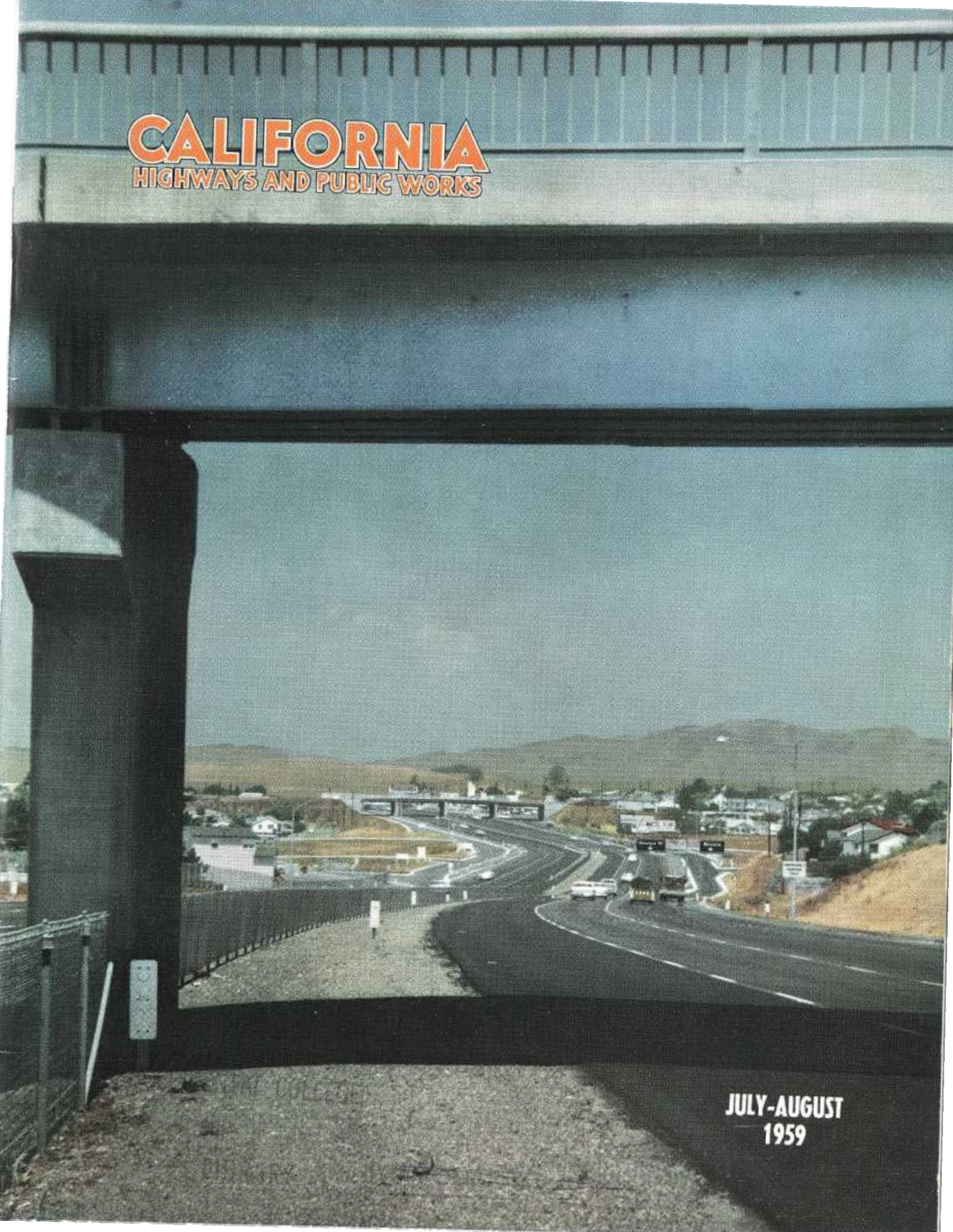
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



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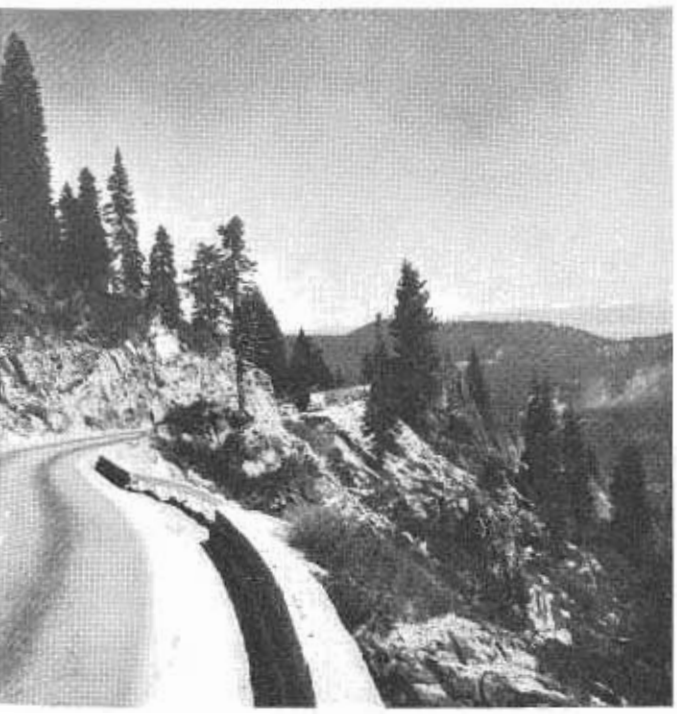
FRONT COVER

The Magazine Street Overcrossing frames this northward view of the new US 40 Freeway through Vallejo.

Photo by William R. Chaney



BACK COVER

Just east of Echo Summit US 50 starts down Meyers Grade toward Tahoe Valley and Lake Tahoe in the distance.

—Photo by Jack Meyerpeter

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Work Improvement

Governor Stresses Better, Faster, Cheaper Methods

On April 1, Governor Edmund G. Brown inaugurated the Work Improvement Project, an intensive statewide program among state employees to find better ways of doing their jobs. It will extend to February 1, 1960.

Following the Governor's directive, Robert B. Bradford, Director of Public Works, issued a circular letter on June 8th to all departmental employees pledging "participation to the fullest extent in this worthwhile program."

Just what is the Work Improvement Project or "WIP" as it has come to be known? What are its objectives and how will they be accomplished?

To begin with, WIP is much more than a simple economy program. WIP is bound to save the State money—probably quite a bit of it—and this is important. But, beyond this, it is interested in ways of giving California taxpayers better service, of doing more work with the men, money and materials we already have. It is a broad, positive program of which the saving of dollars is only one phase.

Nor does WIP mean that any state employee is going to lose his job. If positions are no longer needed, the necessary reduction will be made by not refilling when normal turnover occurs, or by transferring employees to other positions of equal level. On a positive vein, the impact of the State's population increase makes WIP's major problem one of how to handle more work with the present number of people.

Employee Participation Vital

Stated simply and inclusively, WIP's aim is to find ways to do work easier, better, faster and cheaper.

It is a "do-it-yourself" project which depends on participation by everyone in state service from top to bottom. It prospers in a favorable work climate which emphasizes the importance of finding these better ways and encourages supervisors and employees to think creatively about their work.

Supervisors form a key group in getting the program under way throughout the State. They will receive training in methods such as work, process, layout and motion analysis for evaluating work now being done and for improving methods and procedures in their sections. This training will provide an added way to tap the reservoir of practical knowledge represented by the supervisory group.

WIP training, which will be given at appropriate locations throughout the State, will include briefing sessions for management personnel, basic training groups for first-line supervisors, followup workshop sessions and training courses in pertinent subjects. In order to make maximum use of the personnel who attend the WIP trainers institutes, the basic WIP training will be planned and organized on a departmental basis. Interdivision training groups will be conducted where possible, serving all department employees in an area.

While planning and providing training courses will be on a departmental basis, the selection, scheduling and authorizing of individuals to attend the sessions will be the responsibility of regular supervisors and will be arranged through normal channels.

However, the individual employee remains the most important factor in WIP. It is on his effort and interest that the success of the program will rest. The cumulative result of each employee sitting back and taking a second look at the duties he performs could be tremendous.

Rapid Consideration Assured

Every work improvement proposal submitted under the program will receive prompt consideration. Review and referral of each proposal will continue until it has either been put into effect or turned down by an official who has the authority to adopt or reject it. The suggestor will always receive a written report of the final action regarding the proposal.

Recognition will be accorded employees who develop improved operations resulting in economies or increased efficiency by cash awards and commendations under the Merit Award Board employee suggestion program, reports of performance and personal commendation by superiors.

All official commendations will be made part of the employee's official agency personnel file.

Overall responsibility for WIP has been assigned to a Work Improvement Committee working under the general direction of the Governor's standing committee. Department of Public Works personnel appointed to the Work Improvement Committee include James F. Wright, Deputy Director, and Ray Rusk, Chief Clerk of the Division of Highways' Marysville office. Rusk is also President of the California State Employees' Association which has given its full support to the program.

Co-ordinators Named

The Director of Public Works has named T. F. Bagshaw, Assistant Director of Public Works, as departmental WIP co-ordinator to assist him in administering the program. The departmental co-ordinator will develop overall plans and assist the division chiefs and their staffs in implementing the program. He will also evaluate the progress of the program, see that information on improvements which may be of use to more than one division is disseminated to the others and see that those who make outstanding contributions as a result of the program are given proper recognition.

Each division chief will see that action is taken in his division to promote and maintain an effective program. This will include selecting supervisors to receive WIP training and making available any of his employees necessary to provide such training, seeing that employees so trained apply the work simplification techniques and

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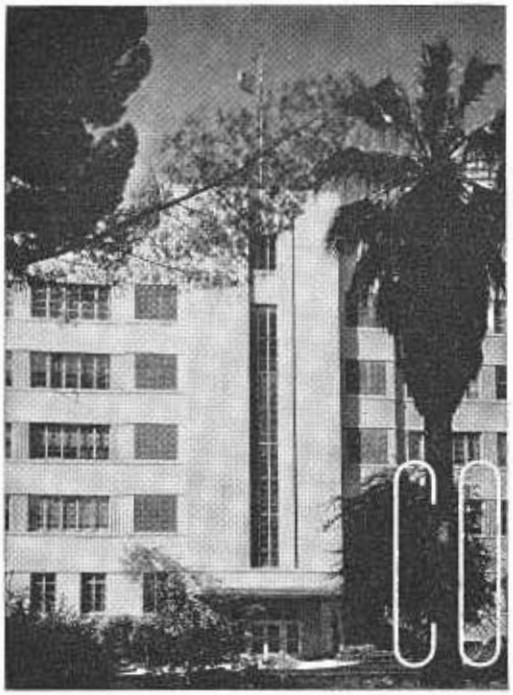

Public Works Building
Twelfth and N Streets
Sacramento

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San Jose–Los Gatos Freeway Completed

On April 30th, the new freeway between San Jose and Los Gatos on Sign Route 17 in Santa Clara County was completed.

Construction of the four-lane, future six-lane, freeway, which began in 1957, cost approximately $5,900,000, exclusive of right-of-way. It is located approximately midway between the Santa Clara-Los Gatos Road and the San Jose-Los Gatos Road (former Sign Route 17), and follows the east bank of Los Gatos Creek between Los Gatos and Campbell, where it crosses the creek and proceeds north to the intersection with Bascom Avenue in San Jose. Included in the construction were frontage roads, six interchanges, four separations, one railroad underpass, one driveway undercrossing and bridges across Los Gatos Creek at two locations.

The portland cement concrete pavement was plaeed by a relatively new method of making a single pour eight inches in thickness and 24 feet in width. This was accomplished by using two dual-drum mixers operating in tandem. All finishing equipment was extended to carry on the 24-foot operation including a dual spraying system for placing curing seal. During 24½ working days the contractor placed and finished 50,100 cubic yards of Class B PCC pavement averaging 2,040 cubic yards per day. A profilograph, which is a new device that measures roughness, was run over the finished PCC pavement. The resulting profilogram indicated a vertical roughness of less than 3½ inches per mile. Specifications allow a maximum of seven inches a mile.

Opening of this 8.8-mile section of freeway has reduced by two-thirds the normal driving time between San Jose and Los Gatos and eliminated many traffic hazards.

Completion of two other projects now under way immediately north of this job will provide continuous freeway between Los Gatos and the south end of the Nimitz Freeway which extends from San Jose to Oakland.

Report From District X

By J. G. MEYER, District Engineer

SINCE last year's report in the July-August issue of *California Highways and Public Works*, District X has made steady progress in providing modern highways in central California. The extent of these accomplishments may be gathered from the following report:

The past year saw many district meetings with the public and informational conferences with local government and civic organizations. The subjects of these meetings and conferences varied from the freeway complexities of the Westside Highway, the Turlock and Modesto Freeways, and the Stockton Master Plan to minor problems on recreational roads in the High Sierras. Public interest in these meetings was extremely high and the active participation by the general public proved invaluable in formulating plans and recommendations at the district level.

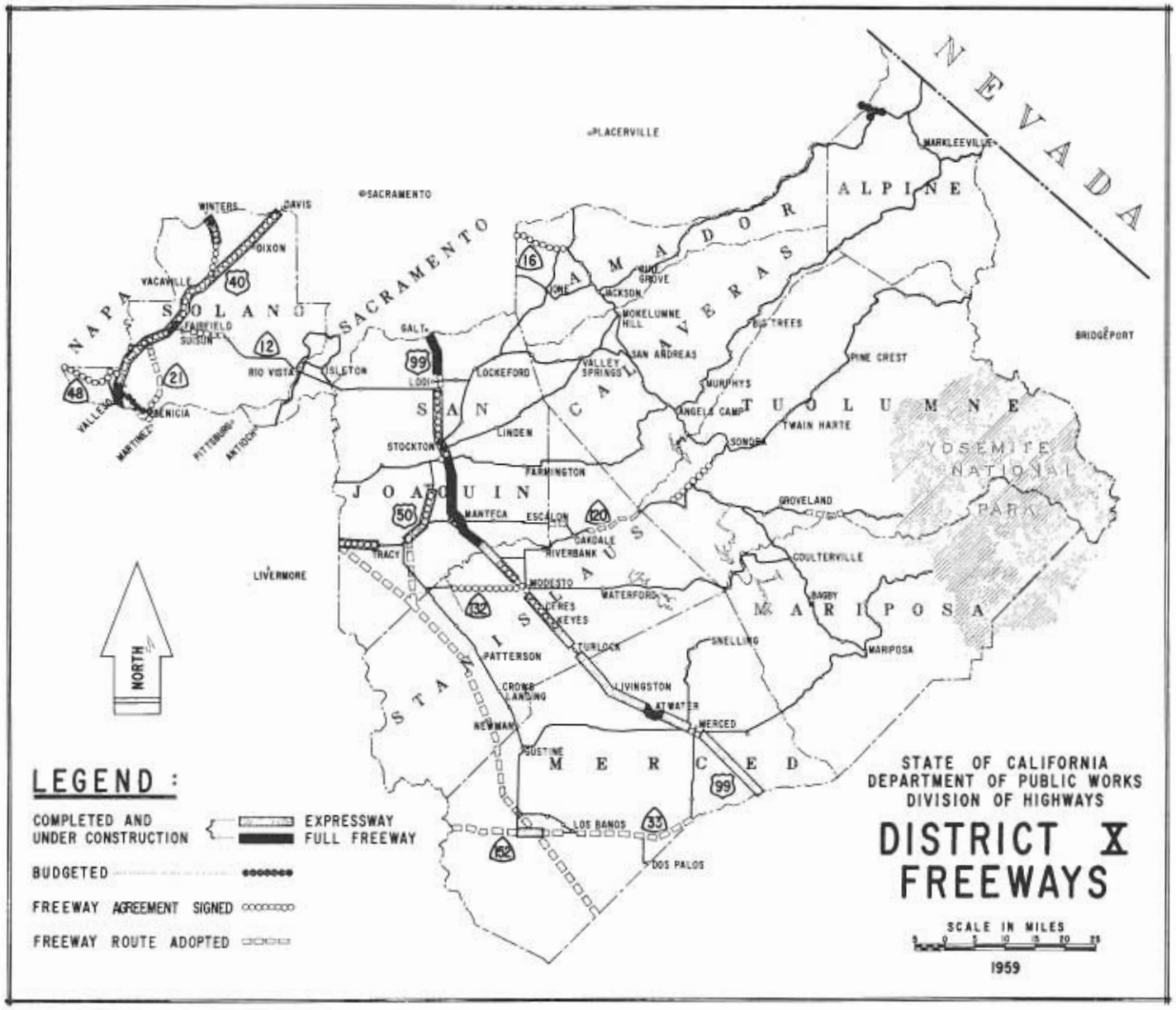
For the first time conferences and meetings were held relative to advanced planning of expressway extensions as a part of a freeway system in the mountain areas with low traffic densities and where future recreational potentials are great.

UPPER—An aerial view southward of the US 99 Freeway Bypass of the town of Atwater in Merced County. LOWER—Looking south along construction on the Vacaville-Dunnigan Cutoff (Legislative Route 90), an interstate highway. The Russell Boulevard Interchange and the twin bridges over Putah Creek, both in Yolo County, are in the foreground with clearing operations visible in the background for a further five-mile extension of the freeway into Solano County.

Progress on the Interstate System within District X continued steadily. Freeway agreements were completed and detailed planning initiated for 39 of the 44 miles on US 40. In addition, freeway agreements were completed for the entire 11 miles of Legislative Route 90 (Vacaville-Dunnigan cutoff), from east of Vacaville to the Yolo county line; and construction was started May 7 on the initial two lanes of an ultimate four-lane facility between north of Sweeney Creek and Putah Creek to connect with similar construction from Putah Creek north to Madison in District III.

Planning on State Route 238, the "Westside Freeway," reach the point where freeway agreements for the portions between the Fresno county line and the vicinity of Tracy are being prepared. The balance of this route from Tracy to the Sacramento county line is currently in the final study stage prior to holding public meetings.

Within the district all of US 99 has been expanded to four-lane status with approximately 95 percent of it being divided. Plans for the early conversion to full freeway status of the remaining portions are well advanced. These remaining portions are urban in nature with the attendant problems inherent in such areas. In the Merced area, however, the freeway agreements are complete and plans are entering the final stage. Public meetings have been held in the Turlock area. Freeway



agreements for the Ceres, Modesto and Lodi reroutes are complete and plans well advanced.

Major emphasis has been placed on the acquisition of rights-of-way needed for the Merced and Modesto freeway projects and on US 40, from Vallejo to Davis.

It is of interest to note that individuals and businesses displaced by the clearance program have been, for the most part, successfully assimilated into their respective communities, often in better facilities than previously occupied.

US 50

Three major projects between Tracy and Stockton were completed during the past year, converting the entire distance from the Tracy Overhead to Stockton to four lanes. From the Tracy Overhead to Grant Line Road and from Richards Avenue to Charter Way, four lanes undivided were provided as interim projects. From Mossdale to Richards Avenue a four-lane expressway, approximately seven miles in length, was completed. Included in the latter project were the Mossdale interchange between US 50 and State Sign Route 120 and an underpass at the Southern Pacific Railroad at a construction cost of $1,934,000.

A project to widen the East Tracy Overhead from three lanes to four is currently underway. The estimated cost of construction is $457,000.

US 40

An additional 3½ miles of freeway in Solano County was added to US 40 upon completion on January 6, 1959, of the portion between 0.2 mile north of Vallejo Wye and 0.4 mile north of Redwood Street. A four-lane expressway was converted to a six-lane full freeway with seven separation structures at a cost for construction of $4,501,500.

US 99

One project near Stockton will convert 1¼ miles to full freeway status. Two structures, eliminating two cross-

ings at grade, the Mariposa Road Overcrossing and the Farmington Road Interchange, constitute the major portion of the work. It is estimated work will be completed about August, 1959, and the final cost will amount to $900,000.

State Sign Route 12

Work on the relocation of State Sign Route 12 from the Rio Vista Bridge across delta land to the Mokelumne River Bridge is about completed and it is anticipated the new stretch will be open to traffic in August. Final cost on this 5½-mile portion is estimated at $900,000. This new route will make a saving of 2.8 miles over the presently traveled route via Isleton. Work is still in progress on the Sacramento River Bridge and approach at Rio Vista.

Sign Route 49

A minor, yet interesting, project is located on State Sign Route 49, in Hell Hollow Ravine south of Bagby, in Mariposa County. This portion of the Mother Lode Highway dates back to the old mining days and was used to transport ore from the mines in the hills to the mills on the Merced River near Bagby.

This work of realigning and surfacing is an interim measure and has been carried on during the past three winters.

Sign Route 88

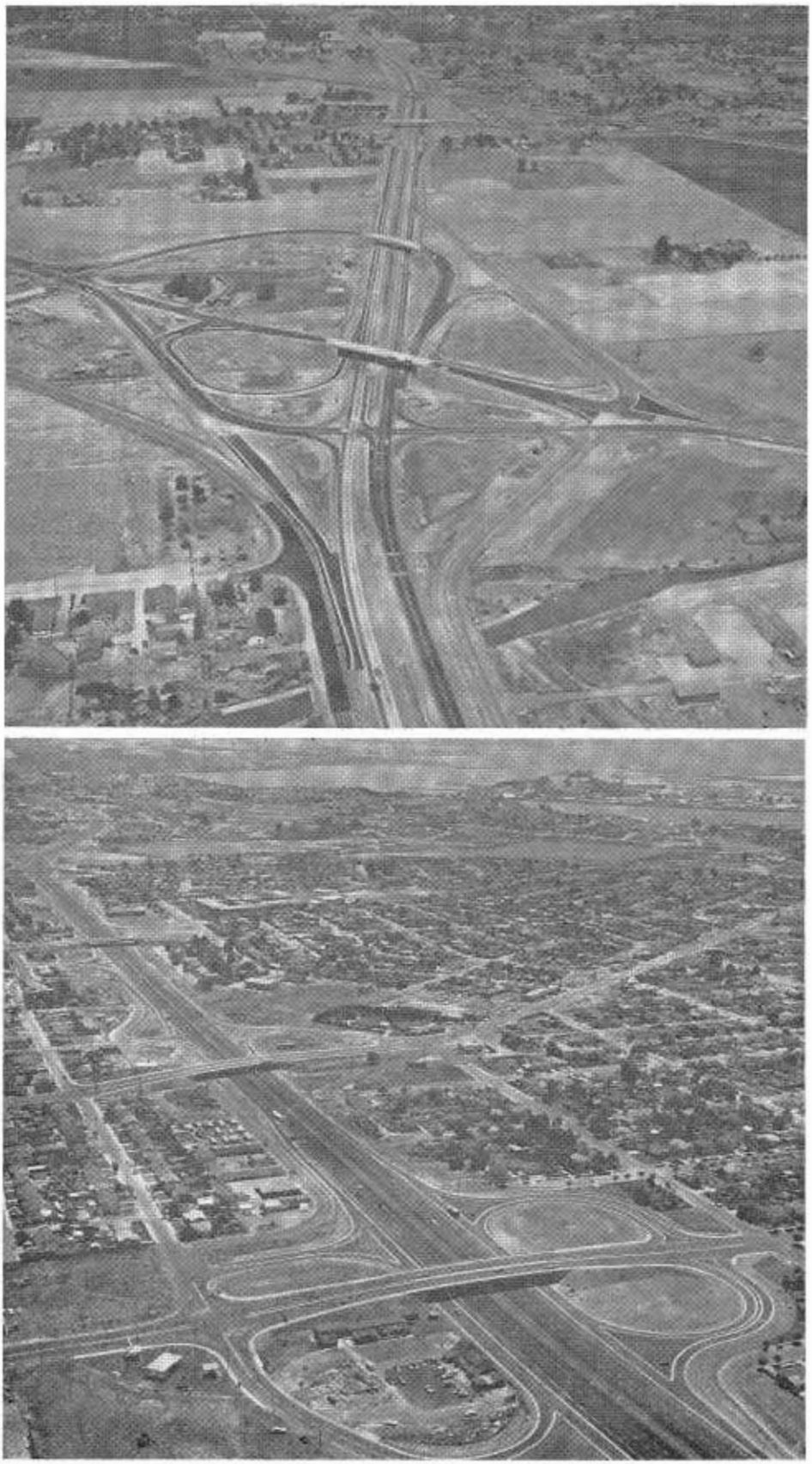
Work commenced in June on 2¼ miles of relocation of the Carson Pass Highway from Carson Spur to just east of the Alpine county line. The work involves heavy grading to improve alignment and eliminate a stretch of steep sidehill section with heavy curvature. It is estimated that 100 working days will be required to complete this project. The estimated construction cost is $425,000.

A section of Sign Route 88 between Lancha Plana Road and one-half mile east of Martell at a construction cost of $1,066,000 was completed late last year. A separate article on this project appears elsewhere in this issue.

State Sign Route 140

Work was completed on June 4, 1959, for one mile of grading and paving at the west entrance to Yosemite

UPPER—The new Rio Vista Bridge under construction across the Sacramento River. Extending from the far end of the bridge and into the background is the construction on the highway between the Sacramento River and the Mokelumne River in Sacramento County (Sign Route 12). LOWER—Looking southward over the improved portion of Sign Route 49 between Bagby (along river in left foreground) and Bear Valley in Mariposa County.



UPPER—The Mariposa Road (foreground) and Farmington Road Interchange on US 99 in San Joaquin County, a step in the conversion of the Stockton Bypass from expressway to full freeway. LOWER—The new US 40 freeway through Vallejo. In the foreground is the Tennessee Street Interchange.

National Park at a construction cost of $166,500. Sign Route 140 is known as the All-Year Highway into Yosemite and one of the more important recreational routes in District X.

Legislative Route 109

Work was started in June on a major interim project on McHenry Avenue between Needham Street and Modesto Irrigation District Lateral No. 3 at the north entrance into Modesto. This project will modernize a conventional two-lane highway into an all-paved four-lane undivided city street section with provision for parking. It is estimated the work will be completed early in 1960 at a construction cost of $1,100,000. Rights-of-way were provided by the City of Modesto.

Budgeted jobs still to be advertised this year are for Luther Pass to Picketts on Sign Route 89 and Cordelia to Fairfield on US 40.

County Roads

During the year of 1958, there were 15 federal-aid secondary county road and bridge projects under construction for a total cost of $4,545,000 in the nine counties comprising District X. The type and extent of construction varied from grading a 1.5-mile length of Blue Lakes Road in Alpine County at a cost of $42,000 to the construction of a double-leaf bascule bridge on Grant Line Road in San Joaquin County at a cost of $662,000.

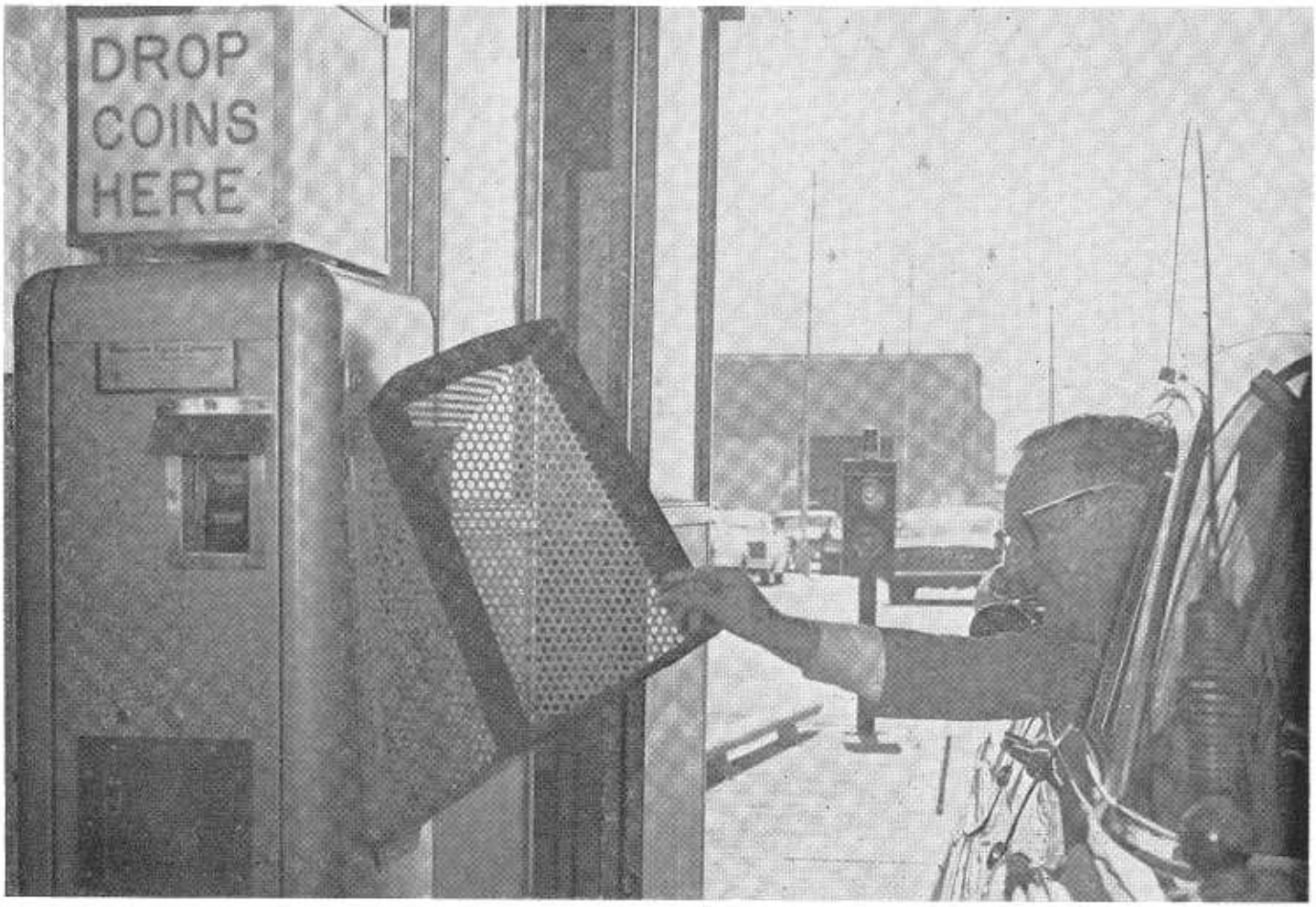
City Streets

During the 1958-59 Fiscal Year, the 34 cities in District X were allocated $973,585 from Section 2107 gas tax funds for both general maintenance of city streets and construction on the major city street system. In addition, these cities were allocated $68,500 from Section 2107.5 funds for engineering expenditures on city streets. During the same period, the district processed memorandums of agreement for 80 city street projects.

On July 1 there were 1,045 contractors prequalified to bid on state highway projects. Their estimated combined bidding capacity is $2,115,000,000. Last year at the same time there were 1,018 prequalified contractors.

Toll Machine

Automatic Collection System May Prove Time, Money Saver



Governor Edmund G. Brown deposits the first quarter in one of the two new automatic toll takers installed at the San Francisco-Oakland Bay Bridge Toll Plaza.

An automatic toll collection system went into experimental operation on the San Francisco-Oakland Bay Bridge on May 21st, with Governor Edmund G. Brown depositing the first quarter in the machine.

The new system is designed to reduce traffic congestion caused by periodic brief jam-ups of traffic at the Toll Plaza without hiring standby personnel, State Director of Public Works Robert B. Bradford told the Governor.

"Where this has been tried in the East, people liked it," Bradford explained. "We want to test the local reaction."

Bradford pointed to another speed-up in toll collection for Bay bridges. The California Toll Bridge Authority changed the truck toll basis on the San Mateo-Hayward and Dumbarton bridges from weight to axle-count, effective June 1st, thus obviating delays while trucks are being weighed. The authority is considering making the same change on the San Francisco-Oakland Bay Bridge.

"These instances of increased efficiency in bridge toll collections," Governor Brown said, "are typical of the many ways in which we will save millions of dollars through work improvement and operating economies without reducing any necessary services to the public.

One automatic toll collection machine went into operation on May 21st to serve one westbound lane of the Bay Bridge; another was put into use the following week to serve one eastbound lane. If they work out successfully, additional machines will be installed.

The machines may be used only for passenger cars and only by motorists who have the 25-cent toll in cash. The machines cannot make change and cannot handle commute book tickets.

