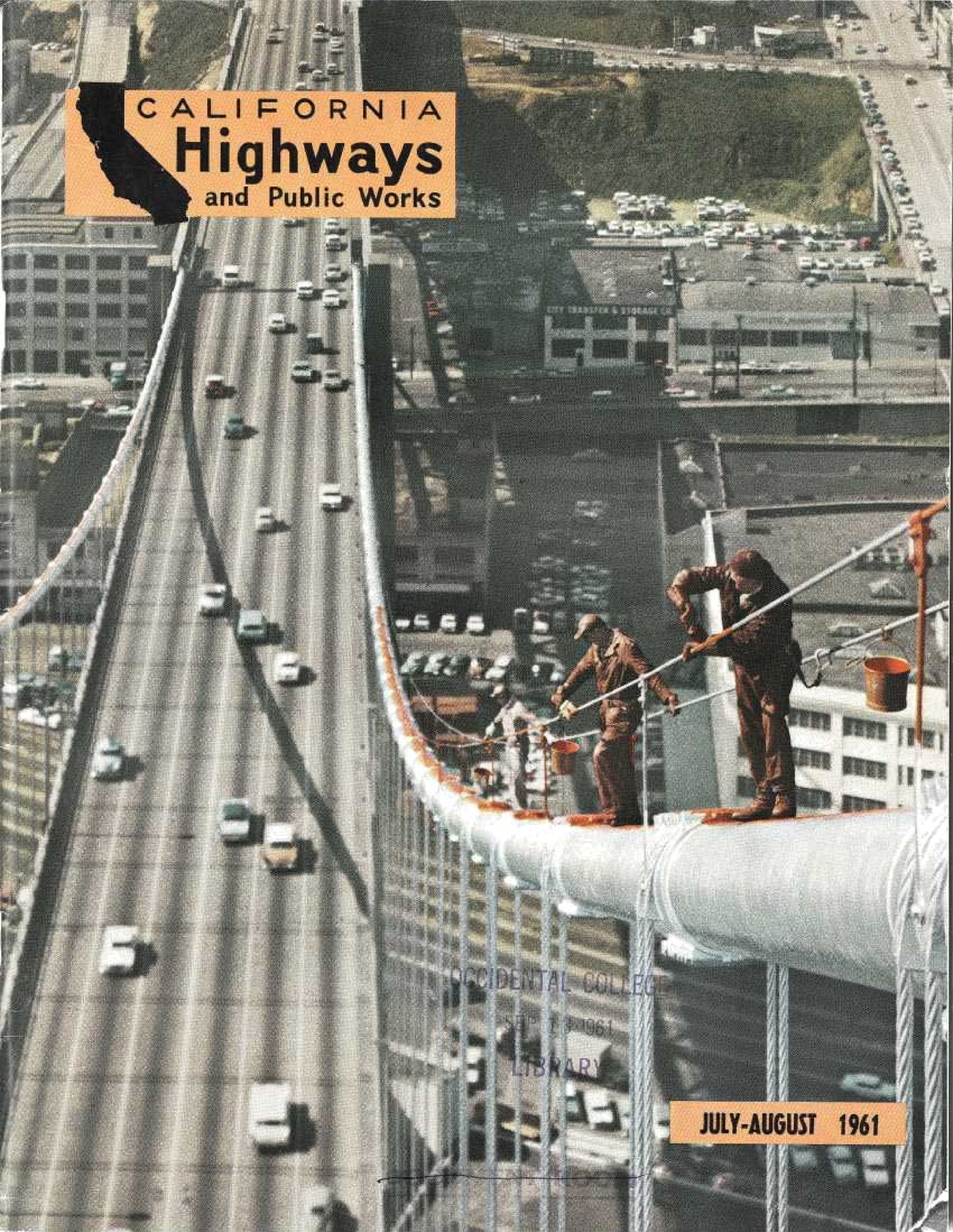
CALIFORNIA Highways and Public Works



JULY-AUGUST 1961

State of California Department of Public Works DIVISION OF HIGHWAYS CIRCULAR LETTER NO. 61-158	File Classification: Planning - Advance Planning - No. 17
TO: All District Engineers and Headquarters Office Department Heads	Date Issued: June 15, 1961 Expires: June 15, 1966
SUBJECT: Cooperation of Division of Highways With Other Governmental Agencies	
References: None	

Increased emphasis is being given by the Governor's office to the necessity for cooperation between State agencies and for cooperation of State agencies with other governmental units at all levels of authority. In the field of highway transportation this policy points toward working with other agencies and coordinating our planning and operations functions with them to the maximum extent possible. A constant attitude of cooperation and an appreciation of the diverse objectives of these agencies as important and vital factors in the public interest and economy of the State should be maintained at all times by Division personnel.

Recognizing that there is no provision of law at the present time which requires coordinated planning of various governmental agencies engaged in the field of transportation, the California Legislature, in a recent session, resolved as follows:

> "That all state and local governmental agencies having jurisdiction over the planning, development, construction, and operation of public transportation facilities including freeways, highways, toll bridges, roads, streets, vehicular parking, motor transit, rail transit, rail rapid transit, and such other public facilities as relate to the movement of people, are hereby urged to cooperate voluntarily in the joint exercise of their powers as is now permitted by law, in planning and developing public transportation facilities to the end that optimum safety, convenience, efficiency, and economy in the movement of people in metropolitan areas may be achieved; and be it further
>
> RESOLVED, that the Secretary of the Senate be directed to transmit copies of this resolution to all state and local governmental agencies having jurisdiction over the planning, development, construction, and operation of public transportation facilities including freeways, highways, toll bridges, roads, streets, vehicular parking, motor transit, rail transit, rail rapid transit, and such other public facilities as relate to the movement of people."

The Department of Public Works and the California Highway Commission subscribe to this legislative directive, copy of which is attached for reference purposes.

The outstanding results of the recent 210, SCR 26 and SCR 62 studies and many other cooperative ventures with governmental units point to the value to the Division of Highways of coordinated effort with other agencies of the State.

Accordingly, I desire that the heads of departments fully apprise their personnel of this philosophy and exercise cooperation and coordination of effort with other agencies within the limitations imposed by the law and wherever it will serve the public interest.

J. C. WOMACK
State Highway Engineer

California Highways and Public Works

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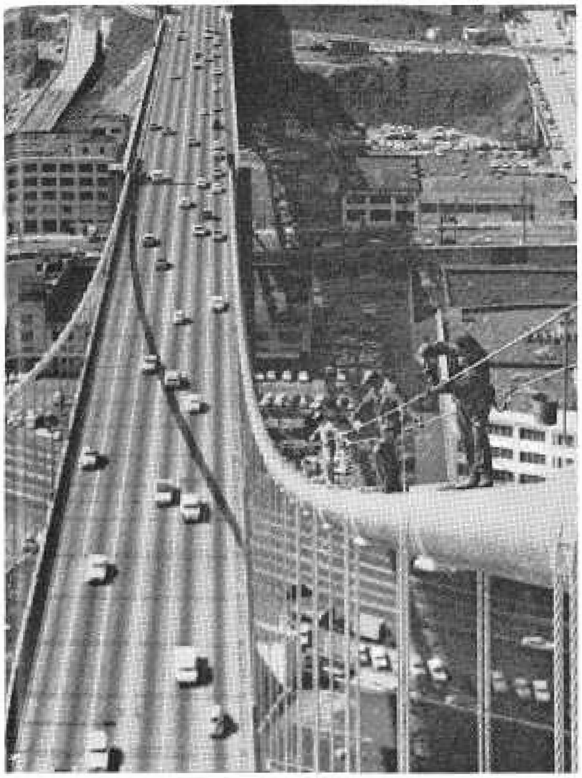
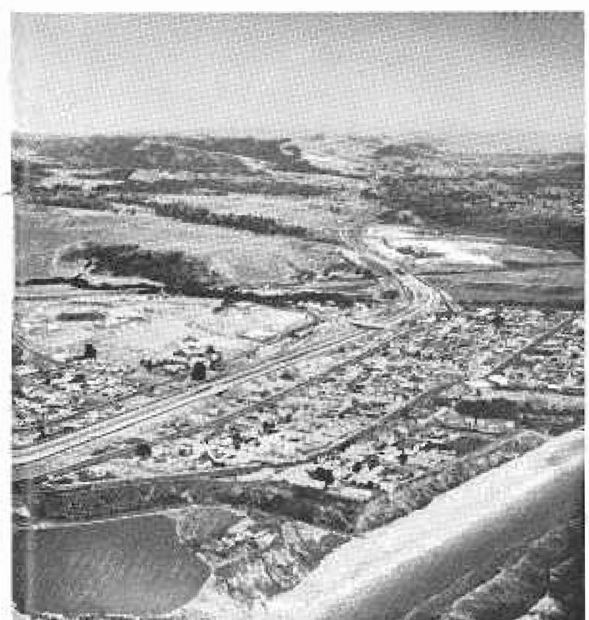


FRONT COVER—Members of the paint crew work on one of the main cables of the San Francisco-Oakland Bay Bridge high above the City of San Francisco. (See "Painting the Bridge," beginning on page 5.)
—Photo by Bob Dunn

BACK COVER—The new section of freeway on U.S. 101 through the City of Pismo Beach parallels the old highway. The broad street farther right is Sign Route 1. The City of Arroyo Grande is in the right background. (See "Pismo Beach," beginning on page 2.)
—Photo by William R. Chaney



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Pismo Beach

Last City Street Section on U.S. 101 In San Luis Obispo County Eliminated

By ROY ALDERMAN, District Construction Engineer

THE MAY completion of the 2½ mile Pismo Beach Freeway has eliminated the last section of city street routing for Highway 101 in San Luis Obispo County. Completion of this project brings the freeway and expressway mileage in San Luis Obispo County to a total of nearly 70 miles. This leaves less than three miles of U.S. 101 in San Luis Obispo County as undivided highway, and even this minor mileage will be eliminated in the near future.

Pismo Beach is an important recreational area with its fine beach, mild climate and excellent clamming and fishing. There is evidence that these factors have attracted tourists to this area for at least 3,000 years. Indian artifacts found in the Contractor's privately owned borrow site were examined by archaeologists from the Division of Beaches and Parks. It was the archaeologists' opinion that the artifacts were 3,000 to 4,000 years old. It was also their opinion that these Indians were not native to this area but were tourists from Arizona. From the number of clam shells associated with the artifacts, the Indians were obviously attracted by the easy living. This tourist attraction in modern times has resulted in an extremely heavy annual increase in tourists and summer residents.

Old Highway Undivided

The existing facility through Pismo Beach was a four-lane, undivided highway with parking on both sides of the roadway and numerous cross streets. The high volume of both local and through traffic with the attendant turning movements and cross traffic created an intolerable traffic situation and was the cause of numerous accidents. The frustration and congestion thus created has been eliminated by the completion of this project.

Alternate locations for this freeway were severely restricted by the terrain. Pismo Beach is situated on a narrow shelf between the Pacific Ocean and the Santa Lucia Mountains. The Santa Lucia Mountains in this area are very steep and rugged and construction of a highway through the mountainous section would have been prohibitive. The location selected for the new freeway was parallel to and approximately 200 feet east of the existing route.

