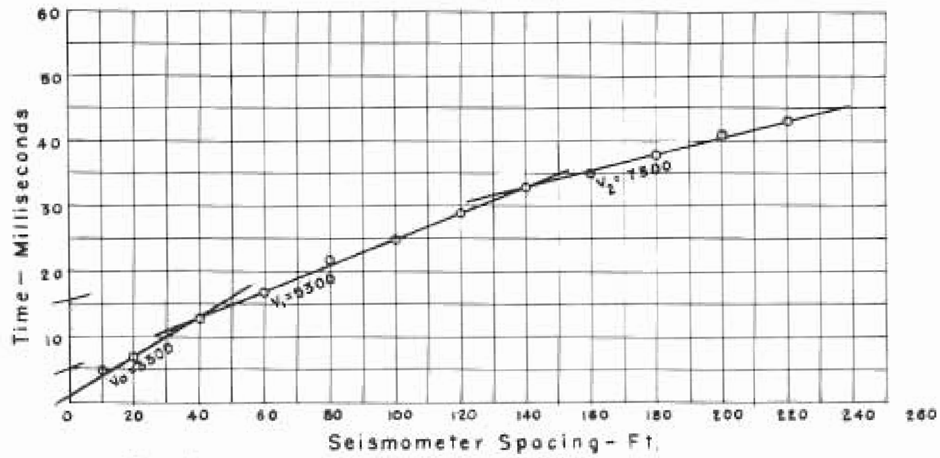
A seismograph recording camera and fire controls with a dark room, developer and fixing bath.

will arrive at the geophones before the arrival of the slower direct wave.

Several portable seismographs are available on the market currently. One such unit was demonstrated at the site by Mr. Horace Church. This equipment consisted of a battery-operated electronic counter, a geophone, an eight-pound sledge hammer, a striking plate and a wire which runs from the sledge hammer to the counter. The electronic counter unit, about the size of a small overnight case, is placed on the ground. Wires are connected to the unit from the sledge hammer and the geophone which is plugged into the ground. The striking plate is placed on the ground, a measured distance from the geophone. The plate is then struck by the hammer and the counter unit is activated by a spring contact switch attached to the hammer. The time from the instant of the blow until the seismic front reaches the geophone is recorded in the electronic counter. The plate is then moved in line with the geophone to another measured distance and the operation is repeated. The distance intervals used are dependent upon the depth and amount of detail required by the observer. This type of instrument is reported to be satisfactory for investigations to a depth of 50′. By the use of blasting as an energy source, the depth of the investigation can be extended.

Portable Unit

The district requested the assistance of the Headquarters Materials and



The depth at which these changes occur can be computed by

V_o = Velocity of 1st material
V_1 = Velocity of 2nd material
V_z = Velocity of 3rd material
X_c = Distance intercept
T_1 = 1st of time intercept
T_2 = 2nd time intercept
Z_o = Thickness of 1st layer
Z_1 = Thickness of 2nd layer

Formula for two layer problem

$$Z_o = 1/2\sqrt{\frac{V_1 - V_o}{V_1 + V_o}} \cdot X_c$$

Formula for three layer problem

$$Z_1 = 1/2\left(T_2 - \frac{2Z_o\sqrt{V_2^2 - V_o^2}}{V_2 \quad V_o}\right)\left(\frac{V_2 \quad V_1}{\sqrt{V_2^2 - V_1{}^2}}\right)$$

Figure 2. A time-distance graph used in seismic recordings.

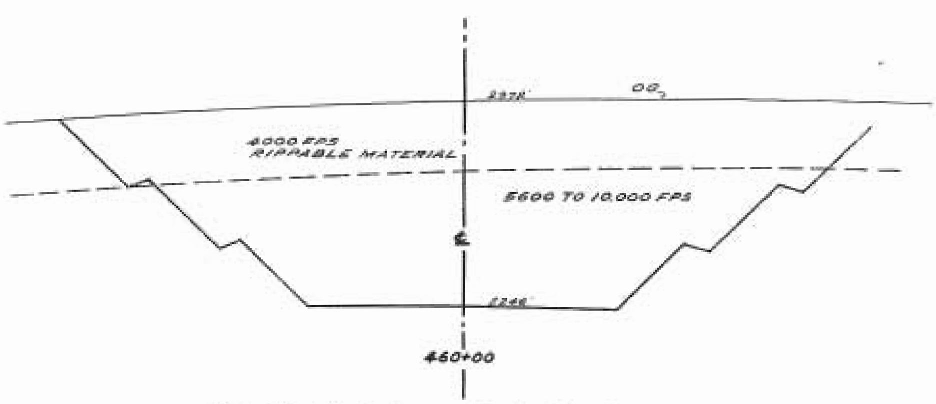


Figure 3. A typical cross section showing velocity zones.

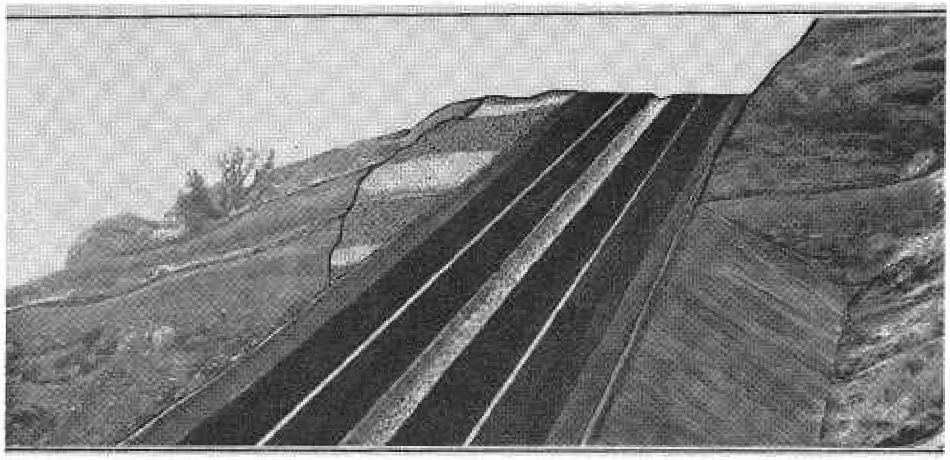


Figure 4. A sketch showing proposed excavation in a sandstone conglomerate bed.

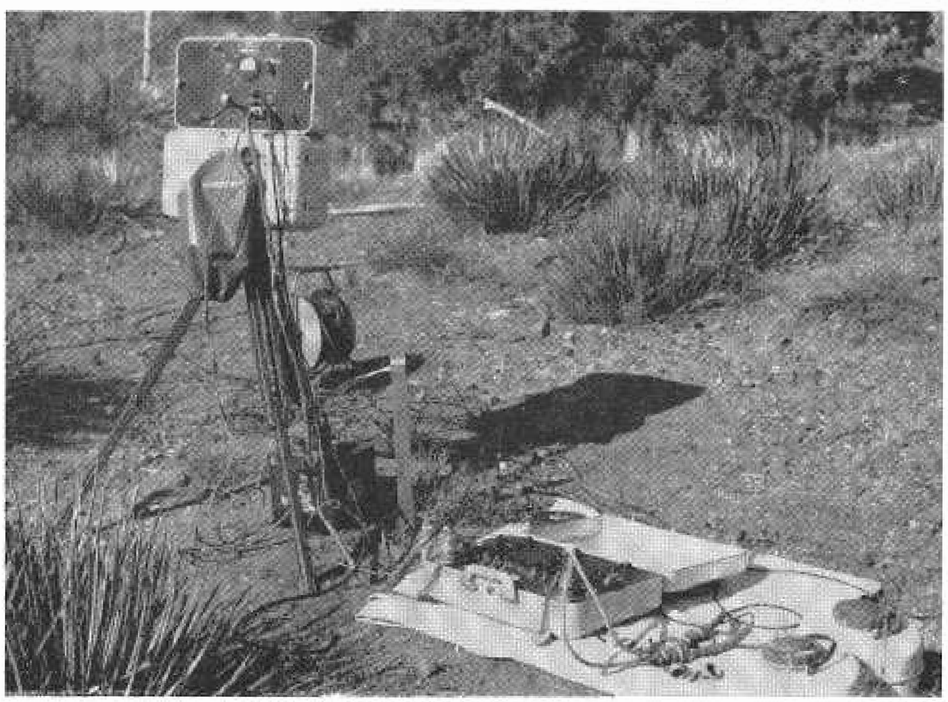
Research Department's refraction seismograph crew. In response to this request, Marvin McCauley and Nick Silken of the Geology Section brought a portable seismograph unit to the site. Although this instrument functions similarly to the one demonstrated by Mr. Church, the operation is considerably different. It consists of a multichannel recorder using 12 geophones. A seismic wave activated at a shot point is picked up by the geophones located at intervals along a predetermined line and carried to a high gain amplifier where the signal is increased several thousand times and fed into sensitive mirror galvanometers in the recording camera. A light beam reflected by each mirror onto rapidly moving sensitive paper imprints signal variations from each geophone. (Please refer to Figure No. 1.) The rate of travel of the paper and the firing instant are synchronized.

One-third to one pound of 40 percent dynamite is used to create the seismic wave. The spacing of the geophones is varied to provide the accuracy desired. Cross profiles using the geophones were run at right angles to the project centerline as a check on the results determined along the centerline profile. On developing the recording paper, a permanent record is obtained showing the time of the firing break and the time that it took the seismic wave-front to reach each geophone. (This is shown on Figure No. 1.)

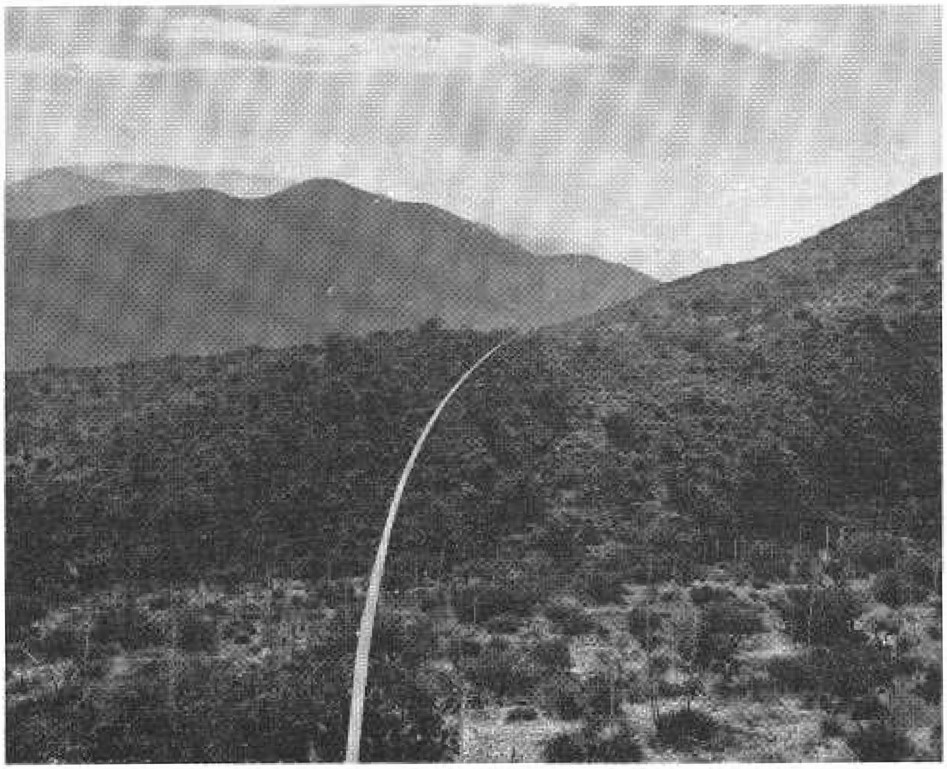
Wave Travel Measured

The time for wave-front travel from the shot point to the respective geophones is determined graphically by interpolation from the time lines placed at 10-millisecond intervals on the photographic record sheet. As will be observed on Figure 2, field distances from the shot point to geophone locations and the corresponding time interval produces a time-distance curve. The slopes of the various sections of the time-distance curve are dependent upon the velocity of the shock wave in each type of material and the depth of the contact surface or interface between materials of different type. Intersection points on the time-distance curve are a function of the thickness of each layer and the depth of the contact surface. The velocity in each segment is equal to the incremental distance divided by the incremental time.

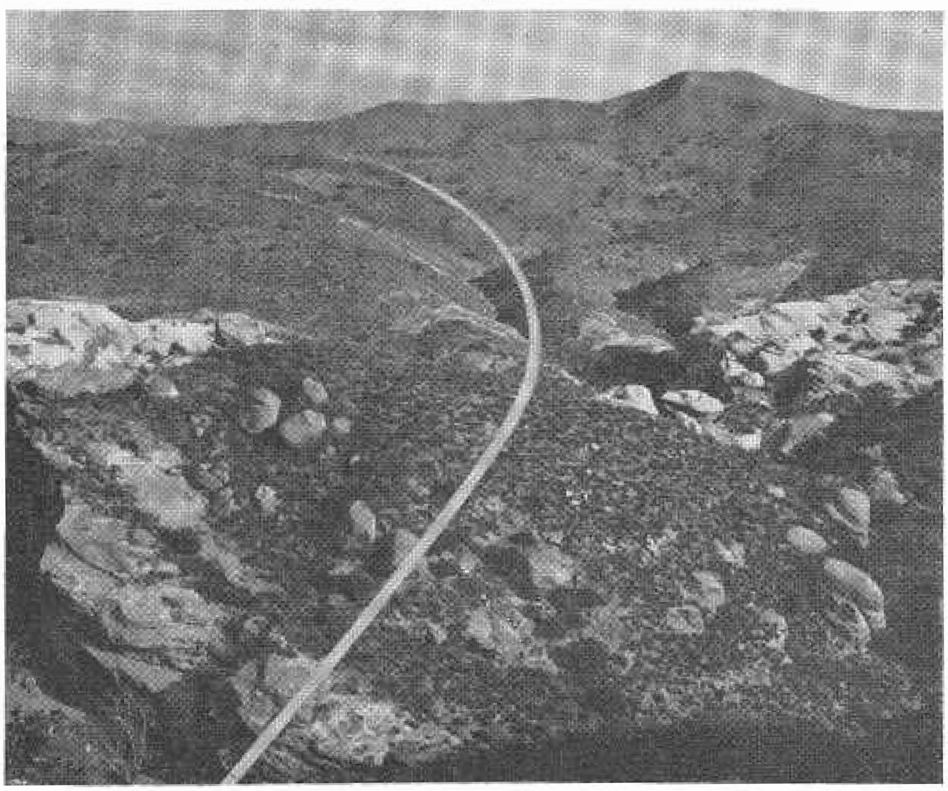
Mike Nigro installs a geophone along the shot line.



Refraction seismograph equipment with recording equipment and amplifier.



UPPER and LOWER. *Typical terrain on the Antelope Valley Freeway with the centerline of the freeway superimposed.*



A general interpretation of the velocity ranges encountered are:

Velocity feet per second	*Excavation method*
Below 4,000	Rippable (conventional earthmoving equipment required)
4,000 to 5,000	Variable. Ripping is questionable
Over 5,000	Blasting will be required

The velocities of the material investigated are considered useful in providing an indication as to whether ripping or blasting methods will be required during excavation of the proposed cuts. Other factors such as joint pattern, stratification, degree of weathering, the amount of fracturing and the tectonic history of the rock can effect rippability. In some instances, water saturation can raise velocity in a low-speed material or lower velocity in a high-speed material in appreciable amount. However, the arid condition of this particular locale precludes much concern for a variance from the general interpretation. In order to provide data for the assistance of prospective bidders in the determination of the type of excavation methods to be employed, it is planned to prepare a series of cross sections through the excavation sites on which will be indicated the different velocity zones for the purpose of calculating the different types of material. A typical example is illustrated in Figure 3.

On the premise that this information is becoming more generally understood by the construction industry, it is believed the providing of velocity zone cross sections will give a more accurate guide to the manner in which the excavation can be accomplished. With this information, interested bidders will have a better guide to subsurface conditions and the State will benefit by receiving lower bid prices.

E. D. Drew, Associate Engineer Geologist and M. McCauley, Junior Engineer Geologist of the Headquarters Materials and Research Department aided in the seismic investigation.

REFERENCES

(1) R. Burton Rose, M.A.—"Seeing Rocks Under the Ground" Southwest Builder and Contractor, June 9, 1950.

(2) Horace K. Church, C.E.—"Reckoning Ripable Rock" Bulletin by Shepard Machinery Co., Los Angeles, California.

Free Fill

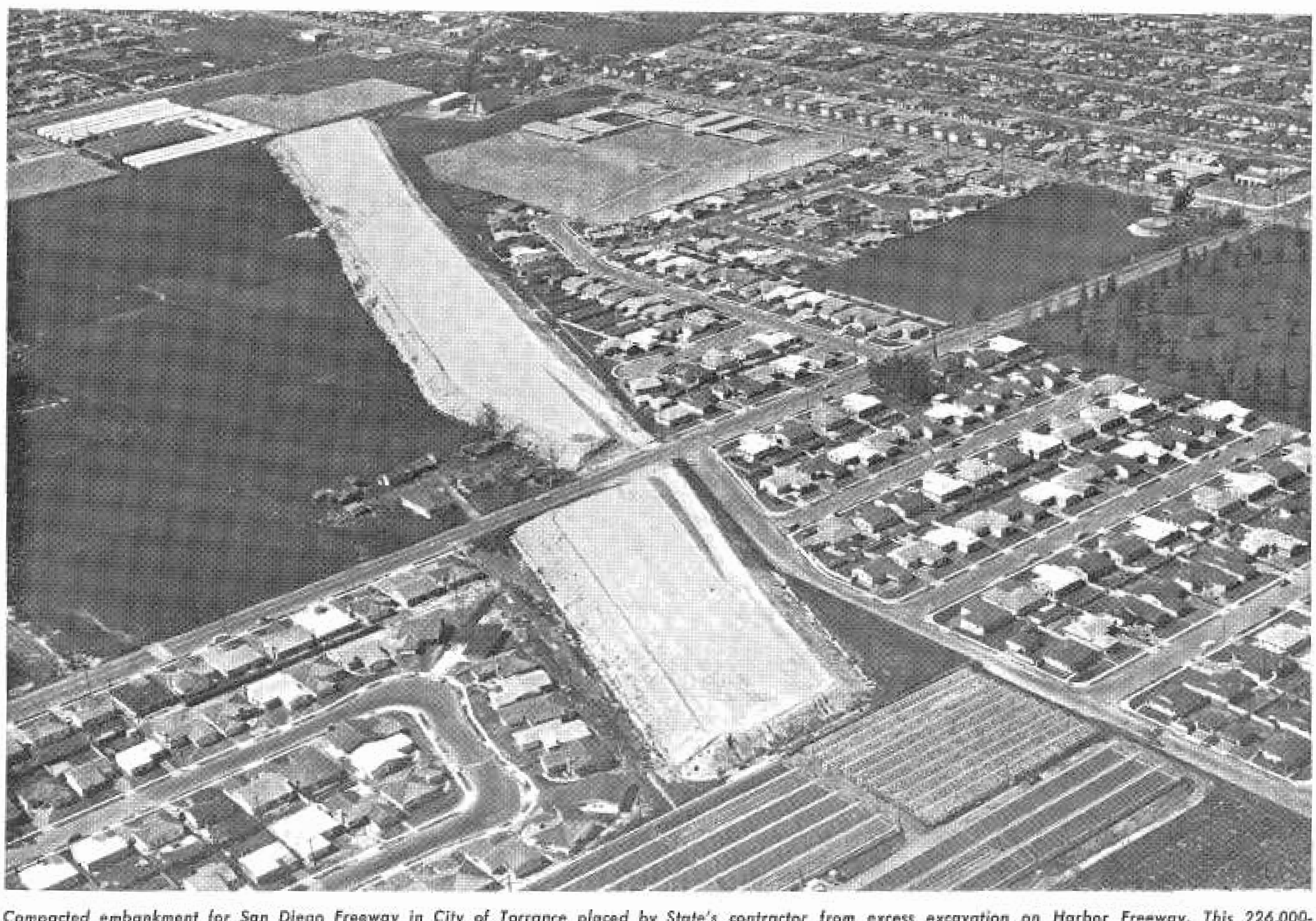
Embankment Material 'Stockpiled' In Place for Future L. A. Freeways

By RALPH E. DECKER, Senior Highway Engineer, and FRED W. RADTKE, Highway Engineering Associate

As FREEWAY construction gains headway in the Los Angeles area, the State Division of Highways is stretching the gasoline tax dollar to provide as many more miles of freeway as possible at the least cost to the public. As a part of this "More-Miles-of-Freeways-at-Less-Cost Program," District VII has initiated a procedure whereby it obtains earth for freeway embankments in advance of the actual freeway construction at little or no cost to the State. This is done through making available to responsible persons certain areas within state-owned freeway rights-of-way as disposal sites for their excess excavation material.

The stockpiling of excess embankment material on nearby freeway rights-of-way from a going freeway project has been practiced for many years. There are many instances where this was done on the Santa Ana Freeway, the Golden State Freeway and the Harbor Freeway. In every case, however, the stockpiling was done by a State's contractor and the excavation material came from a state freeway project. It has been only within the last two or three years that the State has enlarged upon this procedure to accept approved embankment material from other governmental agencies and from private contractors.

From the beginning we realized that making arrangements with outside people for placing fill material on state-owned rights-of-way made it



Compacted embankment for San Diego Freeway in City of Torrance placed by State's contractor from excess excavation on Harbor Freeway. This 226,000-cubic-yard fill is in addition to the 1,080,000-cubic-yard 1959 disposal program, as detailed in the accompanying article.

mandatory to organize a standardized procedure, not only for the State's protection but also to assure complete fairness to the people involved.

Potential Sites Determined

Approximately a year ago this activity was made the responsibility of the District Right of Way Clearance Section. The Clearance Section contacts the District Design Department to determine which freeways have potential embankment sites and how much fill material these sites will accommodate. After the right-of-way is acquired by the State, locations which contain large embankment areas normally requiring imported material for construction are given an early priority for clearance of buildings and utilities to prepare these areas for potential disposal sites.

As these sites become available, we are in a position to consider requests from outside parties who have excess earth for disposal. Applicants are advised of the general requirements for use of state lands for disposal sites. Experience has shown that we cannot economically handle small quantities of material and a minimum of 5,000 cubic yards has been established. We have also found it necessary to have the work done under a standard Maintenance Department Encroachment Permit, to which Special Provisions are attached and made a part. Also, a Faithful Performance Bond is required from the permittee. Control of these encroachment permits was delegated to the Right of Way Clearance Section since this section is also responsible for the demolition and clearance of buildings and the relocation of utility facilities which must be accomplished prior to commencement of stockpiling operations.

Conditions Attached

Special Provisions to guarantee the proper placement and compaction of suitable embankment material consistent with freeway construction requirements are attached to and made a part of the Encroachment Permit, and include in general the following: Work Control, Authorized Use of Disposal Site, Work Hours, Storage of Permittee's Equipment and Material, Standards of Construction (consisting of Workmanship, Foundation, Clearing and Grubbing, Concrete Removal, Embankment Material, and Embankment Construction), Disposal of Materials, Expense of Inspection, and Protection of Work. These Special Provisions are similar to and consistent with state requirements for freeway construction projects.

A view of the future Golden State Freeway alignment in the vicinity of the Glendale Freeway Interchange. In the foreground are 14 disposal sites with compacted embankments, a total of approximately 400,000 cubic yards of material. Los Angeles River in background.

The time duration of an Encroachment Permit authorizing construction of embankments on state-owned land will normally vary from 30 to 90 days, depending upon the amount of material the permittee has available for disposal purposes. Generally the time allowed is as follows:

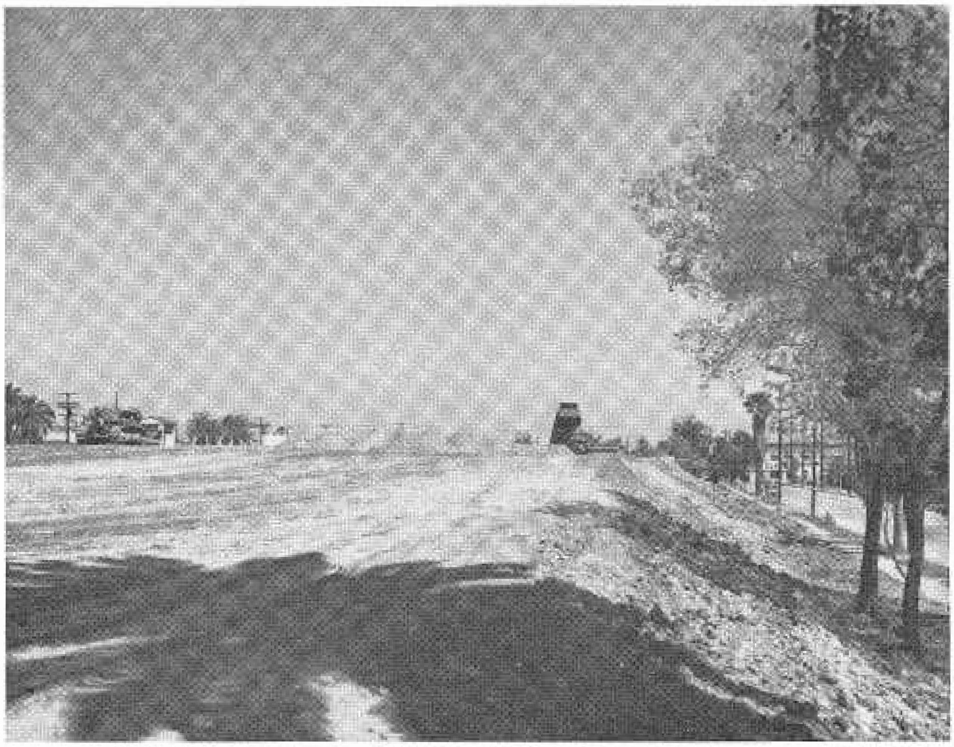
Quantity of material	*Time limit*
5,000 cu. yds.	30 days
10,000 cu. yds.	60 days
20,000 cu. yds. or more	90 days

The permittee is required to furnish the State with a faithful performance bond, known as a P-4 State Highway Permit Bond. The amount of such bond is determined by the State, but usually will be based on the amount of material proposed for embankment as stated in the Permit, as follows:

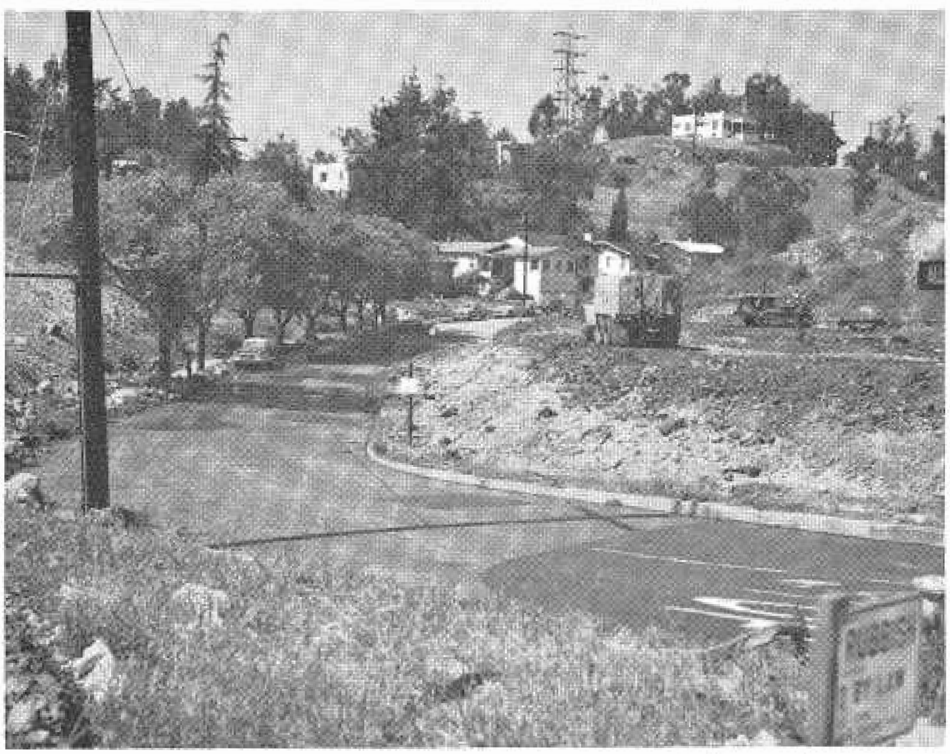
Quantity of material	*Amount of bond*
5,000 cu. yds.	$5,000
10,000 cu. yds.	10,000
20,000 cu. yds. or more	20,000

A brief summary of the general requirements for embankment construction follows:

In advance of embankment construction, all existing material within the disposal area which is unsuitable for embankment foundation shall be



The proposed alignment of the Santa Monica Freeway between Vermont Avenue and Budlong Street. Approximately 200,000 cubic yards of material has been placed at this location.



Approximately 40,000 cubic yards of material under permit is being placed by a private contractor from excavation obtained from the Pacific Telephone Company building site located at Fourth Street and Grand Avenue, City of Los Angeles. Note dust control by watering of street.

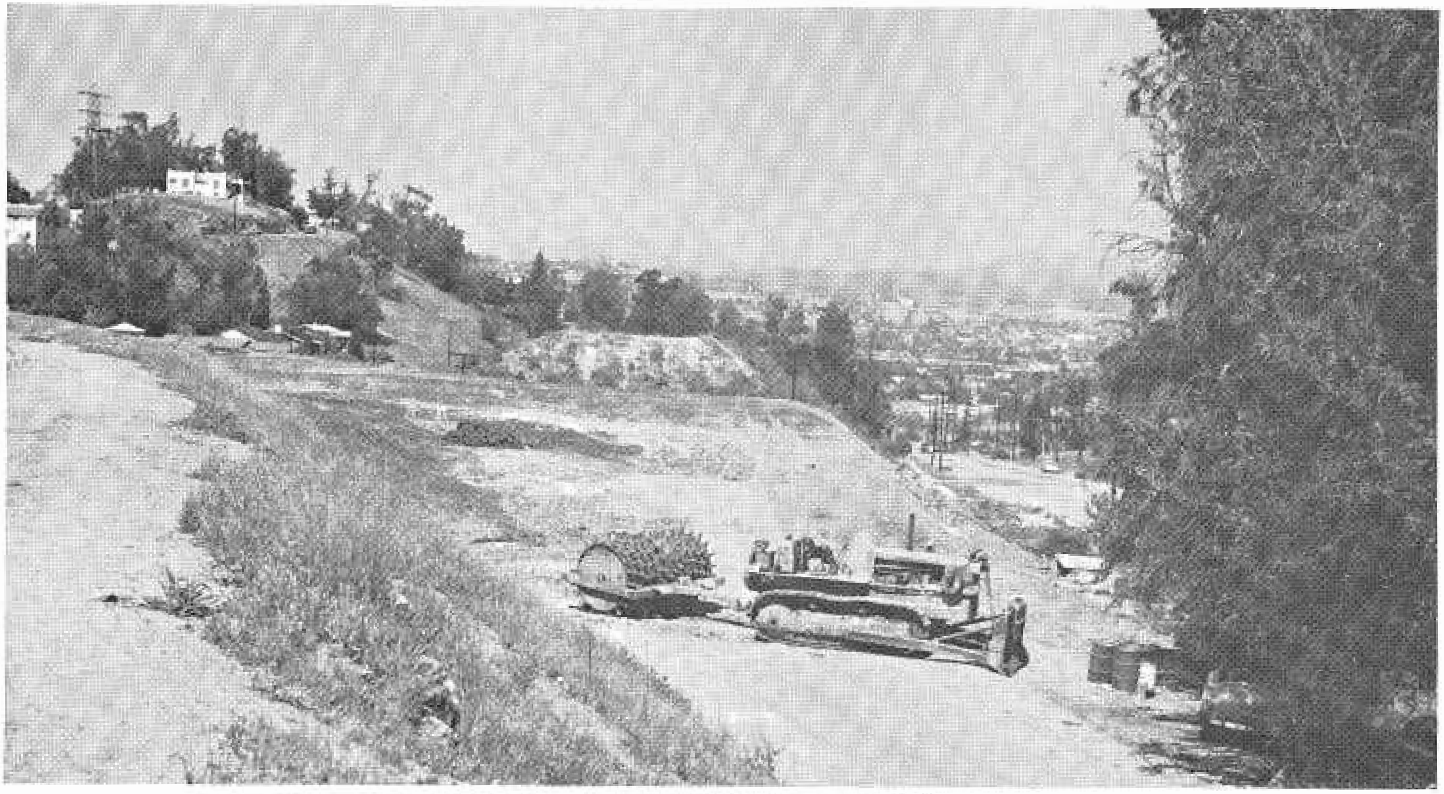
removed from the site to a location outside of adjacent state-owned lands. The site is to be cleared and grubbed. Material which may be acceptable, such as cement pavement, slabs, curbs, gutters, etc., shall be broken up, removed and/or prepared for embankment as directed by the State. The embankment material must have a minimum R-Value of 15, be free of objectionable material, and be approved by the Division of Highways.