Use of automatic machines, if the experiment works out, will permit more lanes to be open during brief temporary peak traffic loads. The machines will enable motorists with the correct change to deposit their tolls as they proceed through the toll lane, slowly but without stopping.

Median Study

Research Project Determines Effect Of Barrier Design on Accident Rate

By GEORGE M. WEBB, Traffic Engineer

THE DIVISION of Highways has completed a new safety study dealing with accidents, particularly the infrequent but usually serious cross-median head-on collisions, on California's heavily traveled freeways, expressways and other divided highways.

The extensive study was the first of its kind and scope covering accidents on divided highways with extremely heavy traffic.

Purpose of the research project was to determine the effect of various median designs on accident rates, and to find the conditions under which a positive median barrier may aid in reducing the accident toll.

Included was a statistical and engineering analysis of 8,000 accidents which occurred on 265 miles of various types of divided highways in 1956 and 1957, plus a close examination of 407 fatal freeway crashes in the last three years. Special attention was given to cross-median accidents.

Divided highways chosen for the study were essentially limited access facilities — freeways, expressways or routes without roadside development —which carry an average from 15,000 to 200,000 vehicles a day. A similar study in 1952 dealt with average daily traffic volumes up to 25,000 vehicles.

Related Study Made

The study was made in conjunction with a series of radio-controlled crash tests, conducted by the Materials and Research Laboratory in Sacramento, in which new median barrier designs were developed. The impact tests and new barrier designs are described in another article in this issue.

As a result of this research, the new types of barriers will be installed shortly on sections of the Hollywood, Santa Ana, Ventura, and San Diego Freeways in the Los Angeles area, and the James Lick (Bayshore) and Nimitz Freeways in the San Francisco Bay region.

If experience with these initial installations proves successful, barriers will be installed on other heavily traveled freeways.

In reporting some of the principal findings of the safety study, it should also be emphasized that scores of recent highway engineering advances are incorporated in today's modern freeways, making this type of highway the safest ever known.

However, it is doubtful that anyone will ever come up with a completely accident-proof highway, and consequently safe driving practices and mo-

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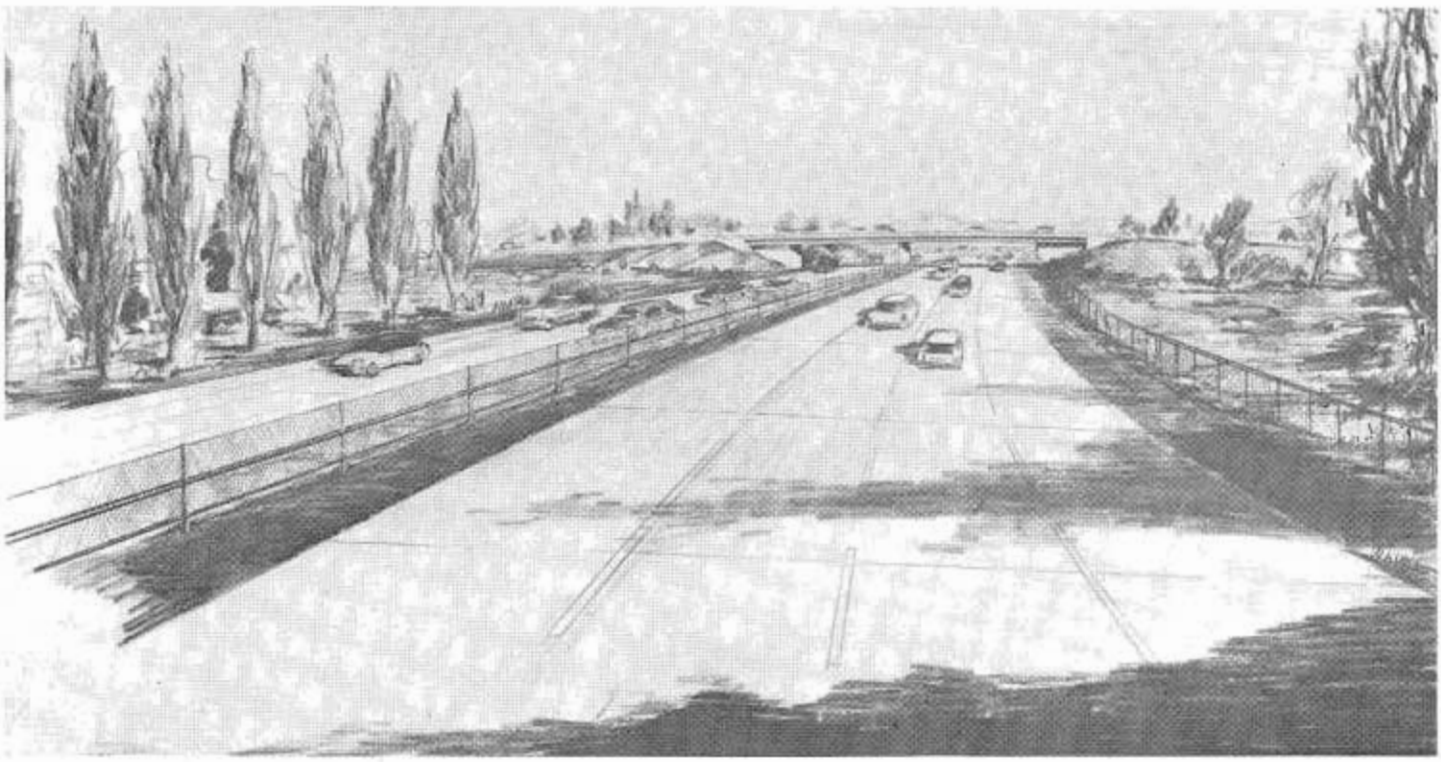
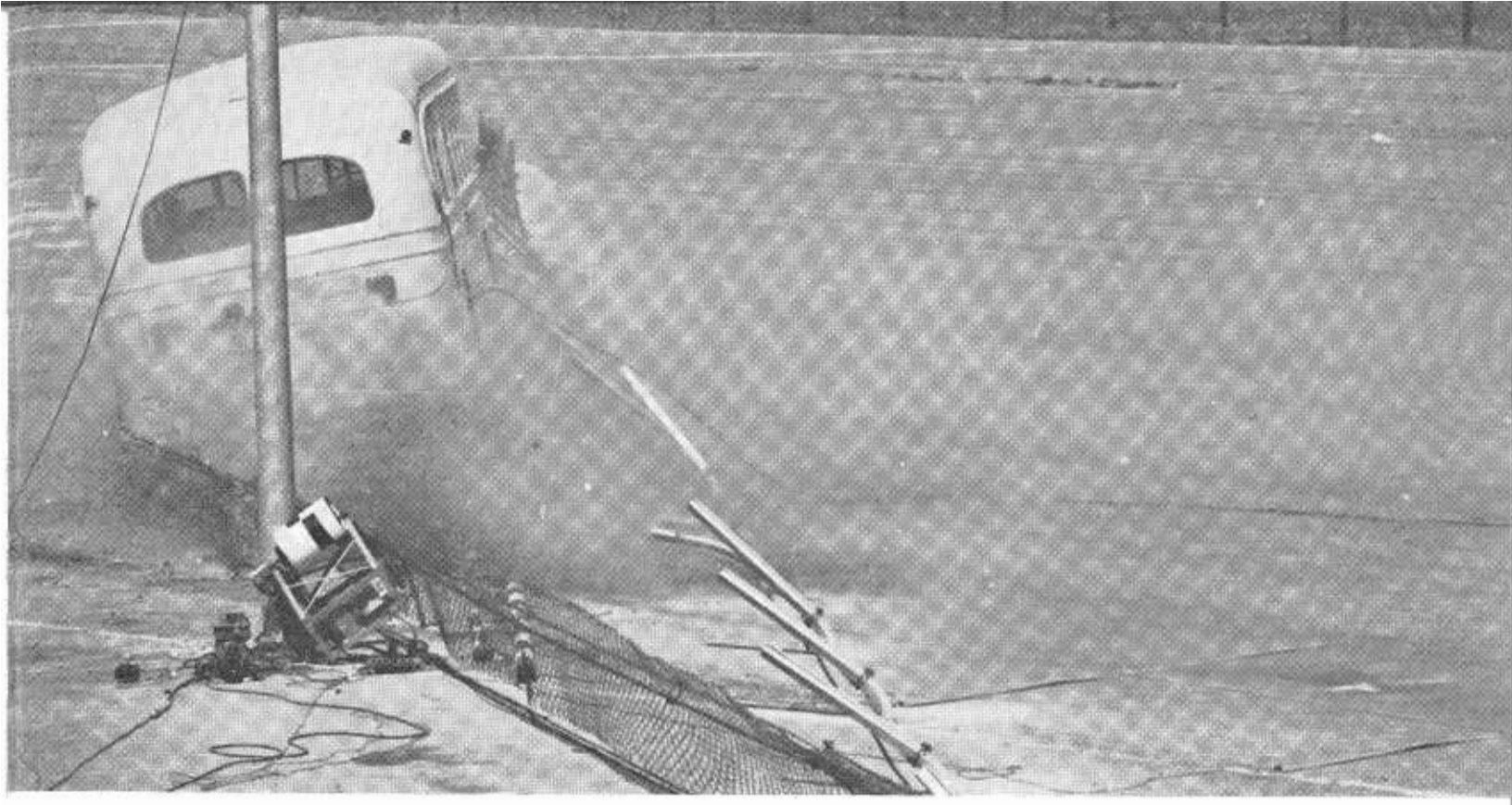


This drawing shows a new type of median barrier which will be installed in the center strip of some of the State's more heavily traveled freeways. The new barrier design was developed by division structural and materials experts during a series of full-scale crash tests. It is the only one of 15 types tested. The design utilizes chain link fence, light steel posts, and three ¾-inch steel cables.



Impact Tests

Barrier Test Crashes Reveal Valuable Data

By JOHN L. BEATON, Chief, Structural Materials Section, and
ROBERT N. FIELD, JR., Materials and Research Engineering Associate

THE DIVISION of Highways has had a comprehensive study of median barriers underway for the past several years. This article will describe one phase of this study—the actual dynamic testing and development of positive barriers for use in the median (center) strips.

It was the purpose of this study to develop a median barrier which would both prevent a high-speed vehicle from getting into the opposite lanes of traffic and to reduce the severity at the same time so far as possible of the accidents which result from a vehicle striking a barrier. It was therefore considered in the order of their importance that the following three functions should be considered to be primary features of a median barrier: (1) positiveness of preventing crossing of the median; (2) minimizing reflection of the offending vehicle back into the traffic stream; and (3) minimizing injury to the occupants of the offending vehicle. This dynamic phase of the study was initiated by the Traffic, Design, and Bridge Departments and approved by the State Highway Engineer on January 9, 1958. All work was guided by the Median Barrier Committee which consisted of members of the Traffic, Design, Bridge, and Materials and Research Departments. This committee originally approved the testing of three designs of bridge rails and 15 median barrier designs.

Figure 1. A 34-passenger bus is test-crashed into a cable-chain link barrier at 40 mph.

With all preliminary planning, instrumentation, and construction concluded during the spring of 1958, the first test was performed on July 10, 1958. The test site was an inactive runway of the Sacramento County Airport located near Franklin, California. Figure 2 shows a plan of the test site. Each test was conducted by first building the selected barrier design, duplicating field conditions as nearly as possible but yet retaining all factors under control so that each test would be as comparable as possible.

Factors Consistent

The crash car was driven into collision by remote radio control from a pilot car following to the rear and left of the test automobile as shown on Figure 2. All of the preliminary tests were conducted by driving a medium-weight four-passenger sedan automobile into the various test barriers at an approximate speed of 60 m.p.h. and at an angle of collision of 30°. This same weight of car, speed, and approach angle was used consistently

within practical limits so as to obtain as good a comparison as possible between the various designs.

The preliminary tests were made on each of the original 15 barrier designs. Additional final tests, using both an automobile and a 34-passenger bus, were conducted on the two designs judged to be most efficient during preliminary testing. (The two most efficient designs are shown in Figures 4 and 5. Twelve other types are included in Figure 3; the design not shown was a modification of Type IV.)

The bus was driven into the barriers at 40 m.p.h. and an angle of 30°. The bus at 40 m.p.h. represented slightly more than twice the kinetic energy developed by the cars at 60 m.p.h. (Figure 1).

Since the primary aim of this study was to test the resistence of the various barriers, it was important that a severe type of oblique accident be employed. At the same time it was felt that the type of accident selected should not be beyond the realm of actual occurrence on a highway. The selection of the angle and speed of the test collision was based on this reasoning supplemented by a background of studies of many actual cross-median accidents as well as through analyzing this department's past experience with the many different speeds and angles of approach which were used during dynamic testing of bridge curbs and rails in the past. Thus it was decided that the 60 m.p.h. speed and the 30° angle of approach combination used for the standard passenger car test vehicle is representative of this severe type of oblique accident. With two exceptions this combination was used throughout the test program.

Approach Angle Varied

Since the majority of actual collisions with roadside railings and barriers usually occur between the angles of 15° and 20°, it was decided that at least one or more tests should be made at a lower than 30° angle of approach. Thus two such exceptions to the 30° approach were made so as to determine the change in reaction of the barrier due to the flatter angle of collision.

An anthropometric dummy restrained by a seat belt occupied the driver's seat of the test car during all collisions. Longitudinal and lateral deceleration recordings were taken from accelerometers located in the chest cavity. Similar decelerometer readings were taken simultaneously from the car frame.

Since the most important action in these test collisions takes place in less than a half a second and all of the movement occurs in less than three seconds, some means of accurately recording the proceedings was necessary for a later study. Therefore, a series of high and normal speed cameras were placed approximately as shown on the typical test site layout diagram, Figure 2, and used to record the tests covering all movements of the vehicle, the dummy, and the barrier during the collisions for this analysis.

The information on film, the strip chart recordings of the decelerations developed by "Sierra Sam" (the anthropometric dummy) and supplementary recordings of various dynamic strains by the use of SR4 gages located on some of the barrier systems made up the bulk of dynamic data collected during this study. In addition to this information, all physical changes in dimensions and conditions of the barrier systems were recorded by trained observers at the site along with observations and appraisals of damage to the car during and after collision.

Best Barrier Described

Of the 15 median barrier designs tested, only one satisfied all criteria as an overall efficient barrier when subjected to high-speed collision. The combination cable-chain link barrier, Figure 4, (1) acted as a positive barrier; (2) minimized the possibility of rear-end accidents by retaining the vehicle within the median strip, and (3) slowed the vehicle gradually, thereby minimizing the probability of serious injury to occupants of the car.

The second most successful design for a median barrier is the blocked out metal beam barrier shown by the test data sheet, Figure 5. This barrier answered all three criteria to some degree: (1) it did act as a positive barrier; (2) while it did reflect the offending vehicle back into the traffic stream, the speed and angle usually was such that following traffic would have some opportunity for evasive action; and (3) it resulted in decelerations of the offending car during collision which while high would be within the possible limits of human tolerance, so there is some probability of surviving a high-speed collision with this barrier.

For center strips where neither of the above two barriers are suitable, such as in areas where not enough space exists for the blocked out metal beam barrier or in places where earth foundation material is not available such as on a concrete structure, a concrete wall type barrier could be used. The concrete wall type design shown by barrier Number XII on Figure 3 proved to be too light by test. An adequate design would need to be slightly stronger than this tested design.

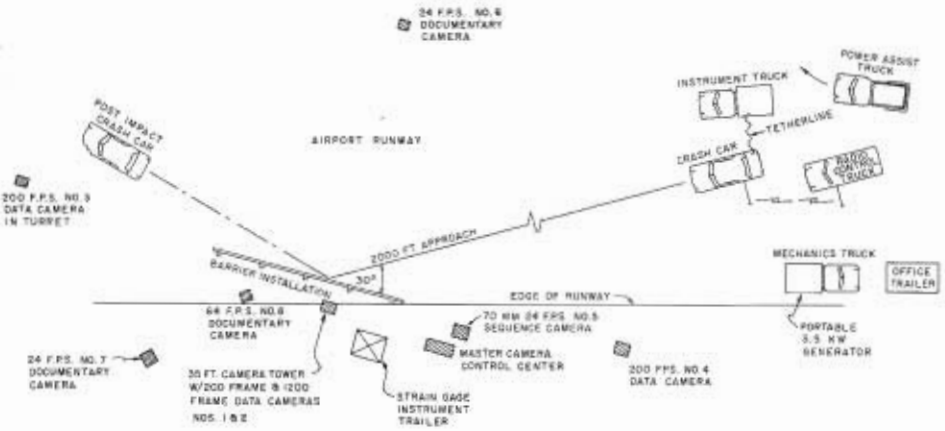


Figure 2. A plan view of the test site. The crash car was driven into collision by remote radio control from a pilot car following to the rear and left of the test automobile as shown above.

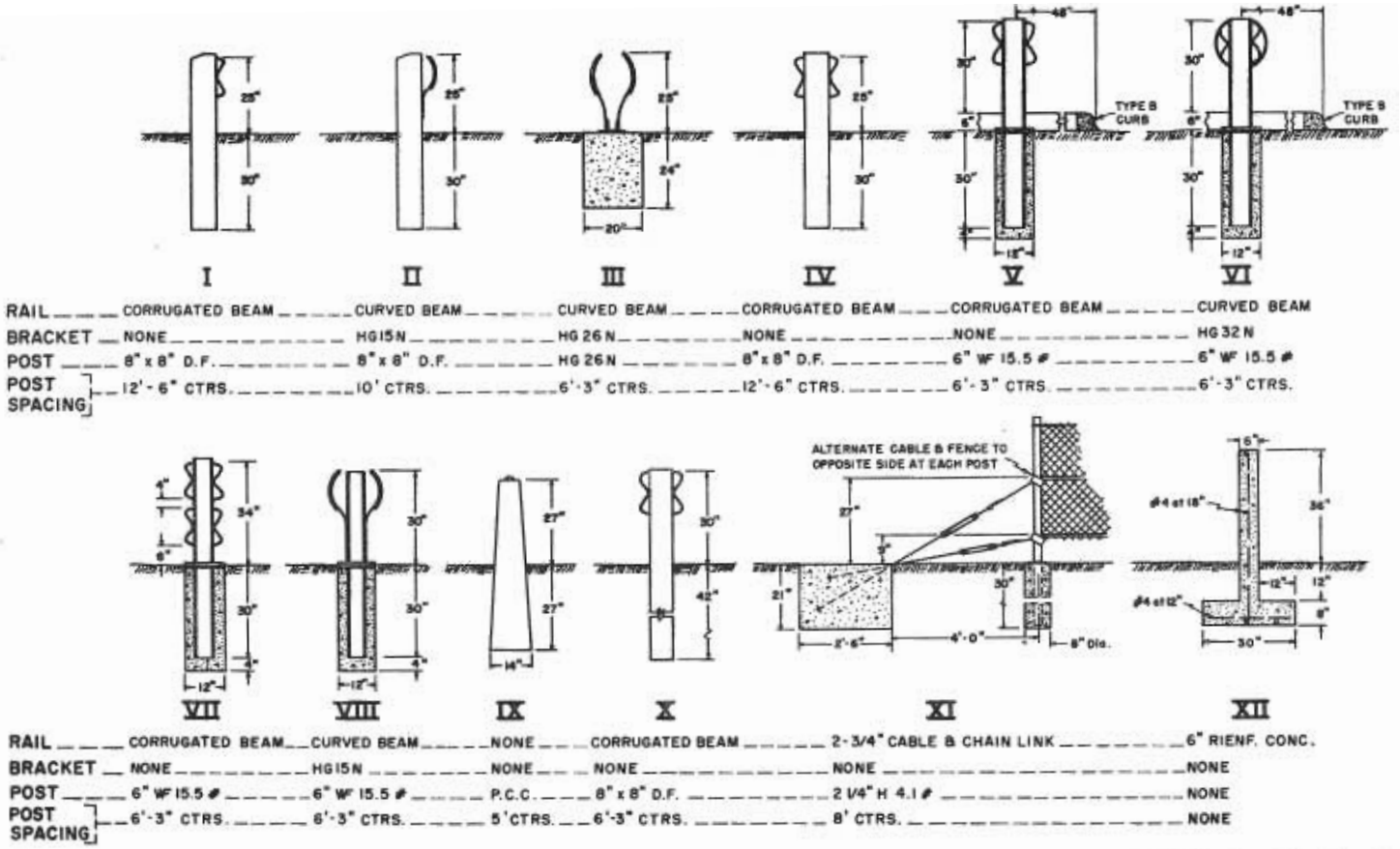


Figure 3. Preliminary tests were made on 15 barrier designs. Twelve of these are shown above. Two others, which proved the most efficient, are illustrated in Figures 4 and 5. The other design was a modification of Type IV above.

Concrete Barriers Tested

Successful tests on concrete wall barriers proposed as bridge railings show that when subjected to severe collisions this type of barrier will satisfy the first two criteria for a successful barrier but probably will not be a success in the third category. In other words, such railings can definitely be constructed to act as a positive barrier, will reflect the offending car back into its traffic stream, and the reflection angle will be such that the following traffic will have some opportunity for evasive action. However, the speed of the car caroming off the barrier will be so rapid that closely following vehicles will have little time for evasive action. Unfortunately, a concrete barrier produces much higher decelerations due to the change in direction during collision than either the cable-chain link or metal beam barriers and therefore the chance of survival during violent collisions appears to be minimized.

A departmental report has been prepared describing and analyzing the results of each test conducted during this program, but due to the limitations of an article of this nature, no attempt will be made here to develop this complete detail. The following discussion of this study is therefore limited to pertinent details.

The attention of the reader should first be directed to the fact that because of the cost of such a test program, it is always necessary to hold the number of tests to the very minimum needed to provide a proper guide to engineering judgment, rather than to attempt to perform sufficient testing to develop the absolute parameters of all details. It should also be pointed out that the results of this test program were tempered not only by the actual operating experience of the Division of Highways with several current designs of median barriers but also by a series of dynamic tests on various barrier curbing and bridge rails performed during the years of 1953, 1954, and 1955. This background will now be further supplemented by operating data of several trial installations of the two designs recommended by this study.

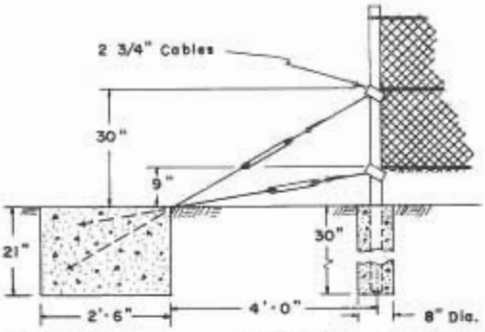
Barrier Types Listed

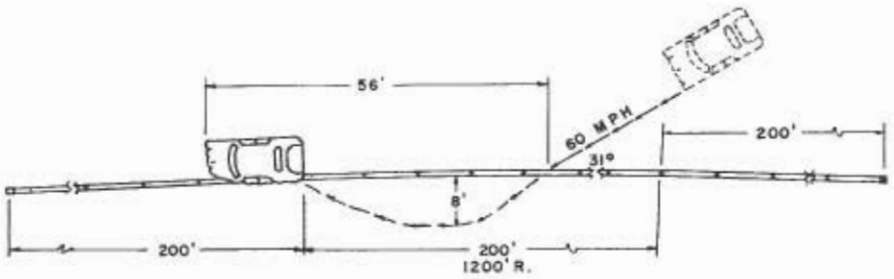
This study as well as research into studies by others led us to feel that barriers should be grouped in three broad classifications. These are the: (1) flexible type; (2) semirigid type; and (3) rigid. The criteria used in this study for a flexible type of barrier was a design which would fulfill the barrier concept while at the same time it would flex and deform under collision such that deceleration of the offending car would be tolerable to its occupants and at the same time would provide safe maneuvering time and space for any following cars in its own traffic stream. This being a relatively new concept insofar as median barriers were concerned, no practical working designs could be found, although certain varieties of rosebushes

POST IMPACT

IMPACT + 750 M SEC.

IMPACT + 225 M SEC.





GUARDRAIL ..... 36"Chain Link Fence w/2 3/4" cables 9" & 30" above pvmt.	DUMMY INJURY ..... Scalp laceration, possible chest injuries.	TEST NO. 21
POST ..... 2 1/4" - 4.1 #/ H Section Fence Post.	GUARDRAIL DAMAGE ..... 56' of fence knocked out. No damage to cables.	DATE 3-20-59
POST SPACING ..... 8' O.C.	POST DAMAGE ..... 12 posts damaged beyond repair.	VEHICLE ..... Chev. 55 Sedan
LENGTH OF INSTALLATION... 600'	VEHICLE DAMAGE ..... Total loss.	SPEED ..... 60 MPH
GROUND CONDITION ..... Wet	MAX. DYNAMIC DEFLECTION OF RAIL ... 8'	IMPACT ANGLE ... 31°
	VEHICLE DECELERATION (PEAK) ... Long. NG ...Transv. NG	VEHICLE WEIGHT... 3850 (W/ DUMMY & INSTRUMENTATION)
	DUMMY DECELERATION (PEAK) ..... Long. 6G ...Transv. 4G	

Figure 4. In order to determine the effect of a curve, a collision test was made on the outside of a barrier with a 1,200-foot radius, as shown above. The curvature had no effect on the overall results.

have been reported to function as such with partial success in wide medians in some of the eastern states. During the study period prior to this actual testing program, several different designs were considered by the Median Barrier Committee but were discarded for various reasons. One design, Design XI, Figure 3, was offered by the Landscape Design Section with the idea in mind that the chain link structure would have a double function as it could also be used to grow ivy or other leafy materials on it to serve as a headlight screen.

Six tests were performed on various detail modifications of this original design until the details shown on Figure 4 were developed. This design appears to be well balanced in that it functioned efficiently both at a low speed, low angle collision and at a high speed, high angle collision with passenger cars and at a high angle and speed bus collision. As noted above, it will support a growth of ivy or other vines to serve as a headlight screen. In areas where growth cannot be obtained, it is suggested that light wooden or metal strips be inserted in the chain link fabric to serve the same purpose. In the latter case it is probable that the chain link fabric should be at least 48 inches wide rather than the 36 inches used in this series of tests. Indications are that this additional foot in height will not seriously affect the operation of the design as a barrier as long as the cable system remains undisturbed.

Lower Cable Serves Purpose

The lower cable has a double purpose of serving to distribute the collision load to the back posts thereby stiffening the system in general while at the same time allowing the colliding wheel to pass over it during initial impact. This also serves as a trap preventing the return of the front wheel, thus helping to retain the car in the center strip. The nine-inch height appears to be about the right elevation for this trapping purpose.

The top cable chord, consisting of two cables, is the most important structural item in this system. Its placement with respect to height is critical, and its attachment to the post is likewise critical. If the cable is placed too low, it will either permit the car to pass on over the system or force the car to bounce back into the traffic stream. If placed too high, the cable might tend to slip over the car hood permitting the car to pass on through, perhaps severing the superstructure.

The final design height of 30 inches above the ground has proven to be approximately the proper height for this top cable. As this cable height is well

above the center of gravity of most cars on the road today, there is no tendency for the car to roll over the cable. At the same time insofar as the average passenger car is concerned, the cable will cut into the body sheet metal and slip over the colliding wheel. This action helps to retain the car in the median area throughout the collision, as well as preventing the return of the vehicle to the traffic lanes. As shown by Figure 1, this height is also effective in stopping a bus.

Single Versus Double Cable

The originally suggested design was tested using a single cable rather than the double cable shown in the final design. A load cell on this cable indicated that insofar as peak load is concerned, the single cable would serve. However, to be most effective the cable should be located on the collision side, thus the two cables. In addition the risk involved in kinking or cutting one cable during collision is such that the factor of safety provided by two cables is well worth the slight additional cost. The fittings used to fasten the cable to the posts must be so designed that they will clamp the cable firmly in place, but under collision loading can slip off the end of the posts, acting as a series of friction brakes. When installing this barrier, no attempt should be made to permanently fix the cable to the post. If the cable were fixed securely to the post, this would result in trapping and cartwheeling the car rather than gradually snubbing it to a tolerable deceleration.

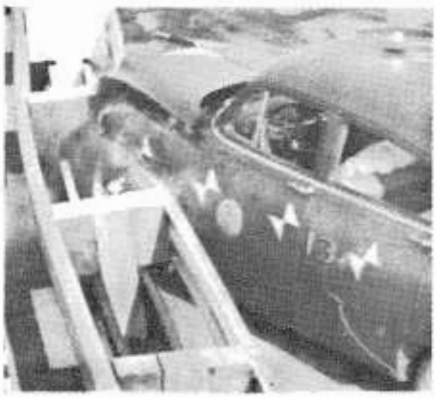
The end anchorages do pose a definite problem. An anchorage strong enough to develop the strength of the cable is so strong that a car striking the cable at an anchorage is tripped rather than snubbed to a gentle stop. This tripping tends to cartwheel the colliding car in an uncontrolled manner with the possible unfortunate result that the car could pass on over the barrier, although such did not occur during the test of the anchorage system during this study.

Anchor Should Be Protected

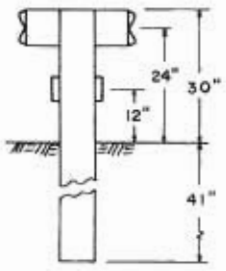
Under operating conditions the anchor should be placed at a point where other fixed objects normally occupy the median area, such as a bridge pier. Insofar as distance between the anchors is concerned, it was determined by tests that each additional 100 feet of spacing would contribute not more than two or three inches of additional side deflection when subjected to collision. The only practical limitation in the length

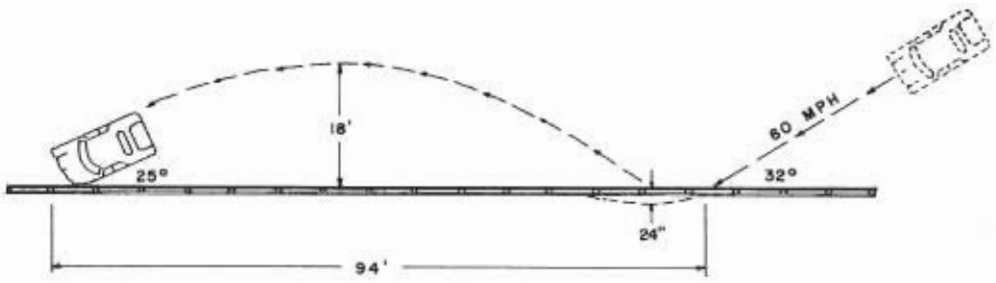
POST IMPACT

IMPACT + 500 M SEC.



IMPACT + 100 M SEC.





GUARDRAIL	W Section	DUMMY INJURY	Possible left shoulder, arm & side injuries.	TEST NO.	13
CHANNEL	6" ⊓ 8.2 #	GUARDRAIL DAMAGE	4 Sections damaged beyond repair.	DATE	12-18-58
BRACKET	8x8x12 D.F Block	CHANNEL DAMAGE	4 Sections damaged beyond repair.	VEHICLE	Chev. 53 Sedan
POST	8x8 D.F.	POST DAMAGE	3 Posts damaged beyond repair.	SPEED	60 MPH
POST SPACING	6'-3" O.C.			IMPACT ANGLE	32 °
LENGTH OF INSTALLATION	125'	VEHICLE DAMAGE	$ 900	VEHICLE WEIGHT	4000
GROUND CONDITION	Dry	MAX. DYNAMIC DEFLECTION OF RAIL	37 "	(W/DUMMY & INSTRUMENTATION)	
		VEHICLE DECELERATION (PEAK)	Long. 10.4 G ... Transv. 19.8G		
		DUMMY DECELERATION (PEAK)	Long. 16 G ... Transv. 18 G		

Figure 5. Tests on a semi-rigid barrier of timber posts in an earth foundation are shown above.

would be that determined by the effect of temperature or the taking up of slack during repair. If an anchor must be placed in an isolated location, then it should be protected with a metal beam barrier. In order to determine the effect of a curve, a collision test was made on the outside of a 1,200-foot radius curve as shown in Figure 4. The curvature had no effect on the overall results.

The cables should be placed and maintained in a snug condition but should not be stretched enough to produce any appreciable initial stress. In order to maintain the cable in this condition, turnbuckles need to be placed about every five hundred feet so as to permit adjustment for average seasonal changes as well as provide reasonable lengths for construction and replacement.