> Mr. A. M. Nash, *District Engineer*
> *Division of Highways*
> *San Luis Obispo, California*
>
> Dear Mr. Nash: At the regular meeting of the City Council of the City of Pismo Beach, held May 1, 1961, the Council voted unanimously to write a letter to the Division of Highways commending your Resident Engineer on Pismo Freeway Construction, Mr. L. D. Kraatz, on the manner in which he handled different mattters that came up during construction, for his help and cooperation with the city, and his attendance at Council meetings, with answers to problems before the Council, at any time he was requested to do so.
>
> It has been a pleasure, to the Council and city personnel, to work with Mr. Kraatz.
>
> Very truly yours,
> CITY OF PISMO BEACH
> Elizabeth Jatta
> *City Clerk*

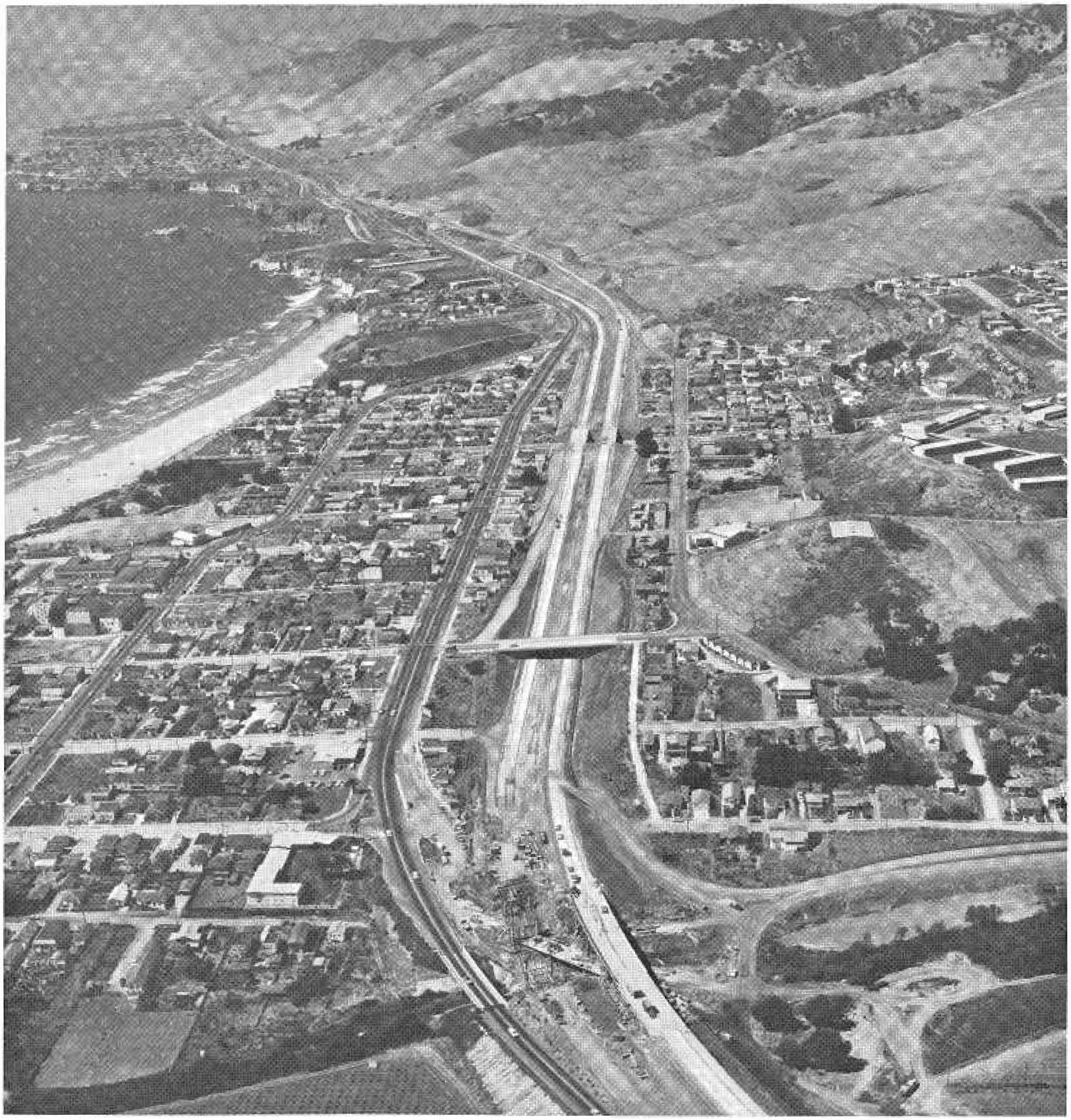
The new facility is a conventional four-lane freeway and connects a freeway section constructed south of Pismo Beach in 1956 to an existing expressway north of Pismo Beach built in 1949. Four new lanes were constructed. The left lane of the existing expressway section at the north end of the city was converted to a combination of frontage road and connection for State Sign Route 1. This frontage road was connected to an existing frontage road which serves the neighboring community of Shell Beach. Local traffic can travel between Shell Beach and Pismo Beach, a distance of approximately one mile, without entering the freeway. This connection was made in the vicinity of the north Pismo Interchange and freeway traffic can leave the freeway here to travel to either community or to the many motels and restaurants served by the frontage road.

Other Interchanges

Other interchange facilities were constructed at Villa Creek, the southerly beginning of the project, Hinds Avenue and Wadsworth Avenue. At Villa Creek the freeway is carried over both the creek and a northbound off ramp by paralleling T-beam bridges, four spans each. A third bridge, also T-beam but with three spans, carries the northbound off ramp over Villa Creek and crosses diagonally under two freeway structures. Hinds Avenue bridge is an overcrossing structure serving to connect Pismo Beach with Price Canyon County road leading inland to fertile agricultural valleys. Wadsworth Avenue traffic is carried by a pair of parallel T-beam bridges, each three spanned and 121 feet long. The north Pismo separation structures are also a pair of parallel T-beam bridges, each 123 feet in length and of three spans.

Pedestrian facilities are provided for on the Hinds Avenue overcrossing, also a pedestrian undercrossing at Pismo Street and existing sidewalks at Wadsworth Avenue, all to accommodate persons going to and from the beach recreational area and to serve local needs.

The freeway itself was a standard PCC pavement construction except for the addition of two feet of Type A imported borrow under the standard PCC structural section. This additional structural thickness was made necessary by the highly expansive soils encountered throughout most of the project. At the extreme north end of the project, the materials encountered changed from the expansive adobe to massive shales and rhyolite. The rhyolite was mostly weathered or altered and blasting was necessary on only a small portion of the core.



The new freeway during construction through Pismo Beach. The view is northward, showing Shell Beach (left background). Bridges under construction in the foreground are over Villa Creek.

Drainage is Normal

Drainage on this project was fairly routine and consisted primarily of the normal drainage facilities. There was a minor channel change at Villa Creek where the channel was narrowed to reduce the span of bridges. To protect the channel, air-blown mortar was placed on the side slopes and broken concrete was placed on the channel bottom. All of the city streets cut by the new facility carried water toward the ocean and cross pipes were required. At two of these streets back water could not be tolerated, and it was necessary to provide a battery of pipes even though hydraulically one pipe would have been sufficient.

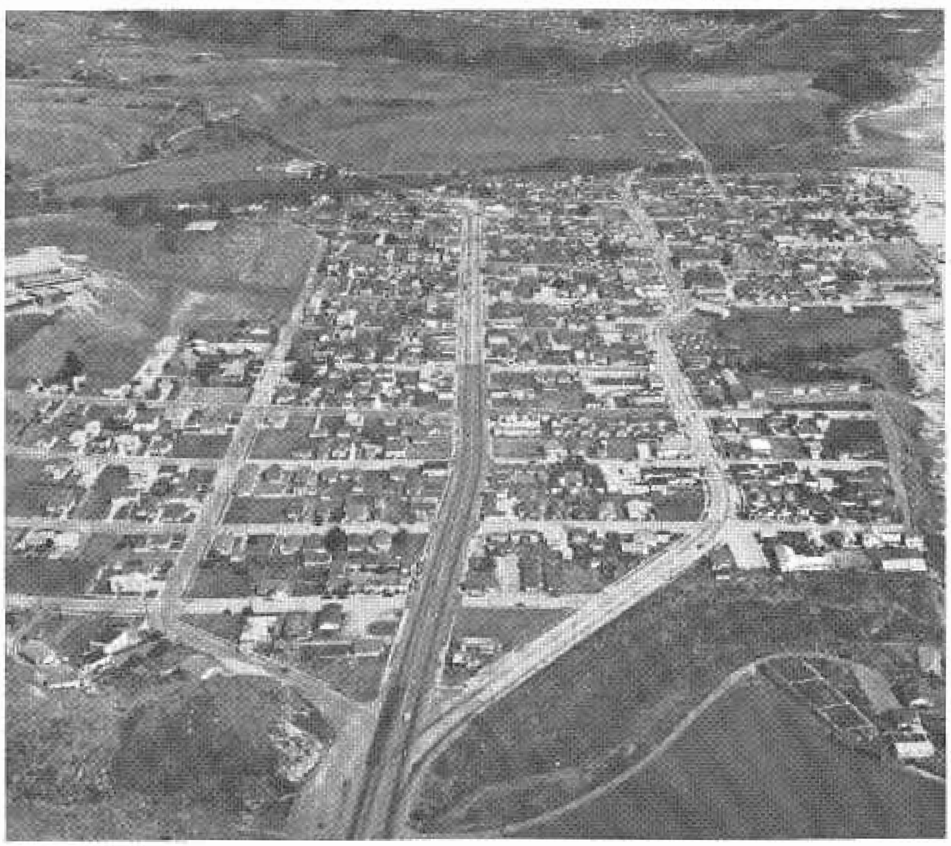
Bello Street, which parallels the freeway to the east, was completely rebuilt between Hinds Avenue and Bay Street, since it was required to serve as a collector and feeder street for the freeway. The portion of the existing expressway lane which is to function as Sign Route 1 was improved by strengthening the shoulder and placing a thin blanket over the traveled way.

Settlement platforms were placed in the approach fills where material overloads and a settlement period were specified. Additional settlement platforms were placed under the Wadsworth Avenue undercrossing fills. While no settlement was anticipated at Wadsworth Avenue, the settlement platforms were placed to provide the District with information should any settlement occur in the future. At the request of the Materials and Research Department, "Botts Dots" (reflective pavement markers) were placed as center stripe on the new concrete to evaluate this type of marking under coastal weather conditions.

This project was constructed by the A. Madonna Construction Company at a cost of $1,500,000.00. Construction began just after Christmas 1959 and completed in April of this year.

The work was under the supervision of A. M. Nash, District Engineer, L. D. Kraatz, Resident Engineer, with Jack Norberg representing the Bridge Department.

A southward view of the Pismo Beach Freeway under construction with traffic still using the old highway which parallels the southbound freeway lanes.



A southward view of Pismo Beach prior to construction of the freeway showing the old U.S. 101 highway (center) and Sign Route 1 (right).

Painting the Bridge-1

Painted Surface Totals 370 Acres

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

DISTRICT IV

CONSTRUCTION of the San Francisco-Oakland Bay Bridge was begun July 4, 1933. The bridge was completed and opened to motor vehicle traffic at noon on November 12, 1936. Interurban train operation commenced on January 15, 1939, and was discontinued April 20, 1958.