Compaction Tests

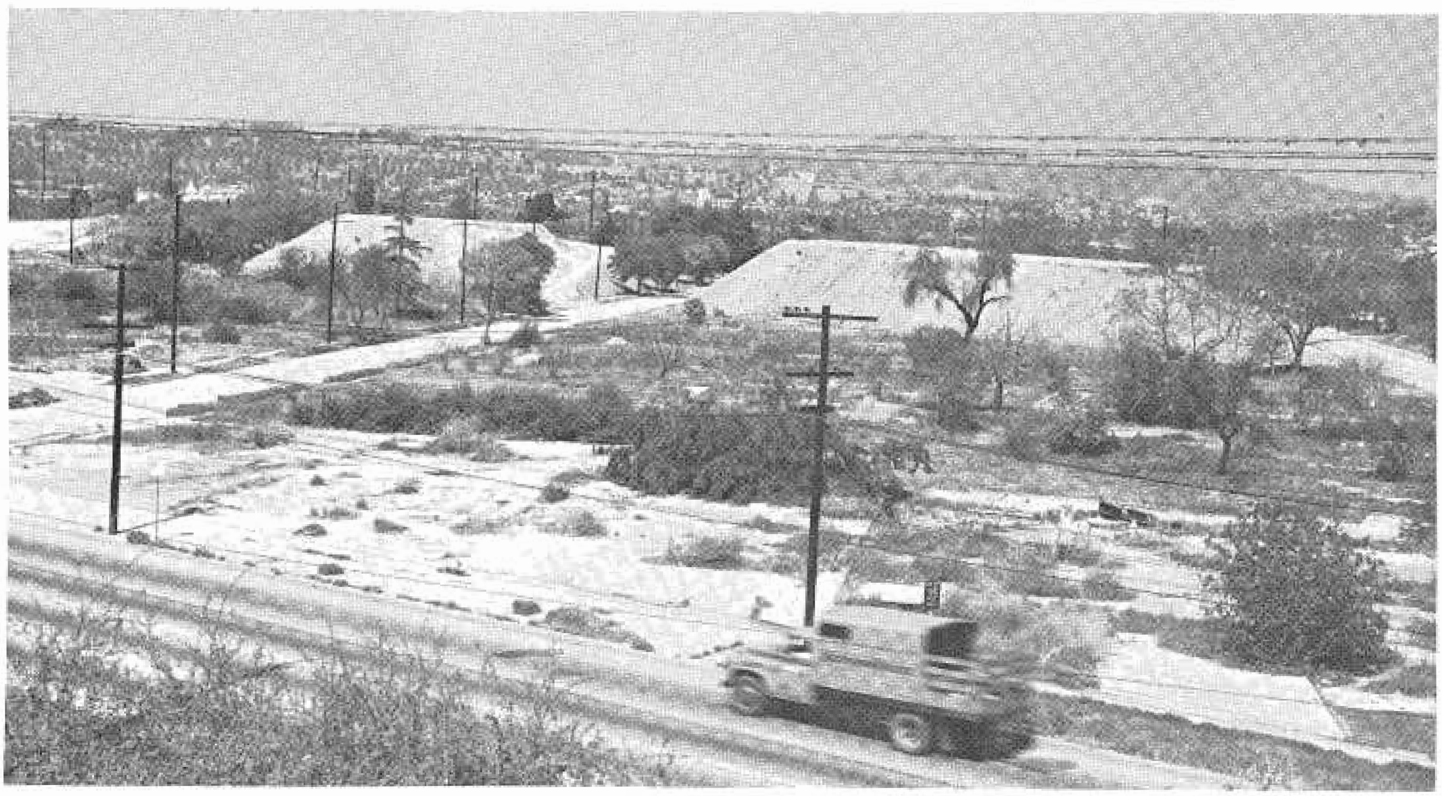
The permittee is required to protect existing street curbs, gutters and sidewalks which are to remain in place. He is also required to furnish and erect any necessary posts for signs furnished by the State, and furnish and erect any other protection considered necessary by the State to prevent unauthorized dumping. The cost of compaction or material quality tests requested by the permittee shall be paid by the permittee. Except as otherwise provided in the Special Provisions, inspections performed by the State will be done without cost to the permittee.

The State will make disposal sites available on a first-come basis. The disposal site is for the sole use of the permittee, the amount of material placed and its source to be as set out in the Permit. Under no circumstance shall the permittee accept material from other sources for disposal on the site, subcontract for material from other sources, or accept payment from others for permission to dispose of unauthorized material from unknown sources.

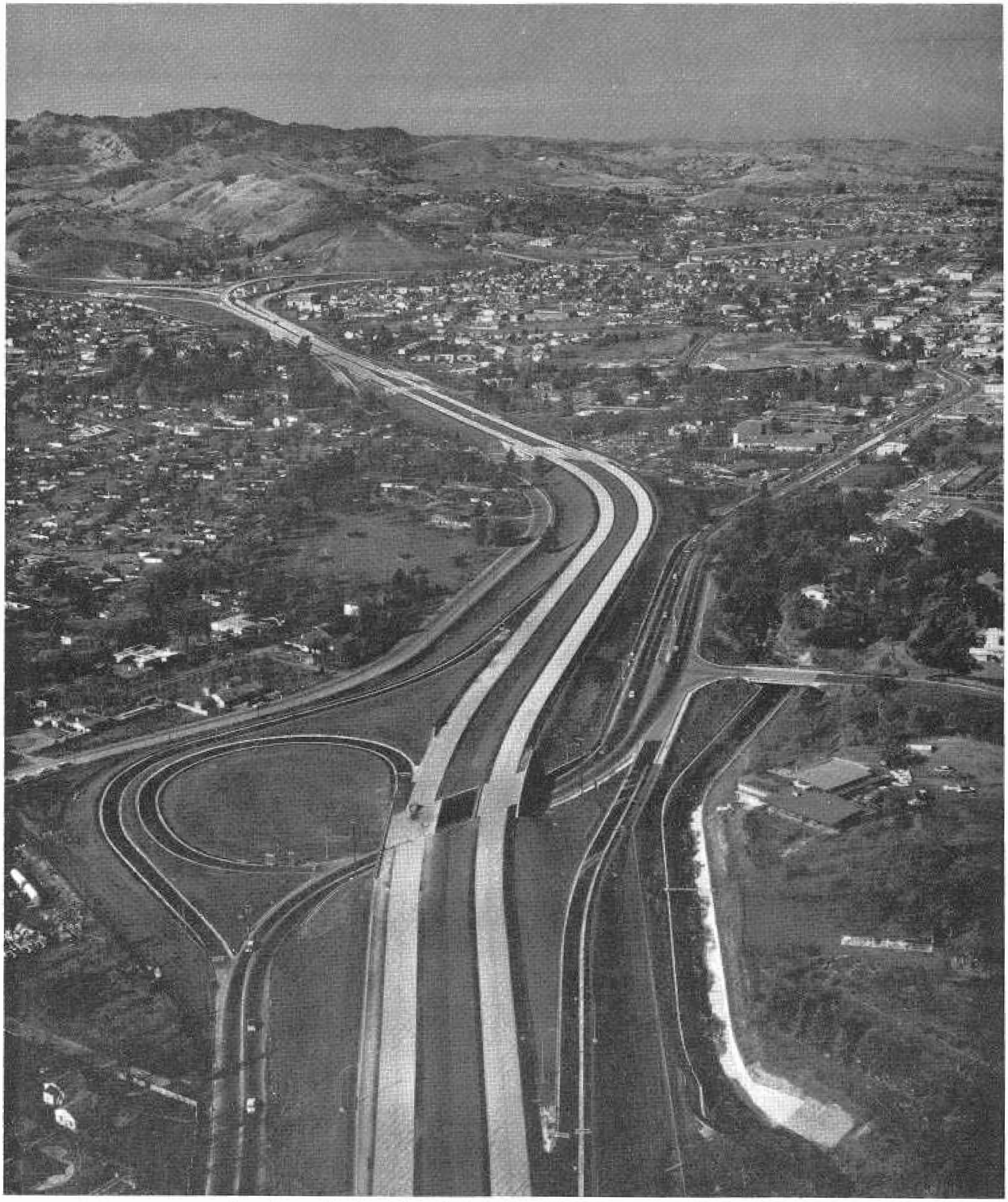
The Special Provisions, which have been developed by the District Construction Department, include paragraphs on clearing and grubbing, concrete removal, embankment construction and protection of work. These are sufficient in detail to insure the State that any embankment construction by the permittee will be equal to freeway embankment placed under a major freeway construction contract. The issuance of the Encroachment Permit creates a contractual relationship between the State and the permittee. The permittee is given the exclusive use of a specified site for placing state-approved fill material in what will later be a freeway embank-



Looking north on the future Glendale Freeway with existing Allesandro Street at the right side of photo. District VII has under permit 100,000 cubic yards of freeway embankment in this vicinity.



Disposal sites on the Golden State Freeway in the vicinity of Riverside Drive and Allesandro Street, viewing northerly across Riverside Drive, with City of Glendale in the background.



Looking northerly on Route 107 with South Main Street interchange in foreground and showing interchange separating Sign Routes 24 and 21 in background.

Orinda to Monument Boulevard is now in service.

Approximately one mile east of the Pleasant Hill Interchange, the freeway also branches south to a connection with Sign Route 21 at Crest Avenue near the southerly city limit of Walnut Creek. The main interchange which carries traffic northerly to Monument or southerly to Danville has been aptly described locally as a giant "Y," and also provides direct connection to the existing city street system of Walnut Creek.

This interchange is perhaps the most outstanding feature of the project. With its five major structures and attendant ramps, the three-level interchange provides for smooth flow of traffic between State Sign Routes 24 and 21. Including this main interchange, there were five major interchanges which involved the construction of 16 major structures.

The work consisted of construction of 4- and 6-lane sections of concrete roadway with provisions for an ultimate 6- and 8-lane freeway. Also involved in the work was the construction of frontage roads, city street connections, an extensive drainage system, a concrete-lined channel change, and the installation of a signalized intersection.

In Interstate System

The north-south portions of this project are a part of the federal interstate highway system which will eventually encircle the lower portion of San Francisco Bay and connect with US 80 in Vallejo. Of interest to

View of "Y" interchange in Walnut Creek. Looking northerly on Sign Route 24 to Oakvale Road Overcrossing with North Main Street interchange in background.

Oakvale Road Overcrossing on Sign Route 24, looking south. Slope stabilization through tie-down process, described in article, shows at extreme right.

motorists traveling the newly opened section of freeway are the red, white and blue shields on overhead signs designating Route 680 of the federal interstate system. This is the first installation of such shields in this area.

As is so often the case, in a highly developed area, a large number of utility relocations required close correlation with construction operations. In addition, traffic was carried through the stages of construction operations via a changing series of detours.

Complexity of this $8,500,000 project posed many construction problems.

One of the major difficulties encountered was the unstable cut in the vicinity of the westerly abutment of the Oakvale Road Overcrossing. The slope of the 70-foot cut in the vicinity of the bridge showed evidence of instability during excavation. To insure support for the westerly abutment at the top of the cut and for the spread footings of bents Nos. 4 and 5, special investigation and specialized treatment were undertaken.

Borings made in the area indicated the instability of the cut was due in the main to a circular plane of slippage aggravated by a high moisture content in the soil. The slippage passed below the elevation of the roadway at the toe of the cut and upward into an existing road at the top of cut behind the location of the westerly abutment. Since the slope could not be flattened due to existing streets and improvements, the decision was made to stabilize the slope by restoring the loading which existed prior to excavation. The method used is probably a first in Division of Highways construction. Loading of the slope was applied through three reinforced concrete beams, 15 inches thick and five feet wide, anchored to the abutment at the top of slope and to a tie beam at the toe of slope.

Use Alloy Steel

Beam loading was achieved through high strength alloy steel stress rods of 1⅛″ diameter and was transferred from the rods to the soil through piles cast in 24″ diameter vertically drilled holes. Each pile was 75 feet deep and there were 14 piles per beam. Based on an allowable soil stress of about three tons per square foot, the stressing system consisted of two rods to a pile, each rod being stressed to a load of 50 tons.

This slope stabilization was started during the winter of 1957 and has worked successfully to date.

Slides also occurred on either side of this stabilized section of cut slope. Northerly of the structure one building was removed and the slope flattened to an approximate 3:1 slope. Southerly of the structure a cup-out near the top of slope was packed with coarse rock. On both sides of the structure an extensive system of horizontal drains was installed as a means of further stabilizing the cut area.

Construction of the southern leg of the project on Sign Route 21 required the relocation of a portion of San Ramon Creek. This relocation consisted of construction of a concrete-lined channel 36 feet in width with a height of 14 feet, for a length of approximately 1,000 feet.

Construction began in June 1957 and all work was completed in May of 1960. General contractor on the project was Charles L. Harney, Inc., resident engineer was W. J. Murray, and Bridge Department representative was W. C. Names, all under the general supervision of J. P. Sinclair, Assistant State Highway Engineer.

Coastal Bluffs

Cliff Erosion on US 101 Causes Major Repair Problem

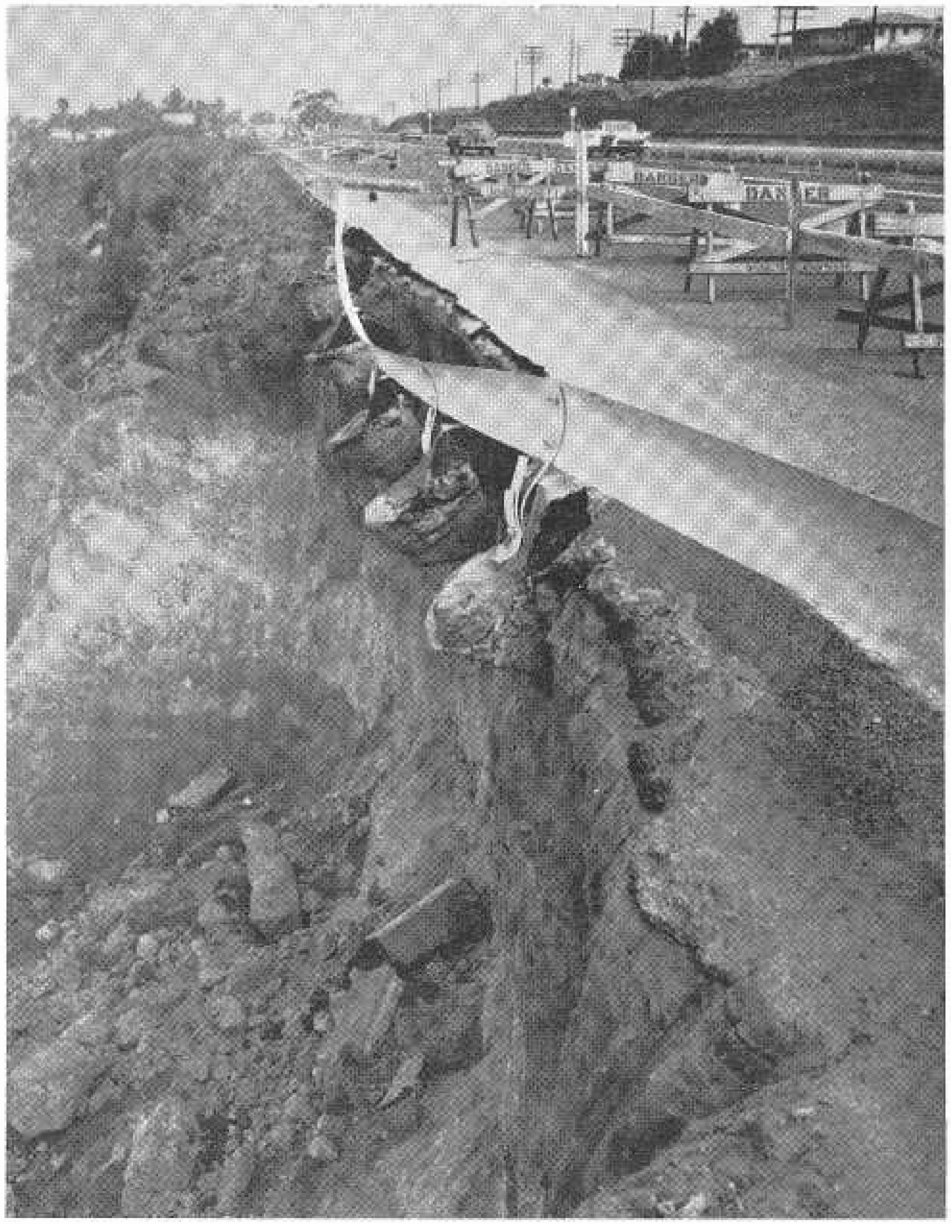
By R. B. LUCKENBACH, Assistant District Engineer, and VIRGINIA J. SMITH, Administrative Section

THE FORCES of nature, together with certain man-made erosive forces, have intensified and accelerated the deterioration of a cliff which supports U.S. Highway 101 in San Diego County.

Just south of the coastal community of Encinitas US 101 follows a bluff along the Pacific Ocean which has been subjected to weathering and erosion by rain, wave action, and percolation of underground waters, causing the face of the cliff to gradually retreat to the extent that the roadway was endangered. The California Division of Highways therefore began studies to find a method of stabilizing the bluff or relocating the highway.

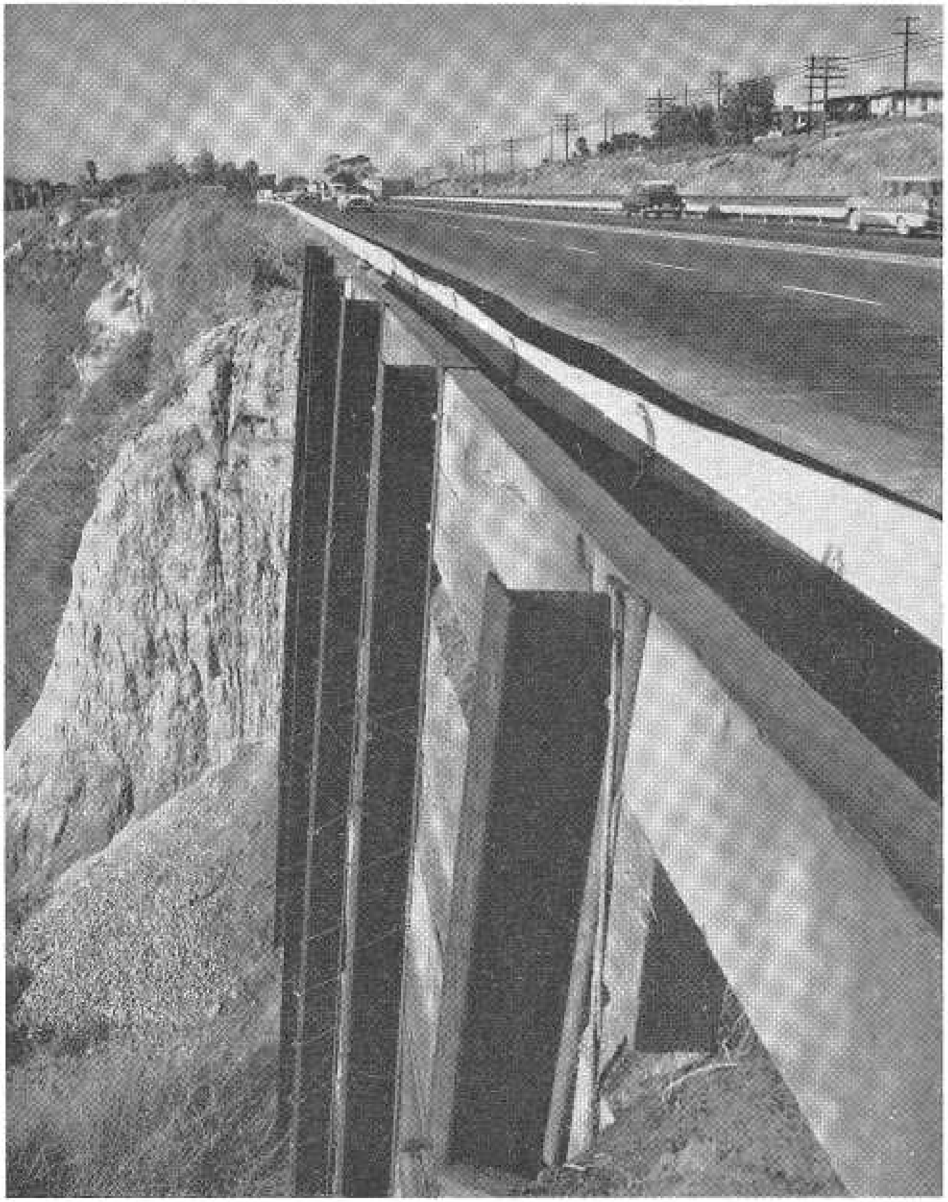
> At its March 1960 meeting the California Highway Commission allocated $490,000 for further erosion control and bluff protection work along US 101 between Cardiff and Encinitas, to the north of the project described in this article.
>
> Bids for the work were opened in Los Angeles on June 2, 1960.

Following a large slipout which occurred in March 1958, plans were completed for installing temporary bulkheading as an emergency measure. At this time a complete study of the entire area was initiated to learn what preventive measures should be undertaken for permanent protection. By this time the cliff had retreated to within one foot of the guardrail. An extended rainy period in April of the same year resulted in a large cave-in, causing the loss of shoulder and guardrail (see photo). Traffic was temporarily routed along the easterly portion of the right-of-way, using the shoulder area for the northbound lanes, while the Maintenance Department constructed the bulkhead retaining wall to restore the full traveled way to use of traffic. Approximately $20,000 was spent on this emergency work.



A view of the slide area on US 101 near Encinitas caused by heavy rains and renewed underground flow. (San Diego Union photo.)

The problem involved in the overall study was a complex one; there was need for immediate correction, as well as for protective measures to pre-



Emergency bulkheading installed by state highway maintenance forces on US 101 near Encinitas prior to the work described in this article.

serve the highway on a long-term basis. So a dual study was begun. One important factor was the average daily total of 25,000 which must be provided for in an area that affords no additional usable width, as the highway is crowded between the ocean bluff on the west and the railroad tracks on the east. Although the proposed freeway location in this area will be further inland, the present Highway 101 will always be required for increasingly heavy local traffic after the new route has been constructed.

As the weathering of the face of the cliff progressed, a talus deposit developed at the foot along the beach which is just 2.5 feet above the highest tide observed and 20 feet behind the line along which the tide intersects the beach.

In addition to the percolation of rain and natural underground water through soft layers, or aquifers, increasing residential development on the higher land to the east contributed excess free water from leaching systems and irrigation. Since the natural direction of flow was toward the ocean, these waters found a pathway through a soft sandstone layer some 15 to 20 feet below the top of the cliff. Following studies by the district, a plan evolved which would provide stage construction to improve the condition and stabilize the cliff, since relocation of the highway at the time was not economically feasible.

Method Chosen

The area involved is partly within the San Elijo Beach State Park and it appeared desirable to choose a method of correction which would provide a minimum of encroachment on the public beach. And, of course, any solution must provide a maximum of protection with a minimum of expenditure. Various proposals were considered, but most had to be discarded as economically unfeasible, or because of the formidable problem of handling traffic. Some of these alternate proposals are shown in the attached drawings. They range from reinforcement of one-half mile of cliff to reinforcement of two 100-foot areas.

The plan decided upon provided for the first step of a stage-construction stabilization program using a rock fill backed by earth at the base of the cliff. This proposal minimized both the cost factor and the beach encroachment (see drawing). The beach encroachment in this instance is 41 feet.

Another phase of this same proposal was the installation of 800 feet of perforated metal pipe underdrains along the easterly side of the highway to intercept and carry drainage waters across the highway and deposit them where they could no longer endanger the cliff. During the period required to make the study and prepare the job for construction, District XI maintenance forces made weekly checks to chart the progress of the cliff erosion and to stand ready to make any necessary emergency repairs.

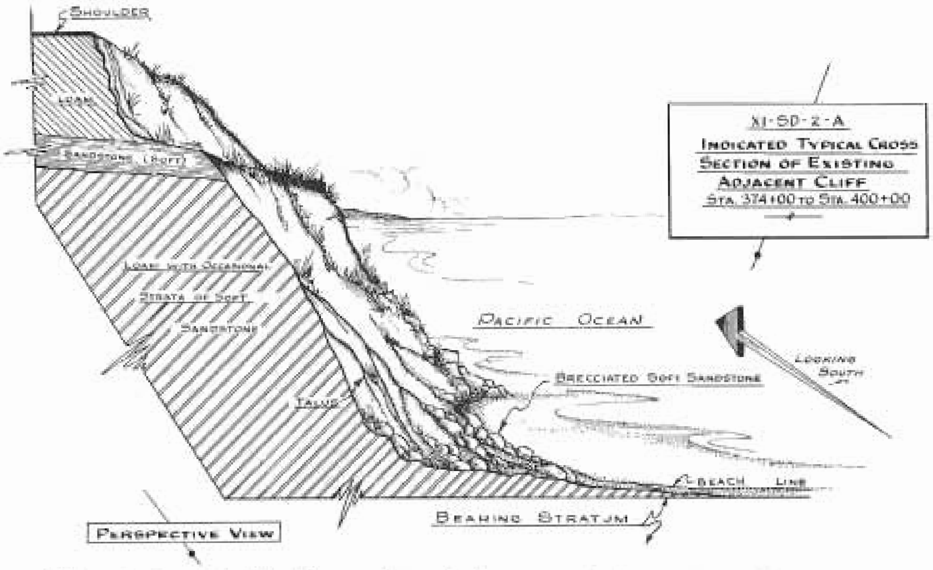
Agreement Is Negotiated

It was also necessary to negotiate an agreement with the Division of Beaches and Parks for permission to obtain needed imported borrow material for the earth fill by excavation from an area which was planned for future parking space in the state park.

Contractor Ralph B. Slaughter began work on July 30, 1959, to perform the necessary construction to retard the recession of the bluff line. Under this contract and in accordance with the agreement with the Division of Beaches and Parks, the contractor prepared a jeep road over which equipment could travel from the top of the cliff to the beach below. This road will also be used by state park equipment in the future.

During the period of construction two minor slides occurred within the limits of the contract in addition to one larger slide in the area proposed for the next step of the stage construction program.

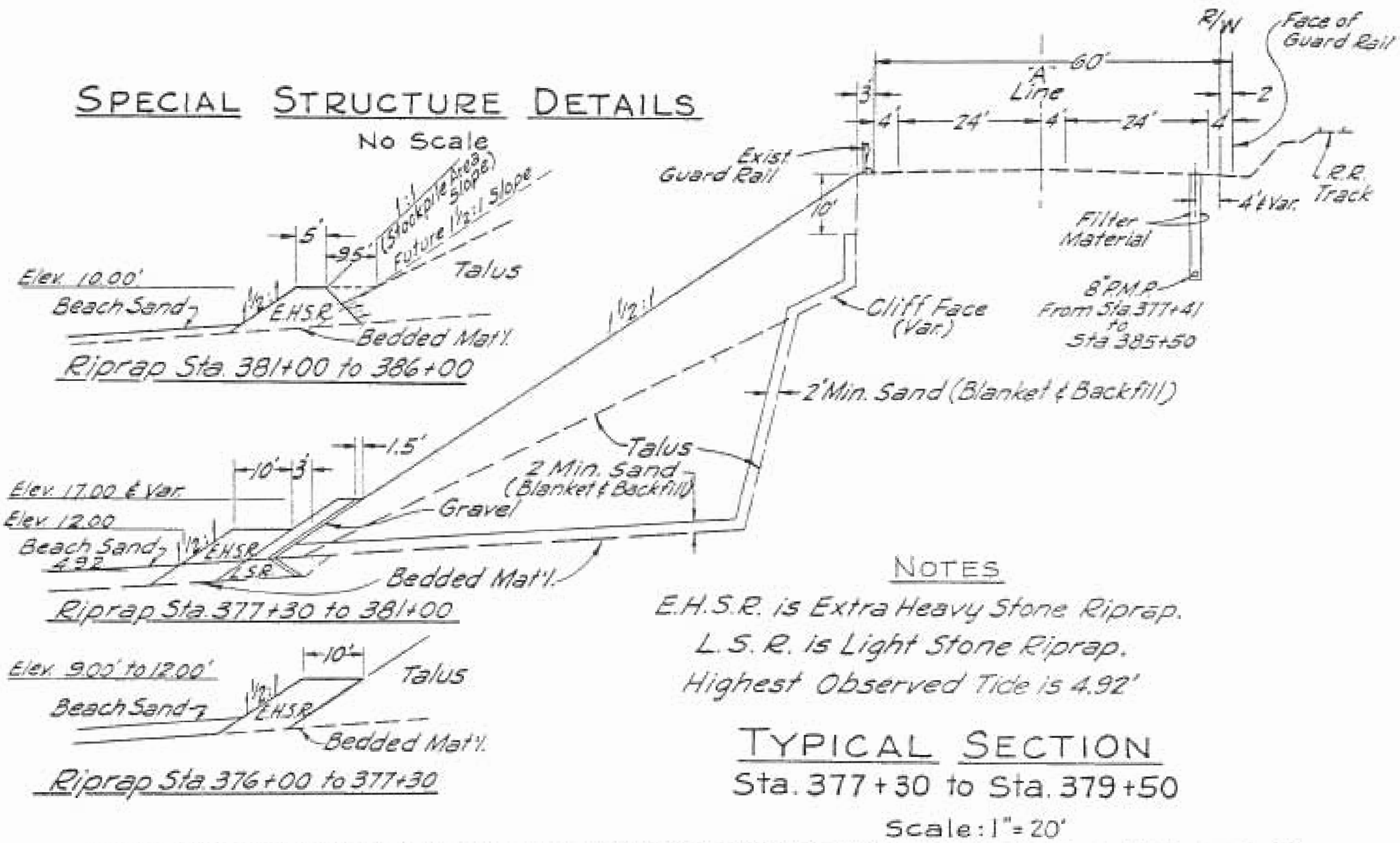
One of the first steps in the project was the removal of the saturated talus material at the base and from the face of the cliff, spreading it out in lifts about one foot deep to facilitate drying and permit its replacement in the completed fill. It was necessary for the contractor to place riprap along the beach to protect this stockpile.



This geologic profile of the slide area shows the location and makeup of the underlying strata.

Under this contract 6,000 tons of heavy riprap and 1,300 tons of lighter riprap were placed at the toe of the slope between Stations 376 and 386, a distance of approximately 1,000 feet. It was necessary for the contractor to time the placing of this riprap to coincide with low tides, since at any other time it was impossible for his equipment to work on the narrow beach shelf. In fact, on two occasions his equipment was caught and stalled by tides.

After removal of the sloping surface from the bluff for its full height, a 1½ to 1 embankment section was



A typical section diagram showing some of the special structure details involved in repairing the slide damage on US 101 near Encinitas.

Looking southeasterly at US 101 showing limits of bank protection work. Dark area in center shows full rock riprap section at toe of completed embankment. Light area to north shows partial rock riprap section and stockpiled talus. The next contract which has been advertised will provide for removal of talus, completion of riprap section and placement of compacted embankment plus additional work to the north. Right center of photograph shows beach access road and parking area formed by excavation of necessary borrow material.

placed against it. With each lift of the fill a two-foot section was cut out adjacent to the cliff and backfilled with sand to allow water to percolate through this sandy layer rather than through the surface layer of soil which was then put in place.