The cable-chain link barrier is estimated to cost slightly less than half as much as the blocked out metal beam barrier. The metal beam design is estimated to cost approximately $11 per lineal foot.

The criterion used in this study for a semirigid type of barrier was a design strong enough to fulfill the barrier concept while at the same time capable of deforming into a smooth curve without "pocketing" under collision. A change of direction of the colliding car would not be as abrupt as if the barrier were as completely rigid as a concrete wall. The semirigid barrier should provide some opportunity to the occupants of the offending car to survive and at the same time permit a reflection of the car at an angle flat enough to allow following cars an opportunity for evasive action.

Nine Designs Selected

During the study period prior to actual testing, nine different designs were selected by the Median Barrier Committee for testing. These are Designs I, II, III, IV, V, VI, VII, VIII, and X on Figure 3. The results of tests of these installations led to the barrier shown on test sheet Figure 5.

General findings of the tests on the first nine designs were that the semirigid barrier height has to be above the center of gravity of the vehicle and permit the front of the impacting vehicle to bind or be entrapped under the top rail. This action tends to brake the car, hold the rail at its original elevation, and reduce the tendency for the car to roll laterally with the barrier when the posts of the system are forced back and down. If such provisions are not made, then a tendency to roll is imparted to the car as is illustrated by Figure 6. Unfortunately, it was also found that when a rail is placed high enough for the car frame and wheel to get under it, it is necessary to protect the posts of the barrier system from direct collision with the vehicle, otherwise the car frame impacts the post and is subjected to excessive decelerations such as is illustrated by Figure 7.

These two problems were solved first by placing the top rail in a position blocked out from the post at a height so that the car, no matter what the angle of collision, would have just sufficient space to force under the rail. The posts exposed below the top rail were protected by a lower rail so as to prevent the car from direct collision with the posts. Test results also indicated that steel posts mounted in concrete were too rigid for this type of barrier, that a balanced design indicated better success with the system if the more resilient action of Douglas fir timber posts in earth foundation were employed. This latter combination created a barrier system which had a good dynamic reaction within the classification of semirigidity. The overall results are shown on the test data sheet, Figure 5.

Rigid Barrier Considered

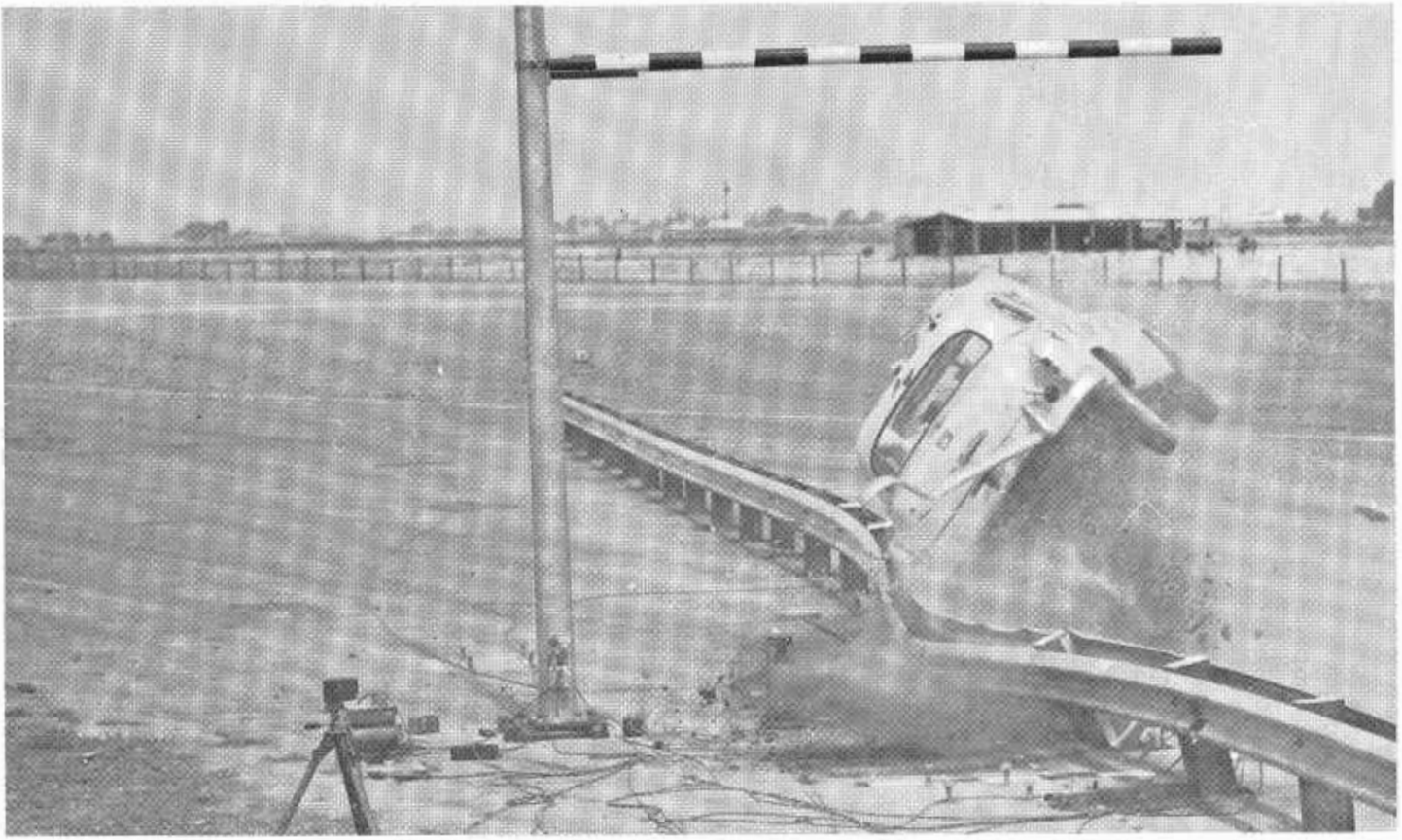
For the purposes of this study a rigid barrier was considered to be a structure that would neither fail nor measurably deflect under collision loading. During this study only one design, Design XII on Figure 3, was constructed specifically as a median barrier. However, this particular design was supplemented by information gained by dynamic tests of five concrete bridge rails performed and reported in 1955 and two such rails tested during this program. The barrier utilized for the current series was extremely light and failed during the test. However, its results coupled with the other information already referred to indicates that a successful concrete median barrier could be developed to cost about $11 per lineal foot.

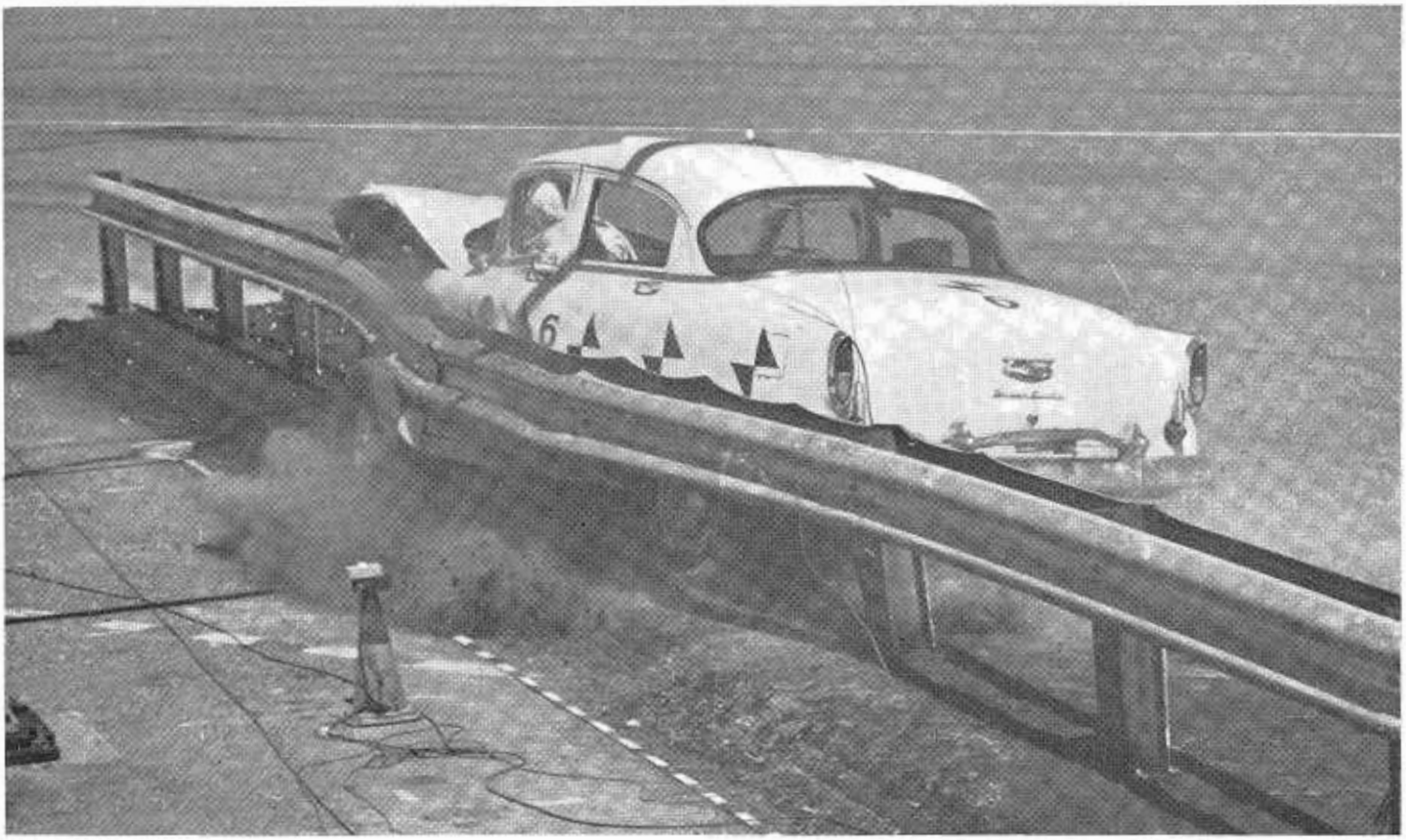
One other type of concrete median barrier was tested during this study. It is shown as Design IX on Figure 3 and consists of a series of truncated cone concrete posts placed at five-foot centers. This design was not effective as a positive barrier and so should be considered only as a deterring type of median barrier.

During this series of tests only one curb height was tested. This was the typical six-inch high Type B curb employed around many California highway median areas. However, the findings from these two tests are supplemented by some 200 previous full-scale tests performed on highway bridge curbing and so are sufficient to support firm conclusions as to the effect of curbings in front of a median barrier. At high speeds the six-inch high type of curb seems to have little or no effect on either the rise or deflection of the collision car. This is explained by the fact that wheels and springs of a car are deflected over the six-inch high curb with little appreciable change in elevation of the car itself. In other words, both the center of gravity of the car and the frame of the car maintain their traveling elevation while the raise of the curb is taken up in the deflection of the tire and the springing system of the car. This effect is only true where the travel time between the curb and the barrier is very short in that the car soon recovers its original relative elevation to the ground and due to rebound is for a short time elevated above normal. Previous studies show that where the curb is eight inches or higher, an immediate "dynamic jump" is imparted to the car. Therefore barriers behind such curbs must contain a provision to contain the dynamic rise.

Standard 4-door Sedans Used

Excluding one 34-passenger 17,000 lb. bus, the vehicles employed in this 1959 test series were standard 4-door sedans weighing about 4,000 lbs. with dummy and instrumentation. The center of gravity of these vehicles was between 21 and 23 inches above the pavement. In converting these cars for radio remote operation, the rear seat, spare tire, and gas tank were removed





UPPER—Figure 6. Tests showed that the height of a semi-rigid barrier must be above the center of gravity of the vehicle; otherwise, a tendency to roll is imparted to the car, as shown here. LOWER—Figure 7. Tests also revealed that if a rail is placed too high, the car frame and wheel may get under it and strike the post, decelerating the vehicle too rapidly, as shown here.

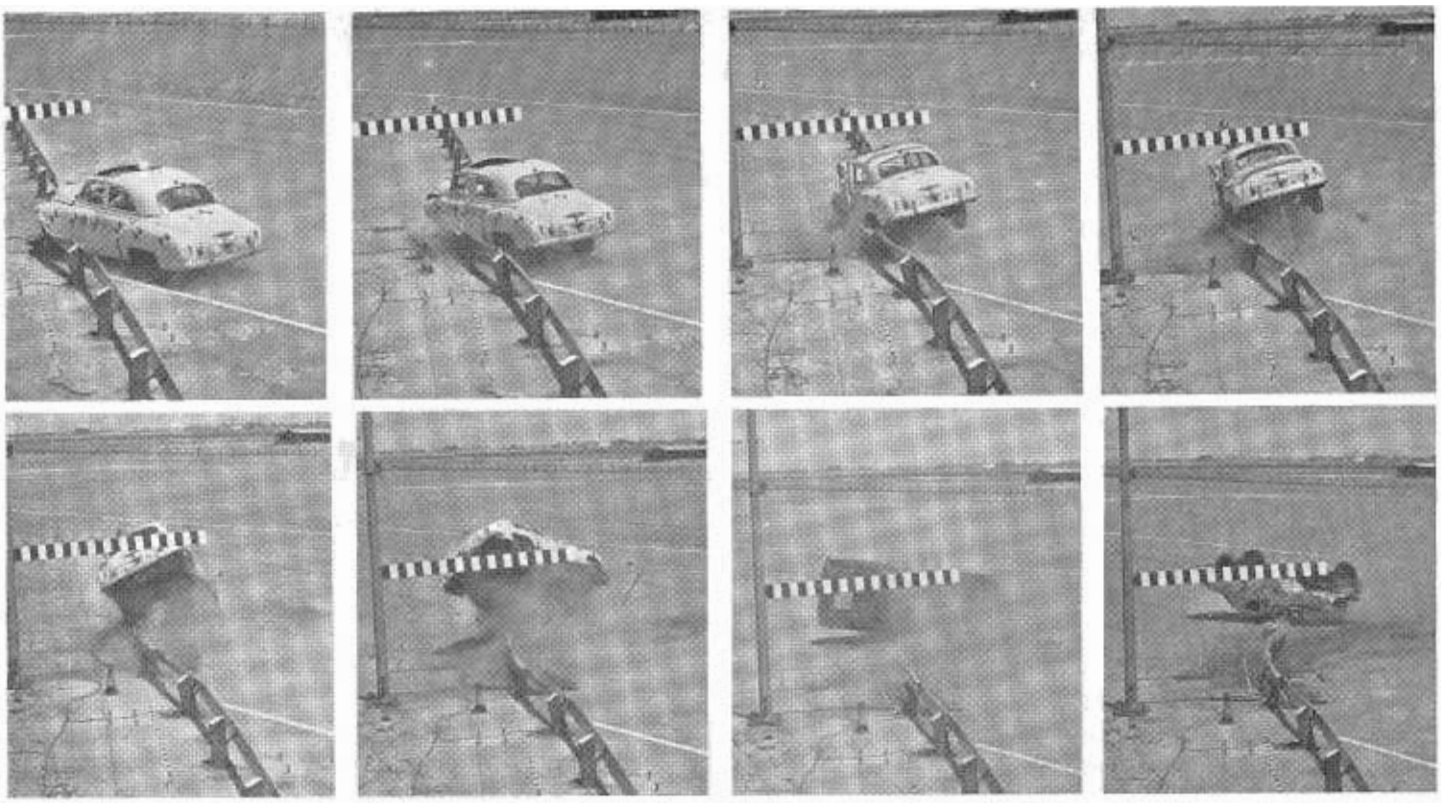


Figure 8. These photos illustrate the film strips used for test analysis. The series shows progressive positions of the test car from the first collision in the upper left corner to rest in the lower right.

and the following equipment was installed:

1. The radio control equipment for remote driving the cars was securely bolted down in the trunk compartment. Whip antennae were mounted on the rear of the vehicle.
2. A small walkie-talkie transmitter mounted adjacent to the radio control receiver rebroadcast the command signals back to the control operator following behind the crash vehicle. This feedback of signals was essential in providing the control operator audio contact with the crash car to insure that command signals were properly received and executed before the actual response of the vehicle was visible.
3. The 12-volt D.C. steering motor was attached to a mounting plate welded to the front floorboard. The motor was belt connected to an adjustable sheave on the steering wheel.
4. A motor actuated Bendix hydrovac booster was attached to the master brake cylinder.
5. The ignition system was bypassed and wired into the radio control receiver.
6. A one-gallon heavy wall gas tank was installed over the spare tire well. Safety vent and supply valves were employed to prevent fuel spillage or damage in case of fire.
7. Accelerometers mounted in the dummy and on the crash vehicle frame transmitted deceleration data to recording equipment through a coiled 300 ft. tether line connected between the crash vehicle and a close following instrument truck.
8. Two 12-volt storage batteries mounted on the rear floorboards furnished power to all control instruments and the radio equipment.

The radio control transmitter was mounted in the bed of the control truck. A special steering switch and brake switch on the dashboard of this pilot car transmitted three specific modulated tones. These tones were received through a selective relay system in the radio control receiver to steer or brake the crash test car. In case of emergency shutting off the transmitter or applying the brakes would kill the ignition in the crash car.

The crash car was placed in operation by clamping the throttle full open, placing the car in high gear, turning on the radio control transmitter which would activate the ignition, and pushing the car with a truck until the engine started and took hold. A peak speed of 58 to 62 m.p.h. on the 2,000 $\pm$ foot collision path was attained.

Camera Produces Sequence

The 70 mm. sequence camera was used to produce a documentary series which could be enlarged to examine details of the impact. The bulk of the photographs reproduced in this article were made with this camera which has proven itself a valuable tool. A sequence is illustrated by the series of stopped action photographs of one test shown by Figure 8.

During the two bus crashes an additional 200 f.p.s. camera was mounted

. . . Continued on page 55

Study Tour

Commission Has On-the-spot Look at North State Highways

Members of the California Highway Commission and engineers of the Division of Highways discuss regional highway problems with city and county officials and other leaders of the North Coast area at a luncheon at Hartsook Inn June 26th. This was one of a series of such meetings which the commission held during a 2½-day tour into Northern California counties.

—Photo by The Redwood Record, Garberville

The California Highway Commission made a 2½-day business tour into Northern California in late June after holding its formal June meeting in Sacramento.

The commission members familiarized themselves with freeway route proposals and other highway planning and inspected construction projects in Tehama, Shasta, Trinity, Humboldt, Mendocino and Sonoma Counties.

A series of similar trips is planned to take the commission to all parts of the State.

The July meeting was scheduled for Los Angeles, followed by a tour into Orange and San Diego Counties.

Robert B. Bradford, State Director of Public Works and chairman of the commission, explained the purpose of the trips.

"We want to get a firsthand impression of planning and construction and the people's ideas," Bradford said.

"Our trips will supplement the more formal procedure and ensure that we, personally and individually, keep in touch with the people and the problems."

After leaving Sacramento on the start of their northern trip, the commissioners drove north along US 99W to Red Bluff, where they split into two groups. One went north along US 99 to Dunsmuir and returned to Redding. The other reached Dunsmuir and Redding after driving over State Sign Route 36, through Lassen Volcanic National Park, and over State Sign Route 89 to US 99.

The first night of the trip the commissioners met Shasta County residents at a dinner in Redding arranged by the Redding Chamber of Commerce.

On the second day, the commissioners drove west on US 299 and stopped at Weaverville to meet with Trinity County officials and citizens. They continued on the same highway to Eureka, where they met North Coast officials and citizens at a meeting arranged by the Eureka Chamber of Commerce and Humboldt County Board of Trade.

During the afternoon of the second day, the commission members again split forces. Some inspected US 101 projects at Trinidad and Big Lagoon, while others remained in Eureka for a public meeting to hear citizens.

The commissioners toured southward along US 101 on the third day, with stops to meet the public at Hartsook Inn, Ukiah and Santa Rosa. City and county officials, chamber of commerce members, and officers of the Redwood Empire Association met the commissioners at these affairs.

Officials of the Division of Highways from headquarters at Sacramento and from district offices at Redding, Eureka and San Francisco accompanied the commissioners on their tour.

Record Award

Department's Andrew B. Schoellkopf Wins $11,808 for Money-saving Idea

Governor Edmund G. Brown has presented an $11,808 merit award check to Andrew B. Schoellkopf, an accounting officer in the Sacramento office of the State Division of Highways.

The Governor said he was informed that this "is the largest check ever given to any federal, state, city or county employee for a suggested improvement in governmental operations."

Schoellkopf, 44, received the check in a ceremony on June 15th in the Governor's office at which his family was present. Also on hand were Director of Public Works Robert B. Bradford and Assemblyman Thomas J. MacBride of Sacramento.

Schoellkopf's suggestion called for legislation making the State Treasurer trustee for all counties in condemnation proceedings instituted by state agencies.

Under the legislation, sponsored by MacBride and approved in 1957, the amount of cash ordered deposited by courts in the condemnation proceedings is placed with the State Treasurer with accompanying instructions that he invest the money in securities with the resulting interest to revert to the State.

Until this legislation went into effect, the money was deposited with the clerks of the courts involved and there was seldom any interest on the money during the frequently protracted proceedings.

In the first year the legislation was in effect, the resulting gain in net interest earnings to the State was $140,176. With increasing interest rates, it is anticipated that the annual amount will be sharply increased in the future.

Schoellkopf received an initial award of $150 from the Merit Award Board. The additional check given him today is based on a sliding scale governing awards dealing with the savings of large sums in state operations.

Governor Edmund G. Brown presents Andrew Schoellkopf (left) the record $11,808 check for his Merit Award suggestion as Assemblyman Tom MacBride (center) beams approval.

Both houses of the Legislature approved a resolution authorizing the payment.

Marvin L. Blanchard, Chairman of the State Merit Award Board, said 16 other state employees are scheduled to receive additional awards this year.

Schoellkopf lives in Sacramento with his wife, Bernice, and two children, Andrew B., Jr., 6, and Nancy, 4. He has been employed by the Department of Public Works in the Division of Highways for 22 years.

"Mr. Schoellkopf's achievement has brought the State and himself substantial financial rewards," the Governor said. "I hope it also serves as a reminder to all of us that we should never accept the idea that there isn't some better way of doing almost anything being done in State Government.

"If we are alert, we can and will find hundreds of ways to improve state operations, to reduce expenses and to realize substantial savings for the taxpayers."

Director of Public Works Robert B. Bradford said in his congratulatory letter to Schoellkopf:

"It was a proud occasion for all Department of Public Works employees when Governor Edmund G. Brown presented you with the $11,808 award. All of us, all 14,000 of us, were glad that it was one of our fellows who contributed an idea that will annually earn for California taxpayers well over $100,000.

"Your suggestion alone would prove the value of California's merit award system. But your suggestion is only one of thousands which state employees make every year as their individual and personal contributions toward improved efficiency and economy in government. The total effect of all the employee suggestions is the significant strengthening of California's State Government."

The new west approach to the I Street Bridge across the Sacramento River at Sacramento was reopened to traffic on July 3d, six weeks ahead of schedule.

McCoy Honored

Legislature Lauds Career of State Highway Engineer

RESOLUTIONS honoring State Highway Engineer G. T. McCoy were adopted unanimously by the State Senate and Assembly in the closing days of the 1959 Regular Session of the Legislature.

Occasion for the resolutions is the impending retirement of McCoy, who will reach compulsory retirement age this fall.

The Assembly's Resolution No. 346 was introduced by Assemblyman Vincent Thomas of San Pedro and the Senate Resolution, No. 168, by Senator Randolph Collier of Yreka. Both resolutions take note of the growth and progress of the California highway program during McCoy's 16-year tenure as State Highway Engineer, and both call attention to the nationwide professional honors he has received.

Text of House Resolution No. 346, introduced June 9th, and adopted June 17th:

"WHEREAS, It has come to the attention of the Legislature that George T. McCoy, State Highway Engineer, is within a few months of attaining compulsory retirement age after a distinguished engineering career extending over 44 years in the public service, 32 years of it in the service of the State of California; and

"WHEREAS, Mr. McCoy has served as State Highway Engineer and Chief of the California Division of Highways since 1943, during which period he has been responsible for the expenditure of more than two and a half billion dollars in the construction, maintenance and operation of the State Highway System; and

"WHEREAS, Under Mr. McCoy's strong and capable leadership the highway program of the State of California has attained a position of widely acknowledged pre-eminence throughout the Nation and the world, particularly in the development of freeways and other modern contributions to the economy, efficiency and safety of motor vehicle transportation so essential to the growth and welfare of the State; and

"WHEREAS, Mr. McCoy has been accorded nationwide professional recognition and honor, including his election in 1954 as President of the American Association of State Highway Officials and his selection by that association in 1958 as the recipient of the Thomas H. MacDonald Award for outstanding achievement in the development of highways, reflecting great honor on the State of California and its highway program; now, therefore, be it

"*Resolved by the Assembly of the State of California*, That the Members of the Assembly of the State of California do hereby express to George T. McCoy the gratitude and appreciation of the people of California for his accomplishments in the field of modern highway transportation and their heartiest wishes for a long and enjoyable retirement; and be it further

"*Resolved*, That the Chief Clerk of the Assembly be directed to transmit a suitably prepared copy of this resolution to George T. McCoy."

Text of Senate Resolution No. 168, introduced and adopted on June 17:

"WHEREAS, The Members of the Senate have learned of the anticipated retirement in September 1959, of the Chief of the California Division of Highways, George T. McCoy; and

"WHEREAS, Mr. McCoy, who was born in Milton, Oregon, on September 12, 1889, spent his early life in the northwestern states, completing his education in engineering at Whitman College, and Columbia University in New York City; and

"WHEREAS, His professional abilities won early recognition with his first major assignment as assistant engineer on bridge and dam construction and highway relocation in connection with the $300,000,000 Catskill Aqueduct; and

"WHEREAS, Returning to the Pacific Northwest in 1916, Mr. McCoy held various positions with Washington, North Dakota, and the United States Bureau of Public Roads before coming to work for the State of California in 1927; and

"WHEREAS, During the succeeding years his exceptional administrative ability resulted in rapid advancement in the California Division of Highways, until in 1943 he was named Chief of the Division by Governor Earl Warren's Director of Public Works, Charles H. Purcell; and

"WHEREAS, As State Highway Engineer for the past 16 years, George McCoy has been in charge of the vast expansion of the State Highway System representing the expenditure of some $2,500,000,000, and involving the construction of 2,300 miles of multilane divided highways; and

"WHEREAS, He has accomplished this tremendous task with commendable speed and efficiency, winning an enviable reputation throughout the states as a top ranking highway engineer and administrator; and

"WHEREAS, His accomplishments were accorded nationwide recognition on December 1, 1958, when the American Association of State Highway Officials conferred on him the Thomas H. MacDonald Memorial Award for outstanding service in highway engineering; now, therefore, be it

"*Resolved by the Senate of the State of California*, That the members take this opportunity to commend George T. McCoy for his long and distinguished career in public service, and to extend their sincere and hearty good wishes for his future health and happiness; and be it further

"*Resolved*, That the Secretary of the Senate is directed to transmit a suitably prepared copy of this resolution to Mr. McCoy."

Benicia-Martinez Bridge Bonds Sold

The California Toll Bridge Authority has sold $34,000,000 revenue bonds to finance construction of the Benicia - Martinez Bridge and approaches.

The bonds were sold July 28 to F. S. Smithers and Company and Associates, New York City.

Low bids totaling $14,238,485 for construction of the bridge substructure and superstructure were received July 22 and 23 by the Division of Highways. The bids on these two largest units of the Benicia-Martinez project totaled about $9,000,000 under estimates.

As a result, it will be possible to go ahead with construction of freeway approaches under bond financing, as originally planned, instead of delaying work on the approaches pending availability of federal and state highway funds.

Total estimated cost of the entire project, including the freeway approaches, is now approximately $29,000,000. Upon completion of the project, the surplus remaining from the $34,000,000 bond money will be available for the bond reserve fund.

California Again Is Top Vehicle State

California again topped all other states in motor vehicle registration last year, according to figures released by the United States Department of Commerce.

A total of 7,013,163 vehicles was registered in California in 1958. This is more than 10 percent of the national total of 68,229,408.

New York had the second highest registration, with 4,876,748. Texas and Pennsylvania also had more than four million. Illinois, Michigan and Ohio had more than three million vehicles, and the totals for New Jersey and Florida were over two million. The nine leading states combined had 51 percent of the national motor vehicle registration total.

Delaware, Nevada, Vermont and Wyoming had fewer than 200,000 vehicles each.

The national percentage gain from 1957 to 1958 was 1.7 percent. California registrations increased 2.7 percent.

Veteran Nevada City Road Foreman Retires

Walter M. Barnes, highway foreman in the Nevada City maintenance territory, retired June 30th after nearly 37 years of service with the Division of Highways.

Barnes began his state service in September, 1922, at Colfax and was made a highway foreman in June, 1923, at Colfax. Succeeding years found him working at Alta from April, 1926, to November, 1926, and returning to Colfax in November, 1926. He also served as foreman at Yuba Gap for a period of seven months in 1941. During his lengthy career, Barnes has work on the three different highways from Auburn to Colfax and has served under nine maintenance superintendents.

Barnes has three daughters, two sons, and 12 grandchildren. He also has two brothers in state service—one with the Department of Employment in Sacramento and the other with the Division of Highways at Antioch.

His plans for retirement include some traveling and hunting.

Newspaper Defends Department's Method, Motives in Acquiring Land for Freeways

The following editorial appeared in the Long Beach Press-Telegram of June 17, under the title "Some Must Sacrifice When Roads Are Built":

"A RECENT story in this newspaper aired some of the problems and protests of citizens whose homes are affected by the routing of the San Diego Freeway through this community.

"We sympathize with all who suffer hardships caused by freeway construction. But we think the public, instead of jumping to emotional conclusions, should consider why these actions against private properties occur.

* * * * * * *

"THE CURRENT complaints are not the first of their kind, and they will not be the last. Obviously the Division of Highways doesn't go around seizing property out of some warped urge to displace comfortably-housed citizens. The property is taken in the name of and for the welfare of the people of California.

"The right of government to take the land it requires for the development of public services is so well-established that it need not be defended.

"Freeways are a public service. Freeways—including the San Diego Freeway—are not imposed upon the public but result from public demand for swifter, safer facilities for the handling of California's enormous flows of traffic.

"By the year 1980, this State will have a population of about 31,000,000 people operating about 17,000,000 motor vehicles at a rate of 200,000,000 vehicle-miles annually. This traffic will require freeways and more freeways. The projected freeway system, according to the Joint Interim Committee on Highway Problems, will save 30,000 lives by the year 1980. The reduction of highway fatalities by 60 to 75 percent would seem a persuasive argument in favor of freeway construction, even though such construction may inconvenience some property owners.

"The process of planning a freeway and obtaining the property in its path is not a sudden, ruthless, and unpublicized one.

"First, the need is determined. Then the public is informed of tentative plans. Adequate hearings are conducted before a route is adopted. After that, the state determines ownership of the lands which are needed, and those lands are appraised by professional appraisers. The State tries to negotiate with the property owners—and in most cases is able to do so satisfactorily. Only in a small number of cases is it necessary to condemn the property in question.

"Property owners near the freeway route wonder, of course, what the freeway will do to property values in the area. The Division of Highways reports:

" 'Resale prices on homes next to freeways follow a pattern similar to that on comparable homes elsewhere in the same tract. Interviews with people living alongside freeways showed that to 5 out of 10 the freeway location made no difference, 3 out of 10 preferred their location and 2 out of 10 did not like it. Noise and fumes from free-flowing traffic on a freeway are much less noticeable than from ordinary stop-and-start traffic.'

"A large percentage of homes in any tract have been purchased through GI loans. When such homes are purchased by the State, GI loan privileges are restored to the owner and can be used for purchase of other property.

* * * * * * *

"SO, THE ACQUISITION of freeway rights-of-way is certainly not a process of sudden, inconsiderate eviction of families from their property. It is a considered, slow process based on public need, with adequate compensation granted by negotiation or, if the owner chooses, through court decision.