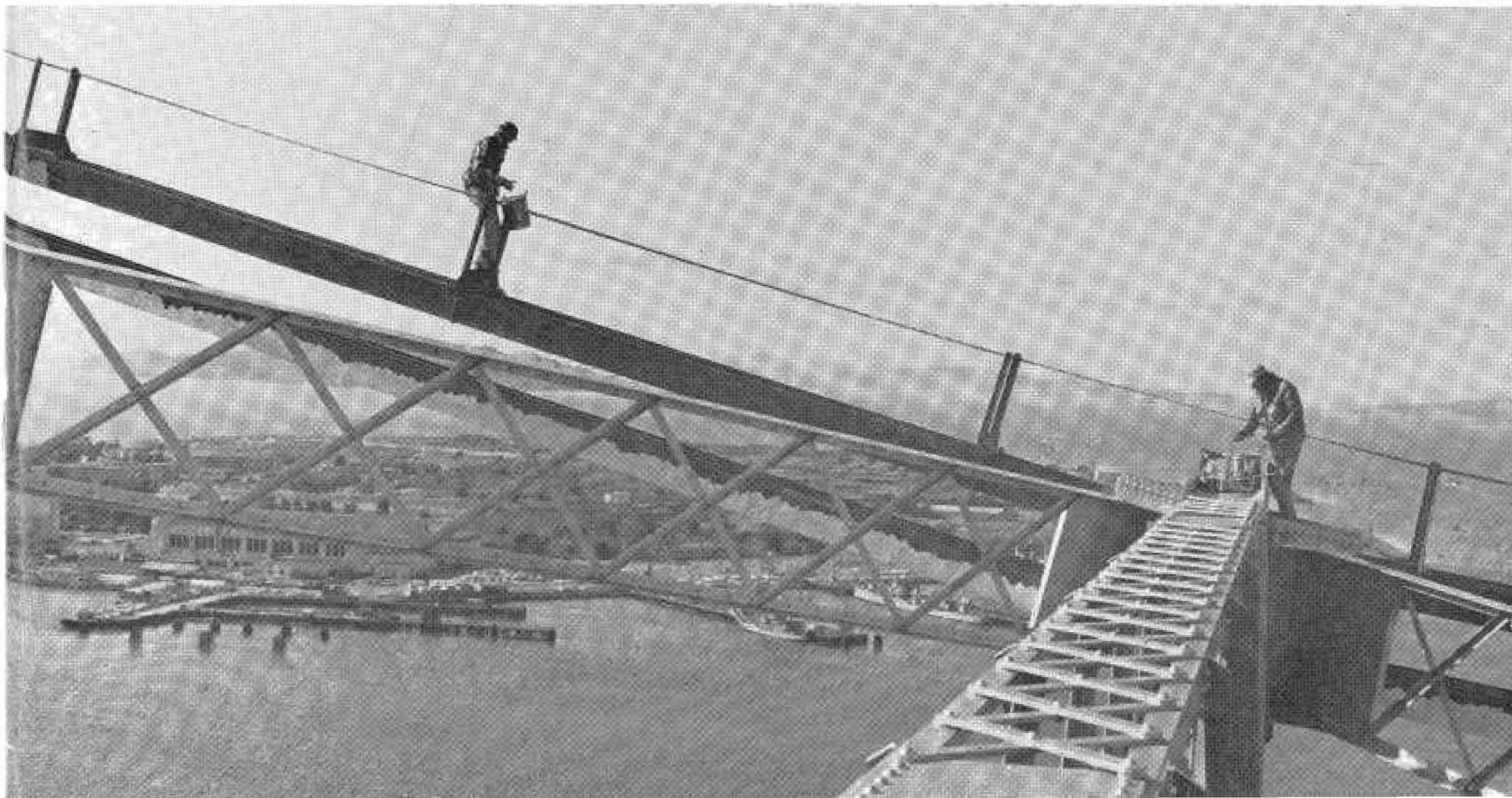
The steel structure is 4½ miles long, runs generally east and west, and extends from about six feet above high water to 530 feet above high water at the airway beacons on top of the suspension bridge towers. The entire West Bay section is above elevation 150 feet, except for the suspension bridge towers below the roadway. On the East Bay section of the bridge, the structure runs from elevation 390 at the tower tops down to a minimum of between six to eight feet at the east end of the bridge.

On most steel towers the lowest elevation of steel is on top of a concrete pedestal approximately 40 feet above high water. There are about 146,000 tons of steel which are painted for protection. This tonnage has about 370 acres of painted surface. 105,000 gallons of paint were required for the original paint job which was applied as three coats of red lead and a finish coat of aluminum.

Original Treatment

Original specifications called for the steel to be sandblasted after arrival in the San Francisco Bay Area and painted with two coats of red lead paint prior to erection. After erection there was a third coat of lead paint and a spot coat of lead paint on rivet heads, seams, and edges, followed by a finish coat of black. Sandblasting and priming were done at three locations. About 50 percent of the steel was sandblasted at Bethlehem Steel Company, Alameda yard, with either sand or steel grit. The suspension bridge trusses were sandblasted and painted at Harbor Pier 92, San Francisco. There was a third steel yard adjacent to the Oakland Mole at Asia Wharf just south of the passenger train terminal there.

The first coat of paint was a 28 pound per gallon red lead with raw linseed oil which was very slow drying. To improve the drying qualities, the formula was changed by the addition of mineral spirits reducing the weight of paint to 27.9 pounds. The second coat paint was a similar red lead with the addition of lamp black for coloring. The original second coat weighed 24.7 pounds to the gallon, and when modified to improve the drying qualities, weighed 24.5 pounds per gallon. The third coat was also a red lead, carbon black, raw linseed oil paint, which weighed 22 pounds per gallon. Before the finish coat was



Painting the aluminum finish coat on the upper chord eye bars on the East Bay cantilever structure. Treasure Island Naval Station is in the background.

applied to the bridge, changes were made from black because of civic pressure, and aluminum was used for the finish coat. The aluminum originally used was a long oil varnish using tung oil. Two and one-quarter pounds of aluminum paste were used per gallon of varnish.

Paint Policy Established

Maintenance began before the bridge was opened to traffic as an Extra Work Order on a construction contract by painting a portion of the upper-deck floor system from the contractor's traveling gantry. These surfaces had been subject to motor vehicle exhaust during construction and were also contaminated by wind off the salt water at the lower or east end of the bridge.

Permanent maintenance crews were established in October, 1937, about a year after the bridge was opened to traffic. A small crew of ten men and a foreman were put to work at the lower end of the East Bay portion of the bridge.

Our program of steam cleaning to eliminate inter-coat contamination and minimize sandblasting and our policy of preventive maintenance were established at this time by the late Carl S. Hamilton.

Rust removal then was done by hand methods using wire brushes and scrapers. Some experimental work was done with electric motor-driven wire cup brushes, with little success. Maintenance painting at this time consisted of two lead spot coats and a spot coat of aluminum.

System is Changed

It was soon found that this was not practical, and the system was changed to be a first spot coat of lead, a second spot coat of lead, and a solid coat of aluminum. This also was found to be impractical because of the mottled appearance of the finish in a few weeks after completion. Another change was made, making the first coat of lead a spot coat, the second coat a solid coat, and the finish coat a solid coat of aluminum. This gave a good appearing finish to the structure, and the solid coat of lead immediately before the finish coat of aluminum has been continued since late in 1939.

Our present routine is as follows:

1. Steam clean all surfaces that can be reached and where it does not interfere with traffic.
2. Rust removal, that is, spot sandblasting, power brush buffing, hand cleaning, and phosphoric acid crack treatment and caulking where required.
3. First spot coat red lead on all seams, edges, rivet heads, and sandblasted areas.
4. Second spot coat red lead on all seams, edges, rivet heads, and sandblasted areas.
5. Third coat red lead, a solid coat.
6. Finish coat aluminum.

This treatment provides protection equal to the original paint job on all raw steel surfaces.

Surface Contaminants Studied

During these early days, some experimenting was done to determine the type of contaminants on the bridge steel. Distilled water wash samples were taken on areas of two square feet. The wash water was bottled and sent to the Division of High-

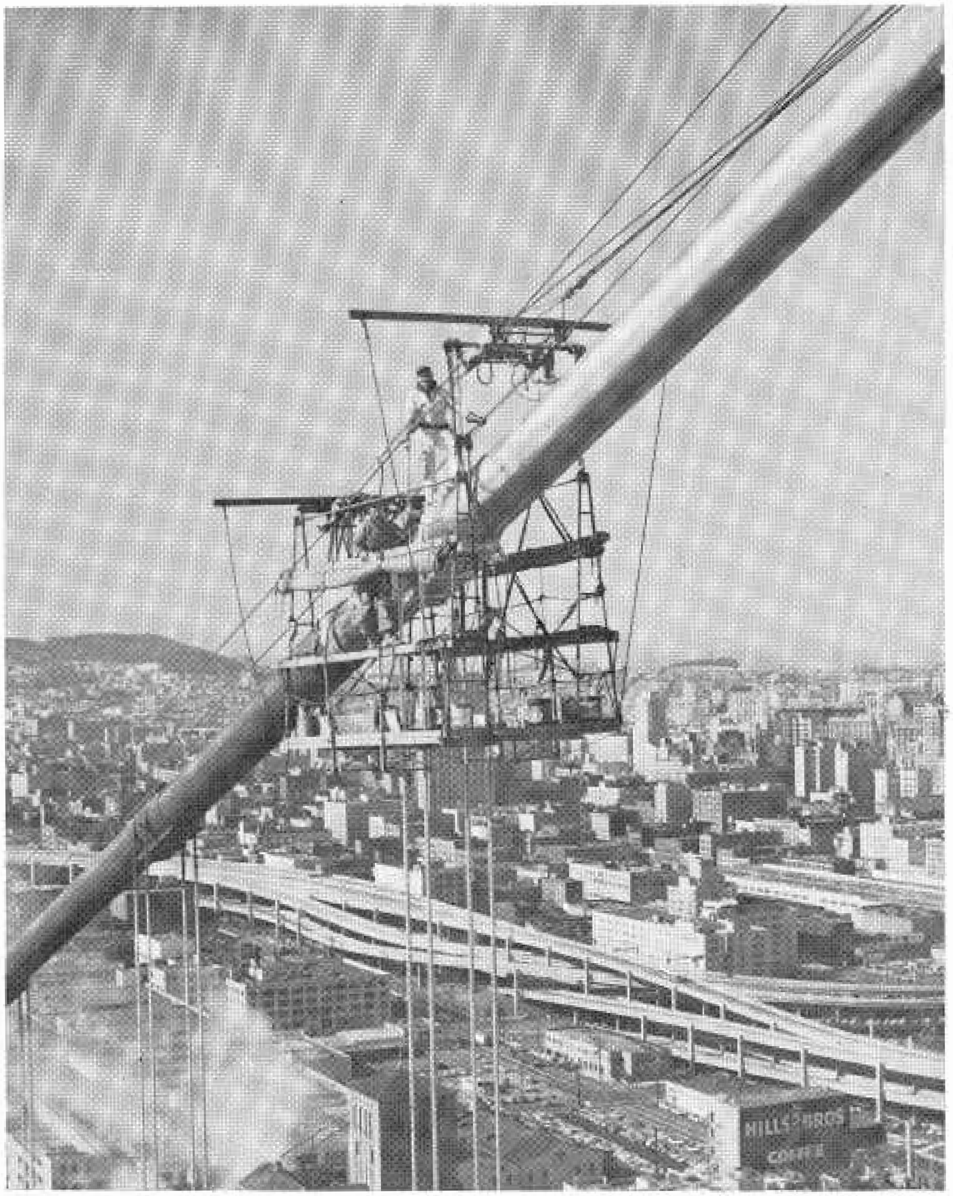
The first spot coat painting is applied on one of the towers of the East Bay cantilever section using air-powered hoists on trussed aluminum scaffolds designed by members of the Bay Bridge staff. The view is eastward with the Berkeley hills in the distance.

Painting the aluminum finish coat on top of the lateral bracing in the cantilever structure.

ways testing laboratory for analysis. A wind-powered air sampler was developed, which sucked the passing air in through a bottle of distilled water. These devices were mounted on the bridge, left for many months, and eventually the distilled water was sent to the laboratory for analysis. At this time there was a smelter on the San Francisco waterfront at the corner of Folsom and Spear Streets, only two blocks from the bridge, in a location where the prevailing winds blew the fumes across a portion of the bridge near Tower W-2. This smelter was removed during the war years.

Paint maintenance progressed westward from the east end of the bridge, the work being done principally on the lower-deck floor system until such time as scaffolding could be designed and installed for painting the upper-deck floor system. It was during this period that we learned from our distilled water samples that sea salt was to be found on the bridge surface as high as 400 feet above the water level. We also learned that on the upper-deck floor system (which is the bottom side of the upper deck, about 20 feet directly above the lower deck) we had heavy deposits from motor vehicle exhaust, soot, sulphurous acid deposits, and a certain amount of white formation which we believed to be aluminum hydroxide. It was after receiving these reports that we first decided to experiment with steam cleaning the bridge surfaces prior to painting. A used garage-type steam cleaner was purchased, adapted to portable use behind a tank truck, and thus began our program of steam cleaning which is continued to this day, although with improved equipment.

Dirty or old aluminum painted surfaces hold moisture, and in shady or poorly ventilated locations, the surface remains tacky or sticky to the touch until nearly noon. This condition is eliminated on steam cleaned surfaces, and they then become dry enough for painting at the regular starting time. We feel that by steam cleaning we gain a great deal by removing dirt, salt, acid, decomposed paint, and other contaminants, thereby providing a clean surface over which to paint, with better bond between coats and reduced inter-coat contamination.