Seeding Prevents Erosion

After placement of this fill material on the slope, it was necessary to place fertilizer and straw, and then to seed with barley, Italian rye and bermuda to prevent erosion of the surface. Ice plant was not considered suitable due to its heavy surface growth and poor root system.

As previously mentioned, the contract work included the placing of approximately 800 feet of perforated metal pipe on the easterly side of the highway, parallel and adjacent to the highway and the railroad. This pipe, which will intercept subsurface drainage, was placed approximately 19 feet below pavement grade in a bed of gravel filter material. The efficiency of this drainage system is indicated by a daily yield of 28,000 gallons at the outlet.

Vibrations of the earth, caused by passing trains on the track only 20 to 30 feet away presented a hazard to the men working in the trench, and the Santa Fe railroad therefore arranged to have its trains reduce speed while passing through the construction area, thus minimizing the danger.

In addition to timing his operations so that the work at the base of the cliff would be done at low tide, the contractor had to give prime consideration to the handling of traffic on this heavily traveled highway. One-lane traffic in each direction was carried through the job during the initial pipe installation during working hours. However, at night two lanes in each direction were available to traffic.

Other problems which presented themselves during the construction period included continuous water seepage which appeared in different areas, and the two slides previously mentioned.

The contract was completed on November 18, 1959, at a total cost of $114,465.80, exclusive of construction engineering.

Benicia-Martinez

New Methods Used In Substructure Work

By L. C. HOLLISTER, Projects Engineer

THE CALIFORNIA Legislature in 1955 made possible the construction of two new highway bridges across Carquinez Strait, which had long been a bottleneck for highway transportation.

The Legislature authorized the California Toll Bridge Authority to issue up to $80,000,000 in revenue bonds, redeemable from tolls, to finance the construction of an additional parallel bridge on US 40 near Crockett and another structure between Benicia and Martinez to replace the existing ferry.

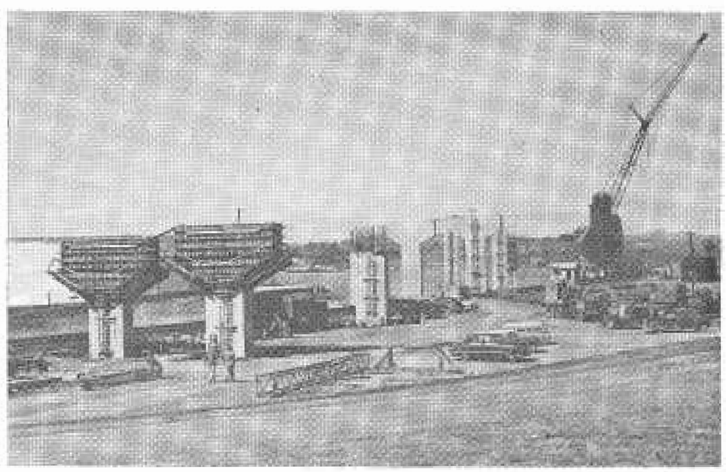
The new parallel Carquinez Bridge, costing a total of $46,000,000, is now complete and has been opened to traffic since November 1958. In August 1959 two contracts were awarded which officially started work on the second bridge across Carquinez Strait between Martinez and Benicia.

This new structure will be another important link in the interstate highway system and will provide an outlet to the north for one of the fastest growing areas in California. It will provide a direct connection to the Sacramento Valley and points east and north for cities such as Martinez, Concord, Walnut Creek, Dublin and San Jose.

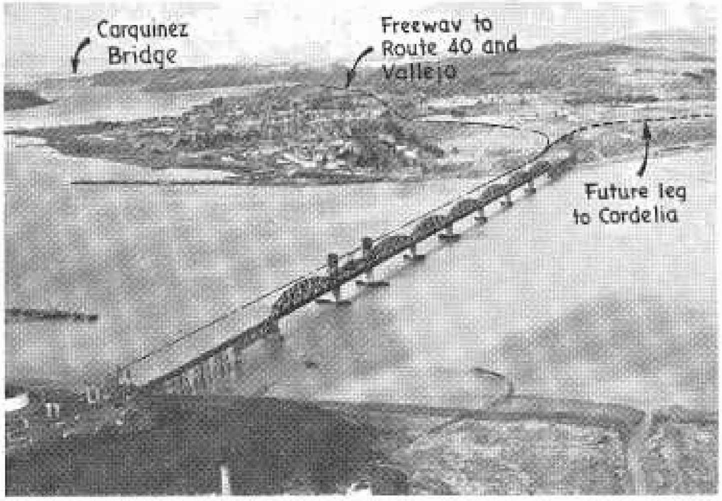
This 78-inch drill will bore the holes for the steel caissons. An air lift pump will remove the material as it is cut.

The Carquinez Strait at this point is somewhat wider than at the two parallel Carquinez Bridges, and because of this greater width the water is not as deep nor as swift. The total length of the new structure is 6,215 feet and will provide for four lanes of traffic on a concrete deck 62 feet wide between curbs. This width will be sufficient for a 10-foot division strip between opposing lanes of traffic. This area will be marked by painted lines, making

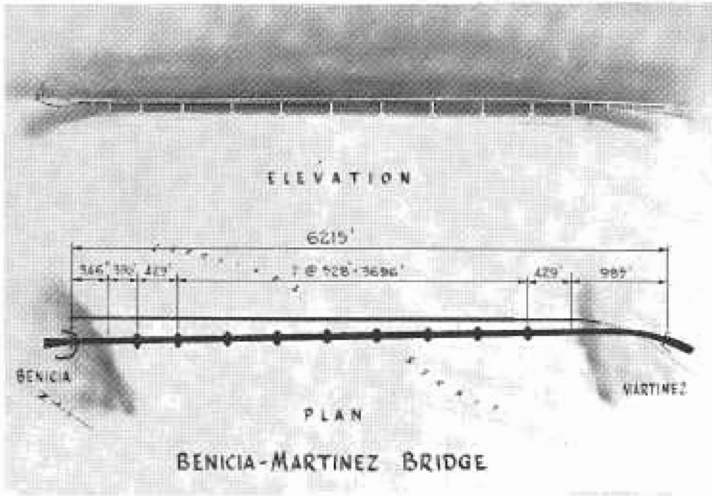
The box footing for Pier 12 has been floated into place and anchored in position. The next operation will be to rig up for drilling the 78-inch holes for the steel caissons.



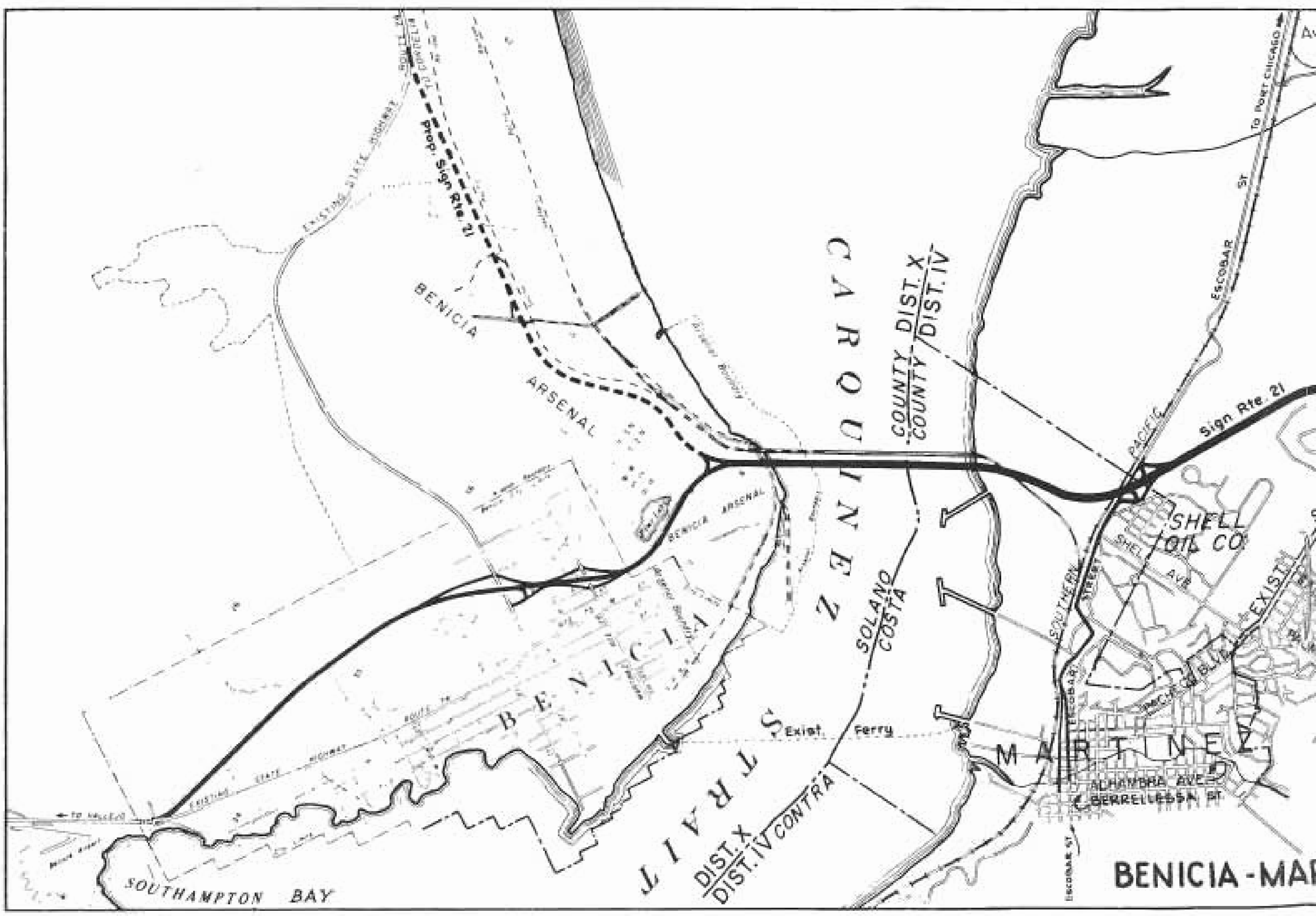
The approach piers under construction. Steel erection on the approach spans began early in May.



An aerial view of the Benicia-Martinez Bridge site. Approach pier construction can be seen at the lower left. The Carquinez Bridge is in the upper right.

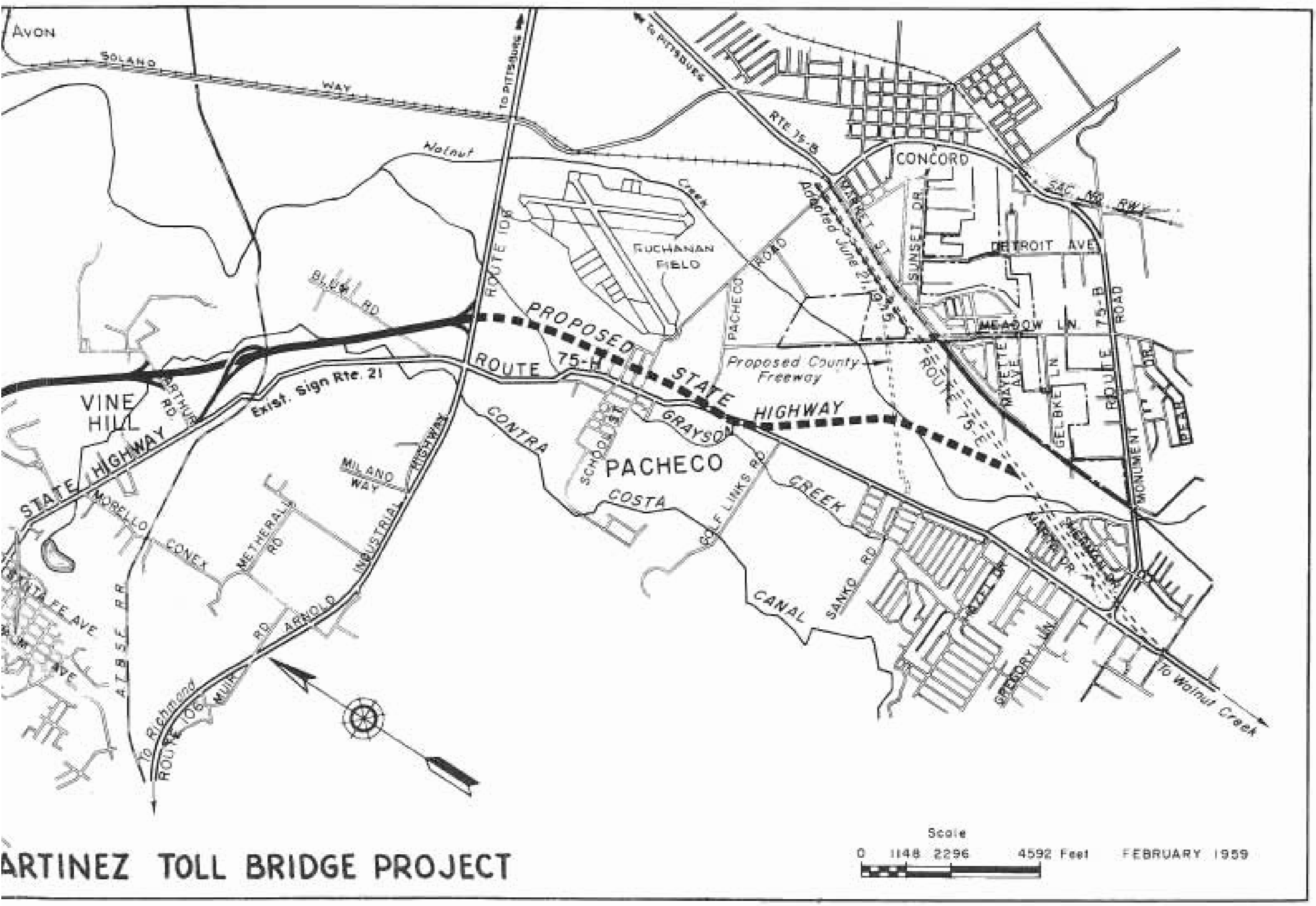


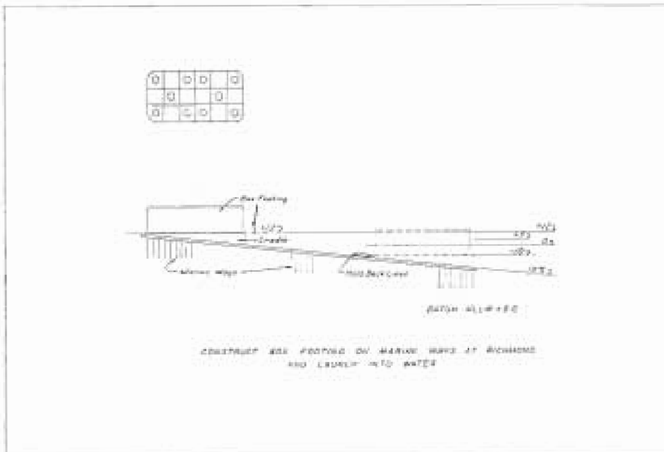
A sketch of the Benicia-Martinez Bridge showing the principal dimensions.



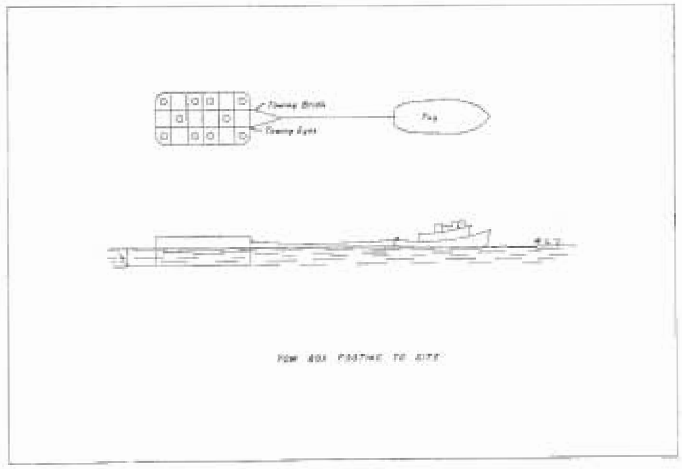
An artist's sketch of the bridge and Benicia interchange as it will appear in the future. The city of Martinez is to the upper right and Mount Diablo upper left.

A sketch of the bridge as it will appear when completed. It will be a high-level structure with no openings required for river navigation.

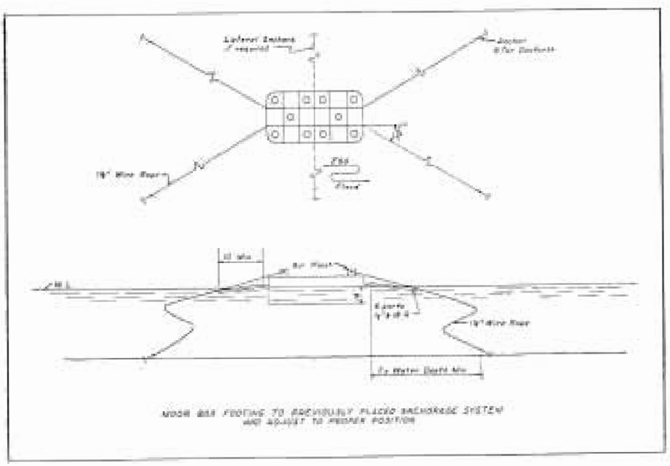




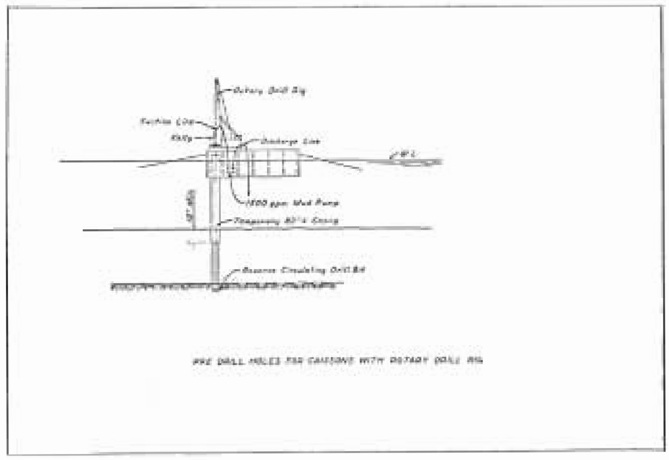
Step 1 consisted of forming and placing concrete bottom slab, walls and partitions for the box footings. After proper curing box footing is slid down the marine ways into the bay.



Step 2 consists of towing box footing approximately 30 miles to the bridge site. Footing weighs about 1,500 tons and has a draft of 14 feet.



Step 3 consists of anchoring the box footing accurately in place. Four anchor lines have so far been used, with attachments available for two additional anchors if required for pier construction in deeper parts of the channel where currents are swifter.



Step 4 consists of setting an 80-inch temporary casing in place. Through this casing a 78-inch drill is positioned and driven by a rotary drill rig at the top. This drill, assisted by an airlift pump which removes the cuttings, bores a hole through the overburden and two feet into bedrock. The 78-inch drill is then replaced by a smaller 62-inch drill, and the hole is bored an additional five feet into bedrock.

the space available for stalled automobiles.

Location Is Downstream

The bridge alignment is not quite parallel to the adjacent Southern Pacific Company railroad bridge and is about 200 feet downstream from it. The location of these two structures is geologically the best location in the area and provides for the shortest length of structure. The new highway bridge, like the railroad bridge, provides for a series of trusses. The highway truss spans are seven at 528 feet, two at 429 feet and one at 330 feet with steel girder approach spans on each end.

Unlike the railroad bridge, however, the highway bridge will be a high-level deck structure providing 138 feet vertical clearance for river navigation and will not have to be opened for the passage of boats.

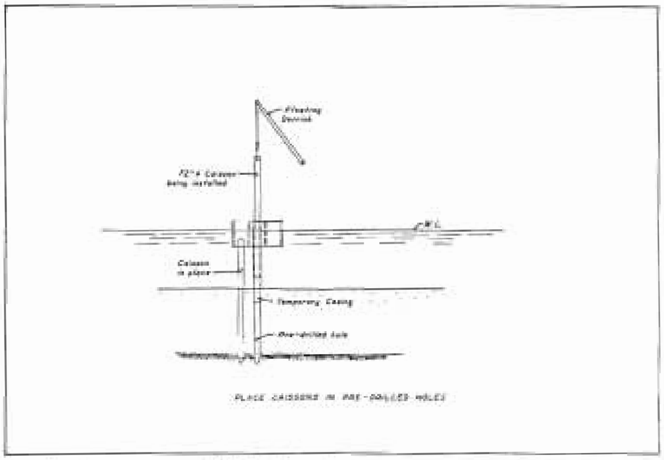
The Yuba Consolidated Industries Inc., through its Judson-Pacific Murphy Division has the contract for both the substructure ($5,769,000) and superstructure ($8,469,465) of this main bridge. Last summer's steel strike has delayed both of these contracts about 3½ months but the work is now going full speed ahead. Contracts are to be let soon for the Contra Costa and Solano County freeway approaches at each end of the structure.

All contracts will be timed for opening the bridge to traffic in the summer of 1962.

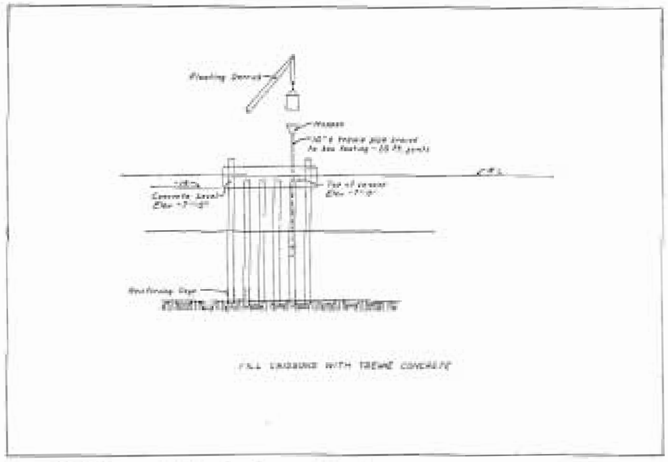
Substructure

Work on the substructure is now progressing rapidly and involves several new and interesting construction features. These features, if proved satisfactory, should have considerable influence on future deepwater pier design and construction for physical situations similar to those encountered at the Martinez-Benicia Bridge.

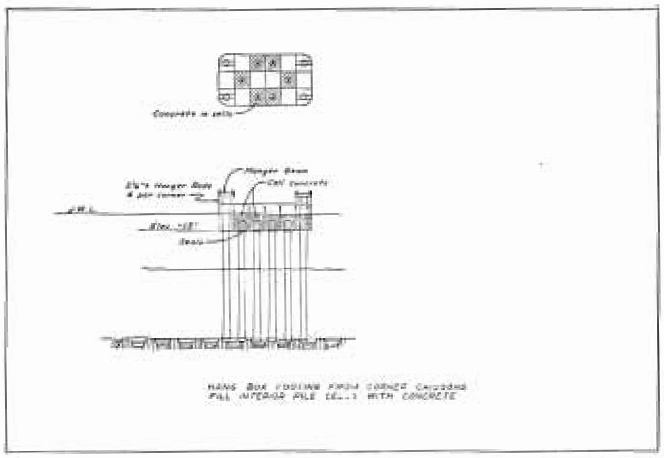
Briefly, the new idea for the foundation design calls for a footing of a type that, if the contractor should elect to do so, the entire footing, which is 86 feet long, 44 feet wide and 25 feet deep, could be built on land and floated into place. The footing as designed is partitioned into 18 cells, making a honeycombed box which can



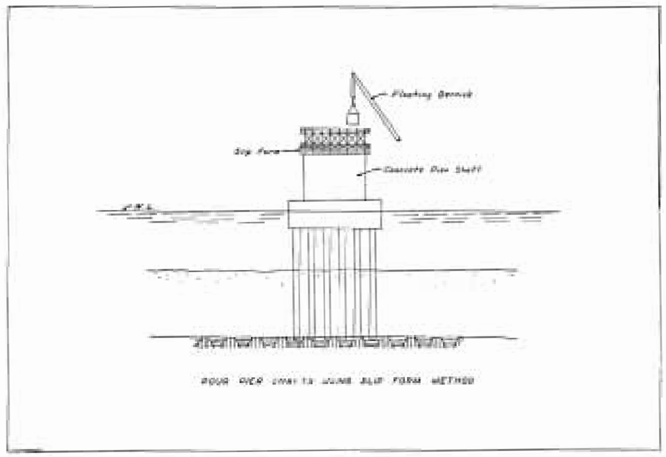
Step 5. The permanent 72-inch steel caisson is placed in the temporary casing down through the predrilled hole and seated on the rock ledge two feet into bedrock. The temporary casing is then removed and made ready for the next drill hole. The permanent steel caisson shell is made from one-inch high-strength steel plates fabricated by welding.



Step 6. Bottom of hole is thoroughly cleaned and inspected by divers to insure that the caisson will rest on and be anchored into good sound rock. A cage of heavy reinforcing steel is then lowered to the bottom of the rock hole and the caisson is then concreted in up to the box footing.



Step 7. The load of the floating box footing is now ready to be transferred to the caissons. This is done by placing heavy steel beams with hanger rods across the four corner caissons at high tide. As the tide goes out the load of the concrete box footing comes to rest on these four caissons. The remaining caissons are then anchored to the box footing. With the load transferred to the caissons the footing and pier are ready for completion.



Step 8 consists of completing the box footing with a 12-inch concrete slab over the top and starting the concrete shaft which will be constructed by the slip form method. Concrete shafts will extend above the footing to a maximum of about 130 feet to form the supports for the steel truss shoes.

be floated. Ten of the cells have 84-inch steel pipes extending from the bottom to well above the water line.

After the footing has been securely anchored in position, 6-foot-diameter steel caissons are lowered through each of the 10 84-inch steel pipe sleeves and sunk to bedrock, which is 120 to 130 feet below mean sea level. This idea is similar to that used by oil companies in the construction of their huge offshore oil drilling platforms.

Sinking the 10 six-foot-diameter steel caissons to bedrock is accomplished in the following manner:

First a temporary casing 80 inches in diameter is lowered into the water and overburden to a point where the mud, sand and gravel overburden is sufficiently stiff to stand on a vertical plane when excavated.

Material Is Pumped

The next step is to lower a 78-inch rotary drill and airlift pump into the temporary casing and drill and pump out the material down to bedrock and two feet into it. At this point the 78-inch drill is removed and replaced by a 62-inch drill which will drill at least five additional feet into bedrock.

If inspection reveals the rock to be sufficiently sound the drill is removed and the 72-inch steel caisson shell is lowered into place at the bottom of the 78-inch hole. The drilled hole five feet below the caisson is then cleaned and inspected by deep sea divers to make sure that the rock footing is of sound material and that the area is clean for receiving concrete. The next step involves placing a reinforcing steel cage in the bottom and concreting the caisson up to the footing block.

The four corner caissons are the first to be placed and concreted in. During this operation, the 86 by 44-foot box footing is still floating. The next step therefore involves transferring the load of the box footing to the four corner caissons. This is done at high tide, and as the tide goes out the footing comes to rest on and is securely anchored to the four corner caissons. When finished the footing

. . . Continued on page 57

Cholame Lateral

Thirty Miles of US 466 Modernized in Six Years

By J. M. STURGEON, Construction Engineer

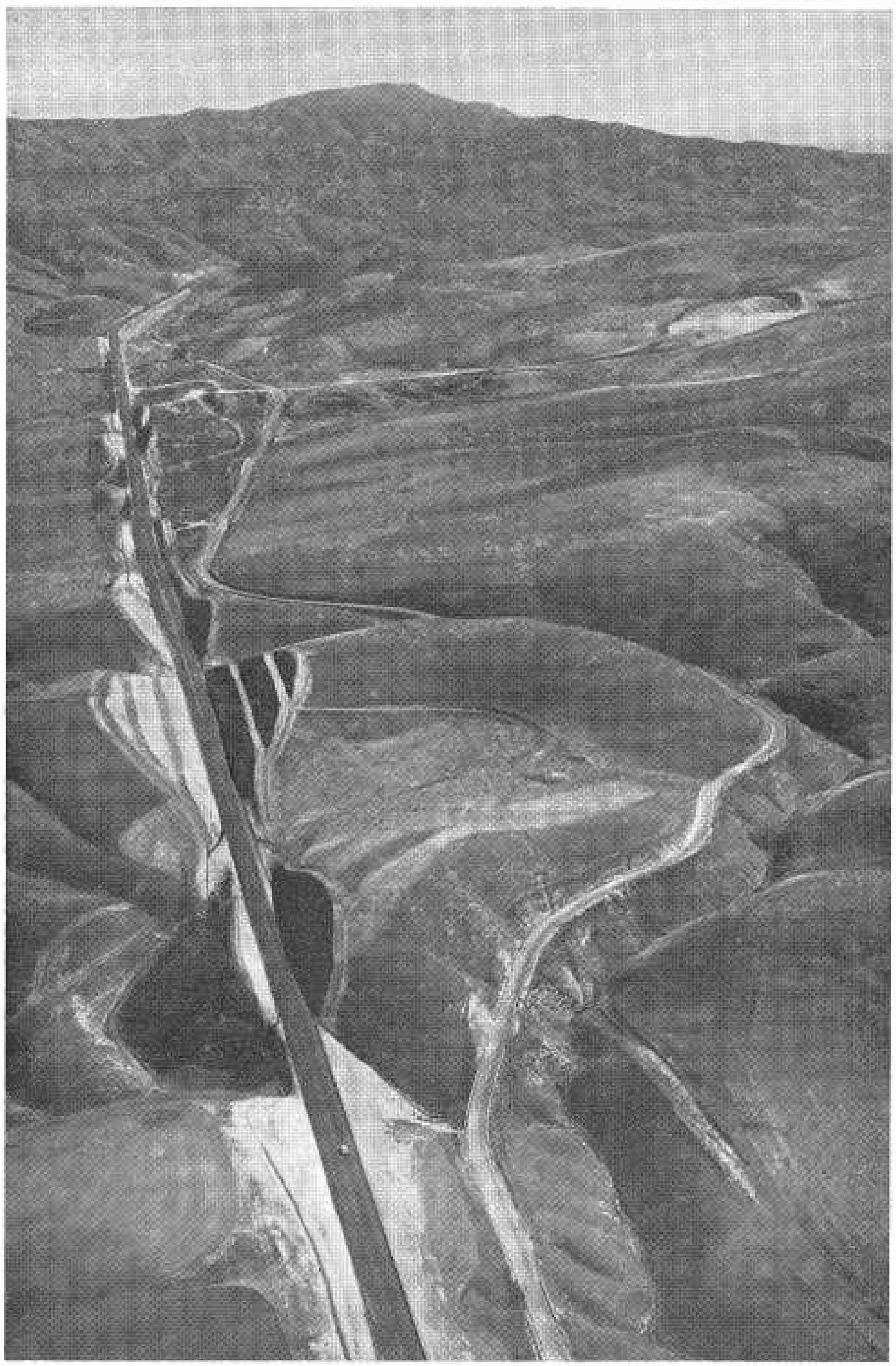
THE SECTION of U.S. Route 466 that runs between the City of Paso Robles in San Luis Obispo County and US 99 near Famoso was planned in the earliest days of California's highway program as an eventual main east-west connection between the southern end of the Great Central Valley and the Central Coastal area of California.

Geography, population development, and the obvious demands of commerce all pointed to the potential of this "Cholame Lateral" for development into a major artery for both commercial and pleasure traffic.

For many years, however, low-standard alignment through the hills of the Diablo Range, coupled with hazardously narrow roadway widths, kept this potential from becoming an actuality. In the late 1940's and early 1950's, traffic surveys indicated that increasing commercial traffic, together with significant increases in the number of private vehicles using the road not only warranted the improvement of the portion of the highway lying within San Luis Obispo County, but made such improvement imperative.

Work Begins

Starting in 1953, the first section of what eventually was to result in complete reconstruction, on almost entirely new alignment, of the better than 30 miles of this Cholame Lateral lying east of Paso Robles within San Luis Obispo County, was placed under contract. This first contract called for the construction of some 7.3 miles of new two-lane highway between Huer Huero Creek, two miles east of Paso Robles and a point about one mile west of the Estrella River. The next year another contract was let to cover construction, again



An aerial showing the improvement of the ascent to Polonio Pass with the previous highway on the right. View is eastward toward the Kern county line.

on new alignment, of almost three miles between the end of the first contract, across the Estrella River, to a point some two miles east of the river. This same year, a 2½-mile length through the small community of Cholame was built to eliminate some particularly dangerous curves. This stretch ran between Palo Prieto Road and the point where State Sign Route 41 (Route 125) turns off to cross the hills to Fresno via Cottonwood Pass. In this two-year period, then, some 12½ miles of new two-lane highway, built to modern standards, were made available to the users of this road.