"As the State grows and the freeway system expands, many thousands of California citizens will find their property affected by state action. An understanding of the basis of the State's demands will make it easier for all concerned."

Sign Washing

Special Crew Keeps Large Freeway Signs Spic and Span

A RAPIDLY growing function of the maintenance department in District VII is the cleaning of freeway signs.

The 280 miles of freeways and expressways completed to date by the Division of Highways in Los Angeles, Orange and Ventura Counties contain more than 500 separate sign structures. Each sign structure supports from one to three signs, depending upon location and design. The signs vary in size from 40 inches to 120 inches in height and from 10 feet to 36 feet in length.

The location of the sign governs to a certain extent the frequency of desirable cleaning. Experience indicates that the average sign should be cleaned annually. However, since sign washing is an item of work that can be deferred in favor of other more urgent items, our cleaning program sometimes includes only the most critical installations.

The equipment presently in use in this district consists of tower trucks, a 300-gallon sign washer, and two types of personnel lifts. Each piece of equipment is specialized and is used at specific locations.

Cleaning in progress on one of the later model overhead signs with a catwalk, this one on the Harbor Freeway.

Normally, a two-man crew is sufficient for washing most of our signs; however, additional manpower and equipment are required at certain locations to provide for traffic control or flagging. On our newer type sign bridges where catwalks, drain spouts, and drip pans are in place, washing may be performed with little or no interference to traffic. On sections where it is necessary to close the outside lane of traffic, we may work only in the off-peak hours. Cones and high level warning devices are set out approximately 500 feet to 750 feet in advance of the work to transition traffic out of the closed lane. On sections where the inside lane, or lanes, must be closed in order that signs may be washed, this work must be performed in the period having the lowest traffic volume. Old type sign bridges and signs mounted on the face of overhead or separation structures, are typical of the type mentioned above. In these areas we perform this work on Sundays between daylight and approximately 9 a.m. when traffic can be funneled into one or two lanes. Local police departments or the California Highway Patrol are always notified in advance of this type operation and one or more officers are specifically assigned to work at the area in question.

Long Life Span

All of our overhead signs and most of our ground-mounted signs are made of porcelain enamel on either iron or aluminum sheeting and are reflectorized by means of acrylic plastic reflex reflectors or are illuminated by fluorescent electric lighting tubes. This type of sign has an anticipated life of over 20 years if not damaged by vandalism or by accident. This material will not be damaged or its life shortened by any standard cleaner that we have found available on the market.

The illuminated signs when new had a contrast factor of approximately 25 to 1 (measured in foot lamberts with a spectra brightness meter). Light readings have been taken on extremely dirty black and white signs and found to have a contrast factor as

low as 6 to 1. On some of these signs we have merely washed the white lettering with a good glass cleaner. Although the daytime appearance has been very favorable we find in checking these signs with the brightness meter that we have not improved the nighttime visibility to any appreciable extent. Therefore, on the basis of the above, it would appear to be mandatory that the entire sign panel and particularly the background surface, be cleaned. We have found that by using a wet method—detergent and water—that we can do an effective cleaning job at the rate of 5 to 10 square feet per minute. This rate, however, is influenced by the amount of dirt on the sign, type of traffic encountered, traffic controls required, etc. Using the dry method—namely, with a paste or liquid applied directly to the panel and then wiped off by hand, we can do approximately two square feet per minute. While this method is more costly, it definitely does a superior job when used on those signs which are subject to the collection of diesel smoke or other foreign material. Actually it is the only satisfactory method we have found to date.

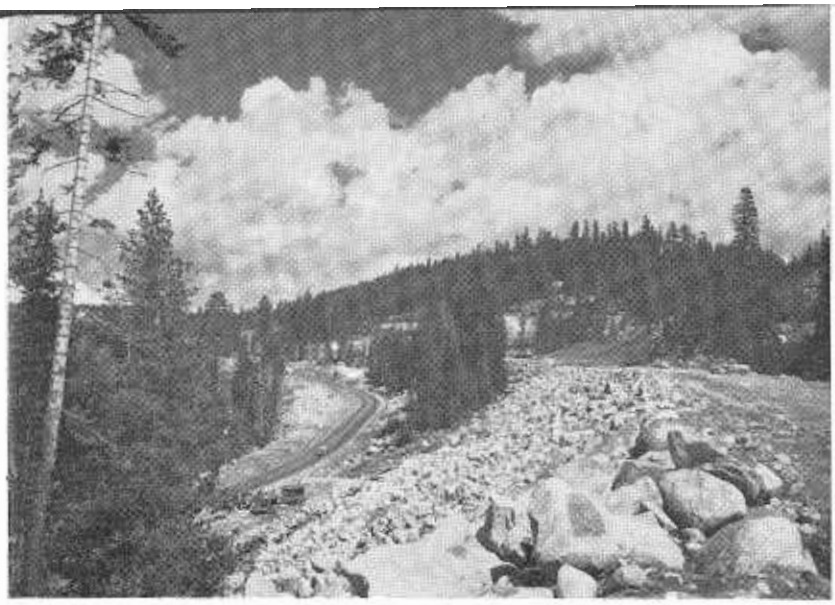
UPPER—On sections where an inside lane must be closed to wash signs, the work is done during a time when traffic is light, usually from daylight to 9 a.m. on Sunday. A flagman is always used to afford further protection to the men and equipment. LOWER—Signs such as this one on the Cahuenga Pass section of the Hollywood Freeway are cleaned from a tower lift on a truck parked on a paved shoulder.

New Crews Necessary

The washing of ground-mounted reflectorized signs is most effectively accomplished by means of a wet method—namely, mechanically washing with a standard detergent.

When considering the large number of ground-mounted and overhead signs in this district in conjunction with information gained from our sign-cleaning studies, it would appear that it will be necessary in the near future to establish a special two-man crew to handle this item of highway maintenance. They, of course, would be supplemented by additional men when required for more efficient operation. This crew will require a ladder truck and our present sign washer. The personnel lift, tower truck, and other specialized equipment normally utilized by our Signal Maintenance Department will also have to be made available when not in other emergency use.

Based on past experience, we would expect that this crew would wash every sign on our present freeway and expressway system, both ground-mounted and illuminated, at least once a year and in addition would be able to clean the problem signs at more frequent intervals when required.



Report From District III

By ALAN S. HART, District Engineer

DISTRICT III is in full swing on another construction season with a heavy current program and a large carryover from the past year. A major portion of the work is on US 40 in the higher elevations. Weather conditions shorten the construction season and every project of any magnitude requires two full seasons of favorable weather.

Major contracts started during the past construction season, having a value of $50,491,000 are being continued and are expected to be completed this fall. The current program covering projects valued at $41,671,000 is progressing rapidly with the various units either under contract or ready for advertisement. Some of these improvements will require more than one construction season to complete.

PHOTOS UPPER LEFT—Looking east at freeway construction on US 40 east of Kingvale in Nevada County. The present highway is on the left. UPPER RIGHT—Construction on US 40 near the Magra Overhead in Placer County showing the present highway (left) and the Southern Pacific Railroad tracks (right).

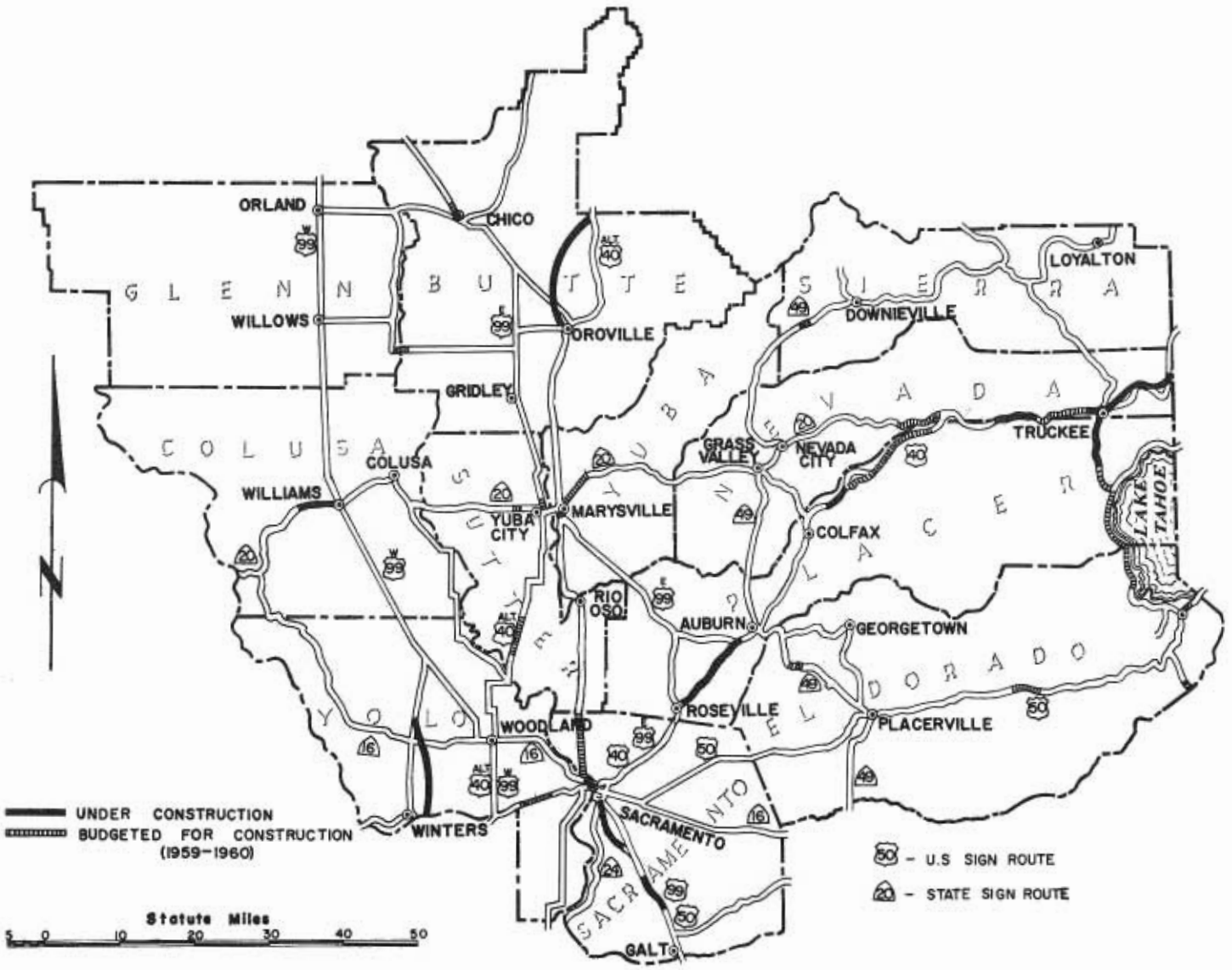
US 40

This season will see nine major projects underway in the conversion of US 40 to full freeway status. Eight of these projects are east of Sacramento. Five of these improvements, providing a total of 37 miles of four-lane divided freeway, are scheduled to be completed during this construction season.

The only major project on US 40 west of Sacramento in District III is the conversion of the four-lane divided expressway to a six-lane full freeway from the Solano county line to Swingle, just west of the Yolo Causeway. Bids were opened on this project on June 10, 1959, and A. Teichert & Son of Sacramento submitted the low bid of $2,083,222. Work is now getting into full swing and the project is expected to be completed during the 1960 construction season.

A public meeting was held in Sacramento on January 14, 1959, to discuss the East-West Freeway route through Sacramento. This project is the largest and probably the most important in the district involving the crossing of the Sacramento River, the access to the downtown area of Sacramento, the junction of the projected Woodland-Grapevine Freeway and the junction of US 40, US 50, and US 99. Because of the complexity and magnitude of the problem, additional meetings will be necessary prior to adoption of a route in this section.

On June 12, 1959, a public meeting was held in North Sacramento covering the proposed conversion of the North Sacramento Freeway from the existing four lanes to eight lanes between Arden Way and El Camino Avenue and to six lanes between El Camino Avenue and Marconi Avenue. The interchanges at Arden Way and El Camino Avenue will be improved with additional ramp facilities and detailed plans will be developed upon execution of the revised freeway agreement. No alignment changes are involved.



Public Meeting Held

The section from Roseville to one mile east of Newcastle, entirely on new alignment, and extending for 11.1 miles is under contract to A. Teichert & Son of Sacramento at a bid price of $6,946,992. The estimated date of completion is December 1, 1959. When opened to traffic, this section will complete a full freeway from Sacramento to Auburn.

A public meeting was held in Auburn on May 7, 1959, to discuss the conversion of the existing four-lane divided expressway between Auburn and Heather Glen to full freeway status, and details are being worked out on the freeway agreement with Placer County.

Between Heather Glen and Magra, west of Gold Run, projects were completed in 1958 bringing this area to full freeway status except for one future interchange structure at Illinoistown.

From Magra to 0.5 mile west of Monte Vista a four-mile full freeway project is under contract to Fredrickson & Watson Construction Company and Ransome Company of Oakland at a bid price of $2,617,777. Completion is anticipated by September 1, 1959.

Between Monte Vista and Baxter, a project to provide 5.1 miles of full freeway has been advertised for bids, to be opened in Sacramento August 19, 1959. The 1959-60 Budget contains $5,000,000 for this project with additional financing to be provided in the 1960-61 Budget.

Alignment Is Changed

From Baxter to one mile west of Emigrant Gap a 7.1-mile section of full freeway is under contract to A. Teichert & Son of Sacramento at a bid price of $4,787,742. This project diverges from the existing route through a part of its length and will accommodate eastbound traffic on the new alignment through this particular portion. Westbound traffic will utilize existing alignment which encompasses Airport Grade, one of the most troublesome snowdrift areas in the district.

From one mile west of Emigrant Gap to Hampshire Rocks 11.5 miles

are in the design stage, and will be scheduled for freeway construction in future budgets.

Between Hampshire Rocks and Soda Springs a six-mile full freeway project is under contract to Clyde W. Wood & Son, Inc., Kirst Construction Company, and Alwood Corporation at a bid price of $5,052,434. The project has an estimated completion date of November, 1959.

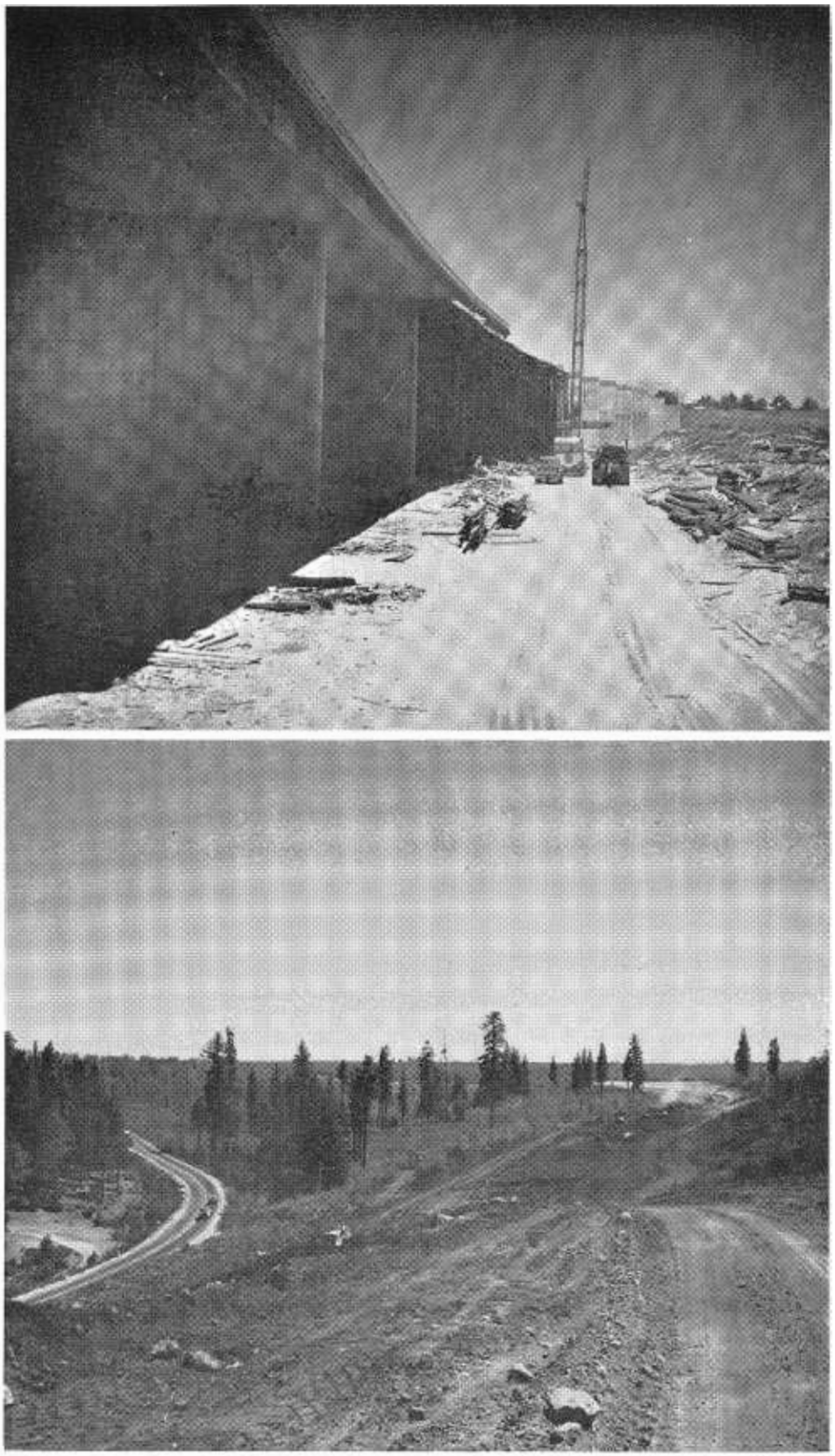
Completion of this section will be a distinct improvement for all traffic. It replaces the Kingvale Grade where high elevation with its consequent power loss and curved alignment through rugged terrain made passing of slow moving vehicles difficult and resulted in long queues. During stormy weather this section has the heaviest chain control use. The new facility with full four-lane freeway pavements and broad surfaced shoulders will greatly improve all driving conditions.

From Soda Springs to the east end of Donner Lake, a 10.1-mile section, estimated at $18,000,000 is complete as to plans and right-of-way certification. It will require three construction seasons to complete the project for which a budget item of $7,500,000 was included in the 1959-60 Budget for the first season of work. This project is all on new alignment and crosses the summit approximately 1½ miles north of the present "Donner Summit."

One of the more serious problems on the existing summit is wind currents which create snow eddies during winter months, reducing visibility to zero and requiring stopping of traffic until the eddies subside. A wind current study made over a considerable period indicates that the new location will almost eliminate this problem.

Business District Bypassed

From the east end of Donner Lake to Boca, an 8.8-mile full freeway project is under contract to Fredrickson & Watson Construction Company and Ransome Company of Oakland at a bid price of $7,620,605. The project, when put in service at the expected completion date of November, 1959, will provide a bypass of the business district of Truckee where serious congestion has been a problem for several years.



UPPER—Work progresses on the new Yuba River Bridge at the south city limits of Marysville on U. S. Highway 99E. LOWER—A view of freeway construction looking eastward from near the foot of Airport Hill in Placer County. Present US 40 (left) will serve as the westbound lane of the new freeway. The eastbound lane is under construction (right).

From Boca to Floriston, a 6.7-mile section of full freeway is under contract to Isbell Construction Company of Reno, Granite Construction Company of Watsonville, and Gordon H. Ball & Gordon H. Ball, Inc. of Danville at a bid price of $7,325,011. The estimated completion date is October, 1959. Because of the rugged terrain on the eastern portion of this project and the traffic problems presented during construction, a detour, 2.8 miles in length from 0.8 mile east of Hirschdale to 0.8 mile west of Floriston, was constructed by H. Earl Parker, Inc. of Marysville, at a cost of $472,800 and has been in use for a major part of this season and last season.

The 5.4-mile section from Floriston to the state line was completed in the fall of 1958 by Gibbons & Reed of Salt Lake City at a cost of $4,976,000. This particular section was constructed without detours and required planned delay to all traffic. Comfort stations were provided at the control points and over 275,000 copies of a brochure entitled "Sorry You're Delayed" were distributed to the waiting motorists during the two construction seasons that the delays were invoked. A surprising aspect of this situation was that very few of these brochures were tossed out of the vehicles after being read. It appears that practically every copy was kept for souvenirs or for future reference by the motorists.

US 50

Several factors have given US 50 a fast-growing importance in District III. The unprecedented growth at the south shore of Lake Tahoe is attracting a large year-around population. The summer vacation attraction has long been recognized, but the more recent development of winter sports is bringing a major traffic stream to the route throughout the entire year. Closer to Sacramento, the development of Mather Air Force Base, Douglas and Aerojet General have magnified the problem. The mushrooming of subdivisions to serve the rapidly increasing employee population of these facilities is developing a constantly increasing traffic problem.

A freeway route has been adopted between Brighton and Nimbus and plans are being prepared for a project to be included in a future budget. The current budget contains an item for an interchange at Nimbus and plans are in preparation for advertising in the near future.

The intersection of Latrobe Road just east of the Sacramento-El Dorado county line was improved by removal of a cut bank to improve visibility by Contractor P. J. Moore, of Sacramento at a cost of $5,320, completed May 8, 1959.

The truck passing lane on Clarksville grade was lengthened over the crest of the grade and the Bass Lake Road intersection was improved under a contract to Reichhold & Jurkovich of San Pablo for $22,544. Work was completed April 24, 1959.

A contract was recently awarded to P. J. Moore to provide truck stopping lanes at the El Dorado railroad grade crossing. The bid price was $9,168 and the work is expected to be completed in August, 1959.

The U. S. Bureau of Public Roads is constructing a 1.8-mile section between Fresh Pond and Pacific House at a cost of $1,000,000. The contractor, Piombo Construction Company of San Carlos, hopes to complete the project late this fall.

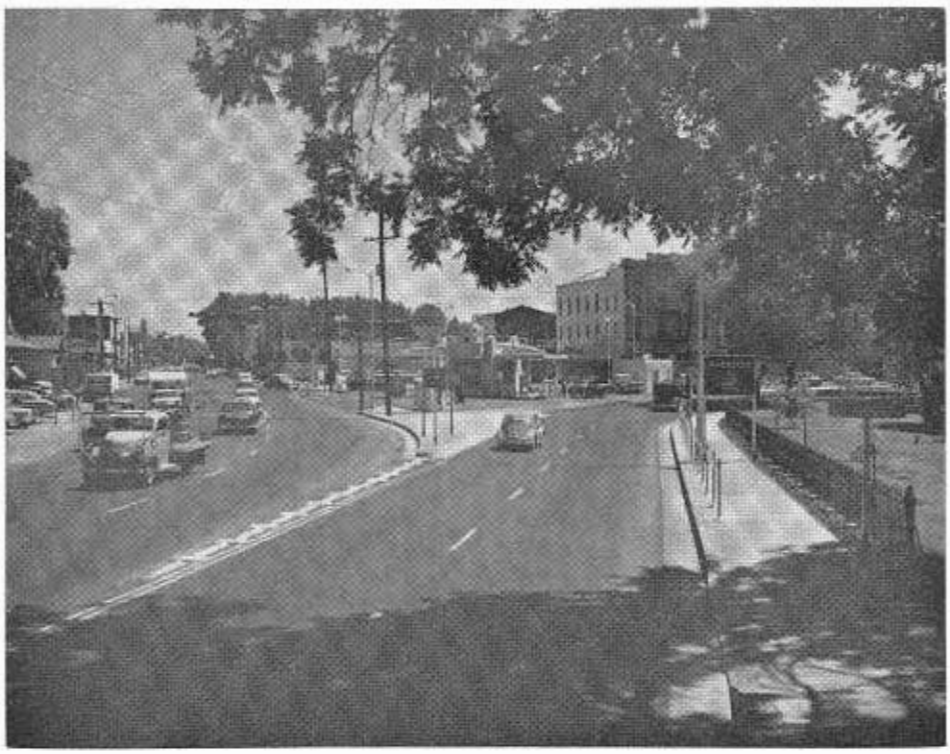
A California Highway Commission hearing was held on May 19, 1959, on the proposed freeway route between Meyers and State Line. Adoption of the route will be considered after review of the transcript of the hearing.

As an interim project the existing route between Mays and Globins is being widened to a 64-foot section under a contract to Harms Brothers in the amount of $371,348. The anticipated completion date is October 1, 1959.

US 99

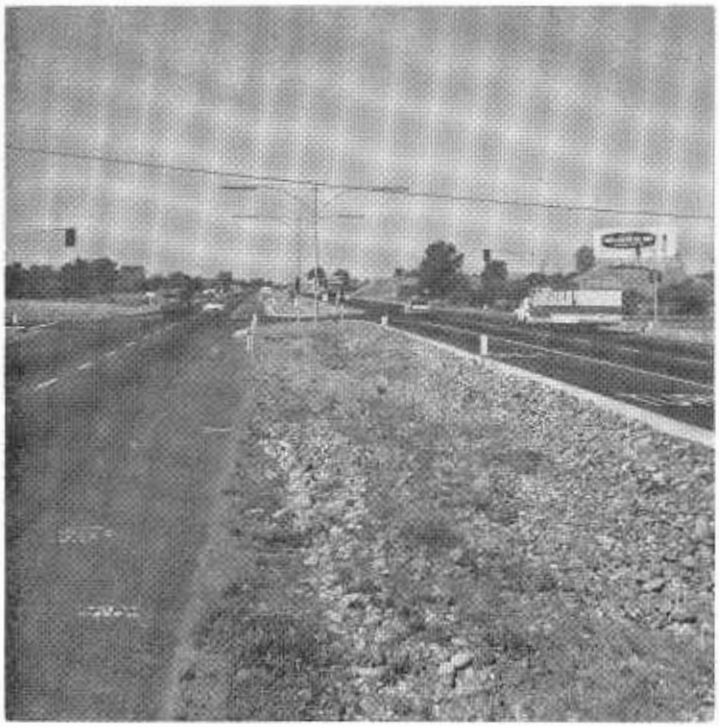
The reconstruction of the southbound lanes between 1.8 miles south of Cosumnes River and 0.2 mile south of Elk Grove Road was completed by Brighton Sand & Gravel Company of Sacramento at a cost of $829,310 for the 5.8 miles. It was opened to traffic on June 10, 1959 and completed US 99 to full freeway from the San Joaquin county line to 1.8 miles south of Florin Road.

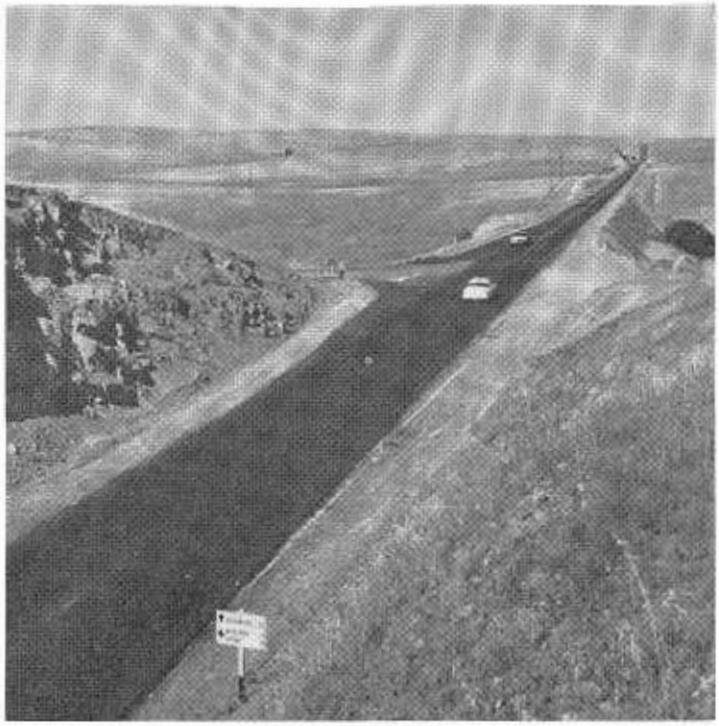
From 1.8 miles south of Florin Road to Broadway in Sacramento, a contract covering the various structures is in progress. The contractor is Lew



Looking southward along Main Street in Chico showing the beginning of the one-way couplet which takes US 99E traffic through the city.

This scenic photo of State Sign Route 89 in Placer County (looking north) was taken near Cabin Creek, two miles south of Donner Creek Underpass.





Improvement of intersections is an important part of the district construction program. Typical of these are (left) the Nimbus Intersection, an interim improvement east of Sacramento on US 50 which will eventually be replaced by a full freeway interchange and (right) the Latrobe Road intersection, also on US 50, where part of a hill was removed near the highway to give better sight distance to motorists.

Jones of San Jose and Brighton Sand and Gravel Company at a bid price of $1,954,023. The expected completion date is September, 1959. Paving will be provided as a future project.

US 99E

The current budget contains $120,000 to improve Washington Street in Roseville between the Seawell Underpass and Grove Street. The project includes construction of an overcrossing, closing of Church Street and signalization of Main Street. Plans are complete and early advertising is expected.

The Yuba River Bridge at the south city limit of Marysville is under contract to R. M. Price Company of Pasadena at a bid price of $3,205,968. It appears possible that the contractor will complete the work prior to the time limit of May, 1960.

In Yuba City, Brown-Ely Company have a contract to widen Live Oak Road (99E) from Colusa Avenue to 0.8 mile northerly, at a bid price of $179,821. The estimated completion date is July 24, 1959.

Between Big Chico Creek in Chico and 0.3 mile north of Lindo Channel, A. Teichert & Son of Sacramento have a contract to widen the esplanade to a 4-lane divided roadway with lighting and traffic signals, at a bid price of $490,740. The estimated completion date is December, 1959.

The same contractor recently completed a contract covering widening of the bridges over Big Chico Creek and Little Chico Creek, improving channelization and traveled way and installing traffic signals at a cost of $206,692 to provide one-way couplet through the business section of Chico on Main Street and Broadway. A unique feature of this project is the radio interconnection of the entire signal system which was put in service April 5, 1959. The traffic signals on the esplanade will be equipped with radio receivers to extend the system to full radio interconnect coverage. The signals and lighting are a participating project in which both the City of Chico and Butte County are paying their proportional share.

US 99W

Plans are prepared for the widening of Main Street in Woodland from Walnut Street to West Street. The current budget contains an item of $110,000 for this project and advertising is expected in the near future.

Studies are well along and several public meetings are being planned for freeway development of US 99W between Woodland and Willows. From Willows to the Tehama county line, the freeway route has been adopted and design work is in progress.

Legislative Route 90

A portion of the Vacaville-Dunnigan Cutoff, Interstate 5W, is under contract to Gordon H. Ball, Inc. of Danville at a bid price of $1,392,945 to construct two lanes of a future 4-lane divided freeway for a distance of 13.9 miles from the Solano county line northerly. The structures and grading were done under a previous contract to the same firm. The expected completion date is late November, 1959.

US Alternate 40

A project covering a new bridge across Cache Creek north of Woodland is included in the current budget under an item for $180,000. Bids were received July 15, 1959.

This large benched cut on US 40 Alternate in Butte County is located just south of the future location of the new West Branch Bridge.

Between 0.5 mile north of Robbins and the Sutter Causeway, a 5.1-mile section of 40-foot all-paved roadway will be constructed by A. Teichert & Son at a bid price of $331,849. Bids were opened June 24, 1959 and work is expected to be under way immediately with a completion date of November, 1959.

The 13.7-mile relocation project between Wicks Corner and Jarbo Gap, under contract to McCammon-Wunderlich Company for $7,292,214, is practically finished, with a completion date of August 1, 1959. The West Branch Bridge and the section from Oroville to Wicks Corner, however, are awaiting financing as part of the Feather River Water Project.

State Sign Route 16

The west approach to the Eye Street Bridge in Broderick was opened to traffic on July 3, 1959, several weeks ahead of schedule. This project, constructed by Stolte, Inc. of Oakland at a bid price of $344,451 replaced the narrow approach that featured a sharp S turn at the top of the ramp. Traffic was necessarily detoured over the four-lane Tower Bridge, creating considerable congestion on both the bridge and Capitol Avenue with vehicles exceeding 60,000 per day. Cooperation from the Southern Pacific Railroad, the Sacramento Northern Railroad and river traffic as well as the City of Sacramento during peak periods eliminated stopping of this extra heavy traffic and facilitated the peak flow.