The main cable scaffold runs on grooved wheels on handrail ropes. The deck is adjustable to keep it level. The wind curtains are rolled up, exposing the two working levels.

Size of Crews

The make-up of the paint crew through the years has been from the original 10 men in October, 1937, as follows: Late in 1938, separate crews were organized for the sections of the bridge east and west of Yerba Buena Island. The crew was gradually increased to 40 men by December, 1941, when the war started. During the war period, our crew dwindled from 40 men to 14 men at the Bay Bridge (and from 8 men to 2 men at the Carquinez Bridge). After the surrender, the Bay Bridge crew was built up to 50 men, at which time the Korean incident developed, and it dropped back again to between 35 and 40 men. Since the settlement of the Korean incident, we have attempted to limit the Bay Bridge paint crew to: 2 foremen, 6 leadmen, 60 painters, 2 laborers and 4 truck drivers. In our current budget, 1960-61, we have provided for 66 painters, which figure was also in the last previous budget, although we were unable to employ that many men because of our inability to recruit them.

Equipment and Tools

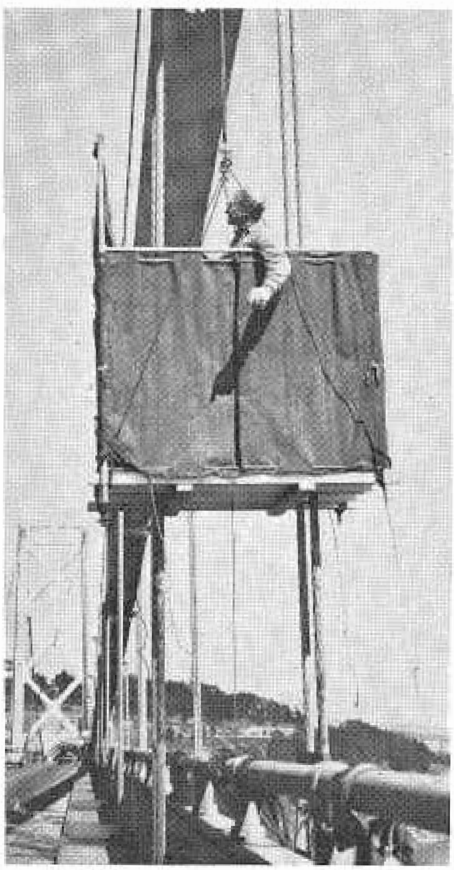
By December, 1938, we had developed three travelers (gantries riding the lower-deck curbs) for reaching the bottom of the upper deck. We also had eliminated the wire rope catenary or springboard rigging used underneath the lower deck and, late in 1939, installed three large suspended scaffolds 6 feet wide and 85 feet long. By this early date it was well determined that ease of accessibility was of the utmost importance for painting a major bridge. Our records had indicated that the conventional methods of rigging require too high a percentage (20%-30%) of the painters' time. We consider this as lost time which could be more profitably used in cleaning or painting the surfaces. From as early as 1938, we have endeavored to have as large as possible scaffold units operating on wheels or on a track and with power drive whenever practical. In some locations rigging time has thus been reduced to only 5 percent of the total.

Tools used at first were found to be inadequate, and we began using compressed-air, power-driven, rotary wire brushes, both cup and wheel type. It was found that 3-inch wheel brushes and up to 3¾ inch diameter cup brushes could be operated successfully on straight buffers or grinders operating at free speeds of 7,000 rpm for cutting rust. It took a lot of trial and error to determine which commercial brushes would stand the abuse given them on this type of work. On broad flat surfaces, we used a 6-inch wire cup brush on a tool operating at approximately 2,400 rpm. These we called salt brushes and used them to remove the general accumulation of dirt and the white formation off the broad faces of floor beams and large steel members.

Many Techniques Developed

Many techniques were developed to fit local conditions, one of which was the use of bottle brushes or as the trade calls them, tube brushes, for painting long slots left in the steel because of erection clearances. One place where these occur is at the 2,400 floor beam connections where they attach to the trusses. To illustrate this, these floor beams are from six to seven feet deep with an open slot or hole approximately ½" x ¾" at each end between the connection angles. Many of these were swabbed with these long-handled bottle brushes. Some were plugged at the bottom and poured full of paint. Others were swabbed first and plugged at both ends. Many anchor bolt holes were cleaned and filled with mastic. Some of these anchor bolts were set in pipes 10 to 15 feet deep in the concrete piers. It was necessary to clean these out with air jets, after which they were either swabbed with red lead and filled with mastic or filled with red lead paint, depending on which was the most convenient at the time and at the location.

Among the other special tools and brushes used is what we call a crack brush or a grainer, which is a pure bristle paint brush, three inches wide, two inches long, and approximately ⅛ inch thick. The use of these enables us to paint in narrow slots and cracks with the best application of paint and without the destruction or severe abuse to the large brushes normally used by a bridge painter. There are over 10,000 linear feet of one slot which is ¼ inch wide and ¾ inch deep.



A hoist behind the railing raises and lowers this suspender rope cage as much as 250 feet. Canvas curtains form a safety fence and protect passing cars from paint spatters.

Sealing of Cracks

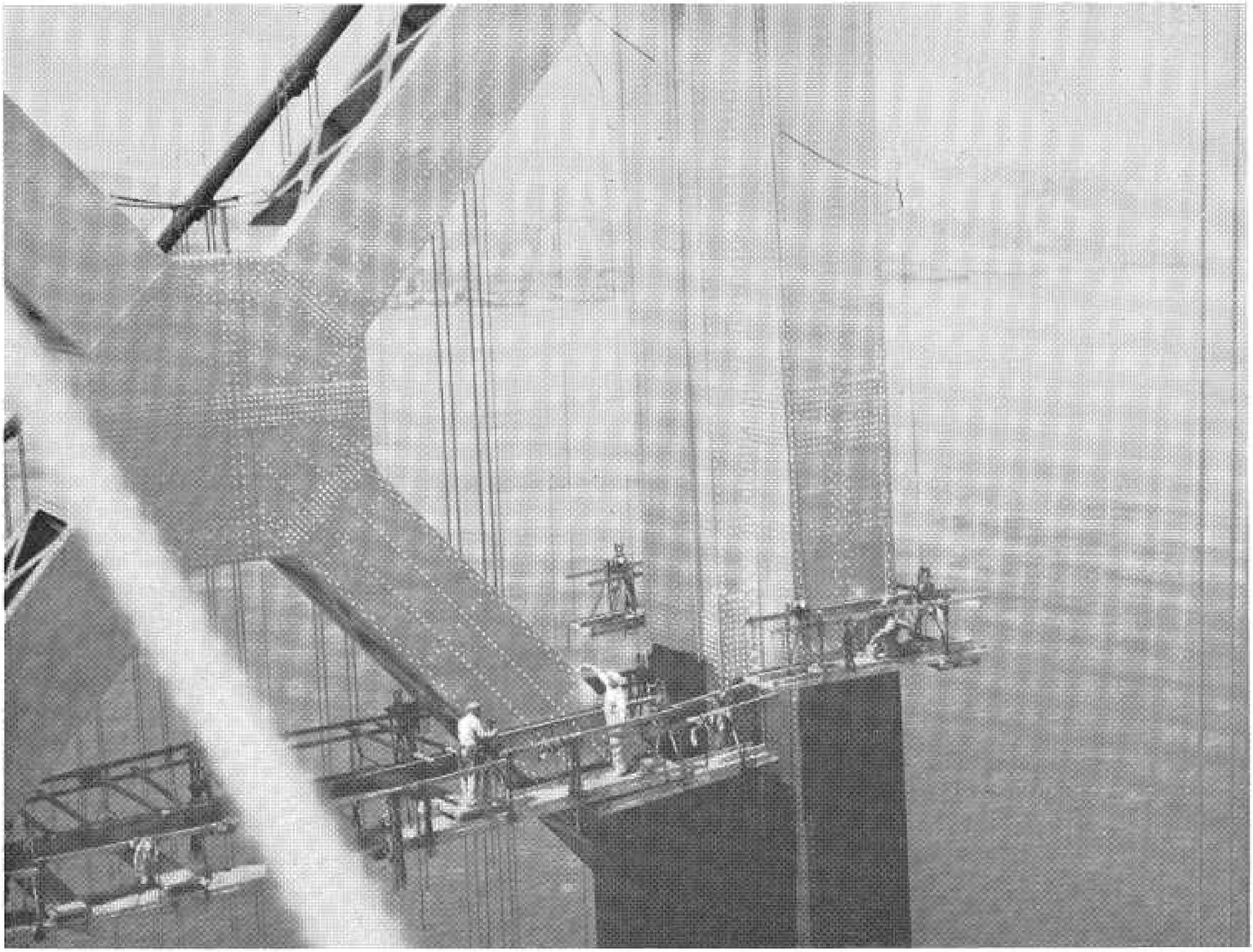
During the first two or three years of bridge painting, the greater percentage of the time was spent on sealing cracks and seams at similar locations to those mentioned above. One inch round sash tools were bought without handles. Handles from 18 inches to 20 feet long are applied for reaching into inaccessible places. Every man on the job is furnished with a size 35 (4 inch) stucco brush, made to our own specification or to an acceptable high quality commercial specification, and a two-inch oval brush, also made to our specification. Seven and nine inch paint rollers with extension handles from 18 inches to 4 feet long are used and are very effective.

Caulking guns were a source of trouble until we abandoned the use of guns having a friction grip to force the piston and insisted on a gun with a ratchet level mechanism for forcing the piston. In addition to the wire cup and wheel brushes and hand scratch brushes, a variety of hand tools have been used for rust removal. We have used the usual hook scrapers, old file scrapers, stiff blade two-inch-wide putty knives, and wire flue brushes. Wire flue brushes have been used both in ¾-inch-round form and in a ¾-inch-square form. This latter is very handy when reaching between two angles, back to back, with lacing bars in between.

Sandblasting Begins

With the crew reduced to 14 men during the war years and after having used several thousand of wire brushes, we began experimenting with sandblasting. This was necessary for three reasons:

1. To speed up the work.
2. Because of the shortage of manpower, maintenance on portions of the bridge was getting ahead of us.
3. We had found that in the San Francisco Bay Area after rust becomes four to six years old it is very difficult to remove with hand or power-driven wire



The main tower scaffold, which is supported by 26 hoists, is articulated and completely encircles the tower. The scaffold works from 40 to nearly 500 feet above the water level.

brushes. At this age, the composition of the rust is such that wire brushes do not scratch it off, but wear it down to a smooth polish or glaze and leave the active tubercules imbedded in hidden pits. This condition is probably related to the water content of the rust flakes. Since 1946, practically all rust removal has been done by sandblasting until very late 1959 when some power brush use was resumed.

Electric Railway

During 1938, the interurban electric railway was being installed on the bridge. When this was finished, we were confronted with bare wires carrying 1,200 volts and suspended 12 inches beneath the upper-deck floor beams. At the completion of railway construction and just before the current was put into this catenary, a coat of lead paint and a coat of aluminum were applied to the soffits of the upper-deck floor beam lower flanges in this area, because it was felt it would be too dangerous to attempt to do it under railway operating conditions.

At one location on six or eight floor beams, the entire beams were painted in this manner over the railway area. The paint on the bridge was only about three years old at this time. Although these extra coats of paint were put on to delay breakdown as long as possible, their true value was not determined for many years. In some places these areas were 20 years old before we were able to repaint them, and by then the advantage of the extra paint was very noticeable. Parts of the bridge, 20 years old without repainting, were found to have a minimum of rust, possibly not over 5 percent of the area involved.

The operation of the bridge railway created its own peculiar conditions and problems. During this period, while we were confronted with working adjacent to both a 1,200-volt overhead catenary system and a 600-volt third rail, and except for minor touches and sparks made by tools, we were very fortunate in having no injuries therefrom. Where the trains

All surfaces that can be washed without serious inconvenience to traffic are steam-cleaned before repainting.

slowed down or applied their brakes, a condition of brake shoe scale developed. This scale or grindings from the brake shoes were leaf-like grindings or scales which were slightly magnetic and which stood on edge and stuck in the paint film. This was very difficult to remove.