In 1956, a contract was let to construct a full freeway on US 101 through the City of Paso Robles. This contract also provided for a new connection at Paso Robles between U.S. Routes 101 and 466, and for the construction on new alignment of two miles of 466 to meet the start of the 1953-54 contract at Huer Huero Creek, providing a total of 14½ miles of continuous, modern two-lane highway from Paso Robles eastward.

In mid-1958 the sudden availability of the so-called "antirecession" federal aid funds made it possible to complete the remaining 17 miles, in effect, all at once, by means of three concurrent contracts.

First Contract Awarded

The first of these contracts to be let was awarded to the Madonna Construction Company of San Luis Obispo on August 28, 1958. It provided for the construction on new alignment of some 8.7 miles between two miles east of the Estrella River and a point some two miles northeast of the town of Shandon. Completion of this $1,022,594 contract was scheduled for early November of 1959.

On October 3, 1958, a second contract was awarded to the Madonna Construction Company for some $717,087 worth of construction on some six miles of new alignment between Route 125 east of Cholame and the Kern county line. Completion was scheduled in August 1959.

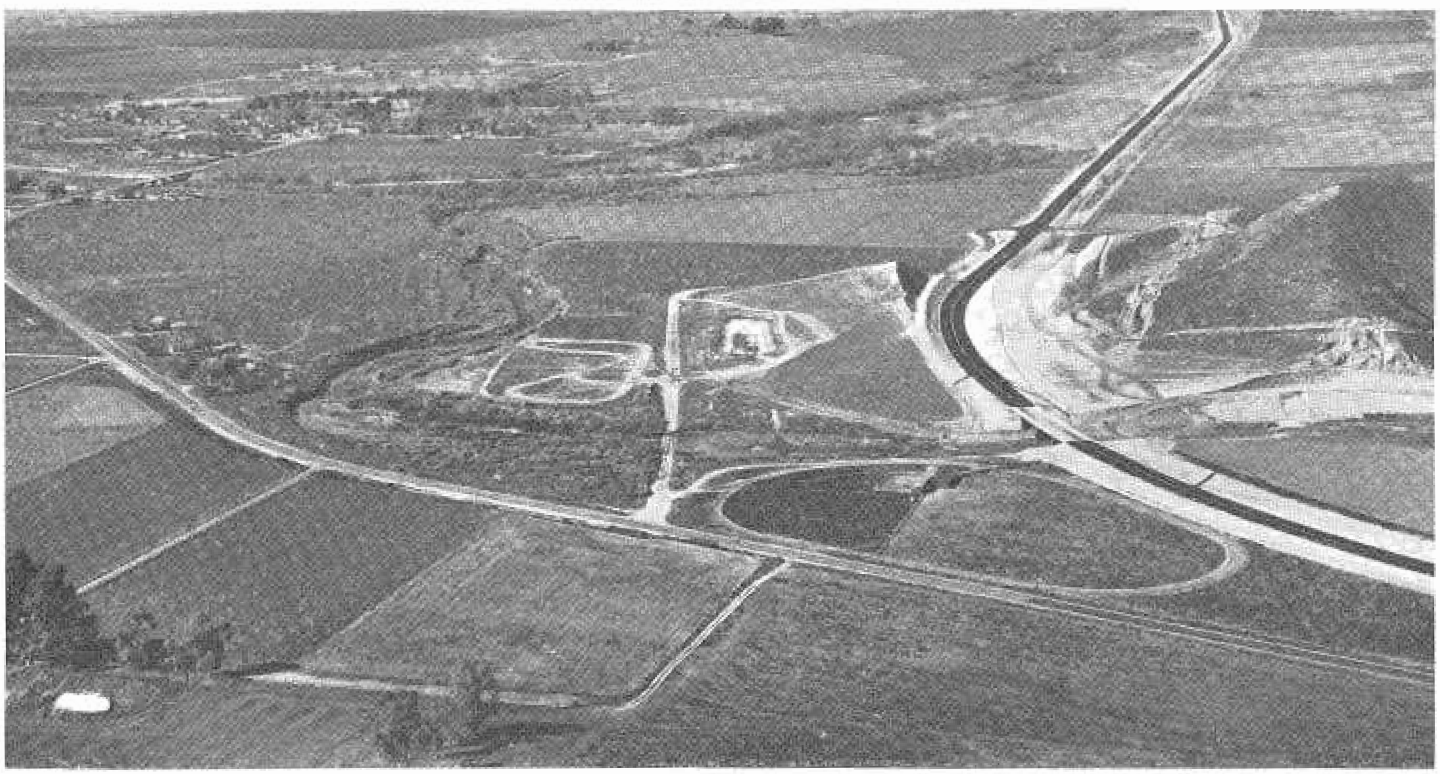
The third contract let, and the first of the three completed, was awarded to the Phoenix Construction Company of Bakersfield on October 8, 1958. This last contract called for reconstruction, mostly on existing alignment, of slightly over 2½ miles between Lucy Brown Road and Palo Prieto Road (the start of the 1953-54 "Through Cholame" project). The contract was for $259,188.

On May 22, 1959, the Director of Public Works accepted this latter project as complete. On October 1, the second contract awarded (between Sign Route 41 and the Kern county line) was accepted, and the final 8.7 miles of the first contract, the "Shandon Bypass," was accepted on November 6, 1959.

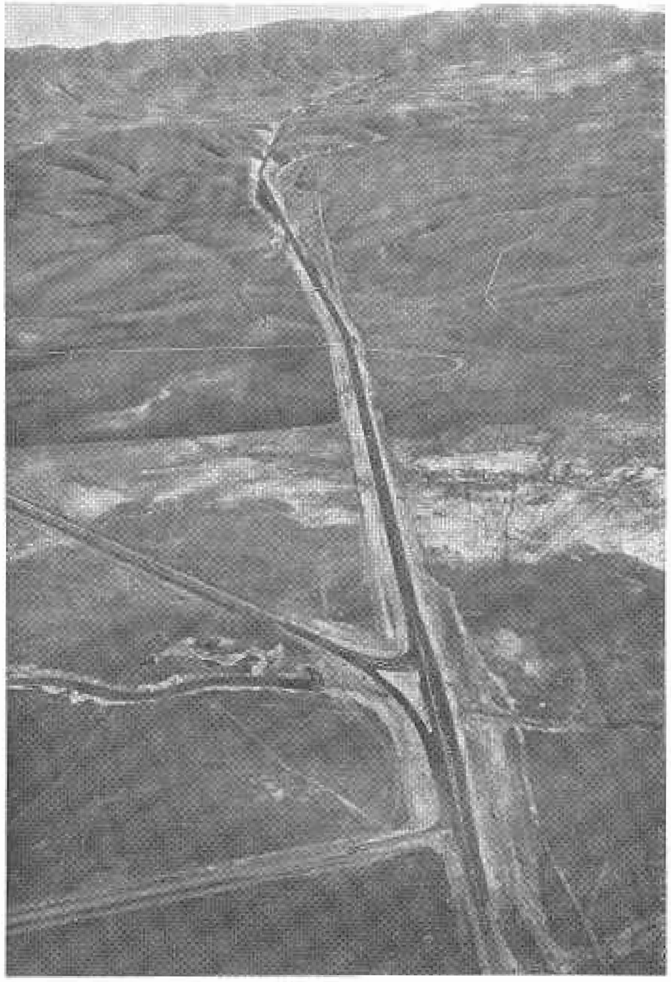
During construction the two contractors on the three projects, together with their suppliers and materials men, excavated approximately 2,034,000 tons of earth (1,453,000 cubic yards), and dug, screened, crushed or otherwise processed some 370,000 tons of graded aggregates for the bases and the asphaltic mixes used. A mining operation involving the production in a little over one year, of almost two and one-half million tons of material from the earth was just one factor of the many concerned in completion of these contracts.

Projects Are Unusual

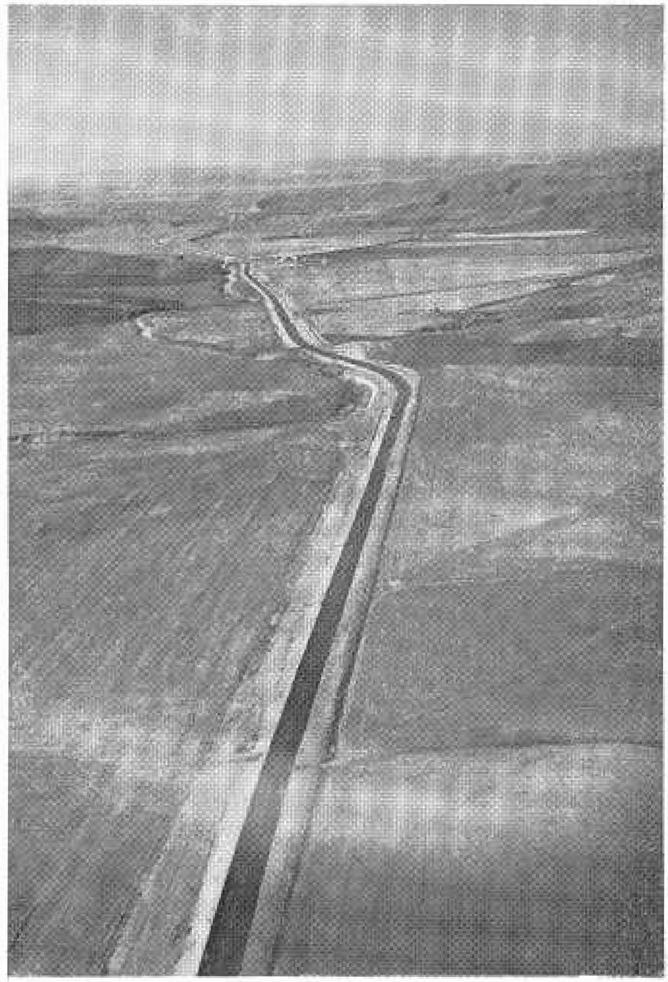
These figures become rather startling when it is emphasized that these



Improved alignment of US 466 showing the former highway passing through the town of Shandon (upper left).



The intersection of Sign Route 41 and US 466 looking east to Polonio Pass and the Temblor Range.



An aerial of the reconstructed highway looking west from Cholame.

contracts were for construction of stretches of two-lane highway, and that none of these contracts could be considered out of the ordinary in size, complexity, length, difficulty or alignment. Further, each of these projects is duplicated many times over in the other districts of the State each year.

As on any construction project, problems were plentiful and troublesome. Grading inspectors learned that deposits of gypsum, in the form of selenite crystals occurring in the area, were accompanied by clay silts and shales that had a nasty tendency toward instability as cut slopes. Substantial additional excavation operations had to be undertaken on both larger projects to handle fairly major slides that developed in such material. Relocation of a rancher's proposed approach road was also necessitated by one of these slides.

The immediate effect of this last tricontract construction surge was to eliminate some 17 miles of twisting, narrow, structurally inadequate pavement, high in accident potential, expensive to both the traveling public in time loss and operational expense, and the Division of Highways, whose constantly strained maintenance budget could not afford the constant drain of the pyramiding maintenance costs on the old road. Polonio Pass, where violent twists and dangerous grades have, for years, acted as deterrents to through commercial traffic, has been tamed to the point of being merely the crest of one of the safest and most economical routes to the coast of Central California.

During the past fiscal year the Division of Highways established 173 speed limit zones on 120 miles of state highway.

Bridge Engineer Wins Traffic Scholarship

Allen M. Rubinstein, assistant bridge engineer at Division of Highways Headquarters, Sacramento, has been awarded an Automotive Safety Foundation Fellowship at Yale University for the academic year 1960-61. The award includes $2,200 to help defray tuition and living expenses while studying at the Yale University Bureau of Highway Traffic in New Haven, Connecticut.

Rubinstein attended schools in New York before entering the U.S. Army Corps of Engineers in 1952. Following his discharge, he enrolled at the University of Southern California from which he received his B.A. in 1957. He began work for the Division of Highways in 1957.

Full Freeway

San Bernardino Freeway Now Continuous for 60 Miles

By W. H. CRAWFORD, District Construction Engineer

ON MARCH 3, 1960, interchanges were completed and opened to public traffic on U.S. Highway 70-99 at Cherry, Citrus, and Cedar Avenues, which marked completion of construction on the San Bernardino Freeway necessary to convert this modern Los Angeles to San Bernardino highway from expressway to full freeway status.

Public traffic using the San Bernardino Freeway can now travel its entire length of 60 miles with no stops for signals or interference with cross traffic. The San Bernardino Freeway extends eastward from the Santa Ana Freeway near the Los Angeles Civic Center via US 70-99 to a junction with the Riverside Freeway east of Colton, and thence north via US 91-395 to its termination at State Sign Route 30 (Highland Avenue) in the northerly part of the City of San Bernardino. The 60.2-mile length of the San Bernardino Freeway is nearly equally divided between Los Angeles County and San Bernardino County. The portion in Los Angeles County (30.6 miles) was completed in 1956.

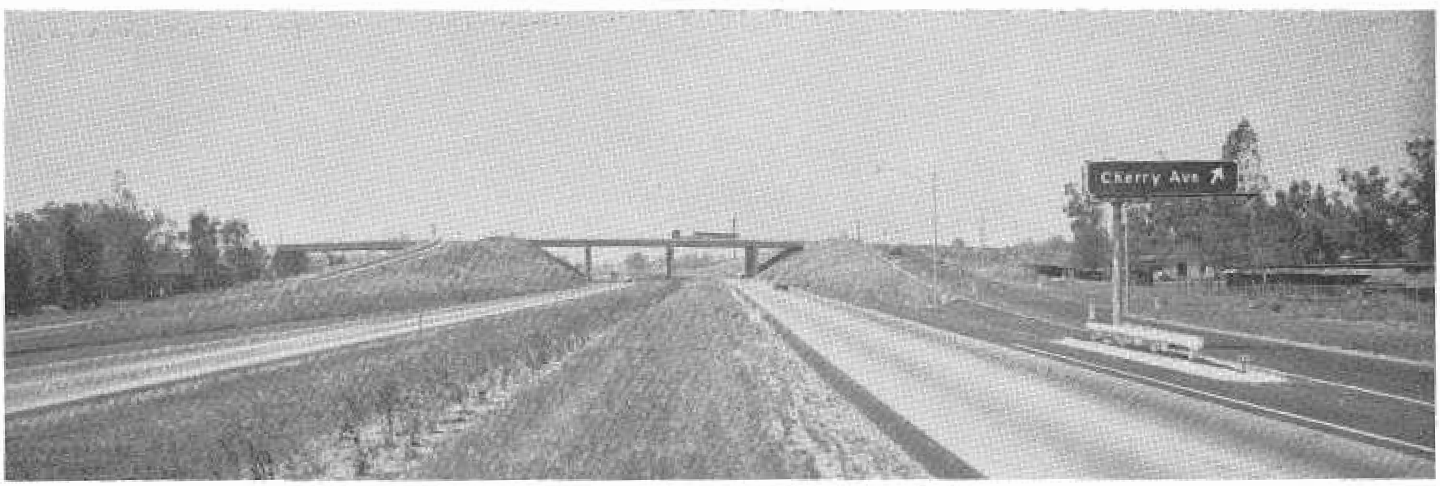
Improvements Necessary

Although construction of this important highway to full freeway standards has been accomplished as rapidly as availability of funds would permit, the demands of traffic have already made numerous improvements necessary. Many improvements have been made to the original freeway construction in Los Angeles County since the completion of that portion in 1956. At the present time, widening from four lanes to six lanes between the Los Angeles county line and 5.7 miles westerly is under contract to Matich Constructors and W. F. Maxwell Co. Other projects nearer Los Angeles, providing for widening from six lanes to eight lanes, will be under construction this summer. In District VIII, plans for widening from four lanes to six lanes between Los Angeles county line and Vineyard Avenue, a distance of 6.8 miles, are now being prepared. Also, a diamond interchange and an overhead over the Southern Pacific Railroad at Pepper Avenue, one mile west of Colton, are being prepared for construction this year in co-operation with San Bernardino County.

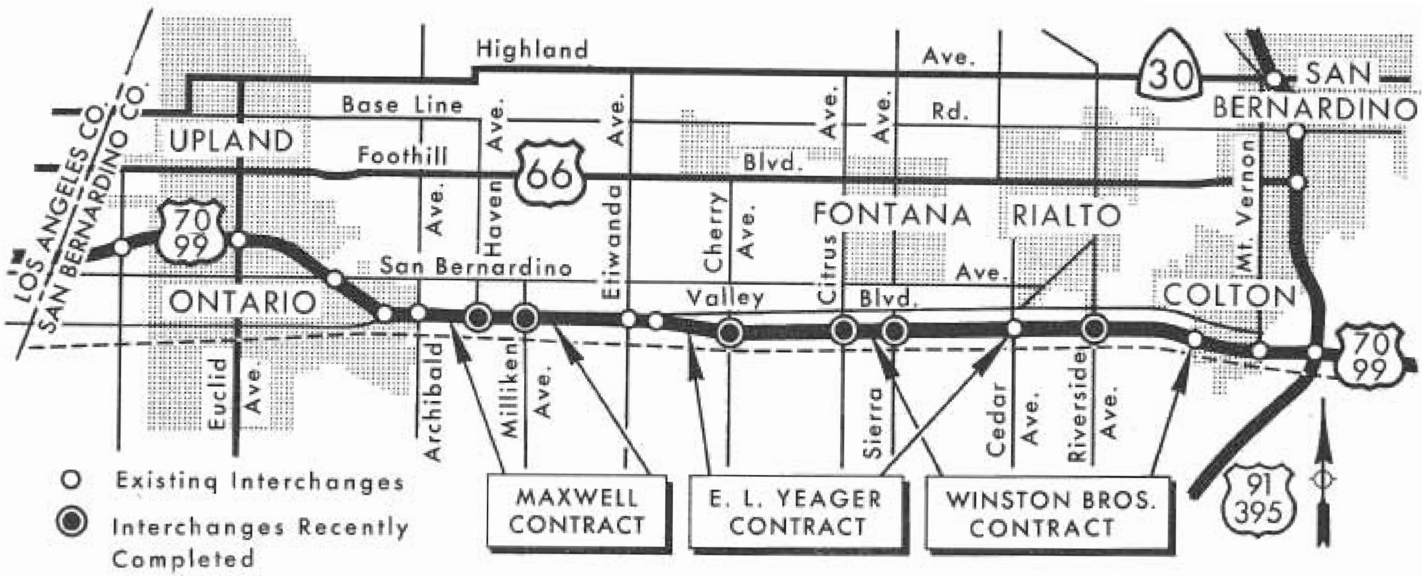
The previously mentioned construction at Cherry, Citrus, and Cedar Avenues, which made it possible for this highway to be operated as a full freeway for its entire length, was a part of a carefully planned program providing near simultaneous construction of interchanges at three locations on US 70-99. These locations, each covered by a separate contract, were at Haven and Milliken Avenues; at Cherry, Citrus, and Cedar Avenues; and at Sierra and Riverside Avenues.

Maxwell Contract

The final stage of converting this expressway to full freeway was started on October 30, 1958, when a contract was awarded to W. F. Maxwell Company of Fontana. This project at Haven Avenue and at Milliken Avenue, 2.05 miles in length, consisted of overcrossings and interchange ramps. Each bridge had precast, prestressed concrete girder spans, with composite reinforced concrete deck, supported on reinforced concrete bents and abutments. The use of precast girders rather than the conventional type of reinforced concrete girders requiring



Cherry Avenue overcrossing is in the center of the picture; Cherry Avenue railroad overhead is to the left of it. These structures and approaches replace the former grade crossing at this location.



falsework for their construction, provided safer passage of public traffic through construction.

Girder erection was permitted only between the hours of midnight and 5 a.m. During these hours, traffic was blocked for periods of time not exceeding 30 minutes for the purpose of erecting girders. Sufficient time was allowed between such periods to allow accumulated traffic to clear.

The work of precasting and prestressing the girders was performed by the contractor on the job. Girders were transported to the bridge site as needed. Two truck cranes, one operating at each end of the girder, were used to transport the girders and erect them to position on the abutments and bents. The contractor was well skilled in this operation and succeeded in erecting the girders in the average time of approximately 20 minutes each. Sixty-four girders in all, ranging from 33′9½″ to 83′1″ in length, were erected. The best production was the erection of 16 girders in a four-hour period.

Traffic Inconvenience Slight

The short erection time proved to be but slight inconvenience to public traffic, which was light during the after-midnight hours when erection of girders took place.

Other work on the project, including ramp construction, highway lighting, and drainage revision, was performed without interruption to public traffic. The importing of 339,000 tons of borrow material, which was used in the construction of bridge approaches, might have caused inconvenience to traffic had it been necessary to haul this material on or across the freeway. By obtaining material sites on each side of the freeway, and by the use of a well-planned hauling scheme, the contractor was able to place the material in its final position in the roadway embankment without necessity of hauling on the freeway.

The imported borrow used was obtained from three material sites located near the project. All of the sites were graded to predetermined elevations and are an improvement to the area. One site when completed was contour-graded to conform to surrounding terrain, another developed an industrial site, and the third opened up a flood control channel.

The project was completed August 28, 1959, at a cost of $639,940. H. F. Strahm was the resident engineer.

Winston Bros. Contract

The next project to be completed was a contract awarded to Winston Brothers Company on December 3, 1958.

This project, 4.43 miles in length, between Sierra Avenue and the City of Colton, consisted of freeway overcrossings and railroad overheads at Sierra Avenue and Riverside Avenue, and interchange facilities.

There being insufficient distance between the existing traveled way and the railroad to construct complete interchange facilities at Sierra Avenue and Riverside Avenue, it was necessary to realign and reconstruct the existing expressway to provide space for ramps between the freeway and railroad. Pavement and other facilities were constructed on new curved alignment with a minimum radius of 5,000 feet for over 3,300 feet at each interchange location. To better control the access to the freeway, existing barbed-wire fence along the right-of-way was replaced with 72″ chain-link fence throughout the project.

Fifty-two precast, prestressed concrete girders, each 68′2″ in length, were used in the construction of the overcrossings, and 30 precast, prestressed concrete girders, 81′0″ in length, were used in the overhead structures. All of the precast, prestressed concrete girders were fabricated by the Concrete Conduit Company of Colton, and were transported to the job by trucks. Erection of the girders at the bridge site was accomplished by simultaneous effort of two truck cranes, one operating at each end of the girder. Handling of the 81-foot-long girders above the Southern Pacific Railroad tracks at the overhead structures was a well-coordinated operation, completed without incident or interference with train movements.

Daylight Work

Differing from the method used on the previous project, the girders for the Sierra Avenue and the Riverside

Avenue overcrossings were erected during daylight hours. Conditions being favorable and there being adequate space, temporary detours were constructed around the bridges for handling of traffic. Use of the temporary detours applied only between the hours of 9 a.m. and 3 p.m. on the day girders were erected. That time was selected for operation of the detour as the traffic volume for those hours was less than during any other six-hour period during daylight hours.

Except for the material used in the construction of the south bridge approach to the Riverside Avenue overhead, where a haul road outside the traveled way was possible, all imported borrow was hauled by truck over county roads and along the freeway to its point of use. Other than the slight nuisance of heavily loaded trucks traveling on the freeway, there was no interference with public traffic by reason of construction on this project.

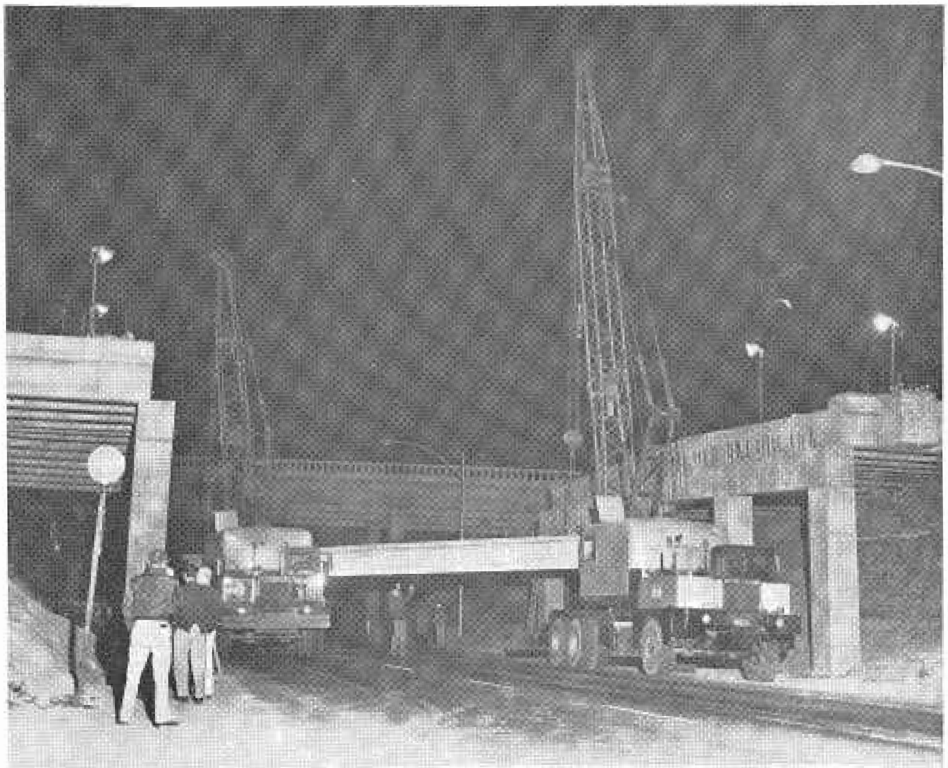
This project was completed on October 22, 1959, at a cost of $1,610,973. Arthur W. Nelson was the resident engineer.

Yeager Contract

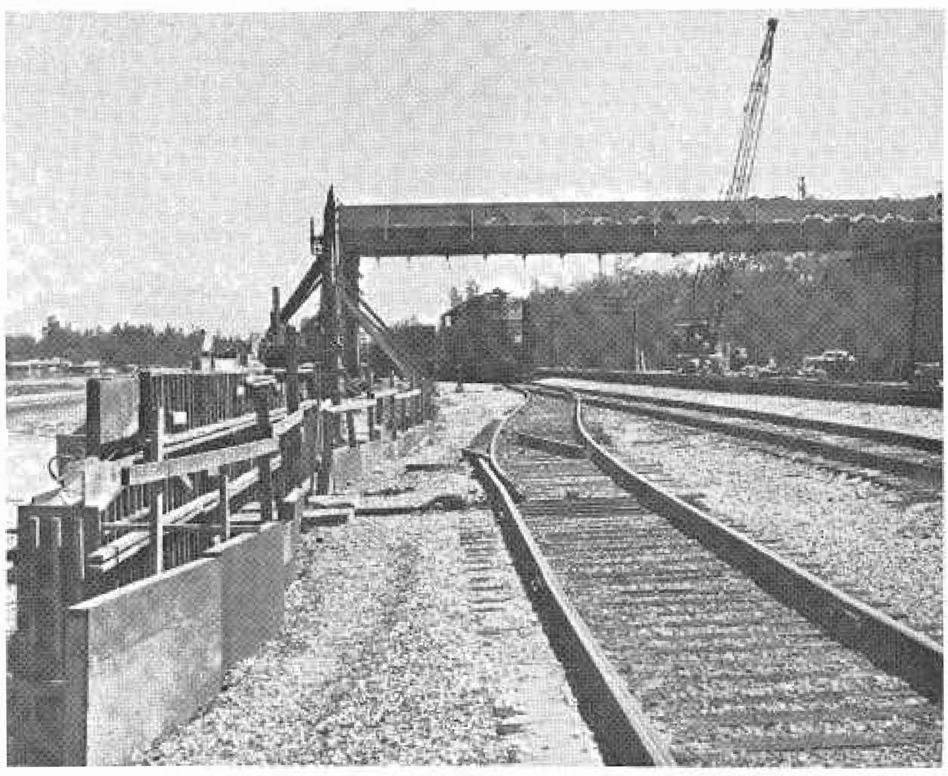
The last of the three projects completed on the San Bernardino Freeway was that awarded to E. L. Yeager Company on December 3, 1958, and completed March 3, 1960.

This project, 5.51 miles in length, between Mulberry Avenue and Cedar Avenue, converted the remaining section from expressway to full freeway status. Diamond-type interchanges were constructed at Cherry Avenue and at Citrus Avenue, overhead crossings of the Southern Pacific Railroad at these streets were constructed, an offramp at Cedar Avenue was reconstructed to higher standard, drainage structures were revised, and better control of access was obtained by replacing existing property fence with 72-inch chain-link fence.

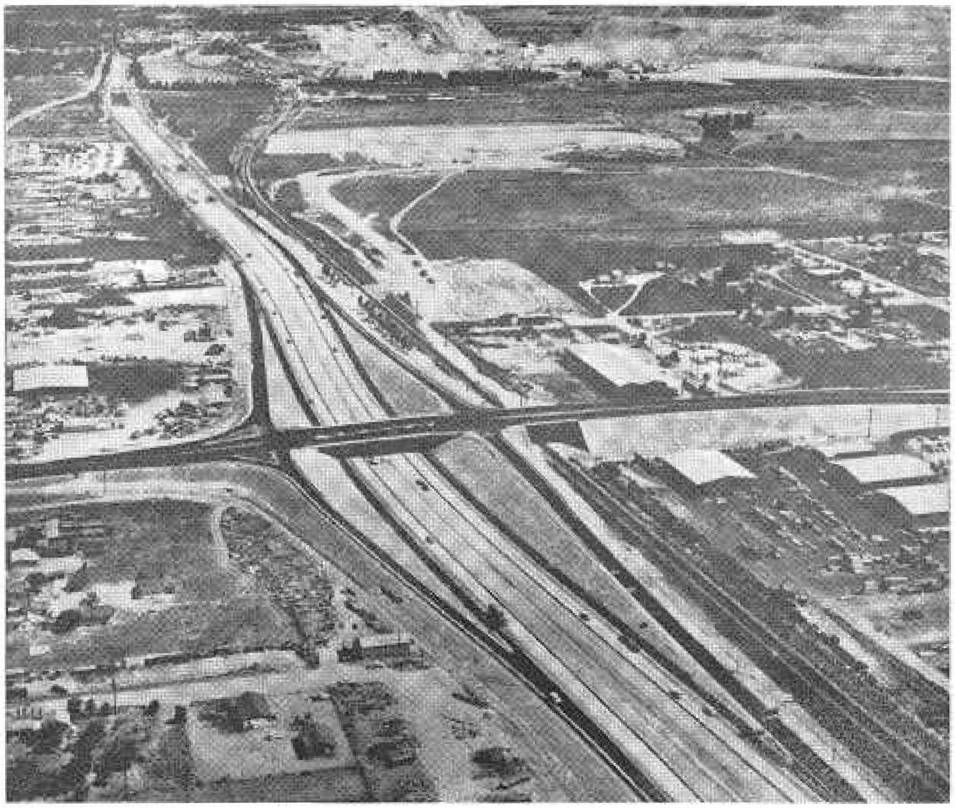
To obtain space for interchange construction at Cherry Avenue and Citrus Avenue, it was necessary to realign the existing expressway outward from the Southern Pacific Railroad, which is parallel and adjacent to the south right-of-way line of the



MIDNIGHT CONSTRUCTION—Under the glare of auxiliary spotlights, workmen manned heavy equipment to lift precast prestressed concrete girders into position at the three-level interchange of San Bernardino Freeway at intersection of US 70-99, with US 91-395. Work on this sector was performed at midnight December 17, 1958, as traffic on the freeway was halted for short periods. (Photo by San Bernardino Sun-Telegram.)



Citrus Avenue Overhead during construction after erection of precast prestressed concrete girders, showing near absence of falsework and minimum of interference to train movements. (Photo by San Bernardino Sun-Telegram.)



Recently completed Riverside Avenue interchange and freeway on US 70-99. Looking east.

highway. Thirty-five hundred feet of existing pavement at Cherry Avenue and at Citrus Avenue were realigned in the same manner as at Riverside and Sierra Avenues.

