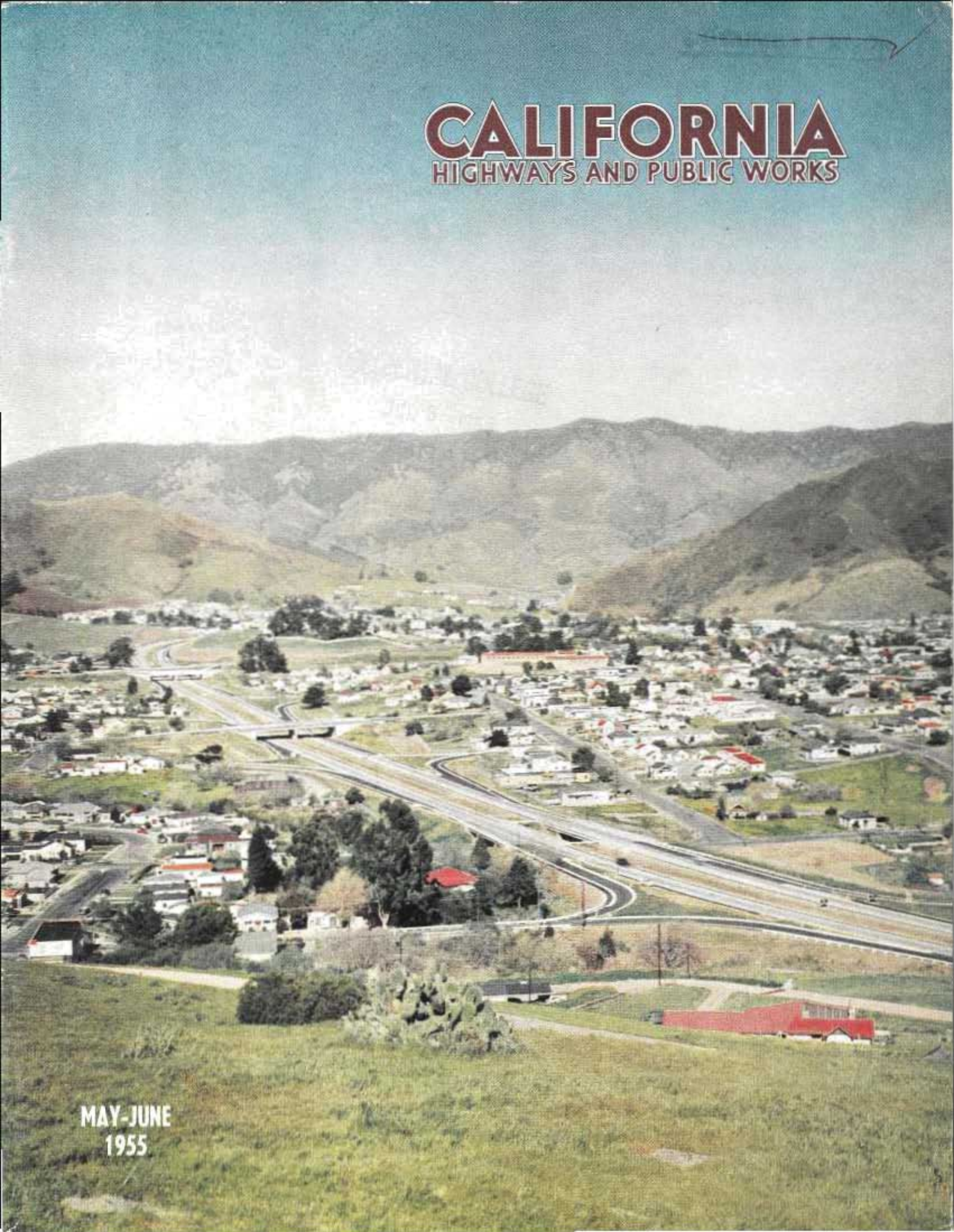
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



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California Highways and Public Works

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CONTENTS

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Borrow Sites . . . Not Borrow Pits

By SAM HELWER
Assistant District Engineer

Project on US 99 Presents Problems of Base Materials

FINDING suitable sources of borrow material for building new freeway lanes and frontage roads through developed agricultural areas has become a major problem in California's accelerated highway construction program.

Earlier freeway projects, with very limited financing available, were of necessity undertaken in a sort of interrupted sequence on any one route. Under these circumstances the individual borrow source problems could be solved in stride. However, with more adequate financing permitting a speedup in closing the remaining gaps between freeway sections, the borrow material requirements have become far more complex.

Problem Acute

The problem of meeting these requirements has been particularly acute in the flat valley section of San Joaquin County through which US Highway 99 is being improved to four-lane divided standards. Starting with the recently completed freeway construction north of Ripon, and extending through to the northerly line of San Joaquin County at the Sacramento county line, the remaining two-lane sections of US 99 are being converted to full freeways in more rapid sequence.

The combination of terrain and adjacent agricultural development has made it very difficult to find a borrow material source, or even a combination of sources, that would furnish the quantities of suitable base and subbase materials required by the present rate of construction.

In solving this problem it is the aim of the Division of Highways to follow excavation practices which will not leave borrow sites detrimental to public interest. Every endeavor is made to leave the sites in such condition as to be actual or potential assets.

San Joaquin Example

How this was done in San Joaquin County is an example of what can be accomplished. By careful cooperative planning with county authorities it was possible not only to protect the natural resources but in some instances to leave the borrow sites in such a condition as to actually increase their potential agricultural productivity.

In addition to established Division of Highways procedures, local ordinances relative to excavation practices were observed in the location and development of suitable borrow material sources. The intent of such regulations is to prohibit excavation practices that might leave unsightly scars, water holes or swamps, or would otherwise destroy potentially productive agricultural land. To this end the San Joaquin County Planning Commission makes a detailed review of applications for excavation permits.

In view of the division's desire to cooperate with local agencies in these matters, the choice of an adequate borrow site of suitable material is generally limited to finding a large enough area of relatively high, unirrigable land in reasonably close proximity to the proposed construction project.

First Major Land Leveling Borrow Site

In the case of the first unit of the development of US 99 to full freeway standards—from north of Ripon to Austin Road, a marginal unirrigable almond orchard was offered as a borrow site by the property owner. About 365,000 yards of excess high ground was removed from approximately 68 acres for the construction of this section of US 99. The excavation operations have left this property in an irrigable state capable of greater productivity of more valuable crops, thereby adding to the economy of the entire community as well as creating a thoroughly satisfied property owner. The obvious economy and logic of the use of such a material site was aptly demonstrated in this instance.

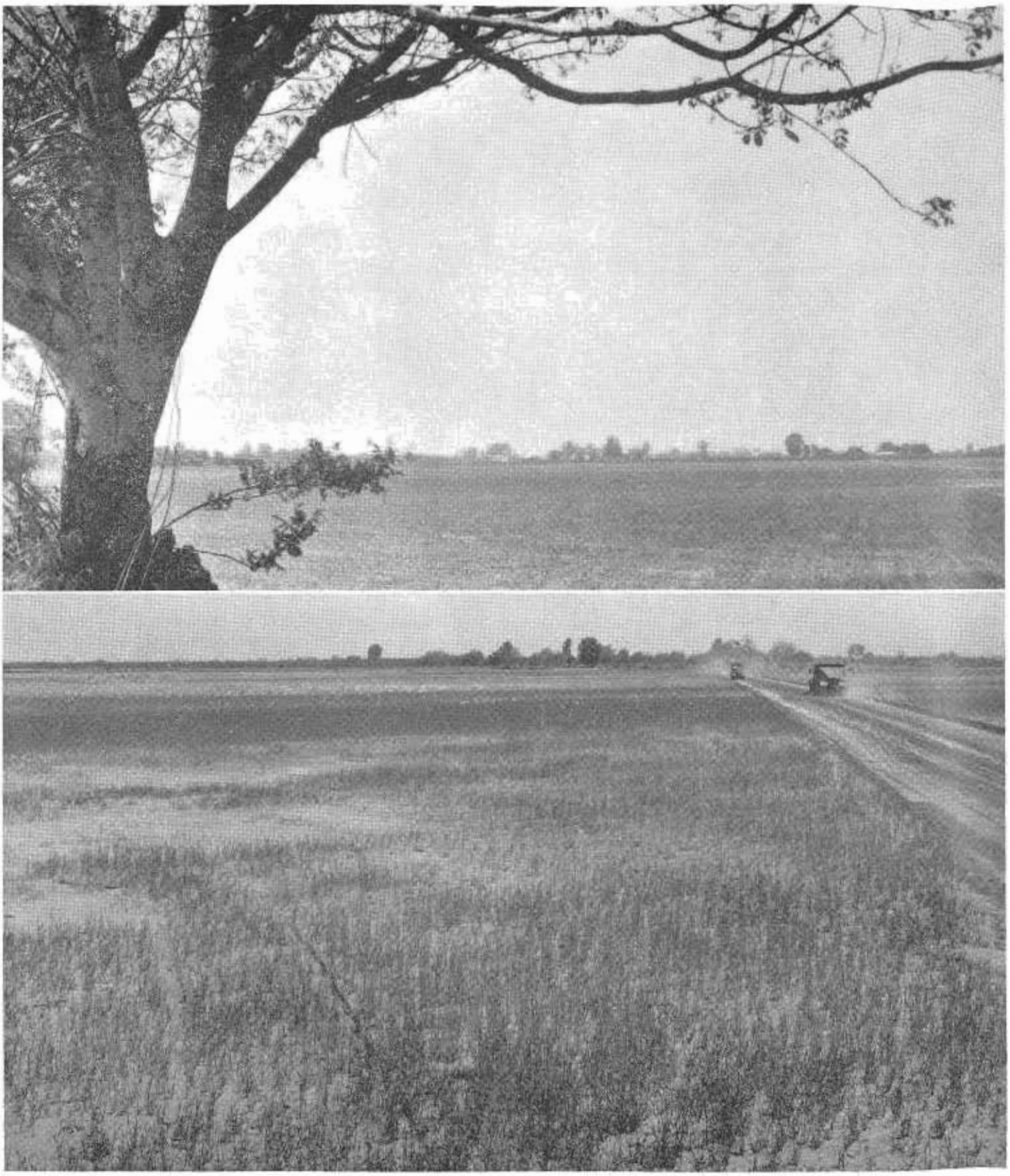
The proposed rapid sequence of construction for US 99 on the Manteca By-pass and on into Stockton dictated that another borrow material source meeting the same general requirements, but on a much larger scale, be found immediately. Extensive search of the area within an economic haul radius revealed not a single source, or even an assembly of smaller sources, that would aggregate a sufficient quantity, except for a 261-acre property located adjacent to the southerly end of the proposed Manteca By-pass.

Borrow Site for Three Projects

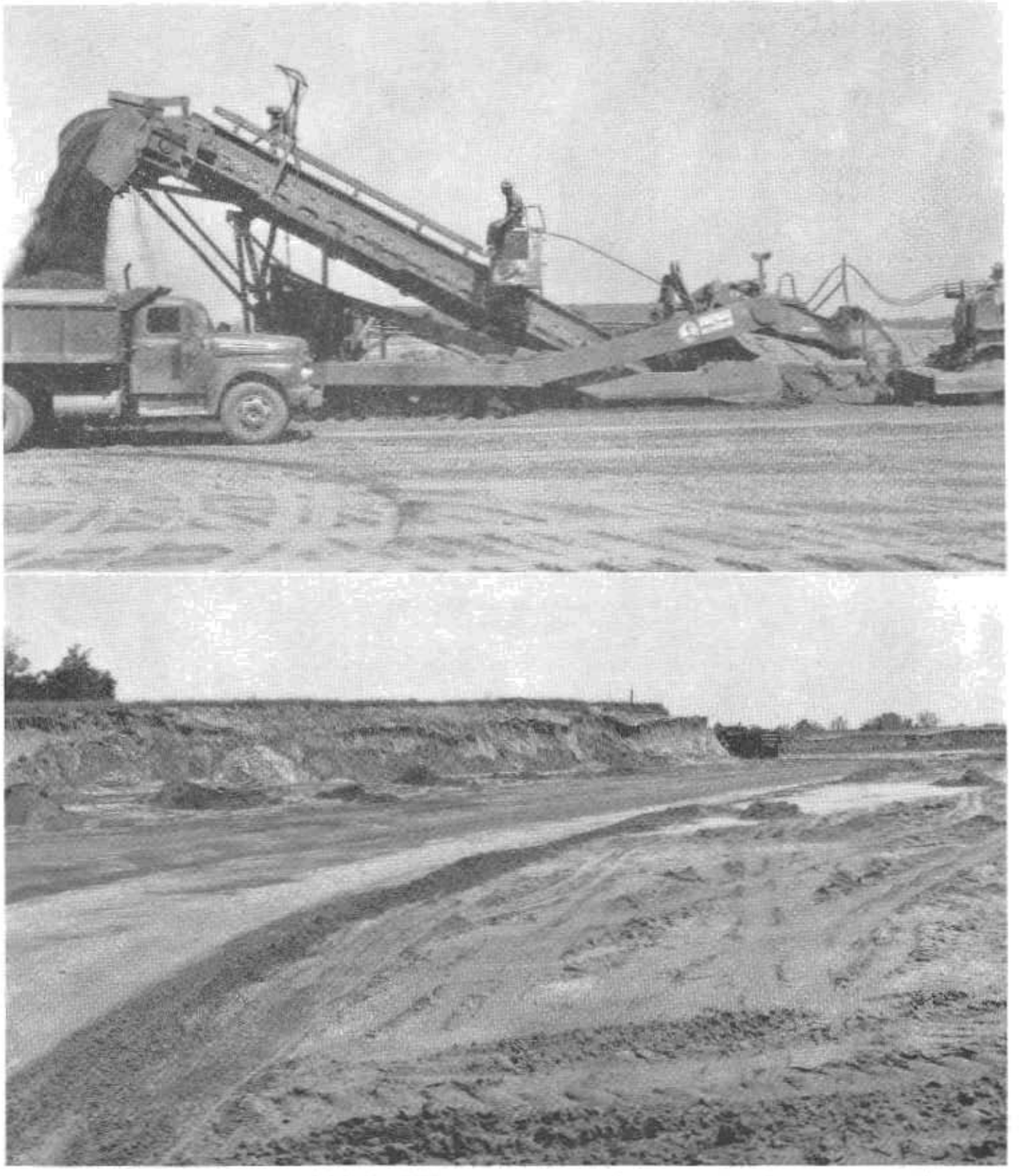
This property, an old vineyard, was owned by a corporation that was more interested in raising grapes to furnish its winery than in furnishing material for the construction of a freeway. Surveys indicated that proper excavation practices would make about 1,300,000 cubic yards of high quality borrow material available for highway purposes.

Acquisition of this borrow material on a royalty basis was unsuitable to both the property owner and the State in this instance. Therefore, after proper setting up of appraisal authority and budget item for acquisition, negotiations were started for the purchase of the entire vineyard. This was accomplished without resort to condemnation procedures.

Using this site excavation operations for the Manteca By-pass project be-



UPPER—Portion of site showing completed grading and sprouting of planted cover crop. LOWER—View of completed grading and start of planted cover crop.



UPPER—Loading with a crawler-type belt loader pulled by a tractor. LOWER—Area of maximum cut showing high, previously unirrigable land being improved to an irrigable graded plane.

gan on October 1, 1954 and are now virtually completed. In addition to about 800,000 cubic yards used for this project, this site also will furnish all the borrow material (250,000 cubic yards) for the project from Turner Station to Kingsley Road (3.1 miles) which is now well under way (K. N. Hatch is the resident engineer on both projects). A third project which will close the gap in the freeway construction between these two projects will use up the balance of the borrow material from this source.

Irrigation Plan Approved

Before operations began, a plan was established that would permit irrigation of the property after the excess high ground had been removed. Grades were established for a 0.05 percent north-south fall from the existing irrigation canal on the south side of the site to form canals through the center of every 40-acre block, and with a 0.15 percent cross-fall irrigation grade east and west from these canals. While these irrigation canals are not completed by the construction operations, the entire area is staked and graded to leave a "pad" from which these canals can be constructed by future owners. After this plan was reviewed by the San Joaquin County Planning Commission, an excavation permit was issued.

Clearing Controls and Operation

Since this property was a producing vineyard, it became necessary to control clearing operations to permit harvesting of crops to the maximum practical extent, ahead of clearing and excavation. The entire property was divided into blocks about 600 feet by 1,700 feet and the contractor was allowed to clear only one block at a time just ahead of excavation operations. A contractual agreement was made with the former owner to pay the State for crops harvested ahead of clearing. Originally it was believed that complete removal of the excess high ground would require several years; this period of time will now be reduced materially due to an accelerated construction program. Actual clearing has been performed, using a large tractor with a brush dozer. This equipment cleared at the rate of about five acres per day.

Crawler-type belt loader pulled by a tractor required push equipment in deeper cuts

Loading and Hauling

Material at the site was loaded by a crawler-type belt loader pulled by a tractor. The loader worked most economically when a two-three-foot bank was encountered. If less cut was encountered, production decreased due to longer loading time per unit of hauling equipment.

If larger cuts were encountered, more tractor push equipment was needed. At the height of hauling operations, hauling equipment carrying 40 to 45 tons was being loaded in 40-50 seconds, a truly economical mass production operation. Maximum tonnage for one eight-hour day was 12,250 tons; the average for the by-pass project was 9,500 tons per day.

Borrow for the Manteca By-pass was hauled almost exclusively by off-highway bottom-dump trucks of 40-45-ton capacity. A total of 15 units of this equipment was in operation. In order to use this equipment, the contractor purchased easements for a haul road through two separate properties between the borrow site and the project. An overload permit was obtained from San Joaquin County by the contractor for overload equipment to cross over Austin Road; conditions of the permit required maintenance of the crossing during construction operations and restoration of the roadway on completion of the project. Another permit requirement was that a flagman be present at the Austin Road crossing at all times during construction operations. The average haul on this project was three miles, and the contract price for the material was 34 cents a ton.

Average Haul Nine Miles

Hauling for the Turner Station to Kingsley Road project is being carried on with 30 10-wheel end-dump trucks carrying 13-ton legal loads and 20 bottom-dump "semis" carrying 20-ton legal loads. All of this material is being hauled over the existing state highway. The average haul on this project is nine miles; the contract price for the borrow material is 72 cents a ton. All of the material removed is weighed on a platform scale of 70-ton capacity.

A comparison of borrow material prices on the two going projects provides an excellent index of the cost of hauling this material. Both projects used identical material from the same material site. The successful bidder on both projects was the same contractor, A. Teichert and Sons, Inc. The only difference has been in the haul; the average haul for the second project was six miles greater for the second project. This indicates a hauling cost of 6.33 cents per ton mile. On large projects requiring 1,000,000 tons of borrow, which is quite common today, each mile increase in haul distance will increase the cost of the project by more than $60,000.

Quality of Material

The material deposit consists of a ridge of loose sandy wind-modified soils classified agriculturally in the Delhi and Hanford series. The Delhi

. . . Continued on page 13

Redwood Highway

Petaluma-Santa Rosa Freeway Progressing

By G. E. DILLON, Resident Engineer

CONSTRUCTION is now well under way on the southerly portion of a new freeway section of the Redwood Highway which will eventually extend from Petaluma to Santa Rosa. This will be a continuation of the 38 miles of existing and proposed freeway leading northerly from San Francisco, over the Golden Gate Bridge through Marin County and to Petaluma in southern Sonoma County.

Work began in the summer of 1953 with a $400,000 contract, awarded to the firm of Ball and Simpson, for the embankment approaches to the bridges to be constructed across Petaluma Creek and over the Lakeville Highway and Northwestern Pacific Railroad lines.

Erickson, Phillips and Weisberg started work on the $850,000 high-level, twin bridges across Petaluma Creek late in 1953 (see *California Highways and Public Works* for May-June, 1954). The structures are now completed and have been opened to the contractor's vehicles hauling excavated material for continuing the embankment construction northerly from Petaluma Creek.

The stage was then set for awarding a road contract for the construction of a substantial portion of usable freeway. Parish Brothers and the Carl N. Swenson Company, Inc., were the successful bidders at $3,425,000, from a field of 13 who submitted proposals, for six miles of completed freeway extending from a point one mile south of Petaluma Creek to the Denman Interchange connection with the present highway, plus an additional two miles of grading. Work is now about 40 percent complete on this Petaluma By-pass section of freeway.

Retention of the extra half-cent of gas tax money and other proportionate taxes by the Legislature early this year permitted financing of the second major road contract approximately a year earlier than might otherwise have been possible. Parish Brothers and the Carl N. Swenson Company were again low bidders, recently, at a figure of $2,140,000 for this project which will continue the freeway northerly from Denman to Wilfred crossing, four miles south of Santa Rosa. Plans are now being prepared for a future contract which will complete construction and connect with the south end of the existing Santa Rosa Freeway.

Avoid Business District

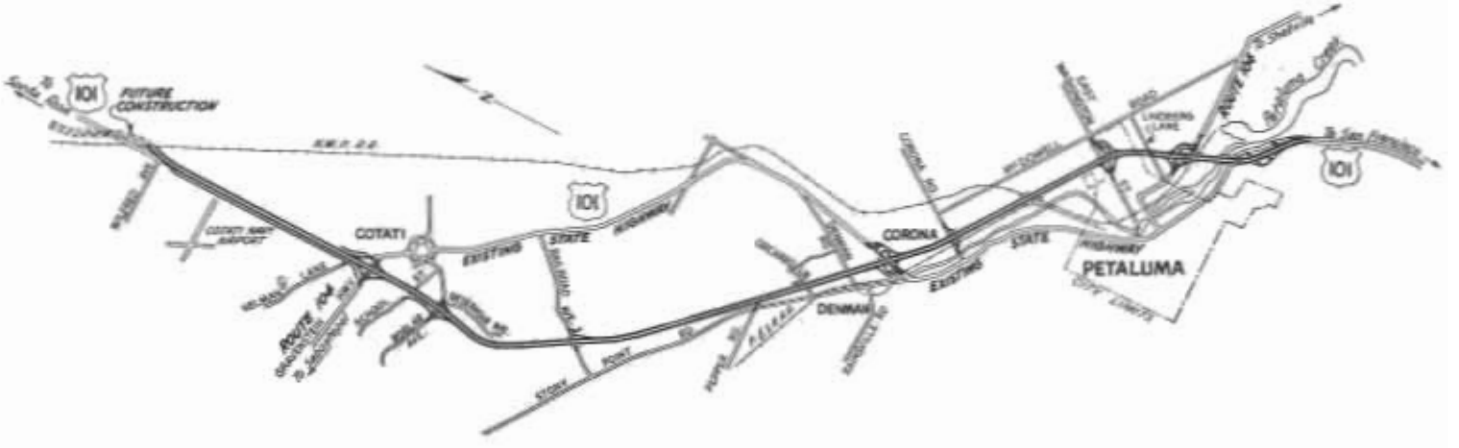
Historically, lines of communication approaching Petaluma from the south have been hemmed in by Burdell Mountain to the west and by Petaluma Creek to the east, forcing roads to wind their way through the city of Petaluma rather than over the more direct and level terrain east of the city. The construction of the major high level structure across Petaluma Creek is the key to the successful relocation away from the busy downtown city streets.

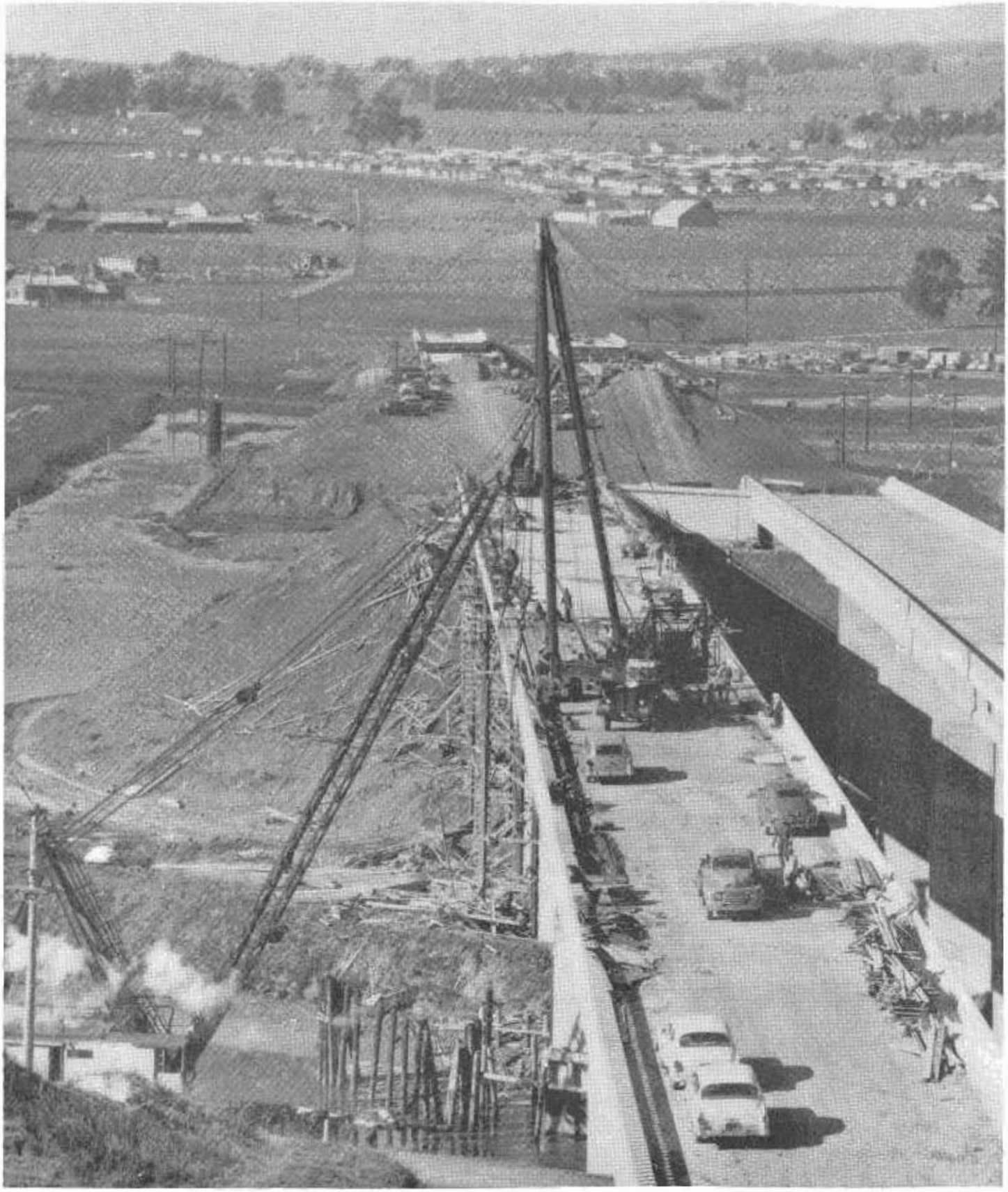
Steady population growth of Petaluma combined with a sharp increase in highway traffic, especially since World War II, has dictated the need for a new traffic artery between Petaluma and Santa Rosa; the most pressing requirement being for the section bypassing Petaluma, through the main downtown streets, of which, the Redwood Highway has always passed. Traffic on the rural portions of this existing highway varies from 12,000 to 20,000 cars per day now.

Full Freeway Basis

This facility is being developed on a full freeway basis, that is, with complete control of access and with grade

Highway US 101 Freeway from south of Petaluma to Wilfred Crossing will stretch along this route when completed late in 1956. Work on plans for remaining 4½ miles of freeway between Wilfred Crossing and Santa Rosa are progressing.





Barge crane and A-frame lifting final precast girder into place on northbound bridge over Petaluma Creek. Route 104 separation and overhead visible behind Petaluma Creek Bridge. Freeway right of way shown curving to left in background, looking north. This and other photos by Petaluma Argus-Courier.

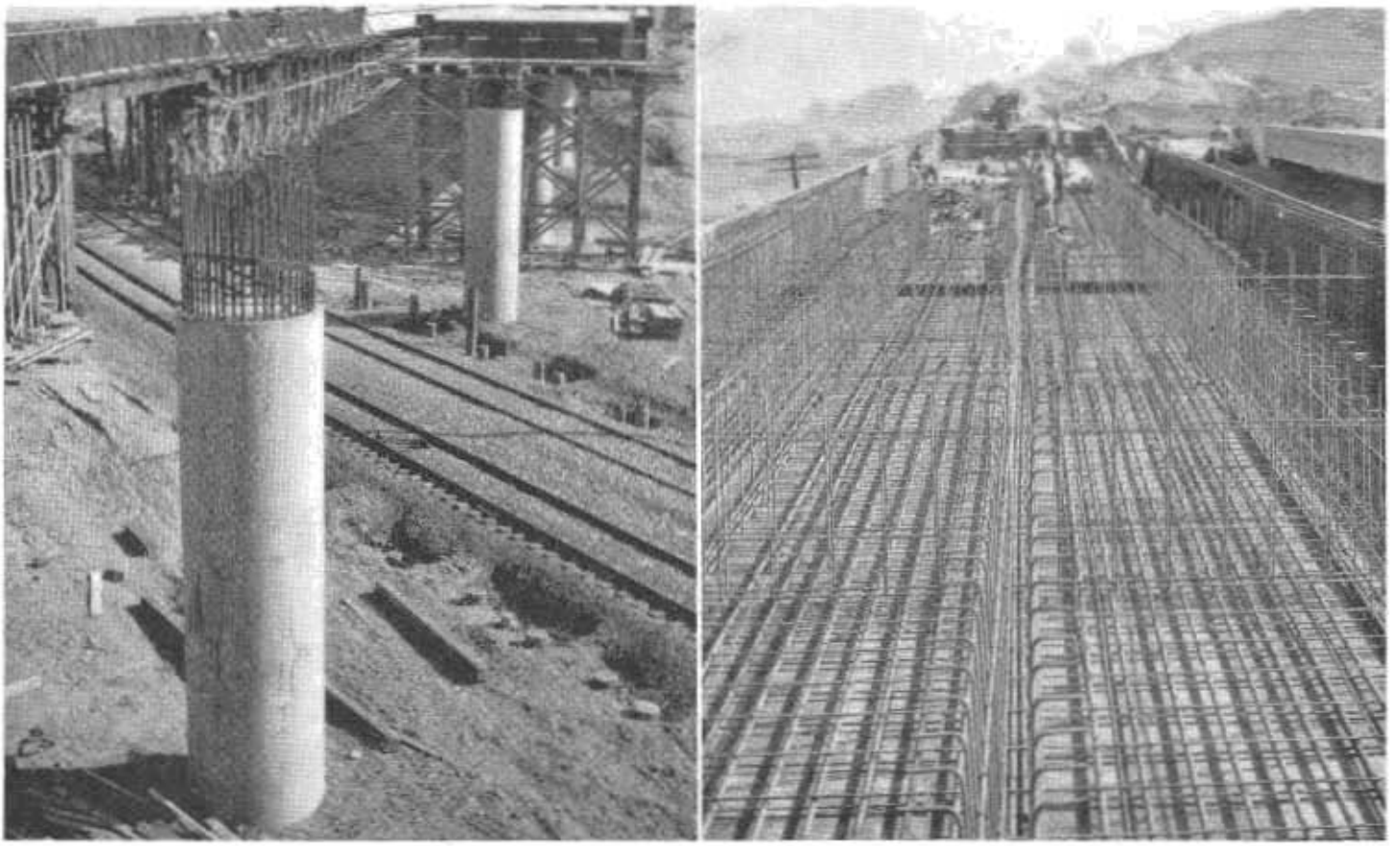
separations for all freeway crossings and left turning movements. Two 12-foot traffic lanes in each direction separated by a 40-foot division strip will allow for future expansion to six lanes when and if necessary at some future date.

Freeway alignment was established with relatively few easy 2,500-foot minimum radius curves, ruling grades are 3 percent, and right of way width is 170-foot minimum.

the existing highway south of Petaluma Creek and going north there will be full interchanges at the crossing of the Lakeville Highway, at Washington Street in the City of Petaluma, and at Denman where the freeway crosses the existing Redwood Highway. There will be an on-ramp at Pepper Road, an off-ramp at Railroad Avenue south of Cotati, a partial interchange at Roblar Avenue in Cotati, and then a full interchange just

Illumination is planned at nearly all interchanges and important connections to the freeway. Fluorescent signs will be installed at the most heavily-traveled turnoffs.

Perhaps the most dramatic phase of construction so far has been the erection of the huge precast concrete girders of the Petaluma Creek twin bridge. The long center span of each structure was bridged with eight 110-foot concrete girders weighing over



LEFT—View of southbound bridge at separation and overhead, looking south. RIGHT—Setting steel in northbound bridge of Route 104 separation and overhead, looking south.

Structurally, the freeway consists of eight inches of portland cement concrete pavement on four inches of cement treated subgrade and six inches of selected material. Ramps and connecting roads are of plant-mixed surfacing on cement treated base and selected material.

Inasmuch as the artery is being developed on a full freeway basis, numerous interchanges have been planned to furnish complete flexibility of movement. Beginning with an interchange at the connection with

north of Cotati where the freeway crosses the Gravenstein Highway and rejoins the Redwood Highway. Between Wilfred and Santa Rosa, other interchanges are now in the planning stage.

Twenty-six Bridges

In connection with the construction of these interchanges and other road, creek, and railroad crossings; a total of 26 separate bridges are required at 15 different locations between Petaluma and Wilfred, ranging in length from 20 feet to nearly 900 feet.

70 tons each. The bridge contractor arranged with the Ben C. Gerwick Company to fabricate the tremendous beams in their Petaluma casting yard. The girders were barged down to a position below the span and carefully hoisted into place by means of a giant barge-mounted crane and a smaller A-frame working from the deck of the bridge. Completion of this important bridge opened the way for earth moving operations by the new direct route across Petaluma Creek to the heavy fills beyond

affording a shorter, more economical haul than the only other available route around through the downtown sections of Petaluma.

Two Parallel Structures

The next most important structure is the Route 1-104 separation and overhead which carries the freeway over the Northwestern Pacific Railroad tracks and the relocated Lakeville Highway. It is a reinforced concrete box girder bridge, consisting of two parallel structures, one 534 feet and the other 641 feet in length, each composed of eight spans supported by reinforced concrete abutments and piers with concrete pile foundations. Each structure will provide a clear roadway width of 28 feet between curbs. Work is now about two-thirds complete.

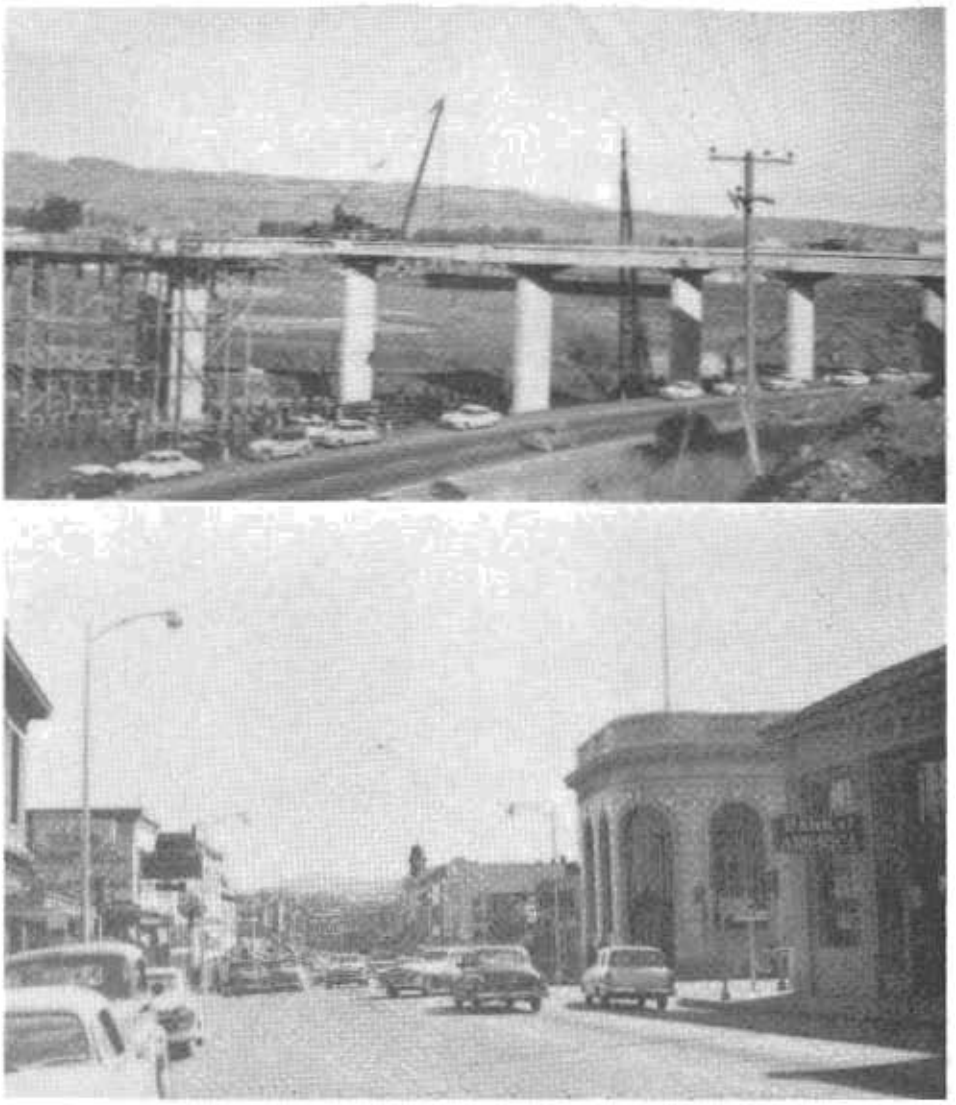
The recently completed Washington Street Overcrossing is a reinforced concrete bridge, 202 feet in total length, composed of two box girder spans and two slab spans, supported by reinforced concrete abutments and center bent with concrete pile foundations. The bridge will provide a clear roadway width of 28 feet between curbs and one 5-foot sidewalk.