State Sign Route 20

A five-mile section from Williams westerly was improved to a 32-foot all-paved section under a contract with M. J. Ruddy & Son of Modesto at a bid price of $341,495. The work was completed in the latter part of May.

The bridge over the Wadsworth Canal west of Yuba City is being widened under a contract with Lester L. Rice and Sons, Inc., of Yuba City at a bid price of $176,696.

Portions of the section between Marysville and Dry Creek were resurfaced by Baldwin Construction Company of Marysville at a bid price of $32,975. Work was completed June 11.

A 7.9-mile section from Steep Hollow to the junction with US 40 is now under contract to Granite Construction Company at a bid price of $73,957.

A bridge over Slack's Ravine east of Smartville is being reconstructed under a contract with Power-Mullin Construction Company of Palo Alto at a bid price of $24,845.

State Sign Route 24

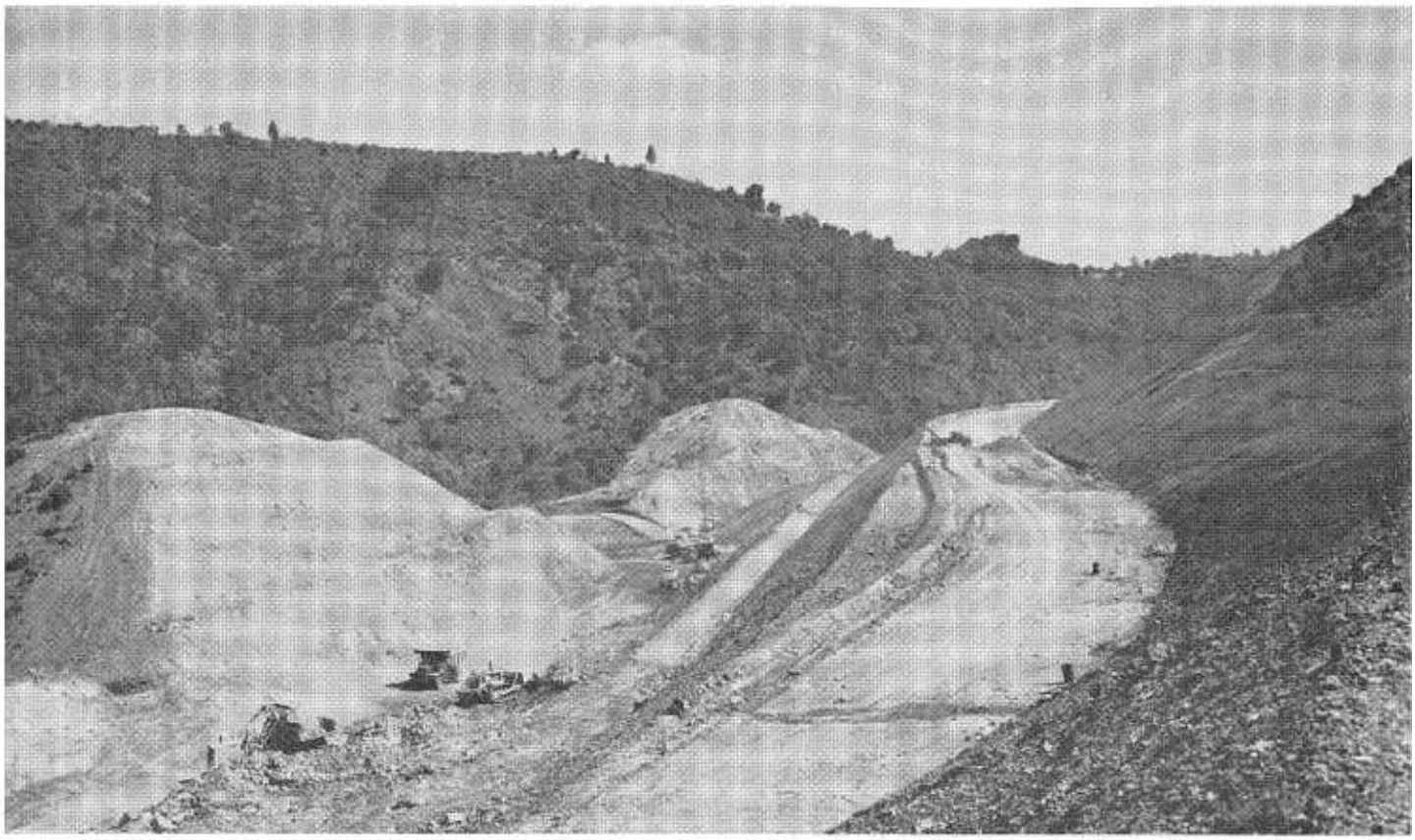
A project to reconstruct base and surface on a 7½-mile section in Sacramento County from Garden Way to the Sutter County line under a budget item of $450,000 has been advertised with bids due July 15.

State Sign Route 45

A 2.1-mile section south of Grimes is being reconstructed under a contract with Flores & Perry of Hanford at a bid price of $141,759. The bids were received June 24, 1959. Completion is expected October, 1959.

State Sign Route 49

The current budget contains an item of $250,000 to reconstruct and widen a 2.4-mile section between Pilot Hill and Hastings Creek in El Dorado County. Bids were opened July 8, 1959. Another budget item of $80,000 is designated for reconstruction and widening between the North Fork of the Yuba River and 0.3 mile east of Ramshorn Creek in Sierra County.



This photo taken two miles east of Cherokee in Butte County shows some of the heavy grading work involved in the construction of US 40 Alternate.

State Sign Route 89

A project providing a 44-foot all-paved roadway for 8.3 miles from Squaw Valley Road to Donner Creek Railroad Underpass is under contract to Frederickson & Watson & Ransome Company of Oakland at a bid price of $1,374,930. The work is virtually complete.

A project to resurface 23 miles from Bay View at Emerald Bay to Squaw Valley is under contract to Clements Construction Company of Hayward at a bid price of $168,900. The expected completion date is late in August, 1959.

Willows-Butte City Road

Another project in the current budget is a 1.2-mile causeway over the Sacramento River overflow area from Codora Four Corners to the Butte City Bridge in Glenn County. $1,150,-000 is included in the budget for this project which is soon to be advertised.

Planting Projects

Four functional planting projects are included in the current budget. These include from the San Joaquin county line for 18 miles northerly on US 99; from Howe Avenue to Fulton Avenue on the Sacramento-Roseville Freeway (US 40); at the Weimar Interchange on US 40 and through Arbuckle on US 99W.

The Arbuckle project is under contract to Bernard Gayman of Sausalito at a bid price of $31,270. The Howe Avenue to Fulton Avenue project is under contract to the Capitol Nursery of Sacramento at a bid price of $7,113. The other two projects will be advertised shortly.

Another planting project in the district is at the Materials and Research building in Sacramento. This project, under contract to L. K. Nelson for a bid price of $21,629, and the expected completion date is October 21, 1959.

The interest shown in the North American Ski Championship events in Squaw Valley during February of 1959 indicates the possible spectator interest in the VIII Winter Olympics in February, 1960. District personnel are planning for special activity made necessary by the heavy traffic volumes expected in the area during the events.

The increase in population, both permanent in the growing industrial areas and transient in the recreational areas, indicates that our planning has not been over expanded. The continuation of our current program will provide the necessary facilities in the foreseeable future, and we are prepared to cope with the problems that arise in the development of the area.

LONG DETOUR AVOIDED

Slides occurred on US 101 Alternate west of Santa Monica, in the Pacific Palisades area where there have been many slides. In view of the possibility of additional slides, maintenance forces of the Division of Highways constructed a 1,200-foot detour by shifting the southbound lanes toward the ocean, and using the former southbound lanes for northbound traffic. This work was completed on June 15th. It was performed without closing the road to traffic, thus avoiding a lengthy detour.

First Contract

Future Interchange Will Join Harbor, Santa Monica Freeways

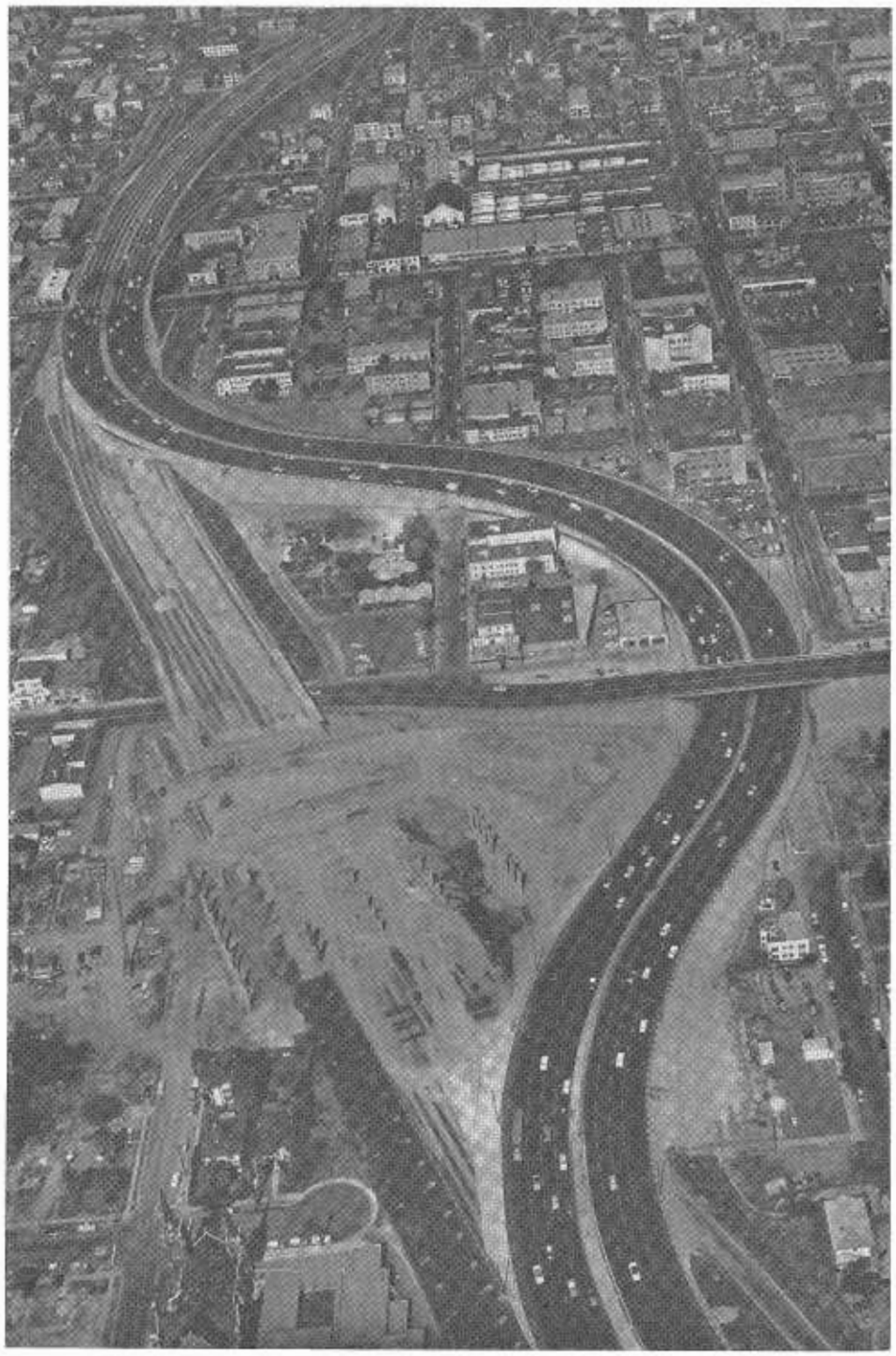
By LLOYD A. COMPTON, Resident Engineer, Bridge Department

THE AWARDING of the separation portion of Santa Monica Freeway-Harbor Freeway Interchange on January 16, 1958, constituted the first major contract in the construction of the Santa Monica Freeway. The project is located within the metropolitan area of Los Angeles, more specifically, between Venice and Washington Boulevards, on the Harbor Freeway. The contractor began his operations on January 20, 1958. The project was contracted at a bid cost of $1,484,677.

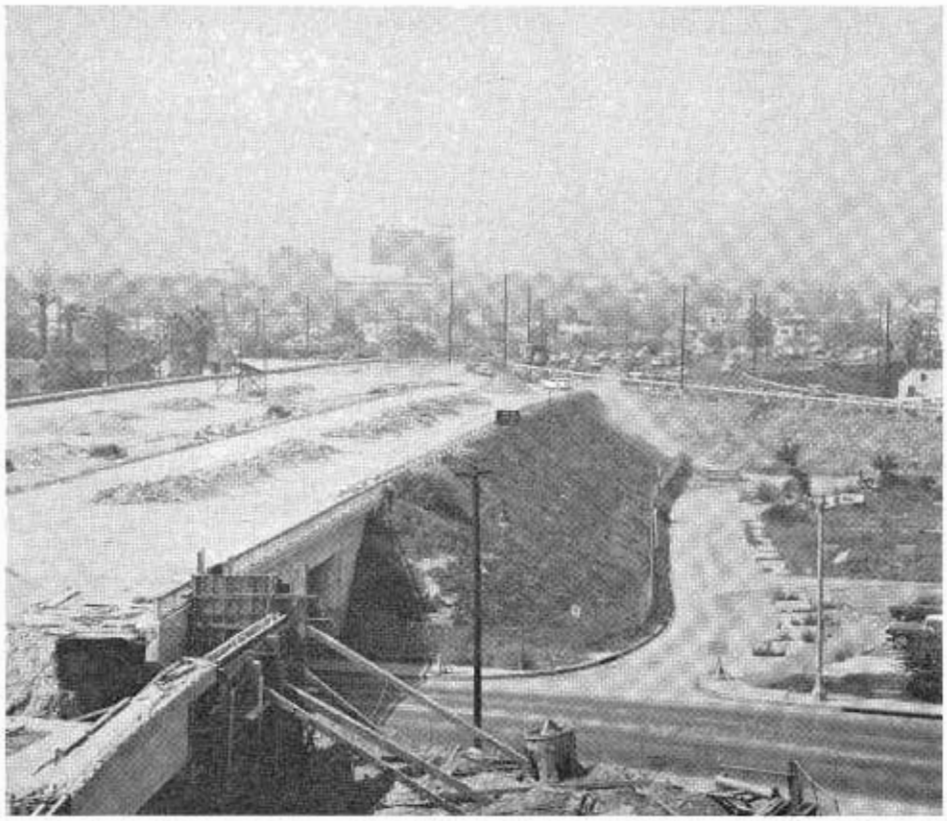
The construction of bridges on highway routes usually includes the providing of a detour to facilitate normal traffic flow. In building the structures to carry the Santa Monica Freeway, with various distributor and connector roadways under and over the existing Harbor Freeway, it was necessary to construct detours. The detour problem was unusually complicated, in that Venice Boulevard, a major city traffic artery, passed beneath the existing Harbor Freeway adjacent to the project site and bisected the loop of the Harbor Freeway detour. This condition necessitated the construction of a temporary bridge, on offset detour alignment, to carry Venice Boulevard over the detoured Harbor Freeway. The normal flow of traffic had to be maintained along these two arterials during their construction and because of the heavy traffic along the Harbor Freeway (in the vicinity of 190,000 vehicles per day), extensive planning and co-ordination was required.

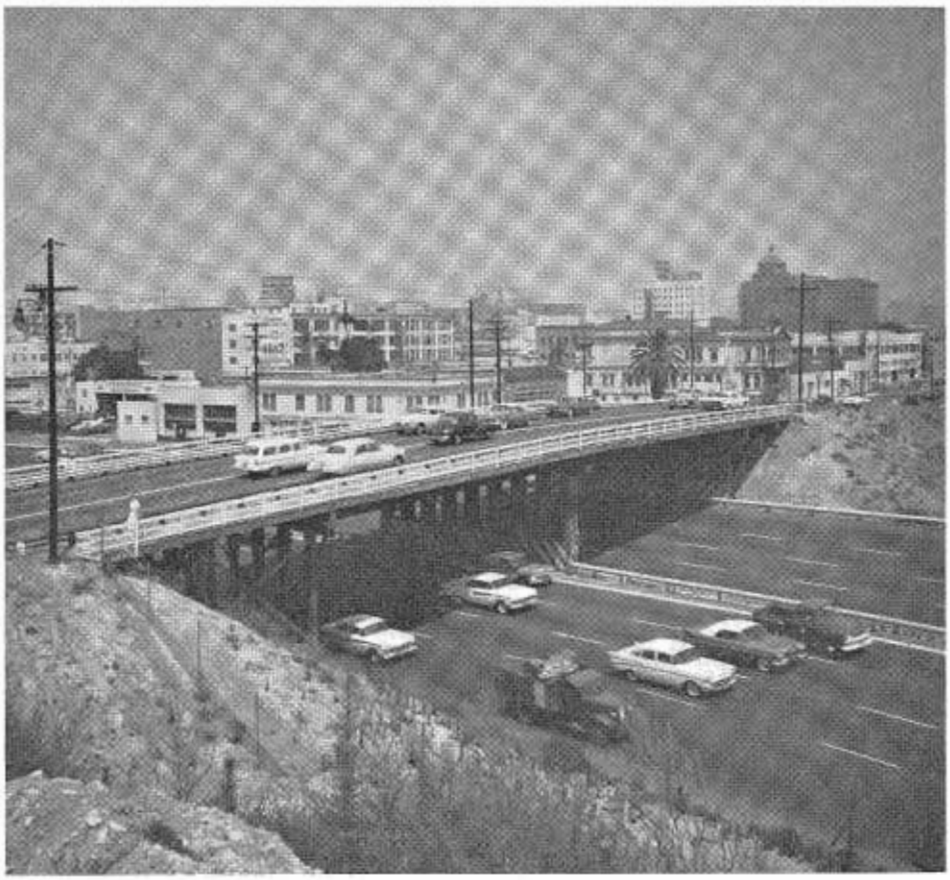
Detour Bridge Built

The embankments for the detours were constructed simultaneously with the erection of a temporary detour bridge for Venice Boulevard. This detour bridge was constructed of timber bents resting on unreinforced concrete footings with approach spans carried by timber stringers and the two main spans supported by 36-inch-



This view northward shows the Harbor Freeway detour around construction of the Santa Monica Freeway separation. Venice Boulevard (left to right) passes under the construction zone and over the detour.





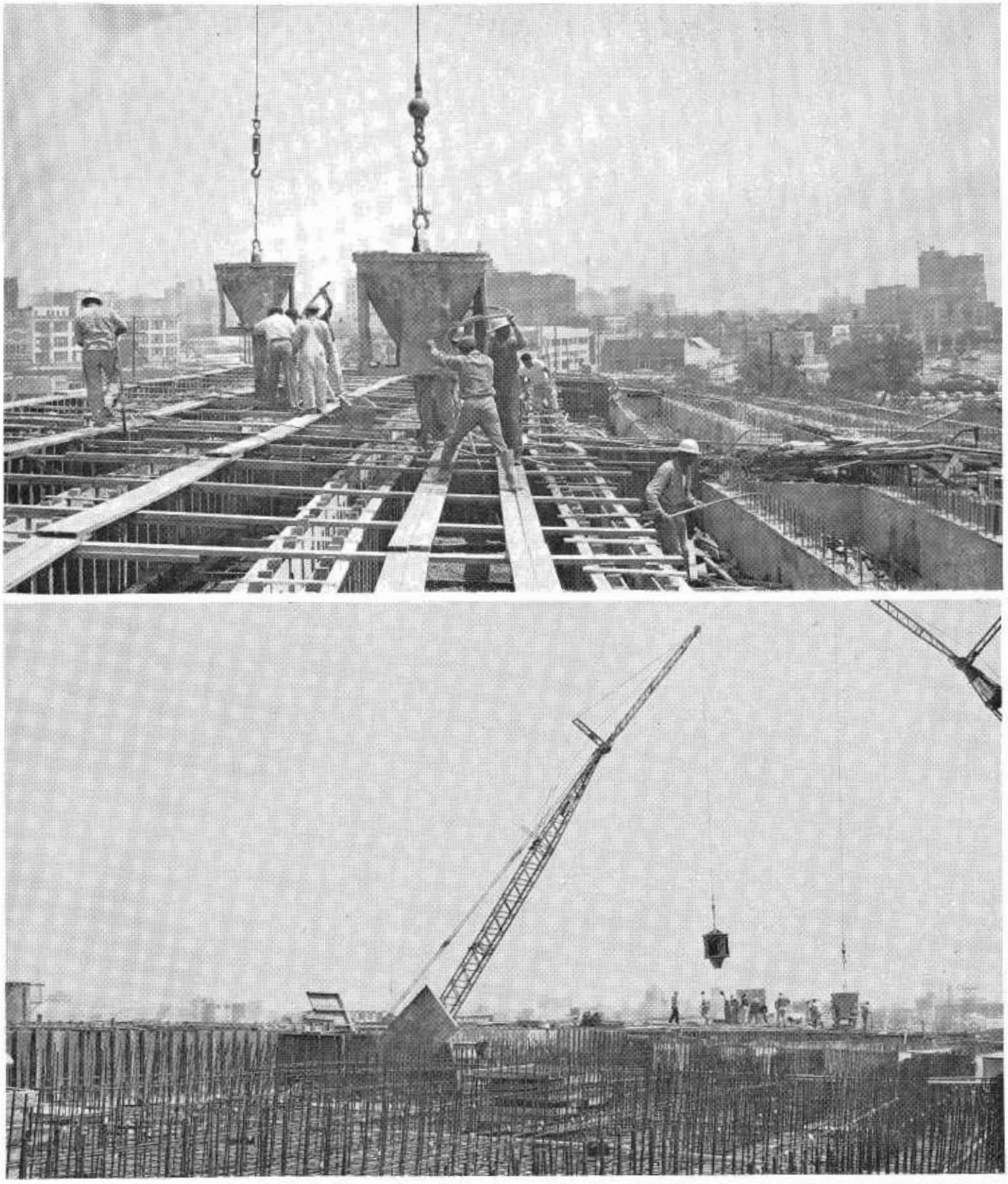
UPPER—Venice Boulevard passes under the construction area (foreground). The north end of the Harbor Freeway detour is in the middleground. LOWER—A temporary bridge carries Venice Boulevard traffic over the Harbor Freeway detour.

wide flange rolled steel girders. Precast, reinforced concrete slabs 6½′ x 22′ x 6″ thick were utilized on the steel girders, being fastened to the top flange by welded stud bolts passed through precast holes in the slabs. The approach slabs were cast-in-place and the entire structure was paved with plant mixed surfacing.

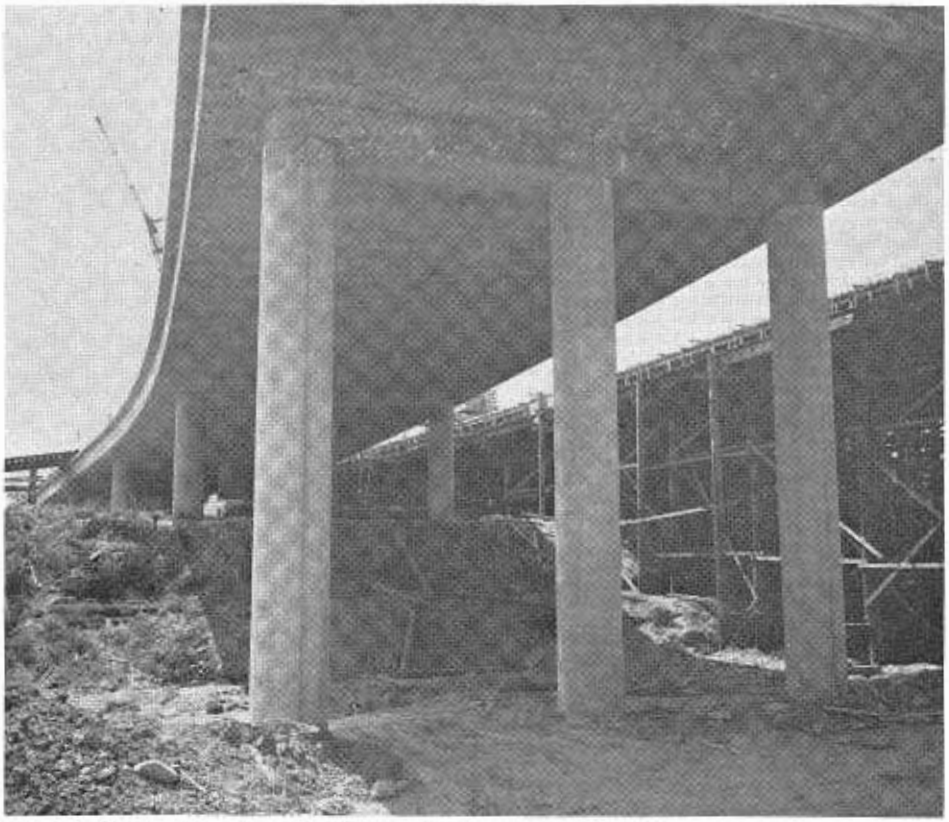
The Venice Boulevard detour was completed, traffic rerouted and the existing roadway removed to facilitate the construction of the freeway detour. The freeway detour was completed except for the end "tie-ins." Owing to traffic volume, this operation had to be carried out on two week ends, after 10 p.m. on a Saturday and completed prior to 6 a.m. on Sunday. The northbound lanes, by nature of location, were the first to be detoured and by a system of confining traffic to the inner lanes, connecting the outer lanes and subsequent shifting of traffic, the transition was accomplished. The southbound lanes were routed onto the detour on the following week end. Long hours of work coupled with extensive co-ordination resulted in a smooth trouble-free operation. The cost of constructing these detours, totaled $380,000. This is undoubtedly the most heavily traveled and most costly detour yet constructed in the State of California for its freeway program.

Start of Major Construction

The completion of the detour, followed by the removal of portions of the freeway embankment, allowed the major bridge construction to begin. Two cuts through the embankment were made providing for bridges to carry Harbor Freeway traffic over the Santa Monica Freeway westbound roadway and for a west to south connector roadway. The westbound structure is a combination of box girders and cored slabs with three solid concrete roof girders. This rigid frame structure rests on a combination of spread footings and 24-inch diameter cast-in-place piles. The roof girders are as much as nine feet in depth and extend upward into the median and shoulder areas of the Harbor Freeway level. Six four-foot diameter columns rest on these roof girders and support a portion of the third



UPPER—Workers pour concrete on the third level of the new Santa Monica Freeway Separation. LOWER—Hundreds of reinforcing steel bars serve as a foreground to concrete pouring operations beyond.



A view of the completed portion of the third level of the separation structure with falsework supporting the uncompleted portion (right).

level. The larger roof girder contains approximately 275 cubic yards of concrete and spans 59 feet.

The westbound to southbound connector profile line was depressed so as to allow a slab deck, rigid frame structure to be constructed with deck grade up to five feet below the Harbor Freeway level. A cut and cover tunnel type operation resulted for approximately 150 of the 190 feet of total structure length, portal to portal.

Sand Blanket Used

The falsework for the bridges was constructed of timber columns with timber and structural steel I-beams as stringers. A system of double timber sills with elevating wedges between, facilitated grade adjustments, and also provided a means for lowering and subsequent repositioning. A sand blanket, approximately two inches thick, was laid under the lower sill. After the superstructure was completed, the sand blanket was washed out and the entire falsework was lowered. The space created by this lowering allowed separating the sills by hydraulic jacks and replacing the wedges with six-inch diameter steel rollers for lateral movement and reuse of the falsework. This repositioning process was repeated as many as five times and proved both efficient and satisfactory.

The third level, carrying the eastbound Santa Monica Freeway, three connector roadways and one distributor roadway consists of multiple span, box girders. It is supported on cast-in-drilled-hole piles, 24 inches in diameter. The piles extend through the existing embankment into an ancient alluvial material. The design loading of the piles is 100 tons. A load test, conducted by the Bridge Department Geology section, revealed a considerably greater capacity. There are 50 columns four feet in diameter supporting this level. The highest of these columns was just over 50 feet. Steel forms were utilized with very satisfactory results. The total structure width, approximately 250 feet, and the length, roughly 330 feet, presented a difficult problem in construction. The initial plan was to construct one portion at a time and move the falsework laterally in a manner similar to that described for the rigid frame structures, making a total of three moves. The time element interfered with this plan and it was necessary to construct additional falsework after only one move. A troublesome condition was created in that accessibility to the "inner" area was denied from the Harbor Freeway level. It was therefore necessary to construct a temporary timber trestle access ramp from the Harbor Freeway level to that portion of the completed third level.

Much Falsework Needed

The construction of reinforced concrete bridges entails considerable falsework erection; the extended area of the third level of structures on this contract made this very apparent. At this writing falsework supports approximately 52,000 square feet of soffit paneling. This means that considerably over an acre of bridge superstructure is being supported by falsework with some 620 twelve-inch diameter columns.

The details of the falsework construction were similar to that of the lower level rigid frames, with extensive use of structural steel shapes for stringers. The use of these steel stringers precludes the "dropping" of falsework upon completion of the superstructure and due to the super elevations of the various roadways, with the outer sides lower than the inner sides, a difficult falsework removal problem is presented.

For information regarding the general layout of the Santa Monica Freeway Interchange with the Harbor Freeway, see page 51, March-April, 1959, issue of *California Highways and Public Works* showing photograph of scale model fabricated by Mr. and Mrs. John Unruh.

The project is scheduled for completion during October of this year. Completion includes the removal of both detours and the detour bridge, with reconstruction to normal alignment of Venice Boulevard.

The contractor is Webb and White of Los Angeles with Paul Fredrickson representing the firm as project superintendent.

Survey Safety

Correct Practices Outlined For Highway Survey Crews

By A. K. GOLDIN, Chief of Surveys, District VII

THE GROWING volume of traffic on our state highway routes requires strict adherence to safety procedures and practices. The necessity for adopting specialized safety techniques to meet the variable conditions encountered in metropolitan areas is all too apparent if tragic accidents are to be avoided. The District Survey Department recognizes that no list of safety rules can be devised to meet all situations, but these are a start in the right direction.