Forty-four precast, prestressed concrete girders, 68 feet 2 inches long, were used in the construction of the overcrossings, and 16 precast, prestressed concrete girders 111 feet long, and 12 precast, prestressed concrete girders 81 feet long were used in construction of the overhead structures. The girders were fabricated by the Colton Conduit Company at their Azusa plant, and were transported to the job by truck. Erection was performed by use of truck cranes. Detours were available to route traffic around the overcrossing structures between the hours of 9 a.m. and 3 p.m. on the days girders were erected. At other times, traffic was afforded clear and unobstructed passage through construction.

No Borrow Hauling

Construction of embankments for ramps and bridge approaches required importing 793,000 tons of fill material. No hauling of imported borrow across the freeway was necessary as sources of material were available on each side of the freeway. This method of construction, whereby imported borrow was brought in from each side of the freeway for bridge approach and ramp construction, resulted in virtually no interference to through traffic on the freeway.

This project was completed at a cost of $1,665,071. The resident engineer was Calvin Mauck.

The completion of these three projects within a period of 16 months removed the last vestiges of the expressway type of highway from a 16½-mile section of the San Bernardino Freeway and removed the hazardous traffic conditions that existed at the six at-grade intersections of the expressway and the four grade crossings at the SPRR.

The new construction also brought about complete control of access to the freeway and provided up-to-date signing conforming to latest standards for Federal Interstate Route 10.

Bridge Toll Machines Removed After 1 Year

The two automatic toll collection machines which have been in operation experimentally on the San Francisco-Oakland Bay Bridge for the past year were removed in May.

State Highway Engineer J. C. Womack said the machines did not prove substantially advantageous as far as expediting the heavy traffic on the bridge was concerned.

"We can see from our year-long trial period where automatic toll collection equipment has probably been helpful on certain toll roads," he observed. "But on the Bay Bridge, where a substantial portion of the traffic uses commute tickets, we appear to be better off in the long run with manual collection."

The machines were installed in one eastbound lane and one westbound lane at the Bay Bridge toll plaza, with the thought that if they proved advantageous they might be installed in additional lanes. The experimental installations were marked with signs restricting their use to motorists with the exact 25-cent change.

Under heavy flows of traffic, particularly at commuter peak hours, Womack said, there were indications that multiple automatic toll collection lanes would not work uniformly well and might actually cause congestion and accident hazard. He noted that the Triborough Bridge Authority in New York had discontinued the use of automatic toll collection equipment on the Bronx-Whitestone Bridge after a similar trial.

"We are proud of the reputation of our toll collectors and other bridge employees for efficiency, courtesy, and service to the motoring public," Womack said. "However, we will continue to look into all possible methods of increasing the economy bridge operation and of expediting traffic."

California freeways, rural and urban combined, had a fatality rate of 2.83 per 100 million vehicle miles for 1958 as compared with the 1957 rate of 3.62.

Slipform Paving—L.A.

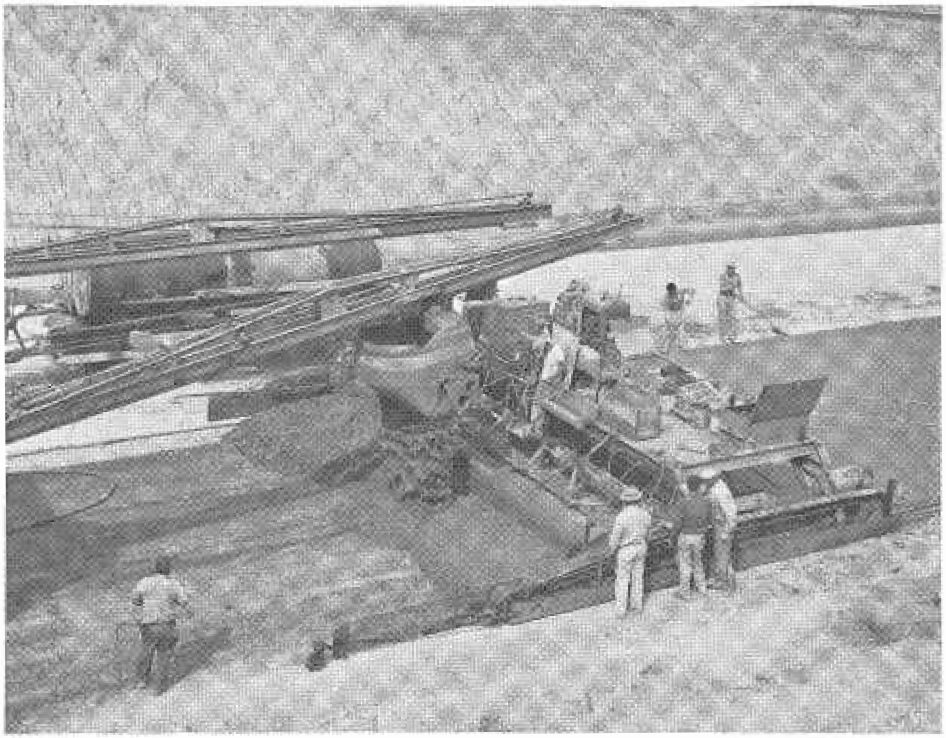
New Technique Used On Harbor Freeway

By R. M. INNIS, Senior Resident Engineer

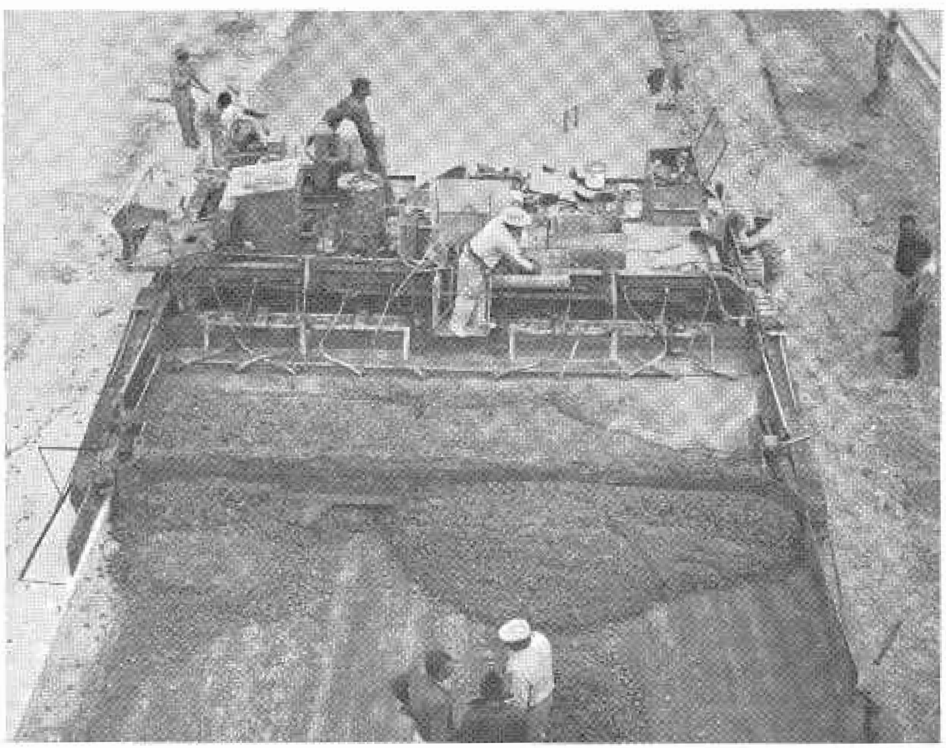
THE FIRST slipform paving on a major freeway in metropolitan Los Angeles was recently completed by Ukropina, Polich, & Kral and J. E. Haddock Ltd. on the Harbor Freeway between 124th Street and 190th Street. Besides introducing this type of slipform paver, this is the first time that keyways, tiebars, and adjacent lane paving have been performed by the slipform method in California.

The slipform paver utilized was manufactured by a well-known midwestern equipment manufacturing firm, and has been in use for several years on highway construction outside of California. This type of slipform paver differs primarily from that used in the northern part of the State (reported on in the January-February issue of this magazine) in that the vertical alignment or grade is not dependent upon a wire and electronic sensing devices. This machine depends instead upon the smoothness of the subgrade and the straightedge characteristics of the 22-foot tracks to obtain the required smoothness. The screed or extrusion meter, as it is termed, is rigidly set for depth of pavement required. Therefore it is readily evidenced that

Slip form paver being fed by two dual-drum concrete paving mixers. Man standing on platform in front of machine is placing center tiebars.



Concrete being placed in front of slip form paver in position for initial strike-off by hydraulically operated screed. Screed is in its rearmost position.



The screed is now at its forward limit of travel. The position of the 10 internal vibrators will be noted behind the screed.

a good subgrade is of prime importance.

Cement-treated Subgrade

The typical section for this portion of the Harbor Freeway provides two 48-foot concrete roadways. The outer 24 feet of each roadway is 9-inch pavement and the inner lanes 8 inches. Underlying the concrete pavement is 4 inches of cement-treated subgrade. The untreated base for the cement-treated subgrade is of ¾ inch maximum aggregate.

Construction Staking

Grade stakes to top of the cement-treated subgrade were offset three feet from the edge of pavement and set at 25-foot intervals along line for both sides of the 24-foot lane. One line stake and marker lathe indicating the percent of crossfall were also set every 25 feet. For the initial 24-foot lane on the roadway the contractor cement-treated 27 feet wide. This not only provided a stable track path for the slipform paver but also cleared the tiebars necessary for the adjacent lane. The tiebars used were 30-inch lengths of ½-inch round reinforcing steel.

The contractor, J. E. Haddock, used three sets of working hubs before the cement-treated subgrade was complete. The first set was placed to balance the material, the second set was placed four inches down to check the bottom of the cement-treated subgrade after initial windrowing, and the final hubs were set to the top of the cement-treated subgrade for final grade after mixing.

Production Averages

Utilizing one traveling pugmill road-mixer, one standard motor grader, and one motor grader equipped with automatic blade control, the contractor averaged 3,500 lineal feet or 94,500 square feet of cement-treated subgrade per day. Compaction was obtained by the usual steel and pneumatic wheeled rollers. With the crossfall percentage noted on the marker lathe, the blade operator using the automatic blade control could easily negotiate the transitions and superelevations.

Close Tolerances

The completed cement-treated subgrade was then profilographed each day using the California Profilograph.

The average reading for the job is 6.5 inches per mile. The smoothest cement-treated subgrade profilographed at 3.1 inches per mile. As can be noted, the subgrade average is under seven inches per mile specified for the concrete pavement surface.

Description of Paver

The paver, weighing approximately 38,000 pounds, travels on two tracks each 22 feet in length. Each track is powered by a three-h.p. D.C. variable-drive motor. This enables the operator to regulate the speed of each crawler track to maintain alignment. Steering is guided by a plumb bob over a string line. The paver's primary power source is a 32-h.p. four-cylinder air-cooled engine driving a hydraulic pump and a 10-k.w. generator.

Now to follow the concrete through the machine. The concrete is placed on the grade between the front wings or sideplates of the slipform paver by two standard dual-drum paving mixers. The concrete is initially struck off by a 24-foot hydraulically operated screed having five feet of fore and aft travel. This is operated by the slipform paver operator and is used to balance the concrete evenly across the front of the machine. Also, this screed has vertical manual adjustments which are used in superelevations.

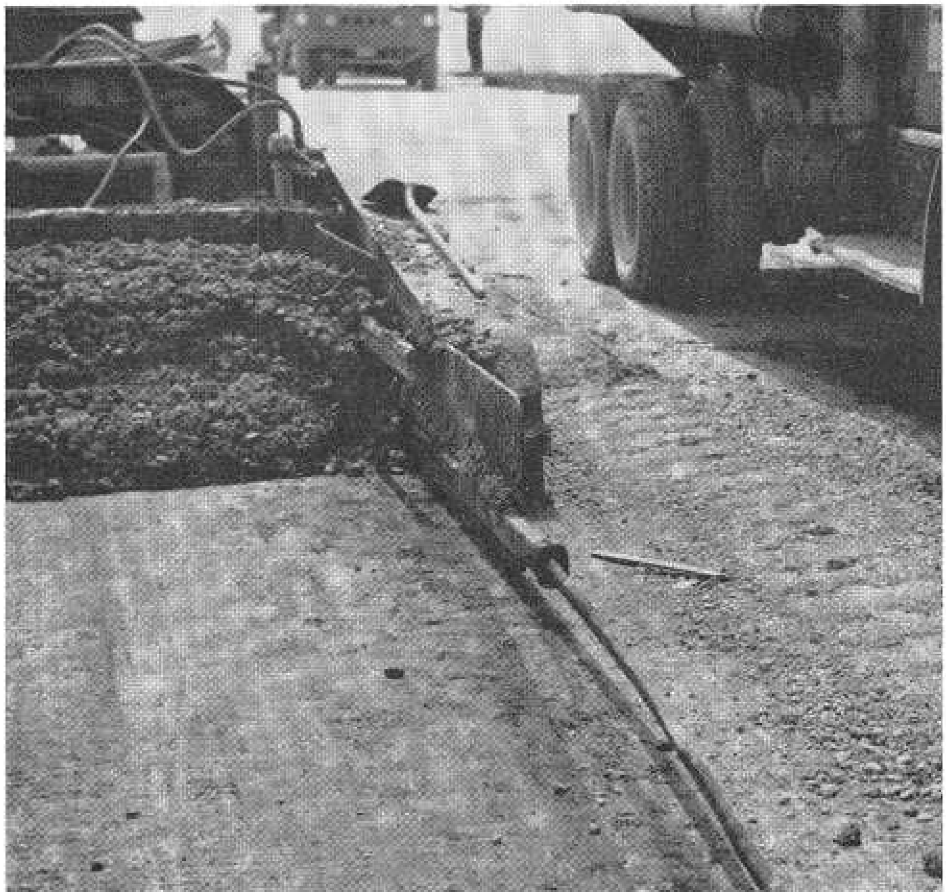
Internal Vibration

Behind the strikeoff, and in front of the extrusion meter, the concrete is vibrated by a series of 10 variable-frequency internal spud-type vibrators. These operate submerged approximately 2½ inches above the subgrade and are powered by a separate 180-cycle A.C. motor generator. No difficulty was encountered in obtaining concrete of specified density.

Behind the vibrators and immediately in front of the extrusion meter is a tamper bar. The tamper bar works to a lower limit of approximately one-fourth inch below the leading edge of the extrusion plate and insures that large aggregate particles are tucked under the screed plate without leaving tears in the completed surface.

Controlled Edge Slump

The extrusion meter is a 42-inch-long by 24-foot-wide steel screed plate. The front edge is rounded and set approximately one-half inch higher than the trailing edge which is set to grade. The exact amount of pitch, which is adjustable, is dependent upon the mix design, water content, etc. The outer six inches, measured transversely, of this plate are adjustable and were turned up from three-eights to one-half inch. This compensates for mortar loss and resulting edge drop in the trailing forms. By adjusting the edges of the extrusion plate, mortar loss and edge drop can be compensated for and a true section obtained. Behind the extrusion meter the surface is given a belt finish by a 24-inch oscillating rubber belt.



Closeup showing method used to insert keyway section in front of slip form paver. This is done only on initial lanes.

Trailing Forms

The contractor started using two 16-foot sections of trailing forms at each edge of pavement; however, after the operation smoothed out, only one 16-foot set of trailing forms on each side was found to be necessary. The need for trailing forms is only that of having time for edging and such handwork as is necessary. The machine, extrusion meter, and trailing forms are all set 24 feet wide with no appreciable narrowing of the section at any point.

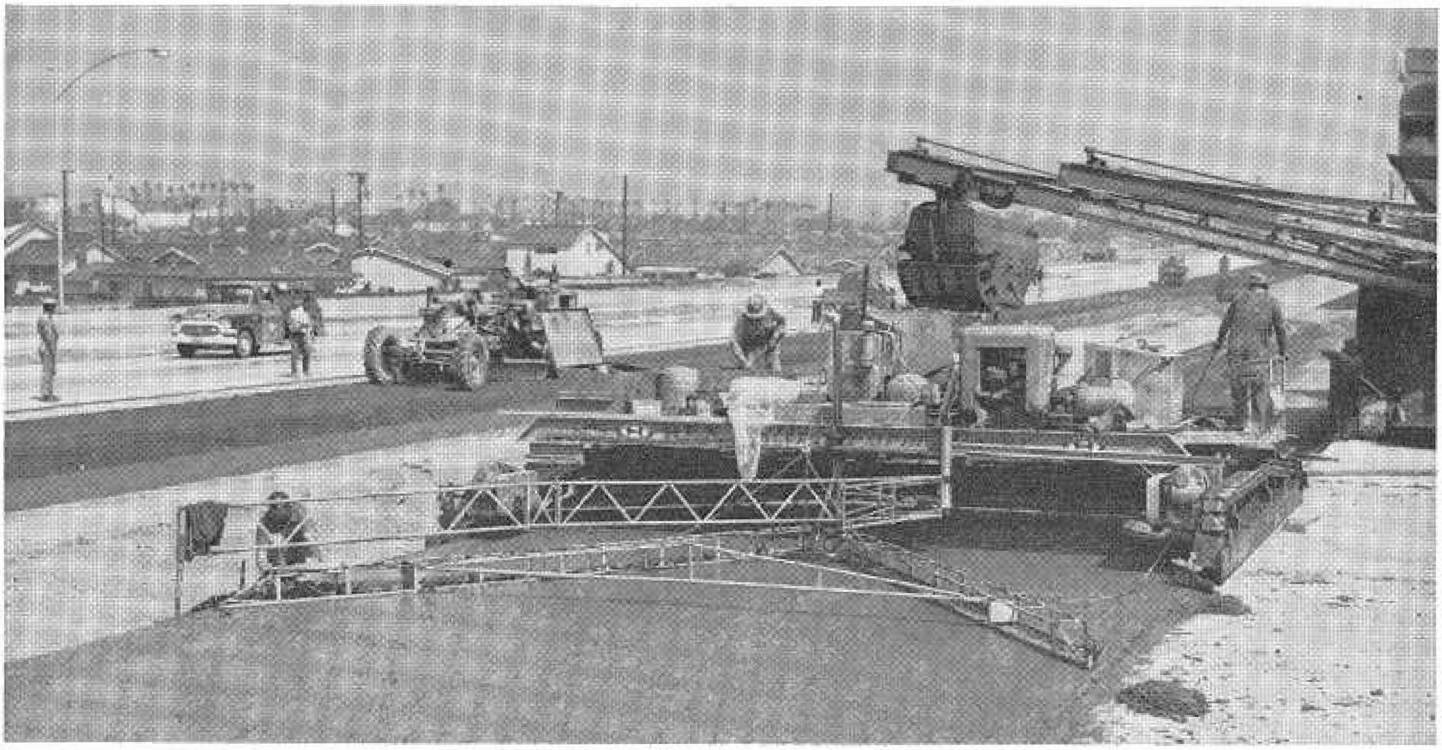
Along the latter portions of the job the contractor attached a chevron float behind the machine which operated between the trailing forms. This improved the smoothness and reduced the labor of the hand finishers.

Companion Lane

The companion or adjacent lane paving posed no great difficulties. The paver was blocked up and one crawler track rode the existing slab. One 16-foot trailing form was used and was diagonally supported to the back frame of the slipform paver by a spring-loaded truss.

Tiebars No Problem

As mentioned in the initial part of this article, keyways and tiebars were placed. The keyway sections, 20 feet long and drilled at 30-inch centers,



Rear view of slip form paver showing chevron float in operation.

were wired together on the grade and inserted into keeper plates or rods fastened to the side of the paver. The slipform machine then traveled forward with the keyways passing on through. A four-foot length of slotted trail form was attached to the end of the trailing form on the machine. As the keyway passed through, the straight tiebars were manually inserted in the holes of the keyway. The center tiebars were placed manually in the concrete by a workman and a platform mounted on the front of the slipform paver.

Edger tools attached to the end of the trailing forms performed the initial edging. A finisher on each side of the machine hand-floated the edge just prior to the edger tool. With some additional modification on the chevron float and trailing forms it is hoped to eliminate the hand floating at this point.

Edging Fresh Concrete

Behind the machine, finishers checked the slab longitudinally with 14-foot lightweight floats or straightedges. Any large irregularities were taken out by finishers using a large bull float from portable bridges across the slab. This work during the latter portions of the job was at a minimum. The usual final edging and burlaping was then performed. Curing compound was mechanically applied by a machine straddling the slab and all joints were sawed.

The production with two mixers has been as high as 2,000 cubic yards per day and the profilograph on the pavement surface has averaged below six inches per mile with the lowest at 2.8 inches per mile.

Water Content Important

Many factors besides good subgrade govern the smoothness; for example: constant water content, steady progress of the machine, and proper placement of the concrete in front of the slipform.

Contractor's representatives were H. Rollston, superintendent, Roy Bennett, foreman, and head finisher Lee Martin.

State-owned Toll Bridges Show Traffic Gain

Traffic on all five San Francisco Bay area state-owned toll bridges showed substantial increases in April 1960 as compared with April 1959.

The greatest percentage increase was on the Dumbarton Bridge which was up 21.29 percent. The San Mateo-Hayward Bridge was second with an increase of 19.04 percent over this time last year. The Carquinez Bridge was up 14.25 percent and the Richmond-San Rafael Bridge showed a gain of 13.54 percent. San Francisco-Oakland Bay Bridge, the most heavily traveled of the structures, had a traffic increase of 3.07 percent.

Total vehicular traffiic on the bridges for April of 1959 and 1960 was as follows:

Dumbarton Bridge—April 1959, 150,196; April 1960, 182,181.

San Mateo-Hayward Bridge—April 1959, 276,435; April 1960, 329,063.

Carquinez Bridge—April 1959, 883,-450; April 1960, 1,009,347.

Richmond-San Rafael Bridge—April 1959, 235,618; April 1960, 267,516.

San Francisco-Oakland Bay Bridge —April 1959, 3,077,229; April 1960, 3,171,783.

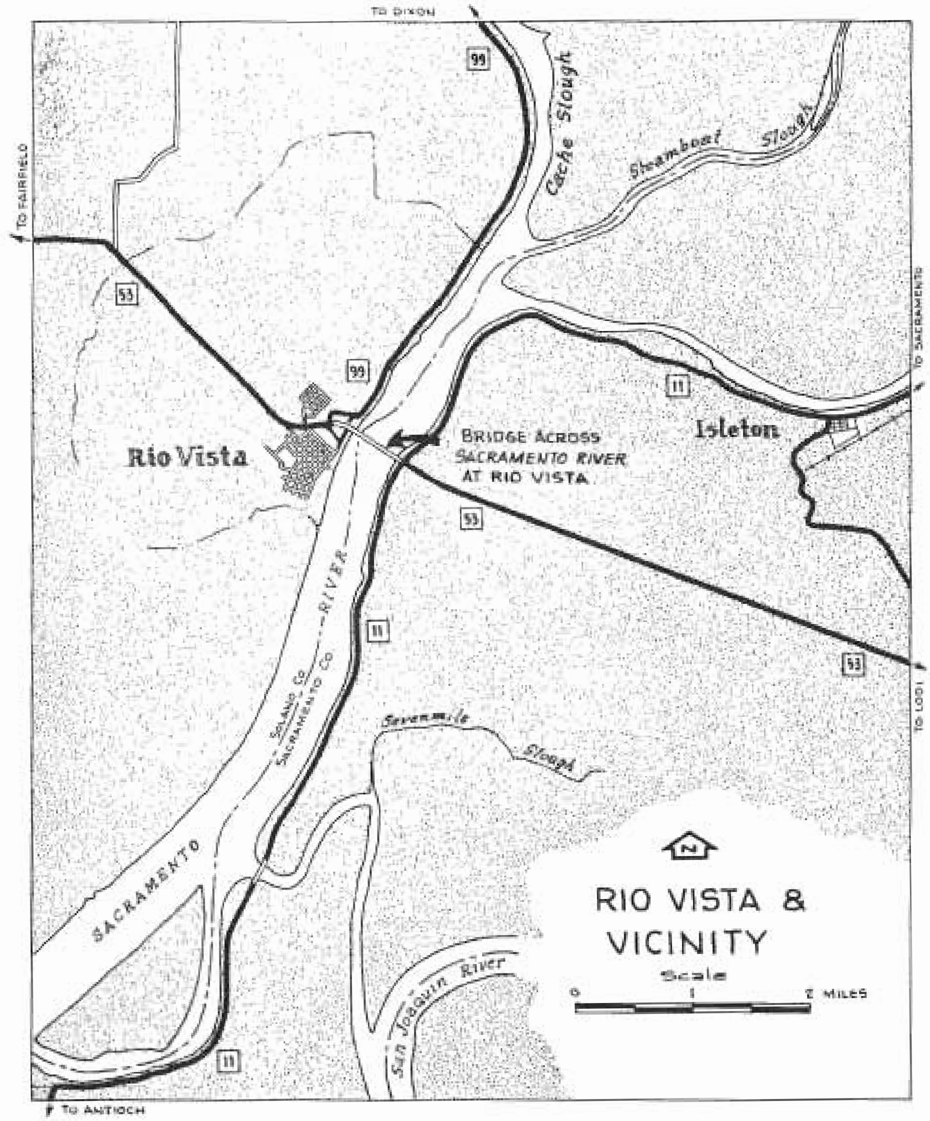
Rio Vista Bridge

Modern Lift Structure Spans Lower Sacramento

LONG AWAITED by residents of Rio Vista and nearby towns, is the completion of the new bridge structure across the Sacramento River at Rio Vista.

In opening ceremonies sponsored by the Rio Vista Chamber of Commerce featuring speeches by Lieutenant Governor Glenn M. Anderson, Senator Luther E. Gibson of Solano County, and T. F. Bagshaw, Assistant Director of Public Works, the bridge was opened to traffic on April 1, 1960.

> **This description of the Rio Vista Bridge project was prepared by G. W. Smith and G. D. Gilbert, Senior Bridge Engineers, E. F. Van Zee, Associate Bridge Engineer who was also resident on the job, and S. J. Robinson and R. T. Fuller, Associate Bridge Electrical and Mechanical Engineers.**



It is a highly important link in the realigned portion of the State Sign Route 12 which extends from Rio Vista to the Mokelumne River some three miles east. Route 12 is the most direct route from the delta region to the San Francisco Bay area. During the harvest season a large amount of produce is trucked over this route from the adjacent farming country.

Peak river traffic occurs during the summer months. As many as 780 bridge openings have occurred during the month of September, which is an average of 26 per day.

Upon completion of the Sacramento Deep Water Channel Project, ocean-going vessels will be passing through this structure plying their trade between world ports and the Sacramento Valley.

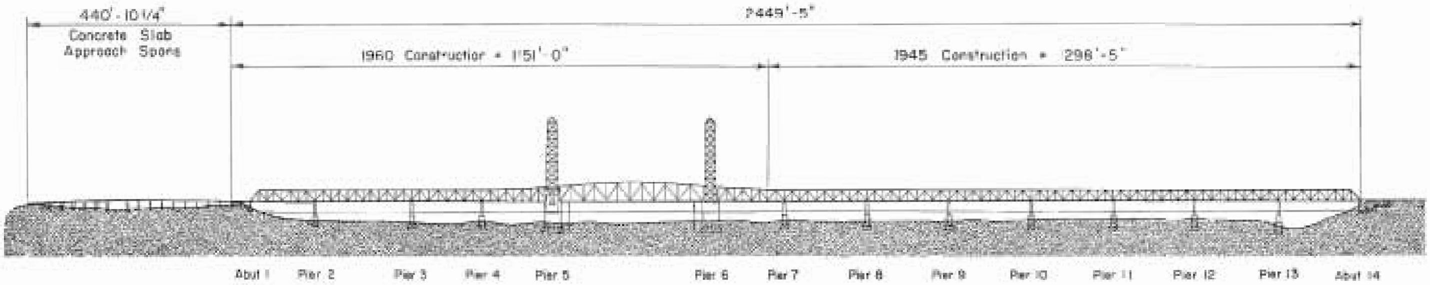
East Portion Completed

The year 1945 marked the completion of the easterly portion of the new structure wherein some 1,300 feet of steel trusses were constructed. Approval for construction of the final portion of the bridge was given by the U.S. Corps of Engineers on February 2, 1950.

Moneys were made available for financing the final portion in the 1958-59 fiscal year. Cost of the 1945 portion of the structure was $730,000, which with the $3,370,000 cost of the present project added, makes the total cost of the bridge $4,100,000.

Completion of the present contract marks the complete replacement of an old structure which was built in 1918. The old structure contained several types of spans, a 70-foot concrete tied arch, a 343-foot Strauss double-leaf bascule, three 120-foot concrete tied arch spans, and approximately 1,670 feet of timber A-frame trestle spans.

In 1945, the old timber A-frame spans then in poor condition were replaced by a series of 180-foot steel truss spans on a new alignment located 60 feet upstream from and parallel to the old bridge. A crossover for traffic was constructed between the truss spans and the westerly portion



ELEVATION

of the old structure, so that from 1945 to 1960 a combination of new and old structure was used.

The recently constructed portion of the main structure is about 1,150 feet long and extends westerly from the end of the truss spans constructed in 1945. It was handled in two contracts, one for the substructure and one for the superstructure. The total length of the completed main structure is 2,446 feet. The superstructure contract also included the construction of an approach structure located immediately west of the west abutment consisting of 441 feet of continuous concrete slab spans. The substructure contract amounted to $960,000 and the superstructure contract including the slab approach spans on the west end $2,410,000. Cost of the 441 feet of slab approach spans alone was $124,000.

The new structure has a 26-foot roadway with a four-foot sidewalk on each side. Minimum vertical clearance for vehicles in the truss spans is 15 feet.

The new 306-foot lift span across the river channel provides a 270-foot clear opening for navigation between fenders. In the up position it allows 135 feet vertical clearance above flood plane elevation of 12.80.

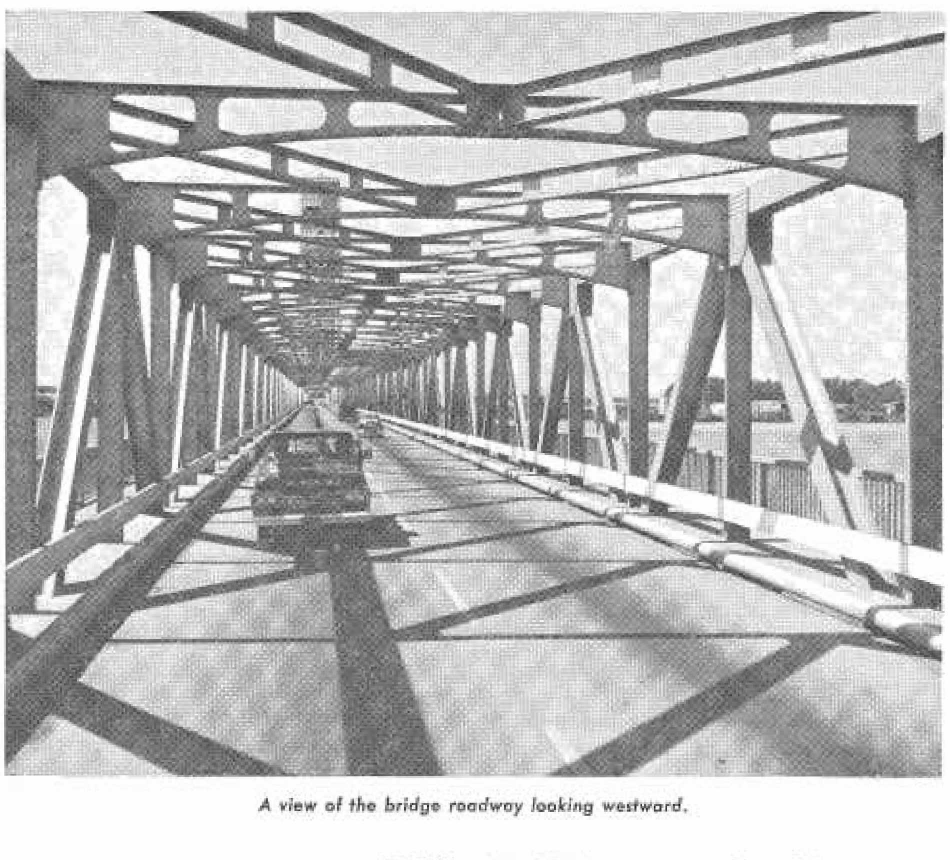
Substructure Contract

Construction on the substructure contract was started on April 2, 1957.