The smaller bridges over Lynch Creek and Washington Street Creek have been completed and work on the off-ramp bridge across Washington Street Creek is in progress.

The other major bridges of the Petaluma Bypass contract at Corona Road, Denman Road and the North Petaluma Overhead are of the concrete box girder type. The three major bridges of the Cotati By-pass contract at Railroad Avenue, Roblar Avenue and the Gravenstein Highway (a second crossing of Route 104) are of the open concrete girder type.

Unusual Features

One of the most unusual features of the construction of the roadway itself is the large amount of grading and overhaul involved. On the Petaluma Bypass section, now in high gear, Parish Brothers will be moving a total of 1,400,000 cubic yards, an average of 1.6 miles for 110,000,000 station yards of overhaul. Nearly a third of this, moreover, will be hauled an even greater distance of about 2½ miles.



UPPER—Hoisting precast girders into place on northbound span of Petaluma Creek Bridge. LOWER—Existing US 101 through congested main street in Petaluma.

At the south end of this project the contractor is using trucks and shovels partly because of the long haul, but principally because of the requirement that the movement of excavated material across the new Petaluma Creek Bridges conform to legal load restrictions. He has been moving an average of 8,000 cubic yards per double shift of 16 hours with a fleet of 15-yard, rear semidump trucks and two Northwest shovels. At the north end of the contract he has been moving an average of 4,000 cubic yards per nine-hour day with a fleet of 12 to 14 scrapers. So far, the rippers have been able to loosen all material and no drilling and shooting has been necessary.

Traffic Control Problem

Cut slopes generally are 1½ :1 with 22-foot benches every 40 feet vertically at the north end where the maximum depth of cut is about 90 feet. The biggest cut at the south end has slopes of 1 :1, with 30-foot benches every 60 feet vertically and a maximum depth of cut of about 130 feet. Most fills have variable slopes from 4:1 up to 1½ :1 with a maximum height of 60 feet north of the Petaluma Creek Bridge.

To ease his traffic control problem, the contractor installed a complete traffic signal system at the point where the freeway crosses the existing highway at Denman. Control by one flagman from a vantage point in a tower

affords efficient and equitable movement of traffic.

Drainage requirements were large in the vicinity of Willow Brook and across Denman Flats as far as Petaluma Creek. Several large culverts were designed to provide for sheet flood flow resulting from the occasional serious flooding of the entire valley when the creeks overflow their banks. At Washington Street, however, it was more economical to enter into a cooperative agreement with Sonoma County for the enlargement of the Washington Street Creek channel, thereby allowing flood waters to run off rapidly at a single location rather than in the form of sheet flow requiring several widely scattered culverts.

Underground Water Conserved

At one location the freeway cuts through a dairy ranch having natural springs which furnished water for stock. The owner's fear that the freeway would intercept and reduce this natural flow affected the establishment of the freeway grade line and resulted in certain measures to conserve all underground water from the freeway underdrainage system and train it to a point where the owner can collect it.

An innovation has been introduced as a paving alternate on the Cotati Bypass contract wherein concrete paving may be placed monolithically 24 feet wide in lieu of the usual 12-foot widths. Tie assemblies consisting of ½ by 30-inch bars will be placed mechanically to a depth of four inches and the longitudinal joint will be formed by sawing.

Major quantities on the Petaluma Bypass contract are: 1,400,000 cubic yards of roadway excavation, 107,000 tons of imported base material, 26,000 tons of plant-mixed surfacing, 32,000 cubic yards of concrete pavement and 14,000 cubic yards of structure concrete. Major quantities on the Cotati Bypass contract which was recently awarded are: 1,100,000 cubic yards of roadway excavation, 96,000 tons of imported base material, 25,000 tons of plant-mixed surfacing, 38,000 cubic yards of concrete pavement, and 4,200 cubic yards of structure concrete.

Changes in Contract

In an attempt to reduce the amount of construction engineering involved in accounting for pay quantities, a few changes have been made on the most recent contract under discussion, the Cotati Bypass project. The specifications for portland cement concrete pavement now state simply that no high subgrade will be allowed and that no payment will be made for extra concrete which must be placed to compensate for unavoidable low subgrade. This eliminates the necessity for time-consuming "stabbing" of the subgrade, i.e., measuring the thickness of the pavement by frequent rod readings before placing concrete, and only sufficient observations will be made as are found necessary to maintain a constant cement factor per lineal foot of pavement.

The quantity of concrete needed for all of the bridges in the contract as well as the quantity of reinforcing steel needed, is being bid as a lump sum instead of a unit price which relieves the bridge engineer of the tedium of hundreds of small and frequently involved calculations. Provisions are made for payment for any changes in plans during construction which alter the original amount of concrete or steel.

Concrete removal, another item which usually calls for considerable engineering measurement and calculating time, is being simplified by paying for pavement removal on a square yard basis and by including the other quantities of concrete removal in the prices paid for earthwork and for clearing and grubbing.

The schedule of construction calls for the freeway to be ready for traffic as far as Denman (Petaluma Bypass) by summer of 1956 and from Denman to Wilfred crossing (Cotati Bypass) by late fall of 1956. Completion of the remaining link between Wilfred crossing and Santa Rosa will depend on the rate future funds accumulate and are allocated for construction.

The Bridge Department Resident Engineer assigned to the Petaluma Creek Bridge was M. H. Jacobs. The work is under the general supervision of Assistant State Highway Engineer B. W. Booker and Assistant District Engineer R. P. Duffy with the author as resident engineer. Federal Aid funds contributed toward the financing.

LEFT—Constructing embankment. RIGHT—Shovel excavating cut.

NATIONAL PARK VISITORS REACH RECORD NUMBERS

National park areas drew nearly 48,000,000 visitors last year, the greatest number in history, and the total this year will likely reach 50,000,000, reports the California State Automobile Association. The attendance was 47,833,913 during 1954, an increase of 1,600,000 over 1953.

Totals for California's four national parks in 1954 were: Yosemite, 1,008,031; Kings Canyon, 511,541; Sequoia, 484,653; and Lassen, 282,443.

Elvas Freeway

Governor Opens Another Approach to Sacramento

By HELEN HALSTED, Assistant Editor

ELVAS FREEWAY, another approach to Sacramento across the American River from the north, was opened to traffic May 12th. The wooden barrier across the freeway at 30th and B Streets was symbolically removed by Governor Goodwin J. Knight, assisted by other state and city and county officials at 11 a.m. Short addresses were made by Governor Knight, H. Stephen Chase, State Highway Commissioner from Sacramento; Director of Public Works Frank B. Durkee, and Frank MacBride, Jr., President of the Greater Sacramento Chamber of Commerce. R. N. Crowell, Chairman of the Sacramento chamber's Highway Committee, was master of ceremonies.

GOVERNOR GOODWIN J. KNIGHT

Several hundred people witnessed the ceremonies and a motorcade lead by Governor Knight traversed the freeway northbound lane from 30th and B Streets and returned on the southbound lane onto 29th Street. Traffic immediately began streaming over the freeway and a traffic count showed that 11,273 northbound and 11,727 southbound vehicles used the new facility during the 24 hours from 3 p.m. Thursday to 3 p.m. Friday.

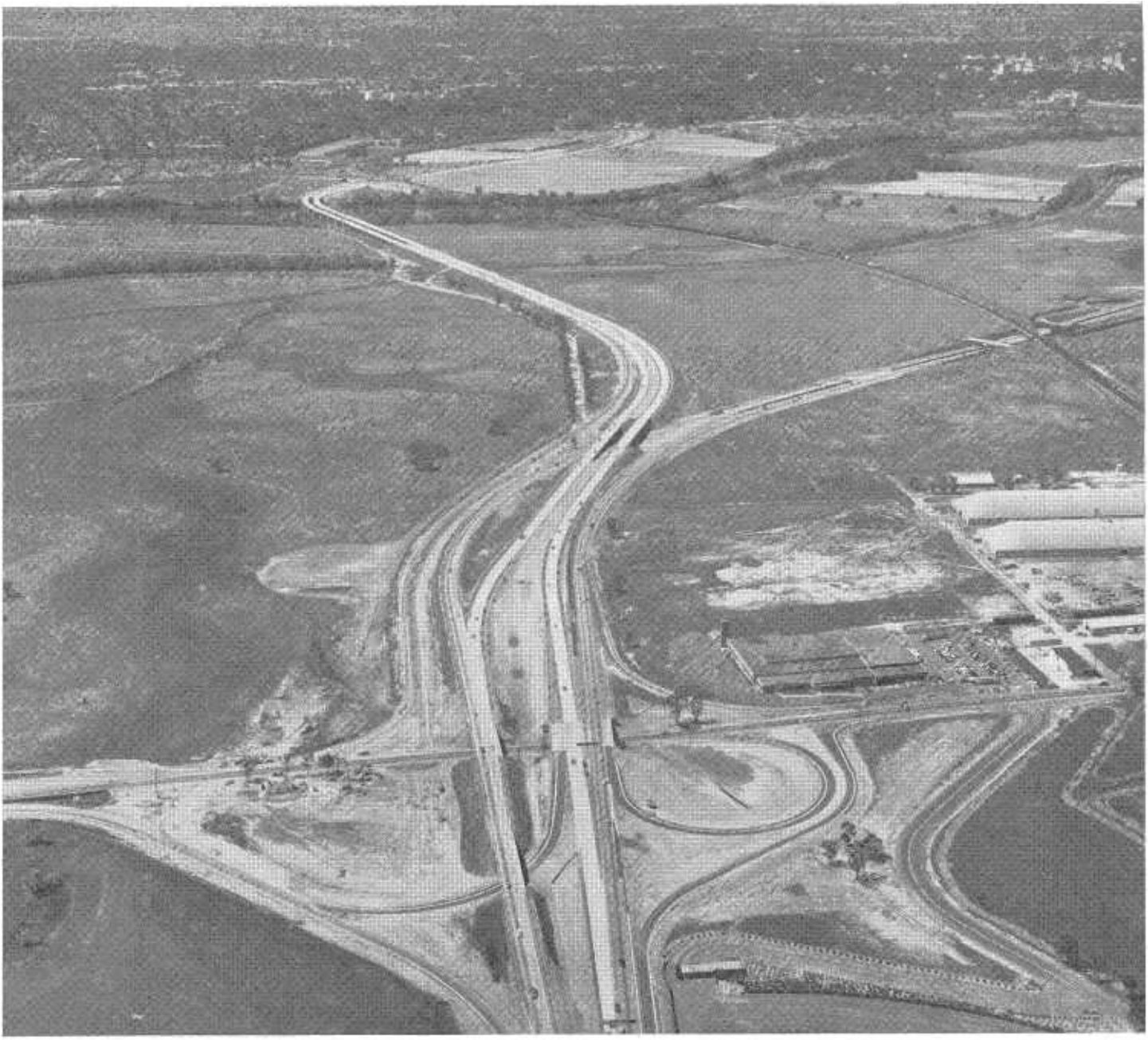
Governor Praises Cooperation

Governor Knight expressed his gratitude for the cooperation extended the State Division of Highways by Sacramento city and county in acquiring right of way for the project and said this area will be immensely benefited by the new highway. He praised the Department of Public Works and the Division of Highways, State Highway Engineer George T. McCoy and F. W. Panhorst, Assistant State Highway Engineer in Charge of Bridges, for a job well done and said the personnel of the department gives service beyond the call of duty. "They have an esprit de corps throughout their organization," he said. "They believe they are important people with an important job and they are right."

Knight, who had just returned from the conference of governors on President Eisenhower's national highway program, referred to California's preeminence in highway construction. He said that California is ahead of every other state in development of safety and good highways, and that in no other state can a motorist travel so many miles over such excellent highways and not pay tolls.

He expressed his satisfaction and pride in having reappointed H. Stephen Chase of Sacramento, first appointed a member of the State High-

HIGHWAY COMMISSIONER H. STEPHEN CHASE



Looking southwest toward Sacramento from above the interchange at Arden Way. The new Elvas Freeway (US 99E) curves off to the left to cross the American River and carry traffic into Sacramento at 29th Street, while the North Sacramento Freeway (US 40) runs off to right to enter Sacramento via 16th Street Bridge.

way Commission by former Governor Warren. "Certainly this great area should be represented on the commission," he said.

Freeway Important to County

Commissioner Chase said the Elvas Freeway is important to the entire county and added: "We of the highway commission and the Division of Highways realize how fortunate we are to have a Governor as well versed and interested in highway matters as is Governor Knight. Because he is so well-informed, his leadership is of the highest type. His personal contribution to solution of the highway problem has been enormous."

Director Durkee said he was very glad the Elvas Freeway job was completed and open to the public but cautioned that it is not the complete solution to the traffic problem in this area. He said: "It was the most pressing problem here when it was started in 1950 but I hope people will not conceive of it as the complete solution."

Durkee introduced several state officials including Fred Bagshaw, his assistant in the Department of Public Works; R. M. Gillis, Deputy State Highway Engineer; A. M. Nash, District III Engineer, Marysville; Milton Harris, Construction Engineer; Fred W. Panhorst, and Don Hislop, resident engineer on the project.

Also introduced were Harry Lord and Charles H. Wick, contractors rep-

resentatives; Acting Mayor Bahnfleth, Sacramento; North Sacramento Mayor R. O. Mayes; Sacramento County Executive Charles W. Deterding, Jr.; Sacramento City Engineer D. J. Faustman; and Selden Menefee, vice president of the North Sacramento Chamber of Commerce; city councilmen, and supervisors.

Four-lane Full Freeway

The Elvas Freeway, will provide 2.9 miles of four-lane full freeway extending from C Street at 29th and 30th Streets in Sacramento to the North Sacramento Freeway at the junction of Arden Way-Swanston Road. The design includes provision for later development to six-lane standards.

Planning for the Elvas Freeway was initiated following completion of the Sacramento Area Traffic Survey conducted in 1947-48 by the Division of Highways in cooperation with the U. S. Bureau of Public Roads and city and county officials.

The survey report recommended:

"That immediate consideration be given to the construction of a new bridge and approach highways across the American River in the general vicinity of Elvas, connecting with the North Sacramento Freeway and Arden Way."

Following the publication of the report early in 1949 and public acceptance of the prime proposal, the Division of Highways made a detailed study of the Elvas routing. On March 22, 1950, the California Highway Commission adopted a routing from 29th and 30th Streets at C Street in Sacramento to the North Sacramento Freeway in the vicinity of Arden Way-Swanston Road, as recommended by State Highway Engineer G. T. McCoy.

Construction plans were advanced rapidly and the first contract was awarded and construction started in July, 1950.

Construction Units

The Elvas Freeway project includes the A Street Overcrossing in the City of Sacramento, parallel two-lane bridges 1,889 feet in length across the American River, two railroad separations (the B Street and Elvas Underpasses), a grade separation just north of the American River (State Fair Overhead), and structures for the interchange with the North Sacramento Freeway (U. S. 40-99E) and Arden Way-Swanston Road.

Work on the Elvas Freeway began in July of 1950 with the start of the contract for the substructure of the parallel American River bridges. The project suffered a severe setback in 1951-52 as a result of steel shortages. The advertising of the B Street and Elvas Underpasses and the superstructure of the two river crossings was delayed for a considerable time until steel priorities could be cleared. Final completion of the freeway project was delayed by unusually wet weather in the spring of 1955.

To construct the parallel spans of the Elvas Bridge, 10,681 cubic yards of structure excavation was required, and 11,287 cubic yards of concrete

View of Elvas Freeway taken few minutes after opening. Looking northeast from A Street Overcrossing.

were used in the structure and footings. Structural steel used totaled 2,233 tons and steel piling aggregated 43,798 lineal feet.

Heavy Excavation

Other structures on the freeway project involved a total of 22,700 cubic yards of structure excavation, 10,700 cubic yards of concrete, and 1,000 tons of structural steel.

Exclusive of structures, the freeway required approximately 240,000 cubic yards of roadway excavation, used 550,000 tons of imported borrow and was paved with 15,700 cubic yards of concrete and 13,500 tons of asphaltic surfacing.

Total cost of the freeway, including engineering and rights of way, was approximately $5,355,000. Construction was performed under six contracts.

Big Traffic Increase

Since 1948, traffic across the American River has increased about 85 percent. The sum of the average daily traffic on the three crossings (Jibboom Street, 16th Street, H Street) existing before the Elvas Freeway was completed was in excess of that on the San Francisco-Oakland Bay Bridge.

The opening of the Elvas crossing to traffic will attract appreciable volumes of traffic from both the 16th Street and H Street Bridges, providing considerable relief from the congestion and delay caused by large volumes of traffic which are presently carried by those two structures.

Motorists traveling between downtown Sacramento and the areas to the northeast will thus have a choice of two or three routes. The Elvas Freeway will, of course, attract only a portion of the traffic now using the other crossings of the American River. Relieved of much of their present congestion, the 16th Street and H Street Bridge routes will probably prove more advantageous to some motorists, depending on their destination and the amount of traffic at certain times of day.

It should be remembered that the Elvas Freeway is only one unit in a system of freeways serving the Sacramento metropolitan area, and this system is far from completion. Its efficiency in providing traffic service is limited to a considerable extent by its relationship to the existing streets and roads to which it presently connects. For example, until the entire north-south freeway which will parallel 29th and 30th Streets has been completed, the flow of traffic on the Elvas will depend on the flow of traffic on 29th and 30th Streets, which are one-way signalized arteries.

Route Designation

The Elvas Freeway will be designated as U. S. Highway 99E. It is a portion of State Highway Route 98 and replaces the former traveled route on 14th Avenue, 65th Street, 57th Street, H Street, Fair Oaks Boulevard and Fulton Avenue between Stockton Boulevard and US 40-99E east of Ben Ali. This route will be relinquished to Sacramento County and the City of Sacramento.

The new location of US 99E extends from Broadway along 29th and 30th Streets and the Elvas Freeway to US 40 at Arden Way-Swanston Road.

BORROW SITES

Continued from page 4 . . .

sands predominate on the higher areas and are, in general, of poor quality for agricultural purposes. Both sands were of high quality for structural use, having average values for the sand equivalent of 35 and 73 for the R value.

The average natural moisture in the material at the site during construction operations, between October and May, was 5 percent by weight. This amount of moisture was beneficial for loading operations and was necessary to permit operation of hauling equipment over the site due to the sandy nature of the material. This natural moisture will decrease during the coming summer months and it is expected it will become necessary to add water at the site.

Noxious Weeds and Erosion Control

To date, the only unfavorable situation encountered in the entire borrow site transaction and excavation operation is the presence of an infestation of whitehorse nettle (*Solanum elaeagnifolium*) scattered over the easterly portion of the site, amounting to about six acres of contamination. This infestation must be eradicated before any borrow can be hauled from this area of the site. After consulting with the office of the San Joaquin Agricultural Commissioner, it was determined that treatment of the infested area would be under the direct supervision of that office. The smaller areas are to be fumigated and the larger areas are to be either fumigated or eradicated by cultivation, the exact method to be determined at a later date.

It was the desire of the County Planning Commission that a cover crop be planted to prevent erosion of the sandy soil during wind storms, planting to be done upon completion of excavation of successive blocks. To comply with this plan a change order was executed with the contractor to plant a barley crop after each block had been leveled to the prescribed grades. This crop was seeded at the rate of 42 pounds per acre. Excellent stands of barley are being obtained which is gratifying to the district and is living testimony to the productivity that will be possible when this land is sold and put under irrigation.

A Creditable, Profitable Operation

After a careful consideration of the many factors involved in an operation of this magnitude, it is clear that acquisition and development of this borrow site has been of definite benefit to all parties concerned. The State has been benefited by virtue of having obtained a large economical source of excellent quality road building material. The road-user's tax dollar has again been stretched to provide additional miles of needed freeways. The community, for future generations, will be benefited by virtue of the higher productivity now possible when this 261 acres of previously unirrigable land is put under irrigation as a direct result of the excavation operations.

MEASURING PAINT THICKNESS

The use of magnetic type meters for measuring paint thickness has proven successful in producing more uniform and effective protective coating on state highway bridges.

Expressway

Riverside County Opens Two Lanes of Limited Access Project

By B. DOUGLAS POWELL, Assistant Road Commissioner

ON APRIL 21, 1955, work was completed on the first stage of the Arlington-Mira Loma Expressway. This is Riverside County's most ambitious federal aid secondary highway project to date, and its completion marks the end of a four-year period of planning, design and construction.

The project is notable from a county highway viewpoint in that the entire 7.36 miles of alignment is constructed on a right of way having full access control, and is of sufficient width to allow for future expansion to four-lane divided expressway standards. Also worthy of note is the fact that planning for the route was based upon providing for the needs of through traffic instead of local service and access, as has been the rule for the majority of the previous Riverside County projects.

> *Riverside County is to be commended for its foresight in the development of its major traffic arteries to modern standards.*
>
> GEORGE T. McCOY
> State Highway Engineer

Direct Connection Needed

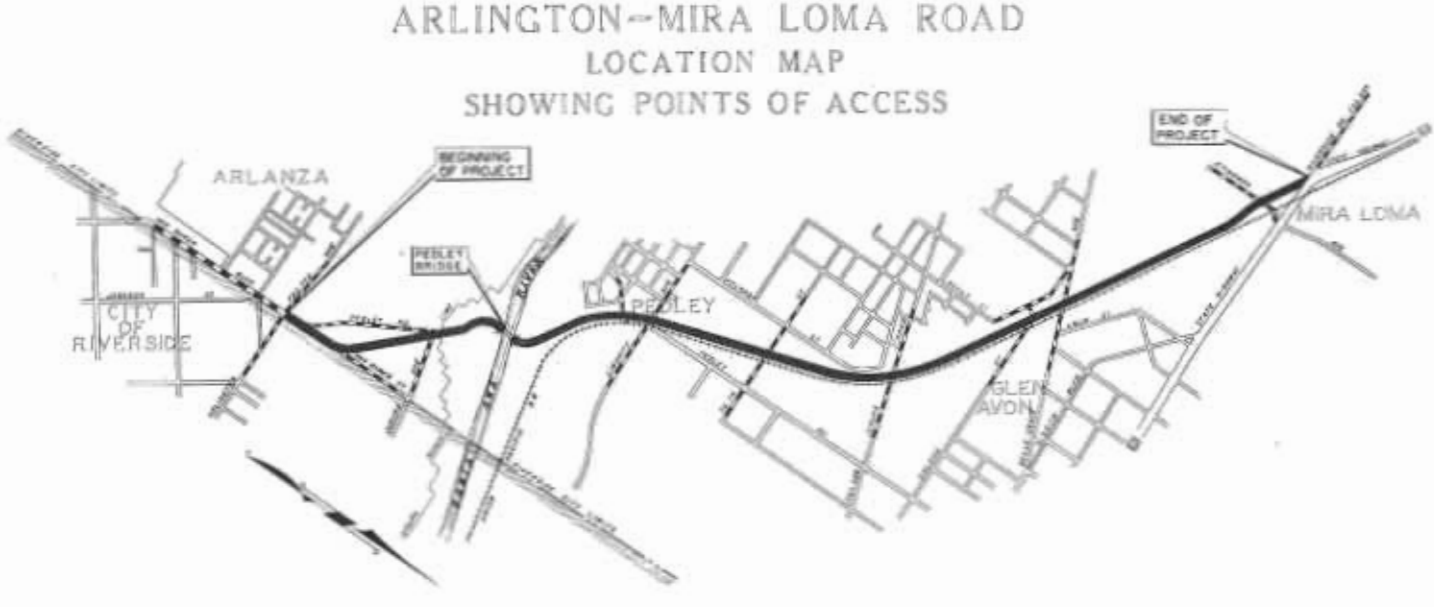
The need for a more direct connection between the rapidly developing areas south and west of Riverside and U. S. Routes 60 and 70-99 (San Bernardino Freeway) to the north had been recognized by the county for some years. It was realized that traffic destined for the metropolitan area of Los Angeles and that generated by the continuous industrial expansion of the Fontana-Ontario districts would represent a considerable percentage of the potential users of such a route.

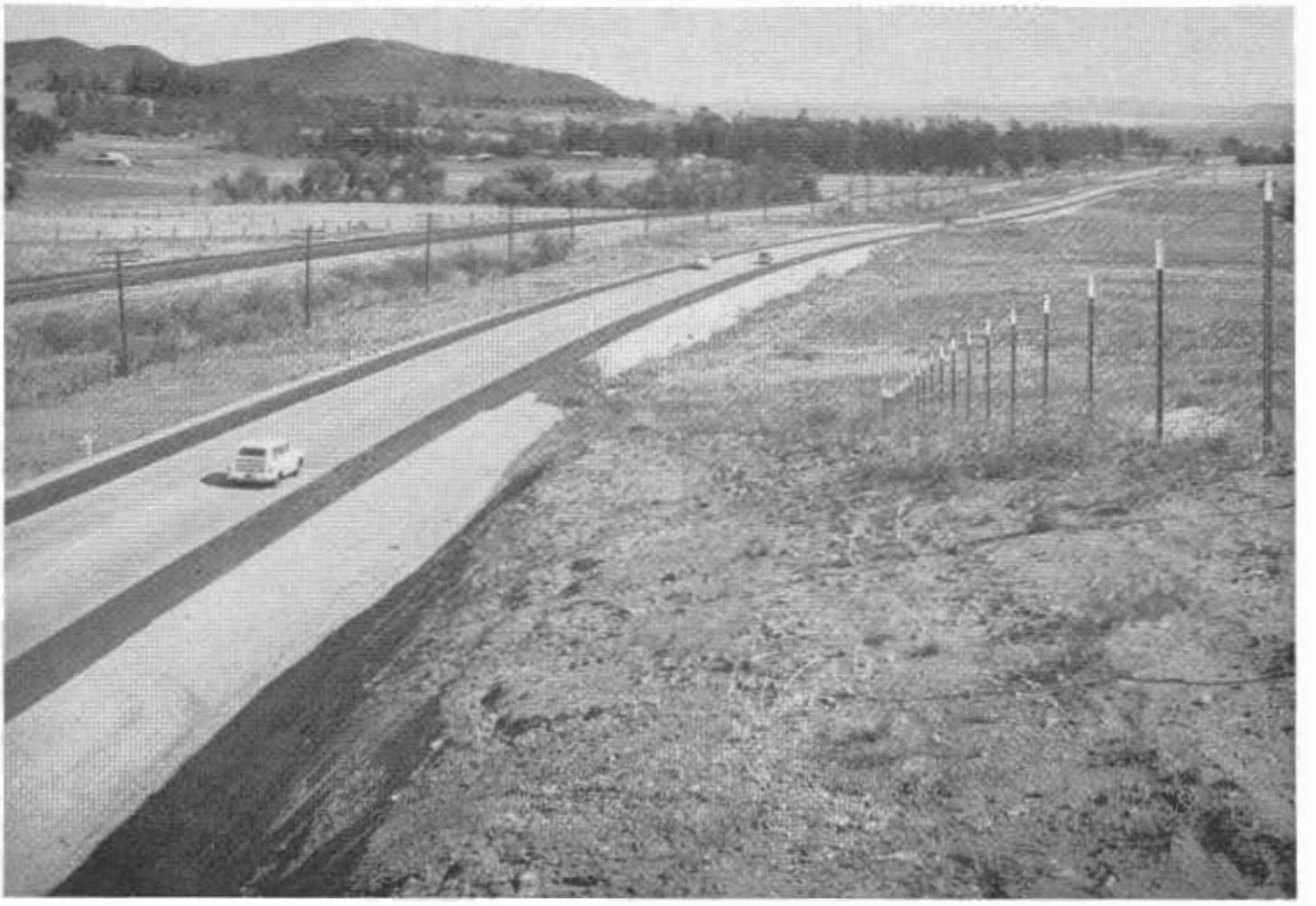
Some initial planning for the new route was done as early as 1943 under the provisions of the State Postwar Planning Act, and some small right of way acquisition was completed at that time. The thinking at this date was primarily on the basis of a local highway to serve the various unincorporated communities north and west of Arlington, and to eliminate the narrow and dangerous underpass of the Union Pacific Railroad just north of the Santa Ana River by passing to the west of it. The Bureau of Public Roads also became interested in the project during the war years because of a proposal that consideration be given to construction of a military access road to connect between the Mira Loma Quartermaster Depot and the Camp Anza Staging area along substantially the same alignment.

Following the end of the war the unprecedented residential and industrial development of the Arlington area and southwestern Riverside made it early apparent that the through traffic to metropolitan centers around Los Angeles was suffering considerable inconvenience by having to use the relatively indirect connections via Pedley and Glen Avon. It was equally obvious that such traffic had no feasible alternate route, since the Pedley Bridge constituted the only available crossing of the Santa Ana River between Route 60 at Riverside and the state highway to the north of Corona.

Origin and Destination Surveys

As a preliminary to actual design, in 1951 the county road department made a series of origin-and-destination





Typical alignment of Arlington-Mira Loma Expressway recently completed by Riverside County under the Federal Aid Secondary Highway Program

surveys of the traffic using the route with the Pedley Bridge as a control point. Analysis of the data obtained showed that nearly 62 percent of the total traffic movement would benefit from a route selection which would be designed to serve to the north and west. An extension of the traffic figures gave a calculated ADT for 1972 of 7,560 vehicles.

Accordingly, and upon recommendation of the road commissioner, the county board of supervisors adopted a resolution in December, 1951, authorizing construction of the Arlington-Mira Loma Road, FAS Route 702, between Arlington Avenue and U. S. Route 60. It was further proposed that the route would be constructed on entirely new alignment, and would run for the greater part of its length parallel and adjacent to the tracks of the Union Pacific Railroad. This location provided a net saving of distance of 1.7 miles over the connection then in use.

Subsequent discussions of the route with the county planning commission, the State Division of Highways, and the Bureau of Public Roads served to confirm the idea that the new alignment was a natural for development as a limited-access expressway on a stage construction basis. Accordingly, and upon the recommendation of these various agencies, the board of supervisors in January of 1952 established the highway as a limited-access facility by resolution, and authorized the road commissioner to proceed with right-of-way acquisition on that basis.

Cross Traffic Problems

The proximity of the proposed road to the main line of the Union Pacific Railroad posed a problem in the potential hazards to cross traffic. It was felt that additional storage space for vehicles awaiting crossing clearance should be provided at all major intersecting roads, and that minimum right of way widths would have to be determined by this storage offset consideration. The final decision was to provide at least 120 feet of right of way at all points, and to flare to the west at major crossings so as to obtain a minimum distance of 150 feet between the center line of the tracks and the center line of the first stage of construction. This arrangement would provide for an ultimate development to four-lane divided construction with a 22-foot minimum median strip. Initial construction would be two-lane and would constitute the ultimate southbound set of lanes, thus being the farthest removed from the railroad at this time.

The plans for the project were prepared entirely by county road de-

partment staff, including all foundation investigation and materials testing work with the exception of Stabilometer testing. This design work was done in close cooperation with the District FAS Engineer and the District Materials Engineer of the San Bernardino Office of the Division of Highways. The technical assistance rendered by state highway personnel and the continuous interest they displayed in the furtherance of this project cannot be given too much credit.

No Design Problems

The final geometric layout of the project presented no unusually difficult design problems. The basic typical section consisted of a traveled way made up of two 12-foot traffic lanes with seven-foot paved shoulders adjacent. Side slopes were 4:1 or flatter in all areas except the heavy cuts. Paving consisted of three inches of plant-mixed surfacing on six inches of cement-treated base. The project was proposed as a select material job, advantage being taken of three sources of suitable base material which were expected to be encountered within the limits of the roadway prism. The thickness of the selected material blanket was varied from 6 to 14 inches dependent upon basement soil conditions. Rural expressway standards of alignment and gradient were adhered to in all respects. Intersections with eight major county roads were designed for access to the project, several of these being channelized. Frontage roads were constructed at three locations to provide access to adjoining properties.

Some delay in the advertising of the project was encountered due to difficulties in right of way negotiations. The county staff was relatively inexperienced in the acquisition of highway right of way on a controlled access basis, and the attendant problems were of considerable magnitude. The final settlements involved building relocations, consideration for well and reservoir facilities, irrigation system reconstruction, some frontage road construction, and property ownership exchanges. Severance damage was high on some parcels, and in one case the center line of construction passed through the front door of a church. Much valuable assistance was rendered by the District VIII Right of Way Agent and his staff, in suggesting possible methods of untangling these many problems and in the obtainment of the final right of way certification.

Completed in April, 1955

The contract just completed was awarded on June 30, 1954, to George Herz and Company of San Bernardino. Their bid of $333,708 was the lowest of the 13 bids received.

The work was started on July 30, 1954, and was carried on without appreciable delay to completion on April 21, 1955.

Construction engineering on the project was performed by county forces with Paul E. Stout as resident engineer. The State Division of Highways Construction Manual and practices are used on county FAS projects with as little deviation as possible. Full use is made of the construction procedures and forms of the Division of Highways, and close cooperation is maintained with the district construction department at all times. The county feels that adherence to this policy has resulted in a much improved knowledge of the changes and current developments in the construction industry by its staff, and welcomes the opportunity it provides to draw on the wide experience of the State in such matters.

The major item in the contract was roadway excavation, the total earthwork being in excess of 210,000 cubic yards. Rather long hauls were necessary, due principally to the wide variation in basement soil and to the placement of the select material blanket course. Total overhaul was approximately 3,700,000 station yards.