During steam cleaning, various types of detergents and softening agents were tried, with little success. Our best efforts were obtained by increasing the amount of wetting agent in our own steam cleaning compound, and in some cases, the use of a special wetting agent in addition to the regular compound. In spite of these additives, it was still always necessary to scrub and scrape the heaviest deposits of brake shoe scale. These deposits would build up in the corners where they were trapped, and in some places were as much as ⅜ inch deep. This created a condition of stain when dampness caused the scale to rust and stain good paint, thereby causing us to remove paint which would not otherwise have required removal.

Local Conditions

Our experience has shown that we have many local conditions caused by (1) elevation of the bridge above the water, (2) position with respect to the prevailing wind, (3) accessibility for rain to wash the surfaces, and (4) rapid temperature change.

Portions of the bridge which have the minimum service life of paint are the upper-deck floor system, exposed to direct vehicle exhaust from the vehicles on the lower deck, the lower-deck floor system, where the vehicle exhaust billows around and is blown underneath, the north face of the north stringer, and the back and bottom of the north sidewalk. These surfaces are not washed by rain, and the surface contaminants hold moisture which absorbs more contaminants from the air and vehicle exhaust while the resulting solutions gradually become more concentrated and active.

Another local condition is in the first 500 feet west of Yerba Buena Island where the salt spray laden wind blows up the steep surface of the hill leaving a salt and moisture deposit which causes rapid breakdown in that area. Similar conditions exist at the east end of the bridge where the steel comes down to sea level. Other local conditions are created at the two curves in the bridge where there is a change of angle with respect to the prevailing wind which causes a high throw down of moisture.

This is the first of two articles on painting the San Francisco-Oakland Bay Bridge. The concluding part will appear in the September-October issue of the magazine.

GUTHRIE AWARDED DOCTORATE

James A. Guthrie of San Bernardino, member of the California Highway Commission since 1943 and currently its vice-chairman, was awarded an honorary degree of Doctor of Humane Letters in June by the University of Redlands.

The degree was in recognition of Guthrie's contribution to the State and his community, both as newspaper publisher and civic leader.

Sand Hills

Historic Dunes Section of U.S. 80 Being Reconstructed as Freeway

By J. DEKEMA, District Engineer, and ROGER F. KOCHER, Resident Engineer

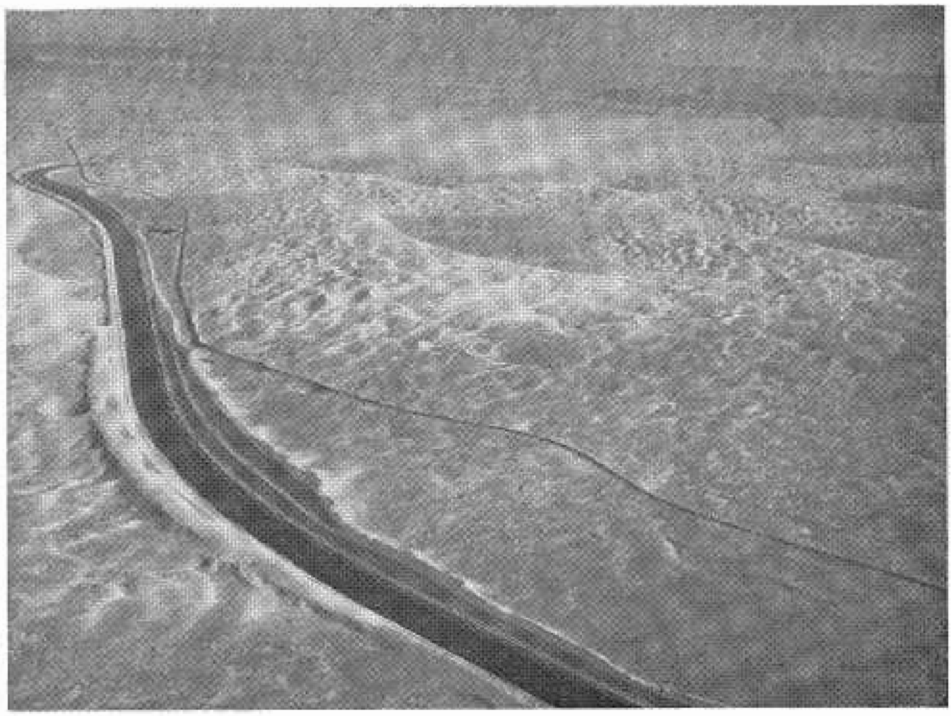
THE SAND HILLS west of Yuma, Arizona, are a 6 to 8 mile width of blow sand dunes stretching from south of the Mexican Border to 45 miles north. Some of the dunes exceed 100 feet in height. Such large dunes move only several inches per year, while small dunes of several feet in height may move 50 feet per hour in high winds. Winds of 50 to 60 MPH are common during the spring, particularly during March and April. Inasmuch as a majority of the sand particles in the area are virtually the same size (0.1 to 0.2 mm.), are non-cohesive, and lack protective cover or shelter, constant shifting occurs. Considerable sand drifting will occur with winds of only 8 to 10 MPH. Winds of this speed are a daily occurrence during the construction period.

These dunes, in a barren, arid desert, have been a barrier to travel since 1540 when Melchior Diaz traveling up the east bank of the Colorado River crossed at Yuma to become the first European to set foot on California soil.

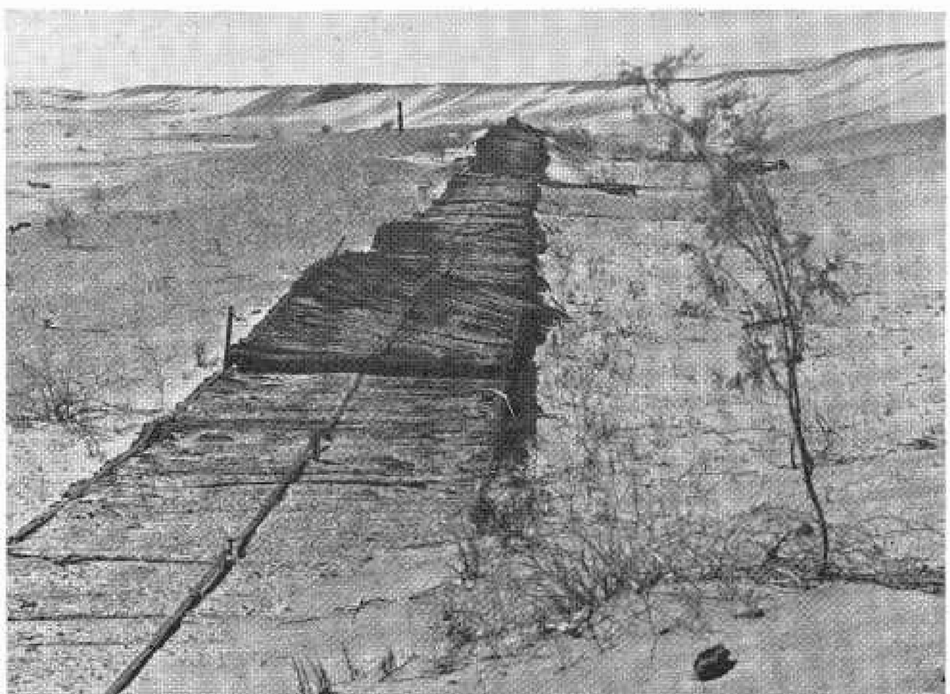
Wagon Trains Lost

Even the intrepid forty-niners passed around the Sand Hills, either overland through Mexico or by boat down the Colorado and the Gulf of California, then up the Pacific Coast. Attempts to cross the Sand Hills were all unsuccessful; legends exist regarding the loss of entire wagon trains in the moving, restless sand.

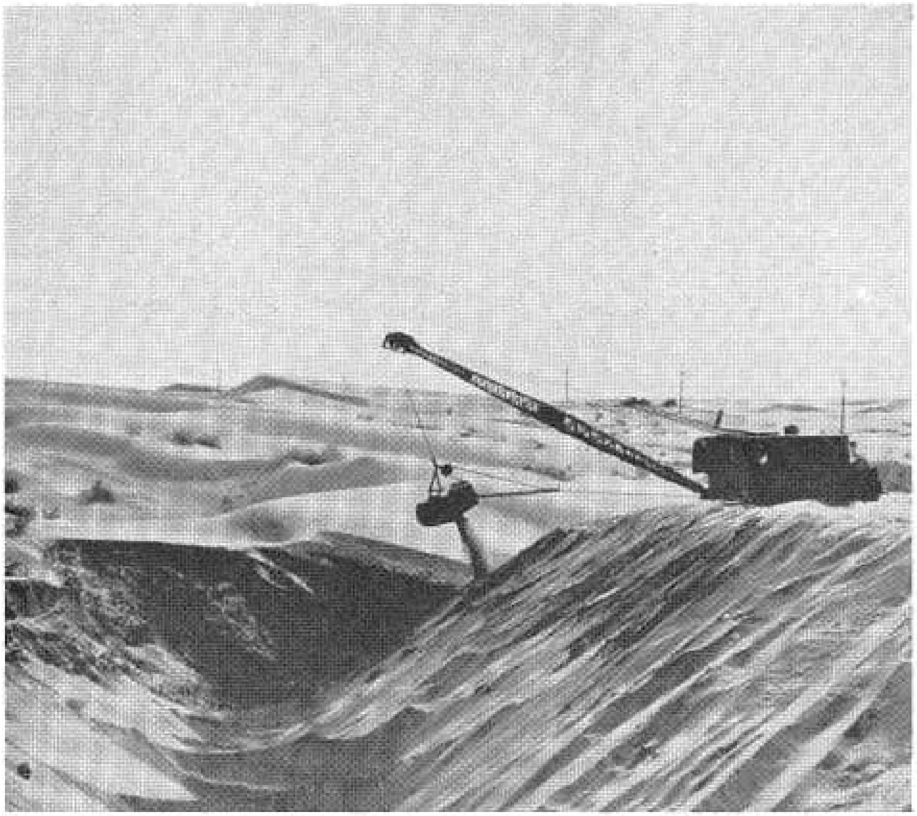
This article was presented as a paper at the 40th Annual Western Association of State Highway Officials Conference in Las Vegas, Nevada, in April, 1961.



This 1956 aerial of the dunes area shows U.S. 80 (thin line right) and the All American Canal (broad ribbon).



A remaining section of the improved plank road constructed by the California Highway Commission in 1916. It was built of eight-foot railroad ties placed side by side and secured with longitudinal iron bars.



A large dragline builds up an embankment on the U.S. 80 construction through the Sand Hills in 1925.

This 1925 photo shows a crew laying pavement on U.S. 80. The planks on the right laid crossways to support trucks carrying asphalt to the construction area.

In 1912, a group of San Diego businessmen, endeavoring to attract motorists from the East, built a crude but successful road across the Sand Hills. Thirty-six carloads of 12-inch planks were used. Two planks, laid parallel to each other and connected with cross boards, formed a section. Sections laid end to end constituted the road. When the traveler found his path blocked by drifting sand, he pulled sections from under their sand blanket and relaid the sections. The 60-mile trip from Yuma to El Centro generally required 12 grueling hours. A few traces of this road still exist as a remnant of the historical past.