Piers for the approach spans consist of two tapered concrete shafts connected at the top by a concrete web wall. Each shaft rests on a 14-foot-diameter circular footing which is founded on 16-inch-diameter prestressed concrete piles. Each footing has a nine-foot-thick tremie concrete seal. Design load for each of the piles is 45 tons.

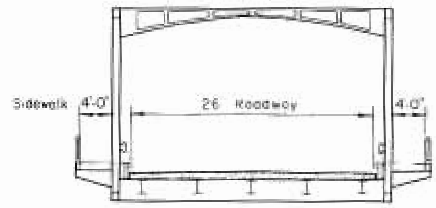
In the construction of the circular shafts of the truss piers a heavy steel sheet pile cofferdam was used for each shaft up to the bottom of the connecting web walls, which is just above normal high tide elevation. The pier shafts were formed with circular steel forms which were previously fabricated and used in the construction of the piers for the easterly half of the bridge in 1945.

The towers No. 5 and No. 6 consist of cellular concrete shafts 36 ft. x 42 ft. in outside dimensions. They are divided into three cells. Each pier is founded on a footing 46 ft. x 53 ft. and 10 ft. 6 in. thick, 7 ft. 6 in. of which is a tremie concrete seal. Under each footing are 145 prestressed concrete piles. For these piers, the contractor constructed a 48 ft. x 54 ft. steel sheet pile cofferdam heavily braced with five frames of welded steel "H" pile sections. The 7-ft.-6-in. thick layer of concrete was placed by means of two tremie tubes to seal the bottom of the cofferdam to permit dewatering. The 1,100 cubic yards of structural concrete required for the tower piers was formed and placed using conventional methods. Concrete for all piers was delivered to the job site on the parallel existing bridge by transit mix trucks. One-way traffic control on the existing bridge was employed while the transit trucks were unloading.



A view of the bridge roadway looking westward.

To drive the 145 16-ft. octagonal prestressed concrete piles for each pier, the contractor used the same method which was used in driving the steel H piles for the easterly piers. This method employed a steel pipe slightly larger than the concrete pile to guide the pile while it was being driven. To locate the pile accurately, a steel template frame was attached to the top cofferdam frame. The bottom of the pipe was imbedded slightly in the sandy bottom and was held in place by the template at top. The concrete pile was then placed inside of the pipe and driven to bearing with a steam pile hammer using a specially constructed steel H pile follower. To get the concrete piles down to the specified tip elevation, the contractor used two 4-inch jets supplied by a three-stage, 500-psi., 600-g.p.m. pump. The substructure contract was completed October 30, 1958.



TYPICAL SECTION

Superstructure Contract

The superstructure contract consisted of placing 1,150 feet of steel truss spans and, in addition, the 441 feet of slab approach spans.

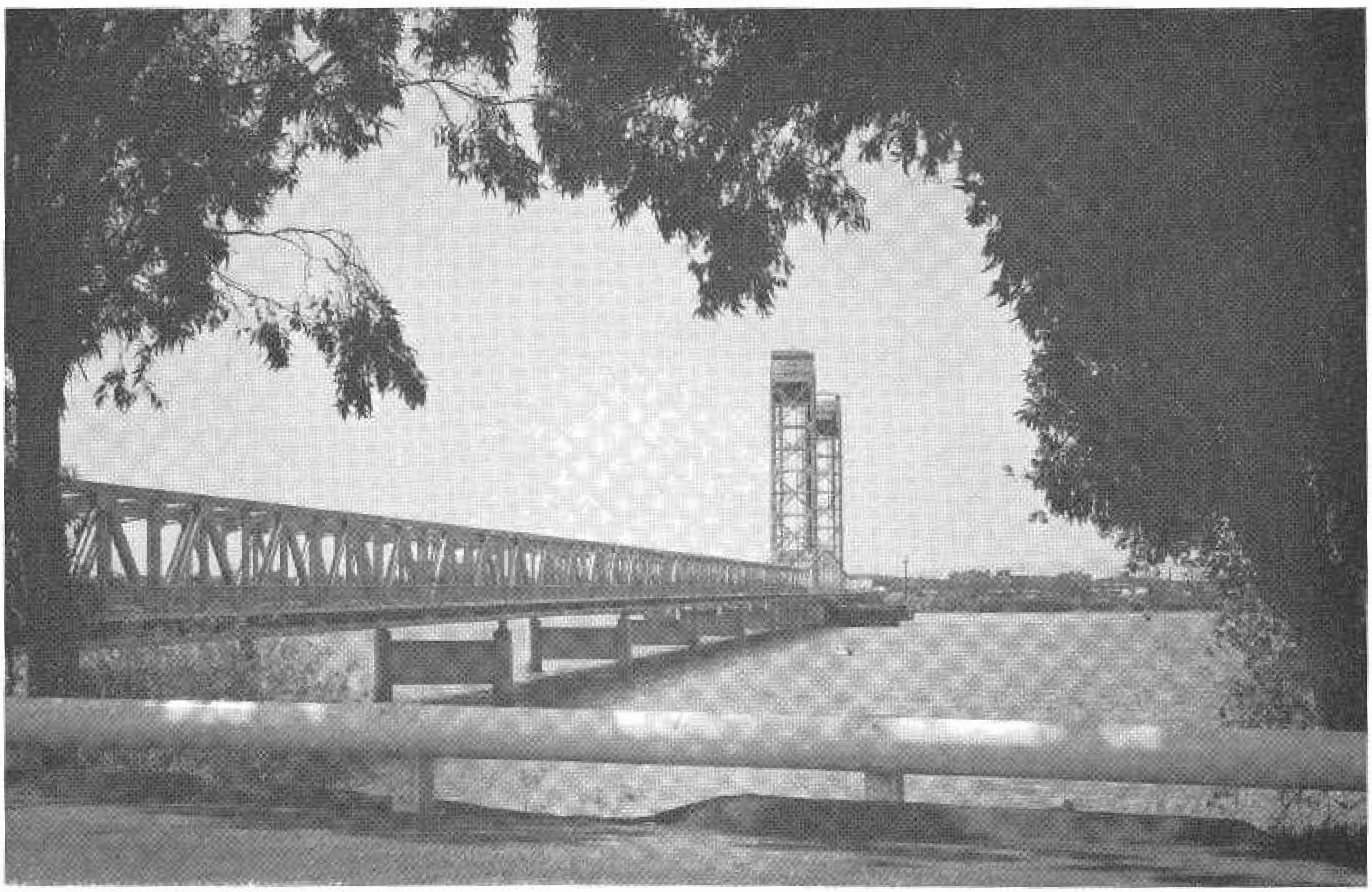
Flanking the lift span are five steel truss spans (one on the east end and four on the west end). The trusses were designed to look like those constructed in 1945 yet including latest features and methods wherever possible. The web members in the new Warren-type trusses mainly consist of rolled wide flange sections. Top and bottom chords consist of two 15-inch channels connected by lacing and stay plates. Connections for these members are riveted, with some uses being made of high-strength bolts.

Lift Span Described

The lift span has an appearance of striking simplicity. This is accomplished by the use of the tower drive. The operator's house is located on Pier 5 with the operating machinery placed in the tops of the towers.

A curved chord Warren-type truss was used to carry out the same general appearance as the other truss spans. All of the main members are built up from channels, plates and wide flange sections, for easy painting access. Floorbeams, as in the approach spans, are 36-inch wide-flange sections. Stringers are wide flanges, supporting a lightweight concrete deck.

At one end a seating detail guides the lift span both laterally and longitudinally; at the expansion end it is



Looking west toward Rio Vista along the upstream side of the completed structure.

guided laterally only. Weight of lift span is 1,550,000 pounds.

Towers on Main Piers

Each tower consists of four legs connected by struts and lateral bracing. The towers are independent of the approach span trusses as they set directly on the main piers. The prominent feature of the tower legs is the accessibility for painting. In the main the legs consist of plates welded together to form a four-point star. Stiffener plates are placed on the legs at approximately 6-foot centers.

Stainless steel rails conforming to ASTM A-176 Grade 2, annealed, finish No. 2D, are attached to each tower leg as tracks for the rollers.

Sheave guards are placed over each of the 14-foot diameter sheaves.

The highest points of the towers are approximately 210 feet above mean low water. Each tower has an automatic electric elevator providing easy access to each tower top and also has a stairway the full tower height.

Counterweights, consisting of heavyweight concrete poured around a steel frame, balance the weight of the lift span. Unbalanced condition of the counterweight ropes are taken care of by balance chains in each tower. In each counterweight, open holes are provided for placing balance blocks to take care of possible future changes in the weight of lift span. Hanger plates are provided for anchoring the counterweights in the up position for future rope replacement.

Control House

The operator's house, a concrete structure which houses control equipment, is located in the south side of Pier 5. It consists of three floors. The lower floor in conjunction with space under the roadway encloses standby equipment and provides for storage. The next floor, at roadway level, houses the electrical switchboard equipment. The top floor includes the operator's house with the control panel and interlocking equipment for controlling roadway traffic. It has been designed to give a clear view to both river and roadway traffic, and thus provide a maximum of safety. Concrete stairways give access to the various floors of the house.

Construction Features

Work started on the superstructure contract on April 24, 1958, with the ordering of structural steel from the mills. The first order of steel erection was the east tower, which started on December 4, 1958.

All structural steel was erected with the use of a steam-operated floating tower derrick crane which could lift 100-ton loads up to a height of 205 feet above water elevation. The north and south faces of the towers were erected in preassmbled 33-foot-high sections weighing approximately 32 tons each. The steel members for the east and west faces of the towers were erected concurrently with the erection of the preassembled sections.

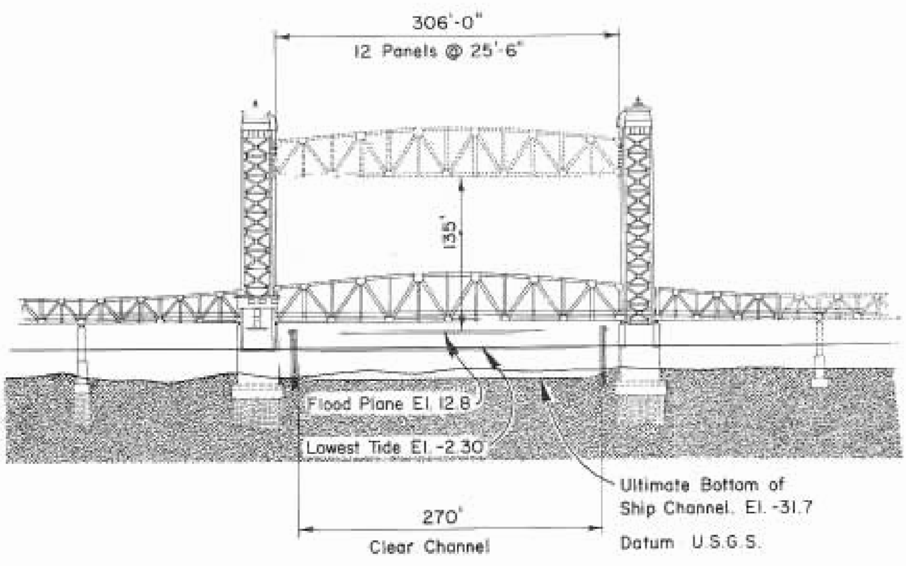
Erection of the two 14-foot-diameter 10-ton sheaves complete with their bearings on top of the towers required the help of high tide to obtain the necessary height of the derrick crane boom.

Each of the 140-foot approach span trusses were erected in complete preassembled individual span units by the floating tower derrick without falsework. The lift span was erected in 102-foot preassembled truss sections supported on falsework bents at the third points of the span. After the trusses for each span were erected, the lateral bracing and deck system steel members were erected and connected to the trusses.

The contract plans allowed the option of rivets or high-strength bolts for all structural steel connections. The contractor used rivets for all shop connections and high-strength bolts for field connections.

All preassembled tower sections and truss units were assembled in the contractor's Richmond, California, yard and barged to the job site. The contractor did not have a work yard at the bridge site because of the limited space available.

Concrete required for the control house and roadway deck was formed and placed using conventional methods. Concrete for the lift span deck consisted of lightweight concrete weighing 98 lbs. per cubic foot with a one-half-inch topping of grout weighing 138 lbs. per cubic foot. Aggregate for the lightweight concrete was expanded shale.



ELEVATION—LIFT SPAN

Counterweight Construction

The counterweight in each tower was constructed in the up position linked to the sheave beams at the top of the towers. In order to balance the weight of the lift span, the concrete for the counterweights weighs 216 lbs. per cubic foot. Aggregate for this heavyweight concrete was magnetite (an iron ore) having a solid weight of 275 lbs. per cubic foot. This aggregate was obtained from a source near Lovelock, Nevada. To form and place concrete for the counterweights at a height of 141 feet above the roadway required some ingenuity on the part of the contractor. The solution consisted of constructing a bottom form, hung from the structural steel frame of the counterweight, to support the weight of a two-foot layer of concrete. After obtaining the proper strength, the bottom two-foot layer of concrete served as a support to carry the construction weight of the remaining 15-foot height of counterweight.

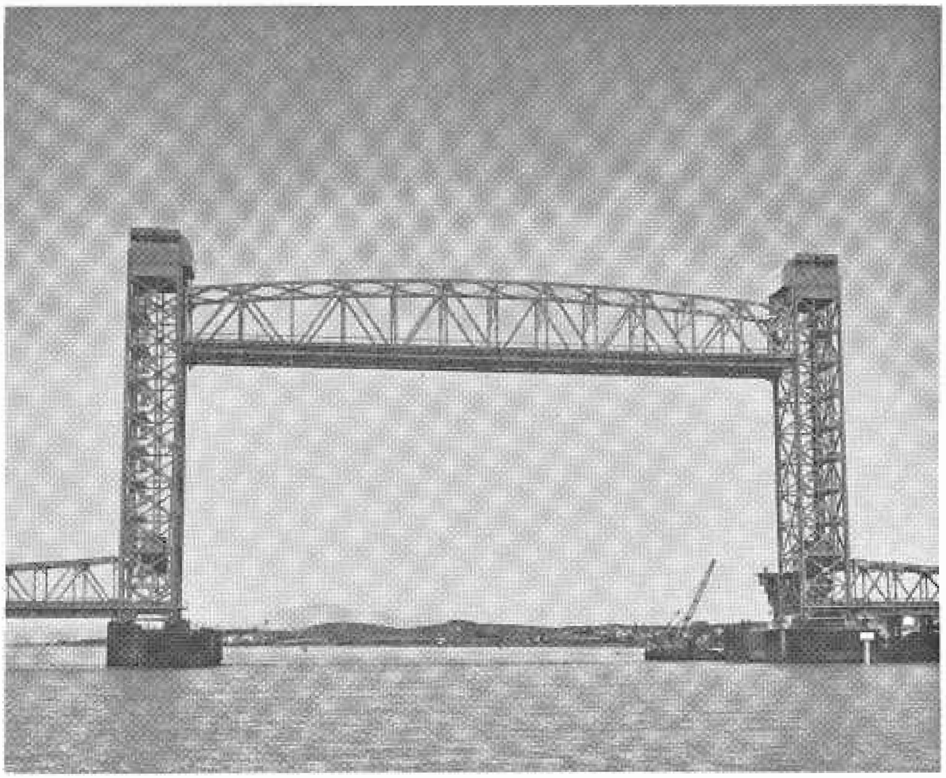
Connection of the 40 two-inch-diameter wire lifting ropes to the counterweights and lift span was accomplished by jacking up the lift span approximately two feet with hydraulic jacks at the four corners of the span and at the falsework bents. After all lifting ropes were connected, the jacks were released and the lift span was lowered to raise the counterweights slightly to permit the removal of hanger link pins and thus free the counterweights from the sheave beams. All lifting ropes were then adjusted by means of the anchoring eyebolts to within 2 percent of equal tension.

Handling Traffic

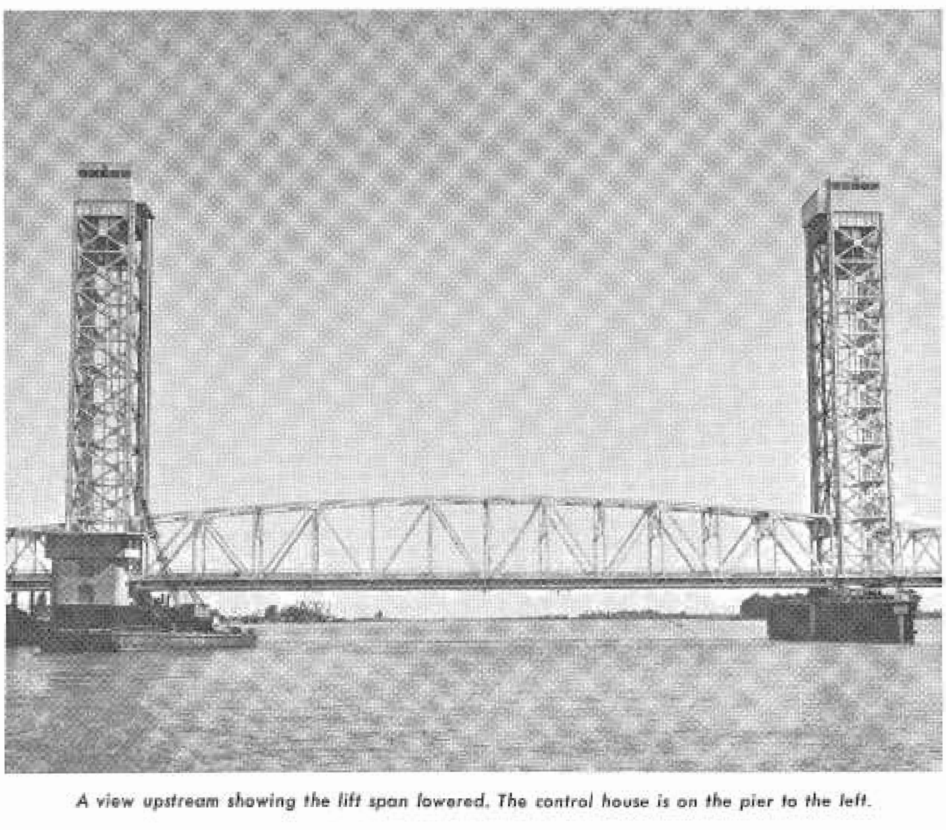
During bridge construction it was necessary to maintain unobstructed flow of vehicular and waterborne traffic.

When in 1944 plans were prepared for the easterly 1,300 feet of the structure, pier locations and length of structure were based on no change in location of the navigable channel. However, when plans for the Sacramento Deep Water Channel were being formulated in 1947, the Corps of Engineers requested that the centerline of the new navigable channel be located some 575 feet to the east of the existing. This necessitated reconstruction of the vehicular crossover used since 1946 and the development of a new plan for handling traffic.

Available roads for vehicular traffic during periods when structure was closed would have entailed long detours over substandard roads. The cost of signing and maintenance of these roads would have been excessive and the circuity of these detours would have been very time-consuming as



A view downstream showing the lift span raised.



A view upstream showing the lift span lowered. The control house is on the pier to the left.

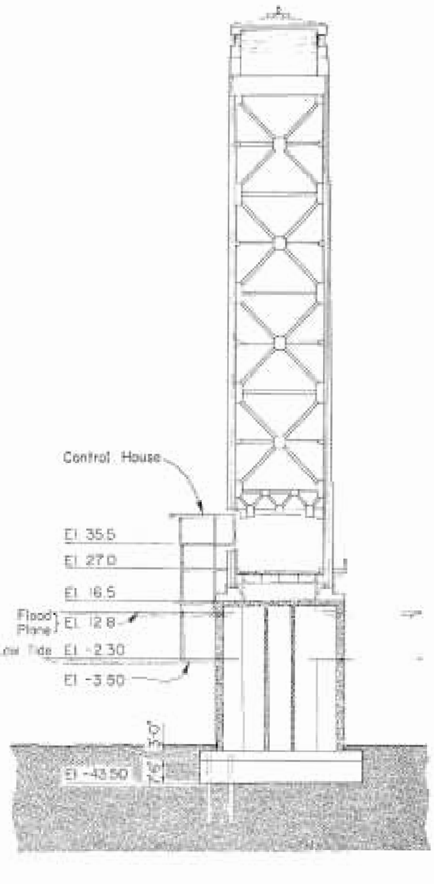
well as annoying to motorists. Good engineering practice dictated the use of crossover structures connecting the old and new construction to properly handle vehicular traffic.

The crossover in use since 1946 and the beginning of this contract could not be used due to relocation of the deepwater channel. It interfered with construction of tower Pier 6.

To carry out the planned stage construction, two crossovers of timber and steel were constructed to handle vehicular traffic—No. 1 east of the new lift span, and No. 2 west of the lift span. Both of these were quite ingenious, since they required entrance through the side of existing spans. On crossover No. 1, one side of the existing truss span was supported on timber pile bents, and the top chord and lateral bracing supported by a strongback placed over the top chord. Five panels of the truss, along with about 180 feet of sidewalk were removed to provide adequate roadway clearance for entry to the truss roadway.

After completion of the new lift span and timber fenders, crossover No. 2 was constructed. This involved entry through the side of an existing concrete tied-arch span. Several hangars between the arch and roadway were removed, and pile bents and steel needle beams placed to support the roadway.

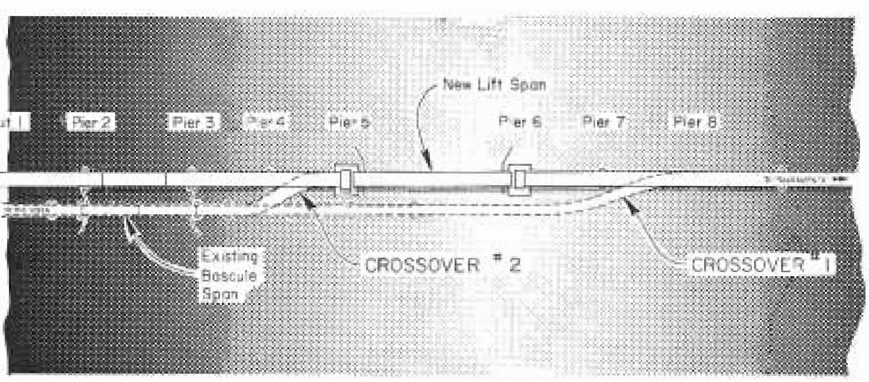
Upon completion of crossover No. 2, traffic was routed over it and crossover No. 1 was removed. This allowed for removal of the easterly portion of the old structure, routing of water traffic through the new lift span, and completion of the new truss over the old navigable channel.



TYPICAL SECTION

Mechanical Features

The lift span is driven by a 30-horsepower motor located in each tower. The fact that only 60 horsepower is required to operate 3,000,000 pounds of lift span and counterweights is due in a large part to the use of antifriction bearings to support the counweight sheaves. The use of bronze bushing-type bearings would have required a 75-horsepower motor in each tower. This saving of 90 horsepower represents a saving of $650 per year in fixed connected horsepower charges alone.



DETOUR PLAN - TRAFFIC

The counterweight rope sheaves are of arc-welded construction, weigh 10 tons each and are 14 feet in diameter. The lift span and counterweights are connected by 40 two-inch-diameter wire ropes each having a minimum breaking strength of 320,000 pounds.

Each counterweight sheave is supported by two spherical roller bearings having internal bores of 16½ inches and outside diameters of 25½ inches. Each bearing supports a dead load of 400,000 pounds.

To guard against a possible failure of utility power a diesel-engine generator set was installed. The 100-kilowatt generator is powered by a 167-horsepower diesel engine.

The lift span is guided during its travel by rollers which move on stainless steel rails fastened to each tower leg. Like the rails, the rollers are also stainless steel and have self-lubricating bronze bearings for maintenance-free operation.

In addition to the stairway, each tower has an electrically operated three-passenger elevator which travels from just above the roadway to a landing below the machinery deck.

Positive post-type barriers which protect roadway traffic from running off the bridge when the lift span is up are mounted below the deck of the approach spans. Each post is driven up and down by a hydraulic cylinder with a stroke of 37 inches. There are also roadway gates and pedestrian gates to protect the public during the period the span is up.

Electrical Features

Accurate stopping and seating of a lift span is one of the most important, yet tedious and time-consuming jobs imposed upon an operator. With this in mind, the electrical control features of the bridge were designed to make the bridge operation automatic. This allows the operator to be free of the mechanical details of span control and more properly give his full attention to control of traffic.

To these ends an automatic span control was developed of the closed-loop type. To raise the span the operator simply holds down the "raise" button on his control console. In response, the span control automatically accelerates the span upward, within the first six feet of travel, to an accurately controlled normal speed of 90 feet per minute.

The span can be raised to the fully open position in just less than 90 seconds. Near the top of the travel, through a series of limit switches, each creating a demand for reduced span velocity, the controls slow the span to a smooth stop. The brakes are then set automatically.

By holding down the "lower" button the span can be returned to the seated position. However, in seating, the span controls perform an additional function to those described for raising.

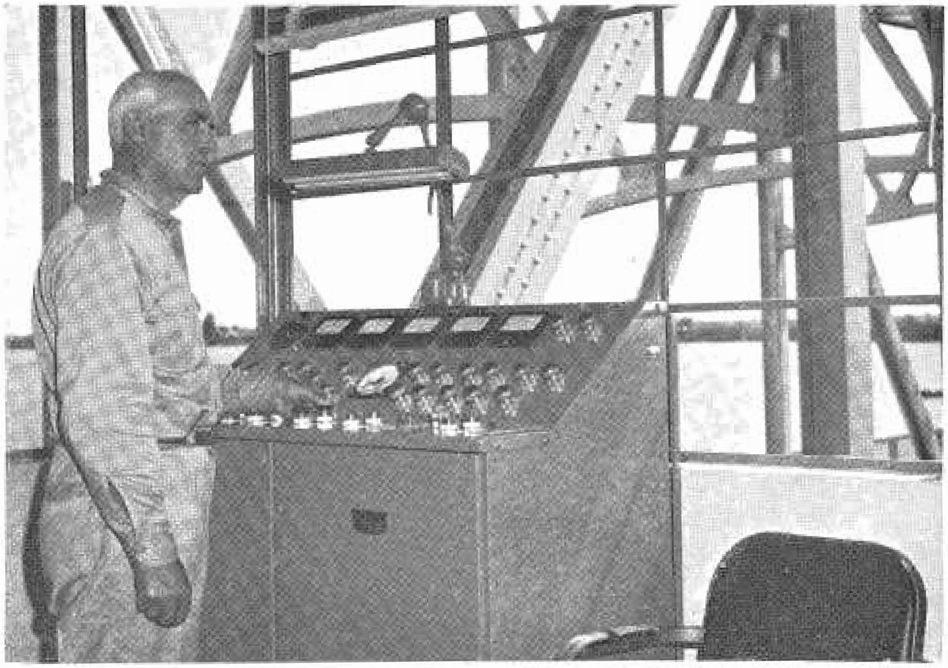
After the span has reached all four seats the span control automatically drives the span tightly against the seats and then sets the brakes. The operator may then release the "lower" button. The object of tightly seating the span is to prevent its bouncing against the seats under highway traffic as it would do if it were simply hanging by the suspender ropes and in light contact with the seats.

To stop the span at any intermediate point between "fully open" and "fully closed" the operator need only release whichever button, "raise" or "lower," is being held down and the span control automatically decelerates the span to zero velocity and sets the brakes. The span may be moved either up or down from any intermediate position.

The span control performs another very important and essential function. It is required to maintain the span in level position at all times. This it does to a high degreee of accuracy, seldom permitting more than a fraction of an inch difference in elevation between the ends of the span even though they are 306 feet apart.

At this writing there still remains some removal work of the old bridge. It is anticipated that all work in the superstructure contract will be completed about July 1960.

Lord and Bishop was the contractor for the substructure, and Judson Pacific Murphy Corp., of Yuba Consolidated Industries, Inc., for the superstructure.



Earl Highley, one of the four drawbridge operators on the Rio Vista Bridge, operates the span control panel.

BENICIA-MARTINEZ

Continued from page 39 . . .

will be completely anchored with considerable rigidity to all 10 of the caissons.

From this point on the concrete pier shafts will be constructed by slip forms to the bottom of the steel shoes supporting the main trusses.

Deep Water Pier Design

The sequence of operation is best illustrated in the sketches showing steps 1 to 8, inclusive. Much interest has been shown in this type of deep-water pier design and construction and more detailed information will be available at a later date.

Each pier when completed will be enclosed in a heavy concrete pile protective fender to guard against any possible damage or shock from navigation.

During April 1960, work was in progress at Pier No. 12 which is the second pier out from the Contra Costa County shore. Box footing for the next pier has been completed and ready to be towed to the site. Construction schedule calls for completion of the piers by December 1961.

Steel erection of the Martinez approach girders is to start this summer, and erection of the heavy truss spans is scheduled to start in September or October of this year.

O. A. Johnson, who was resident engineer for the parallel Carquinez Bridge, is in charge of construction activities on the Benicia-Martinez structure, with Wallace Ames again serving as his chief assistant.

IN MEMORIAM

District VII
Merle J. Markland, Highway Equipment Operator-Laborer.

District VIII
Atley T. Moore, Skilled Laborer.

District XI
Kenneth E. Wyatt, Assistant Highway Engineer.

Shop 2
Everett W. Bossuot, Highway Equipment Superintendent II.

State-owned Toll Bridges
John Ribeiro, Laborer.

Almost 43 tons of obsolete records were sold as waste paper by the Division of Highways during the last fiscal year.

McHenry Ave.

State, Modesto Team Up To Widen Congested Road

By JOSEPH J. SPAETH, Assistant City and County Projects Engineer, and F. M. BABCOCK, Resident Engineer

LOCAL citizens, working with and through their municipal organization, and District X of the Division of Highways, traded rights-of-way for a widened highway and a storm drain system. This action expedited the construction of a 1.7-mile section of State Highway Route 109, known locally as McHenry Avenue, and, at the same time, solved a difficult drainage problem of considerable magnitude for the City of Modesto. Approximately $1,300,000 of state highway funds was required for the recently completed street and sewer project. Right-of-way costs were paid from city funds.