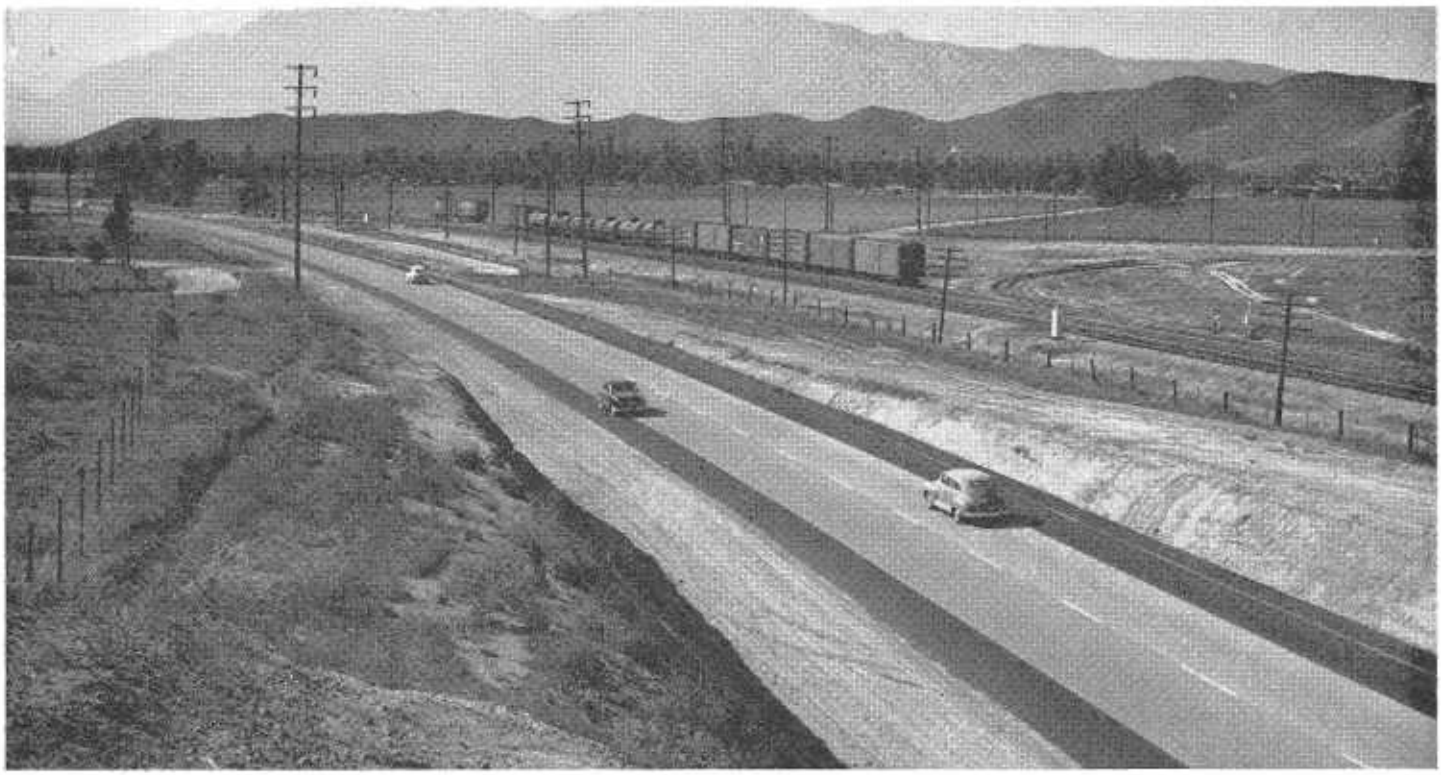
Box Culverts Required

Exclusive of the Santa Ana River, the alignment was crossed by four major drainage channels which required the construction of multiple barrel concrete box culverts. Minor waterways were passed under the road with corrugated metal culverts ranging in size from 78 inches to 24 inches. Due to the proximity of the Union Pacific Railroad, drainage structure requirements and locations were largely controlled by railway installations. Use was made of the existing Pedley Bridge across the Santa Ana River without modification except for resurfacing and the installation of new approach guard railing. Development of the route to full four-lane status will require the construction of a parallel crossing at this point.

The cement treatment of the top six inches of the select base material was performed by Gardner Road-mixers, Inc., of Redlands. This organization has pioneered in the development of specialized types of equipment for this work, some of which were used on the project. Of special interest was a subgrading machine constructed on a standard motor grader chassis and capable of shaping a full 23 feet of the roadbed at a single pass. Also used by the subcontractor during the base operations was a segmented-wheel compacting roller for the compaction of the cement-treatment. Both of these units produced exceptional results and materially speeded up this phase of the construction. Some 110,000 square yards of cement-treated base were prepared and spread, using approximately 3,400 barrels of portland cement.

New Asphalt Plant

The plant-mixed surfacing for the project was produced and mixed in the contractor's new asphalt plant located just west of the Mira Loma Quartermaster Depot about one mile from the north end of the project. This new plant incorporated the latest developments in the field and is one of the finest in the entire valley area. The high production rate possible with this plant resulted in the placement of 1,540 tons of plant-mixed surfacing in one day of operation on this project. A considerable portion of the paving for the project was spread by the use of a new model pneumatic-tired paving machine, an operation which was viewed with considerable interest by state and local road officials and valley area contractors. The machine performed very well, and checks on the finished surface smoothness made by the Headquarters Construction Department Roughometer showed a roughness coefficient of only 8.2



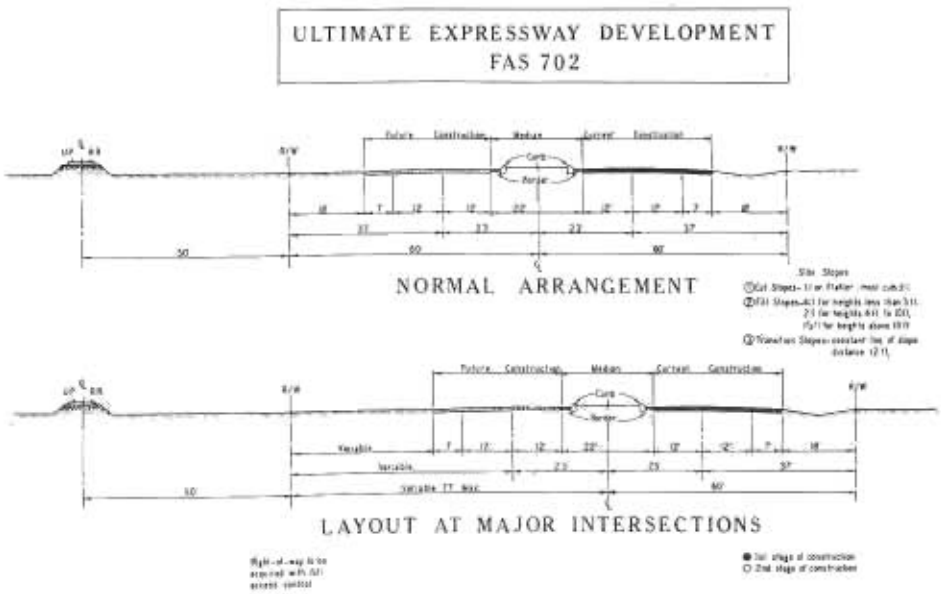
Riverside County's limited access highway between Arlington and Mira Loma built under Federal Aid Secondary Program. This seven-mile project has only seven intersections and will be later converted to a four-lane divided expressway by the addition of another two-lane highway between existing road and railroad.

inches per mile. Approximately 31,000 tons of plant-mixed surfacing was placed under this contract.

Seal coating of the traffic lanes on this road was done by the use of another innovation in road-building equipment. This machine was a self-propelled chip spreading device furnished and operated by Contractors Specialty Company, subcontractors for this phase of the work. Use of this device also attracted a considerable audience from the district construction office and from local contractors. The performance of the machine can best be demonstrated by the fact that the seal-coating of the entire 7.36 miles of the project was performed in nine working hours. The operation of the unit is such that joints are required only very infrequently, one section being sealed continuously for a distance of 5,000 feet without the necessity of stopping to make a joint. Three rollers were required in order to keep up with the pace set by the chip spreading machine.

Miscellaneous Items

Only the traffic lanes of the road were given a medium-fine chip seal coat, all other areas, including frontage roads were treated with a penetration-type seal coat.



Miscellaneous items of construction performed on this contract included the installation of eight and one-half miles of property fence to protect the access, and the demolition of almost 5,000 linear feet of abandoned irrigation facilities.

Additional and extra work on this project resulted in a final cost of $342,149.57 exclusive of preliminary engineering and right of way. This figure represents a cost of $46,500.34 per mile for the completed expressway development.

Traffic counts taken in the brief period since the opening of the new

. . . Continued on page 26

Henderson New Deputy Director of Public Works

Appointment of A. H. Henderson as Deputy Director of the State Department of Public Works was announced on April 21st by Frank B. Durkee, Director of Public Works. The appointment took effect April 22d. Henderson was appointed, Durkee stated, from a civil service list after passing a civil service examination for the position.

Henderson has been in the state service for 37 years; 29 of these years, Durkee stated, were in the Department of Public Works, in different positions in the Division of Highways, Division of Architecture, and in the director's office. Previously, Henderson was assistant director and deputy director of the department for six years under the late C. H. Purcell. He is being promoted from his present position of departmental disbursing officer.

The former deputy director of the Department of Public Works, Russell S. Munro, recently left this position to accept the appointment of Governor Goodwin J. Knight as director of the new Alcoholic Beverage Control Department.

Henderson was succeeded as disbursing officer by Leo S. Fahy.

APPRECIATES HIGHWAYS

California Highways and Public Works

DEAR SIRS: Please note my change of address from 435 North Catalina Street, Pasadena 4 to 1547 North Durfee Avenue, El Monte.

I hope to continue to receive your wonderful magazine. It has helped my driving habits and enjoyment of my native state. It also gives me good foundation for explanation to out-of-state people where our gasoline tax goes and the fine highways we have. Your department has made California a much prettier state and much safety has been added to our driving through your efforts.

Thank you,

GEORGE H. BROWN

BAKERSFIELD IMPROVES A MAJOR CITY STREET

By J. HOLFELDER, Bakersfield Director of Public Works

Bakersfield recently completed the improvement of Union Avenue between 21st Street and Nile Street. The project is a typical example of the expenditure of State Highway Users Tax Funds to improve a major city street in this city.

Although a relatively small project (0.28 mile) the job included more work items than the average larger project. The operations included:

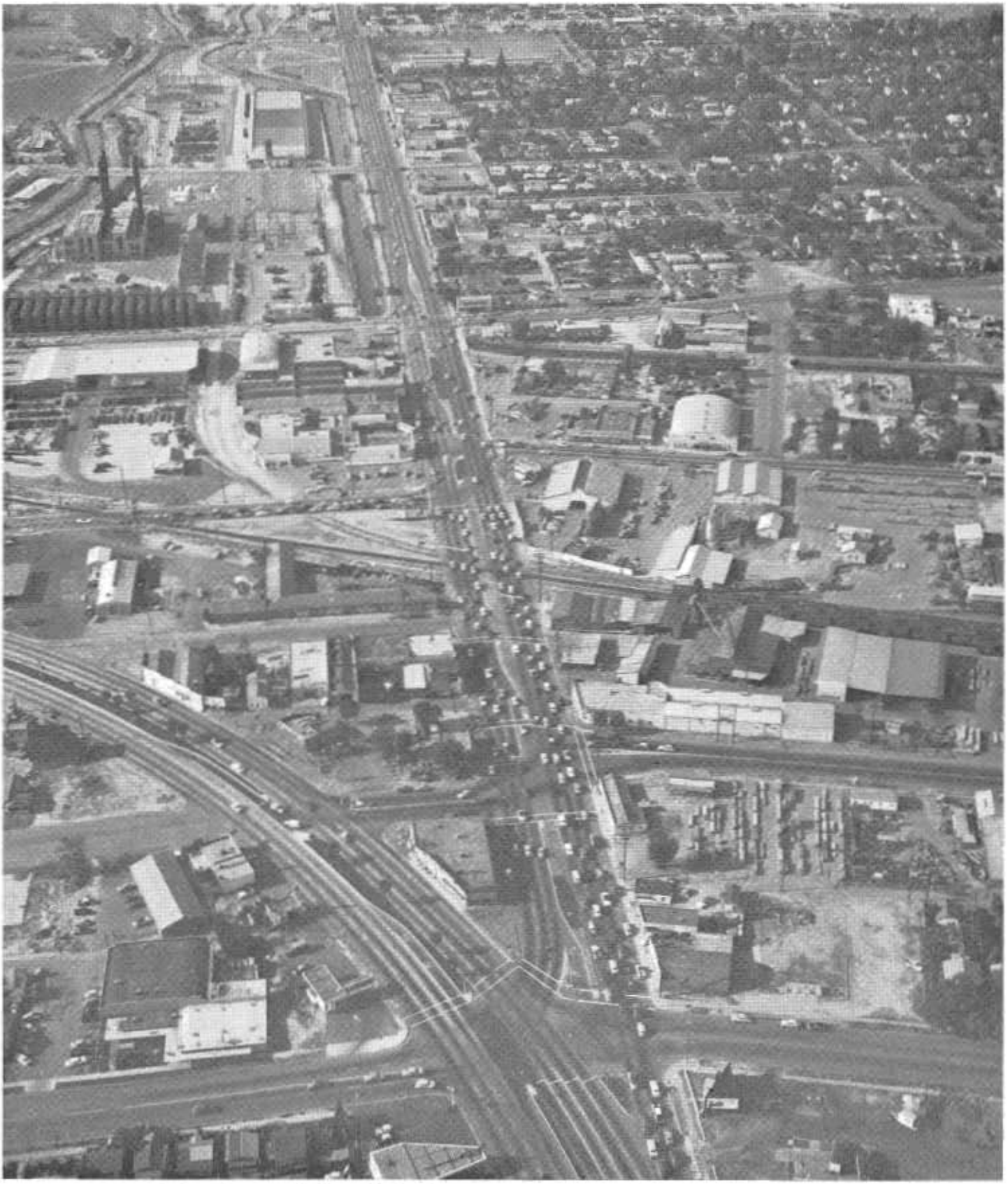
1. Widening the existing pavement with four-inch plant mix surfacing.
2. Resurfacing existing pavement with one-inch of plant-mixed surfacing.
3. Removing and reconstructing curbs, gutters, sidewalks, driveways, and constructing curb dividers.
4. Constructing storm drains with inlet junction structures.
5. Installing traffic signals and mercury vapor street lighting including traffic-actuated signals at Sumner Street (State Rt. 58) and synchronizing these signals with the State's signals at 21st Street and Golden State Avenue, U. S. 99, one block away.
6. Installing automatic flasher beacon at the Southern Pacific Railroad main-line crossing.
7. Widening and extending the box culvert at the East Side Canal.

The total cost of the project was $127,650 distributed as follows:

City funds	$8,937
⅛¢ gas tax funds	105,385
State Highway Fund	9,957
Southern Pacific Railroad Fund	3,371
Total	$127,650

The plans and specifications were prepared by the Engineering Division of the City of Bakersfield. Advice on the plan preparation and construction inspection was furnished by the Division of Highways together with all field and laboratory testing required. Acknowledgment is made of the Division of Highway's fine spirit of cooperation without which the project's successful progress would have been doubtful.

Looking south across the intersection of Union Avenue with Twenty-fourth Street



Looking north along Union Avenue in Bakersfield from above intersection with US 99, which curves off to left. Evening peak-hour traffic.

Montgomery Freeway

Completed to Mexican Border

By E. E. WALLACE, District Engineer

By Assembly Concurrent Resolution No. 16, adopted on March 16, 1949, the portion of US 101 beginning at 13th Street in National City and extending to the international boundary at Tijuana was designated as the Montgomery Freeway. The entire 11-mile section of this freeway is now completed and a dedication ceremony is contemplated on June 17, 1955.

The original routing of US 101 extended through the business districts of National City and Chula Vista along National Avenue, thence via a two-lane highway with substandard width and alignment to the border connection south of San Ysidro. This resulted in traffic congestion and a very high accident rate.

The relocation of U. S. 101 began in June, 1950, when the first unit of the freeway was started between Seventh Street and 16th Street in National City and completed at a cost of $122,624.

The second unit extended from 14th Street in National City to H Street in Chula Vista, over a length of three miles. This section was completed in September, 1951, at a cost of $1,410,085.

Unit number three involved a separate contract for two grade separations, one at H Street and one at Main Street. Work was completed in April, 1951, at a cost of $147,973.

The fourth project extended from G Street in Chula Vista to Elm Avenue in Palm City, a length of 3.8 miles, and was completed in April, 1952, at a cost of $1,270,699.

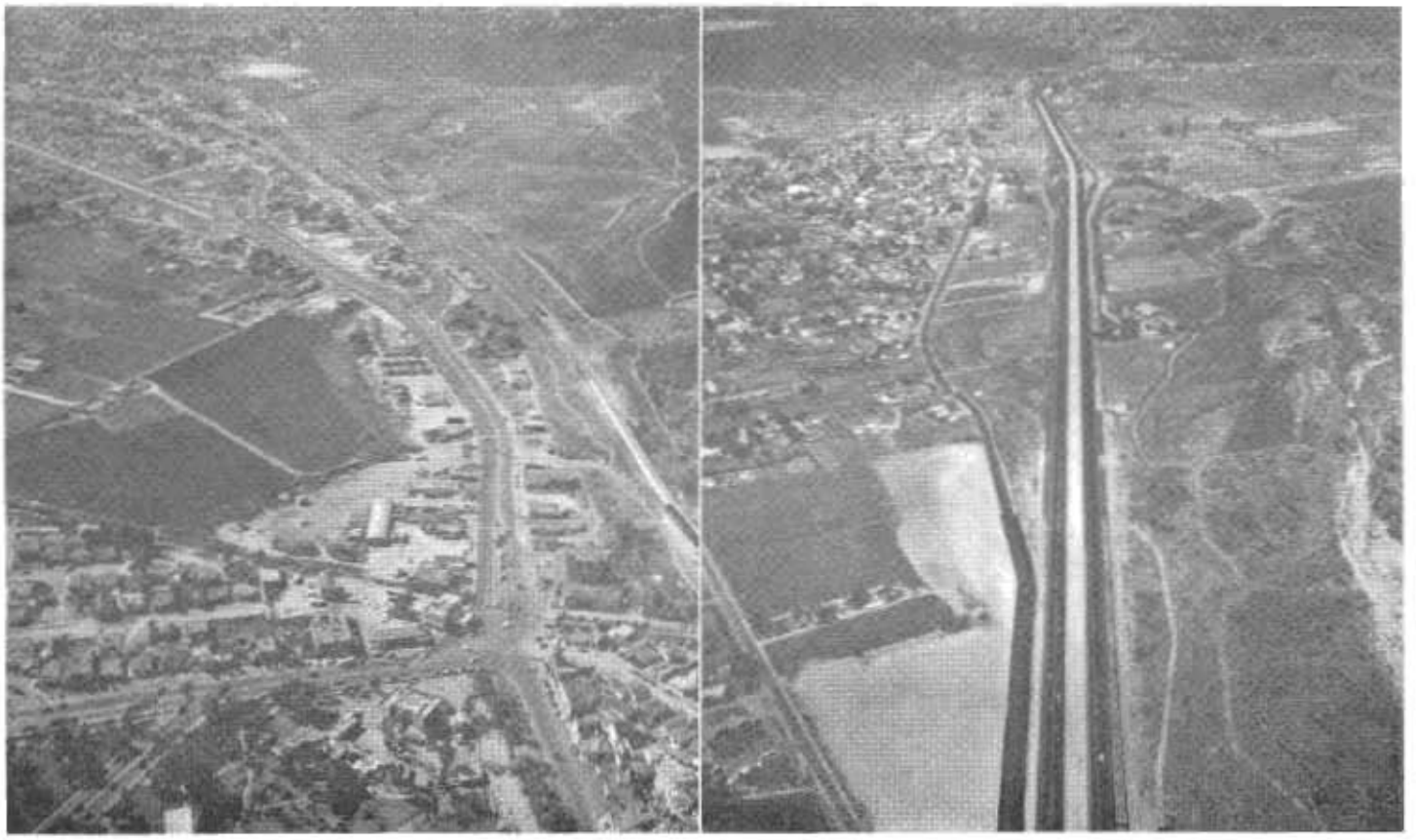
Unit number five extended the construction from Palm Avenue in Palm City to one-half mile south of Nestor, a length of 1.1 miles. The project was completed on June 23, 1953, at a cost of $332,135.

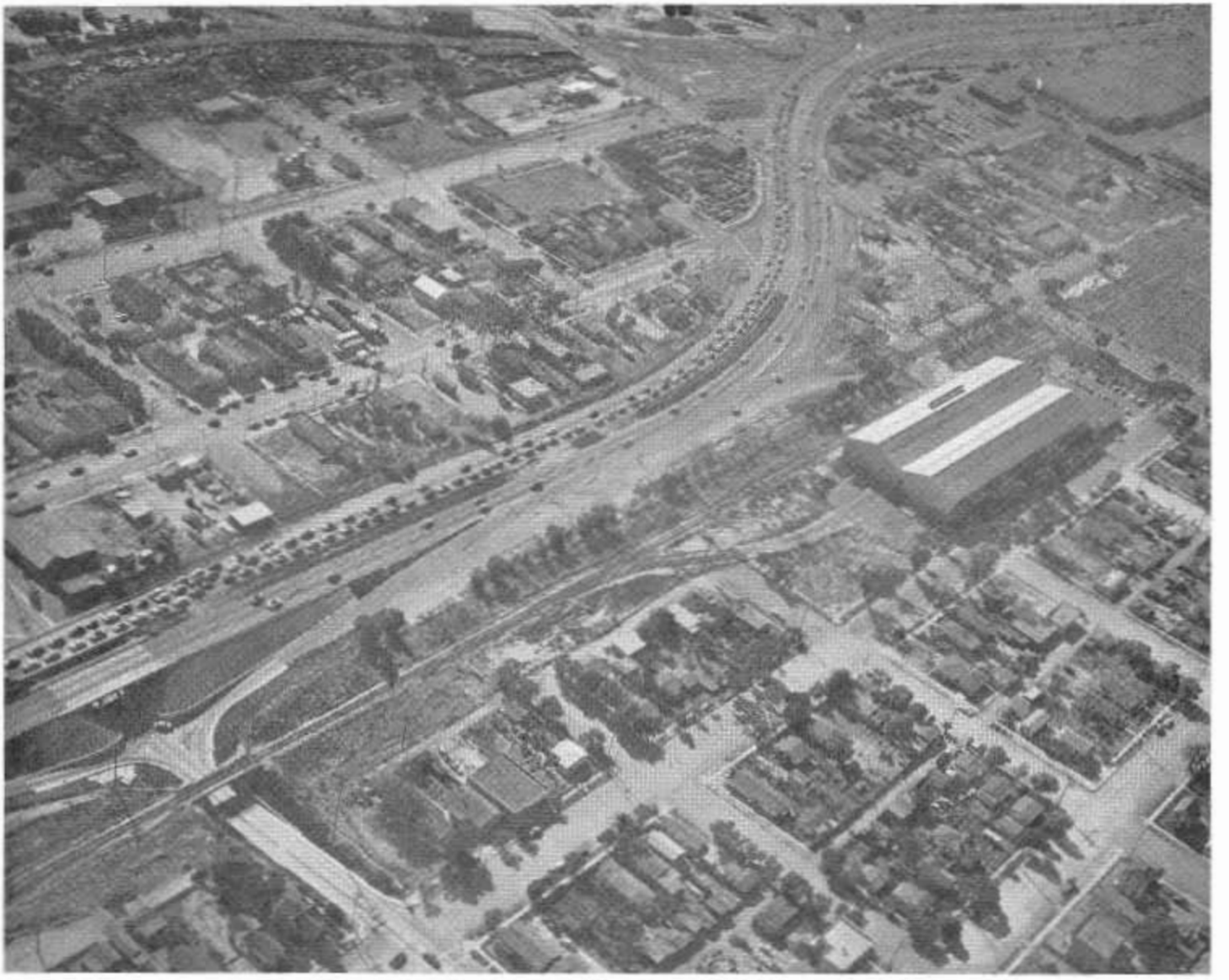
Final Major Unit

The sixth unit, from one-half mile south of Nestor to the international border south of San Ysidro, was completed in April, 1955, and covered a length of 3.9 miles at a total construction cost of $1,198,829.

The seventh, and final major unit, consisted of construction of a complete interchange at L Street in the City of Chula Vista, replacing a temporary grade intersection which was controlled with signals. The cost of this project was $187,805.

LEFT—International border station at Tijuana, looking north on freeway. RIGHT—South end of freeway: San Ysidro in U. S. on left; Tijuana in Mexico at top.





Traffic at Eighteenth Street Undercrossing. Looking northwest.

Several minor contracts for highway lighting, traffic striping, revision of signals and other minor improvements amounted to $132,878.

Summarizing the complete project from Eighth and Harbor Streets in National City to the international border, the total cost for the 11.1 miles was as follows:

Construction	$4,803,000
Right of way	2,000,000
Grand total	$6,803,000

Twenty-five Structures

Twenty-five structures were involved, with traffic interchanges at nine different locations; railroad separations at three locations; bridges across major drainage channels at four locations; and one pedestrian underpass.

Because of insufficient financing it was necessary to place temporary grade intersections at Dawson Street, at Dairy Mart Road and at Palomar Street. These will be replaced with separation structures in the future as they can be financed. The cost of these future interchanges will be about $370,000.

With the completion of the three separations memtioned there will be provided a full freeway consisting of a four-lane roadway with wide center division, ample shoulders, and elimination of all intersecting traffic and complete control of access from 13th Street in National City to the connection with San Ysidro Boulevard near the border.

Heavy Traffic

The Montgomery Freeway is already carrying average daily traffic of 23,500 vehicles throughout its length, with maximum traffic as high as 32,000 vehicles per day.

US 101 to the border carries a large volume of tourist traffic destined for a visit to Old Mexico through the Tijuana gate. Traffic has been increasing rapidly and this border crossing ranks first in the Nation as a border port of entry.

The Collector of Customs reports that vehicular traffic entering the United States through the border gate at San Ysidro in 1954 was 3,611,882,

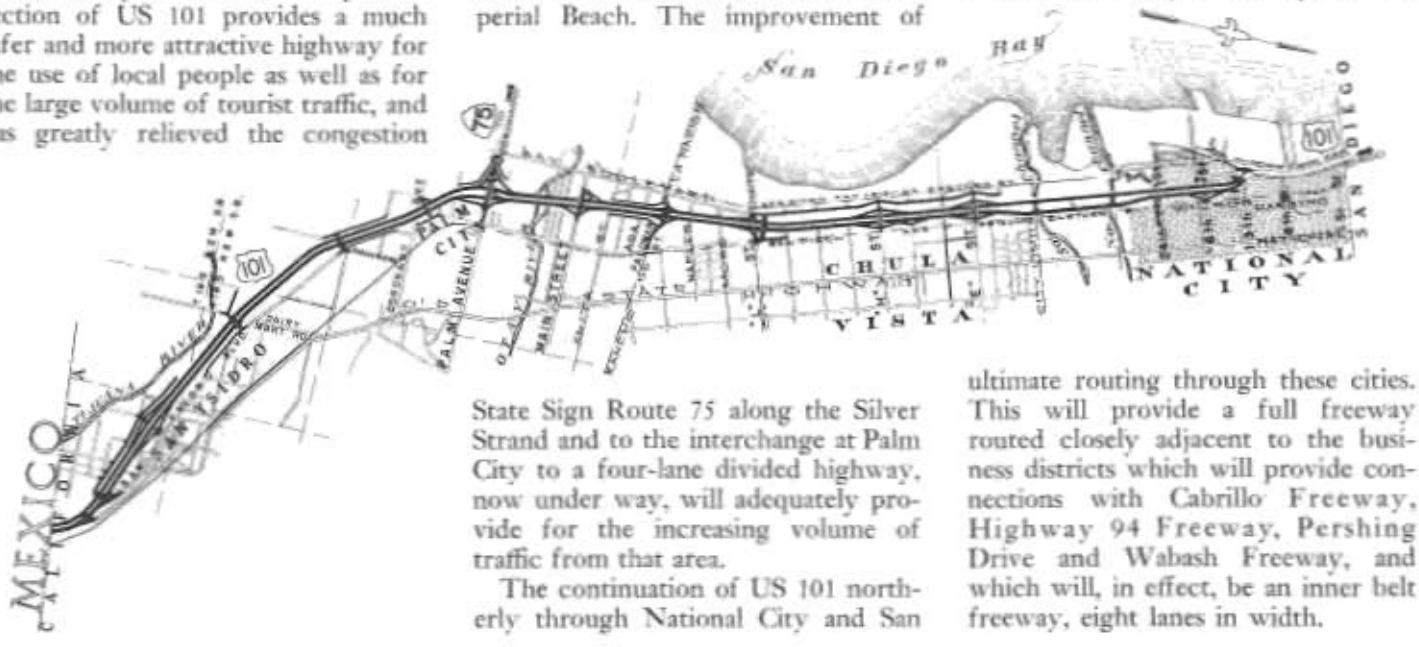
LEFT—Main Street interchange and in distance three-level connection to Palm Avenue. RIGHT—Approaching freeway from North Eighth Street intersection in National City at left center. Curves will be eliminated by adopted freeway routing.

which is a 28 percent increase over the year 1952. The number of persons entering, including both pedestrians and passengers, was 12,365,199, which is a 19 percent increase over 1952.

The completion of this important section of US 101 provides a much safer and more attractive highway for the use of local people as well as for the large volume of tourist traffic, and has greatly relieved the congestion through the business communities of National City and Chula Vista, thus permitting unrestricted trade and development through those areas.

The Montgomery Freeway also serves the cities of Coronado and Imperial Beach. The improvement of State Sign Route 75 along the Silver Strand and to the interchange at Palm City to a four-lane divided highway, now under way, will adequately provide for the increasing volume of traffic from that area.

The continuation of US 101 northerly through National City and San Diego has advanced a step nearer accomplishment through the cooperation of the city councils of National City and San Diego and by the recent adoption by the State Highway Commission as a major freeway, of the ultimate routing through these cities. This will provide a full freeway routed closely adjacent to the business districts which will provide connections with Cabrillo Freeway, Highway 94 Freeway, Pershing Drive and Wabash Freeway, and which will, in effect, be an inner belt freeway, eight lanes in width.



Traffic Line Markers

Raised Buttons Give Night Visibility in Wet Weather

By H. A. ROONEY, Associate Chemical Testing Engineer, and
J. A. CECHETINI, Assistant Physical Testing Engineer

THIS ARTICLE describes a research project performed by Materials and Research Department as part of a study in seeking to make the visibility of traffic lane marking as effective at night during heavy rainfall as the visibility of white traffic paint striping is effective in clear or foggy weather.

Type IV white traffic paint, currently used for traffic striping by the Division of Highways, has good wearing qualities and the striping exhibits excellent day and night visibility in clear or foggy weather. However, at night during heavy rainfall the ability of traffic paint striping to delineate traffic lanes is reduced to almost zero. A wet traffic line, even when containing embedded glass spheres, will not reflect light to the driver of an approaching vehicle as the water diffuses the light and the white traffic line appears to be engulfed in the darkness of the pavement.

Raised Surfaces

It is well known that properly shaped white surfaces positioned at a level of only a fraction of an inch above the highway surface will reflect light better under all weather conditions than a white painted line on the highway surface. These reflectant surfaces must be slanted or curved and oriented toward the incident light in order to be most effective. Traffic line markers based on this principle have been employed to delineate traffic lines but due to the materials used to fabricate the marker and to the means employed in attaching the marker to the highway surface, the marker soon became dislodged or broken under the repeated impact of traffic.

The Chemical Section of this department, under the direction of E. D. Botts, undertook a research program to develop a raised traffic marker and a means for permanently attaching the marker to the highway surface. Previous extensive work done by Botts and Rooney with epoxy resins showed that these resins used in conjunction with thiokol polysulfide rubbers and fillers formed a remarkable adheseive or cementing agent which would bond tenaciously to concrete. Concrete slabs were cemented together with this adhesive formulation and subsequently subjected to vertical shearing stresses parallel to the resin bond.

In all tests the concrete failed when its limit in shear was exceeded and no failure was noted in the resin bond. In other tests broken concrete beams were cemented together with the adhesive and after proper curing were subjected to flexual stresses. In every test the beams broke in new places, the adhesive bond remaining intact. Limited experimentation has shown good adhesion to asphaltic concrete provided the aggregate of the concrete is exposed and free of oil.

Button-type Markers

The first traffic markers developed by the Chemical Section were about four inches in diameter, convex in shape with a ¼-inch crown as shown in Figure I and referred to as the "button" type in this report. They were composed of an epoxy-thiokol binder with titanium dioxide as a white pigment and glass spheres as the aggregate. The impact strength of these button markers was far in excess of that which would be required on a road surface; several full blows of a large sledge hammer being required to disintegrate the marker. The button traffic marker is installed by cementing it to the portland cement or asphaltic concrete pavement surface with the epoxy-thiokol adhesive.

The most satisfactory adhesion will be obtained if the area of contact with the pavement surface is first cleaned by sand blasting in order to expose clean concrete and to remove any oil film. The molecular crosslinking or setting action of the epoxy resin is caused by the addition of an organic amine curing agent which is added just prior to the use of the adhesive. The setting time of the adhesive is dependent upon temperature; a temperature of 45° F. or below will stop the setting action while a temperature of 80° F. or above will cause the adhesive to set sufficiently to bear traffic in about 2½ hours.

Setting Time Speeded Up

In critical areas where traffic lanes cannot be closed for longer than 15 minutes or when air temperatures are less than 80° F., the setting time of the adhesive attaching the raised traffic

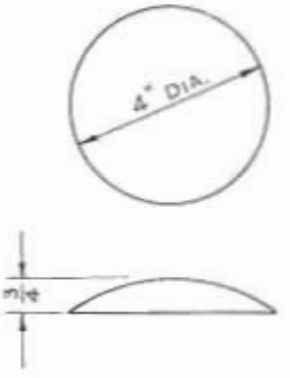


FIG. I

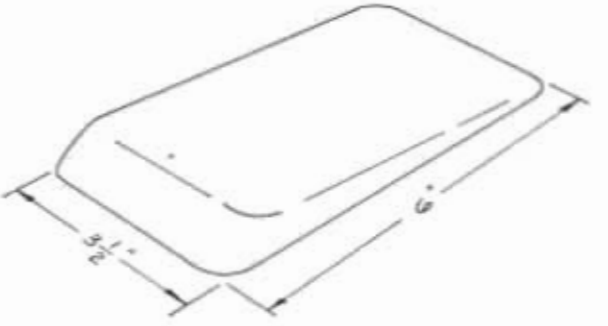


FIG. II

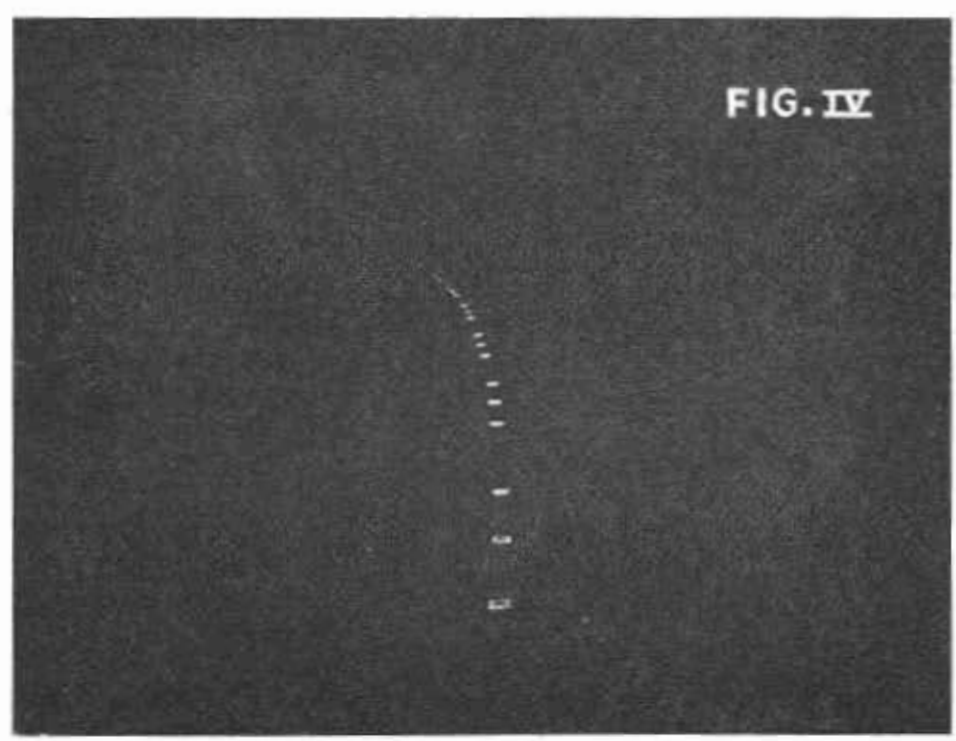
marker to the pavement may be speeded by the application of heat. Applying a butane torch to a small oven inverted over the marker for about three minutes and allowing the marker to remain in the heated oven for 15 minutes will generally induce a complete set so the marker will be capable of bearing traffic.