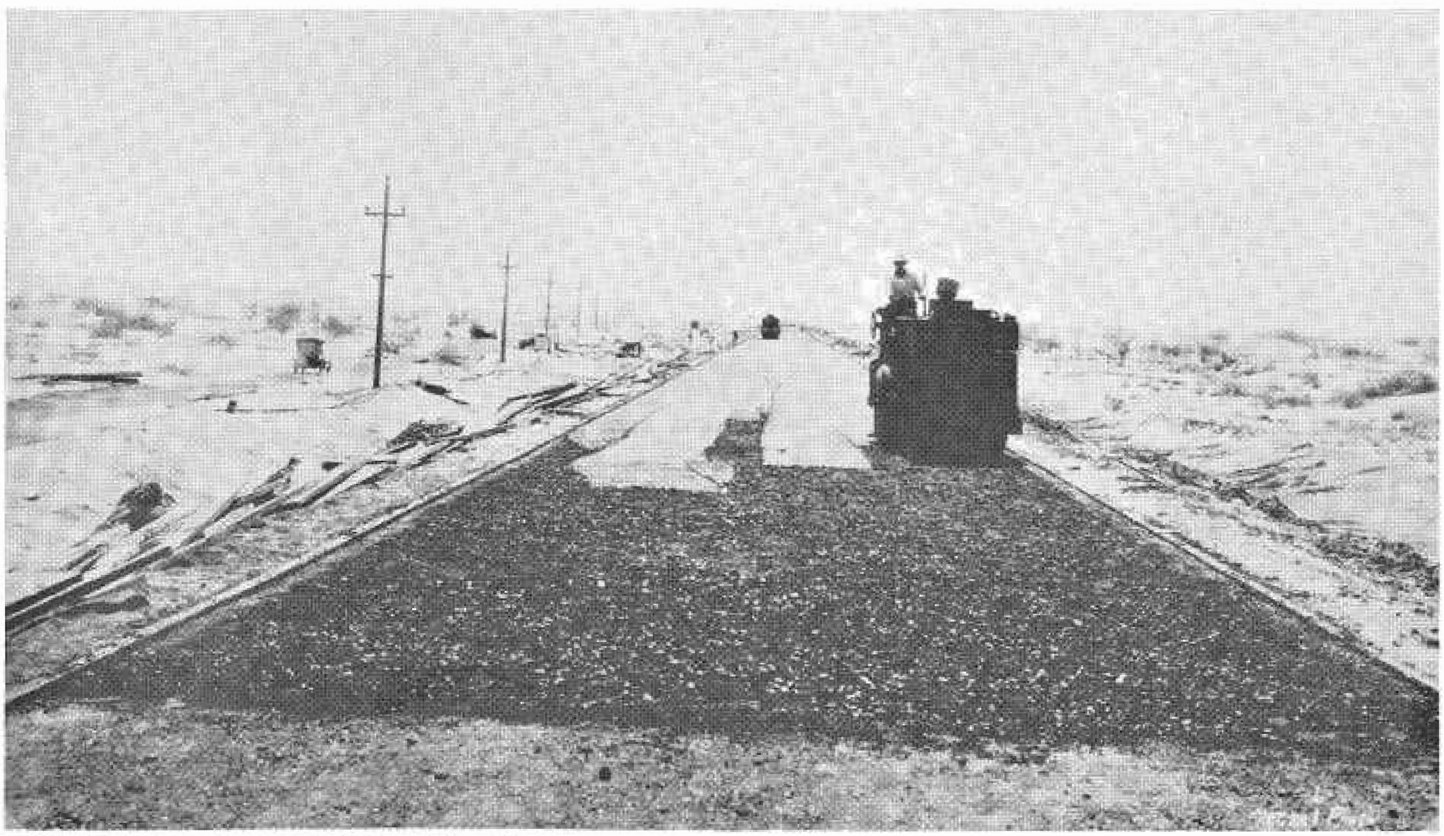
In 1915, at a cost of $102,000, a highway bridge was constructed across the Colorado River at Yuma, greatly increasing automobile traffic, and making the recently built plank road obsolete as well as ending the days of the colorful ferry. In 1916 the California Highway Commission constructed an improved plank road across the Sand Hills. This timber ribbon was constructed of 8-foot long railroad ties. These ties were dipped in tar and laid solidly crosswise to the road. The ties were grouped in sections and held in place with longitudinal iron bars. A turnout, 8 feet extra width, was built each half mile. This road, a great portion of which is still visible, was too heavy to be moved easily and had to be periodically cleared by teams and scrapers. $35,000 annually was spent to keep this 7½ miles of roadway passable.

Asphalt Road Built

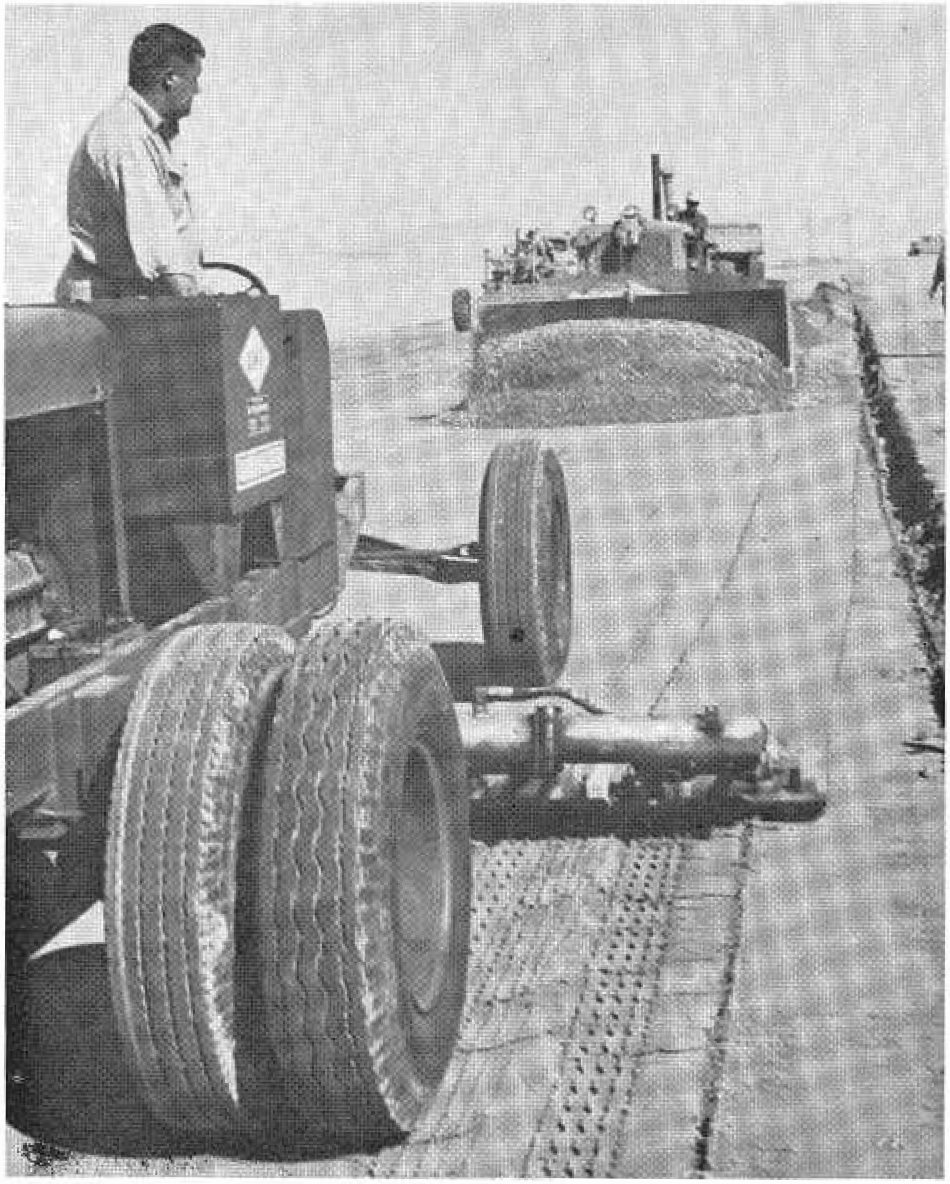
A 20-foot wide asphalt concrete road was built through the Sand Hills in 1925 and is in use at this time. The embankment was constructed with a dragline. Two 4-horse fresnoes were used to shape and level off the top of the grade and the slopes. Only the top three feet of the sand fill was watered and the trucks delivering asphalt concrete ran over planks laid on the sand subgrade. The asphalt concrete pavement on top of the sand has stood up well for more than 35 years, testifying once again that sand is a wonderful road-building material if it can be confined.

A duplicate crossing of the Sand Hills about 20 miles to the north was

A section of the improved plank road constructed by the California Highway Commission across the Sand Hills in 1916.



This photo was taken during construction of the 20-foot wide asphalt concrete road built in 1925.



Modern equipment in action on U.S. 80 reconstruction through the Sand Hills. A vibratory compactor is in the foreground. Beyond, a dozer spreads base material.

accomplished by the Imperial County Road Department in 1957-58. Under the direction of County Road Commissioner David Pierson, a sand fill was constructed entirely by bulldozers, pushing up about 1¾ million cubic yards of sand on 1¾:1 slopes. The top six feet were watered by a pipe line sprinkling system. The watering, together with the vibration from the bulldozers, gave 90% relative compaction.

Placement of the gravel base presented problems because trucks would sink into the sand. In order to permit trucks to use the subgrade, the County added a small amount of silt to the top six or eight inches. This was scarified in and laid down with a motor patrol and self-propelled rubber-tired roller. The structural section consisted of three inches road-mixed surfacing and four inches gravel base on the sand subbase. To date there is no sign of any trouble.

Slopes Sealed

In order to reduce wind erosion, the slopes were sealed with asphalt. It was essential that the slopes first be smooth because the wind would start undercutting at any opening and blow away the oil blanket. Smoothing was accomplished by tying a railroad rail between two tractors, one at the bottom of the fill, one at the top. The rail was then dragged back and forth, after which SC-3 was sprayed in two applications of 0.25 gal/sq yd each. A special angled spray bar was devised

This Division of Highways jeep is equipped with large tires for driving on the sand dunes.

because it was not practical to operate on the slopes.

Even today's low pressure tires will rut the sand subgrade on the current Interstate construction project and the contractor has had considerable difficulty preparing subgrade in advance of the crushed rock base to the close tolerances required by California's 1960 Standard Specifications.

Even after thorough compaction, the tires of the motor grader used to trim the grade, rutted the subgrade to depths of several tenths of a foot. Steel wheel and rubber-tired rollers buried themselves in the sand in attempting to prepare subgrade. A satisfactory subgrade was obtained by using a vibratory compactor as a finishing machine. By this means, subgrade was made within several hundredths of a foot of blue top stakes.

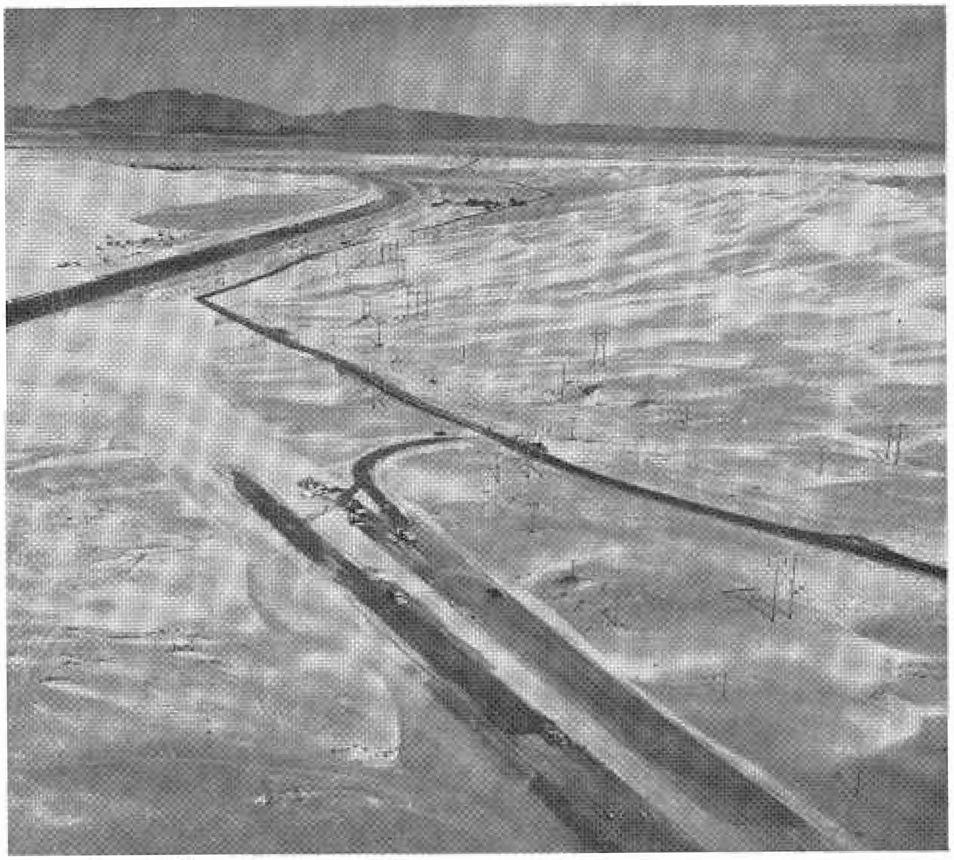
The base material must be placed upon the soft blow sand without contamination by the sand. Hauling vehicles and placing equipment could not be allowed upon the prepared subgrade. The base is placed in two 6″ lifts. The first lift is started by backing the truck and end-dumping a load of base upon the subgrade. This pile is leveled and spread ahead with a "V" dozer. The next load and successive loads are placed by backing trucks over the previously placed base and end-dumping on the leveled base pad. This load is then spread ahead and the operation repeated.