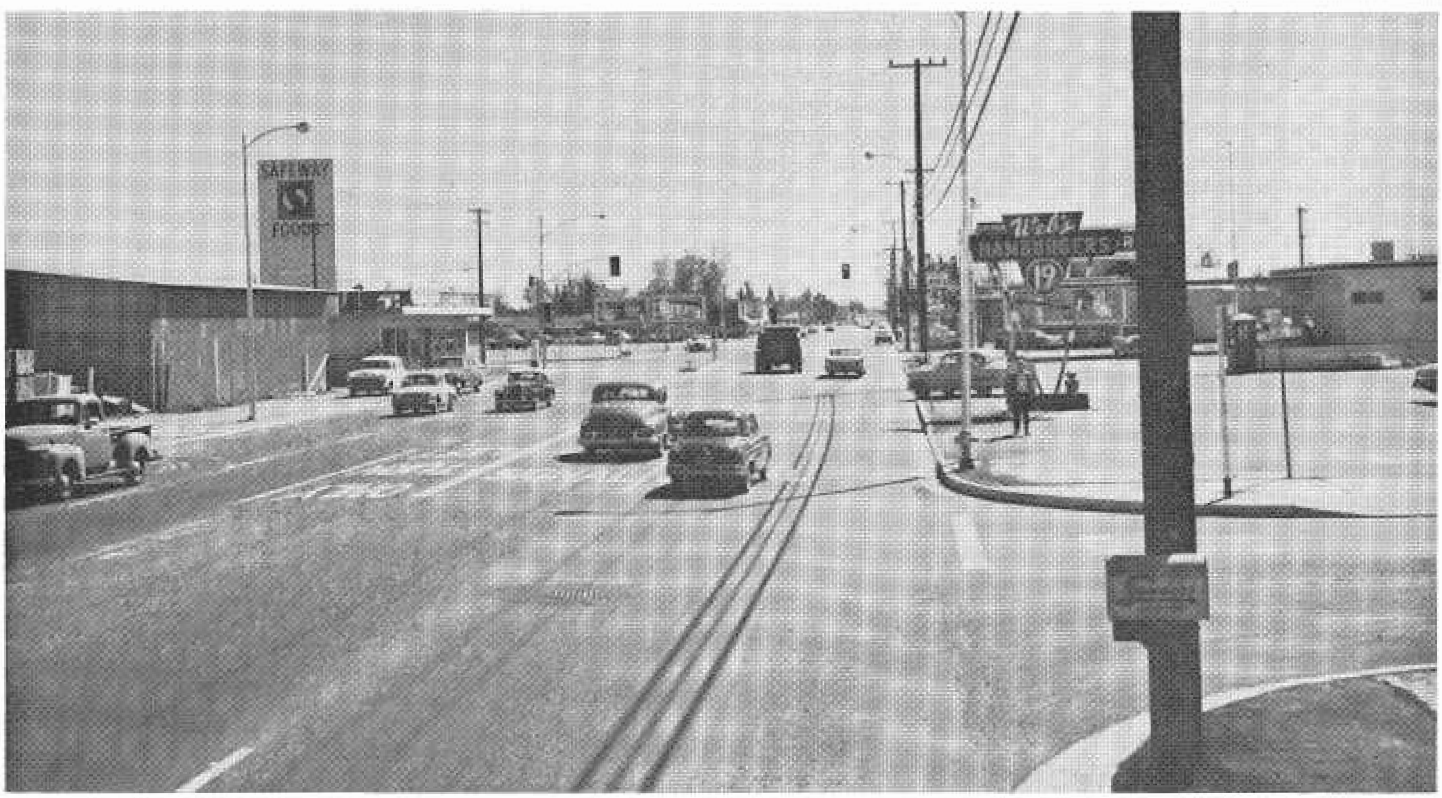
The existing situation was a two-lane rural-type road, portions of which were inside the Modesto city limits. "Ribbon-type" commercial development in this urban area had decreased the highway capacity, added to local traffic and aggravated an already unsatisfactory drainage situation which depended upon percolation and evaporation for the disposal of storm water. No natural waterways existed in the area. The highway was subject to average daily traffic movements of 15,000 vehicles. Natural drainage had deteriorated to the extent that the traveled way was partially inundated during heavy rainstorms.

Storm Sewer Planned

To alleviate these conditions, the City of Modesto was planning a storm sewer system for the entire area and the Division of Highways was planning increased highway capacity for McHenry Avenue. The city's plan called for an 84-inch and 72-inch reinforced concrete pipe drain to be placed under McHenry Avenue and the Division of Highways plan called for an increased width of right-of-way and the construction of two additional traffic lanes.

Logically, the situation called for installation of the storm drain prior to improvement of the highway. However, the usual situation of having more worthy projects than available funds with which to construct them prevailed, and the city found it could not finance the cost of the storm drain system within a reasonable period of time.

The city's estimate of cost for constructing the storm drain was equiva-



NOW—McHenry Avenue, looking south toward the Orangeburg intersection, March 1960.

McHenry Avenue, October 1959, while construction operations were under way.

lent to the State's estimate of cost for acquiring the additional rights-of-way for the highway project. It was at this point that the local citizens, through the McHenry Avenue Improvement Association, offered to donate the land for widening the highway if the city would pay for disturbed improvements and if the State would construct the storm drain.

As a result, a formal co-operative agreement was executed in July 1957, which provided that the city would (1) acquire and convey to the State the rights-of-way necessary for the highway widening project; (2) complete the design of, and furnish construction plans and specifications for, the storm drain system; and (3) provide for the continuous operation and maintenance of the storm drain system after completion. The State agreed to construct the storm drain system and four-lane street section.

THEN—McHenry Avenue, looking south toward the Orangeburg intersection, November 1959.

The magnitude of the right-of-way acquisition problem, for the City of Modesto, is indicated by the fact that 144 parcels were involved, many of which had buildings or other improvements to be relocated. The assistance rendered by the McHenry Avenue Improvement Association is gauged by the fact that all of these 144 parcels were settled amicably. Payment was made by the city for improvements only. No payment was made for land. The contract was awarded to McGuire and Hester, of Oakland, in May 1959 and the project, under the supervision of General Superintendent C. Aldrich, was completed in February 1960.

When construction started, a pamphlet, which outlined not only the work to be done but the order of work, together with a small project map, was furnished to all adjacent property owners. During construction, numerous newspaper articles plus daily newscasts from a local radio station assisted in keeping the public informed and expediting traffic through the construction area. These actions, plus excellent co-operation from the utility companies and a contract specification which limited the length of open storm drain trench to 100 feet, helped to create a very favorable relationship with the traveling public and adjacent land owners.

Mixer Tests

Uniformity of Concrete Mixed Under Varying Conditions Studied

By BAILEY TREMPER, Supervising Materials and Research Engineer

The Materials and Research Department has completed tests of the uniformity of concrete mixed in a 34 E dual-drum paving mixer operating under variable conditions of batch size and time. The U.S. Bureau of Public Roads co-operated in financing and furnishing test data.

The tests were requested by Mr. Harold Allen, Chief, Division of Physical Tests, Bureau of Public Roads. Mr. Allen said that the states have widely different requirements for time of mixing and maximum size of batch in concrete paving mixers and that specification limits should be based on factual data of measured performance of mixers and that if such data were available better reconciliation between the requirements of the states should be possible. He requested that as many states as possible perform tests. It was realized that tests of a single mixer made at one time would not provide answers of universal application. However, a group of tests made in a number of states might provide information on which realistic decisions could be made.

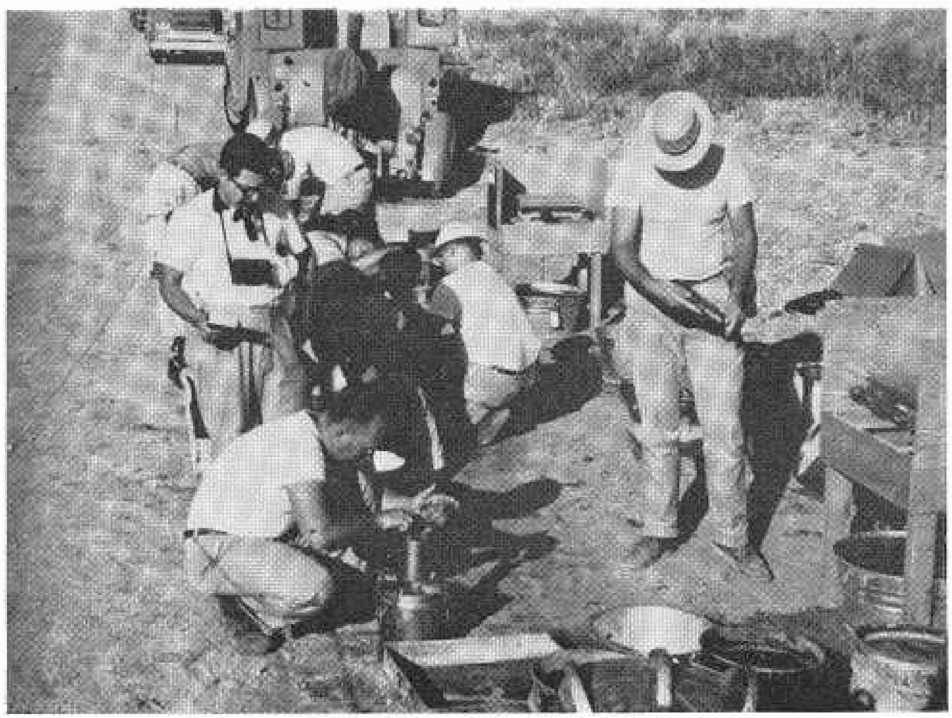
Test Selected Batches

In compliance with Mr. Allen's request, provisions were made for mixing concrete in batches of 34.0, 37.4 and 40.8 cubic feet, each mixed for 30, 50 and 70 seconds. 100 batches of each of the nine combinations were to be mixed in succession and samples from the first and last portions of selected batches as discharged were to be furnished to the State for testing purposes. Special provisions for such work were included in a project, III-Pla-17-A,Roc,B. This project is on US 40 (Interstate Route 80), between Roseville and Newcastle in Placer County. Contract 59-3TC17-FIPD involving this work was awarded to A. Teichert & Sons.

Preparation for the tests were made soon after award of the contract. In order to secure samples directly from

. . . Continued on page 71

A crew carries on tests to determine the percentage of air in mixtures of concrete. Note the series of wash buckets in the foreground.



The general arrangement of the test area showing the dual facilities for two wash crews.

Sand Hill Road

San Mateo County Completes 2.9-mile FAS Highway Job

By ODO G. CAMEROTTO, Resident Engineer, San Mateo County

DURING 1958, the San Mateo County Board of Supervisors authorized the County Engineer and Road Commissioner to initiate a co-operative project with the State Division of Highways and the U.S. Bureau of Public Roads under the Federal-aid Secondary Highway Program for the improvement of Sand Hill Road.

A portion of this San Mateo County primary road is FAS Route 1004 and is the final link of road to be improved under the Federal-aid Secondary Program in the Alpine Road-Portola Road-Sand Hill Road loop which serves the more thickly populated areas of Woodside and the Portola Valley at the westerly end and the Cities of Menlo Park and Palo Alto at the easterly end. This project extended from Whiskey Hill Road, about one mile south of Woodside, to Santa Cruz Avenue, south of Menlo Park, a distance of 2.9 miles.

History

This road was first used in the 1850's to transport supplies and people to and from the historic town of Searsville, located just west of this project. Searsville was originally a gold rush town but because of the demand for timber, and its plentiful supply in the mountains nearby, turned to a lumbering town. Lumber wagons and stagecoaches used the road to get to Mayfield, now the area known as South Palo Alto, and Redwood City. During the wet winter months, Sand Hill Road, because of the nature of its underlying soil, was by far the best route to take to the Bayside communities. The other route to Redwood City, through Woodside, was frequently muddy and impassable.

Increased Traffic

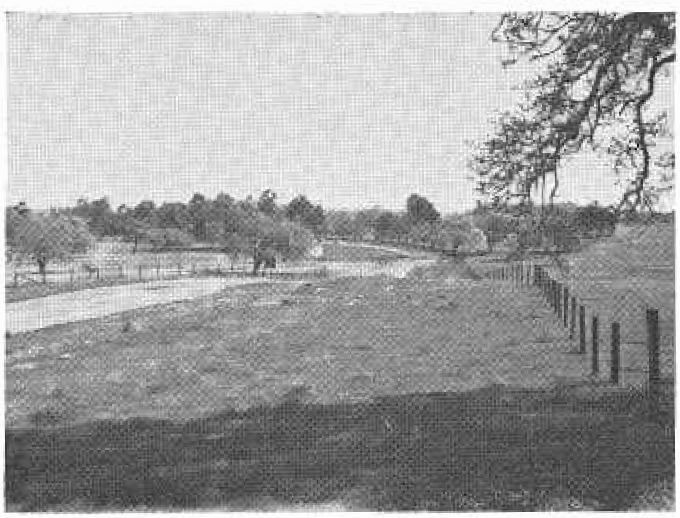
The Leland Stanford Junior University, a primary landholder in this area, has recently started construction of homesites on its lands adjacent to Sand Hill Road. The historic Sharon property, one of the last remaining large estates on the Peninsula, is also in the process of being subdivided. It, too, adjoins Sand Hill Road at the easterly end of the project. The presence of these subdivisions has and will continue to increase traffic on Sand Hill Road. The two-lane highway at this location carries about 3,500 vehicles per weekday which increases to 5,000 vehicles per day on weekends due to recreational facilities at Searsville Lake.

Road Section Realigned

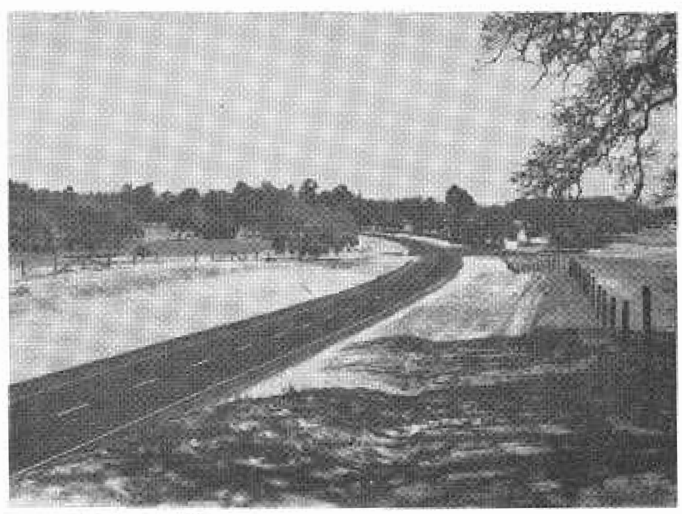
The project was designed as the initial stage of a future four-lane highway, the northerly two lanes being constructed at the present time. The future four-lane project will accommodate four traffic lanes 12 feet in width, with five-foot shoulders in cuts, and with eight-foot shoulders in fills, together with a 12-foot median strip dividing eastbound and westbound traffic.

Design and construction engineering for the project were provided at county expense and by personnel operating under the direction of Don S. Wilson, County Engineer and Road Commissioner. County personnel consisted of Odo G. Camerotto, Resident Engineer, Edward Bohlen, Office Engineer, and George Gaddy and Stanley Combs, Construction Inspectors.

About 640 eucalyptus trees, 5,600 shrubs and 53,000 ice plants will be used for landscaping on the San Francisco-Oakland Bay Bridge approach (US 40-50, Sign Route 17) between the Port of Oakland and the East Bay Distribution Structure.



A view of Sand Hill Road before reconstruction by San Mateo County.



A view of Sand Hill Road after reconstruction under the FAS program.

Talking About Highways—*Comments from the California Press*

These comments about highways appeared recently in California newspapers or were taken from other sources:

"We Cuss Them, But They Work"

Malcolm Epley in his "Beach Combing" column in the Long Beach *Press-Telegram* tells of several fast, long-distance freeway trips which he and acquaintances have made since the completion of the Ventura Freeway in the San Fernando Valley.

"I mention these experiences, not to prove that local people are fast drivers, but to remind that, section by section, the freeway builders are accomplishing what they set out to do.

"It takes time, and a lot of us get pretty impatient, but there finally comes a day when traffic takes off on another new and vital link in the dangest highway system on earth."

Epley reports that it is now possible to drive 120 miles from Ventura to San Juan Capistrano without encountering a traffic light.

"That indicates what has happened to facilitate traffic movement in an area that would have, without the freeways, the greatest jamups imaginable. We cuss the freeways, but they're working."

* * *

Good News in Humboldt

"More good news seems to emanate from the Highway Commission, via our local Division of Highways office, than you can figuratively 'shake a stick at.' We only wish all important news was half as good.

"Latest item was District Engineer Sam Helwer's announcement that funds for the Fortuna Freeway have been upped to $3 million, thus making it possible to finish that necessary job a year ahead of schedule. That was a real break.

"It wasn't long ago that many people hereabout were saying that they did not expect to see a freewayed route to San Francisco 'within our lifetime.' As matters are turning out, it is well they did not wager money on that prediction.'—Editorial in Humboldt *Standard*, Eureka.

* * *

New Era on Boulevard

With the opening of the Ventura Freeway, "a new era has dawned" along Ventura Boulevard, the former highway, according to an editorial in the Studio City *Graphic*.

"The eternal traffic congestion, long the merchants' nemesis, has been alleviated.

"Now's the time for boulevard businessmen to plan vital, promotional programs; to provide adequate parking; to begin thinking about beautification of their buildings and the boulevard in general. All these merchandising assets, hitherto discouraged because of the intolerable traffic, can now be cultivated."

* * *

Make Haste Slowly

The San Mateo *Times and News Leader* offered this editorial comment concerning a fatal accident on the Bayshore Freeway which occurred during a storm:

"If all of the drivers on the freeway had used common sense and slowed down their customary speed to a pace allowing full control of autos, despite the rain and gusty crosswinds, there would have been no fatality and no accidents.

"But a few careless drivers tried to drive through the storm at high speeds—ignoring the poor visibility and rain-slick condition of the roadway . . .

"The result was tragedy, the maiming of accident victims and heavy property damage. Thousands of man-hours of work were lost because a few tried to save a few minutes.

"Some loose-thinking people blame the freeway for this. But it is not the fault of the freeway.

"The fault lies with the careless and reckless drivers who abuse the use of the freeway and refuse to realize that it is subject to the need for due caution to be observed under adverse weather conditions. In this it is no different from any other thoroughfare.

"Under best of conditions the freeway is no safer than the drivers using it. And, unfortunately, a few bad drivers can endanger the lives of all good ones."

* * *

Consider Stomach Condition

George W. Savage in his San Bernardino *Sun Telegram* column commented on reminiscenses of E. Q. Sullivan, former district highway engineer, printed in "Profiles," publication of District VIII, Division of Highways.

"What interested us especially," Savage noted, "was his quote from a February 11, 1924, editorial which appeared in the San Bernardino *Sun:*

" 'It is to be hoped that we have heard the last knock aimed at the condition of the Old Trails Highway between this city and Needles, so long as it is maintained in its present condition. When it is possible for motorists to cover the 248 miles from the Colorado River town to this city in seven hours, or a maintained speed of 35 miles per hour for the entire distance, it might indicate that the driver who complains about the condition of the road ought to consider the condition of his stomach. It is not the highway that is bothering him.' "

"Just image the cases of dyspepsia there would be today," Savage added, "if motorists had to travel this busy route at only 35 miles an hour."

Construction will begin soon on the $20 million, 6,010-foot bridge over the main channel of Los Angeles Harbor. It will be Southern California's first toll bridge and financed by Toll Bridge Authority bonds, state highway funds, and highway user tax funds.

The California Highway Commission has adopted a freeway routing relocating portions of State Highway Route 87 (Oroville-Chico Road) in Butte County between Wick's Corner and U.S. Highway 99E.

Urban Planning

Highway Officials at AASHO-AMA Seminar

STATE and federal highway officials took part in a seminar on "Urban Planning and Its Relation to General Urban Development" April 11-13 at the University of California, Berkeley.

The seminar was the first of a series planned for various sections of the United States by the American Association of State Highway Officials, through its special committee on Urban Planning Seminars. Rex M. Whitton, chief engineer of the Missouri State Highway Commission, is chairman of the special committee.

At Berkeley, the arrangements were made by the university's Institute of Transportation and Traffic Engineering, including not only campus facilities but also the obtaining of some of the outstanding experts who conducted the sessions.

General Plan Needed

Highlights of the seminar included discussions led by T. J. Kent, Jr., Professor of City Planning, University of California. Kent pointed up the need for a general plan, defined the technical elements of the plan, described the legislative function of the plan and concluded with an analysis of the weaknesses in the present planning practice.

"One of our major weaknesses," said Kent, "is our inexperience at the job of building new cities and expanding and reorganizing old cities. In California our efforts to understand and dominate the powerful forces that are radically changing our cities and regional landscape are only 10 to 15 years old. I also feel quite certain that the constructive hard-driving postwar program of the California State Division of Highways to provide freeways in and around the cities of the State will be seen, in retrospect, as one of the major explanations for the establishment of effective local planning programs and the preparation and use of general plans by our city and county governments during the decades of the 1950's and 1960's."

"The Spatial Form of the City," presented by M. M. Webber, Associate Professor of City Planning, gave insight on how transportation and land use aspects of the master plan are integrated with all aspects of a city's development so as to assure attainment of the fundamental goals of a city.

Factors in Use Pattern

Paul F. Wendt, Professor of Finance and Director, Real Estate Research Program, University of California, emphasized that "as cities grow with the expansion of their economic base, they tend to develop a rational pattern of land use based on competition of uses." However, Professor Wendt pointed out that basic land use patterns may be modified by transportation routes which improve access of land, as well as by irrational property development and by specific physical conditions.

A promising technique as to how to evaluate the impact of improved transportation services, extension of sewer and water systems, available land for development, tax rates, etc., on land use development was demonstrated by Alan M. Voorhees, Traffic Planning Engineer, Automotive Safety Foundation. Such evaluation of land use development can be an effective basis for traffic forecasts and delineation of highway transport systems.

Richard M. Zettel, Research Economist and Lecturer, Institute of Transportation and Traffic Engineering, discussed the complex facets of highway finance in relation to the urban transportation system.

Co-ordination Keynote

The main theme of the seminar was summarized by John T. Howard, head, Department of City and Regional Planning, Massachusetts Institute of Technology.

"The future livability and prosperity of our cities," Howard said, "will be largely measured by our success in co-ordinating the careful design and control of our urban land uses with the careful design and construction of our circulation systems, highways and transit.

"To win this success, we need to exploit the growing movement toward co-ordination among the number of governmental agencies and levels that are concerned with land use and with highways, and also the better professional understanding that is developing between highway engineers and city planners."

Harmer E. Davis, professor of civil engineering and director, Institute of Transportation and Traffic Engineering, moderated the three-day session.

Participants included highway officials from eight western states, and representatives of the U.S. Bureau of Public Roads, the American Municipal Association, AASHO, and the Joint AASHO-AMA Committee.

California representatives in attendance included State Director of Public Works Robert B. Bradford, Deputy Director Harry D. Freeman, State Highway Engineer J. C. Womack, and nine other high-ranking officials of the Division of Highways.

FEDERAL-AID CONTRACTS

A total of 6,743 federal-aid highway construction contracts was awarded through the various state highway departments during 1959, involving a total cost of approximately $2.5 billion, according to the Bureau of Public Roads, United States Department of Commerce.

The contracts awarded in 1959 had an average cost of about $370,000. They varied in size from less than $25,000 to about $8,000,000, with an equitable distribution throughout the entire range. Twenty-nine percent of the federal-aid highway construction contracts awarded by the state highway departments were for amounts less than $50,000. Another 17 percent of all contracts were for amounts between $50,000 and $100,000, and 23 percent were between $100,000 and $250,000.

Martin A. O'Brien Retires on May 1

Martin Anson O'Brien, Highway Signing Supervisor, retired May 1 after 26 years of service with the California Division of Highways.

A native Californian, O'Brien was born in San Francisco, studied civil engineering at St. Mary's College in Oakland and graduated from the University of California at Berkeley with a degree in mining. His first job after graduation was with the Black Oak Mine in Soulsbyville where he worked as a solution man in the cyanide mill.


MARTIN A. O'BRIEN

In August 1917 he joined the Army and during his two-year hitch he saw much of Europe and was selected to attend the University of London where he studied law and geology until sent back to the states for discharge. He worked for the U.S. Shipping Board as an assistant purchasing agent for several years and was later affiliated with a number of the major oil companies in California in various engineering capacities.

O'Brien was appointed senior clerk for the transportation survey of the State of California in 1934 and has worked for the Division of Highways in the Maintenance Department since that date. He was editor of the 1949 Highway Maintenance Manual and editor and author of the 1958 manual. As Highway Signing Supervisor O'Brien has played a major part in the development of California signing practices. He also worked closely with interested agencies and groups on the placement of historical landmark roadside markers throughout the State.

Mrs. O'Brien (the former Gertrude Greene) is also a native Californian, as are the three O'Brien children, Mrs. Dorothy J. Wilkins, John A. O'Brien, and Mrs. Jean C. Lindsey. The O'Briens celebrated their 40th wedding anniversary two days before he retired from state service.

'Tempus Fugit' Corner

Twenty-five years ago. The following items appeared in the May and June 1935 issues of *California Highways and Public Works.*

US 99 Relocation

Construction of the proposed Kennett (Shasta) Dam will necessitate the rebuilding of some 16 miles of State Highway Route 3 (US 99) in Shasta County and approximately 37 miles of the Southern Pacific Railway.

Preliminary surveys for the relocation of both highway and railroad began in February of this year, and fieldwork on both surveys was practically complete by June 1. Plans and estimates are in progress.

Beauty Award Winner . . .

. . . in a bridge contest and not a card game, is the new state-designed "Smith Point" Bridge on the Redwood Highway where it crosses the South Fork of the Eel River just south of Garberville.

It is the first continuous steel girder bridge built on a curve in America and was awarded honorable mention in a national competition for the most beautiful steel bridge built last year.

Emergency Measure

Protests against federal taxation of gasoline were filed with members of Congress by more than 250 organizations representing millions of citizen taxpayers, and 21 states adopted memorials asking that the tax be ended June 30, 1935.

The gasoline tax, it was pointed out, was enacted in 1932 as a temporary emergency measure and was re-enacted in 1933 and again in 1934.

Ramona Boulevard Planting

The first comprehensive state highway landscaping project was started on Ramona Boulevard from Los Angeles civic center to Garvey Avenue.

About 8,000 trees and shrubs and 25,000 ground cover plants were placed under this first state landscaping contract on record, for which $30,000 in federal aid money was allotted.

Eureka Engineer Retires on June 30

Charles P. Sweet, Assistant District Engineer, Operations, District I, in Eureka, will retire on June 30, 1960, after 38 years with the California Division of Highways. A native Californian, he was educated in Ferndale schools and at Healds School of Engineering in San Francisco. Except for a three-year period spent as assistant city engineer for the City of Santa Barbara (1927 - 1930) Mr. Sweet has been employed by the State of California since April 1919 in some phase of engineering.


CHARLES P. SWEET

Starting work in Eureka as a surveyor on highway construction projects he advanced to the position of assistant resident engineer on construction projects and resident engineer on the early work done by honor camp forces from state prisons in the Redwood Creek area in Humboldt County. In 1925 he was transferred to the San Luis Obispo district where, in addition to supervision of road and bridge construction projects, he also worked on special studies in connection with the State Materials and Research Laboratory of Sacramento. (Among these special studies was a test of the degree of compaction obtainable with the first sheepsfoot roller used in compacting highway embankments in California.)

After his employment with the City of Santa Barbara he returned to Eureka where he advanced from resident engineer on highway construction projects to district office engineer. In 1935 he was appointed district construction engineer. He was promoted to assistant district engineer, operations, in 1951.

Sweet has two sons, Charles, Jr., (Resident Engineer in District IV) and Raymond (City and County Cooperative Engineer, District I in Eureka). He also has a daughter, Mrs. Francis Walker of Ferndale.

Division Announces Recent Retirements

Headquarters Office

F. W. Panhorst, Assistant State Highway Engineer, 32 years

Edward L. Schreiber, Junior Research Technician, 11 years

District I

Bernard J. Burgess, Highway Equipment Operator-Laborer, 29 years

Harold E. Eyles, Highway Field Office Assistant, 24 years

District II

Loran Risley, Skilled Laborer, 20 years

District III

Arthur S. Haskell, Highway Leadingman, 27 years

District IV

Fred H. Leighton, Highway Leadingman, 25 years

District V

Millard A. Dawson, Assistant Highway Engineer, 30 years

District VII

Alex G. Black, Assistant Highway Engineer, 30 years

William L. Jump, Carpenter I, 26 years

Ray W. Lawson, Groundsman, 4 years

District IX

H. V. Haskett, Highway Equipment Operator-Laborer, 22 years

District X

Clayton P. David, Drawbridge Operator, 26 years

Ted McClurg, Highway Equipment Operator-Laborer, 31 years

District XI

David S. Julien, Storekeeper I, 11 years

Horace V. Lerwill, Window Cleaner, 5 years

Eugene Sorin, Associate Highway Engineer, 33 years

Bridge Department

John W. Green, Supervising Bridge Engineer, 30 years

Materials and Research Department

John E. Borchert, Assistant Physical Testing Engineer, 23 years

Margaret F. Callaway,* Intermediate Stenographer-Clerk, 10 years

Shop 2

Edmund K. Miller, Skilled Laborer, 28 years

* Disability retirement.

Shop 3

Janice H. Wald, Accounting Technician III, 27 years

Grove-Shafter Freeway Project Provides For Possible Future Rapid Transit System

The State Division of Highways has found a way to provide for possible rapid transit lines in connection with the Grove-Shafter Freeway in Oakland without delaying current and budgeted construction on the MacArthur Freeway, it has been announced by State Director of Public Works Robert B. Bradford.

Subject to an agreement with the San Francisco Bay Area Rapid Transit District covering the additional costs involved, Bradford said, the State is willing to defer some structural work originally planned for the interchange area of the two freeways near Telegraph Avenue. This structure work was to have been included as part of a MacArthur Freeway construction project soon to be advertised for bids.

The rapid transit district has proposed that its planned Oakland-Richmond and Oakland-Concord transit lines be located within the dividing strip between the two roadways of the Grove-Shafter Freeway.

"Consistent with our policy of maximum co-operation with other agencies to solve overall transportation problems," Bradford said, "the State's engineers have arrived at a solution to the problems of proceeding on schedule with the urgently needed MacArthur Freeway without precluding future rapid transit plans on the Grove-Shafter."

Bradford said General Manager John M. Peirce of the rapid transit district was being informed of the State's readiness to work out a mutually satisfactory agreement. He was reiterating in his letter to Peirce, he said, "the fact that the Department of Public Works is vitally interested in the overall transportation needs of the State," including rapid transit as well as highways, and especially the 8 a.m. and 5 p.m. commuter peak hour problem.

He explained that the Division of Highways had planned to build some structure foundations and supports for the Grove-Shafter Freeway as part of a budgeted project on the MacArthur Freeway, in the vicinity of Telegraph Avenue and West Street near 35th Street in Oakland. This job is scheduled to be advertised for bids in April.

By completing certain structural work on the Grove-Shafter Freeway early, Bradford said, the remaining work on the interchange could be done later without disrupting traffic on the MacArthur Freeway, which would then be in operation. However, in order to make the proposed rapid transit plan possible, he said, the State was agreeing to defer most of this advance structural work. There would be no appreciable delay in construction of the MacArthur Freeway, he emphasized.

In his letter to Peirce, Bradford said the State would approve the location of transit lines in the Grove-Shafter center strip "provided that the rapid transit district bears all the added construction and right-of-way cost by reason of such location, and that such plan does not delay construction of the Grove-Shafter Freeway.

A firm agreement between the rapid transit district and the State should be reached by July 1, 1961, he said, in order to meet Division of Highways schedules for right-of-way acquisition and construction.

The rapid transit district is planning to finance construction of a transit system in the San Francisco Bay area through the issuance of general obligation bonds. A bond election is expected to be held in the fall of 1960 or the spring of 1961.

During the past fiscal year, Division of Highways installed 19,464 new signs along state highways.

Scenic Coast Route Urged by Committee

In a report to Governor Edmund G. Brown, the Standing Committee on Public Works and Natural Resources of the Governor's Council has proposed a "Pacific International Scenic Drive" extending through the coastal scenic areas of California, Oregon and Washington from Mexico to Canada.

The committee recommended that Governor Brown confer with the governors of Oregon and Washington and seek the co-operation of those states in preparing separate but concurrent and co-ordinated studies and plans for their portions of the route.

The report states that "The natural character of the coastal area of California is such that a scenic route through the area would be a priceless asset in fostering the preservation and public use of world-renowned scenic areas, recreation areas, sites of historical value and in promoting the economic welfare of the area traversed and the State of California as a whole."

The proposed route would compare as a pleasure route with the Blue Ridge, Appalachian and Great Smoky Routes and the Mississippi Route established in other parts of the country.

The report recommended:

"All new or existing highways comprising the scenic route should be located and designed to preserve the natural landscape through rural areas, which may be accomplished by acquisition of suitable land, beyond right-of-way needs, or by scenic easements through appropriate state agencies. For urban areas the route should be appropriately designed for a high order of utility, safety and aesthetic quality. The terms 'utility, safety and beauty', as applied to the Mississippi Valley Parkway, should govern the design and construction of the entire route."

Director of Public Works Robert B. Bradford said the route would provide motorists with an "unparalleled and changing panorama of beauty." He said that "not only are there many miles of beautiful scenery that can be viewed from this highway itself, but it will also provide easy access to numerous scenic and recreational areas."

Bradford noted that 95 percent, or 985 miles, of the route in California is in the state highway system and will, in the normal course of events, be improved to adequate standards with state highway funds. He estimated the cost of bringing these highways up to proper standards at a little over $900,000,000 which he said could be accomplished in approximately 20 years under the present financing structure.

The route in California would be about 1,030 miles in length.

During the past fiscal year the Division of Highways approved requests for a total of 27,270 signs, consisting of 5,774 warning signs, 7,198 regulatory signs, 11,762 guide signs and 2,536 construction and other miscellaneous signs.