The Materials and Research Department has made four major and one minor experimental installations of the button type epoxy traffic markers in the last nine months. Markers were installed on a crosswalk over four lanes of concrete pavement on the El Camino Real at Palo Alto in September, 1954. Those markers are hit by traffic more than 20,000 times per day and to date none of the markers have been dislodged or broken. The markers in this installation are subject to impact of traffic which is many times more severe than would be obtained on markers used to delineate traffic lanes. Similar satisfactory results have been obtained at all other installations such as the portion of the San Francisco-Oakland Bay Bridge where the button markers where installed 24 feet apart on the white tile traffic line in September of 1954; the markers installed on the North Sacramento Freeway and the approaches to and over the H Street Bridge at Sacramento where markers were also placed 24 feet apart and at the centers of the unpainted portions of the broken white traffic lines. A small number of "button" markers was placed on the Santa Ana Freeway on the southbound lane, just north of Slauson Avenue intersection in Los Angeles.

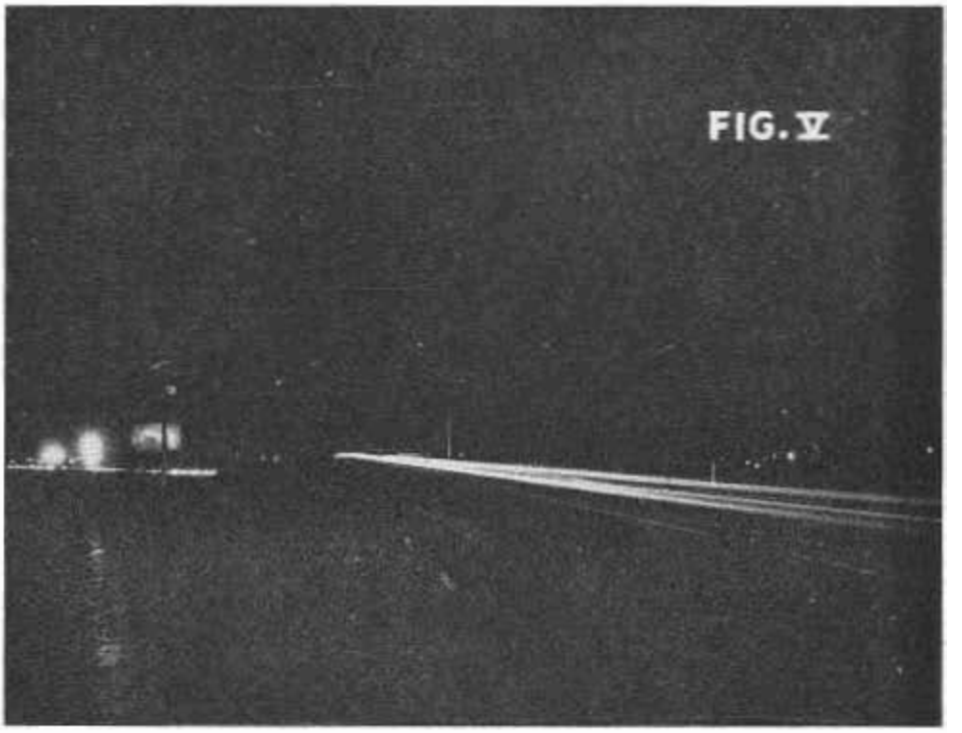
High Visibility

The intent of these installations was that the raised marker would be supplementary to the white lines for wet weather visibility. During the heavy rains of the past winter it was conclusively shown that the raised white markers were highly visible both day and night, whereas the white painted lines were difficult to see.

While the epoxy-thiokol traffic button marker possesses excellent structural qualities, it also presents manufacturing difficulties, and high cost of materials. Experiments were conducted by L. P. Kovanda, Associate Materials and Research Engineer of the Concrete Section of this department, to develop a material which would be suitable for traffic markers, reduce the costs and produce of highly reflectant surface. The material selected as possibly being the best for the manufacture of traffic markers consists of white portland cement, glass spheres, aggregate and titanium dioxide as a white pigment. Button traffic markers of the shape and size as shown in Figure No. I were fabricated from this material and allowed



to harden in a moist atmosphere for seven days. Compressive strength tests show the material to attain a strength of 2,800 psi at seven days. The exposed surface of the button markers was treated with hydrochloric acid in order to expose the glass spheres embedded in the body of the markers and to make the surface highly reflectant. Although this marker has the brittleness characteristic of most portland cement products, tests on an installation of this marker on Fair Oaks Boulevard east of the H Street Bridge at Sacramento have shown after seven months that it will withstand the impact of a large volume of traffic when properly cemented to an asphaltic pavement. The resistance to impact and dislodgment of this marker is no doubt due to the ability of the epoxy-thiokol adhesive to firmly attach the marker to the pavement and at the same time reinforcement it provided the adhesive is applied to the marker so that no voids exist in the area of contact with the pavement.



Used on Elvas Freeway

James A. Cechetini of the Concrete Section designed a new shape in concrete traffic markers as shown in Figure II. This marker is wedge-shaped, 3½ inches wide, six inches long and sloping from a height of one-eighth inch in the front to one-half inch in the rear.The Materials and Research Department made an experimental installation of these reflectant concrete "wedge" markers on the eastbound concrete lanes of the Elvas Freeway at Sacramento. On this test section, which is about 2½ miles long, only the concrete wedge marker will be used to delineate the traffic line.

Spacing of the concrete wedge markers varies with the alignment of the road, the markers being installed at 6, 12 and 24 feet apart. All concrete markers were cemented to the concrete pavement with the epoxy-thiokol adhesive. The object of this test section is to determine the service life of the concrete wedge markers, their reflectance under all weather conditions and the cost of their installation and maintenance compared to the cost and maintenance of a painted traffic line. The wedge markers of this installation were photographed at night under headlight illumination during clear and rainy weather as shown in Figures III and IV, respectively. Figure V shows the poor visibility of a painted line as photographed during the same rainstorm when the photograph of the wedges shown in Figure IV was taken.

Applications for Patents Filed

No conclusion can be drawn as to the feasibility of adopting reflectant markers as a traffic stripe until the experimental test section has seen service for at least two years. Although technical data does not indicate that the epoxy-thiokol adhesive will lose its adhesive properties over a period of time, only exposure to actual road service conditions will verify this.

TOLL COLLECTORS PRAISED

ALBANY, CALIFORNIA

CAPTAIN M. L. SILVEY
Toll Plaza Administration Bldg.
San Francisco-Oakland Bay Bridge

DEAR CAPTAIN SILVEY: This message comes to you concerning the courtesy of the men who collect tolls at the San Francisco-Oakland Bay Bridge, and has been waiting to be written for some time.

Having come to the Bay area about five years ago, I was very pleasantly impressed with the almost never-failing "thank you" spoken by these men, and wondered how they could keep it up so nicely moment after moment! I have since become a regular daily commuter over this bridge, and as no doubt happens in many cases, too often seem unaware of hearing it, although frequently conscious of a time when it isn't said.

One day within the past few weeks, on a particularly trying morning from a personal standpoint, I came through as usual—absorbed in private grievances—when the collector at that time spoke a most pleasant "thank you," accompanied by a smile. This quickly changed the whole atmosphere of the morning, and I found myself smiling also, being grateful for this impersonal courtesy. I am sure this cannot be a unique experience just for one person, and realizing that this spoken word may have an influence far beyond its immediate expression, I sincerely hope that the pressure of those jobs will never eliminate this rare public service. My sincerest "thank you" to those patient collectors of tolls!

Sincerely yours,

MRS. F. C. GOERGES

In Memoriam

MICHAEL D. POBOR

On April 30th Michael Pobor, Junior Civil Engineer for the Materials and Research Department of the State Division of Highways, met death with the car he was driving collided with a train in Sacramento.

Born in Miama, Arizona, on November 7, 1919, Pobor's life was eventful and varied. He was a capable amateur boxer, parachute instructor, mathematician, and inventor. He spoke six languages, including Slavonian, Spanish, Italian, French, and Russian.

Mike was employed by the Division of Water Resources in 1950, by the Bridge Department from 1951 to 1954, and by the Materials and Research Department since June, 1954.

He is survived by a widow and one son.

EXPRESSWAY

Continued from page 17 . . .

route have demonstrated that the traveling public has taken immediate advantage of the time and saving benefit it represents. The average daily traffic for the first two months was 6,250 vehicles, which makes the Arlington-Mira Loma Road the heaviest traveled rural highway in the entire Riverside County system. It is expected that the volume will continue to increase as more and more people become familiar with the route. It is hoped that an origin and destination survey can be made in the near future to establish the use pattern and thus determine if the original design assumptions were correct.

Since 1946 the county has been working in close cooperation with the State Division of Highways and the Bureau of Public Roads in an effort to keep the county's FAS system abreast of the expanding Southern California economy. In this period some 15 projects have now been completed, comprising five bridges and 47.6 miles of road at a total expenditure in excess of $2,130,000.

Employees Receive Twenty-five-year Awards

Employees of the Division of Highways who became eligible for 25-year awards between December 31, 1953, and May 31, 1955, are:

Name	Total service Yrs.	Mos.	Days
ELIGIBLE ON DECEMBER 31, 1953			
Rodriquez, Peter V.	25	0	11
ELIGIBLE ON JANUARY 31, 1955			
Grohmen, George J.	25	0	19
ELIGIBLE ON APRIL 30, 1955			
District III			
Cormier, Isaac D.	25	0	7
District IV			
Allendale, Ernest H.	25	0	29
Coles, Wilfred W.	25	0	20
District VI			
Porter, Harvey W.	25	0	5
District VII			
McBroom, E. H.	25	0	19
District VIII			
Barnes, Harold M.	25	0	10
Lucas, Pearl F.	25	0	27
District X			
Vergara, Dolph J.	25	0	9
Young, Lester W.	25	0	10
District XI			
Webber, Arthur D.	25	0	17
Shop 11			
Rosenbaum, Charlie H.	25	0	5
Department of Public Works, Directors Office			
Klauser, Helen P.	25	0	12
ELIGIBLE ON MAY 31, 1955			
District I			
McMahon, William G.	25	0	28
District III			
Nicholson, R. L.	25	0	6
Sherwood, Harold F.	25	0	16
District VI			
Harbey, George A.	25	0	23
Parker, Robert B.	25	0	5
District VII			
Lamb, Giles Harvey	25	0	9
Preston, Allen	25	0	5
District IX			
Baxter, Frank E.	25	0	6
District X			
Lucas, Frank L.	25	0	19
Thomas, Everett R.	25	0	23
District XI			
Moore, Burton F.	25	0	24
Reinius, Carl O.	25	0	22
Central Office			
Carr, Alden W.	25	0	19
Small, M. J.	25	0	26
Warmby, Edwin W.	25	0	5
Bridge Dept.			
Green, John W	25	0	5
Bay Bridge			
Bunce, Ivan	25	0	6
Shop 7			
Mayer, Paul L.	25	0	13

Employees of the Division of Architecture who became eligible for 25-year awards between September 1, 1954, and May 31, 1955, are:

Name	Birth date
ELIGIBLE ON SEPTEMBER 3, 1954	
Estimating Section	
Booth, Richard L.	3- 8-12
ELIGIBLE ON FEBRUARY 6, 1955	
Drafting Section	
Ellis, Charles L.	9-27-98
ELIGIBLE ON APRIL 6, 1955	
Civil Section	
White, Asmoe D.	6-19-96
ELIGIBLE ON MAY 15, 1955	
Structural Section	
Brownfield, Allen H.	11- 2-04
ELIGIBLE ON MAY 20, 1955	
Structural Section	
Muller, Herman C.	5-16-05

The county road department feels that one of the most valuable aspects of the federal aid secondary highway program is the opportunity it provides for the county staff to work with, and become familiar with, the design and construction practices of the State Division of Highways. The training, methods, and engineering know-how acquired by the county staffs during the planning and construction of these projects has been integrated into their own road building efforts and is reflected in the increased standards of such work in the years since the program's inception.

New Expressway

Paso Robles-San Miguel Project Rated as Unusual in Design

By E. J. L. PETERSON, District Engineer

A 6.5-MILE SECTION of expressway in San Luis Obispo County, a portion of US 101, following the Salinas River along the foothills of the Santa Lucia Mountain Range between Paso Robles and San Miguel, has been completed and opened to public traffic.

Mission San Miguel Archangel, situated in the Town of San Miguel, marks the northerly terminus of the project. This mission, which was founded in 1797, is one of the string which marks the path of the Padres through California. The southerly terminus is at the City of El Paso de Robles, so named by the Mission Padres because of the beautiful oaks.

In the design of the new facility the existing highway was incorporated into the construction of the northbound lanes between two miles south of San Miguel and San Miguel, and between Paso Robles and one mile north. The remainder of the facility is on new alignment, slightly west of the existing road. The mile-long segment of the northbound lane just north of Paso Robles was designed with a plant-mixed surfacing and will become a ramp when the freeway through Paso Robles is constructed. With this exception, the typical section provides traffic lanes surfaced with portland cement concrete, with opposing lanes being separated by a median generally 46 feet wide.

Design Was Unusual

The design of this section of highway was unusual in that photogrammetric contour maps (contour maps made from aerial photos) and contour grading plans were used to prepare the contract plans. Each one of these features has been employed to a limited extent in highway design, but this is one of the first projects in which they were combined. Considerable survey and design time was saved by the employment of this procedure as excavation and embankment quantities for the contract plans were calculated from contour maps with five-foot intervals. A comparison of the total quantity of roadway excavation obtained by the standard methods, that is average and area, and by the contour grading plans, disclosed a difference of only 0.11 percent which is an unusual degree of accuracy and was due to several favorable factors, primarily the rolling nature of the terrain with its sparse growth of brush and trees made it favorable to the contour method and the accuracy was a result of compensating errors rather than consistent accuracy.

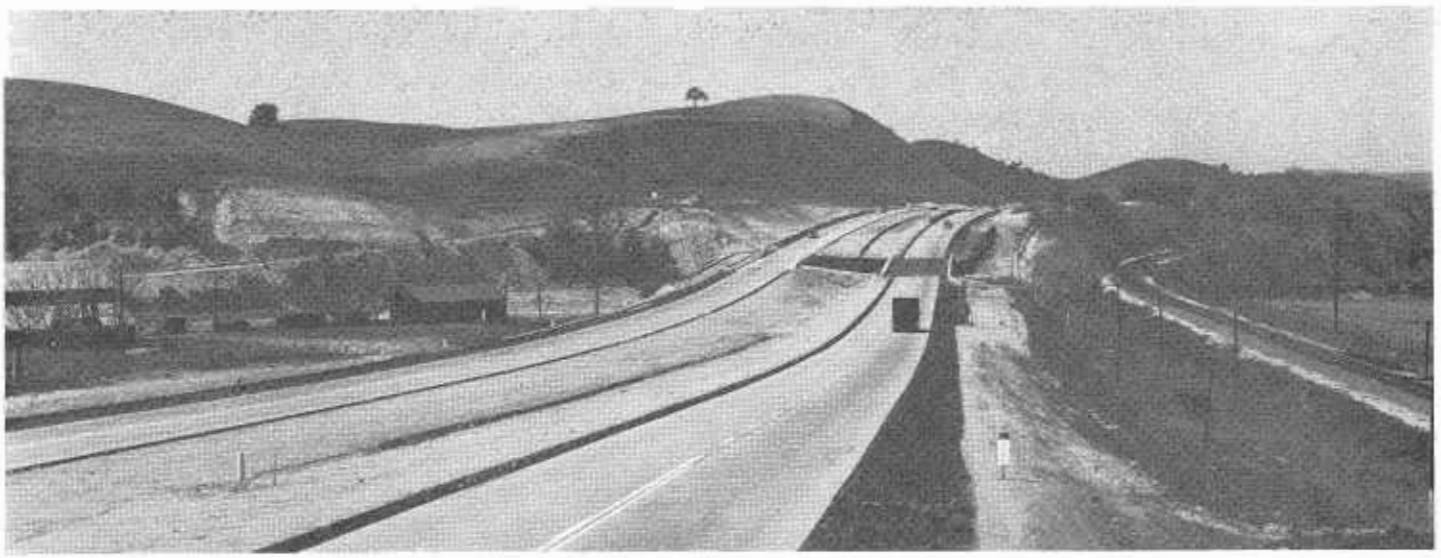
Favorable Results Obtained

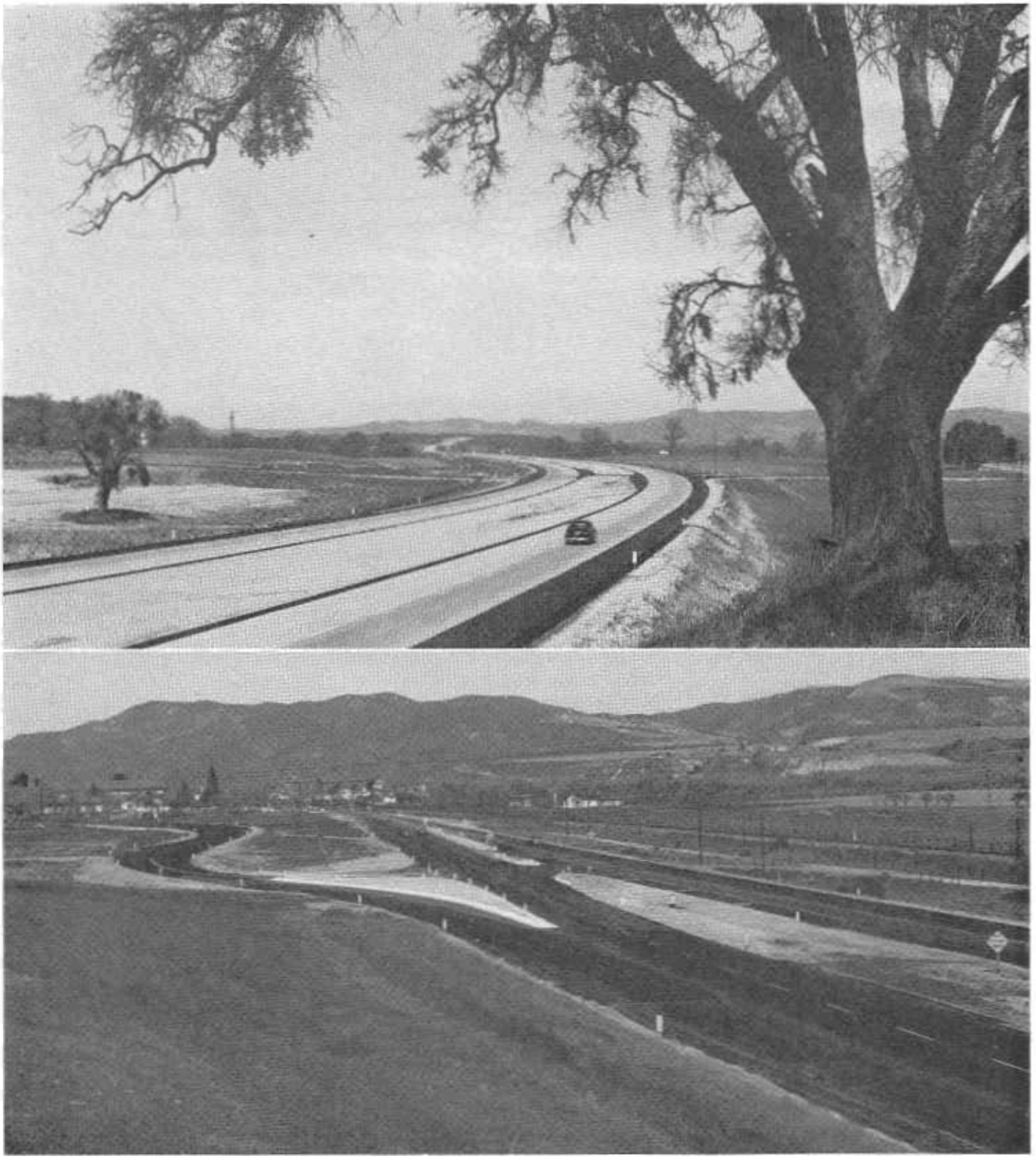
In view of the favorable results obtained with the contour method for the grading quantities on this project, it has since been employed very successfully in the design and construction of other projects.

The construction of the project, which included approximately a million yards of roadway excavation and the placing of 35,000 cubic yards of portland cement concrete pavement, was performed under two contracts. The first contract included the major portion of the grading, the construction of drainage structures and the construction of a reinforced concrete slab bridge across San Marcos Creek and was awarded to Madonna Construction Company of San Luis Obispo on May 20, 1953. Work began June 1, 1953, and was completed March 12, 1954, at a cost of $638,362.

The second contract included grading, paving and other work required to complete the project which was awarded to the firm of Gordon H.

View of expressway near San Marcos Creek, looking northerly

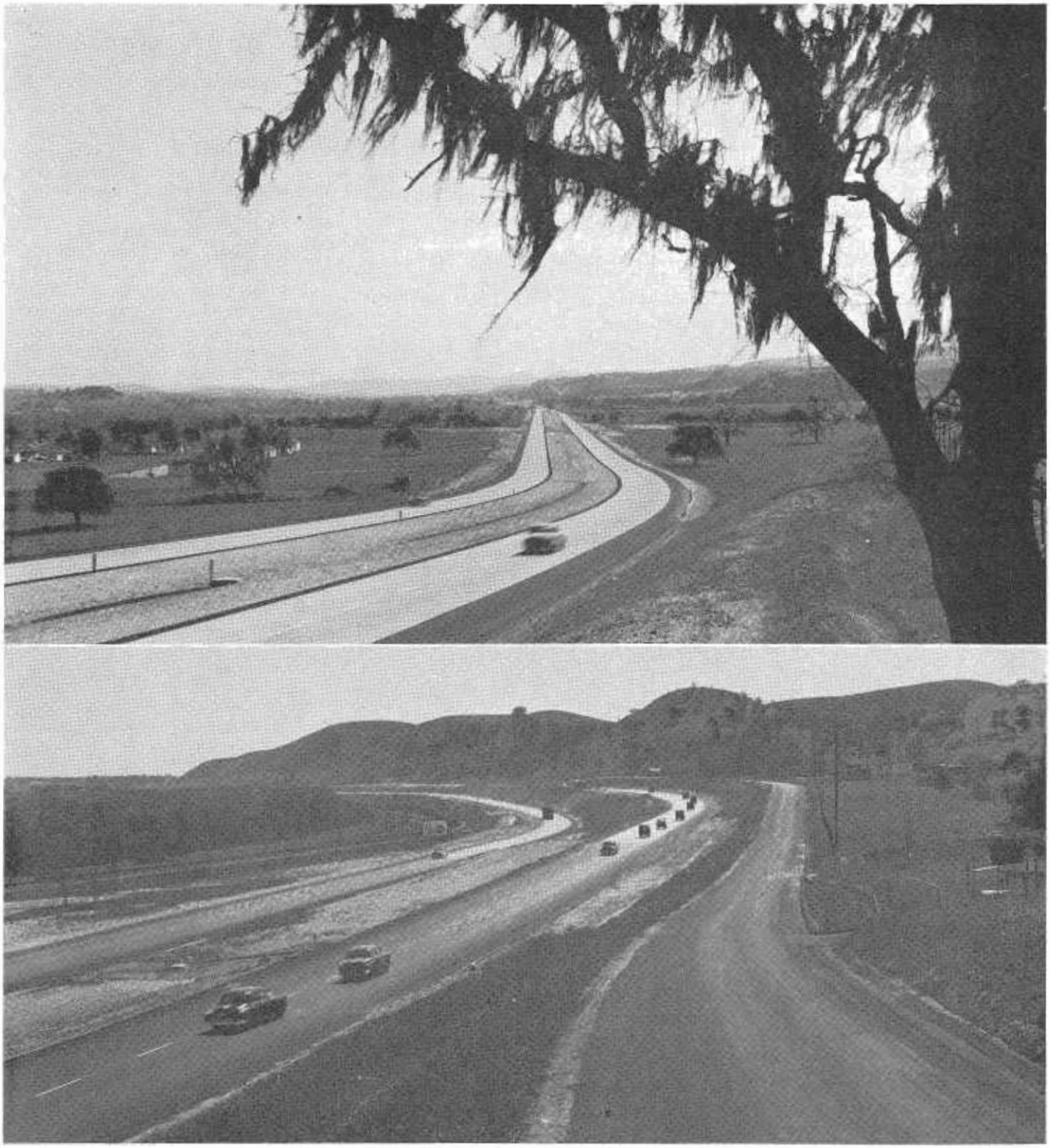




UPPER—View of completed freeway looking northerly toward the Santa Lucia Mountains near Paso Robles. LOWER—Northerly terminous of expressway at San Miguel with mission at left.

Ball and San Ramon Valley Land Company of Berkeley, California. Work began March 31, 1954, and was completed December 31, 1954, at a cost of $1,026,154.

The magnificent sweep of the expressway through the Salinas Valley is both pleasing and comfortable and relieves traffic congestion by permit-



UPPER—Looking southerly toward Paso Robles from the oasis on left. LOWER—Looking southerly from San Miguel.

ting increased and uniform safe driving speeds, saving travel time and reducing driving fatigue.

G. D. Gardner, representing the Division of Highways, was Resident Engineer on both contracts. Hooper Knowlton was the bridge department representative on the San Marcos Creek Bridge. Robert Osborne was general superintendent for Madonna Construction Company on the grading contract, while John Vickrey, was general superintendent for the firm of Gordon H. Ball and San Ramon Valley Land Company.

FROM ISTANBUL

SULEYMAN TANSES
Karayollari I. Bolge
Arastirma Sefi

ISTANBUL/BOSTANCI, TURKEY

DEAR SIRS: I received the November-December edition of your *California Highways and Public Works* magazine. Thank you very much for your sincere interest. It is really the best of its kind and I always learn something new when I read it.

I hope it will continue to be published in the same perfect way.

With my best wishes,

Yours sincerely,

SULEYMAN TANSES

MAN OF SEA LIKES HIGHWAYS

MR. KENNETH C. ADAMS, *Editor*

I wish to tell you how much I enjoy receiving the highway magazine. It is the most prized of all the magazines I take. I have spent most of the 15 years past in California and have traveled over most of the main highways and many of the secondary roads. I have followed quite closely the wonderful improvement of the highway system as so clearly shown in the highway magazine and by personal observation.

I came around Cape Horn in a sailing vessel and landed in Honolulu in 1896 and was employed as pilot at Pearl Harbor and Honolulu Harbor before retiring in 1939.

I wish to congratulate you on the wonderful magazine you put out and hope to receive it for the next few years that I am around. I am 79 years old.

Very sincerely,

RICHARD NELSON
2939 Park Street
Honolulu 17, Hawaii

NEW BOOK ON SURVEYING

The third edition of Elementary Plane Surveying, by Raymond E. Davis, Professor of Civil Engineering, University of California, published by McGraw-Hill Book Company, Inc., 330 West 42d Street, New York, is off the press.

All States Will Participate in New Road Tests

California State Highway Engineer G. T. McCoy, president of the American Association of State Highway Officials, has reported that detailed arrangements are now being made for financial and engineering participation by all 48 states, Hawaii, Puerto Rico and the District of Columbia in the forthcoming A. A. S. H. O. Road Test project in Illinois.

Announcement of the test, which is designed to measure the effects of vehicle weights on roads and bridges, was made in Washington, D. C., by Secretary of Commerce Sinclair Weeks. The project will cost an estimated $12,000,000, to be contributed by the participating states and territories, the Federal Government, and industry groups, with the State of Illinois paying most of the construction cost of the road itself.

McCoy disclosed that the test vehicles are tentatively scheduled to start rolling on the nearly 12 miles of pavement in north central Illinois some time in 1956. The project will be much larger than the two previous cooperative road tests, which, like the A. A. S. H. O. project, were conducted by the Highway Research Board of the National Academy of Sciences.

McCoy has been a member of A. A. S. H. O. committees which have been working with the U. S. Bureau of Public Roads, the Highway Research Board and the automotive, petroleum and tire industries for the past two years, planning the design of the project and the financial participation by the various interested governmental units and other groups.

An active California participant in the planning of the road test project, in addition to McCoy, has been Francis N. Hveem, Materials and Research Engineer of the State Division of Highways. Hveem was also a member of the advisory committee on the western road test project in Idaho.

In Memoriam

ADDISON KING NULTY

On February 23, 1955, death claimed another "Old Timer" of the Division of Highways. With the passing of Addison King Nulty, District X lost a colorful Resident Engineer.

Born in Missouri on August 17, 1885, King was educated in the deep South, receiving his B.S. degree in 1907 from the Virginia Polytechnic Institute. He went to work immediately as Chief of Party for the Interstate Coal and Iron Company of Virginia. In 1908 he moved to the West Coast and went to work as instrumentman for the City of Chehalis, Wash. After serving as surveyor for several railroad companies, King went to work permanently for the Division of Highways in District X in April, 1924.

During his stay, King was Resident Engineer on various projects throughout the district, many of which, except for seal coats, remain as he left them. King had the distinction of being Resident Engineer on the first portland cement concrete job in Northern California to use the, then new, Johnson Finishing Machine.

On August 4, 1943, King entered Bret Harte Sanitarium where he stayed until his death, with the exception of one year. He is survived by his sister, Mrs. Laura Kate Parks of Abingdon, Va.

Possessed of a keen sense of humor, King was a pleasure to work for and though he had been absent for 12 years, his passing was mourned by all who ever worked with him.

ARDENT READER

PACIFIC GAS AND ELECTRIC CO.
245 Market St.
San Francisco 6, California

MR. KENNETH C. ADAMS, *Editor*

DEAR MR. ADAMS: I have read, cover to cover, several issues of your publication and have thoroughly enjoyed each issue for the information and leisure reading it contained.

Yours very truly,

R. H. WILLIAMSON
Department of Water Systems

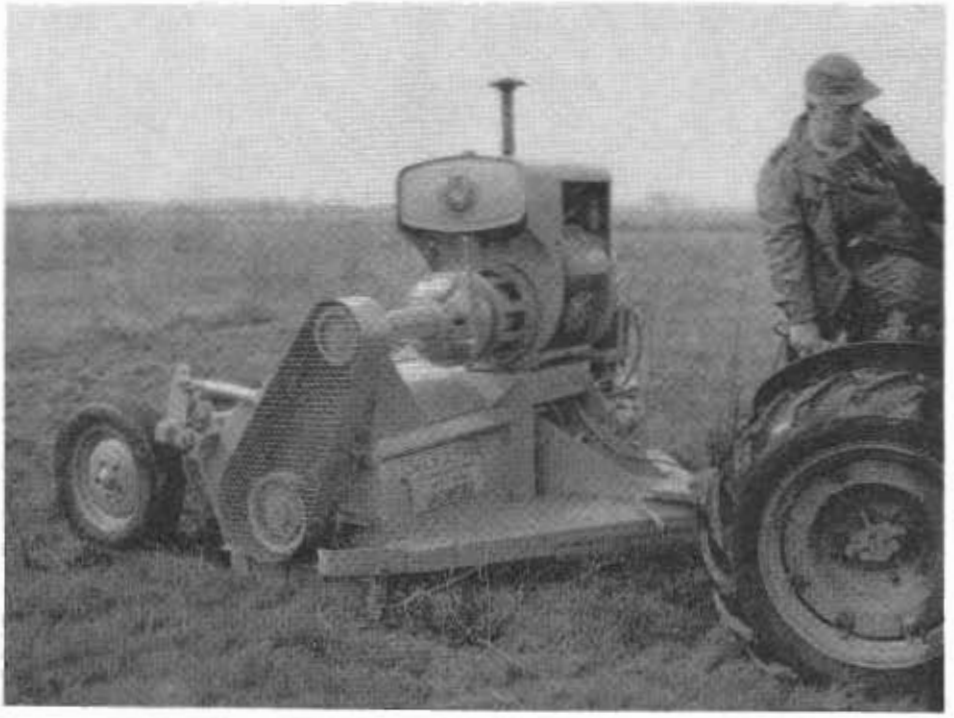
Rotary Flail

Special Equipment for Weed Cutting on Highways Developed

By EARL E. SORENSON, Equipment Engineer

THE CONTROL of grass, brush and weeds along the roadsides and dividing strips of highways has always been an expensive and difficult problem. The difficulties are caused by: first, nonuniform terrain, obstacles that cause damage to the mower such as tin cans, bottles, odd bits of metal, etc., that continue to be discarded by the passing motorists; and second, the problem of disposing of the cut material.

The present method of cutting weeds on highway roadsides utilizes conventional, heavy-duty mowing machines. In areas where the cut material must be removed, this operation is followed by a crew which disposes of the waste material. The use of conventional mowers is not too satisfactory as the machines are easily disabled by tin cans, wire, bottles, etc., which results in excessive repairs, costs in "down-time," and most important of all, lack of productivity while the mower is disabled.



Close-up view of new weed and brush flail

Rotary flail in operation, showing modern method of pulverizing weeds

Answer to Problem Found

An improved method for disposing of grass and weeds on highway roadsides and dividing strips has long been sought. The problem has been studied with a view toward developing a machine that could both cut and dispose of grass and weeds and yet be completely operated by one man. The satisfactory solution was, of course, a machine that cut the weeds, then completely pulverized them into a mulch that could be incorporated into the soil.

The answer to the problem has been found in a farm implement used for mowing, shredding and pulverizing and commonly known as a "Rotary Flail." This is a tractor-drawn machine which consists of a series of rotating flails operating within a steel housing, which passes over the top of

the ground and cuts and pulverizes everything that is contacted. The machine, as sold for farm use, is designed for operation behind a tractor which is equipped with a power take-off to drive the flails. Its use is primarily for pulverizing corn stalks, cotton stalks, the tops of beets, vegetables or other cover crops. On the farm, the machine would ordinarily be used on ground well known to the farmer, with no obstructions such as the previously mentioned debris found on the highway roadsides. The power take-off on the farm tractor would therefore do a satisfactory job in farm-type operations of the machine. However, in order to adapt this unit for use on highway roadsides and dividing strips, it was necessary to strengthen and reinforce it and also provide it with an independent source of power to operate the flails.

Rotary Flail Rebuilt

A "Rotary Flail" was purchased and rebuilt for highway use by the equipment department. The machine was structurally reinforced and a 30-horsepower engine was added to drive the flails at a constant speed independent of the tractor speed. In addition, a remote, electrically-controlled hydraulic system to raise and lower the flails was provided. This was necessary in order to give the tractor operator full control of the machine on uneven ground. By structurally reinforcing the machine and making its operation completely independent of its towing power, it has proven very successful in tests conducted under the most severe conditions with excellent results and no damage to the unit. The unit may be operated at a speed equivalent to a fast walk and in heavy weeds only one pass is required to completely pulverize everything in its path.

It may be towed by a small tractor and, when so towed by a tractor, the operator has complete control due to the hydraulic system of raising and lowering the flails.

The effectiveness of the unit in handling heavy growth is illustrated in the accompanying photographs.

The results of the tests have indicated that if the machine is operated at a speed of four miles per hour, for a normal shift, approximately 25 miles of highway roadside may be cleared in one day, with no further work required for removing the debris.

Locking devices are provided on the machine that allow it to be towed to and from the job site at the regular highway speed of the towing unit.

The development of this self-powered "Rotary Flail" has been the result of the close liaison that exists between the Maintenance and Equipment Departments of the Division of Highways in assisting each other to develop machines and tools required for the specialized work of maintaining California's highways.

FOURTH ANNUAL BONNEROO HONORS CONTRACTORS

With Frank B. Durkee, Director of Public Works, making the presentation, the contracting firm of J. E. Haddock, Ltd., was the recipient of the "Topper," a miniature golden roller trophy, for having completed the best highway contract in District VII during the calendar year 1954. Scene of the award presentation was the fourth annual "Bonneroo," a stag banquet sponsored by the District VII Construction Department of the California Division of Highways, which was held at the Rodger Young Auditorium in Los Angeles on May 6, 1955. Approximately 600 state highway employees and representatives of contracting firms, construction equipment companies, and construction materials suppliers attended the annual affair.

R. M. Gillis, Deputy State Highway Engineer, presented a similar trophy to Herbert Belford, State Resident Engineer in charge of the winning project, a section of the Harbor Freeway between Olympic Boulevard and Second Street, in downtown Los Angeles.

The annual affair, the fourth of its kind, is held for the primary purpose of honoring those contractors and resident engineers who completed what are judged the best 10 highway contracts in District VII, comprising Ventura, Los Angeles, and Orange Counties, during the preceeding calendar year. The winners for 1954 are:

Deputy State Highway Engineer R. M. Gillis (right), presents Herbert Belford, Resident Engineer in charge of winning project, with trophy.