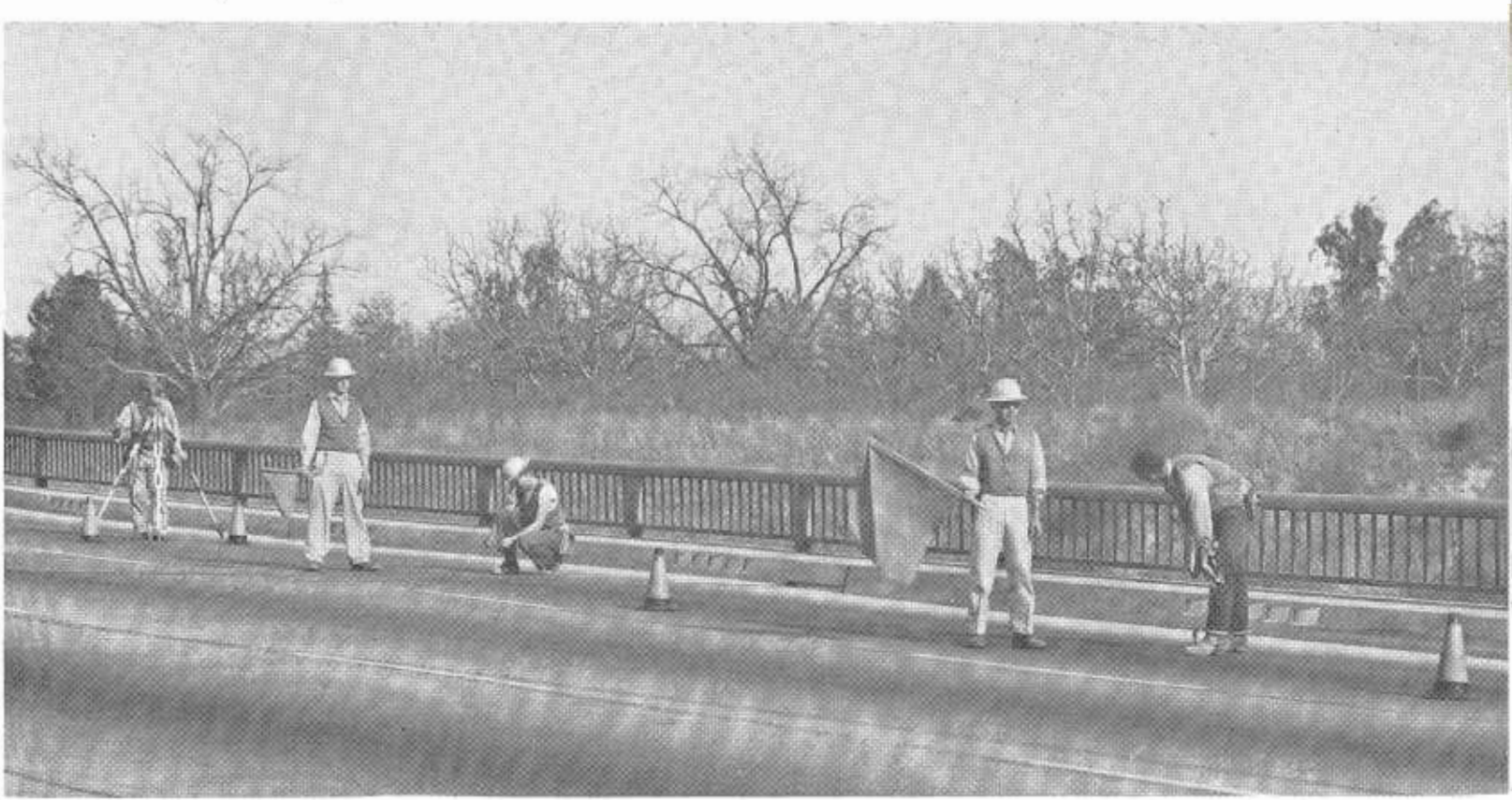
The selection of effective safety procedures and the most suitable methods of performing assigned field tasks is one of the principal responsibilities of all survey supervisors and survey party chiefs. They must establish the work hours of the field parties to avoid working in traffic lanes during peak hours of traffic flow on freeways in the metropolitan areas. Only by working in this manner can the assigned tasks be accomplished on time and with safety.

It is the experience of the Survey Department of District VII, that to get required work done in metropolitan areas with their large volumes of fast-moving traffic, larger survey parties are necessary to safeguard the personnel and equipment used in the performance of survey operations, than is required in outlying areas where traffic is lighter. The cost of increasing the size of the survey party in metropolitan areas is offset considerably by the time saved in performing the work more expeditiously. By having adequate help in caring for their safety while working, party members are less hindered in performance of their duties.

Extra Flagman Effective

The "buddy system," which requires a flagman to go along with each head chainman, rear chainman or rodman for the protection of his partner, allows survey party members to carry on with their duties relatively unhampered and unworried about their personal safety. This is conducive to both speed and accuracy. The "buddy system" flagmen perform their duties under the watchful eyes of the survey party chiefs who modify prescribed safety rules as becomes necessary to meet the exigencies of the situations that develop. The basic safety rules of procedure are those as set forth in the State Division of Highways Bulletin, entitled "Instructions to Flagmen." Flagmen following the "buddy system" on survey parties must develop good judgment and be extremely careful in estimating the speed of oncoming vehicles in order to prevent traffic tie-ups and collision accidents. This system has proven very efficient and is well worth the small additional labor cost.

Conscientious following of the State Division of Highways signing and traffic cone placement charts is essential when surveying work is being done under heavy traffic conditions. Use of vehicles, such as pick-up trucks, station wagons and survey trucks, properly signed and distinctively colored, has proven of great value. These vehicles delineate the work areas and protect the survey party and the engineering instruments being used. The most able and experi-



BELOW—The "Buddy System," which requires a flagman to accompany each head or rear chainman or rodman, allows survey party members to carry on their work with less concern about their personal safety.

Members of survey parties working on any portion of a highway wear a red shirt, poncho, vest or coat. These may be luminous or standard cloth.

enced members of the survey crew are assigned to the task of driving these vehicles, because the safety of the party personnel and of the traveling public on the highway is in their hands.

Sign Placement Important

Careful attention is given the placing of advance warning signs. The signs are placed at distances far enough in advance of the site of the work to warn oncoming traffic and yet close enough to prevent traffic from picking up speed before reaching the work zone. The distances for signs is as set forth in the State Division of Highways Bulletin wherever applicable and other distances are established by the party chief, who takes into consideration the road conditions and special hazards.

A telescoping high standard to elevate flags is a new development and it helps warn oncoming traffic, delineates the work area and incorporates two features which make it more effective than the older warning devices. These features are a telescoping column and two or three sockets for holding flags. The telescopic column makes it possible for the sign to be raised so it can be seen over fairly high stationary objects and over automobiles.

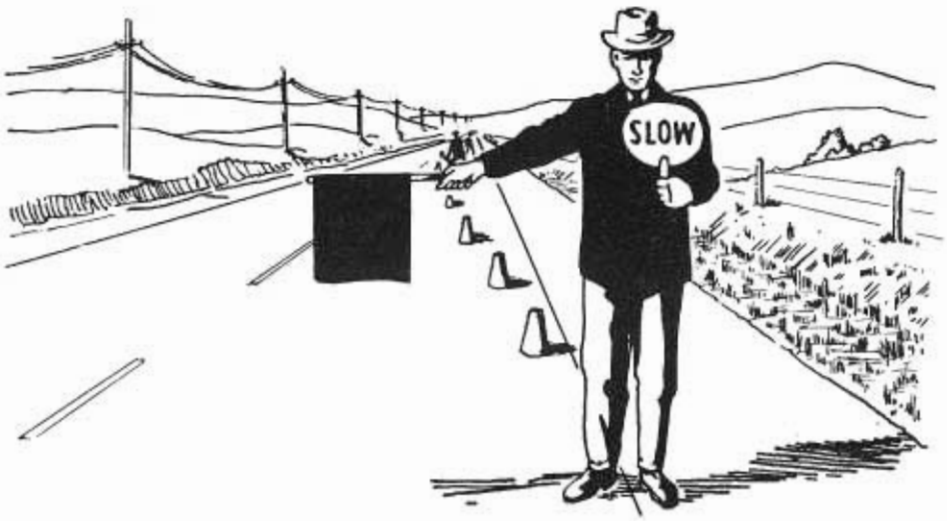
The placement of traffic cones is extremely important. The cones are positioned in a long taper for properly channelizing traffic to protect the instrument man and his survey instrument. Careful placing is necessary to provide workers with ample area for their operations but not as to impede traffic flow. The taper of the line of cones should be visible throughout its entire length to be most effective. Additional precautions should be taken when the roadway is on summit vertical curves or when freeway on or off-ramps complicate traffic flow into the work zone. In these special cases the party chief will use his best judgment in determining the placement of traffic cones. Our experience has shown that traffic cones should be placed far enough apart in the taper so as to protect and delineate and yet not allow so much space between them that drivers will become confused and drive between cones instead of along cones. As an average spacing, 50 feet apart is suggested for traffic cones.

Must Wear Red

It is mandatory in District VII that all members of survey field parties wear red jackets or red vests while working on traveled roadways. Other governmental agencies and some private organizations in this area have also adopted this procedure. The Survey Department Supply Section takes care of colored vests and jackets having them laundered and repaired as as necessary. The new luminous cloth used in jackets, vests and flags is an added improvement and has been well received both by our survey parties and by the traveling public.

Safety helmets or "hard hats" are issued by the department to crews working on construction jobs where work is in progress on overhead structures or where steep slopes may be subject to ravelling. Excepting for these special conditions, safety helmets are not required.

Clothing for our surveyors is not specified but short jackets and



Flagging is done with red luminous cloth flags in the method outlined in the Division of Highways pamphlet "Instructions to Flagmen."

Traffic on a freeway inlet is temporarily stopped while surveying operations are in progress.

sweaters are suggested so as not to impede action.

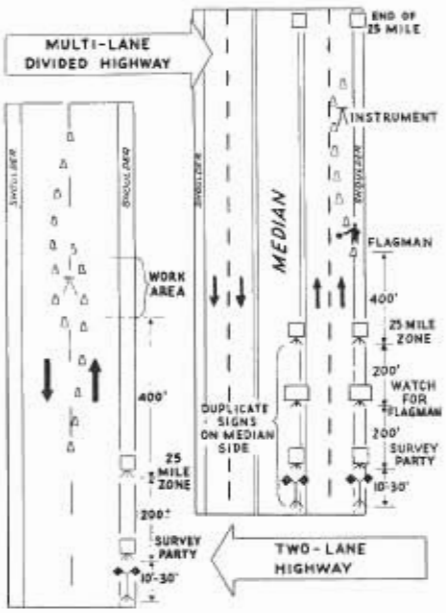
Attached to the roof of the survey truck, a covered wire cage with the hinged top allows the survey party to carry an adequate supply of stakes, lath, flagging materials and small tools. This appliance keeps the contained material from accidentally spilling on the roadway and obstructing or endangering traffic.

The warning sign attached on the rear of an express type truck is composed of two parts. The back part is full length with the word "Slow" on both sides. The second part is suspended by hooks and is reversible, with the "Keep Left" on the front and "Keep Right" on the back side. This sign helps to slow the fast traffic down more effectively than other types that have been used. The truck is usually 200 to 300 feet ahead of the other signs. When authorized, flashing lights may be added to the upright brackets. Experience has shown that where the flashing lights have been used there is a marked improvement in the control of traffic. District VII has used the flashing lights for surveys on completed freeways open to traffic.

Cross sectioning on any freeway, after it has been opened to traffic, is done by taking profiles, and then only one traffic lane at a time is tied up for the operation with a minimum hindrance to public traffic flow. This takes careful planning on the part of the supervisory staff of the Survey Department.

Instructions furnished by the manufacturer's agent in the use of power tools are strictly followed. Classes are held periodically in District VII and the manufacturer's agent serves as the instructor. Only employees who have been fully instructed are permitted to operate powder-actuated equipment. They are required to wear safety goggles and strictly follow the rules as set forth in "Construction Safety Orders, Article 28," under powder-actuated tools. This tool can be dangerous in the hands of untrained and inexperienced personnel.

The party chief gives instruction in the use of axes, brush hooks and other cutting tools to the new personnel. The party chief also supervises all brushing operations and sees that proper spacing is maintained between survey party members engaged in the operation. Vises have been placed on the rear of all District VII survey trucks to facilitate the sharpening of the cutting tools. The use of the vise has reduced accidental injuries from this cause.



Placement of warning signs, cones and barriers vary with conditions. They are placed where they will be seen by the motorist. The diagram above shows two examples with minimum distances indicated.

A member of a survey crew demonstrates a safe method of sharpening the blade of a brush cutter with the handle held in a vise.

Observance of proven safety rules at all times and development of new safety procedure have paid off. To the knowledge of the author there has not been a serious on-the-job accident in the survey department of District VII since the initiation of safety measures described in this article.

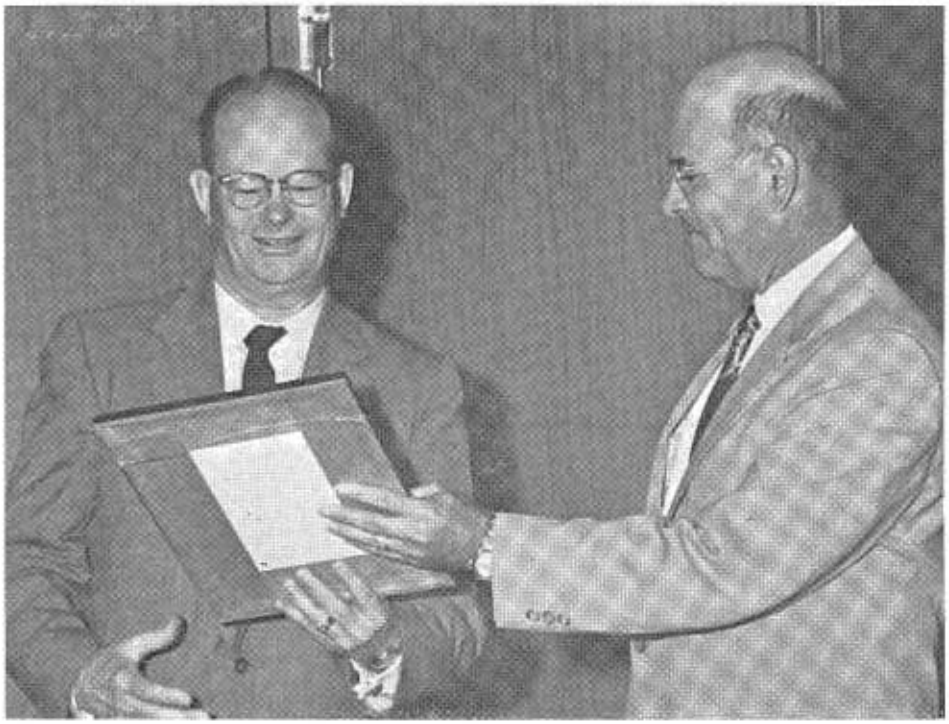
All Bridge Traffic Increases in State

Traffic counts were higher last month on each of California"s state-owned toll bridges in the San Francisco Bay area than in the same month in 1958, the Division of Highways reported today.

Traffic counts on the bridges were:

San Francisco-Oakland Bay Bridge —June, 1959, 3,221,575; June, 1958, 3,127,124. San Mateo - Hayward Bridge — June, 1959, 298,107; June, 1958, 288,502. Dumbarton Bridge—June, 1959, 166,278; June, 1958, 142,-436. Richmond-San Rafael Bridge—June, 1959, 278,746; June, 1958, 253,-330. Carquinez Bridge—June, 1959, 1,078,787. (Toll collection started November 25, 1958.)

Best Accident Prevention Record Wins Top Achievement Award for District III



Alan S. Hart (left), District Engineer, receives the Safety Certificate of Achievement on behalf of District III from Scott H. Lathrop, Principal Highway Engineer. The award was made at the Materials and Research Laboratory Building in Sacramento on July 7th.

District III, with headquarters in Marysville, has been declared winner of the 1958 award for the best accident prevention record among the various districts. The award was won in competition with California's 11 highway districts and the San Francisco Bay Toll Bridges. District V, with headquarters in San Luis Obispo, also won an award, for the greatest improvement in its safety record.

The Certificate of Achievement for District III was presented to District Engineer Alan S. Hart on July 7th at the Materials and Research Laboratory Building in Sacramento during the monthly District III Safety Committee meeting. Principal Highway Engineer Scott H. Lathrop made the presentation for State Highway Engineer G. T. McCoy.

This is the first award of this type won by District III. District Engineer Hart attributes his district's success to the constant and unremitting hard work of the district's safety supervisor. In accepting the award Hart commented, "If it weren't for the safety supervisor, perhaps some of you might not be here to listen to what I am saying."

District III includes the counties of Butte, Colusa, El Dorado, Glenn, Nevada, Placer, Sacramento, Sierra, Sutter, Yolo, and Yuba. It maintains almost 1,400 miles of state highway. Included in its mileage are vital routes US 40 and US 50 over the Sierra Nevada through an area where total winter snowfall sometimes is 80 feet, and also included is the booming Sacramento area with its complex freeway problems.

On July 10th at headquarters in Sacramento, State Highway Engineer G. T. McCoy presented District Engineer A. M. Nash of District V with a Certificate of Achievement for the greatest reduction in accident frequency among the districts in 1958. McCoy congratulated Nash on the reduction of accidents in his district during 1958 by more than 50 percent. District V is a central coast district and includes the Counties of San Benito, Monterey, San Luis Obispo, and Santa Barbara.

L. A. River Bridge

Will Form East End Of Freeway Viaduct

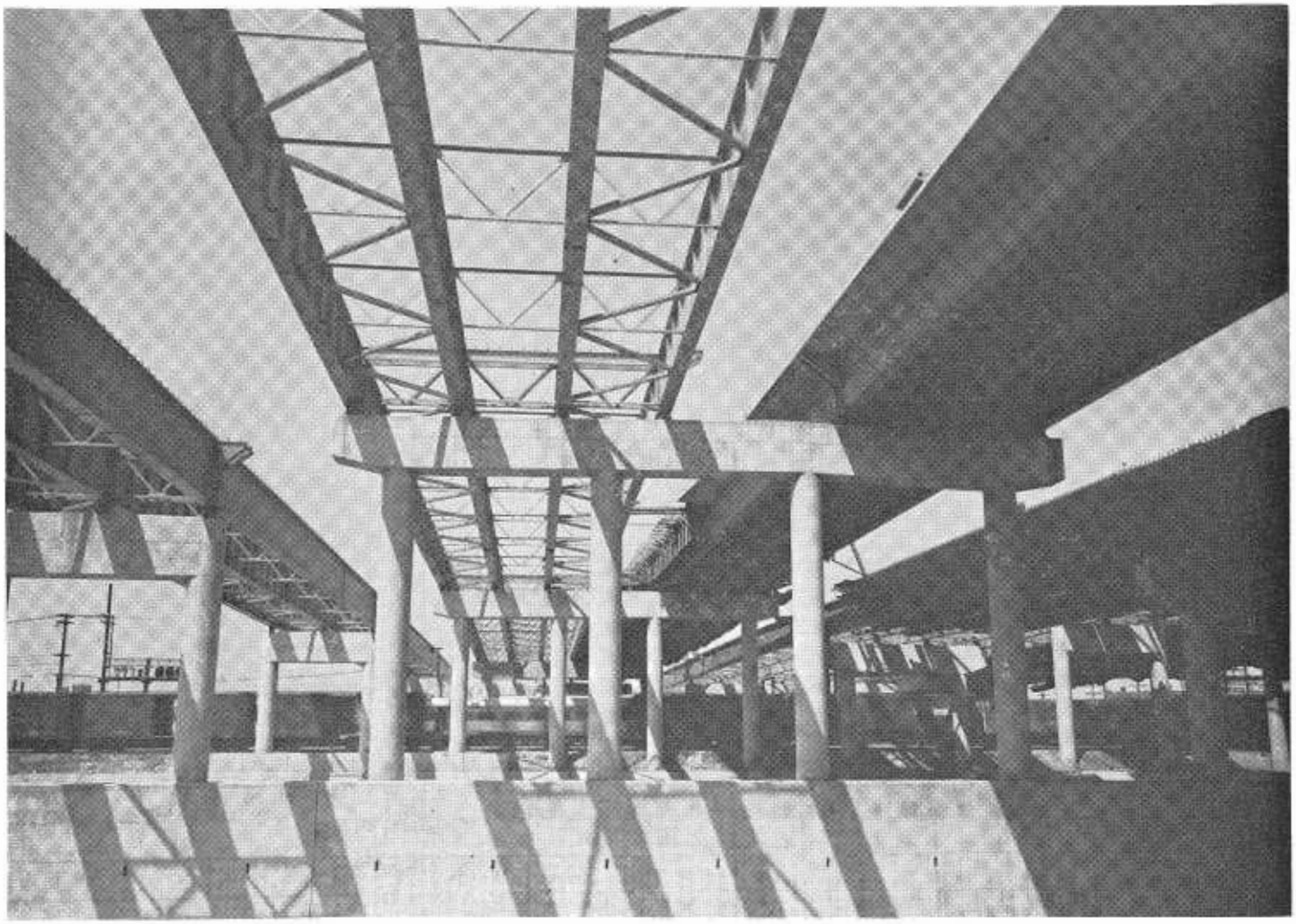
By H. J. SCOTT, Resident Engineer, Bridge Department

WORK on the Santa Monica Freeway is well under way, with the second major contract on this freeway, the Los Angeles River Bridge and Overhead, now nearing completion. The Santa Monica Freeway is to be constructed as a viaduct from its intersection with the Harbor Freeway till it crosses the Los Angeles River, about 3½ miles away. On the Los Angeles River Bridge and Overhead, the freeway is carried across the coach yards and main lines of the Santa Fe Railway, the Los Angeles River, and the main line of the Union Pacific Railroad on six parallel roadways with a combined width of 14 traffic lanes. East of the Union Pacific tracks, the roadways divide and cross each other to connect with the massive interchange between the Santa Monica, Santa Ana, and Golden State Freeways, construction of which is now in progress under another contract totaling nearly $10,000,000.

The Los Angeles River Bridge and Overhead is primarily a structural steel girder bridge with concrete deck slabs designed for composite action with the top flanges of the steel girders. The girders are supported on reinforced concrete caps, columns, and footings, all of which are carried by concrete piles. Incorporated in the structure are three piers, one on each side and one in the center of the Los Angeles River, which were constructed under a separate contract by Jones Brothers Construction Company between June and November of 1957.

Load Capacity Tested

The concrete piles supporting the structure are cast in drilled holes having a minimum diameter of two feet



This view westward of the bridge construction was taken under the main eastbound roadways. There will be a total of six parallel structures with a combined width of 14 traffic lanes.

and varying in depth from about 25 feet to 50 feet. Average depth was about 30 feet. The top 12 feet of each pile (or the top one-third of the deeper piles) is reinforced by eight 1-inch steel bars. In the piers adjacent to the Los Angeles River, the pile reinforcement extends 3 feet below river bottom. The piles are designed to carry safely a load of 100 tons each. To check this capacity, three piles in line on five-foot spacings in one footing of Bent 7 were used as a test group. The outer two piles were used as anchors for a reaction beam and a load was applied to the center pile by hydraulic jacks. The test pile withstood a load of nearly 300 tons with less than the settlement allowable for double the design load. For further information, one of the anchor piles was tested for uplift, and successfully resisted a vertical upward load of nearly 200 tons.

Except in a few instances where it was necessary to bridge underground structures, the columns of the structure are supported upon individual footings, which are, in turn, supported by from 2 to 10 concrete piles. The columns, for the most part, are round and usually 4 feet in diameter, although some are 3 feet. A few special columns are elongated in section, 4 feet thick by 7 to 10 feet in long dimension, with flat sides and semicircular ends. Column heights vary roughly from 30 to 60 feet, and except for "2-story" bents, columns are unbraced from footings to bent caps. Bent caps are normally of concrete, the thickness being the same as the diameter of the supporting columns, and the depth from 4½ to 7 feet. Rigid frame bents of from 2 to 4 columns each are formed by each bent cap and each cap supports from 2 to 7 girders. Major reinforcement in columns and caps consists of large bars, each having a cross sectional area of 4 square inches.

This view of the construction area was taken just after the erection of the reinforced concrete columns which will support the six parallel bridges over the river.

Span Length Varies

In general, structural steel for the bridge consists of welded plate girders varying in depth from 4½ feet to 8 feet and in length from 75 feet to 172 feet, and of welded steel cap girders varying in depth from 5 feet to 10 feet and in length from 30 feet to 60 feet. Span lengths vary from about 75 feet in Span 13 to 190 feet in Span 2 which is over the Santa Fe Railway yard. Girders of Span 1 and 3 extend as cantilevers 30 feet into Span 2 to support suspended girders 130 feet long.

Steel plates varying in thickness from ⅜-inch to ¾-inch for girder webs and from ¾-inch to 2¼ inches for flanges are structural steel for welding conforming to American Society for Testing Materials Specifications, Designation A373. All major shop welding was performed by the submerged arc process and checked by selective radiographic inspection. Inspection covered 100 percent of welds in tension flanges and about 10 percent of other work. Of the 218 girders in the structure, 61 were too long to be transported to the job site in one piece and were, therefore, spliced in the field by full-penetration butt-welding, using low hydrogen electrodes. Field splice welding was checked by radiographic inspection covering 100 percent of the work.

Two-crane Operation

Erection of the steel was done by mobile cranes varying in capacity from 25 tons to 70 tons, working from the ground. The heaviest lift was approximately 39 tons, for the girders of Span 3, over the west half of the Los Angeles River, but the necessary reach was so great that two cranes, one of 70-ton capacity with 110 feet of boom, and one of 45-ton capacity with 100 feet of boom were used together to set these girders. Two cranes, one of 25 and one of 35 tons capacity were used to set the 33-ton girders of Span 1. All other steel on the job was set by a single crane.

The Santa Fe Railway Company co-operated in the erection of the 33-ton, 130-foot long suspended girders in Span 2 by clearing their yard and controlling train movements so that these girders could be set from the ground. The 20 girders involved were erected in 6 nights, working from shortly after midnight until about 7 a.m.

All girder bearings were held to concrete caps by 1½-inch anchor bolts and all masonry plates were supported by ½-inch thick, rubber impregnated fabric pads, rather than the customary grout pads. Because of this type of bearing, the contact areas of the concrete bent caps were ground to true planes with an overall maximum deviation tolerance of ⅛-inch.

Field connections of all girder bracing and fixed end connections of girders to steel bent caps were fastened by ⅞-inch diameter high strength bolts, which were tightened by the use of pneumatic impact wrenches to a minimum torque of 470 foot pounds. Equipment was adjusted and workmen were trained to consistently exceed this minimum. Spot checking the tightened bolts with a calibrated torque wrench indicated an average value of about 600 foot pounds was achieved. Where restricted clearance between overlapping roadways made the use of concrete impractical, steel girder bent caps were used. The steel caps are fastened to each of the concrete columns supporting them by from 4 to 8 high-strength steel anchor bolts, 3 inches in diameter and 10 feet long. Specifications required that these large bolts be "prestressed" to 24,000 psi by torquing the lower of the double nuts holding the cap girder. Representatives of Headquarters Materials and Research Department installed and observed electronic strain gages to determine that the required stress was attained.

This crew is pouring concrete for the deck of the westbound distributor roadway over the Santa Fe Railway yard.

Barrier Will Protect Traffic

The concrete deck is being finished by the use of a mechanical strikeoff followed by double floating with a 16-foot "bull float" and final trimming with a 16-foot, steel-shod, cutting float, both of the latter being operated with the length of the float parallel to the traffic lanes. The mechanical strikeoff is operated on 1-inch by 2-inch steel channel screeds supported solidly from the top flange of the steel girders at 30-inch intervals. Transit mixed, Class A concrete is used. The mixers discharge into a portable hopper from which the concrete is transported to the forms by ½-cubic yard capacity power buggies.

Traffic on the bridge will be protected by barrier-type concrete railing, topped by a 5-inch diameter aluminum pipe rail.

The prime contract for the work, in the amount of $3,410,310, was awarded to Peter Kiewit Sons' Company and work started in May, 1958. Completion is expected by November, 1959. Major items of work include 5,200 tons of structural steel, 1,700 tons of reinforcing steel, and 18,600 cubic yards of portland cement concrete. Representing the contractor on the job are Julian S. Goble of their Arcadia office and Zel Mullican and Robert Davick, job superintendents.

Contract administration is by the State Division of Highways Bridge Department under the general direction of F. W. Panhorst, Assistant State Highway Engineer–Bridges, with offices in Sacramento. Jason Plowe was chief designer for the project.

Sutter FAS

Last Section of County Master Program Completed

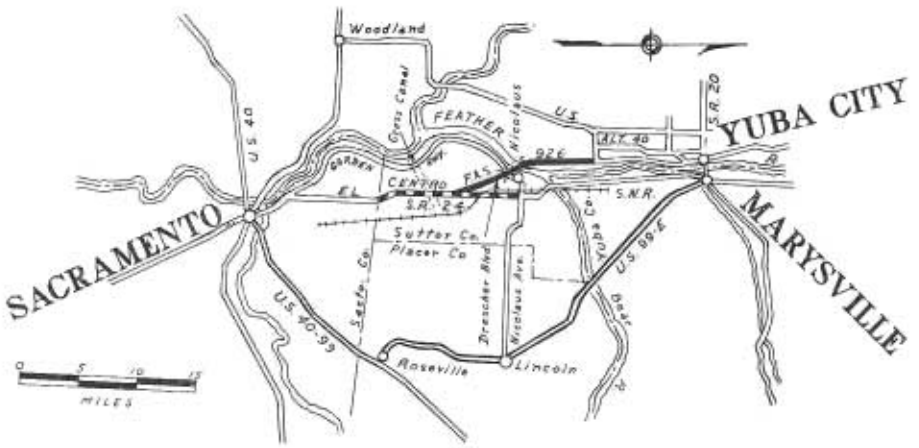
By E. E. WATKINS, Road Commissioner, Sutter County

ON JUNE 1, 1959, the Board of Supervisors of Sutter County opened to traffic the last unit of their first master FAS highway program, for which construction was started in March, 1949. The program consisted of 14 miles of new alignment and nine miles of reconstruction, including two major bridges: one 3,200 feet long and one 500 feet long. The total cost of the program was $3,569,000 (exclusive of right-of-way costs) embracing a total of 11 contracts, four of which involved the construction of a new bridge with approaches to replace the old bridge across the Feather River at Nicolaus, which was destroyed by the flood of December, 1955. The construction of this bridge was the major contract in this program.

In the late 1930's and early 1940's the authorities of Sacramento County and Sutter County conceived a direct farm-to-market highway between Yuba City and Sacramento. The adopted route, namely El Centro Boulevard (now State Sign Route 24), and the northern portions of the Garden Highway, was approved by the Bureau of Public Roads, as a part of the federal-aid secondary system. First construction in Sutter County started in March, 1949. This entailed two contracts: one for eight miles of highway construction consisting of grading, drainage and base, and one for a 500-foot, two-lane bridge across Cross Canal. The location of this first improvement was from the Sacramento county line northerly to the future intersection with Drescher Boulevard.

County Extends Road

In 1953 Sacramento County completed the southerly extension from the Sutter county line to Garden Highway at the Sacramento River. Upon the completion of this southerly connection the importance of the road was readily noticeable. During 1952 and 1953 Sutter County extended the improvement another four miles northerly to Nicolaus Boulevard. By 1955 this entire length of 12 miles constructed by Sutter County was fully paved. On July 1, 1957, this portion of Sutter County FAS route was taken into the State Highway System and is now known as Legislative Route 232, State Sign Route 24.



The above map shows the location of the highway project described in this article.

In the spring of 1955 the Board of Supervisors of Sutter County authorized route study and preliminary plans for that portion of the route northwesterly from El Centro Boulevard starting at the intersection of Drescher Boulevard thence across the Feather River and to tie into Garden Highway on the westerly side of the Feather River. These preliminary studies were underway when the disastrous floods of December, 1955, hit Sutter County destroying the existing bridge across the Feather River at Nicolaus. Passage of the Flood Relief Law of 1956 provided state funds to assist the county in financing the cost of a new bridge across the Feather River. Also available for replacing the destroyed bridge were federal emergency relief funds, which were allocated on a one-half cost basis.

The county, by use of these federal and state flood relief funds, constructed a new bridge across the Feather River on the adopted relocation line, which had been under study prior to the flood. The cost of this bridge with the immediate approach system was $2,300,000, one-half of which was federal emergency relief funds and one-half state funds authorized by the Flood Relief Law of 1956 (Chapter 9).

One Removable Span

The new Nicolaus Bridge is two-lane, 28 feet deck width, and is 3,200 feet long. It is constructed of precast, prestressed concrete girders, 105 feet long. The pier construction consists of reinforced concrete piers founded on 20-inch square, with 12-inch hollow core, precast, prestressed concrete piles. One mid-channel span is removable to permit passage of levee-repair dredges.

The location of the new bridge required construction of five miles of highway on the newly adopted alignment. The construction of this highway was accomplished by Sutter County through two federal aid projects. The work was effected under two contracts: one for a one-mile new highway northwesterly from the bridge to tie into existing Garden Highway, and one for four miles of

. . . Continued on page 53

Wilbur Avenue

Road Bond, FAS Funds Finance Highway Project

By VICTOR W. SAUER, Public Works Director, Contra Costa County

THE GROWTH of Contra Costa County from an agricultural community to an expanding industrial and residential area presented many problems to the governing body, one of which was providing adequate access roads to the developing areas. The people and the board of supervisors solved this problem by approving a road bond program of $10,250,000 on June 3, 1952.

A part of this program consisted of the reconstruction of Wilbur Avenue, which at one time served a few farms and fishing resorts, but which at this time had become a heavily traveled road with the development of the area into industrial and residential sites. The growth of the area and the importance of this road as a connecting link between the City of Antioch and State Sign Route 24, qualified it on October 4, 1956, for acceptance into the Federal Aid Secondary System.

With the approval of the road bond program by the voters of the county, the planning and design of Wilbur Avenue was started. It was planned that ultimately a four-lane road with a dividing median would be provided, but in the interim, stage construction, consisting of a heavy duty two-lane road with maximum grades of 3.5 percent would be provided.