Control of First Lift

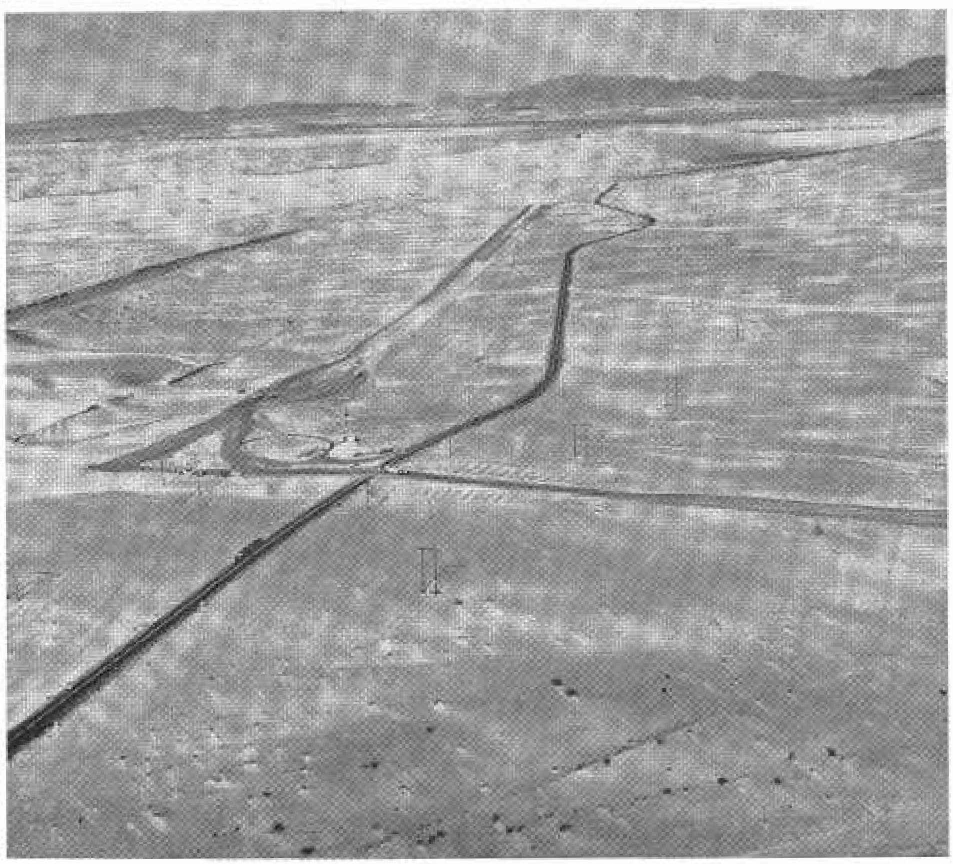
Spread and thickness control of this first lift is achieved by placing 6″ stake elevations on the subgrade just ahead of the spread. The lift is finally trimmed with a motor grader to close tolerance stakes.

The second lift is placed with a self-propelled aggregate spreader. After rolling, the finished surface is too rough and uneven for the base material to meet the thickness tolerance of 0.05′; therefore, the surface is staked with blue tops and trimmed with a motor grader and re-rolled.

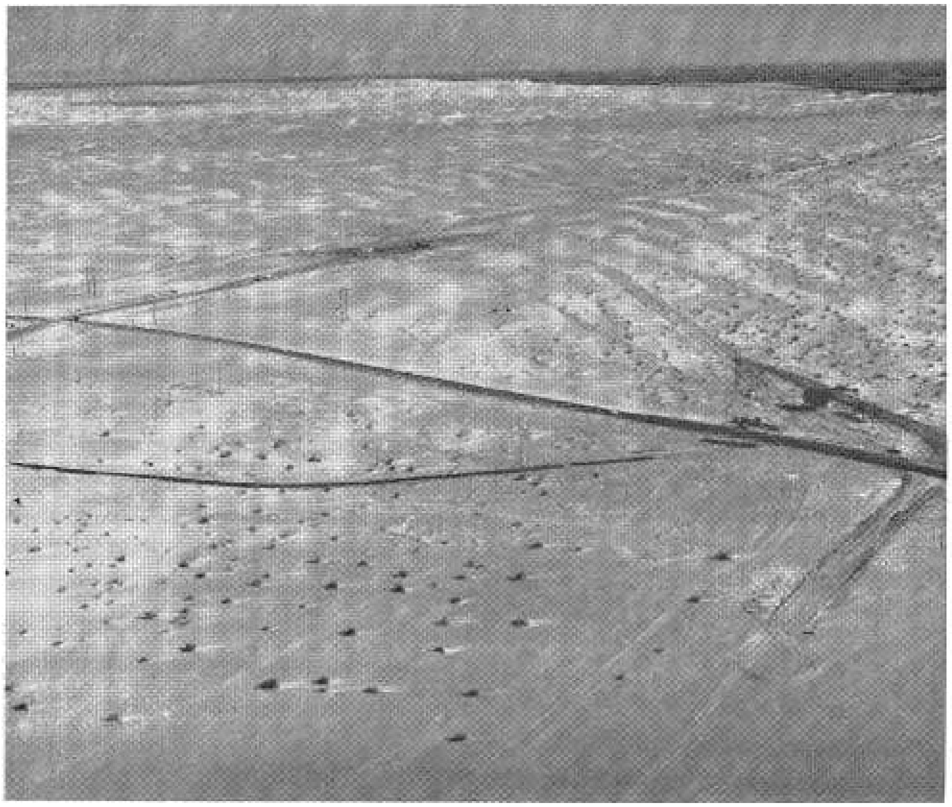
The compacted sand subgrade, although non-cohesive, has a "Resistance" value of "70" when confined. A change order is therefore being processed to reduce the total base thickness to 8″ placed in one lift.



An aerial photo of base-spreading operations during the current reconstruction of U.S. 80.



An aerial view of the haul road for construction equipment crossing the present highway.

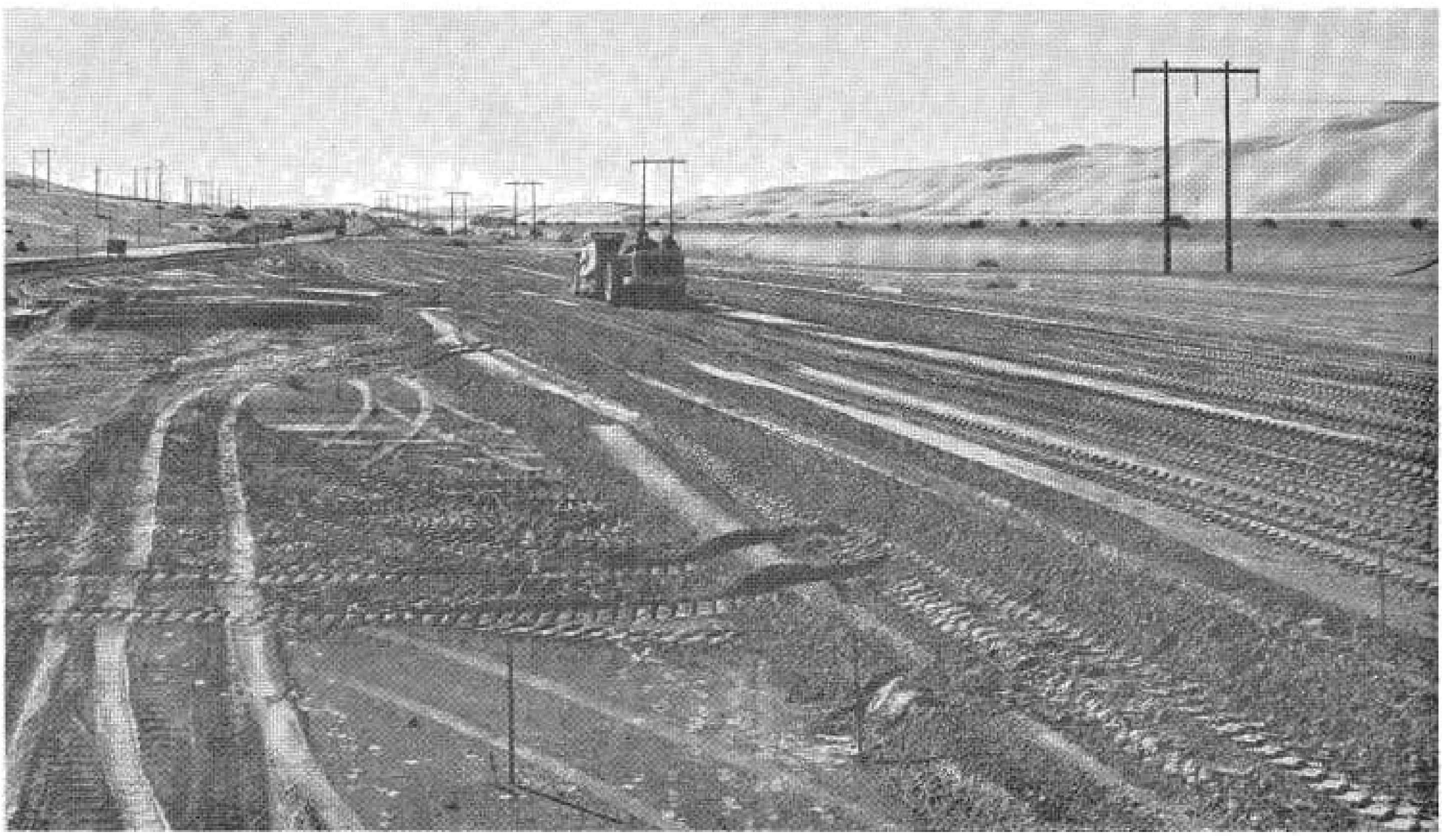


An aerial showing the location of the borrow pit in relation to the construction. A total of 2½ million cubic yards of borrow will be used in the completed embankment.

Trucks will break through a 4" lift and a bulldozer only is used on end-dumped material. Segregation has been reduced by pushing piles of aggregate approximately 50 feet prior to actual laydown. Fairly successful attempts have been made to decrease segregation at the plant; however, it appears that dozer remixing on the street is necessary.