No. 1

Harbor Freeway, Los Angeles County, Olympic Boulevard to Second Street. J. E. Haddock, Ltd., Contractors. H. E. Belford, Resident Engineer.

No. 2

Ventura Boulevard in Ventura County, Route 155 to Conejo Grade Summit through Newbury Park. Fredericksen & Kasler, Contractors. L. S. Higley, Resident Engineer.

No. 3

Santa Clara Avenue in Ventura County, between Central Avenue and State Highway Route 9. Baker & Pollock, Contractors. W. K. Loban, Resident Engineer.

No. 4

Hollywood Freeway, Los Angeles County, Mulholland Drive to Hollywood Boulevard. Bongiovanni Construction Co., Contractor. F. E. Sturgeon, Resident Engineer.

No. 5

San Bernardino Freeway, Los Angeles County, Jackson Avenue to Rosemead Boulevard. Griffith Co., Contractors. B. N. Frykland, Resident Engineer.

No. 6

Long Beach Freeway, Los Angeles County, 223d Street to Atlantic Avenue. Ukropina-Polich-Kral (Atlantic Constructors), Contractors. H. F. Melnke, Resident Engineer.

No. 7

174th Street, Los Angeles County, between Inglewood Avenue and Normandie Avenue. J. E. Haddock, Ltd., Contractors. L. W. Sixt, Resident Engineer.

No. 8

Long Beach Freeway, Los Angeles County, Dominguez Street to Del Amo Boulevard. Webb & White, Contractors. F. W. Buck, Resident Engineer.

No. 9

On Route 101 in Ventura County, between Calleguas Road and Central Avenue through Camarillo.

. . . Continued on page 37

On the Malibu

New Highway Construction On US 101 Alternate Completed

By KENNETH MOCK, Resident Engineer

A CONTRACT awarded to A. Teichert and Son, Inc. of Baldwin Park for 12.3 miles of State highway construction of US 101 Alternate was completed on February 16, 1955. The major part of this construction project, extending from Little Sycamore Canyon in Ventura County to Escondido Beach in Los Angeles County, was through the historically famous Rancho Malibu.

This rancho originally was a Spanish land grant to Don Jose Bartolome Tapia in 1804 and comprised some 13,000 acres with 22 miles of shore line along the Pacific Ocean. The U. S. District Court in making settlement of California land grant cases gave title in 1864 to one Matthew Keller who had paid the Tapia heirs the sum of $1,400 for quit-claim deed to the ranch. Title to this ranch then passed to Frederick Hasting Rindge for $300,000. In 1905 the Rindge heirs constructed a narrow gage railroad from Santa Monica extending nearly 40 miles along the coast line, abandoned portion of which can still be seen from the State highway.

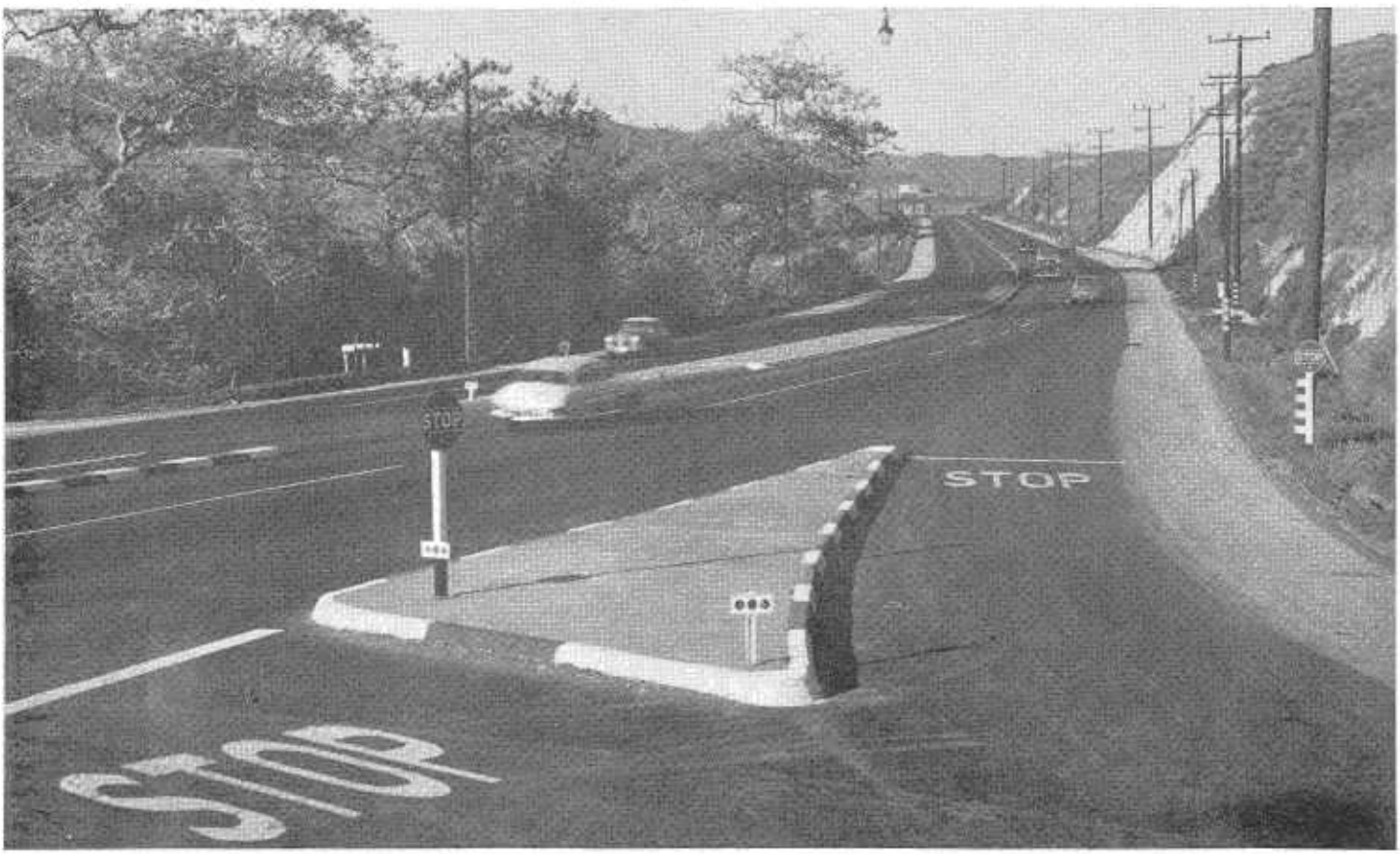
Extensive Litigation

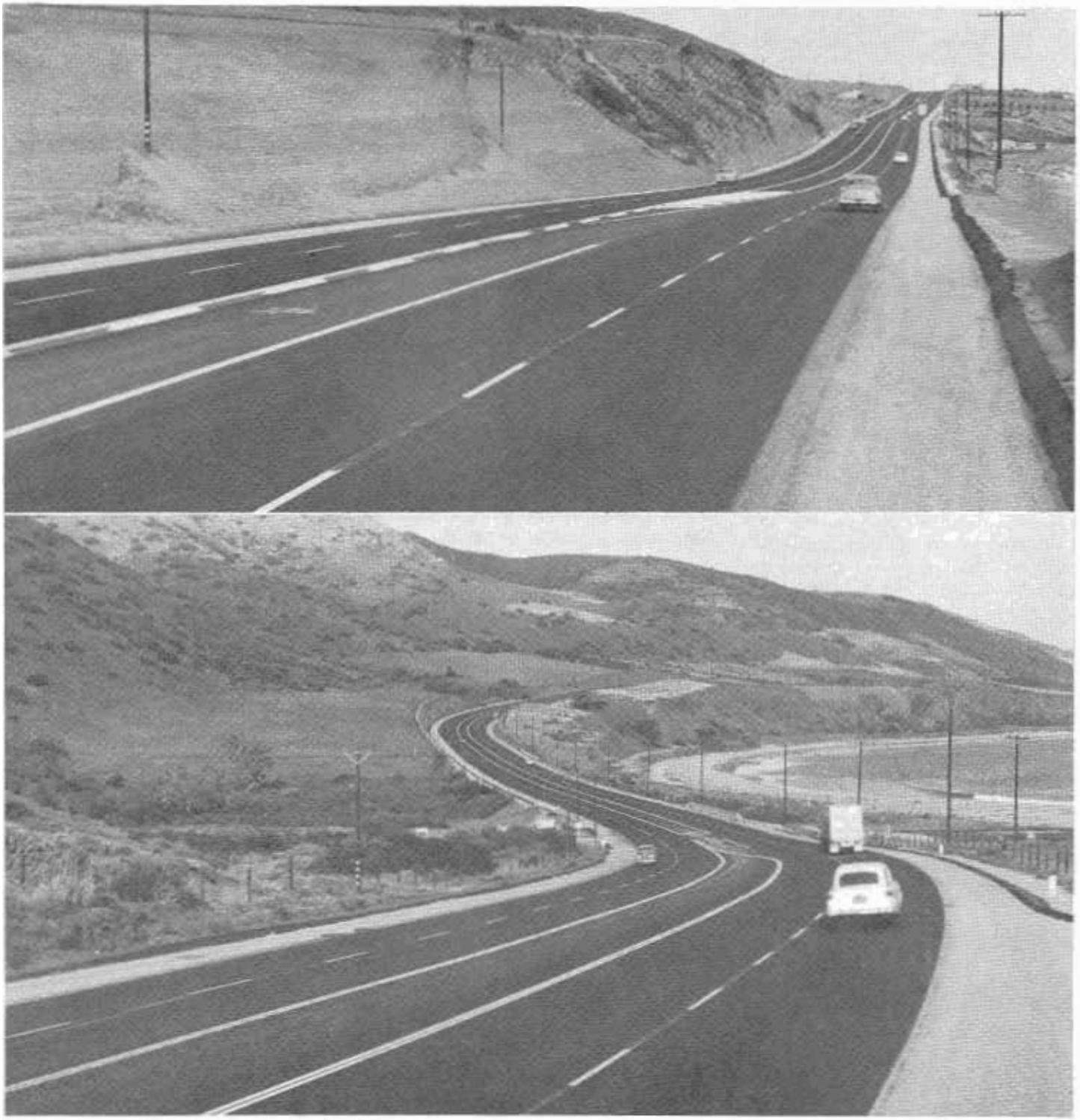
Preceding the building of the original State highway through the Rancho Malibu there was extensive litigation. This is concisely summarized by Dave Duncan, writing under the title, "Historical Malibu." With Mr. Duncan's permission the following is quoted:

"Between 1908 and 1925 raged the longest and most bitter contest of its kind in California's history. County, State and Federal Government took turns in attempting to force the granting of rights-of-way through the ranch for road purposes. Rindge's widow, May K. Rindge, spent a fortune in atorney's fees alone in the contest. High fences were built along the ranch boundaries and line-riders, armed to the teeth, rode the ranch boundaries in an effort to repulse and keep out surveying parties.

"Finally, on October 14, 1925, the superior court handed down the concluding decision in this most famous of road cases, giving the State right of way for the highway, and awarding the Marblehead Land Company, which Mrs. Rindge and her three children, Sam, Fred and Rhoda, had founded, a judgment of $107,289 for damages to the ranch property. The highway was constructed and immediately squat-

Looking northeasterly along completed construction in Zuma Canyon, showing in foreground channelization with Bonsall Drive and Westward Beach Road





UPPER—Looking easterly from Little Sycamore Canyon, showing in foreground channelization lane for Yerba Buena Road. This section of the project is in Ventura County, with Los Angeles county line just beyond limits of photograph. At left, grading operations are in progress by abutting property owner under permit, to provide a location for a service station, business office and restaurant. LOWER—Looking easterly along completed divided highway, showing in center the widened bridge across Arroyo Sequit Creek. Extending, center left, is Mulholland Drive, that goes up Arroyo Sequit Canyon. The striping has been carried out to provide left turn lane into Mulholland Drive.

ters swarmed in. Another struggle began, which culminated in the Spanish land grants being upheld by the highest courts in the land and the squatters were finally moved out."

Original Construction

The original highway construction through the Rancho Malibu provided two-lane pavement and surfacing that was under later contracts widened to three- and four-lane width. The construction undertaken by A. Teichert and Son, Inc. consisted of resurfacing

approximately 6.6 miles of existing four-lane highway and channelizing various strategic road intersections with concrete curb, placed as recommended by the District Traffic Department. The remaining 5.7 miles consisted of eliminating the old three-lane pavement that had been constructed on an extremely rolling grade line established some 30 years ago by widening the grade line improvement, or, as one native so aptly put it, "taking the waves out of the highway."

Roadway excavations and embankments were widened, crown vertical curves lowered, and grade sags filled in order to produce uniformity of grade line and obtain an increased sight distance for safety of motorists. Public traffic was carried through construction at all times with as little inconvenience as possible. This sometimes introduced difficult problems of traffic handling. Where the height of the fills was excessive and they could not be brought to finished grade and still maintain a two-lane width of roadway for through traffic, it was necessary to adopt a three-stage construction plan. The first stage was to construct one side of the fill as high as it could be carried to maintain a 24-foot width on top. A temporary surface was placed, and traffic then routed over it. The second stage was to construct the other side of the fill to final grade and place the permanent pavement thereon. The third stage of construction was to finish to ultimate grade the portion of the below grade fill that had been carrying public traffic.

Tons of Crushed Rock

Some 276,000 tons of crushed rock were required as base material, mineral aggregate for cement-treated base and mineral aggregate for plant-mixed surfacing. The contractor obtained this by quarrying ledge rock in Big Sycamore Canyon and crushing it by the following sequence of operations:

(1) Hauled from quarry with 20-ton trucks and end-dumped into 48-inch x 54-inch jaw crusher.
(2) Belt conveyed to a 24-inch x 36-inch jaw crusher.
(3) Vibrated over scalping screens.
(4) Dropped into 8-inch cone crusher.
(5) Belt conveyed into a secondary roll crusher.
(6) Belt conveyed to bunkers or stockpiles.

Looking easterly along Trancas Beach, showing newly installed channelization, center left, to provide safe ingress and egress to community development. Dume Point is shown in background left.

In order to eliminate excessive "secondary shooting," 40 tons of powder was used in a 100-foot "coyote" hole, with four branch tunnels, to loosen the ledge rock and break it to crushable size. Plant-mixed surfacing was produced at the crushing site and placed on the street at an average rate of 1,100 tons per day.

The four inches of plant-mixed surfacing was placed on eight inches of cement treated base material, having under it from four to twelve inches of rock subbase. The completed improvement consists of two 24-foot plant-mixed surfaced roadways with eight-foot shoulders, separated by a 14-foot paved median strip, outlined by double stripes.

The writer was resident engineer on this contract working under the general supervision of Assistant District Construction Engineer E. A. Parker, Assistant District Engineer Frank B. Cressy, and District Engineer W. L. Fahey. The contract which was completed February 16, 1955, and nine days later formally accepted by Mr. Frank B. Durkee, State Director of public Works, makes more readily accessible the picturesque shore line of the Rancho Malibu with its intriguing canyons and mountainous back country. This is the country which in the early twenties attracted a group of movie stars, writers, directors and producers to establish what has been called "the movie colony" of Malibu Beach. Many finely appointed homes were erected along the ocean front, complete with tennis courts and swimming pools which are still extensively used. Even more rapid development than has already occurred is not anticipated in the building of fine homes and expansion of public recreational facilities along the beautiful beaches.

WINS PRIZE IN PHOTOGRAPHY

Harry B. Norris, a Division of Highways warehouse employee who retired in November, 1952, has achieved fame as a color photographer in his home community of Arcadia.

When Norris retired, his fellow-workers at the Los Angeles warehouse of the Service and Supply Department presented him with a color camera. With Mrs. Norris, he then set off for a trailer tour of the United States.

One of the slides resulting from the trip, "Autumn Aspen in Colorado," was judged grand prize winner in the First Grand Salon held recently by the Arcadia Colorsliders Club.

Cooperative Project

Gilroy Highway Widening Celebrated

By F. W. MONTELL, City and County Cooperative Projects Engineer—District IV

MODERNIZATION of historic Monterey Street through the City of Gilroy, on U. S. 101 was fittingly celebrated by city officials. This project, which included a contract for widening of Monterey Street by state contract with local cooperation, a related drainage contract by the city, and a street lighting modernization program under city supervision, has resulted in a street thoroughly modern in every respect, with greatly improved capacity for motor vehicle and pedestrian traffic. Greater convenience for shoppers and local traffic transacting business in the downtown area, and uninterrupted service to all traffic has resulted from the improved cross-section of the street, and improved drainage conditions on Monterey Street have further provided for the free flow of traffic where formerly impeded during periods of heavy rainfall.

History of Project

Monterey Street, which is the principal business street of Gilroy, was originally paved with portland cement concrete pavement 15 feet wide and four inches thick, in 1914. The pavement was widened and thickened and curbs constructed prior to 1921 to a final width of 60 feet between curbs. As a result of successive reconstruction projects, the cross slope became excessive and this, coupled with the unusually high curb face in the business district (as high as 12 inches), caused difficulty to shoppers in opening car doors, with the result that vehicles parked well out from the curb restricted traffic in the adjacent traveling lane.

Because of this condition, city officials originated discussions with the Division of Highways as early as 1938, looking toward the eventual elimination of the excessive crown of the pavement and high curb face through the business district. At that time it was felt that plan lines should be established on Monterey Street to provide for an eventual widening to 68 feet between curbs, which would provide four 12-foot driving lanes with eight-foot parking lanes, and a four-foot curbed median strip. This could be accomplished by reducing the sidewalk width from 14 feet to 10 feet on both sides of the street.

Conferences Held

In view of the many critical deficiencies in Santa Clara County, the correction of which had to be undertaken during the following decade, no further action could be taken toward achieving adequate standards on Monterey Street until August 12, 1948, when at the city's request, a meeting was held at the District IV office of the Division of Highways to discuss the possibility of bringing Monterey Street up to modern standards. At that time, the city officials proposed that the widening be accomplished as a cooperative project in order to insure financing of the project at the earliest possible date. By this time conditions for the through traffic and shoppers had become aggravated due to the increased volume of traffic and local business.

Between August, 1948, and January, 1949, several meetings were held to consider engineering problems concerning the proposed project as well as methods of financing the city's share of the improvement, and on January 1, 1951, the city's one-half cent sales tax earmarked for its share of the widening of Monterey Street became a reality.

With the city's share of the financing assured, engineering studies were resumed by both the city and the State with the objective of including the project in the State's 1953-1954 Fiscal Year budget since it appeared that the city would be in a position to fulfill its financial obligation at the time the project could be completed, which was estimated at January, 1955. The District Design Department then proceeded to prepare plans and specifications for advertising the widening of Monterey Street as a state contract. In addition to financial participation, the City of Gilroy through its city engineer, W. J. Hanna, furnished preliminary engineering data to the District Design Engineers.

Construction Features

The modernization of Monterey Street consisted of three phases: First, in order to correct bad drainage conditions resulting from overloaded gutters on Monterey Street, the city undertook a drainage contract to provide an additional outlet to Miller Slough. This contract, known as the Eighth Street Outfall, relieved the bad drainage conditions both above and below Monterey Street by providing faster run-off. This project, costing $80,444, was completed by the P. and E. Company, Inc., contractors, prior to the widening project for Monterey Street. The widening project was the second phase, and was covered by the contract awarded by the State to the Granite Construction Company of Watsonville on June 24, 1954.

This contract provided for drainage correction on Monterey Street, the widening and resurfacing of the roadway, the construction of new curbs of standard six-inch height, and the construction of a four-foot curbed median strip paved with portland cement concrete. In addition, a traffic signal was installed at the intersection of First Street and Monterey Street, which is also the intersection of State Highway Routes 2 and 32.

The third phase provided by the City of Gilroy consisted of the installation of double-pendant electroliers in the center dividing strip. These replaced obsolete electroliers of insufficient illuminating capacity which were located in the sidewalk area on both sides of the street. The new street lighting system utilizes mercury vapor luminaires and results in a well-

lighted roadway surface through the business area. The contractor on this work was The Howard Electric Company of Gilroy.

The cost of the combined cooperative drainage and widening project was approximately $368,000, of which $150,000 was contributed by the City of Gilroy, the remainder being state highway funds. The State's widening contract was completed March 1, 1955, and the city's lighting contract was completed on March 25, 1955.

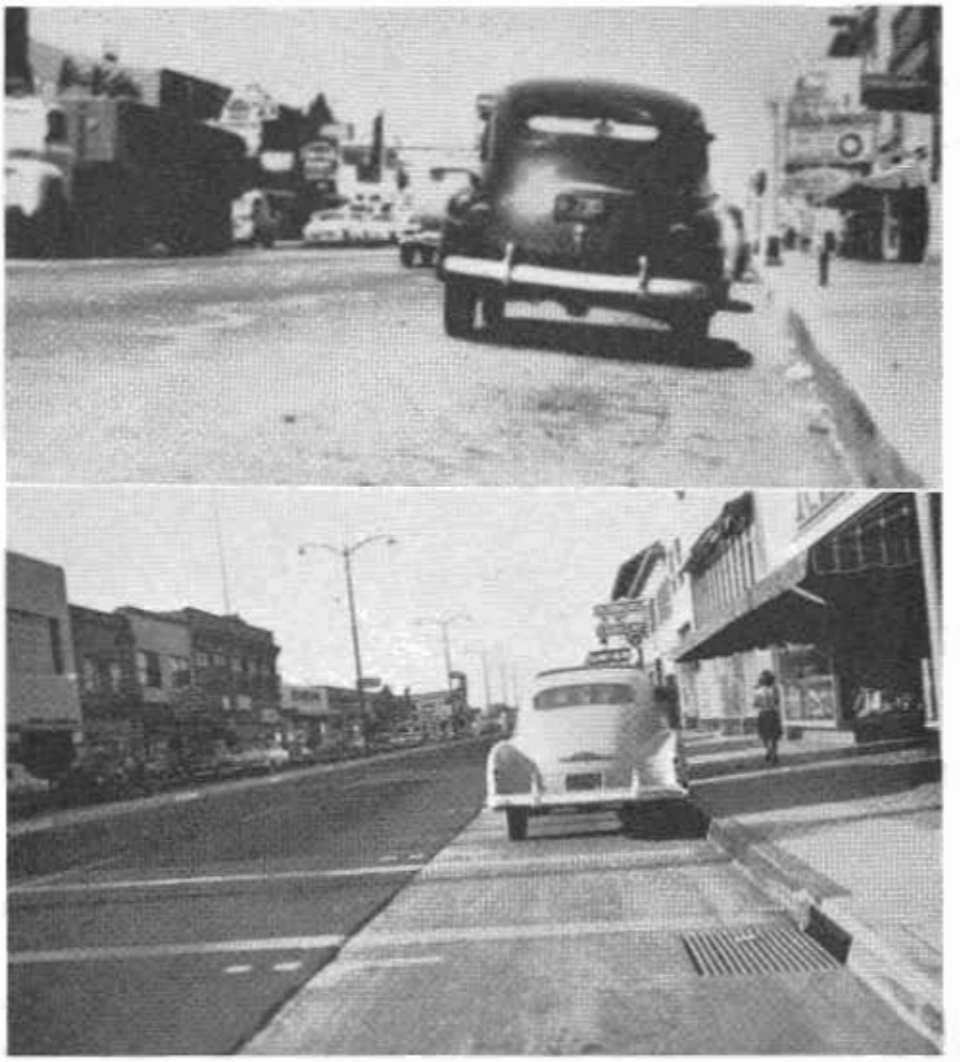
Dedication Ceremonies

At dusk on March 25, 1955, in the presence of several hundred interested spectators, brief but fitting ceremonies were held to celebrate the consummation of several years of planning on the part of city and state officials. Former Mayor George Milias officiated at a ribbon cutting ceremony in front of the city hall. Just prior to this, the lights were turned on for the first time.

Dedication ceremonies were arranged by the Gilroy Chamber of Commerce. Councilman Carl Pate represented Mayor George Mason who could not be present.

Brief congratulatory remarks were made by former Mayor Milias under whose term of office negotiations were first undertaken with the State. He was followed by Supervisor Arthur W. Brown of Santa Clara County and State Senator John F. Thompson. Resident Engineer W. S. Smith, in charge of the State's contract, was introduced and thanked the city for its cooperation and understanding during construction operations. Colonel John H. Skeggs, retired Assistant State Highway Engineer, District IV, who was responsible for the preliminary planning of this project, expressed gratification that the project had been successfully completed after many years of planning. He lauded the city officials for their foresightedness and initiative in overcoming financial obstacles and thus assisting in obtaining a street adequate for future needs. Chelso A. Maghetti, Secretary of the California Highway Commission, congratulated the city on the consummation of the project, followed by Fred Bagshaw representing Frank B. Durkee, Director of Public Works.

J. P. Sinclair, District Engineer, represented B. W. Booker, Assistant State Highway Engineer, under whose over-all supervision the project was designed and constructed.



UPPER—Photo taken in 1951. LOWER—Photo taken in 1955. Both on Monterey Street showing the difference in typical parking conditions. The high crown and high curb shown in the earlier photo made it difficult to open car doors unless the car was parked some distance from curb, as shown in the photograph.

BONNEROO

Continued from page 32 . . .

Griffith Co., Contractors. R. A. Collins, Resident Engineer.

No. 10

Colorado Freeway, Los Angeles County, between Avenue 64 and San Rafael Avenue. Guy Atkinson Co., Contractors. L. E. Steele, Resident Engineer.

The contracts are rated primarily on excellence of workmanship on the various items of work and smoothness of the finished pavement. Complexity of the job, engineering cost, public relations, and diligent prosecution of the contract are also factors which are considered in determining the 10 best projects.

In addition to the "Toppers" awarded to the contractor and the resident engineer, Certificates of Merit were awarded to the following men in recognition of their respective contributions to the construction of the best contract: H. Rollston, superintendent for the contractor; W. E. Bastues, bridge department representative; R. Delaney (deceased), principal assistant resident engineer; C. Palmer, principal assistant resident engineer; G. Camps, G. Dickey, J. Upham, W. Rhodes, M. Camp, E. Bedal, M. Meizlisch, J. Nausler, C. Fremed, J. Callahan, R. Hagstrom, assistant resident engineers; H. Schindler, Materials Department representative; H. Kurland, D. Neuman, chiefs of party.

DEVELOPMENT OF SIGN ROUTE 75 FROM PALM CITY TO CORONADO

Highway Commissioner Fred W. Speers, left, dedicates new highway. Seated, left, Supervisor Dave Bird and C. A. Maghetti, Secretary, State Highway Commission

On the afternoon of April 23, 1955, the South Bay District Chamber of Commerce celebrated the completion of a $350,000 highway project. The celebration was attended by a large representative crowd of citizens of San Diego County and particularly the South Bay district. C. A. Maghetti, Secretary of the California Highway Commission officiated with David Bird, local county supervisor, in the ribbon cutting, and Highway Commissioner Fred Speers addressed the gathering, outlining the recent highway accomplishments in San Diego County.

The project which is 1.9 miles in length, extending from the three-level interchange structure on the Montgomery Freeway at Palm City along Palm Avenue to Seventh Street in Palm City, provides a four-lane divided highway with a 22-foot separation together with proper channelization and 24-foot wide parking lanes on each side with right of way 150 feet in width. This will provide for an ultimate expansion of six lanes for through traffic.

The three-level Palm Avenue interchange structure connecting with the Montgomery Freeway was completed in 1952 as a unit of the full freeway development on US 101. This facility is common to both US 101 and SSR 75 and provides for adequate interchange of traffic between the two major routes.

Extension Provided For

Funds have been budgeted and plans have been completed for the extension of the four-lane divided section northerly along the Silver Strand to Dana Place in Coronado. This project will be under construction this summer and will provide a much-needed improvement on a heavily traveled highway which is the only highway outlet from the extensive Eleventh Naval District developments on North Island. It also provides direct access to the Naval Amphibious Base on the strand just south of the Coronado business district and provides the only access to a large California Division of Beaches and Parks development where extensive parking and recreational facilities are being provided. Proper connections are to be made for the entrance to the state park in the way of a separation structure so that there will be no surface intersections. Three pedestrian underpasses are to be constructed as a part of the project connecting the state park properties on both the east and west sides of the highway and railroad.

The completion of the entire development on SSR 75, extending from Coronado to US 101 will amount to approximately $2,000,000 for construction and rights of way.

The improvement as outlined above was made necessary by the rapid increase in traffic along the Silver Strand. The present volume of traffic is approximately 7,000 vehicles per day and is an increase of about 32 percent since 1950. The heavy volume of traffic on the narrow two-lane road with the type of traffic developed through the federal installations, state park and large residential area in the South Bay district caused a heavy accident frequency and made necessary the improvements recently completed and underway.

Freeway Accident Rate in State Is the Lowest

California's full freeways are the safest highways in the world, Governor Goodwin J. Knight believes.

Following the pattern of previous years, the over-all accident rate on the heavily traveled rural and urban full freeways in California in 1954, the Governor reported, was about one-half the rate for the rural state highway system as a whole, and the fatality rate was less than one-fourth as high.

The freeway fatality rate last year was 1.92 for every 100 million vehicle-miles of travel. This, the Governor pointed out, is considerably lower than the rate of 2.43 for a portion of the New York State toll Thruway which was publicized nationally several months ago as the safest highway facility in the world.

Lowest Fatality Rate

The 1954 California freeway fatality rate, one of the lowest ever recorded, is a drop of about 10 percent from the 1953 rate of 2.12. It went hand in hand with a comparable reduction in traffic fatalities state-wide. The Governor pointed out that 1954 was the third successive year of marked reductions in fatalities on the State Highway System in California despite a constantly increasing volume of traffic.

The average amount of traffic last year on the 131 miles of full freeway which had been in operation long enough for valid statistical compilations was 45,194 vehicles a day. (California now has 180 miles of full freeway completed, another 152 miles under construction and an additional 62 miles budgeted and scheduled for early construction.)

First Freeway in 1940

The first California freeway was opened in 1940. Since that time, travel on full freeways in this State has amounted to nearly six and a half billion miles, with an unmatched composite safety record over the 14-year period of 2.15 fatalities for every 100 million miles traveled.

"The consistent fine safety record on full freeways," Governor Knight stated, "is a clear indication that modern highway engineering can contribute substantially to saving lives in the face of mounting traffic volumes. It also bears witness to the wisdom of California's emphasis on full freeways for our most heavily traveled routes. We are now more determined than ever to push our freeway program ahead as rapidly as possible."

The Governor added, however, that freeways will never constitute the complete solution to the traffic accident problem.

"Despite all the built-in safety features of freeways and despite our enforcement and education campaigns, there were still 39 lives lost on freeways last year," he said. "We must continue to seek new ways to bring home to every motorist the fact that on his own behavior at the wheel rests the major responsibility for his safety and that of others."

NICKERSON GETS TWENTY-FIVE YEAR SERVICE PIN

MERRITT R. NICKERSON, Chief Photographer for the State Department of Public Works, had a new experience recently. He had to pose for pictures of himself. He has taken thousands of photographs for the department. The occasion for his posing instead of manipulating the camera was the presentation to him by G. G. McGinness, Service and Supply Engineer, Division of Highways, of his 25-year service certificate and pin.

Nickerson was born in Nevada City, California, and moved to Sacramento in 1913. He is a veteran of World War I, having enlisted in Troop B, a cavalry unit composed mainly of Sacramento men. Later this troop with three others served in France as the 145th Machine Gun Battalion.

Upon returning in 1919 he worked for District I, Division of Highways, in Dunsmuir. He left the state service in 1920 and was employed by a local commercial photographic concern for about 12 years, during which time he handled various contract photographic assignments for the State of California and the Division of Highways.

G. G. McGinness, right, presents M. R. Nickerson with service pin

He was re-employed by the Division of Highways in 1932 and in his present work supervises all photographic work for the department, which includes *California Highways and Public Works* magazine, aerial photography and photographs for the various divisions of the department.

Highway Pioneer Dies

John R. Graham, father of the "Yosemite-to-the-Sea Highway," died on May 2d in Hayward at the age of 87.

One of the major segments of the highway he helped develop is now the Pacheco Pass route which links Highways 101 and 99.

Mr. Graham was a pioneer leader in the State's "good roads" movement.

He lived in Merced until his retirement several years ago. He was a former Merced City Councilman and a former Merced County Supervisor.

Since his retirement, he lived at the home of a grandson, R. Bruce Graham of 20060 Times Avenue, Hayward.

REVIEW OF CEMENT TREATED BASES IN CALIFORNIA

By CARL ALZUETA, Assistant Engineer, Construction Department

Cement treated bases have been used extensively by the California Division of Highways for about 15 years. During this period the State has constructed more than 29,000,000 square yards of cement treatments, or about 35 percent of the total amount placed throughout the United States. As a result of this extensive construction it is now possible to review to good advantage the specifications and current practices that have evolved in California from so much experience in constructing many miles of these bases.

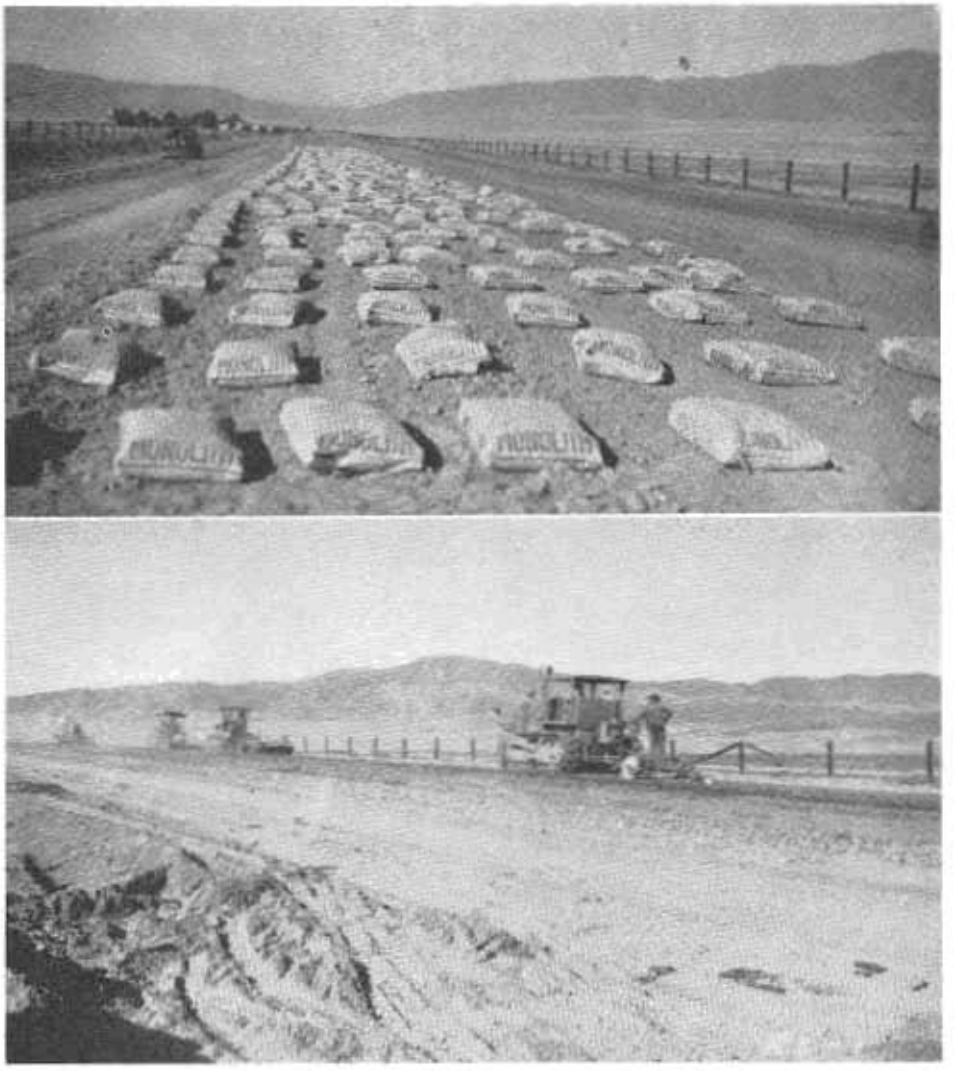
California now specifies two types of treatments, cement treated subgrade which is a solidification treatment under concrete pavement and cement treated bases which are intended for structural use directly under bituminous surfacings.