Built In Three Sections

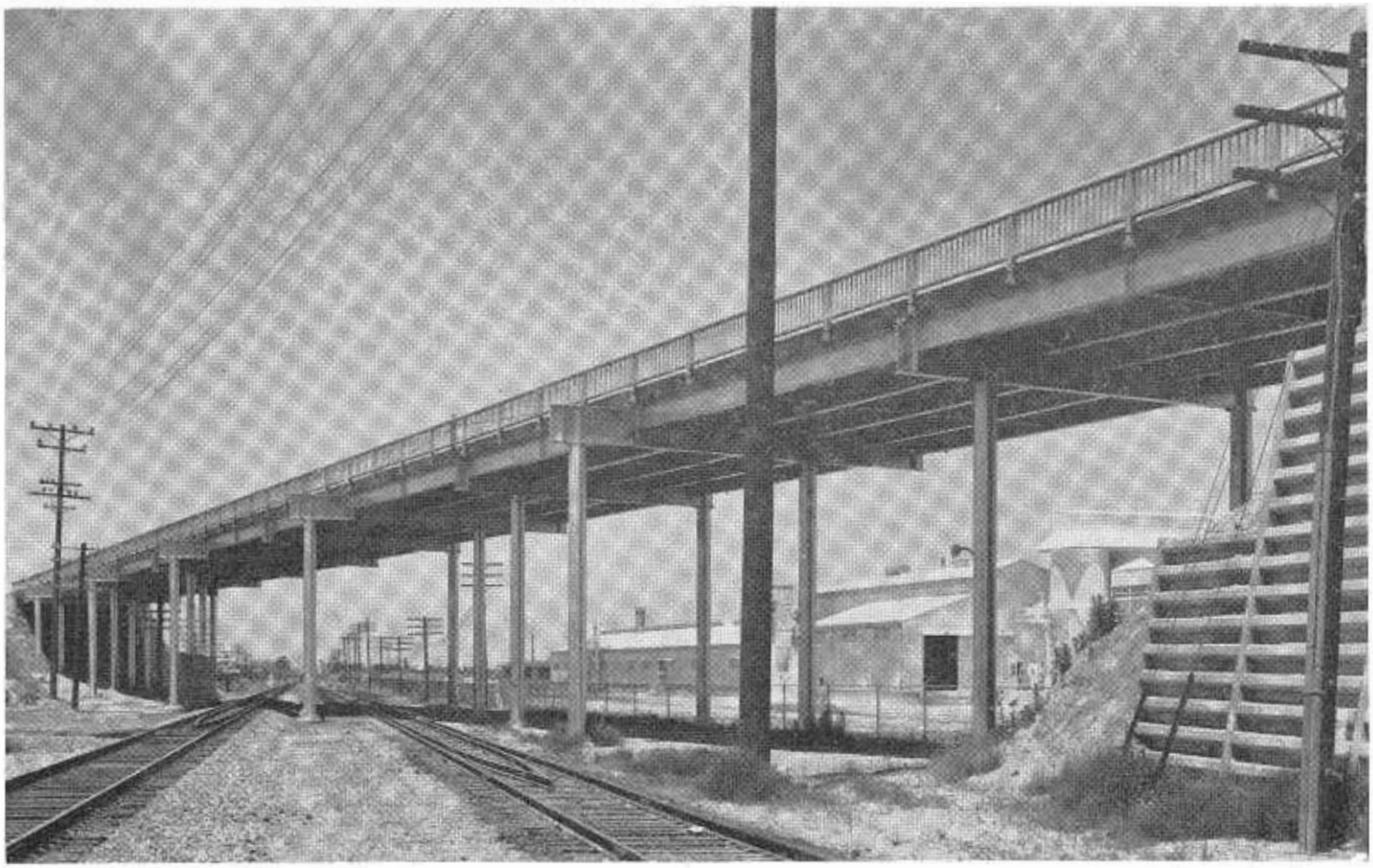
The road was built under three different contracts. The first section from A Street in Antioch to Orchard Avenue was placed under contract in August, 1956, and consisted of the grading and paving of a four-lane road. This section was built to the four-lane ultimate, as it passes through a densely settled subdivision area.

In December, 1957, the second section, extending from Orchard Avenue to 1,200 feet east of the Atchison, Topeka and Santa Fe Railroad, was let to contract. This section consisted of two 12-foot traffic lanes with two eight-foot shoulders.

This section also included the construction of a structure 485 feet in length over the railroad tracks. The overpass consists of 12 spans supported on two-leg pipe column bents. The superstructure provides for an an initial 28-foot roadway and two safety curbs. In the future, the design provides for an additional 28-foot roadway and a two-foot median strip.

The superstructure consists of a steel stringer and concrete composite

This is a portion of Wilbur Avenue, an industrial highway east of Antioch, recently improved by Contra Costa County under its road bond and federal-aid secondary program.



The new overcrossing which carries Wilbur Avenue traffic over the Santa Fe Railroad Tracks east of Antioch. Note the method of aligning the columns to make them parallel to the tracks by staggering their positions in relation to the highway structure.

deck. The stringers are framed into the bent cross beams with high strength bolts. The bents are placed perpendicular to the road, while the railroad tracks are skewed 15 degrees. This necessitated 23-foot clearance under the cross bents which actually spanned the tracks. Framing of the superstructure steel stringers into the side of the bent cross beam instead of on top saved approximately three feet in the elevation of the deck, and thus considerably reduced the height of the bin walls and approach fills.

Many Tests Made

The substructure bents consist of a 36-inch wide flange beam with two 18-inch concrete filled pipe columns. Filling the columns with concrete greatly reduced the amount of steel required. An additional column is all that will be needed in the ultimate four-lane structure. The bent columns are supported on belled caissons drilled to a 10-foot depth. Extensive soil bearing and settlement tests demonstrated that the 70-foot layer of sand at the site was most favorable to this type of foundation. This type of foundation proved to be considerably more economical than piling.

Column base plates are supported on leveling nuts capable of jacking the entire structure if future differential settlement becomes a problem. Only one-inch maximum settlement on one of the columns was observed during the construction period.

Because of this method of construction, temporary relocation of railroad tracks during construction of the overhead was not necessary. The design for this portion of the project was developed under the supervision of John Shotwell.

While the second section was under construction, the third and final section extending east to State Highway 24 was let to contract. This section consisted primarily of two 12-foot traffic lanes with eight-foot shoulders, except at the entrance to the Crown Zellerbach Paper Plant and the Fibreboard Products Paper Mill, where median strips and left-turn storage lanes were provided.

One of the most unusual aspects of the project has been the financing. Funds from six different sources were used to finance the work; namely, county general tax, bond program, gas tax allocated to counties, federal aid secondary funds allocated through the United States Bureau of Public Roads, state highway matching funds administered by the Division of Highways, and funds of the Atchison, Topeka and Santa Fe Railroad Company.

Construction enginering was performed by the county under the supervision of Edmond M. McCarthy. Stage 1 was constructed by the Antioch Paving Company. Stage 2 was constructed by the Bos Construction Company, and Stage 3 by the Antioch Paving Company. Resident Engineer for Stage 1 was Dexter Ahlgren, for Stages 2 and 3, Roy L. Bailey.

Sign Route 41

Highway Relocation Through Kettleman Hills Completed

By J. M. McDOWELL, District VI Construction Engineer
and A. J. ZIMMERMAN, Resident Engineer

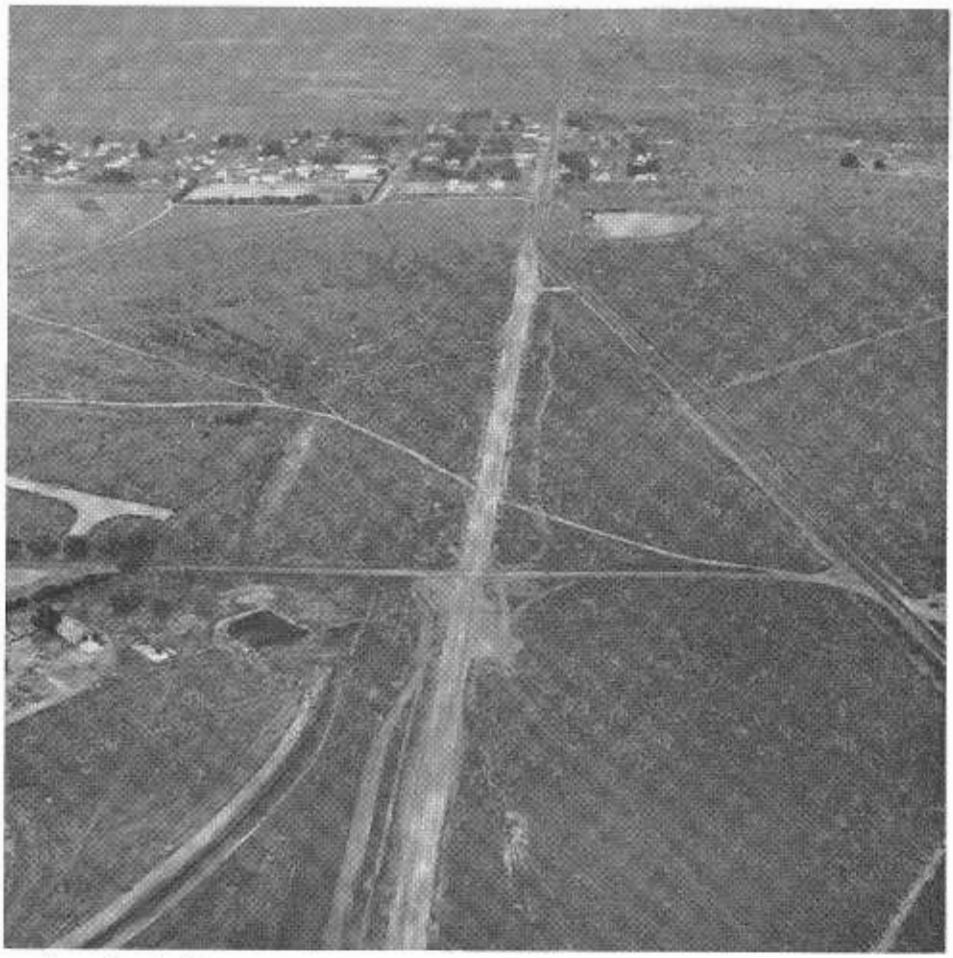
MOTORISTS on the Morro Bay-Yosemite Park Highway in Kings County have bid a not-so-fond farewell to that portion of State Route 125 (SSR 41) with the lowest driving standards which has been replaced by 6.6 miles of new construction, knifing through the Kettleman Hills, cutting three miles from the length of the route.

The Kettleman Hills occupy an area about 30 miles long and five miles wide lying adjacent to the foothills of the Coast Range along the western border of the San Joaquin Valley. With an average annual rainfall of less than six inches, the ground surface is barren of shrubs and trees although a limited amount of livestock grazing is supported by a sparse growth of grass. The hills rise abruptly from the valley floor to heights in excess of 1,300 feet above sea level, then slope gradually to the south and merge again with the plain. An anticlinal formation of marine and sedimentary deposits, the initial oil discovery in 1928 has since determined the area to contain the great proportion of the petroleum resources of Kings County.

State Route 125, traversing this area, is one of the few laterals between US Routes 99 and 101 and is the most direct connection between Paso Robles, the San Joaquin Valley, and the recreational areas of Yosemite and Kings Canyon National Parks.

A large proportion of the traffic is thus of the summer recreational variety, although there is considerable heavy trucking to and from the oilfields and from neighboring farm communities during those periods when crops are moving to market.

The former highway, built by the county and incorporated into the State Highway System in 1933, was of thin oiled earth of variable narrow widths having many short radius blind curves and grades of up to 10 percent. The sinuous alignment contained some 90 separate curves with total angular deflection in excess of 2,700 degrees.

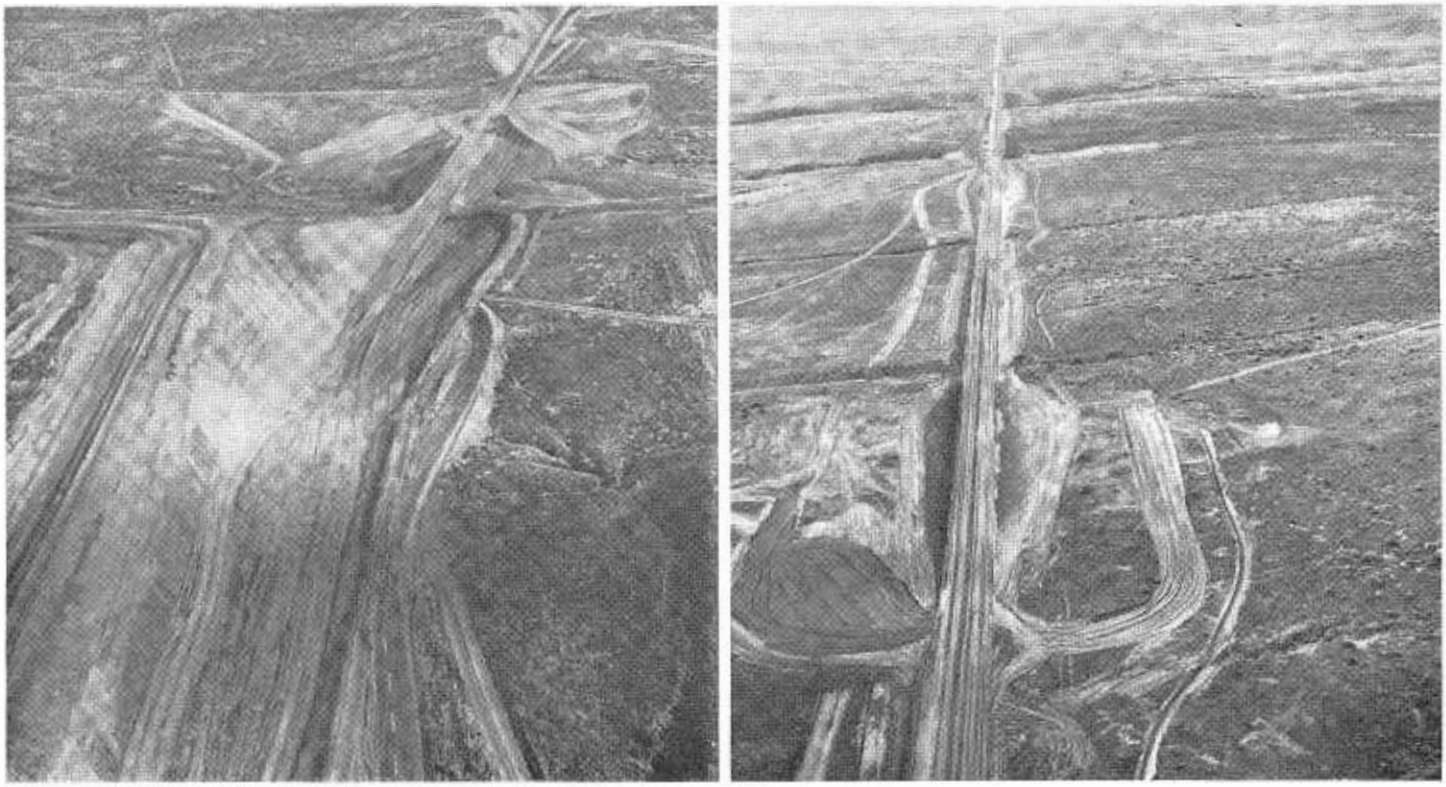


The north end of the Sign Route 41 relocation project joins the existing highway at Kettleman City.

Water Was a Problem

By contrast the new construction consists of a 32-foot all-paved section made up of three inches of plant-mixed surfacing over six inches of Class C cement-treated base on variable thicknesses of select material. This material came from four sources located throughout the project and was placed in layers ranging from 6 inches to 17 inches depending upon the quality of the underlying soil. The maximum grade of the new highway is 5.7 percent and there are but four horizontal curves with a total deflection of 85 degrees. Minimum radius of curvature is 3,000 feet and intervening tangents are at least a mile in length.

Because water is hard to come by in this arid area and because of the hot, dry summer winds that cause rapid evaporation, a dry-fill method was utilized in constructing all embankments. No water was applied until the fills reached 30 inches below finished grade, the requirement being 90 percent compaction at the in-place moisture content of the material by



LEFT—The deepest cut (65 feet) and the highest fill (70 feet) are shown in the aerial with the detour on the left. RIGHT—This view southward from the middle of the job shows the relocated private road connections taking shape.

the impact compaction test. When the cuts were opened it was found that the moisture content of the material was at or near optimum which resulted in excellent compaction with a minimum of effort. Above this plane, optimum moisture was applied and 90 percent compaction by the 10-layer method obtained.

The titled nature of the material to be moved presented to view a wide variety of quite different soils with varying shrinkage factors. It became necessary to revise the profile grade line, widen fills, and level gullies when it became apparent that an excess of material was developing over that originally anticipated.

Special equipment, designed and constructed by the contractor to cope with the 780,000 cubic yards of roadway excavation and the attendant 7,000,000 station yards of overhaul, has contributed to the satisfactory progress of the grading operations. Stretching out the length of their scrapers by adding a four-foot telescoping extension to the scraper bed enabled each rig to be push-loaded with 24 yards of dirt in one minute's time. Production reached as high as 11,000 yards a day with six of these special scrapers working.

Contour Variance

Although local rainfall is light, the ruggedness of the terrain and the lack of cover vegetation combine to cause rapid storm water runoff. Prior to the start of construction operations it became apparent that estimated quantities for some drainage items would be exceeded because of variances from available contour maps. This led to one of the more significant contract change orders—an increase of nearly $17,000 in related drainage items which raised the value of contemplated work to $588,600.

Drainage from the larger watersheds is carried in two reinforced concrete double-box structures and three field-assembled metal pipes of up to nine feet in diameter. Smaller contributory areas are provided for with the placement of 3,500 feet of culvert pipe varying in diameter from 18 inches to 60 inches. It was also necessary to relocate or realign several natural drainage channels which meandered through the construction area. This work required the removal of 16,000 cubic yards of material and extensive use of sacked concrete riprap, used both for slope protection and for culvert inlet and outlet structures.

Aggregates for plant-mixed surfacing were manufactured by the contractor from a material site near the beginning of the project. Stream-laid gravel deposits were fed to portable crushers, then screened and stockpiled. A continuous type bituminous mixing plant was erected, from which material was transported to the project in large bottom-dump trucks.

Bill Anderson was job superintendent for the contractor, a joint venture of Ralph B. Ellis and Fisher and Stokes Construction Company. The authors are the representatives of the Division of Highways.

To the statistics of savings in time and distance which this new facility will provide, there must be added certain more intangible benefits to the motorist. Where previously many chose alternate routes rather than drive this tortuous section, there now will exist an easily traversable roadway of high standards, making for greater driver comfort.

Sign Route 88

Ione-Jackson Highway Improvement Completed

By C. F. RODERICK, Resident Engineer

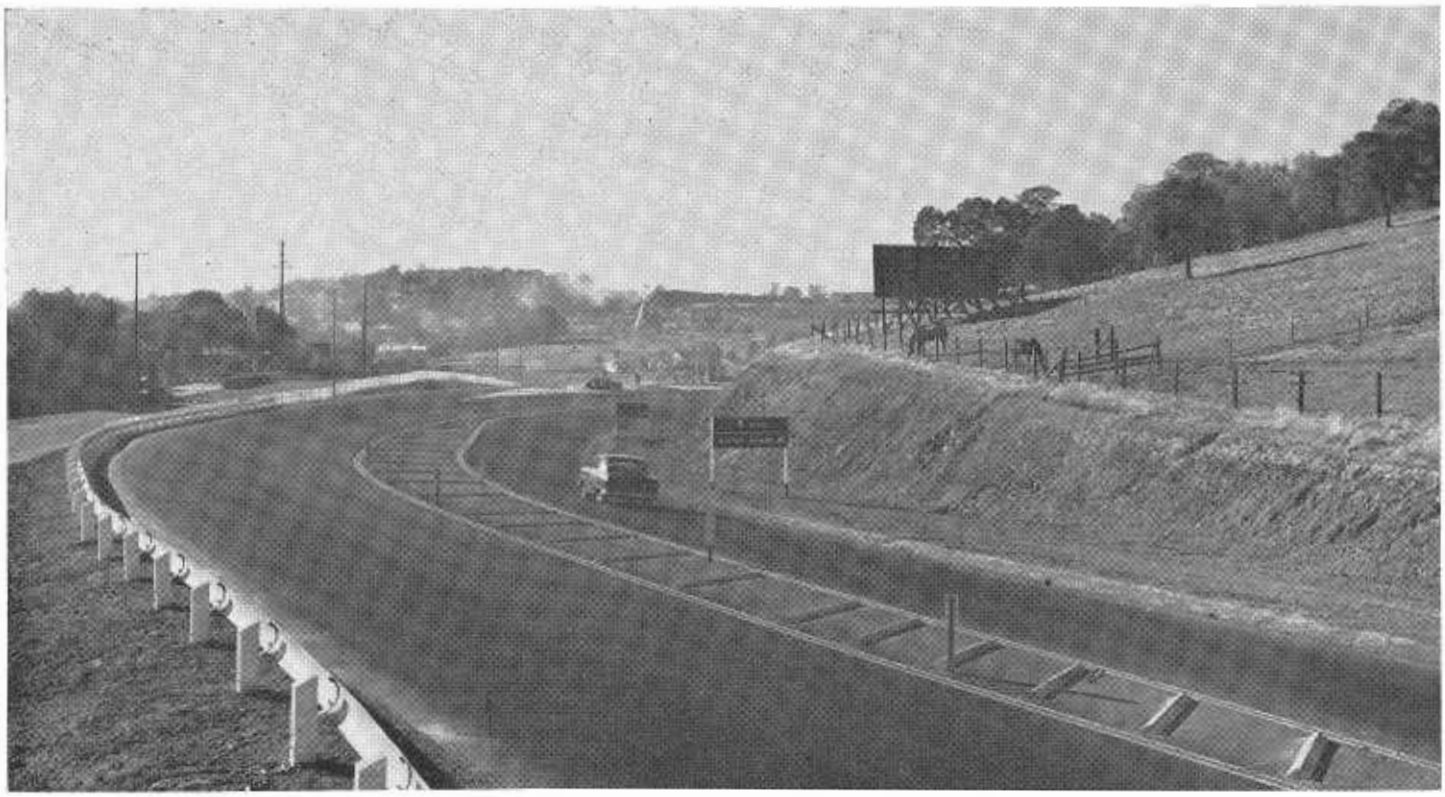
THE IONE-Jackson Highway through Amador County on State Sign Route 88 has just added a little more history to its already historical background by the recent completion of a 7.8-mile stretch of modern highway between Lancha Plana Road and a point one-half mile east of Martell. This 32-foot wide all-paved section of highway has eliminated over 50 sharp-radius curves and a narrow pavement to make a safe and easy route into the Sierra Nevada Mountains for the use of hunters, fishermen and lovers of nature of all kinds as well as for trucking, industry and other business traffic.

The new route closely follows the old, crossing it 23 times in all. The 12-mile-long Amador Central Railroad, said to be the shortest standard-gauge railroad in the United States, doesn't get too far from the highway alignment either. It is crossed by one underpass and three crossings at grade. The grade crossings now have new crossing alarm signals to protect them. At the East Ione Underpass, a new 95-foot riveted steel through girder span replaces the old wooden trestle underpass. Route 88 joins Sign Route 49 at Martell and the routes continue into Jackson before separating again. The last one-half mile of the project relocates the joint routes with an improved alignment which also provides a scenic view for the traveler.

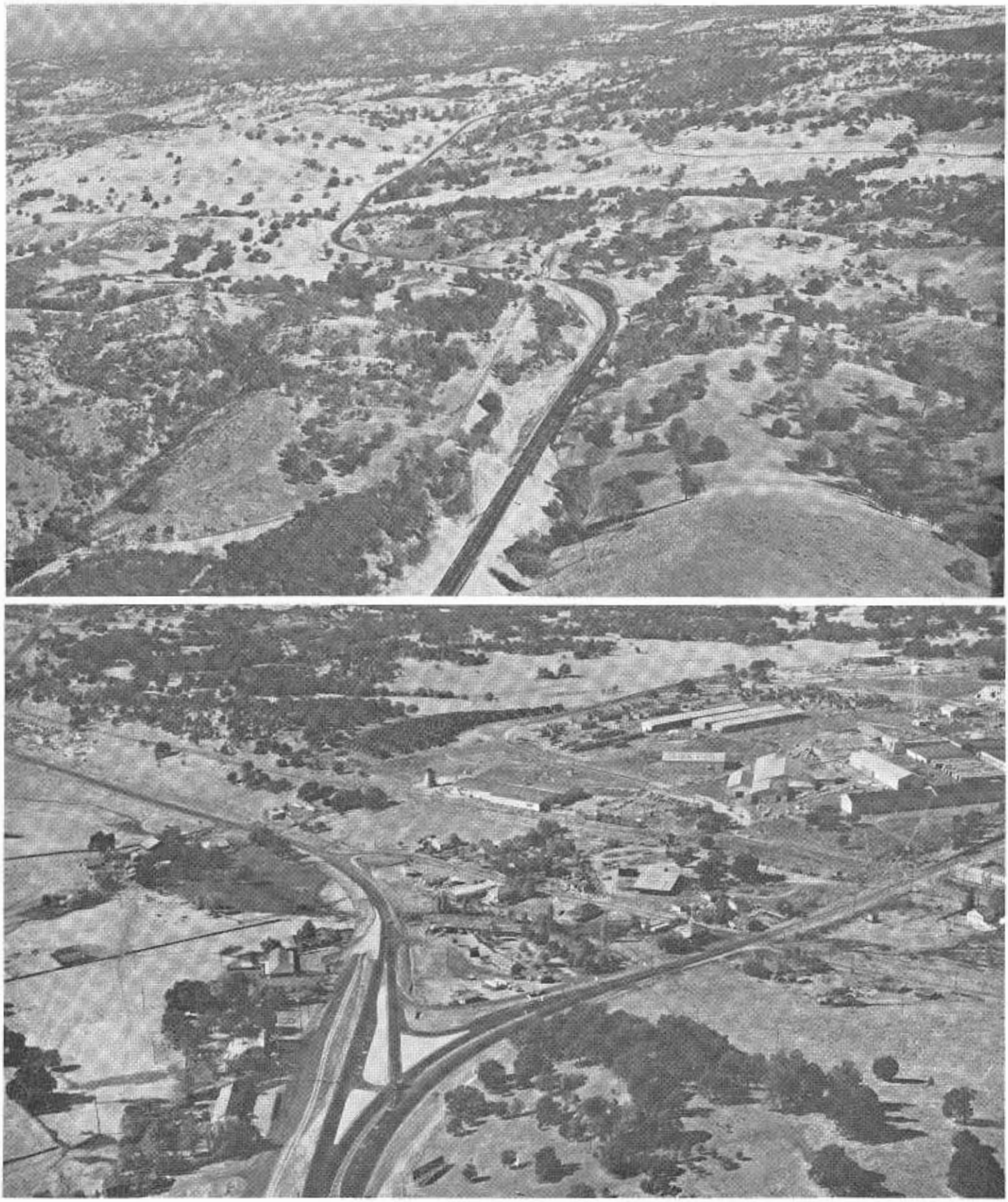
Intersection Modernized

The junction at Martell gives Amador County its first experience with a modern traffic-channelized intersection which includes traffic islands, traffic bars, and overhead highway lighting. The intersection occurs in a cut of 25-foot maximum which was widened considerably on the inside of the curve in order to secure a long sight distance and to provide needed fill material. About 65,000 cubic yards of roadway excavation was obtained within 1,000 feet and it was overhauled nearly two miles before being entirely used for making the embankments.

Many springs were encountered in the work, some of which were anticipated but many of which came as surprises. The most troublesome one was in the vicinity of the railroad crossing at Station 274 and at the lower end of the project's steepest grade, a 7 percent grade about 1,200 feet long. This was an anticipated spring area at the historic "Mountain Springs" stage coach station. The



The Martell Junction looking northwest. The highway in the foreground is combined Sign Route 88-49 with Sign Route 88 to Ione bearing left and Sign Route 49 North bearing to the right.



UPPER—Sign Route 88 looking toward Jackson. The new steel span of the East lane Underpass can be seen in the middle of the photo. LOWER—An aerial of the Sign Route 88-49 intersection at Martell with Route 88 veering left and Route 49 heading right. Compare this photo with the ground level shot on the previous page.

spring serving the old stage coach station was still running and it was the State's obligation to pick it up and convey the water to the property owner at the right-of-way line. Construction operations caused loss of the spring at the original location but it was picked up again from under the highway and satisfactorily piped to the right-of-way line. The whole area from the railroad crossing at Station 274 ahead for about 700 feet was a wide streak-like spring area, easily diverted from one location to another by even a small amount of excavation. All the soft material overburden was removed until hard material was reached, thus exposing a rugged, rough surface. The entire area was covered with filter material giving a minimum thickness of 18 inches but with many places three to four feet in thickness. Eight-inch perforated metal pipe underdrains were irregularly spaced diagonally across the roadbed to lead the water to an open ditch along the low side of the highway. The ditch conveyed the water to specially built culvert boxes which normally pick up the water for the property owner's use but in time of storm carry the excess water well away from the highway. Between the filter material blanket and the untreated base of the roadbed broken rock from the nearby cuts was placed, insuring a firm, stable roadbed over this spring area.

No Traffic Holdups

Work began on this contract in July, 1957, and continued until December, 1957. Work was then suspended until April, 1958, when the work was resumed. The job was completed on October 31, 1958. The contractor was required to carry traffic through the project during all of his operations. (This aspect of the project was covered in an article entitled "Dust Control" in the May-June, 1959, issue of *California Highways and Public Works*.)

The Ione to Jackson Highway has a history, not as far back as some roads in the State, but an interesting one. Here, in brief, are some of the highlights of that history:

In 1849 the first white people settled in the Ione and Jackson areas, and consequently a road was necessary to connect these new settlements. The first was a mere trail and was a long way around. This trail left Ione and went some five miles south to Buena Vista, then easterly to Jackson along Stony Creek and came in on what is now called Hoffman Street, still noted as "the old road to Ione." This road was widened by the first Jacksonite, a man named Tellier (at his own expense), to permit wagon traffic. Prior to the widening of this route, freight was $1,000 per ton from Sacramento to Jackson.

The third route, which is very much the same as the present route, came into existence in 1866 with the construction of the "Kennedy Grade," which was the road from Jackson to the Kennedy Mine and on to what is now known as Martell. Subsequently a connection between Mountain Springs and Martell was built. As this was the shorter and better route, the second route was abandoned. The first route is now paved and used as a county road; however, the connection to Mountain Springs has been abandoned.

Old Way Stations

As these early routes became more traveled, way stations were set up for changing horses and food and rest stops for the travelers. The first of these on the route from Ione to Jackson was the "Miller House" located some 500 feet west of the East Ione Underpass. All remains of the site were obliterated by the construction of the highway in 1921.

Another rest stop was located just a short distance east of the "Miller House." On this site, the remains of the "Rantlett Post Office" were still standing until the construction of the present highway. The third stop is believed to have been in what is now known as "Sunnybrook." The next and possibly the most widely known, was "Mountain Springs" where evidence of buildings, etc., can still be noticed. The Mountain Springs area is now set up as a roadside rest area with benches and tables and fresh spring water for weary modern-day travelers.

The trip between Ione and Jackson is only a 15-minute drive today; but in the early stages, it was a full-day's ride on horseback or by stage.

In 1921 the California Highway Commission opened bids for state construction on this same stretch of highway. The construction work was done with old armored cars, trucks and tanks of World War I vintage. This was the last work done on the highway except for some work in the Martell area in 1932, until construction was started in 1957.

This later construction, completed in October, 1958, converted the highway to a 24-foot paved road with four-foot paved shoulders. The work was done by Transocean Engineering Corp. of Hayward; the Resident Engineer was C. F. Roderick, and was under the jurisdiction of District Construction Engineer W. F. Fleharty.

Commuter Habits Are Object of New Study

The State of California has begun a study of the commuting habits of its downtown Sacramento employees with the possible objective of rescheduling working hours to spread the traffic volume evenly throughout the hours of going to and from work.