TWENTY-FIVE-YEAR AWARDS

Employees who have received 25-year awards since those listed in the January-February edition of *California Highways and Public Works*

DIVISION OF HIGHWAYS

Headquarters Office
Horace H. Bosworth
Kenneth A. Keyes
Ann Tucker
Clifford J. Tyack
Paul I. Wagner

District II
Victor Lammers
Henry H. Pickrell

District III
David W. Roberts
Clifford H. Willett

District IV
Leon W. Couch
George R. Weymouth

District V
Henry C. Anderson
Clarence E. Blinn

District VI
U. H. Erickson

District VII
James B. Griffin
Chester N. Wilczek

District VIII
Seth P. Alexander
Herman B. Crass
Bernice Updyke

District X
Robert E. Brown

District XI
Don C. Smith

State-owned Toll Bridges
John R. Doran
Cecil West

Headquarters Shop
Edward H. Higginson
Frank T. Myers

Shop 4
Arthur M. Gehl

Cost Index Down for First Quarter of 1960

During the first quarter of 1960 the California Highway Construction Cost Index continued its downward course. The index now stands at 219.8, a drop of 9.3 points or 4.1 percent from the fourth quarter of 1959, which is a lower rate of decrease than the 12 percent drop which occurred in the fourth quarter of 1959.

Despite continued pressure of wage increases and rising costs of materials and equipment in the construction industry, it appears that highway projects in California advertised for bids in the second quarter may continue to be built at lower cost to the State. Apparently this is due to keen competition (an average of 10.5 bidders per project for the 12 multimillion-dollar freeway projects opened in the first quarter).

Belts Favored For Drivers, Passengers

State, county and city officials in charge of the operation of motor vehicles almost without exception favor the use of seat belts by drivers and passengers, according to a recent article in the Los Angeles *Herald-Express* by feature writer Charles Page.

Page reported that "an untold number of lives and injuries are being saved by the use of automobile seat safety belts in public-owned vehicles, and greater use of the device is being urged by public officials on the basis of this experience.

Seat belts are not new in public vehicles, Page reported. In 1955 belts were installed on state-owned vehicles, and virtually all emergency vehicles in Los Angeles City and County are equipped with belts.

The article refers to statements by State Director of Public Works Robert B. Bradford in a letter to division heads.

Bradford's letter emphasized that the use of seat belts is mandatory in the Department of Public Works, and pointed out that two state employees killed in recent accidents "might still be alive had they used seat belts."

Los Angeles police officers are sold on the use of belts, Page wrote, particularly if they are on patrol duty where emergency runs are routine.

He cited the case of two officers who "are confident they were spared death only because of their safety belts."

The two men escaped with concussions when their vehicle was involved in a collision "with an impact so great that the siren, fastened on a front fender, ended in the seat after the impact and the two rolls taken by the car."

A veteran accident investigator for the Los Angeles Police Department told Page of an accident resulting when a car skidded on slippery streets.

"The driver, whose seat belt was fastened, received a stomach jolt, but his passenger, ignoring the belt, was thrown from the car and received a fractured skull."

Page reported that there are so many other cases, that officials say they can be certain installation and use of belts pays off in lives saved.

R-SR Bridge Users Will Get Pamphlet

Tourists using the Richmond-San Rafael Bridge will soon receive an informative pamphlet answering many of the questions asked about the bridge by those crossing it since its completion in 1956.

The pamphlet, which will be available on request at the toll stations, includes a map of the area served, a brief description of the other bridges forming the "steel triangle," and a more detailed description of the Richmond-San Rafael Bridge including current toll costs for various vehicles.

The map shows how the three bay bridges—the Golden Gate, San Francisco-Oakland, and the Richmond-San Rafael—form the scenic "steel triangle" spanning San Francisco Bay. It also shows how the Richmond-San Rafael Bridge provides access from the interior valley and East Bay cities to the rich recreational areas of the northern California coastal counties.

Another section of the pamphlet contains information as to the length, cost, and capacity as well as the type of span construction of the bridge. Toll schedules for various vehicles from motorcycles to three-axle buses are contained in the pamphlet. A special section is devoted to telling the driver what to do in case of an emergency while on the Richmond-San Rafael Bridge.

Contractor's Letter Asks Co-operation

Personal letters to the public notifying them of the beginning of work on seven and one-half miles of freeway construction on U.S. Highway 91 were received in Corona recently from the contracting firm of Fredericksen and Kasler in an effort to gain community interest and understanding.

The letter indicated that it was to the financial best interest of the individual taxpayer and property owner to have the work completed as quickly and economically as possible. To accomplish this it was necessary to use heavy construction equipment. "We realize, of course," said the letter, "that the presence of construction equipment in any neighborhood is welcomed only by citizens under the age of six. For the rest of us, it's something of an inconvenience—but it is only temporary."

Fredericksen and Kasler state that they will be glad to co-operate with the community in meeting problems in dirt moving, dust, traffic, safety and noise. Their equipment operators are trained to take every precaution, but, they warn, "parents are cautioned that equipment holds great fascination for our mechanically minded younger set."

National Convention For ASCE Planned

Many employees of the Division of Highways who are members of the American Society of Civil Engineers will attend the national convention of the organization which will be held in Reno June 20-24.

The Sacramento section of ASCE and its Nevada branch are cohosts for the convention. General chairmen for the meeting are R. Robinson Rowe, Sacramento, principal bridge engineer of the Division of Highways and former national director for District XI, and Dean Howard B. Blodgett of the University of Nevada. Stewart Mitchell of Sacramento, retired Division of Highways bridge engineer, is program chairman.

More than 100 papers, sponsored by 11 of the society's technical divisions, will be presented during the five-day meeting. Several of the papers to be presented are concerned with the conversion of sea water for domestic, agricultural and industrial purposes, and the problems involved in utilization of land with a saline content.

Highway programs, particularly in the mountain areas, will be under study with the ASCE highway division conducting two sessions, and holding joint sessions with the construction division and the surveying and mapping division. The highway program includes three panel discussions.

Tours and programs are being planned for the ladies.

R-SR Bridge Marks 10,000,000th User

The ten millionth driver to cross the Richmond-San Rafael Bridge turned out to be truck driver Dean Hoagland of Fresno, and his vehicle was a truck and trailer operated by Kings County Truck Lines of Tulare and carrying canned evaporated milk.

Hoagland was a surprised driver as as he pulled into the westbound toll lane just before 4 p.m. on Sunday, March 27, and was asked to wait for a moment after paying the $3 toll for the five-axle refrigerated combination.

The ten millionth driver to cross the Richmond-San Rafael Bridge since it opened in September 1956, was truck driver Dean Hoagland of Fresno (left). Hoagland, whose five-axle combination was hauling refrigerated canned milk from Chowchilla to Eureka, is shown receiving a letter from Governor Edmund G. Brown, delivered by Assistant State Director of Public Works T. Fred Bagshaw (right).

He was greeted by a group of state officials and newspaper photographers and was handed a letter from Governor Edmund G. Brown calling attention to the "10,000,000" milestone in the history of the 3½-year-old bridge providing a direct overwater link between the Redwood Empire area and the East Bay and Central Valley regions.

Representing the Governor at the brief ceremony was Assistant Director of Public Works T. Fred Bagshaw. Others present included Norman C. Raab, chief of the State Division of San Francisco Bay Toll Crossings, who supervised construction of the bridge; Bridge Manager A. P. Simatovich; and Toll Lieutenant R. A. Schimmel.

H. Ray Judah

Former State Senator H. Ray Judah, 78, died on May 5 in his home city of Santa Cruz after a short illness.

Mr. Judah served as a member of the California Highway Commission from May 1936 to March 1939, including more than a year as its chairman.

A native of Menlo Park, he was a grandnephew of Theodore D. Judah, chief engineer of the Central Pacific Railroad in the 1860's. He was a cofounder of the Santa Cruz *News* in 1907, and remained as its publisher until it merged with the *Sentinel* in 1938. He also served as manager of the Santa Cruz Civic Auditorium and as chamber of commerce manager. He retired in 1959 as auditorium manager.

He was one of the organizers of the California Newspaper Publishers Association and was its president for two years in the late 1920's.

Mr. Judah was elected to the State Senate from Santa Cruz and San Benito Counties in 1940 and served until he decided not to run again in 1952.

He is survived by his wife, Eva Bowman Judah; two daughters, Mrs. Barbara Sprague of Santa Cruz and Mrs. Janice Futch of Hayward; and a brother, Floyd Judah of San Francisco.

County Vehicle Fees Total $115 Million

County shares in $115 million of motor vehicle license revenues will be smaller during the 1960-61 fiscal year for 38 of California's 58 counties due to the 1960 federal census, according to State Controller Alan Cranston.

Distribution of the revenue is based on population figures contained in the most recent federal census. The revenue, which is in lieu of a local property tax on vehicles, is collected by the State with approximately 50 percent being returned to the cities and 50 percent to the counties.

Since the federal census is taken only once every 10 years, the population figures used in allocating these funds may not reflect actual population changes, especially during the final years of the old census period. This often means that there will be a wide disparity between the allocations for the last year of the old census period and the first year of the new one.

Estimated apportionments for cities will not show such great fluctuations since population figures are adjusted regularly to encompass special censuses, annexations and incorporations.

Bridge Design Manual Now Available at SPO

The Bridge Department of the California Division of Highways announced publication this month of its "Manual of Bridge Design Practice" for sale to interested individuals in the U.S. and abroad.

The publication grew out of the large number of requests for the information since it first appeared in multilith form in 1952 as in-service training material. The manual has been revised several times since then and is believed to be the only published work containing complete and practical procedures for the design of the usual types of bridges.

The 14 sections of the manual cover such subjects as Bridge Economy, Review of Moment Distribution, Bridge Loadings, Slab Bridges (longitudinally reinforced), Design of T-Beam Highway Bridges, Design of Box Girder Highway Bridges, Simple Span Rolled Beam Bridges, Design of a Welded Girder Highway Bridge, Simple Span Composite Girder Bridge, Design of a Deck Girder Railroad Bridge, Design of Through Girder Railroad Bridge, Simple Span Deck Truss Bridge, Theory of Prestressed Concrete, and Design of a Prestressed Concrete Girder.

The "Manual of Bridge Design Practice" can be obtained from the State of California, Printing Division, Documents Section, North 7th Street and Richards Boulevard, Sacramento 14, California. Postpaid prices per copy are: $12.50 (within U.S. excepting California), $13 in California (includes sales tax), $13.50 outside continental U.S.

GEODIMETER

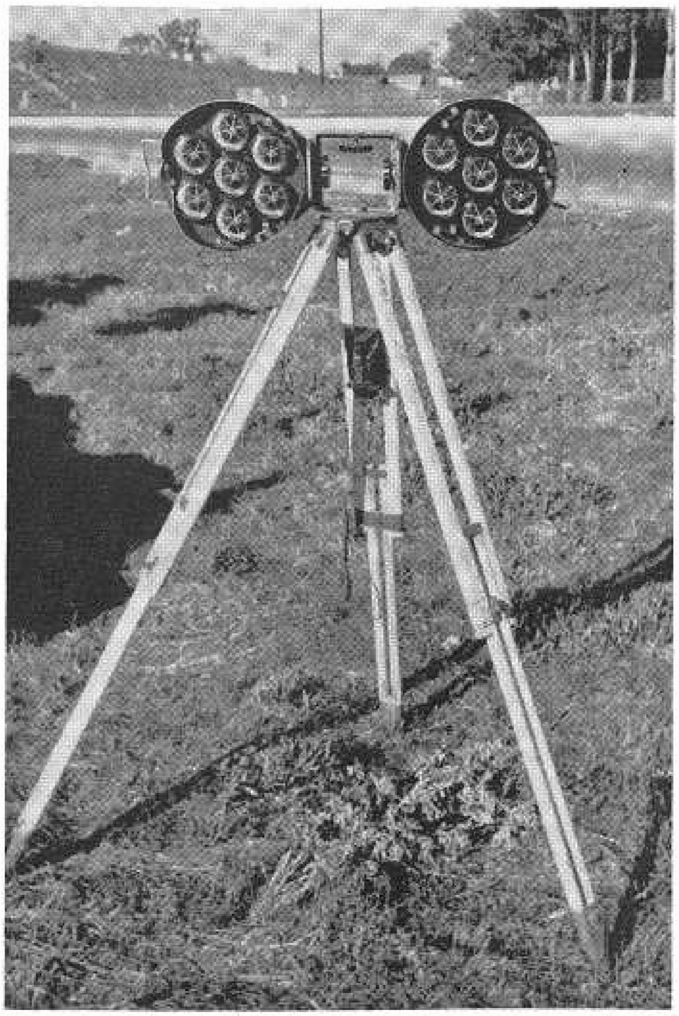
Continued from page 16 . . .

The purpose of this triangulation net was to provide primary control upon which subsequent lower order nets could be based. These secondary nets were to control photogrammetric mapping and location of a transmountain highway, which was to follow the East Fork of the San Gabriel River. The Llano Base Line was established to provide a much-needed extension of the geodetic Control System of Los Angeles County into the Antelope Valley.

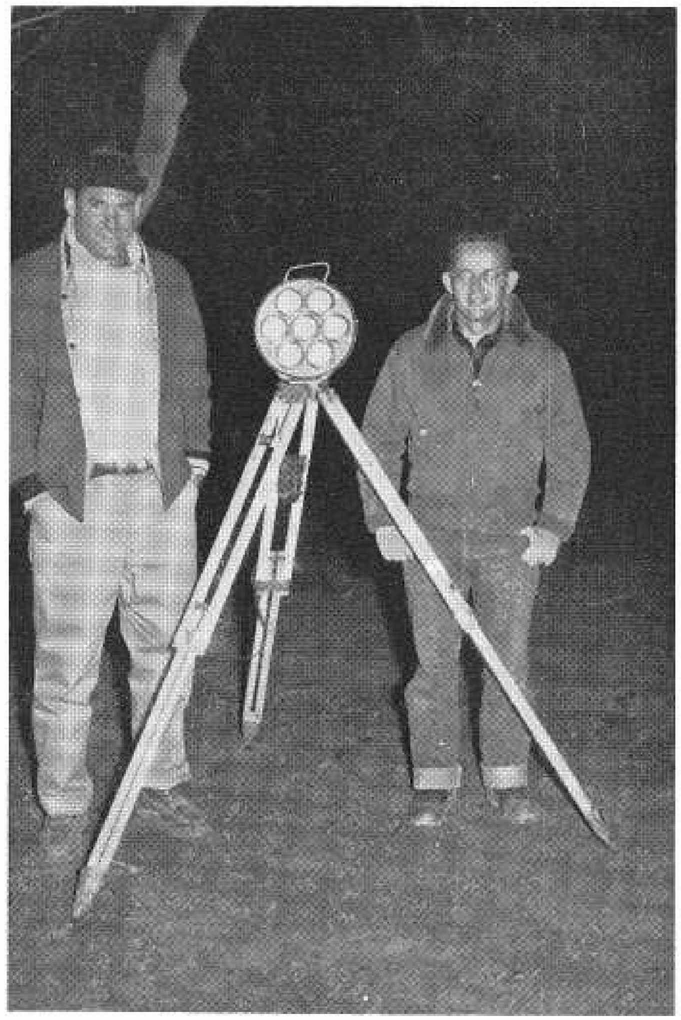
Difficult Terrain

This county triangulation project involved field observations in exceedingly rough terrain, the occupation of stations up to 9,000 feet in elevation, and many grueling climbs for the

To the left is the master unit ready for observations and measurements. To the right is the theodolite to measure the horizontal angles between stations being observed.



The double reflector slave unit used for measuring long lines.



District survey personnel with the single reflector slave unit used for measuring short lines.

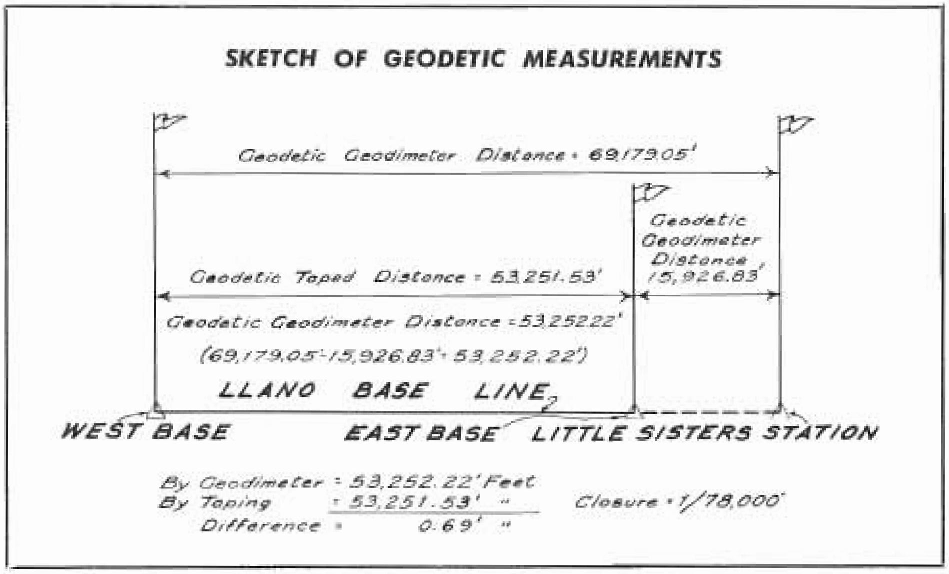
county field personnel. All angle turning was performed at night with a directional theodolite reading to 1/10 of a second, sighting on lights at the distant points. To help strengthen the geometric configuration defined by the points used, a base line approximately 10 miles in length was laid out by county forces along the Antelope Valley floor from station Little Rock H-11 (Llano West Base) to station Black Butte E-9 (Llano East Base). The actual taping of the Llano Base Line was done by an eight-man party over the period of September 2 to 15, 1954. All procedures and standards of first order geodetic taping were used. Briefly, this involved using 50-meter invar tapes which had been calibrated previously by the National Bureau of Standards, and applying the necessary corrections for calibration, temperature, sag, alignment, tension and slope. The last item required spirit leveling over the chaining bucks to determine the actual difference in elevation for each tape length.

The reduced taped length gave a result of 53,259.24 feet as the geodetic length at ground elevation with a probable error of ± .021 foot, or 1 part in 2,564,000. Finally, this distance between end stations was reduced to sea level giving a geodetic distance of 53,251.53 feet. This latter amount was used in the subsequent least squares adjustment of the entire triangulation net. It is interesting to note the Llano Base Line had a preliminary closure of 1 part in 100,000 with a fixed line in the southerly portion of the net some 20 miles away.

All the geodetic work in the establishment of the Llano Base Line was performed by the Los Angeles County Engineer Department under the direction of E. T. Mankey, Division Engineer of their Survey Division, before the State Division of Highways entered the picture.

Base Line Gives Control

The District Survey Department decided to use the Llano Base Line because it was the latest first order base line available in the area and would give the district the needed control to check into, evaluate and adjust our triangulation nets. The use of this base line provides a perimeter of control for our co-ordinate maps covering a large part of the district's area of operations. It gives first order precision at a very low cost.



The state personnel of the geodimeter crew consisted of two men from headquarters and augmented by four men from the district's survey department. The headquarters men were trained geodimeter operators or instrumentmen and the district men did the work of light tending of the slave unit, and measurings of horizontal and vertical angles.

The geodimeter measurement of the Llano Base Line required three nights due to inclement weather. This could have been accomplished in one night, weather permitting. The district crew turned the horizontal and vertical angles used in the triangulation system after the geodimeter crew had finished their distance measurements.

A direct measurement between the West Base, Station Little Rock H-11, and the East Base, Station Black Butte E-9, could not be done. Intervisibility was not possible, without the use of towers, along the base line. The measurement by the geodimeter was accomplished by measuring two segments as illustrated in the accompanying sketch. Both segments were measured from one station, called "Little Sisters," a point set on line at an elevation so that the Llano Base Line would be seen in its entirety.

The difference in the distance from Little Sisters to West Base and Little Sisters to East Base gave the required base line measurement.

Data Are Processed

All field data and measurements were submitted to Sacramento Headquarters and processed through the electronic computer section. The results were returned to the District Survey Office within a week. The processed data was in turn incorporated into the district's co-ordinate control maps.

The geodimeter measurement by state forces of the Llano Base Line gave a closure of 1/78,000. This closure is of a precision suitable for all purposes of the district's use and is highly acceptable.

This district has used the geodimeter in measurements of other lines that have not been so rigidly controlled and we now have full confidence in the exactitude of those previous measurements. The same procedures were employed on the other lines as were employed on the Llano Base Line. The use of the geodimeter is a most satisfactory method for measuring lines of great length, in establishing triangulation nets and for measuring ties to other controls for our co-ordinate maps.

The economic benefits of utilizing the geodimeter over conventional survey crews in taping long lines and triangulation systems are self-evident.

MIXER TESTS

Continued from page 60 . . .

the mixer drum during discharge, the contractor cut a hole in the side of the discharge bucket at the top and installed an inclined swivel chute which could be swung in and out of the discharge stream from the mixer as the bucket was being filled. Samples of concrete during discharge of the first and last quarters of the batch were collected in wheelbarrows which the contractor delivered to pans on the opposite side of the roadway.

100-Batch Combinations

Testing of the samples was performed by personnel of the Materials and Research Department. From each group of 100 batches of each combination of size and mixing time either three or four batches were selected for sampling and testing. Each batch was timed accurately with a stopwatch by personnel of the Bureau of Public Roads.

The tests performed on each portion of each sampled batch were slump, air content, unit weight of air-free mortar, weight of coarse aggregate per cubic foot of concrete, compressive strength and cement content. Comparison of these test properties between the two portions of the batch provided data for evaluating the uniformity with which the ingredients were distributed throughout the batch. In addition to these results, a comparison of all compressive strength results for each combination of batch size and mixing time provided data for measuring the effects on the quality of the concrete produced under these conditions.

The required number of 900 batches was mixed during two days of operation: July 25 and 26, 1959. The work of mixing, sampling and testing proceeded smoothly due to careful preparation on the part of the contractor and laboratory and to trial runs previous to the test dates.

New Mixer Used

The mixer used by the contractor was relatively new and most of the original blades had been replaced with new ones prior to starting work on this contract. The results obtained were, therefore, applicable to mixers of a particular make in good condition.

According to criteria established for performance, all of the tested batches except one were mixed to an acceptable degree of uniformity. The unacceptable batch was the last one discharged prior to the noon shutdown. At this time the first drum of the mixer presumably was empty. It is reasoned that the transfer chute was not closed and that remnants from the first drum dribbled into the second drum and did not become thoroughly intermingled before discharge. While this may be an isolated example of abnormal operation, the possibility of its occurrence is present twice each day when shutdowns are made at noon and night, and at other times if there are prolonged delays in paving operations.

Although, with one exception, satisfactory intermingling of the constituents was accomplished under all operating conditions with this particular mixer, the trends were examined with a view to the possibility that unsatisfactory mixtures might be produced in other mixers that might be in poorer condition or that might be inherently less efficient. The data point to the following tentative conclusions:

For 34 E paving mixers in good condition, mixing times as short as 30 seconds appear to produce acceptable intermingling of the constituents.

Condition Important

For 34 E paving mixers, batches of 40.8 cubic feet (20 percent overload) may not be satisfactorily intermingled when mixed for periods up to 70 seconds, unless the mixer is in first-class condition.

Very careful planning and supervision on the part of the contractor were required in order to discharge batches of cement and aggregates into the skip of the mixer at a rate fast enough to perform the mixing consistently within a period of 30 seconds.

Apart from producing concrete in which the ingredients are uniformly distributed, the question remains as to the effect of mixing conditions on the quality of the resulting concrete. The compressive strength of the concrete is one measure of its quality. The test data indicate little or no effect of mixing time within the limits of the test program but they do point to a moderate loss in strength with increasing size of batch as shown in the following tabulation:

Size of batch cubic feet	*Relative compressive strength, average of all mixing times*
34.0	100
37.4	97
40.8	93

The test results of themselves do not have great significance except as to the performance of a particular mixer in a particular state of condition. When considered together with similar data provided by other states, it is probable that dependable conclusions leading to greater uniformity in specification requirements can be reached.

The contractor used two mixers operating in tandem. Batch sizes were varied simultaneously in both mixers, but mixing time was varied only in the mixer used for testing. It is not possible to distinguish between the products of the two mixers in the constructed pavement. The effect of the batch size on future performance of the pavement can be studied but no conclusions can be reached as to the effect of variations in mixing time.

Dredge, Fill Work For Bridge to Start

The State Department of Public Works has opened bids on the work of dredging and constructing fills in connection with widening of the San Mateo-Hayward Bridge.

The work calls for the dredging of an access channel adjacent to the west end of the bridge approximately 8,000 feet long and 100 feet wide to a minimum depth of 14 feet; and for the transporting of the dredged material to a designated fill area adjacent to the bridge approach road on Brewer Island.

Approximately $70,000 is available for the work.

Norman C. Raab, chief of the Division of San Francisco Bay Toll Crossings, said this will be the first major overwater contract on the $35,500,000 project to widen the two-lane San Mateo-Hayward Bridge to four lanes.

The access channel will be used for contractors' floating equipment for subsequent structural work.

EDMUND G. BROWN
Governor of California

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
CHESTER H. WARLOW, Vice Chairman . Fresno
JAMES A. GUTHRIE . . . . . San Bernardino
ROBERT E. McCLURE . . . . . Santa Monica
ARTHUR T. LUDDY . . . . . . Sacramento
ROGER S. WOOLLEY . . . . San Diego
JOHN J. PURCHIO . . . . Hayward
JACK COOPER, Secretary . . . . Sacramento

DEPARTMENT OF PUBLIC WORKS

ROBERT B. BRADFORD . . . . . . Director
FRANK A. CHAMBERS . . . . Chief Deputy Director
RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)
T. F. BAGSHAW . . . . Assistant Director
JOHN H. STANFORD . . . . . . Assistant Director
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. W. TRASK . . . Assistant State Highway Engineer
J. A. LEGARRA . . Assistant State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
E. R. HIGGINS . . . . Comptroller
FRANK E. BAXTER . . . . . Maintenance Engineer
L. L. FUNK . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
GEO. LANGSNER . . . . Engineer of Design
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . . Equipment Engineer
G. M. WEBB . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . . . Projects Engineer—Carquinez
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area
R. R. ROWE . . . Bridge Engineer—Special Studies

Right-of-Way

FRANK C. BALFOUR . . . Chief Right-of-Way Agent
E. F. WAGNER . . . Deputy Chief Right-of-Way Agent
RUDOLF HESS . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . 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
A. M. NASH . . . . . . 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
C. V. KANE . . . . . . District VIII, San Bernardino
E. R. FOLEY . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
J. DEKEMA . . . . District XI, San Diego
HOWARD C. WOOD . . . . Bridge Engineer
State-owned Toll Bridges

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

ANSON BOYD . State Architect, Chief of Division
HUBERT S. HUNTER . . Deputy Chief, Administrative
EARL W. HAMPTON
Deputy Chief, Architecture and Engineering

HEADQUARTERS OFFICE

ARTHUR F. DUDMAN . . . Assistant State Architect
CHARLES M. HERD . . . Chief Construction Engineer
WILLIAM R. VICK
Principal Architect—Project Management
IAN LEE WATSON . Supervisor of Project Co-ordination
THOMAS CHINN . Supervisor of Scheduling and Control
WILLARD E. STRATTON
Supervisor of Professional Services
HENRY R. CROWLE . . Administrative Service Officer
CARLETON L. CAMP . . . . . . Principal Architect
CLIFFORD L. IVERSON . Chief Architectural Draftsman
EDWARD G. SCHLEIGER . . . . Principal Estimator
GUSTAV B. VEHN . . . . Chief Specification Writer
ALLEN H. BROWNFIELD . Supervising Structural Engineer
O. E. ANDERSON . . Supervising Mechanical Engineer
STUART R. DAVIES . . Supervising Electrical Engineer

LOS ANGELES OFFICE

TOM MERET . . . . Assistant State Architect
THOMAS LEWANDOWSKI
Supervisor of Project Management
JAMES A. GILLEM . . . . . . Principal Architect
CHARLES PETERSON . . Principal Structural Engineer
RAYMOND J. CHEESMAN . Chief Architectural Draftsman
ROBERT J. PALEN . . . . . Supervising Estimator
HENRY C. JACKSON . . Supervising Specification Writer
CHARLES W. RHODES
Supervising Mechanical and Electrical Engineer

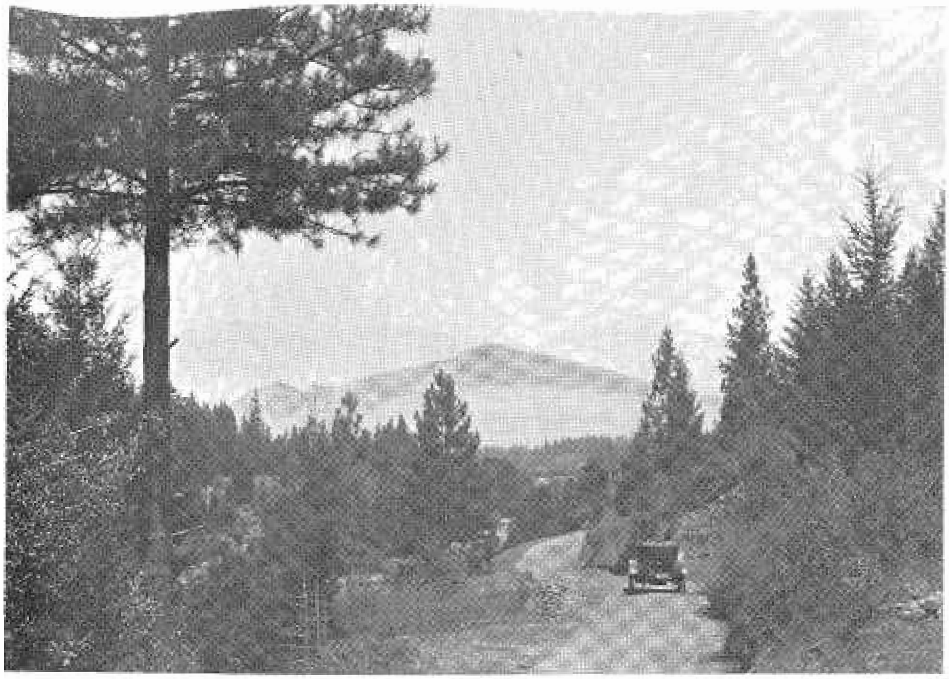
AREA CONSTRUCTION SUPERVISORS

THOMAS M. CURRAN . . . . Area I, Oakland
J. WILLIAM COOK . . . . . . Area II, Sacramento
CLARENCE T. TROOP . . . . Area III, Los Angeles

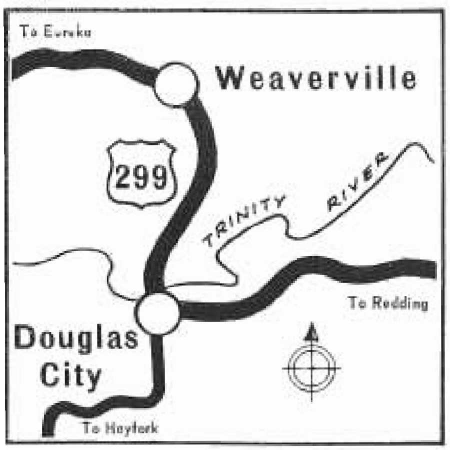
AREA STRUCTURAL ENGINEERS SCHOOLHOUSE SECTION

MANLEY W. SAHLBERG . . . . Area I, San Francisco
M. A. EWING . . . . Area II, Sacramento
ERNST MAAG . . . . Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 18255 8-60 41,000



1914



In the early days of the state highway system, when California was sparsely populated and there was a woeful shortage of funds for improvements, mountain roads got little attention. The one in the old photo above was good for its day. Mountain traffic was light, and mountain drivers were expected to be competent—those who weren't stayed out of the mountains.

Today's drivers want to range freely through the mountains, and routes such as this which give access to important recreational areas must be well engineered for safety.

Both views are made at approximately the same spot, looking north toward the Trinity Alps from a spot slightly south of Weaverville. This route is now US 299. The portion from Redding to Weaverville was taken into the state highway system in 1909, the remainder of the route to Arcata and Eureka in 1915. A portion of an older alignment no longer in use is seen at lower right in the bottom photo.

1958