Economic Advantage

Cement treated bases are used with the objective of obtaining a limited slab strength greater than natural materials but less than that of concrete. To conform to the degree of anticipated loading, treated bases are subdivided into three specific classes of A, B and C with Class A being the highest quality.

The principal advantage in using Class A and B cement treated bases is that a reduction in required total thickness of the structural section, as compared to untreated bases, can be obtained due to the slab strength and the resulting high cohesion value assigned in the California design procedure. Another economic advantage is realized by being able to utilize cheaper local materials rather than importing expensive quality aggregates.

California specifies Class A cement treated base where traffic demands are high and good quality untreated base materials are difficult to obtain economically. Class B bases are, in general, comparable to Class A except that a lesser amount of cement is used and strength requirements for Class B are approximately 50 percent of that required for Class A.



UPPER—Cement treatment in 1937. Bagged cement spotted along grade is ready for spreading on this pioneer project by state forces. LOWER—Teams of tractors tow farm plows to mix in-place material and cement.

Requirements

In all cases where the thickness of cement treated base exceeds seven inches, the Standard Specifications require that the base be placed and compacted in two or more layers of approximately equal thickness. In this type of construction the Class B base is used extensively for the bottom four-inch layer. However, it is not confined to this type of construction alone.

Class C cement treated base employs the use of relatively small amounts of cement (1%-2½%). It is used for several different reasons, depending upon the circumstances. For example, it may be used to:

1. Improve the resistance value (R value) of material selected from roadway excavation or imported borrow.
2. Offset the chance inclusion of adverse clay in base materials.
3. Provide a more stable working table for construction, particularly where sandy soils are involved.

4. Bring substandard material up to specification requirements.

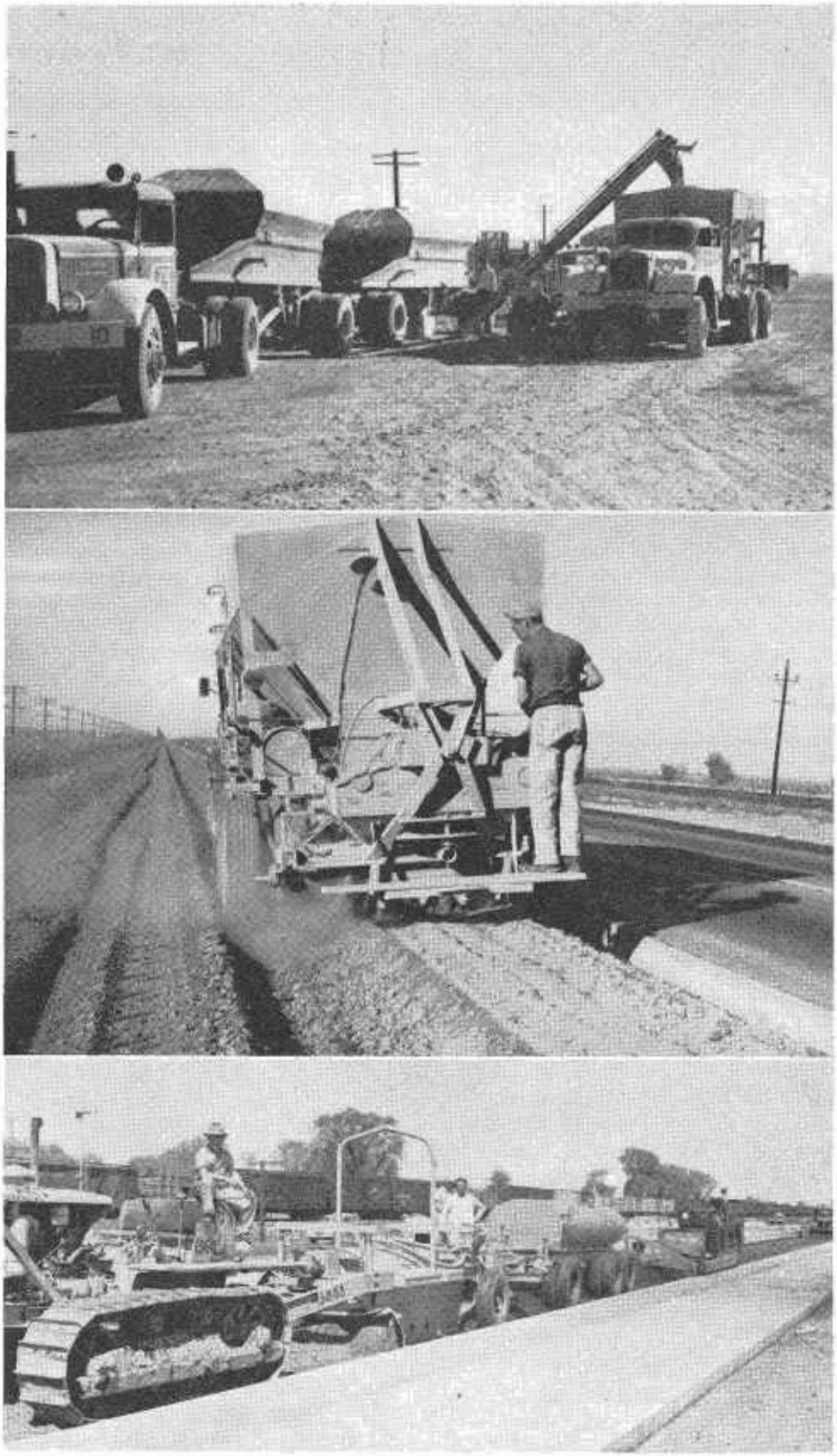
In general, Class C cement treatments are applied to base materials whose supporting value is slightly less than that required by design. Since the amount of cement is small the uniformity of distribution becomes a problem in fine cohesive materials. This type of treatment is not recommended where the margin of correction is large.

Cement Treated Subgrade. In California practice cement is added to the layer of material directly under concrete pavement for the purpose of providing an erosion resistant layer. A comparatively low cement content is normally used on this type of work. While no definite compressive strength is required for cement treated subgrade, it is generally recommended that they be designed on the basis of approximately 200 to 300 psi compressive strength at seven days. Since this subgrade treatment is not intended to provide additional structural strength for the pavement, high compressive strengths indicate an uneconomical use of cement.

Materials. Generally speaking, a wide range of mineral aggregates can be used for cement treatments. However, because of construction and economic limitations usually materials of a somewhat granular nature with sufficient binder are used.

Practically all soils can be stabilized with cement, but not all soils can be stabilized easily and economically by this method. Thorough pulverization of the soil and thorough mixing with cement and water are prerequisites to success. Hence, cement treatments are limited to granular and friable soils which can be pulverized readily. Soils which have a high silt or clay content require more cement and present difficulties during construction, particularly during pulverizing and blending.

Conversely, materials deficient in fines require high percentages of cement to develop the required compressive strengths. In this regard a desirable relationship has been found to exist between the fine and coarse material. For cement treatments this relationship is based on the amounts passing the No. 30 and No. 200 sieves



Modern cement treated operation. UPPER—Cement is hauled to project in large truck-trailer combinations from which it is bulked off into smaller distributor trucks. CENTER—Cement is uniformly distributed to the windrow. LOWER—Mixing train follows. Tractor-powered mixer works windrows, adding water from following tank truck. Towed blade breaks down and distributes it. A roller immediately compacts the treated material.

and is generally expressed as follows: "—not less than 15 percent or more than 40 percent of the material passing No. 30 sieve shall pass the No. 200 sieve." For example, a material having 20 percent passing the No. 30 sieve should have between 3 percent and 8 percent passing the No. 200 sieve.

When Class C cement treated base is specified and fine grained sandy materials are being used, the maximum amount of cement in the specification range should be added. With this type soil, failures have occurred near the surface of the base itself because of lack of shear strength in the sandy material. Incorporating coarse aggregates or portions of an existing surfacing, also improves the shear strength of these bases.

Mixing. California specifications permit the contractor to choose between mixing the cement treated base on the road or in a plant. The road mixed method has proven most popular with the contractors since it permits a much larger daily production. In addition, road mixing is a separate operation utilizing a different type of equipment and for that reason both the base construction and bituminous plant mix can be done concurrently without the necessity for two separate plants. On certain projects because of local conditions no choice of mixing methods is permitted and the type of mixing is dictated. The average cost of mix and compact exclusive of cost of material in 1953 was $0.21 per square yard.

Cement treated subgrade is completely road mixed since it is naturally adapted to this type of operation. Contractors have developed equipment trains that operate from the pavement side forms to shape, windrow and trim the treated subgrade. Cement treatment is always done before placement of the side forms because of the difficulty experienced in placing them accurately on the hardened surface. The average cost of this treatment, exclusive of cost of material, in 1953 was $0.24 per square yard.

Plant Mixing. Contractors generally elect to plant-mix cement treated base when it is to be used for shoulders, borders or ramps, or where road mixing operations may be seriously hampered by traffic. Variable width construction, in particular, is not suited to road mixing because of the difficulty encountered in proportioning and controlling the cement and water properly.

California specifications require that the aggregates be separated into two sizes, one size to consist of material passing a No. 4 sieve and the other retained on a No. 4 sieve. The exact size of the separation screen is not important as long as the finished product conforms to the above requirement. The size of the screen opening the contractor will elect to use will depend upon the amount of retained moisture and the amount of fines in the aggregate. It is not the intent of the specification to require the use of a drier for aggregate containing less than the optimum amount of moisture. However, under certain conditions contractors may elect to dry the mineral aggregate in order to facilitate screening. In this event, heating of the aggregates is limited to not more than 150 degrees F. This will prevent flash set of the mix with a resulting loss of compaction and strength.

Where bulk cement is being used, it should be prevented from hanging up in the weigh hopper and chutes. Vibration may be provided if necessary to maintain a free flow. The mixer should be properly cleaned daily and since build up of cement and aggregate on mixer shafts, paddles, and liners is rapid, any neglect even for a short time materially reduces the capacity and efficiency of the mixer.

The horsepower demand in mixing this type of material is considerably more than that for a bituminous mixture. The normal practice is to space the paddles farther apart and reduce the number per shaft, but this can be overdone. If there is any question as to the efficiency of mixing, the power should be cut off at the end of the mixing period, and samples obtained from each end and the center of the mixer, and test specimens fabricated from each. Comparisons of compressive strength will serve as a check on the distribution of cement.

Mixing—Road. Under the road-mix method it is essential that windrows of material to be treated be sized immediately prior to mixing. Where material is mixed from a blanket the depth of mixing should be checked. This is required in order to maintain a constant proportion between the cement and aggregate and to provide a uniform consistency. For similar reasons, material that is brought in for treatment should be mixed as uniformly as practicable at the source.

Cement is spread on the windrow in bags by hand or in bulk by means of a distributor truck. In dumping the bags, the cement should be spread as uniformly as possible throughout the length of windrow that the bag is to cover. Because of lower costs California contractors generally use bulk cement.

Accuracy in the spread of bulk cement by means of mechanical devices may be checked by laying out building paper in the "V" notch and spreading upon it, after which a measured section is gathered up and weighed. It has been found that the spread from certain distributors is influenced by the quantity of cement in the bin over the screw. When the bin is full, larger amounts of cement will be spread than desired; and when the bin is nearly empty, less cement is distributed. It is recommended that the spread be checked at various bin levels.

Test Specimens

If the efficiency of mixing or distribution of cement is questioned on a project, three test specimens are taken from material from any one point along the windrow; one from each side midway in the height of the windrow, and one from the center of the bottom face. Class A and B cement treated bases and cement treated subgrade are tested by compressive strength cylinders and Class C cement treated base by stabilometer tests to indicate the degree of uniformity.

The following types of road mixers are being employed by California contractors:

1. The pugmill or auger machine that mixes from a windrow. This type is the most commonly used by the contractors.

The pugmill or auger mixers should be carefully checked to see that the material near the bottom of the windrow is being lifted from the subgrade and is receiving thorough mixing.

This type of mixer can also be easily overloaded with lower resultant uniformity of mixing. As the trend is toward thicker bases the width of lane and thickness of layer that can be mixed in a single pass must be carefully studied. The manufacturer's recommendation should be followed, and the uniformity of mixing checked periodically by methods previously described.

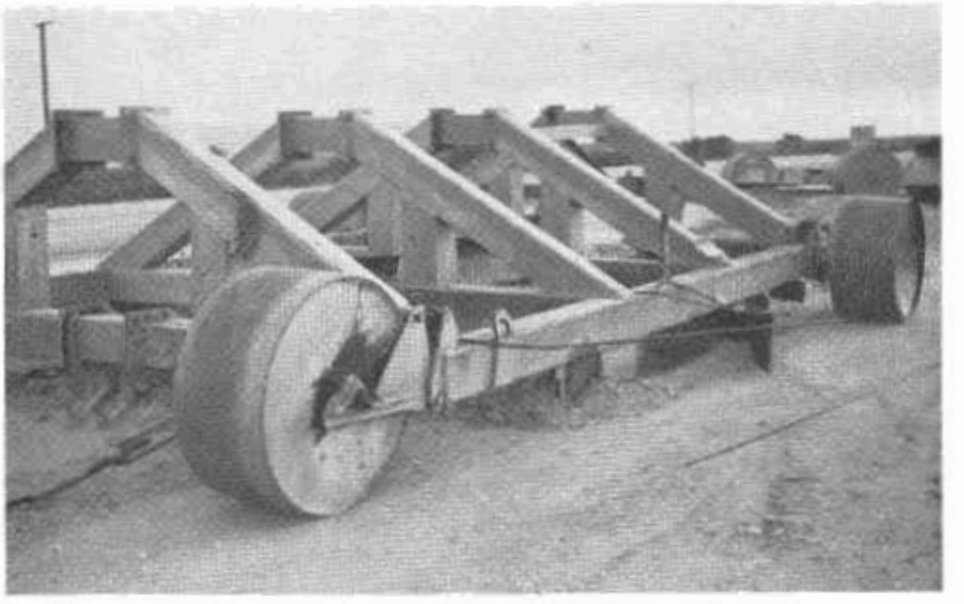
2. The transverse shaft type that mixes the material by means of revolving paddles. This mixer does not require that the material be windrowed, which means less interference to traffic. On narrow mountain sections this results in a minimum of interference to traffic.

The mixer should be checked for depth and uniformity of mixing. Every effort should be made to add the cement to the mineral aggregate when the latter is dry. Balling of the cement results if the cement is placed on damp aggregates and may require excessive mixing passes to blend in uniformly.

3. The elevating mixer which combines a loader and a pugmill unit. This mixer has the advantage that it can mix large windrows of material, making it possible to treat larger quantities of material in a single pass.

Spreading and Compacting. Since cement treatment hardens rapidly after compaction it is generally more difficult to obtain a satisfactory subgrade for the bituminous surfacing. Riding qualities of the bituminous pavement superimposed on a cement treated base are largely influenced by the spreading of the cement treated base, supplemented by the trimming with the self-propelled blade grader. The trimming operation is highly important and should be very carefully performed. The more care taken in the spreading, the less trimming will be necessary and less scarring of the surface will result.

Strength of cement-treated materials is largely dependent on the density obtained. To insure good compaction, it is essential that the base be compacted as soon as possible after the material is mixed. Sufficient moisture must be present in the mix to provide lubrication and maximum density. Slightly more than this amount will result in spongy spots during the rolling. Best results are generally obtained with a moisture content just short of instability or "quaking" under a roller.



Towed frame developed by a California contractor to scarify and windrow in-place material preparatory to cement treatment. Equipment can be adapted to work from side form by replacing wide base steel wheels with narrower flanged wheels.

If a motor grader is used to spread the cement treated base, it is recommended that a roller be used after the first pass of the grader in order to remove the tire tracks immediately. If the tracks are filled in before rolling, they contain more material than the adjacent areas, resulting in an irregular section and uneven compaction.

Between the operations of compaction and finish surface rolling the surface is trimmed where necessary with a blade grader and the cut material wasted.

Shaping or blading after spreading has been found undesirable as it develops horizontal planes, or laminations, in the material. Every effort should be made to make the initial spread smooth and uniform.

The trimming should be done before the cement treated base has hardened in order to reduce surface tearing to a minimum. A pneumatic-tired roller equipped with a water spray bar provides the final compaction and a close-knit texture to the surface.

Thickness of Layer. Cement treated bases should never be placed in layers less than 4 inches in thickness. Thinner layers laminate and may develop slippage between the planes.

Surface Texture. There have been instances where the bituminous surfacing placed on cement treated bases has slipped because of a smooth slick base surface texture. This condition is usually encountered with fine grained materials such as sand or disintegrated granite which are lacking in large particles. Under such conditions consideration should be given to roughening the surface texture by means of a sheepsfoot tamper or other such roller. Tractor cleats should be avoided since they tear the surface excessively.

Curing Seals. Except for Class C cement treated bases, the surface of these treatments are kept moist until the application of the asphaltic emulsion curing seal. Class C cement treated base which has no compressive strength requirement generally does not receive a curing seal and is usually primed as in the case of any untreated base.

Bituminous membranes are applied to cement treated bases for the following purposes:

1. To retain moisture during the curing period.
2. To protect the surface under the action of traffic.

3. To provide a tack coat for bituminous surfacing.

An MC-2 curing seal is added to cement treated subgrade not only for the first two purposes but also (and primarily) to toughen the surface and provide additional resistance to erosion.

Traffic Through Construction. It is considered advisable to close cement treated bases to traffic for a period of seven days of curing; however, this is not always practicable, and the specifications permit immediate use when necessary.

Every effort should be made, however, to keep traffic off of the new base until it has developed sufficient slab strength to resist breaking up under the traffic loads. This is of particular importance during fall, winter and early spring construction seasons when the presence of excess moisture may cause a yielding subbase.

Class A and B cement treated bases, if placed on yielding subbases and subjected to traffic before they have developed sufficient slab strength, may break up and defeat the purpose of the treatment. This condition, if it occurs, can lead to ultimate failure of the section.

California has found that cement treatments have very little resistance in themselves to traffic abrasion. Where heavy traffic must be carried over cement treated bases for long periods, provision must be made to protect the surface. Curing seals are helpful in providing this protection, and in the more extreme cases consideration is given to the use of MC-2 instead of the emulsion generally specified. The greater penetration of MC-2 provides a better wearing course and lessens the surface abrasion. Where traffic must be carried throughout the winter over a base without the surface cover, it may be advisable to tailgate a ¾-inch to 1-inch mat of a bituminous mix material to serve as a temporary wearing course.

California began its first cement treatment of soils in 1921. The operation was slow in being adopted and it was not until 1938 that cement treatments were included on contract work. Today in California cement treatments have progressed to the point where it is unusual to review a set of plans without some type of cement stabilization.

Cement treatments offer the highway engineer the advantage of a base with increased supporting power and positive insurance against the bad effects of inadvertently including nonuniform base material. The use of increased cement must, of course, be balanced against the possible adverse effects resulting from loss of pavement flexibility.

Description of Projects

(1) Project 4.8 miles in length. Consisted of placing base and surfacing over previously constructed roadbed. New alignment with no public traffic. Surfaced with two inches of dense graded and one inch open graded bituminous plant mix.

(2) Project 4.3 miles in length. Consisted of constructing graded roadbeds for a divided highway with the necessary roadbeds for out highways and detours, and placing base and surfacing over a selected material. Traffic carried through project but not over lanes under construction. Surfaced

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REPRESENTATIVE UNIT BID PRICES ON RECENT PROJECTS

The contract	Cement treated base				Cement		Surfacing		Class CTB
County Contractor	Thickness (inch)	How mixed (road mix or plant mix)	Quantities (sq. yd.)	Unit price	Cement (total barrels)	Price of cement (per barrel)	Top course	Curing seal	
1. Mendocino Co., Granite Const...	4	Road	159,700	$0.20	13,960	$4.65	3" plant mix	Asphalt emulsion	A
2. Siskiyou Co., A. Teichert & Son..	6	Road	124,000	.15	7,000	4.70	3" plant mix	Asphalt emulsion	B
3. Tehama Co., Rice Bros.....	6	Road	120,000	.16	6,100	5.15	3" plant mix	Asphalt emulsion	B
4. Yolo Co., Ukropina-Polich & Kral.	4	Road	108,000	.20	5,800	4.45	8" PCC	Ashalt emulsion	Cement treated subgrade
5. Marin Co., Guy F. Atkinson.....	8	Plant	17,500 (tons)	3.00 per ton	4,470	3.75	3" plant mix	Asphalt emulsion	A
6. San Mateo Co., Piombo Const....	8	Road	233,000	.22	15,600	3.50	4" plant mix	Asphalt emulsion	B
7. Santa Barbara Co., Griffith Co....	4	Road	92,000	.19	3,500	4.30	8" PCC	MC-2	Cement treated subgrade
8. Ventura, Los Angeles, A. Teichert & Son	8	Road	200,000	.20	18,500	4.50	4" plant mix	Asphalt emulsion	4" of A & 4" of B
9. Riverside Co., Robert Parker Co..	6	Road	71,000	.20	2,900	5.00	3" plant mix	None	C

* Does not include cost of cement.
† Quantity may also include cement for other purposes.

Aluminum Falsework

Is Used on Richmond-San Rafael Bridge

By FRANCIS J. MURPHY, C.E.*

A CONTRACT in the amount of approximately $25,000,000 for the construction of the superstructure of the Richmond-San Rafael Bridge was recently awarded to Judson Pacific-Murphy-Kiewit, a joint venture consisting of the Judson Pacific-Murphy Corporation of Emeryville, California; Peter Kiewit Sons' Company of Omaha, Nebraska; Stolte, Inc., of Oakland, California, and the Fred J. Early, Jr., Company of San Francisco, California.

* NOTE: Francis J. Murphy received his B.S. in Civil Engineering at the University of Santa Clara. He is an associate member of the ASCE and project manager on the superstructure contract of the Richmond-San Rafael Bridge. A registered engineer in the State of California, Mr. Murphy has been employed by the Judson Pacific-Murphy Corporation since its formation in 1945.

The bridge is 4.01 miles long and, when completed, will be the second longest over-water bridge in the world; the longest being the San Francisco-Oakland Bay Bridge, and the third longest being the recently completed Chesapeake Bay Bridge. The new span is being built under the direct supervision of Norman C. Raab, Projects Engineer of the Division of San Francisco Bay Toll Crossings.

New Developments

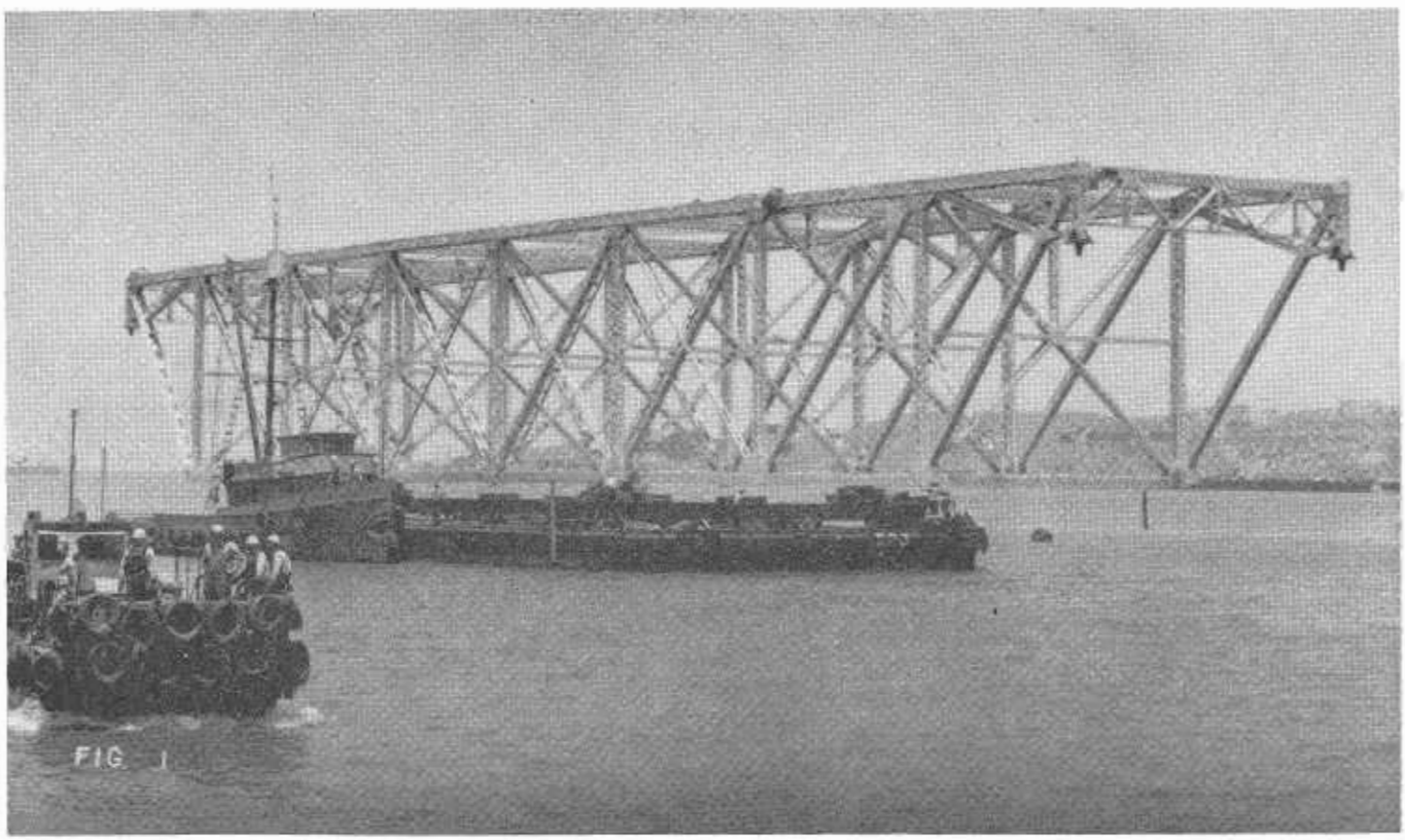
There are many new developments being used by the contractors in the construction of this job. One of the most noteworthy, and the one we shall dwell upon in this article, is the use of structural aluminum for falsework. It is believed that this is the first such use of aluminum in construction history.

The job is composed of 36 100-foot girder spans, two cantilever spans having identical anchor spans of 537.5 feet with main span clearance of 1,070 feet, and 36 289-foot truss spans. The aluminum falsework is being used for the erection of 27 of the 36 289-foot spans. The remaining nine 289-foot truss spans have been floated into place in one piece because the bottom chord elevation was low enough so that the use of aluminum was not necessary.

Method of Erection

The aluminum span as shown in *Figure 1* was fabricated in Judson Pacific-Murphy Corporation's plant in Emeryville and riveted and assembled

Aluminum falsework truss being towed to bridge



by joint venture personnel at its Richmond yard. It was then raised by two conventional derrick barges onto two Army surplus BK barges and floated out to the jobsite. It was then raised into position and supported by vertical wooden timber bents attached to the existing steel towers and, after erection, it forms a falsework platform. The wooden towers can be seen at either end of the aluminum span in *Figure 2*. The span will support the individual members of the truss span until it is finally swung into place and literally becomes a bridge.

Figure 3 shows a view of the aluminum truss before the steel erection is started. This truss is 285 feet long, 42 feet wide and 42 feet deep and weighs 110 tons. A similar truss made of steel would weigh approximately 330 tons and could not be handled by conventional hoisting equipment.

Figure 4 shows steel erection using a double-boomed erection traveler with the aluminum span as falsework. These aluminum spans cost approximately $150,000 each, and are one of the largest applications of structural aluminum in history. The only larger applications, tonnage-wise, are an arch-type bridge in Canada and the Alcoa Building in Pittsburgh.

FRANCIS J. MURPHY

Steel Rivets Used

Channels up to 12 inches, plate up to three-quarters of an inch, and angles to five-eighths of an inch were rolled at Alcoa's Massena, New York, mill and constituted 90 percent of the tonnage. The largest individual sections of the aluminum truss built up on plates and angles have a cross section of 27¾ inches x 19 inches. The heavy sections and long lengths required the limits of the Massena mill, one of the largest aluminum mills in the world.

Steel rivets were used in the aluminum assembly since they were more readily available and easier to heat and drive.

The firm of Earl and Wright, San Francisco was engaged by the contractors as consultants on this job, and thy have certainly performed remarkably well. In designing the aluminum, they followed closely the "Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy" published as paper No. 2532 in Volume 117 (1952) of the Transac-

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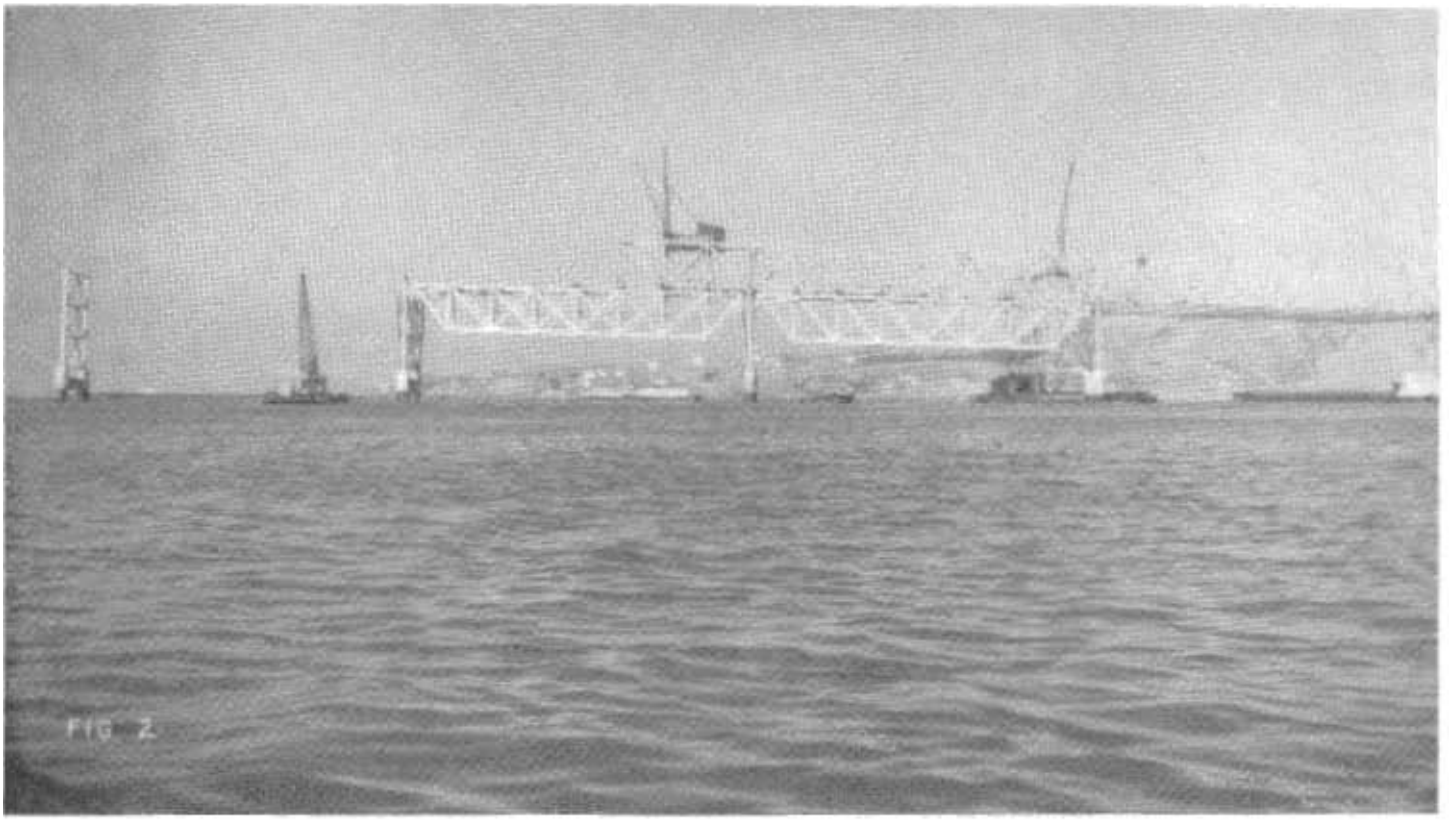
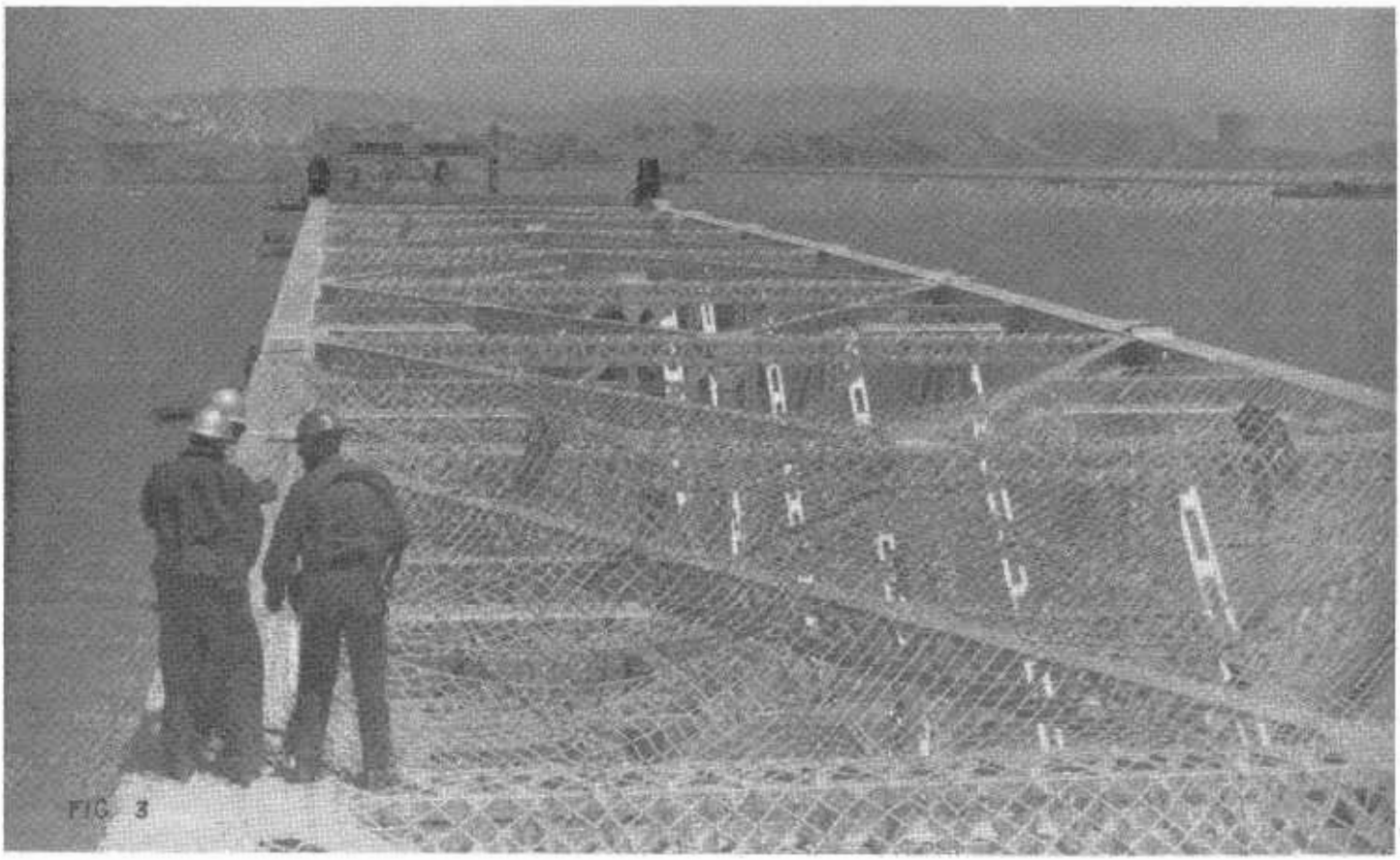
Aluminum falsework truss supporting erection traveler





Spreading safety nets on the aluminum span

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

Status of work under contract for the Richmond-San Rafael Bridge project as of April 30, 1955:

Contract No. 1002A—Borings, $62,000. Awarded February, 1952. Completed July, 1952.

Contract No. 1003—Substructure, $14,500,000. Awarded February, 1953. Completion October, 1955. Status—99 percent complete.

Contract No. 1004D—Superstructure, $21,000,000. Awarded February, 1953. Completion October, 1956. Status—69 percent complete.