The survey is part of Governor Edmund G. Brown's program for increased efficiency in State Government and is being conducted by a committee under the chairmanship of James F. Wright, Deputy Director of the Department of Public Works.

The Department of Public Works was the first state agency to make such a study of the commuting habits of its employees.

Questionnaires have been distributed to nearly 12,000 state employees in 11 state-owned buildings and 13 privately-owned buildings in the downtown area.

The employees indicate in the questionnaires how they travel between home and work, and the major traffic corridor they use. They are also asked to express a preference for hours of work – ranging from 7.30 a.m. to 8.30 a.m. beginning time, and including either one hour or 45 minutes for lunch.

MEDIAN STUDY

Continued from page 8 . . .

toring courtesy will continue to be the most effective weapons in the fight against traffic accidents.

Categories Described

For the purposes of the safety study, various median designs were placed in two categories – "deterring" or "nontraversable."

The deterring types includes many of the earth medians, the raised bar or low dike facilities, and the center strips with mountable double curbs.

The nontraversable category includes medians with barriers, and nonmountable curbs, separate roadways, and earth medians with a continuous obstruction or with steep slopes. In addition, all medians more than 100 feet wide were classified as nontraversable.

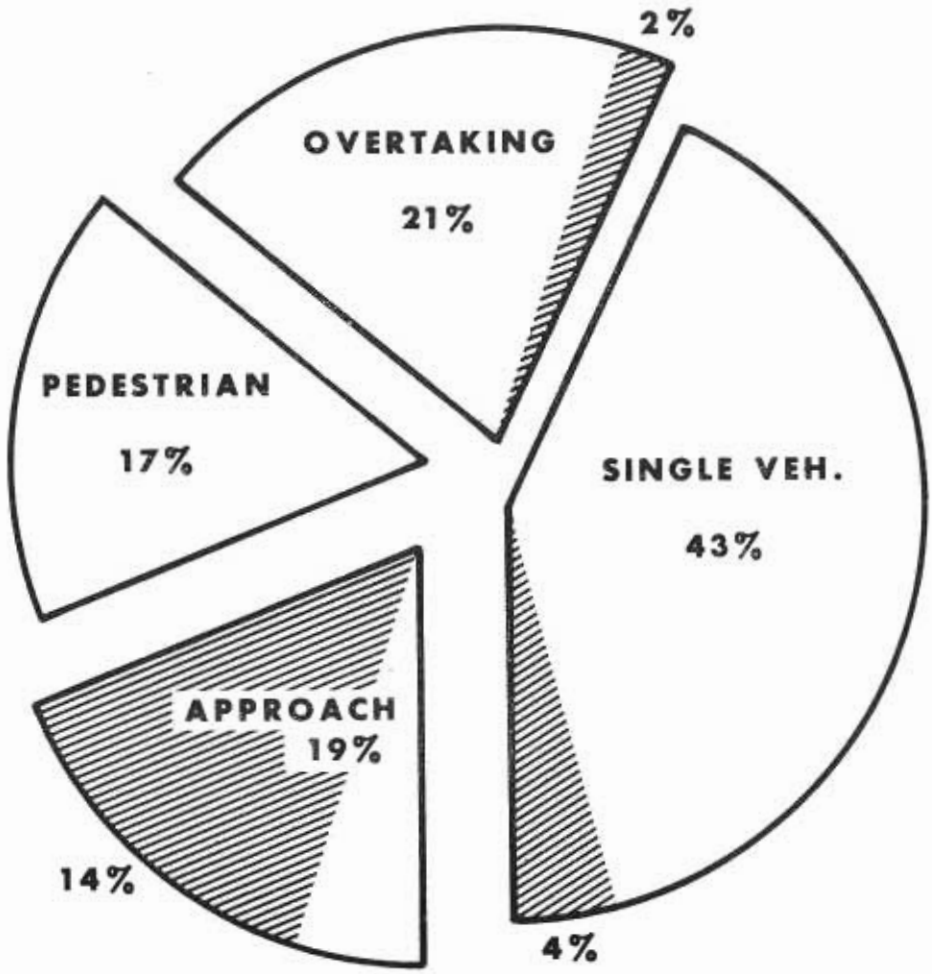
Part One of the safety study involved an analysis of 8,000 accidents which occurred over a two-year period (1956 and 1957) on the 265 miles of divided highways selected for the study.

Among the items considered in this portion of the study were the influence of traffic volume on the accident rates for highways with both types of median, and the influence of the median design on the type and severity of accidents.

Statistics were developed which indicated that operating conditions, as measured by average daily traffic, made a difference in the relative safety of routes with deterring medians and those with nontraversable medians.

In the volume range from 15,000 to 130,000 vehicles a day, nontraversable median designs had higher overall accident rates and higher injury (includes fatalities) rates. As expected, the nontraversable medians had fewer head-on accidents than deterring medians, but the higher rates for overtaking and single vehicle accidents more than offset this advantage. In this volume range, head-on accidents account for 1/25 of all accidents and 1/21 of the injury accidents.

On highways carrying more than 130,000 vehicles a day, the nontraversable medians showed lower rates than the deterring type for both injury accidents and all accidents.



This chart shows the types of fatal accidents on California freeways during 1956, 1957 and 1958. The shaded portion represents cross-median accidents.

Past Studies Noted

The findings of this portion of the study coincide with those of two before-and-after studies of freeway sections where barriers have been installed in the past.

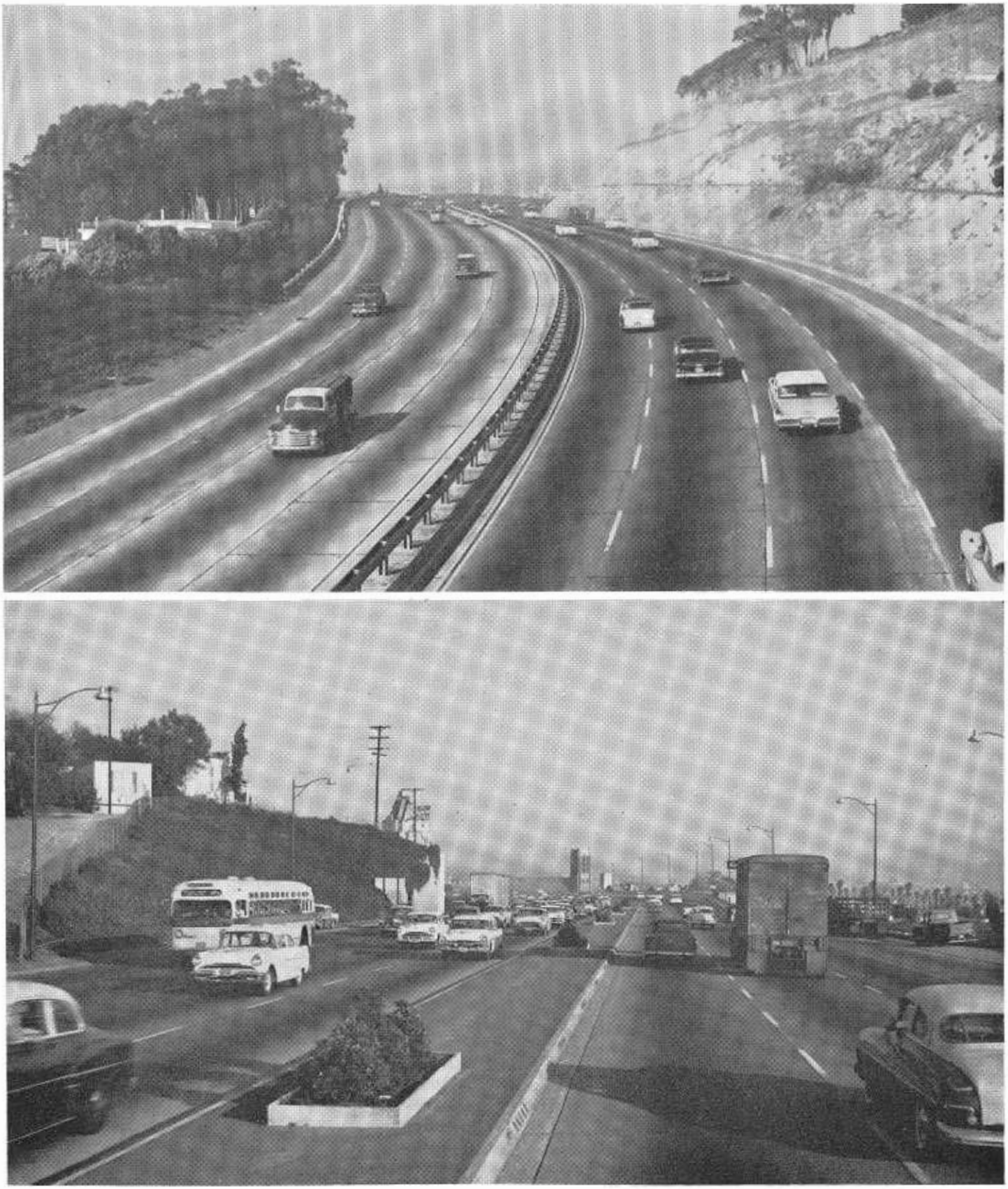
Since 1951, the division has made three such before-and-after studies. The accident rates decreased after a steel guardrail was placed in the median on a section of the James Lick Freeway in San Francisco; however, the results were much different in the two other cases.

On the San Bernardino Freeway in Los Angeles, the accident rate jumped 75 percent and the injury rate increased 116 percent after a median barrier was installed. On the Grapevine Grade (US 99) in Kern County, the accident rate went up 88 percent and the injury rate climbed 53 percent in the afterperiod.

In view of the unfavorable record of barriers in two of the before-and-after studies and also in the new 265-mile study, it is worthwhile to examine some of the probable reasons for the adverse effect of barriers installed in the past.

First, the introduction of a physical barrier in a traversable or deterring median *reduces the usable width of the median*, thereby limiting the space available to motorists for emergency maneuvers and parking in the center strip. There are undoubtedly a large number of vehicles which enter and in some cases cross the median without being involved in an accident. More important, perhaps, is the fact that stalled vehicles are frequently parked in median areas.

In addition, collisions with barriers, such as those used in the past, may mean serious injuries to occupants of a vehicle, or result in other collisions as a vehicle bounces back into the traffic stream.



UPPER—The effectiveness of various median designs was evaluated in a recent Division of Highways safety study. Medians with barriers, such as this one on the James Lick Freeway in San Francisco, were among those classified as nontraversable. LOWER—This type of curbed center strip on the Hollywood Freeway in Los Angeles was one of the deterring median designs included in a recent Division of Highways freeway safety study.

Curbed or Earth Medians

These are probably the main reasons why Part One of the study indicates that a nontraversable barrier median is not as good as the curbed or earth median from the standpoint of overall traffic safety or severity of accidents, except on highways carrying extremely heavy traffic.

As a corollary to the accident analysis of Part One, the second phase of the study covered only the 407 fatal accidents which happened on the State's full freeways in 1956, 1957 and 1958. Emphasis was on the fatal cross-median accidents.

The purpose was to determine a basis for dealing with the problem of the infrequent but usually serious cross-median collision through the use of median barriers.

In connection with this part of the study, it is appropriate to note that 10 times as many fatal head-on accidents occur each year on conventional roads, streets and highways in California as occur on the State's freeways. Nearly all such crashes on both kinds of highway are the result of driver error or negligence.

While many people are inclined to attribute head-on crashes which happen on ordinary roads, streets and highways to speed, drinking, immaturity or some other driver factor, the comparatively few which occur on freeways are often blamed on highway design.

The factual study reveals this widespread impression to be a fallacy.

Pedestrian Rate High

As a starting point for the second portion of the study, fatal freeway accidents were classified according to type. As shown in the accompanying chart, 43 percent of the fatal accidents in the three-year period involved only *one vehicle;* an *overtaking* collision was responsible for 21 percent of the fatal accidents; and *pedestrians,* most of them illegally hitchhiking or using the freeway as a footpath, were involved in 17 percent of the fatal mishaps. (See "pie" chart.)

About 19 percent of the fatal smashups were the approach type. This includes crashes brought on by wrong-way drivers, as well as head-on accidents in which a car or truck crossed the dividing strip.

The number of fatalities resulting from each type of accident was also recorded. Forty-two precent of the fatalities resulted from single-vehicle accidents; 20 percent from overtaking accidents; 24 percent from approach accidents of all types; and 14 percent from pedestrian mishaps.

Crossings of the median were present in 55 of the approach type fatal accidents, seven of the overtaking type, and 15 of the single-vehicle fatal accidents. (See shaded areas in chart.)

It should be explained that the accident classification is determined by the first event. Thus, the cross-median overtaking accidents involved an overtaking collision before the vehicle crossed the madian.

Cross-Median Crashes

A significant fact derived from the classification of accidents was that the 62 cross-median collisions of two or more vehicles accounted for 95, or about one-fifth of all fatalities on freeways during 1956, 1957 and 1958. (During the same years there were 11,005 traffic fatalities on all types of streets, roads and highways in the State.)

The next step was to attempt to find the conditions under which cross-median collisions of two or more vehicles are most likely to occur.

The large majority of these accidents, it was learned, happened on sections of a relatively few heavily traveled freeways. In fact, two-thirds of all the fatal cross-median collisions occurred on routes which carry more than 60,000 vehicles a day.

Thus, to make a significant attack on the problem of cross-median collisions, consideration should be given to the installation of barriers on freeways with average daily traffic of more than 60,000 vehicles.

This poses a dilemma, since the first part of the study, as well as past experience, shows that barriers may have a detrimental effect on accident and injury rates, except on routes which carry more than 130,000 vehicles a day.

The answer to this dilemma may be found in the operating effectiveness of the new types of barriers developed by the Materials and Research Laboratory in the course of the impact tests.

Barrier Requirements Listed

To be an effective aid to safety, a median barrier must meet very exacting requirements. It must, of course, prevent crossings of the median; but it must also absorb high speed impact in such away as to minimize possible injuries to occupants of the vehicle and reduce the danger of the vehicle bouncing back into the traffic stream.

Barriers installed in the past have not been satisfactory in meeting all of these requirements, the crash tests revealed. The new designs, however, appear to be more effective, particularly in reducing the severity of collisions with the barrier.

This leads to the encouraging belief that the new barriers will prove to be beneficial under actual operating conditions on heavily traveled freeways.

Auto Club Counsel J. A. Davis Retires

J. Allen Davis, for 20 years general counsel for the Automobile Club of Southern California and representative of the motorists' organization in Sacramento, announced his retirement in July. He has been succeeded by Harry V. Cheshire, Jr., former legislative counsel.

Davis rewrote the California Vehicle Code in 1923 and has served continuously on the California Advisory Committee on Motor Vehicle Legislation since his first trip to Sacramento in 1922. From 1946 through 1950 he served as secretary to the Committee on Laws and Ordinances of the President's Highway Safety Conference.

Davis is a member of the statewide Highway Committee of the California State Chamber of Commerce which has sponsored important highway legislation in California.

He was born in Denver, educated in the public schools of Los Angeles and graduated from Stanford University in 1912, receiving his Juris Doctor there in 1914.

SUTTER FAS

Continued from page 42 . . .

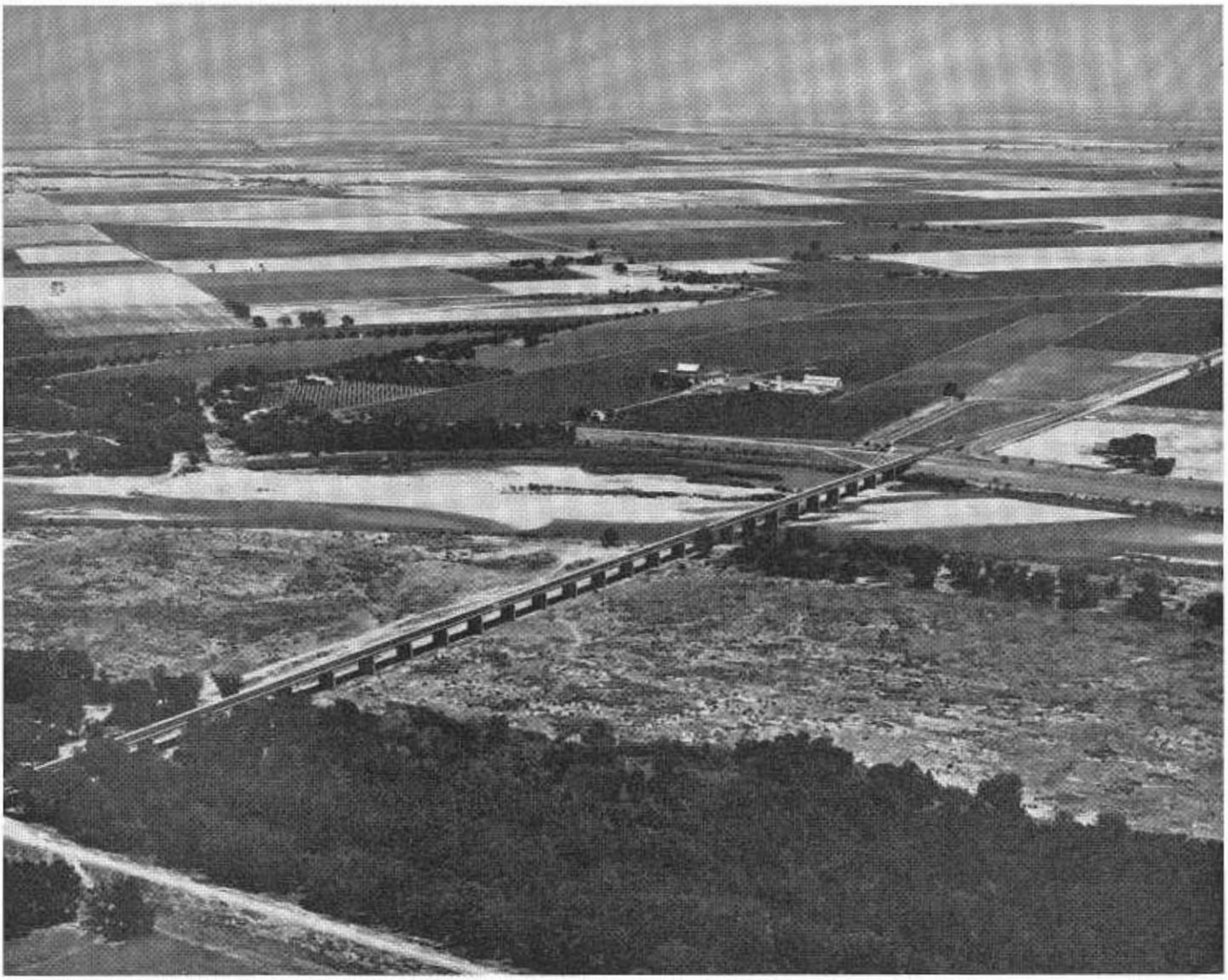
new highway running southeasterly from the bridge to tie into State Sign Route 24. This new highway is known as Drescher Boulevard. The latter contract was the one just completed and opened to traffic on June 1, 1959.

Some of the outstanding features of the completed FAS route, including that portion taken into the State Highway System since construction are:

1. The unrestricted highway distance between Sacramento and Yuba City is reduced from 52 miles to 41 miles.

2. The route eliminates a great many curves and many miles of dangerous levee roads by using flat valley alignment. (Only five curves with a minimum radius of 2,000 feet in 14 miles of new alignment).

This new section of Drescher Boulevard in Sutter County is the final link in 41 miles of improved highway between Yuba City and Sacramento. From a connection with State Sign Route 24, the recently completed FAS road (center) extends northwest toward Nicolaus, where a new bridge carries traffic across the Feather River.



Replacing the structure washed out in the floods of December, 1955, this modern concrete girder bridge now carries traffic across the Feather River near Nicolaus. Cost of the bridge and its immediate approaches was $2,300,000. Site of the old bridge is marked by the open space through the trees at the town of Nicolaus (left center).

3. The project provides a route from Yuba City to Sacramento without a single railroad crossing.

4. A 41-mile direct route from Yuba City south to Sacramento is established without a single arterial stop or traffic signal, while northbound traffic from Sacramento to Yuba City has only three arterial stops, two of which are at the outskirts of Sacramento and Yuba City.

This FAS route is truly a "farm to market" highway in the full sense of the term. Much credit for the successful completion of this project must go to the Board of Supervisors of the County of Sutter, for without their tenacity to see the completion of the project, it would never have been completed. All FAS funds allocated to Sutter County have been spent on this project.

The total amount of federal funds spent on this project is:

FAS funds and "D" funds	$574,000
Emergency relief funds	1,150,000
Total	$1,724,000

The total amount of state funds spent on this project is:

State highway matching funds and county highway aid act funds	$323,000
Chapter 20 Funds (Construction and Employment Act of 1946)	227,000
Chapter 9 Funds (Flood Relief Law of 1956)	1,150,000
Total	$1,700,000

The total amount of county funds spent on this project is:

County total	$145,000

The grand total of all funds is:

Grand total	$3,569,000

The Division of Highways has reported that, to date, more than 1,600 of its employees have been presented with 25-year service certificates and pins.

IMPACT TESTS

Continued from page 16 . . .

in the bus to record the kinematics of the anthropometric dummy.

Pressure sentitive micro switches mounted in the path of the crash car were uesd to trip flashbulbs located behind the barrier in view of the tower camera. These flashbulbs permitted accurate evaluation of the vehicle approach velocities by noting these flashes on the film of the 1,200 f.p.s. overhead camera. This particular camera also recorded 1,000-cycle timing pips on the film which permits accurate timing of the sequences as well as crash car velocities.

A third flashbulb mounted on the crash car was set to fire at a 2 "G" deceleration level. A pulse from this flash placed a pip on the accelerometer oscillograph base line, which permitted correlation of the oscillograph impact records with the reactions observed in the various data film.

A segmented drum revolving at 1,600 r.p.m. in view of the cameras provided a time interlock between all cameras.

Stresses Correlated

On those occasions when strain gage readings were made of the various guard rails, the individual timing pips were taken from the flashbulb circuits and placed on these oscillograph recordings in order to correlate the various stresses with the position of the crash car.

Altogether the operation of various cameras and the means of sequencing these units with the various instruments may appear complicated. In effect the system was relatively simple as all equipment was operated from a central control board. The care taken in interrelating the timing of sequences during the various crashes has paid off in correlating details while working up the final studies.

The actions and reactions of the anthropometric dummy during the crashes have been found to be exceedingly complex. In a number of the initial crashes a portion of the car roof was removed over the driver's seat in order to permit high speed photographic study of his gyrations. In general, the 30° angle of impact at 60 m.p.h. produced a transverse impact of 15 to 25 "G" against the left front door, causing the dummy to break the door open. During the initial part of the impact, the guard rail would retain the car door closed, but as the car reflected from the rail, the door would fly open. In most instances the seat belt was the only thing that prevented the dummy from being ejected from the car.

A number of other rather pertinent and interesting observations were made during the crash studies, but space does not permit inclusion of all of these. One rather unique experience was that with the special radio control receiver and relay system, which was used in all 25 crashes, the only damage sustained in the period was the loss of one tube and one wire pulled loose. This is an outstanding record as accelerometers on the car frames occasionally indicated peak decelerations as high as 200 "G."

TWENTY-FIVE-YEAR AWARDS

Employees who received twenty-five-year awards since those listed in the March-April edition of *California Highways and Public Works*

DIVISION OF HIGHWAYS

District I
Percy A. Main

District II
Cecil F. Koenig
Frank Noel

District III
James C. Cleek
Florence Jewell Schade
Henry R. Vierra

District IV
Leo Immel
Harry B. Pearce
Sidney Silver
Joseph D. Silvera
Lawrence D. Bigelow

District V
John E. Brocklebank
Arthur F. Durrant
L. E. Elder
Elmer H. Tenscher

District VI
Henry H. Rickels
Samuel A. Dodd
Raymond E. Munson

District VII
Marshall W. Burke
Bob J. Carter
Ralph V. Chase
Elmer L. Smith
George F. Stransky
Erwin O. Tagley
Ralph Truesdale
Leonard Walter Ford
Charles S. Gwinnup

District VIII
Leo P. Wagner

District X
Joe A. Macedo
Francis O'Neill
Joseph M. Silva
Clair N. Steele
Carl A. Bennett
Frank T. Lavagnino
Joseph H. Perrin
Kirk Thomas

District XI
Austin C. Erwin
Claude L. Horton
Edward W. Shedaker
G. E. McCain
Laurence L. Pearson
Carl A. Wolin
Fred Young

Headquarters Office
Keith E. Pilkenton
Thomas W. Reynolds

Bridge
C. L. Caldwell
R. Robinson Rowe

Materials and Research
Roy B. Stratton

Shop 7
Arvid H. Mathlin

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY
Jennie C. Thomson

Winners Announced By Merit Award Board

Employees of the Department of Public Works receiving certificates of commendation and cash awards since the last list was published in the May-June issue of the magazine are:

CHARLES D. ANDERT, Highways, San Diego. Certificate of commendation for recommending use of "KEPS" nuts in Traffic Actuated Dispatchers.

DONALD D. ARNDT, Architecture, Sacramento, $40 for recommending use of a color code to identify project folders.

GORDON D. HANSON, Architecture, Northridge, $40 for recommending zoning of gang showers and installation of gate valves for servicing.

G. W. HEVRON, Highways, Oildale, $25 for recommending installation of coil springs on tail gate hinges of mechanics' trucks.

GUY C. HUDSON, Highways, Big Sur. Certificate of commendation for recommending use of an attachment for front-end loaders.

JAMES LEM, Highways, San Francisco, $25 for recommending use of double-exposure process for reproducing contract plans.

JACK LYNN, Highways, Bridgeport, $150 for recommending use of a special wrench for installing shear bolts on rotary snow plows.

WILLIAM A. MCCARRON, Highways, Redding, $25 for recommending revision of control and detail cards.

JACK N. MCQUOWN, Highways, Redding, $10 for recommending revision of daily shop time card.

MISS C. VERA MESQUITA, Highways, Sacramento, $40 for recommending use of addressograph machine for addressing labels to engineers and district offices.

BILL A. METZEL, Highways, San Bernardino. Certificate of commendation for recommending that use of copyrighted material in State publications be controlled.

LAWRENCE M. PERRY, Highways, Norwalk, $15 for recommending an improved position for pickup brooms in street sweepers.

CONRAD G. PUDER, and FREDERICK W. SCHWARZ, Highways, San Luis Obispo, $80 shared equally for recommending use of lightweight timber barricades.

HAMILTON QUAYLE, Highways, Sacramento, $50 for recommending enactment of legislation requiring cities to file legal descriptions and maps of annexations with the Division of Highways.

MRS. WILMA F. RIEGER, Highways, Stockton, $30 for recommending that counties, routes and sections be specified on work orders.

PIPPO M. SCANDURRA, Highways, San Francisco, $15 for recommending addition of driveway details on the standard plan sheet.

GEORGE A. SMITH, Highways, San Diego, $40 for recommending installation of an electric timer to the off switch on all white printer machines.

Street Naming Honors District II Engineer

Aramayo Way is a new road name on the official maps of Tehama County—probably the first instance on record of a county road being named in recognition of the work of a State Division of Highways engineer.

The road runs between the towns of Los Molinos and Gerber, south of Red Bluff. It was completed this spring as a federal aid secondary construction project, and is named for Luis Aramayo, assistant district engineer of District II (Redding). Aramayo formerly served as City and County Co-operative Projects Engineer for the district.

Aramayo was invited to the ribbon-cutting ceremony without being told of the honor. As reported in the Corning *Daily Observer:*

"Aramayo was taken completely by surprise by the gesture of naming the road for him. Announcement of the choice of name for the stretch of highway linking the two communities was made by Don Drane, president of the Los Molinos Chamber of Commerce.

"Selection of the name by the board of supervisors, Drane said, was made in recognition of Aramayo's interest in the development of highways in the smaller counties of the State."

The honor accorded Aramayo is considered an additional mark of California's excellent state-county relationships in the planning and construction of county roads on the Federal Aid Secondary System.

New Booklet Answers Freeway Questions

The booklet, *Freeway Facts*, which is distributed at public meetings on proposed freeway routes, has been revised and reprinted by the Division of Highways.

The booklet outlines the freeway route selection procedure and answers general questions about freeways as part of the division's continuing effort to keep the public fully informed on freeway route matters.

Statistics have been brought up to date, and some of the material in the booklet has been revised to better answer questions frequently asked at the scores of public meetings on proposed freeway routes which are held each year by the Division of Highways.

Charles K. Boyle

Charles K. Boyle, Highway Engineering Technician, was killed by a truck while working on a construction project near Napa on June 4th.

He came to work for the Division of Highways in July, 1955, as a junior civil engineer.

Prior to coming to work for the Highway Division he was employed as an engineer by the City of Reno, Nevada, the California Division of Beaches and Parks and a private engineering firm.

He was born in Brooklyn, New York, where he graduated from high school in 1935.

During World War II he served with the U. S. Army in the European and Asiatic Theaters. He was awarded the Presidential Unit Citation with cluster and the French Croix de Guerre.

He was active in Boy Scout work.

He is survived by his wife, Carol, a stepdaughter, Billie Jean, of San Francisco, his mother, Mrs. Charles Cameron Boyle, of Brooklyn, New York, and a brother in East Meadows, Long Island.

WORK IMPROVEMENT

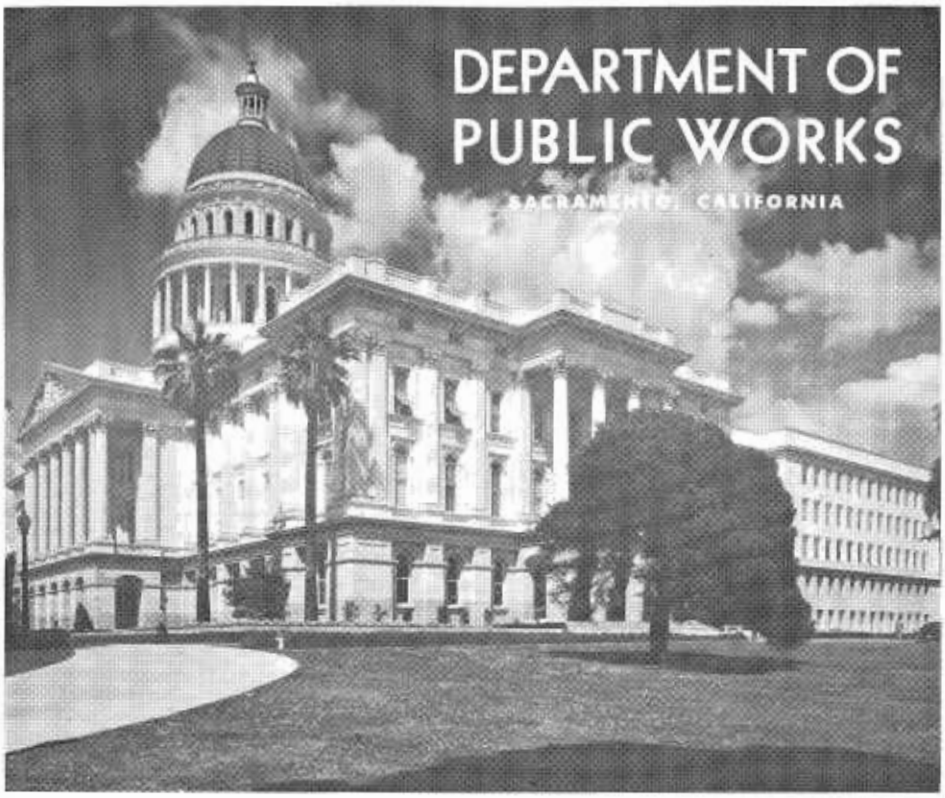
Continued from page 1 . . .

that frequent evaluation is made of the progress of the program within his division.

Each division chief will be assisted by a division WIP co-ordinator, whose duties will be similar within the division to those of the departmental co-ordinator.

As much as possible, WIP will be carried on through the regular organizational channels within each department. It is not the intention of WIP to curtail the right of any line official to determine work organization and methods in his section and the number of temporary WIP committees or positions under the program will be held to a minimum.

EDMUND G. BROWN
Governor of California



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District VII

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