Contract No. 1005—Mole Fill, $248,000. Awarded May, 1953. Completed December, 1953.

Contract No. 1007—Trestle Approach, $192,000. Awarded September, 1953. Completed August, 1954.

Contract No. 1008—Richmond Approach, $741,000. Awarded December, 1954. Completion March, 1956. Status—29 percent complete.

Contract No. 1009—San Rafael Approach, $216,000. Awarded March, 1954. Completed November, 1954.

Contract No. 1010—Buildings and Toll Plaza, $290,000. Awarded August, 1954. Completion August, 1955. Status—61 percent complete.

Contract No. 1011—Electrical Work, $1,000,000. Awarded December, 1953. Completion August, 1956. Status—20 percent complete.

Contract No. 1012—Toll Collection Equipment, $280,000. Awarded September, 1954. Completion May, 1956. Status—10 percent complete.

Contract No. 1015—Separation Structures, $610,000. Awarded August, 1954. Completion November, 1955. Status—30 percent complete.

Status of the work on the entire project is 70 percent complete.

Director of Public Works, Frank B. Durkee, on May 12 awarded the last major construction contract on the project as originally planned. Paving of the lower deck of the structure will follow as a separate contract.

The contract awarded went to J. H. Pomeroy & Co., Inc., San Francisco, in the amount of $844,344.40 for the construction of eight reinforced concrete piers on steel piles at pier locations, the erection of 17 structural spans and the erection of 11 structural spans at pier locations in Contra Costa and Marin Counties.

Coincidentally Durkee authorized the Division of San Francisco Bay Toll Crossing to advertise for bids for grading and paving the Richmond toll plaza and approach roads for the bridge and grading and paving the yard area of the San Rafael Maintenance Building and constructing a separation. This work is estimated to cost in excess of $400,000 and with the Pomeroy contract is to be financed from the $50,000,000 construction fund set up under the $62,000,000 issue of Series A bonds, Richmond-San Rafael Bridge Toll Bridge Revenue Bonds.

Retirements *from* Service

John H. Obermuller

John H. Obermuller, Assistant Planning Engineer of the Division of Highways, retired on May 1st after 27 years with the State and a career of nearly 50 years in engineering work.

JOHN H. OBERMULLER

Obermuller was born in Hayward, California, and attended school there. His first engineering job was with the Western Pacific Railroad on the Feather River location project in 1906. He came to work for the State of California in 1928.

As Assistant Planning Engineer of the division, the position he held at his retirement, he has performed important liaison work between the Division of Highways and other agencies. Because of his engineering and administrative experience with other government and private agencies before coming to work for the State, he was assigned the responsibility of working out many of the now estab-

. . . Continued on page 49

Margaret Kenyon

Margaret Kenyon, Supervising Clerk II in the State Division of Highways Planning Department, retired on May 1st after more than 20 years in state service.

She was the guest of honor at a dinner given by her fellow employees on April 27th at the University Club.

MARGARET KENYON

Mrs. Kenyon came to work for the Maintenance Department of the Division in October, 1934, on a temporary two weeks appointment as a stenographer-clerk to help in the preparation of the California Highway Transportation Survey of that year, one of the forerunners of present day highway traffic studies. She has been with the division ever since, rising through the civil service ranks to become Supervisor of the Planning Department files.

When the Traffic Department, then known as the Safety Department, was formed in 1938, she was one of four employees making up the personnel of this new unit.

As supervisor in charge of the Planning Department records, she had charge of setting up the Planning Library, as well as working out many of the filing and recording procedures now in use by the division. She also took part in developing the forms now used in accident analysis by the Traffic Department. She has also aided in the compilation of many of the subsequent reports prepared in whole or in part by the Planning Department.

Mrs. Kenyon was born in Clayton, Missouri, and came to California in 1907. She has a son and a daughter and three grandchildren.

After retiring from state service, she plans to go into newspaper circulation promotional work.

Leo J. McCarthy, Sr.

The retirement of Leo J. McCarthy, Sr., for the past three years Property Disposal Agent and Auctioneer for the Excess Land Section of the Division of Highways in District VII, became effective the early part of April.

LEO J. McCARTHY, SR.

Mr. McCarthy is a native son, having the distinction of being born in San Francisco. Until 1935 he lived most of his life in and around the northern city, having graduated from schools and colleges in San Francisco and Oakland. His crisp, incisive speech still suggests the invigorating tang of salt air from his beloved northern coast.

He graduated from Sacred Heart College in San Francisco in 1904 and received a bachelor of arts degree from Saint Mary's College in Oakland in 1906. At Saint Mary's he also received a solid gold medal for oratory, attesting his brilliant performance in this field.

. . . Continued on page 49

JOHN F. OBERMULLER

Continued from page 48 . . .

lished procedures used in drawing up agreements between outside agencies and the State of California involving highway improvement and relocation.

Before reorganization of the division to handle the augmented construction program made possible by 1947 legislation, Obermuller was principal assistant to the Engineer of Surveys and Plans, with responsibility for review of all planning. The increased volume of highway construction and long-range planning resulting from the Collier-Burns Act of 1947 required full time assignment of Obermuller to interagency engineering liaison.

In addition to working on the Feather River railroad location project, his prestate experience also included seven years in Canada as resident engineer with the Grand Trunk Pacific Railroad, laying out the railway between Prince Rupert and Fraser Lake; two years as Assistant City Engineer of San Francisco supervising the location and construction of roads on the Hetch-Hetchy project; and 10 years with the U. S. Bureau of Public Roads.

As an engineer with the B. P. R., Obermuller had charge of much of the planning, location and construction work throughout the State under the forest highway program.

Obermuller lives at 716 34th Street in Sacramento. He is married and has one son, John C., an Assistant Construction Engineer with the Division of Highways, and three grandchildren.

He intends to spend his time after retirement traveling, working on his ranch in Nevada County, and doing some engineering consulting work.

He also will devote some time to perfecting his "camera-gun," a camera which he has set on the end of rifle stock and which can be set off by pressure on a trigger fastened to the camera shutter release by a length of taut piano wire.

By using his "gun," Obermuller says that he has all the pleasure of stalking an animal without having to kill it. By referring to a certain spot on each developed film he can tell whether a bullet would have struck the animal or not and where.

Obermuller has even stalked animals with his "gun" in national parks, although not without causing a certain amount of dismay at first to park rangers watching him through field glasses until they could reach him and find out what he was up to.

LEO J. McCARTHY, SR.

Continued from page 48 . . .

To enumerate briefly the various high spots of his eventful career: He has been superintendent of streets for the City of Oakland; secretary and managing director of the National Catholic Welfare Council in San Francisco; realtor and appraiser in Oakland; field secretary to Most Reverend Edward J. Hanna, D.D., Archbishop of San Francisco; Assistant District Right of Way Agent in District IV; Assistant Chief Right of Way Agent, Legal Department, California Highway Commission; appraiser for the Federal Land Bank of Berkeley; broker, general real estate and insurance, and appraiser, referee and trustee for the Superior Court of Alameda County.

He came to District VII, Division of Highways, as a Right of Way Agent January 2, 1935, and on January 26, 1937, was appointed a district right of way agent, a title he held until he retired. In these latter positions he has had remarkable success in acquiring for the State unusually large parcels of land from prominent land owners, particularly in Ventura County.

He has been married over 40 years to the very gracious and lovely lady who shares his joys and sorrows, Mrs. Loretta McCarthy. They have five children and 10 grandchildren—a regal family of which they are justly proud.

From 1919 to 1920 he was Master of the Fourth Degree (highest degree in the Order of the Knights of Columbus) of Northern California and Nevada, and now holds title of Past Master.

He is a past president (1943) and charter member of the American Right of Way Association, Chapter No. 1, and a member of CSEA, Highway 101 chapter.

His hobbies are fishing—any time or place—and debating with Frank C. Balfour on the relative merits of the two great Catholic universities, Saint Mary's and Santa Clara.

Three Veterans Of Highways Are Retiring

Three veteran Division of Highways maintenance foremen, whose combined service with the State totals 99 years, are retiring.

They are Lester C. Harmon and L. Ernest Roy, who retired on May 1st, and Leo W. Sackett, scheduled to retire at the end of July.

All three men have served with District III (Marysville) during the latter part of their careers.

Harmon came to work for the division in 1921 as an operator of heavy trucks and tractors. He became subforeman in 1925, and was promoted to foreman in 1932. He has worked in District X (Stockton) and District IX (Bishop), transferring to District III in 1936 where he worked until his retirement. Since 1937 he has served as foreman in the Roseville area.

Roy was first employed by the division in District X in 1929. After a short assignment to District IX between 1936 and 1937 he transferred to District III as foreman in the Georgetown area. He was later transferred to El Dorado, where he now resides.

Sackett started to work for the division in 1916 driving a six-horse team on the old road between El Dorado and Placerville. In 1924 he operated one of the first motor graders bought by the State. Three years later he became maintenance foreman at Camp Pyramid, 40 miles east of Placerville, later transferring to Placerville where he remained until 1937. After a two-year assignment in Marysville, he was transferred to the Sacramento territory where he has worked for the past 19 years.

Harmon and Sackett are native Californians, Harmon being born in Jackson, Amador County, Sackett in El Dorado. Roy was born in Black Hawk, Colorado.

All three men intend to spend a lot of their time hunting and fishing after their retirement.

ALUMINUM FALSEWORK

Continued from page 46 . . .

tions of the American Society of Civil Engineers.

Highest Strength Aluminum Alloy

These specifications were drawn up for the highest strength aluminum alloy (14S-T6), formed by alloying copper and other light metals with aluminum followed by heat-treating. According to these specifications, the following factors in structural aluminum design are important:

Basic allowable tensile working stress is 22,000 psi based on minimum yield strength of 53,000 psi and minimum tensile strength of 60,000 psi.

Modulus of elasticity in tension and compression is 10,600,000 psi (this compares with 30,000,000 psi for steel).

Coefficient of expansion is 0.000012 per degree (double the 0.0000065 per degree F. of steel).

Weight is 0.10 pci (steel is 0.28 pci).

Aluminum structures must be protected by paint, although alloying aluminum reduces resistance to corrosion. The fabricated members are first given a thorough cleaning with a mild phosphoric acid solution. This is followed by a prime coat of zinc chromate. Finish coat for the erected spans is an aluminum pigmented paint.

The major reasons for the contractors using aluminum as falsework are:

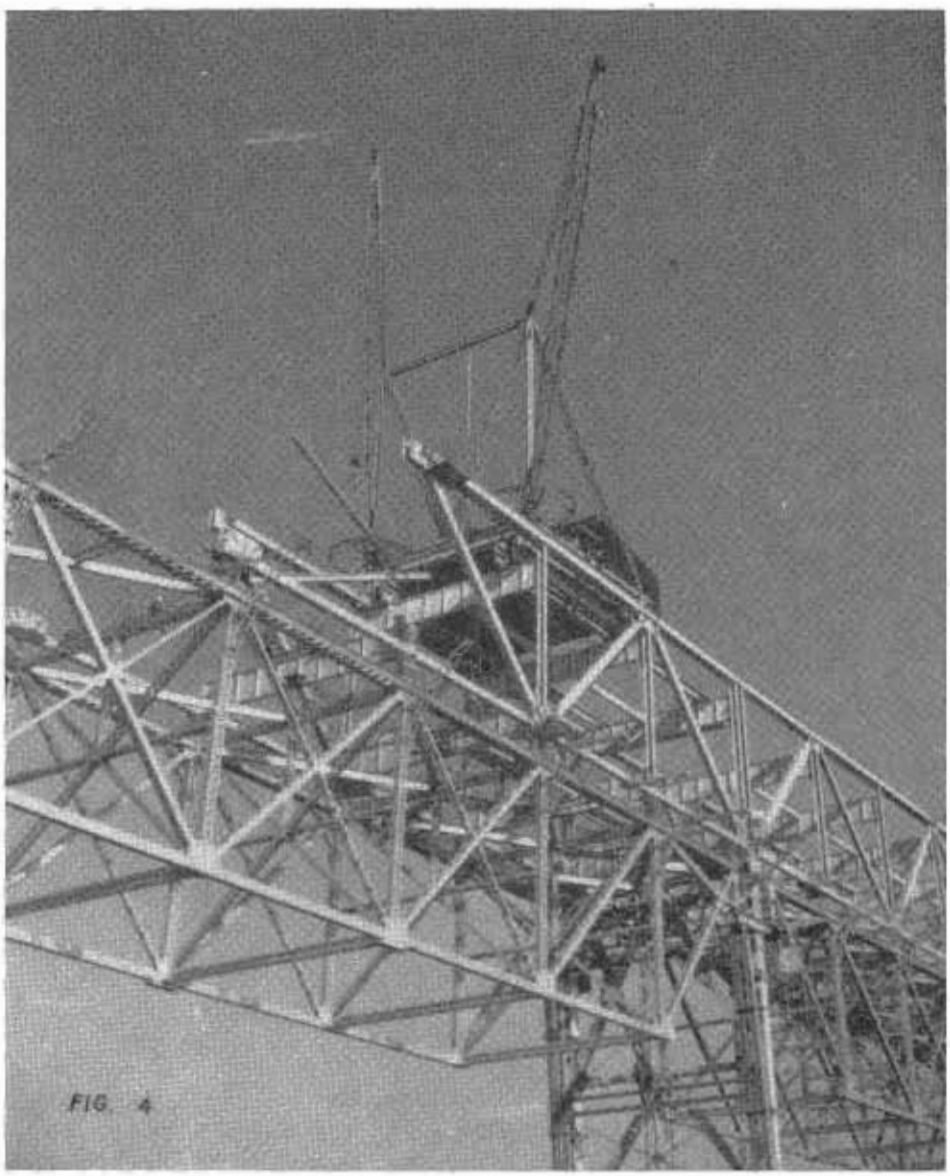
1. It eliminated the use of conventional falsework piling for the 27 spans which, due to the location and height of the bridge, and because of the depth of water and mud (down to minus 200 feet in some places) would prove extremely expensive.

2. The fact that the bridge was designed with 36 typical 289-foot truss spans made it advantageous to use a falsework system that would allow repetition of operation.

3. The aluminum span is covered with a safety net, and the contractors feel that this is one of the safest methods of bridge construction ever devised.

Construction on Schedule

The Richmond-San Rafael Bridge was designed by the Division of San Francisco Bay Toll Crossings under the direction of Norman C. Raab. The engineers for the Judson Pacific-Murphy-Kiewit joint venture who actually designed the aluminum falsework are Earl and Wright of San Francisco.



Double-boomed traveler setting steel

Construction of this huge project is on schedule, and it is estimated that the bridge will be complete and ready for traffic late in 1956.

PLEASED WITH FREEWAYS

SUPPLEE-WILLS-JONES MILK COMPANY
Lincoln-Liberty Bldg.
Philadelphia 7, Pa.

HIGHWAY COMMISSION
Sacramento, California

GENTLEMEN: I had occasion to visit Los Angeles recently and had the pleasure, I might add, extreme pleasure, of riding on your new wonderful freeways in that area. I had been in Los Angeles some four years ago when the freeways were just being started. In the meantime, I had heard here in the east, a lot of newspaper talk about traffic congestion in Los Angeles. I certainly will say that you people have it pretty well licked with your freeways. I want to add my congratulations to the vast number I know you must already have received.

Very truly yours,

SUPPLEE-WILLS-JONES MILK CO.
D. J. CRUMLISH,
Chief Engineer

CEMENT TREATED BASES

Continued from page 44 . . .

with three inches of dense graded bituminous plant-mixed surfacing.

(3) Project 7.23 miles in length. Consisted of placing base materials on portions, of scarifying and breaking up the existing base and surfacing, and of mixing the broken material with cement and recompacting and placing three inches of bituminous plant-mixed surfacing thereon. Traffic had access to working areas.

(4) Project 4.0 miles in length. Consisted of placing base materials and eight inches of PCC pavement over previously constructed roadbed and of resurfacing existing highway with bituminous plant-mixed surfacing. Cement treatment and paving operations were on new alignment and experienced little interference from traffic.

(5) Project 4.0 miles in length. Consisted of grading a six-lane divided roadway, constructing tunnel and other structures, and of placing base materials and surfacing over a portion of the project.

(6) Project 5.0 miles in length. Consisted of constructing a graded roadbed for a divided highway with the necessary roadbeds for outer highways and ramps, and of placing base materials and bituminous plant-mixed surfacing. Some traffic interference to the construction operations.

(7) Project 3.4 miles in length. Consisted of placing base materials and eight inches of PCC pavement over a previously constructed roadbed. New alignment with little traffic interference to cement treatment and paving operations.

(8) Project 12.3 miles in length. Consisted of constructing a graded roadbed and of placing base materials and bituminous plant-mixed surfacing, both over base materials and existing pavement. Some traffic interference to the construction operations.

(9) Project 4.8 miles in length. Consisted of grading and surfacing an additional roadbed with plant-mixed surfacing on cement treated base, and resurfacing existing pavement with plant-mixed surfacing, to provide a four-lane divided highway. Construction of frontage roads and connections also included. No traffic interference to construction operations.

MANY RACES MAN HIGHWAY OFFICES

MELTING POT- Cass M. Rose, senior highway engineer, leans on table in Substructure and Minor Contracts Section of State Division of Highways in Los Angeles. Surrounding him are workers of many racial origins. From left, (1) Tim Leong, Chinese; (2) Andres Passivo, Italian; (3) Robert A. Ryan, Irish; (4) Aurora Adajian, Armenian; (5) Sumiko Fujimoto, Hawaiian-Japanese; (6) Mona Sanchez, Mexican; (7) Louis E. Glick, Jewish; (8) Michiko Omori, Japanese; (9) Robert Cauderc, French; (10) Morton Rabinowitz, Jewish; (11) Frank Plesko, Czech—all of them Californians. Because of the many nationalities office is known as melting pot. Los Angeles Times photo.

You won't find a more interesting office than the Substructure and Minor Contracts Section of the State Division of Highways in Los Angeles.

For two reasons:

(1) The work they do, and (2) the people who do it.

This office, located on the fifth floor of the Tishman Building, 3460 Wilshire Boulevard, is a vertible "engineering melting pot."

Among its 32 employees are represented no less than 14 nationalities, four different races, and five basic religions.

Only One of Kind

Headed by Cass M. Rose, a senior highway engineer, the office is unique and comparatively new. It was established little more than two years ago. And it is the only one of its kind in the entire State Division of Highways. It gains additional distinction by being sort of an "earn while you learn" training school.

Its principal functions—as you might surmise from its title—are to map and catalogue all underground facilities so that highway engineers excavating for a freeway or a bridge won't encounter any surprises, and to prepare specifications for minor contracts that may range from little $250 jobs to $25,000 projects.

Fourteen Nationalities

As to the office's aspect as a Little United Nations—well, when you walk in, you're greeted by a petite Japanese girl or an attractive Mexican senorita at the front desk. In the file room, where there are some 200,000 prints on file, you can get data on underground lines from a Greek or an Irishman. Go into the drafting room and you'll find an Italian helping an Armenian girl plot a map. At an adjoining table, a Chinese and a Hebrew are discussing a right of way. And, at other drafting tables, you'll find a Frenchman, Dutchman, a pretty Hawaiian-Japanese girl with a flower in her hair, a Swede, a Pole, an Englishman, and, believe it or not, just plain Americans. All of them, of course, are American citizens—and proudly Californian.

—Art Ryon in Los Angeles Times

Cost Index

Little Change in Construction Costs During First Quarter 1955

By RICHARD H. WILSON, Assistant State Highway Engineer;
H. C. McCARTY, Office Engineer;
JOHN D. GALLAGHER, Assistant Office Engineer

DURING the first quarter of 1955 state highway construction costs were down 1.5 percent from the fourth quarter of 1954 as indicated by the California Highway Construction Cost Index. The Index stands at 189.3 (1940 = 100) for the first quarter of 1955 which is 2.9 points below the 192.2 of the fourth quarter of 1954.

Examination of the accompanying tabulation of the Highway Cost Index, from 1940 on, indicates that during 1954 and the first quarter of 1955 construction costs have fallen back to the approximate levels of 1950 and at the present are more or less stationary. How long this stationary condition in the levels of bid prices can hold in the face of increasing materials cost, equipment prices and labor rates is a matter of conjecture. To quote the March 3, 1955, issue of the *Engineering News-Record* in commenting on continued low bid prices in the face of rising costs:

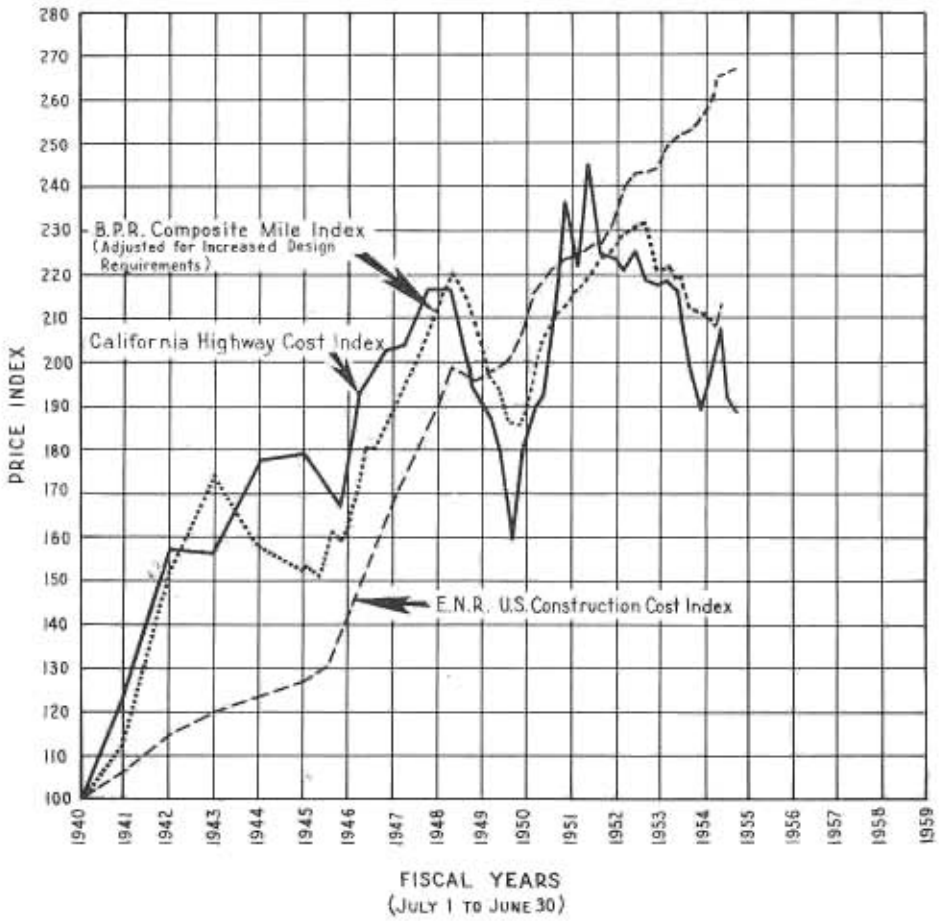
THE CALIFORNIA HIGHWAY CONSTRUCTION COST INDEX

Year	Cost index
1940	100.0
1941	125.0
1942	157.5
1943	156.4
1944	177.8
1945	179.5
1946	179.7
1947	203.3
1948	216.6
1949	190.7
1950 (1st quarter)	160.6
1950 (2d quarter)	180.0
1950 (3d quarter)	189.2
1950 (4th quarter)	194.8
1951 (1st quarter)	215.4
1951 (2d quarter)	238.3
1951 (3d quarter)	221.9
1951 (4th quarter)	245.4
1952 (1st quarter)	224.8
1952 (2d quarter)	224.4
1952 (3d quarter)	221.2
1952 (4th quarter)	226.2
1953 (1st quarter)	218.3
1953 (2d quarter)	217.5
1953 (3d quarter)	218.0
1953 (4th quarter)	216.7
1954 (1st quarter)	199.4
1954 (2d quarter)	189.0
1954 (3d quarter)	207.8
1954 (4th quarter)	192.2
1955 (1st quarter)	189.3

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PRICE INDEX CONSTRUCTION COSTS

1940 = 100



"contractors have already squeezed a lot of productivity and profit-trimming into their bids."—"Contractors cannot continue to absorb materials price increases and higher labor costs. They've already used up many of their opportunities for cutting their costs."

These comments confirm the opinions which this department has been expressing in these quarterly releases on highway construction costs during the past year. Such costs must start an upward trend to follow the increases in labor rates and materials costs.

As stated in our January, 1955, release, the currently high number of large highway contracts in California involving large quantities of work and materials coupled with the continued keen competition among bidders does have a marked effect in holding down unit prices. Nevertheless it is still the opinion of this department that bid prices will begin a steady rise in the near future.

As a gauge to the current volume of state highway construction in California, it is noted that on April 1st the Division of Highways had under way 309 contracts with a total contract value of $221,283,700.

Inspection of the average unit prices bid during the first quarter of 1955 for the eight principle items upon which California Highway Construction Cost Index is based (see accompanying tabulation) show a marked increase in the average unit price for roadway excavation, this rise was 17.1 percent over the average for the fourth quarter of 1954. Portland cement concrete pavement rose 2.3 percent; bar reinforcing steel was up 1.1 percent; and structural steel increased 3.6 percent during the quarter. These increases were not sufficient to raise the over-all Index, the decreases of 11.7 percent in structural concrete, 5.8 percent in plant-mixed surfacing and 5.1 percent in untreated rock base were enough to lower the Index 1.5 percent. However, these four items up and three items down would almost presume the static condition of construction costs as indicated by the Index for the fourth quarter of 1954 and the first quarter of 1955.

The accompanying chart, showing the California Highway Construction Cost Index, the *Engineering News-Record* Construction Cost Index and the United States Bureau of Public Roads Composite Mile Index compares these three Indexes, all reduced to the 1940 = 100 base.

CALIFORNIA DIVISION OF HIGHWAYS AVERAGE CONTRACT PRICES

	Roadway excavation,	Crusher run base,	Plant mix surfacing,	Asphalt concrete pavement,	PCC pavement	PCC structures,	Bar reinforcing steel,	Structural steel,
	per cu. yd.	per ton	per ton	per ton	per cu. yd.	per cu. yd.	per lb.	per lb.
1940	$0.22	$1.54	$2.19	$2.97	$7.68	$18.33	$0.040	$0.083
1941	0.26	2.31	2.84	3.18	7.54	23.31	0.053	0.107
1942	0.35	2.81	4.02	4.16	9.62	29.48	0.073	0.103
1943	0.42	2.26	3.71	4.76	11.48	31.76	0.059	0.080
1944	0.50	2.45	4.10	4.50	10.46	31.99	0.054	0.132
1945	0.51	2.42	4.20	4.88	10.90	37.20	0.059	0.102
1946	0.41	2.45	4.00	4.68	9.48	37.38	0.060	0.099
1947	0.46	2.42	4.32	5.38	12.38	48.44	0.080	0.138
1948	0.55	2.43	4.30	5.38	13.04	49.86	0.092	0.126
1949	0.49	2.67	4.67	4.64	12.28	48.67	0.096	0.117
1st quarter 1950	0.34	2.22	3.65	3.74	.....	40.15	0.077	0.081
2d quarter 1950	0.40	2.13	4.48	3.74	10.86	43.03	0.080	0.105
3d quarter 1950	0.41	2.32	4.25	5.50	10.91	44.34	0.093	0.131
4th quarter 1950	0.42	2.81	4.64	4.61	12.55	43.18	0.098	0.120
1st quarter 1951	0.45	3.07	4.06	5.22	11.71	46.38	0.103	0.206
2d quarter 1951	0.63	3.88	4.56	4.63	12.93	51.50	0.105	0.166
3d quarter 1951	0.56	2.88	4.59	3.90	12.41	46.14	0.107	0.165
4th quarter 1951	0.66	2.91	5.66	4.89	12.71	49.38	0.105	0.169
1st quarter 1952	0.56	3.25	4.88	4.77	14.25	47.46	0.094	0.152
2d quarter 1952	0.53	3.19	5.29	4.13	14.20	49.12	0.091	0.143
3d quarter 1952	0.55	2.61	5.49	4.60	12.80	48.21	0.094	0.132
4th quarter 1952	0.66	2.68	4.97	.....	12.53	48.45	0.094	0.128
1st quarter 1953	0.45	*2.48	5.27	4.46	12.47	53.19	0.098	0.150
2d quarter 1953	0.50	2.07	5.38	4.59	13.06	52.68	0.091	0.132
3d quarter 1953	0.54	2.15	5.30	4.82	13.78	49.23	0.092	0.129
4th quarter 1953	0.48	2.11	4.74	4.47	14.77	53.41	0.105	0.139
1st quarter 1954	0.45	2.28	4.23	4.78	14.89	47.52	0.092	0.126
2d quarter 1954	0.38	2.09	4.29	5.18	14.28	47.12	0.093	0.114
3d quarter 1954	0.43	1.85	4.68	7.00	12.63	49.59	0.095	0.162
4th quarter 1954	0.35	1.78	4.83	.....	13.13	46.08	0.094	0.135
1st quarter 1955	0.39	1.69	4.55	.....	13.44	40.66	0.095	0.140

* Untreated rock base substituted for crusher run base at this point.

The *Engineering News-Record* Construction Cost Index, which comprises all types of construction on a national scale and is computed on the basis of labor rates and materials prices, was up 0.4 percent in the first quarter of 1955 over the fourth quarter of 1954.

The U. S. Bureau of Public Road Composite Mile Index, which, while nation-wide in scope is computed on the basis of actual average bid prices (as is the California Index), was up 2.2 percent for the fourth quarter of 1954 over the third quarter.

In comparing the three Indexes it may be noted that in the California Index, computed from a smaller base, the effects of local conditions of individual projects are more pronounced, while broad national base of the other two Indexes produce smoother curves. The U. S. Bureau of Public Roads Composite Mile Index and the California Highway Construction Cost Index, both being based only on highway contracts, more or less follow each other while the *Engineering News-Record* Index including all types of construction shows considerable variance from those two.

AIR PHOTOS HELPFUL

Time, money and engineering manpower have been saved through extensive use of aerial photographs during the planning and design stage on practically all California highway projects involving new alignment. Contour maps obtained from air photos are used in about 50 percent of such projects.

Traffic Headaches

Engineers Plan Carefully in Advance to Avoid Them

By A. L. ELLIOTT, Bridge Engineer, Planning

ONE EARLY morning in Los Angeles recently, a linotype operator completed setting the type for the morning edition of a paper and started home. Crossing the Los Angeles River on Aliso Street at 4 o'clock in the morning, he found his way blocked and had to take a detour of several blocks around some bridge construction.

A little earlier the same night, a bartender closed up shop and started for home in Oakland. When he got to the distribution structure at the east end of the San Francisco-Oakland Bay Bridge, he also found his way blocked and had to detour several blocks to get around some bridge construction.

Each of these motorists was probably annoyed a little, but traffic was light and the delay of detouring was negligible and he too was soon home. Next morning however, when the morning rush surged onto the streets and impatiently elbowed its way to work, the roadways were running full. Traffic flowed like a never ending tide, and except for rare occasions, showed barely a ripple as it passed over temporary detours around the construction work.

Traffic Handling Planned

These incidents in widely separated parts of the State are in a way quite unrelated. In another very real way however, they are very closely related because they are both part of very carefully planned traffic handling operations on two large construction projects.

Every day about 1,000 persons come to California. Some come to visit. Many come to stay. With every two persons comes an automobile. All of these cars coming in, plus all of the cars already here—more than any other state in the Union—can only mean one thing: Traffic, lots of it—and congestion. These traffic jams all concentrate in the heavily populated areas. It follows very naturally then, that to relieve the congestion, there must be a lot of new construction in these heavily populated areas.

New construction usually adds to congestion for a time and, occasionally results in severe inconvenience for a few. As one public utility freely admits on its construction signs: "You can't have progress without inconvenience."

Matter of Understanding

If you are having your living room repainted, you don't expect to throw a party in the midst of the operation. If you are having a new stove installed in your kitchen this afternoon, you don't expect to have dinner as usual tonight—you'll probably have to eat out at the local beanery. You, as the occupant of your own house, understand these things. You put up with the inconvenience and step over the plumber's tools. You have a vision in your mind of how nice the new color scheme is going to look or how convenient it is going to be to cook on that new stove. However, when you as the occupant of your community, as the user of your streets and highways, come upon a highway remodeling operation, it's not always so easy to understand. Maybe the vision of better things to come is not so bright. Maybe the snail's pace gait and the jammed-in bumper of the car ahead of you hamper your broadmindedness.

Detours Important

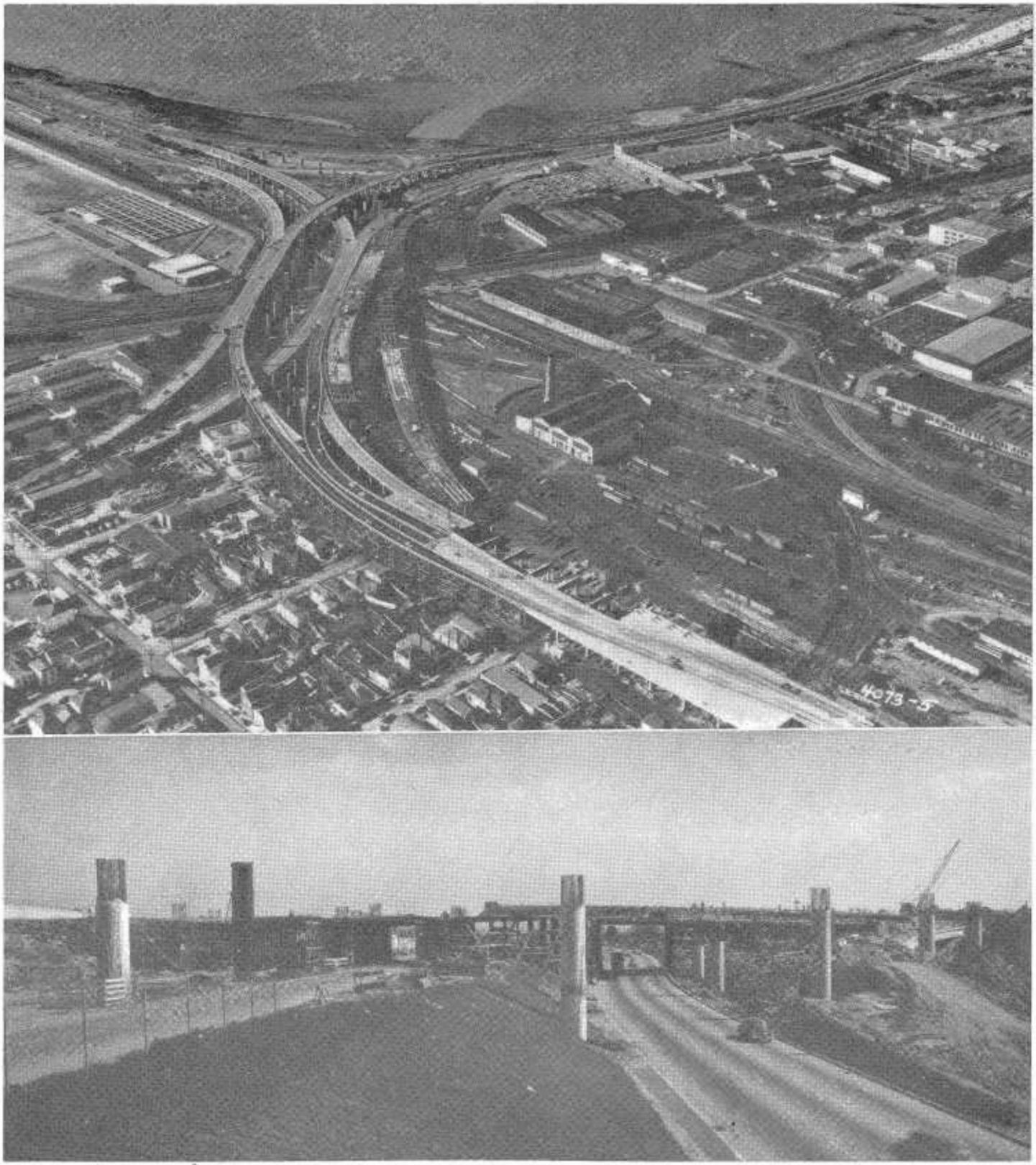
Throughout the State in every Division of Highways Office, this traffic problem is assuming greater and greater importance. Time was when detours were accepted as a normal part of highway travel. Detours in those days were often not very luxurious affairs either. In these days, with modern traffic, with as many as 165,000 cars streaming in an endless pouring torrent over one major artery in a 24-hour period—detours that impede traffic cannot be tolerated.

In the design of a structure or the planning of a complicated interchange, more time is often spent figuring out how to handle the traffic during construction than is spent figuring stresses and strains in the structure. Supports must be placed where they are back from the edges of the pavement. Roadways which will be in constant use must be kept free and unrestricted. The side clearances must be ample so that timid drivers will not slow down in apprehension and cause traffic jams which can back up for miles within a matter of minutes.

Temporary Bridges

Where structures must be built over busy streets, the members are designed to be erected in one piece and then, in the wee hours of some morning when the traffic is at its lowest ebb, the street will be closed for a few hours and the girders quickly hoisted into place. Later, when the flood tide again comes pouring to work, motorists find a new framework against the sky but underneath the roadway is clear and the traffic flows on.

Sometimes it is necessary to spend a great deal to build a temporary bridge just to carry traffic during construction. These "temporary" bridges are often respectable structures in their own right. When a new approach was built on the San Joaquin River bridge at Antioch, the bridge could not be closed for more than a few hours. Thousands of tons of tomatoes, asparagus, and other produce from the rich Delta region are trucked out over this bridge every season. To carry the never ending stream of trucks and automobiles a bypass structure was built nearly 100



UPPER—Aerial view of the $5,000,000 reconstruction job on the East Bay Distribution Structure in Oakland. In the foreground, traffic flows over the high timber trestle detours which were built around the points where portions of the old structure had to be removed and new connections made. LOWER—Construction underway on the interchange of the Long Beach and Santa Ana Freeways in East Los Angeles. Note the ample openings left for traffic, in background, and columns in foreground set well back from the roadway to give sufficient clearance as further structural work progresses.

feet above the river to carry the traffic from the main bridge onto the old approach until the new connection could be built. This high trestle was a sizeable structure in itself. Its cost of $80,000 was a material part of the $860,000 it cost to do the whole job.

Bay Bridge Project

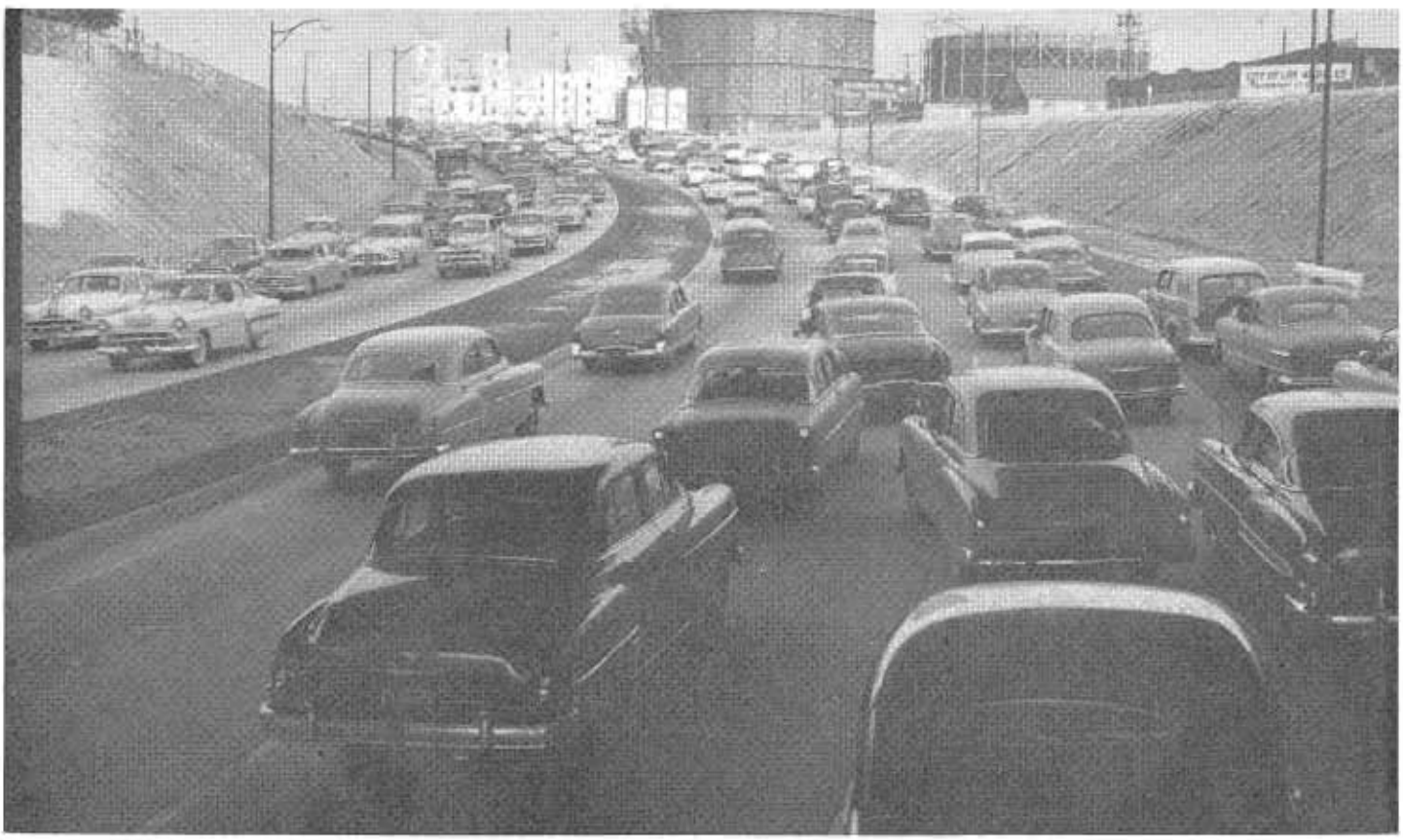
Five million dollars are being spent on the distribution structure at the east end of the San Francisco-Oakland Bay Bridge to relieve the congestion and to sort the traffic out and send it out in the proper direction without the necessity of weaving in and out through lines of cars. Every day this structure carries over 130,000 vehicles. It would be out of the question to detour this traffic—no place to go. Equally impossible would be any plan to limit the number of lanes—to try to do the reconstruction part at a time. The only solution was to build a temporary bridge completely out and around the areas where roadways had to be torn out and new connections made. This temporary bridge cost $300,000. This is a large sum but, when you stand beside the roadway almost any time and watch the zoom—zoom—zoom of a car every two-thirds of a second on the average day and night—or when you see the actual miles of cars that pile up in a few minutes when even a minor accident occurs—then you realize full well that this traffic is not to be stopped. It should not even be slowed down. If $300,000 must be spent to keep it rolling while a $5,000,000 improvement is being made, then it is well worth the money.

Los Angeles River Bridge

Two sheets of the contract plans for the Los Angeles River bridge were used merely to show how the traffic would be handled. How small parts of the work had to be completed and traffic moved over before some other work could be done. It was all worked out in meticulous detail to make sure that there would always be a full roadway and that the cars would be kept rolling.

There is another factor that enters into our planning. When you hire a man to do a job, you don't get nearly as impatient if you see he is working hard all of the time. When you are paying his wages, you like to see him work. If you hire a plumber to install a new sink—he tears out the walls, he scatters his tools all over the floor, he messes up everything. You impatiently watch from a distance. You wish he'd hurry. It seems to take twice as long as it should. But, when you look in the kitchen and find everything still messed up and the plumber gone to finish up some other job he considered more urgent than yours, your righteous indignation really boils over—and probably showers all over the plumber and his boss. As occupants of your community, you feel the same about your highway work, and quite often with good justification.

This is a sample of the traffic on the Santa Ana Freeway in downtown Los Angeles, just west of the Aliso Street Bridge over the Los Angeles River, which must be carried with a minimum of delay through two major construction projects—the widening of the bridge and, just beyond it, the adding of a new ramp to the Santa Ana-San Bernardino Freeway interchange.



Typical Reaction

A contractor starts a new piece of freeway. He tears up the landscape. He digs ditches and scatters pipes along the right of way. Then maybe the work seems to drag. Maybe it even seems to stop. You impatiently ride along and you can't even find a single man working. And right there you become indignant. You write to your newspaper. Your newspaper writes editorials. Sometimes you write to us.

We get concerned about these delays too. We probably knew, even before you suspected it, that the job was dragging. Unfortunately, we are in the middle. When we find contractors inclined to drag their jobs or when we have a job we want to get finished in the shortest possible time, our only defense is to shorten the time limits and increase the penalties for not getting through on time. This we have done, and are doing more and more on the critical jobs.

Time Limits Set

In bold faced type in the specifications for an urgent job we tell the bidders that we have set a time limit which will require them to press the job to its utmost and maybe even work double shifts to get through on time. If they do not get through within the allotted time we have increased the penalty. For the Los Angeles River bridge on Aliso Street in the heart of Los Angeles and for the terminal separation structure in downtown San Francisco, the penalty was set at $500 for each day the contractor ran over the time limit set. Progress schedules are required for each portion of the work so that a dragging schedule can be nipped in the bud and hurried to make up for lost time.

This effort to keep the wheels rolling has paid off. As part of this effort, the Aliso Street bridge widening project which will correct one of Los Angeles' worst traffic headaches, was 70 percent complete when the time was only half gone. But more than that, there were no empty excavations. There were no detours around construction where nothing was happening. The dirt kept flying and almost any time that you chose to drive by you could see and hear parts of the structure rising into place—see men busily at work. And, though you may have been impatient, you understood and had greater patience. Our mail is lighter. Our phones do not ring for irate citizens to complain. We know you like to see the work being done rapidly.

Increased Program

There is much talk these days about an increased program. Whether any specific program now under consideration is adopted or not, it is obvious that the ever increasing number of cars on our highways will require a further step up in highway improvement schedules. What will it mean? It all adds up to more rush to get work under way, more pressure to get work completed sooner. Certainly, "business as usual" has gone out the window and will probably not return within the foreseeable future.

What will all this mean to our planning for handling traffic? It will become more important than ever. The congestion will be greater, the planning will have to be more careful. More money and effort will have to be expended to get traffic through the work without hindrance or delay. Contract times will be shortened even more to force contractors to get the work done in the minimum possible time so the period of inconvenience will be made as short as possible.

Oh yes, traffic will still pile up. There will be bottlenecks here and there, some honking horns and frayed tempers. But to those who, in the face of the inevitable cost of progress can relax and enjoy it, these things will be merely one more indication that in highways, like in most everything else, the future holds a store of wonderful things.

Old Timers May Remember These Strict Laws

Ever since the first horseless carriage started sputtering and roaring its way along our streets and highways back before the turn of the century, everyone from the embattled farmer to the indignant city father has been doing his darndest to write some laws that would curb the newfangled monster.

Perhaps the wildest of these laws, according to the National Automobile Club, were drawn up by the Anti-Automobile Society that was formed back in Pennsylvania when the problem was first coming to the fore. There the farmers decided that anyone driving a horseless carriage along the road at night should come to a stop every mile and send up a signal rocket, then wait 10 minutes for the road to clear. If a team of horses should approach along the road, the motorist was obliged to pull off the road and cover his vehicle with a large canvas or painted cloth that would blend with the surrounding landscape. If the horses refused to pass even then, the motorist had to take his vehicle apart piece by piece and hide the pieces under the nearest bush.

Speed Limit 12 Miles

The city fathers got around to having their little say, too. In Connecticut back in 1901 they passed the first speed law in the United States, setting it down in the book that no driver should drive faster than 12 miles per hour in the cities or faster than 15 miles per hour in the country. In Cleveland, Ohio, they passed a law against driving your car while you had someone on your lap. Out in Green Bay, Wisconsin, they got the idea that oil dropped from cars would damage their pavements, so they set a fine of $5 on every drop of oil. In Memphis, Tennessee, they made it unlawful for any motorist to drive while he was asleep, and out in Utah they wrote it down in their books of law that birds always have the right of way. And then, of course, there was the enigmatic sheriff who posted the sign that read: "The speed limit is a secret this year. Motorists breaking it will be fined $10."

This was the law and the horseless carriage!

El Camino Real

New Section of Divided Highway in Ventura County

By BRUCE A. GENTRY, Resident Engineer

Located on the coast of Ventura County, whose fertile valleys were once the hunting grounds of the Chumash and Saticoy Indians, was a tiny fishing village which has since become known as the City of San Buenaventura (the City of Good Fortune). Four hundred and thirteen years ago, Juan Rodriguez Cabrillo landed on its beach in the course of his explorations. He was several days traveling, either by sea or overland, from the pueblo of Los Angeles, some 70 miles to the south. Today, he could step from his longboat into an automobile and be in the neighboring metropolis in an hour. The old conquistador would undoubtedly be impressed as he traveled through beautifully cultivated farms and orchards, dotted with modern ranch houses and homes. He would be following a trail that once led Fra Junipero Serra between his missions, later becoming the El Camino Real that carried stagecoaches through country dominated by the outlaw, Joaquin Murietta. This road is now known as Ventura Boulevard, U. S. Highway 101, another important unit of which has just been improved to a four-lane divided, limited access highway.

Four Lanes on Long Stretch

On June 15, 1954, a contract in the amount of $1,685,727.85 was awarded to Fredrickson and Watson Construction Co. of Oakland, California, for the construction of 5.97 miles of State Highway Route VII-Ven-2-C between Central Avenue and the Santa Clara River. This project closed the gap between the previously constructed four-lane divided highway extending from east of Camarillo to City of Ventura, and, except for the short section over the mountainous Conejo Grade, there is now a four-lane divided highway from the city limits of Los Angeles at Calabasas all the way to the City of Ventura.

This part of US 101 traverses an alluvial plain which is subject to flooding during periods of heavy rainfall. Therefore, it was designed as a four-inch plant-mixed surface over eight inches of untreated rock base on imported borrow averaging three feet in thickness. The construction of the roadway embankment required approximately half a million cubic yards of imported borrow, most of which was placed within five months after the start of the contract. The major portion of imported borrow was taken from the bed of the Santa Clara River and hauled with two-wheeled tractors and scrapers, and 20-yard cable lift semitrailer dump trucks. This material was a granular mixture of sand and rock which provided an excellent "R" (resistance) value, and was sufficiently porous to qualify as a self-draining subgrade considered particularly desirable in this area. The structural section required 116,000 tons of untreated rock base and 60,000 tons of plant-mixed surfacing.

New Westbound Roadway

The southeasterly mile and one-half of the project consisted of building a completely new westbound roadway parallel to the existing two-lane facility and improving and resurfacing the existing roadway to serve eastbound traffic. The remainder of the contract required all new construction on the south side to be parallel to the existing road, leaving the old traveled way for a frontage road. A small community, known locally as Nyeland Acres, is located near the intersection with Rice-Santa Clara Avenue and numerous other residential and commercial improvements such as the town of El Rio, the Ventura County Service Center, and the State Highway Maintenance Station occupying the frontage on the north side of the existing highway for most of its length all the way to the Santa Clara River. The requirements of access for all these developments are admirably met by the design provision of leaving the old highway for a frontage road. Furthermore, future subdivisions will be easily accessible when the ultimate development of the area is complete.

Interchange Facilities

The right of way was primarily through orchards and truck farms, and adjacent improvements were as little disturbed as possible. However, the interchange facilities at the intersection of US 101 and Saviers Road required clearing enough area for the construction of interchange ramps.

The windbreaks of large eucalyptus trees lining both sides of the old highway were thinned out and trimmed. The remaining trees are picturesque and form a screen between the main line and the frontage road, thus serving both a useful and ornamental purpose.

The Y intersection at the junction of US 101 and US 101—Alternate was designed and constructed to eliminate all intersections at grade. Full traffic circulation, as well as access to the commercial establishments around the perimeter of the area, is provided for by circumferential frontage roads.

Five Bridges

Included in the contract were five bridges which were built under the direction of Louis E. Dunn, Bridge Department representative. Two of the structures were grade separations between state highways; one at the intersection with Saviers Road, and the other at the intersection of Coast Highway 101—Alternate. Both of these structures, as well as the frontage road overcrossing, which takes the previously mentioned peripheral frontage road over the Coast Highway, were built with structural steel girder decks. The girders varied in length, the longest measuring 123 feet

UPPER—View west in vicinity of Rose Road showing old highway right for use as north frontage road, taken just before completion of chain link fence and shoulder seal coat. LOWER—View toward east during latter stages of construction. Typical preservation of eucalyptus windbreak between new expressway and frontage road. Eastbound lanes at this point had not yet been put in operation.

The mountains back of the City of Ventura are framed by the separation structure at the intersection with Saviers Road. Picture taken from southbound off-ramp prior to placement of untreated rock base and plant-mixed surfacing on southbound lanes. Pneumatic-tired compactor seen in center proved most effective in consolidating granular fills.

and weighing approximately 17½ tons. The other two structures were built with reinforced concrete slab decks. Foundation problems required that four of the five structures be supported on piles.

Also as a part of the contract, 23 20,000-lumen electroliers and two sign bridges were installed. The larger sign bridge has a 60-foot span, and the frame, mounted with a minimum overhead clearance of 17 feet, is approximately eight feet high.

Traffic Through Construction

Handling public traffic through the construction zone was difficult only during such peak hours as occurred on holiday weekends, but with the helpful cooperation of the California Highway Patrol, delays were usually of short duration. Accidents were infrequent, and for the most part were not attributed to construction operations.

Weather conditions were ideal throughout the period of the contract. This was doubly fortunate since one leg of the detour at the west end of the job carried the westbound traffic across the bed of the Santa Clara River and it was possible to reroute traffic back over the bridge shortly before the riverbottom detour washed out.

Bernard V. Fredrickson, who was the contractor's superintendent on the project, took full advantage of the favorable weather to finish the job a month and a half before the expiration of the allotted official time limit of 275 working days.

The field supervisor for the District VII Construction Department was E. A. Parker, working under Assistant District Engineer Frank B. Cressy and District Engineer W. L. Fahey.

It is planned at some future date to build grade separation bridges at Rose Road and Santa Clara Avenue and to widen the Santa Clara River bridge. When these items of future construction are accomplished, a considerable length of this section of Ventura Boulevard will have the status of a full freeway. In the meanwhile, California motorists are collecting large dividends on their gasoline taxes by reason of the newly completed construction.

FROM MINNESOTA

MINNESOTA MINING & MANUFACTURING COMPANY
Saint Paul 6, Minnesota

California Highways and Public Works

GENTLEMEN: Your publication has recently come across my desk and I find that it is one of the most informative and well written periodicals on highway activities that I have seen for quite some time.

In the course of our activities with highway officials and consulting engineers throughout the Country, we find that a great deal of interest is shown in what you are doing with your complex traffic problems in California.

Cordially,

R. D. LOEFFLER

State Highway Contracts Awarded

MARCH-APRIL, 1955

Alameda County—US 50—At the intersection of US 50 and Harder Road. Widen and channelize the existing highway and connecting streets and install a traffic signal system and highway lighting. Contract awarded to Independent Construction Co., Oakland, $63,988.30.

Alameda County—At the intersection of Hoffman Boulevard with Buchanan Street. Construct additional roadway width for right-turn lane, place untreated base, place plant-mixed surfacing on untreated base and on traffic islands and install a two-phase traffic-actuated signal system and flashing beacon system. Contract awarded to Ets-Hokin and Galvan, Oakland, $11,024.

Alameda and Contra Costa Counties—SR 21—Between US 50 at Dublin and 0.2 mile north of Contra Costa county line. Construct a graded roadbed, partially on new alignment, together with ramps, road connections and approaches and place plant-mixed surfacing on imported subbase material and cement treated base and construct a reinforced concrete bridge, 2.2 miles. Contract awarded to Fredrickson & Watson Const. Co., Oakland, $531,606.10.

Alameda County—SR 227—Between Thornhill Drive and Ascot Drive, 1.3 miles. Construct a graded roadbed and place plant-mixed surfacing on cement treated base and untreated base and construct two reinforced concrete bridges and one steel bridge, completion of which will provide four-lane divided highway with bridges at Park Boulevard Overcrossing, La Salle Avenue Overcrossing and at Bruns Drive Pedestrian Overcrossing. Contract awarded to Chas. L. Harney, Inc., San Francisco, $1,158,882.20.

Butte County—Alt. US 40—About 1.6 miles east of Pulga Bridge. Construct a graded roadbed, place imported base material and road-mix the upper two inches with liquid asphalt, 0.2 mile. Contract awarded to H. Earl Parker, Inc., Marysville, $44,655.

Colusa County—SR 20—Near the south city limits of Colusa. Extend the existing reinforced concrete box culvert on the left, widen the approaches and place untreated base, cement treated base and plant-mixed surfacing, 0.16 mile. Contract awarded to Baun Construction Co., Inc., Fresno, $14,367.

Contra Costa County—SR 24—Between 0.8 mile west and 0.5 mile east of Pleasant Hill Road, 1.3 miles. Construct a graded roadbed, pave with portland cement concrete on cement treated subgrade, surface, and construct a reinforced concrete bridge, to provide a four- and six-lane divided highway together with the Pleasant Hill Road Undercrossing. Contract awarded to Stolte Inc. & Gallagher & Burke, Inc., Oakland, $1,173,108.30.

Contra Costa County—SR 24—At the intersection of Sign Route 24 and Grant Street-Solano Way, in the City of Concord. Install a two-phase, full traffic-actuated signal system, rewire the existing highway lighting system in underground conduit, and remove and salvage portions of the existing span-wire mounted flashing beacon system. Contract awarded to Hall Sloat Electric Co., Inc., Oakland, $8,366.

Del Norte County—US 101—Between 0.4 mile south of Crescent City and the Oregon state line (portions). Place plant-mixed surfacing over existing surfacing at one location, construct cement treated base and untreated base and surfacing with plant-mixed surfacing at another, and construct cement treated base, cement treating the existing surfacing and base and surface with plant-mixed surfacing at another, 12.1 miles. Contract awarded to Mercer, Fraser Co. & Mercer, Fraser Gas Co., Inc., Eureka, $569,273.50.

Del Norte County—US 101—Across Smith River Overflow, about nine miles north of Crescent City. Construct a reinforced concrete bridge. Contract awarded to F. Fredenburg, Temple City, $71,781.50.

Del Norte County—SR 46—Between Klamath and 0.5 mile easterly. Construct a graded roadbed, place imported subbase material and imported base material and surface with road-mixed surfacing and replace the existing bridge with a reinforced concrete bridge, 0.5 mile. Contract awarded to Arthur B. Sizi, Inc., Santa Rosa, $136,354.50.

Fresno County—SR 41—On Abby Street and Blackstone Avenue, between Divisadero Street and Hedges Avenue. Construct a graded roadbed, place plant-mixed surfacing on cement treated base and on existing pavement and apply seal coat; construct a reinforced concrete bridge, and highway lighting and traffic signals, 1.5 miles. Contract awarded to Gene Richards, Inc., Fresno, $262,713.20.

Fresno County—SR 41 and US 99—At the intersection of Route 41 with Maple Avenue and US 99 with Highland Avenue. Construct channelization and install traffic signal system and highway lighting. Contract awarded to Volpa Brothers, Fresno, $14,819.

Humboldt County—US 101—Between 16th Street and west city limits. Surface with plant-mixed surfacing on the existing traveled way, shape the existing shoulders with additional untreated base and apply penetration treatment, 1.0 mile. Contract awarded to Mercer, Fraser Co., Inc., & Mercer, Fraser Gas Co., Inc., Eureka, $27,844.75.

Humboldt County—At the State Highway District Office in Eureka, develop and plant the grounds. Contract awarded to Bernard Gayman, South San Francisco, $9,106.88.

Humboldt County—US 101—Between north city limits of Eureka and 0.5 mile north of Gannon Slough, 5.3 miles. Place cement treated base and plant-mixed surfacing on an existing divided highway. Contract awarded to Mercer, Fraser Co. & Mercer, Fraser Gas Co., Inc., Eureka, $613,771.

Humboldt County—US 101—Between 0.4 mile and 0.9 mile south of Orick (portions). Construct a chain-link fence. Contract awarded to San Jose Steel Co., Inc., San Jose, $2,274.27.

Humboldt County—US 101—Between 0.8 mile and 2.5 miles north of Arcata. Construct two parallel reinforced concrete bridges at Arcata Overhead and a concrete bridge at Route 20/1 separation, remove an existing timber bridge and portions of an existing reinforced concrete and timber bridge and fill area provided by removal, all to provide for a future four-lane divided highway, 0.7 mile. Contract awarded to Mercer, Fraser Co. & Mercer, Fraser Gas Co., Inc., Eureka, $370,982.50.

Humboldt County—SR 96—Across Slate Creek, 8.2 miles east of Weitchpec. Redeck a bridge. Contract awarded to John W. J. Petersen, Beatrice, $11,585.

Humboldt County—FAS 1201—Between south city limits of Eureka and 0.8 mile southerly. To be graded and surfaced with plant-mixed surfacing on imported base material and seal coats to be applied. Contract awarded to Arthur B. Sizi, Inc., Santa Rosa, $64,726.65.

Humboldt and Del Norte Counties—US 101—At the Garberville, Orick and Crescent City maintenance stations. Construct chain-link fences with gates. Contract awarded to United States Steel Corp., Amer. Steel & Wire Division, Cyclone Fence Dept., Oakland, $7,083.54.

Humboldt County—US 101—Across Eel River, south of Scotia. Clean and paint the existing bridge. Contract awarded to George C. Punton, San Diego, $29,970.

Humboldt County—US 101—At the intersection of US 101 and Humboldt Hill Road. Widen the existing roadway and surface channelization area with plant-mixed surfacing, 0.25 mile. Contract awarded to Mercer-Fraser Co. & Mercer-Fraser Gas Co., Inc., Eureka, $10,345.

Humboldt County—SD 36—About three miles east of Carlotta, at Cummings Creek. Construct a graded roadbed and surface with plant-mixed surfacing on imported base material, on new alignment, and construct a box culvert, 0.4 mile. Contract awarded to Paul E. Woof, Fresno, $44,370.

Imperial County—US 80—Between the Dahlia Canal and Route US 99. Grade, place imported subbase material, place plant-mixed surfacing on cement treated base and on existing pavement, apply seal coats completion of which will provide a new four-lane divided highway, 0.5 mile. Contract awarded to N. L. Basich, Garvey, $80,583.

Imperial County—US 80—At El Centro Maintenance Station. Construct an office building. Contract awarded to Frank M. Pardue, El Centro, $15,984.50.

Kern County—US 6—Between Los Angeles county line and eight miles south of Mojave. Surface with plant-mixed surfacing on the existing traveled way, 8.3 miles. Contract awarded to Ralph B. Slaughter, Julian, $72,132.50.

Kern County—US 6—Between two miles north of Ricardo and Little Dixie Wash. Construct a graded roadbed and surface with plant-mixed surface on untreated base and place plant-mixed surfacing on existing pavement, 6.3 miles. Contract awarded to Basich Bros. Const. Co., R. L. Basich & N. L. Basich, South San Gabriel, $198,184.05.

Kern County—SR 178—At Bodfish Maintenance Station. Clear and grub the two-acre site, grade two-thirds of the site on two levels and grade two road approaches. Contract awarded to Irv. Guinn, Contractor, Bakersfield, $2,850.

Kern County—SR 139—Near the City of Wasco at Sixth Street. Grade and surface with road-mixed surfacing, 0.3 mile. Contract awarded to Geo. E. France, Inc., Bakersfield, $5,314.50.

Kern County—US 99—At Fort Tejon. Replace the existing wooden bunker with two metal tanks. Contract awarded to Chas. I. Cunningham Co., Oakdale, $7,682.

Lake County—SR 20—Between Laurel Dell Lake and Tule Lake (portions). Grade and surface with plant-mixed surfacing on cement treated base and construct connections and approaches, 2.4 miles. Contract awarded to Granite Construction Co., Watsonville, $418,268.

Lassen County—FAS 988—Between Stone Ranch and Slate Creek. Shape the existing roadbed and place plant-mixed surfacing on untreated base and apply a fog seal coat, 15.3 miles. Contract awarded to Claude C. Wood Co., Lodi, $214,711.

Los Angeles County—Between Pacific Electric Railway and Center Street, on Valley Boulevard. Widen the existing highway, place plant-mixed surfacing on untreated base and modify the traffic signal system and highway lighting. Contract awarded to Huskey Paving Co., El Monte, $13,130.75.

Los Angeles County—Between 70th Street and Santa Barbara Avenue, on Harbor Freeway, 2.4 miles. Grade, pave with portland cement concrete on cement treated subgrade, place plant-mixed surfacing on cement treated base, untreated base, imported base and existing pavement and construct 11 bridges, four pedestrian undercrossings, portion of pedestrian undercrossing, one pump house and 13 retaining walls, completion of which provides an eight-lane divided freeway together with frontage roads, ramps, interchange lanes and connecting streets at Gage Avenue Undercrossing, 61st Street Pedestrian Undercrossing, 59th Place Undercrossing, Slauson Avenue Overhead, Slauson Avenue West Pedestrian Undercrossing, Slauson Avenue East Pedestrian Undercrossing, 54th Street Overcrossing, 52d Place Overcrossing, 51st Street Overcrossing, 49th Street Overcrossing, 47th Street Overcrossing, Vernon Avenue Overcrossing, 43d Street Overcrossing, 42d Street Overcrossing, 41st Street Pedestrian Undercrossing, 54th Street Overcrossing Pumping Plant, and portion of 40th Place Pedestrian Undercrossing. Contract awarded to J. E. Haddock, Ltd., Pasadena, $4,484,517.10.

Famous Test Driver Praises Directional Signs in California

Ab Jenkins, executive assistant to the State Road Commissioner of Utah and nationally famous as an auto racing and test driver, had high praise for California's State Highway System and laboratory research work when he called on Director of Public Works Frank B. Durkee.

Jenkins holds all automobile speed records and has driven more than 2,000,000 miles without an accident of any kind. He has visited every state as a traffic safety engineer. He is a former mayor of Salt Lake City.

"I am out here in California checking on the different highway safety devices," Jenkins said. "The one in which I am very much interested is your striping equipment for highway striping. There is no state in the Union that is better marked with directional signs and stripings than the State of California.

"It is almost impossible to get lost in California, and it isn't necessary to waste a lot of time asking questions—your highways are so well marked that if one is driving from one city to another, even though you are going to a small community, you will find a sign "TURN RIGHT," "TURN LEFT," within a radius of 1,000 feet—maybe the next one, 500 feet; then a large overhead sign that points in the direction in which you should go.

"That is what I mean by your markings."

TRAFFIC ENGINEERS PLAN FOR SILVER ANNIVERSARY

The Institute of Traffic Engineers held its first meeting on October 2, 1930, in the William Penn Hotel in Pittsburgh, Pennsylvania. There were 19 members present at the first organization meeting.

In 1955, the members of the institute are returning to the William Penn Hotel in Pittsburgh for the Silver Anniversary Meeting which is scheduled for October 23d to 27th inclusive. The membership has grown in 25 years from 19 to approximately 800.

New Law Will Speed Highway Construction

State Highway Engineer George T. McCoy commented on legislation signed by Governor Knight permitting award of state highway contracts on and after the first day of January preceding the July 1st beginning of the fiscal year in which the projects are budgeted. Previously, the law provided that the award of contracts could be made on and after the first day of April.

McCoy said the change in the law would assist the highway program in several ways. First, it will permit earlier start of construction whenever weather and local conditions are favorable—thus increasing the effective length of the construction season and permitting earlier completion of projects. This is particularly important for jobs which can be completed in one season. Many of the late fall finishing troubles can be avoided and many projects can be completed which would, under past practice, have required a winter shutdown, with completion the next season.

Another advantage will be that projects can be advertised and awarded over a longer part of the winter period when contractors have available time to examine projects and prepare bids. Earlier award dates will also permit stockpiling of materials during the winter on jobs which can be started in the spring.

A COMPLIMENT

4020 BAYVIEW AVENUE
San Mateo, California

California Highways and Public Works, Sacramento, California

GENTLEMEN: From time to time I have had occasion to see copies of your magazine, *California Highways and Public Works*. I have not only found these occasional contacts with the magazine a distinct pleasure but it always creates a sense of pride in my native State and a large degree of admiration for the Division of Highways.

Very truly yours,

BRIAN E. MENZIES

In Memoriam

BORIS MICHAEL SHIMKIN

It is with great sorrow that the Bay Bridge office has to report the death of Boris Michael Shimkin, Associate Bridge Engineer, at the age of 66, after a long and varied career in engineering.

Mr. Shimkin, a member of the Russian nobility of Smolensk province, was born in Omsk, Siberia, the son of Michael Boris and Lydia C. (Kolobov) Shimkin. He received his technical education at the Tomsk Technological Institute of Nicholas II from which he was graduated in 1914 with the degree of Civil Engineer. After coming to the United States, he received the degree of master of science in civil engineering from the University of California in 1928. He was married on January 8, 1912, to Dr. Lydia J. Serebrov.

During World War I Mr. Shimkin served the Russian Government as a colonel of engineers in the Imperial Russian Army. He spent most of 1919 and 1920 in Vladivostock where he was chief engineer on port installations and other facilities. He escaped with his family just before the Bolsheviks seized the city, and made his way to Java. After two years in Java he came to the United States, in the summer of 1923, bringing his family with him. He became an American citizen in 1928.

After working for several employers in the San Francisco area, generally in the structural engineering field, he was appointed Associate Bridge Engineer in the Bridge Department of the Division of Highways in October, 1933. For the next 10 years, with the exception of about a year and a half at the Bay Bridge design office, Mr. Shimkin worked at Bridge Department Headquarters in Sacramento. In the latter part of 1943 he was transferred to the Bay Bridge engineering office where he served as Associate Bridge Engineer until the time of his death.

He is survived by his widow and two sons, Dr. Michael Shimkin and Dr. Demitri Shimkin, to whom deep sympathy is extended.

GOODWIN J. KNIGHT
Governor of California

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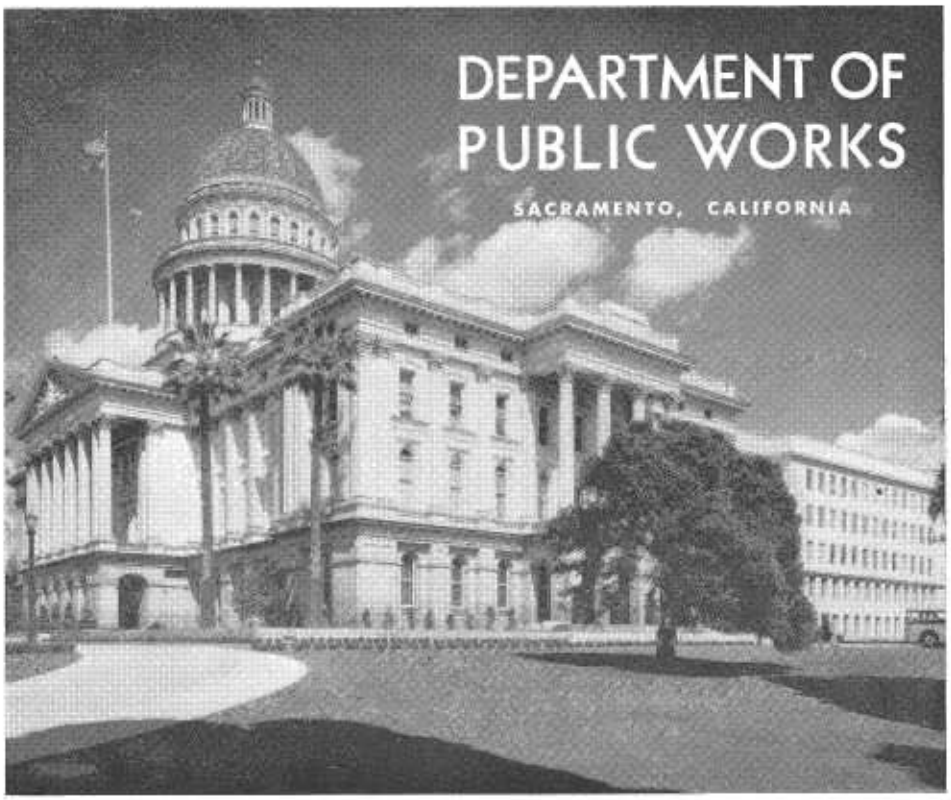

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