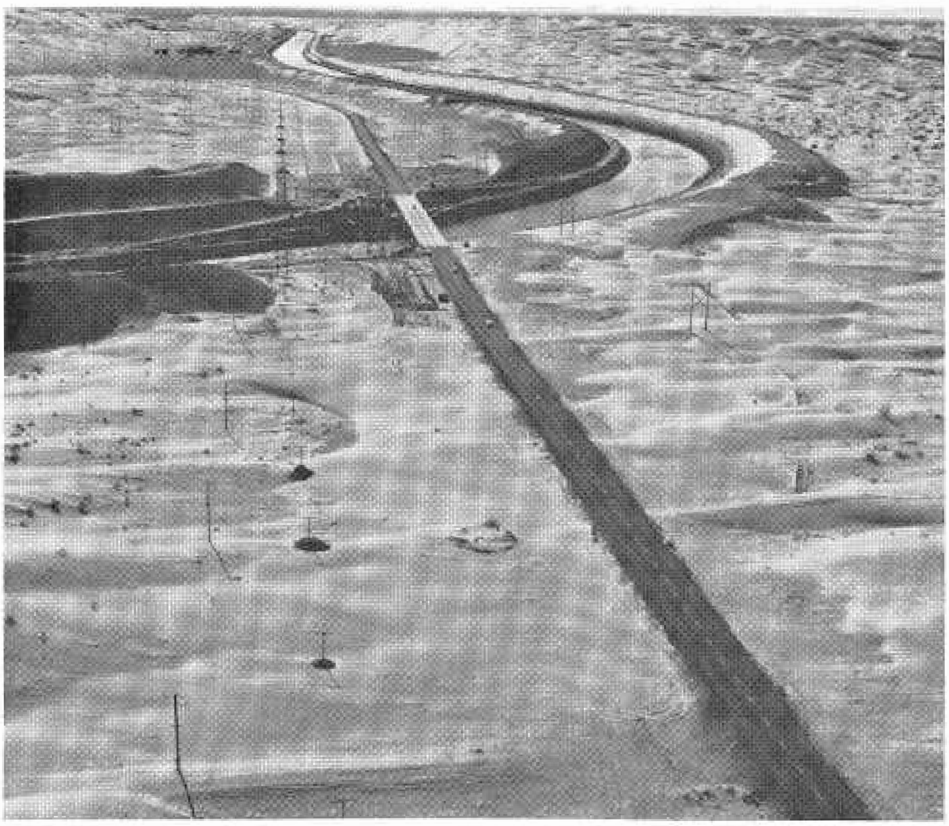
Finish grade staking required specially made stakes, 30" long, diagonally cut 2 x 4's. Smaller stakes were found to be subject to movement. The contractor restricts his subgrade preparation to areas that can be covered by aggregate base within a day's time. Any subgrade left open to the elements—wind and sun—rapidly dries and erodes or is covered by drifting sand. Close coordination between the base and subgrading operations is necessary at all times.

Embankments are constructed of blow sand obtained from sites located approximately 1000 to 2000 feet south of the project. Average haul length is about 45 stations. A total of 2½ million cu. yds. of borrow is being



Grading operations on the current reconstruction of U.S. 80 through the Sand Hills. The present highway is on the left.

An aerial view of the All American Canal maintenance station and yard on the present highway which will be removed for construction of the new freeway.



A westward view of construction on U.S. 80 showing the bridge across the All American Canal. A second bridge is being built to the left of the existing one.

placed and paid for by the cubic yard in completed embankment.

70-Foot Fill

Since high sand dunes rise abruptly from the desert floor at the westerly end of the project, a very large volume of fill (635,000 cu. yds.) was required to construct a maximum allowable 3% grade at this location. This single fill rises 70 feet above the desert floor. Embankment slopes are 2:1 or flatter.

The contractor attempted to move rubber-tired scrapers into the borrow pit areas without success. The scrapers were virtually unable to move in dry sand and little more success was found even when the area was saturated with water. It appeared that track laying equipment, only, would negotiate this type of material. Various measures such as lowering scraper tire pressure and filling tires with water or water solutions aided movement, but it was still necessary to push the scrapers with track laying equipment from the pit to the fill.

The borrow haul problem was finally solved by using rubber-tired scrapers with power drive on front and rear axles. These units moved very well in the saturated sand. Incidentally, the engineer's special jeep with oversize tires could not operate uphill in the soft sand on the lee side of the dunes.

The contractor has constructed seven haul roads, totaling about 13,000 feet in length, between borrow pits and embankment areas. These haul roads, 30 to 40 feet in width and 4 to 6 inches thick, were built of about 8,000 tons of pit-run gravel. The total cost of these haul roads is estimated to be about $6,000. The proportionate cost per cubic yard hauled over such roads is negligible ($0.0025). The cost per load ($0.06) is minor.

It appears each scraper hauls approximately 8,000 sta. yds. per hour. Approximately 20,000 cu. yds. of embankment are placed daily by seven scrapers working seventeen hours.

Two Tractors Used

The scrapers are loaded by two push tractors, thus a total of 1,000 and more HP is used in loading. A typical

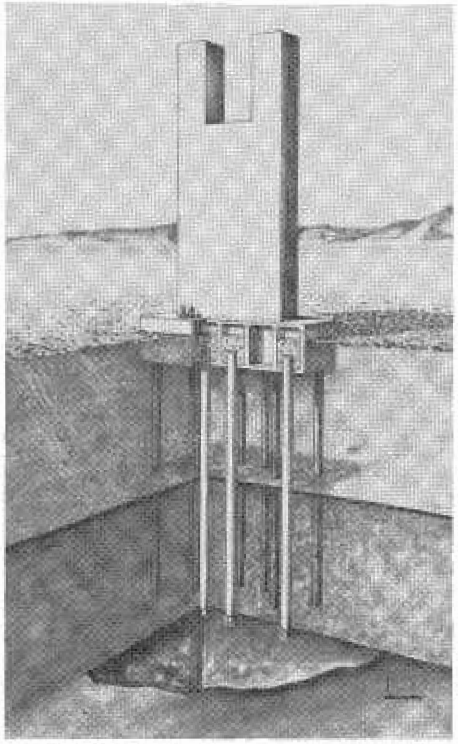
. . . Continued on page 30

Bridge Progress

Benicia-Martinez Job Completion Scheduled for Summer of 1962

By L. C. HOLLISTER, Bridge Engineer—Special Projects

Sometime in the summer of 1962 the fourth bridge across Carquinez Strait will have been completed and opened to traffic. Three of these bridges are highway structures and the fourth is a railroad bridge supporting two tracks of the Southern Pacific Company's main line.

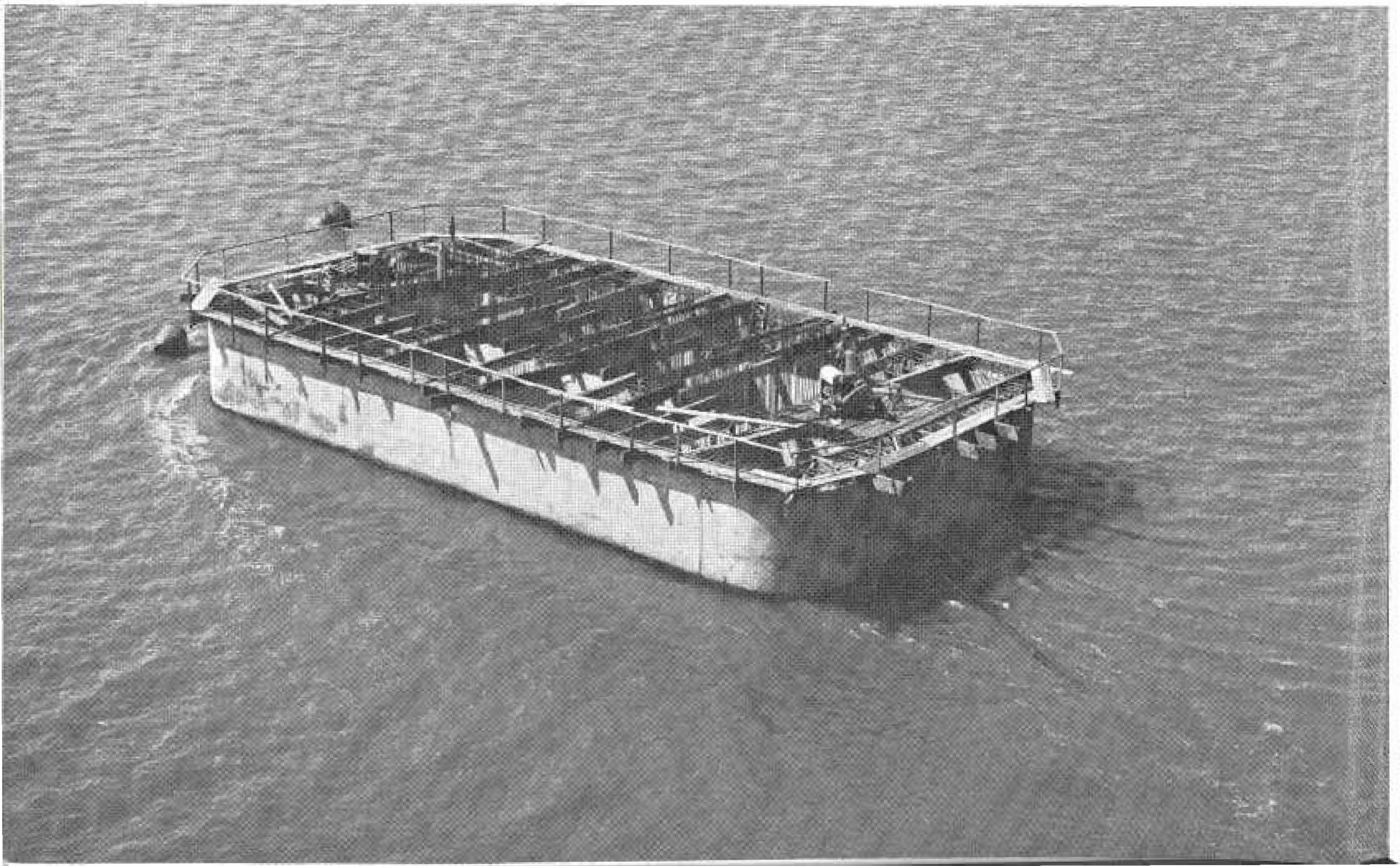


This sketch shows how each pier was constructed. The 10 steel caissons were lowered to bedrock and sunk about two feet into it. Then an additional 5-foot socket was drilled into the rock, and the steel caissons and socket filled with concrete. The tops of the caissons were then anchored to the footing block by placing concrete in the cell around the caissons. From a theoretical standpoint, the 10 caissons of each pier were designed for earthquake by applying a theoretical horizontal load equal to 10 percent of the dead load of the superimposed trusses and the pier with the force located at the center of gravity of this dead load. The caissons were assumed fixed to the footing at the top and at a point about 30 feet above bedrock at the bottom of the caisson.

PHOTO BELOW—The empty celled concrete box footing was constructed on land, floated into place and then securely anchored in exact position ready to receive the first 6-foot in diameter, 130-foot long steel caisson.

The Carquinez Strait is a magnificent body of water and a great asset to the State of California. But in spite of its great commercial, recreational and aesthetic value, it has always been a troublesome problem to both highway and railroad transportation.

General Vallejo, with his great land holdings extending from Benecia to Santa Rosa, was the first to recognize that some type of highway transportation would have to be established across the Carquinez Strait if his great empire was to grow and prosper. Accordingly, in about 1848 he made efforts to establish a ferry across the Carquinez Strait between Benicia and Martinez. It was not until 1853, however, that a successful ferry was put in operation between these points. This was the start of the great ferry systems that were to serve the San Francisco Bay area for so many years, and in July 1962 the opening of the Benicia-Martinez Bridge will draw the final



curtain on this picturesque era that many will remember.

Structure is Planned

In spite of the success of these ferries, men were dreaming and scheming of some way to cross the Carquinez Strait with a structure. There was considerable skepticism however, as attested by the following quotation from the January 1899 issue of the Contra Costa *Gazette*:

> "The possibility and impracticality of a bridge across Carquinez Strait has been discussed for a long time both by the Railroad Company and by the leading Bridge companies in California.
>
> "A bridge between Port Costa and Benicia has also been considered. The prospect of a bridge between these two places is so absurd on the face of it that no engineer or company has ever surveyed or even advanced the proposition to the Railroad Company. I think that unless some wealthy lunatic of a company comes along and builds a bridge, that a bridge across Carquinez Straits will remain unbuilt till the end of time."

In spite of this rather typically dim view which was held by many, a three lane highway bridge was built across Carquinez Strait and opened to traffic in 1927 by the American Toll Bridge Company. Following the completion of this highway bridge, the Southern Pacific Company opened its bridge to railroad traffic in 1930.

Bridging the Carquinez Strait has not been easy, however, and the difficulty has been mostly in the foundation construction. Bedrock in the Carquinez Strait lies approximately 130 feet below the water surface. At this elevation bed rock consists of tipped up layers of shale and sand stone. Over the bed rock lies 50 to 90 feet of mud, sand and gravel. The problem has therefore been to penetrate this overburden through rather swift and changing currents of water and establish some type of pier foundations on the bed rock below.

First Pier Construction

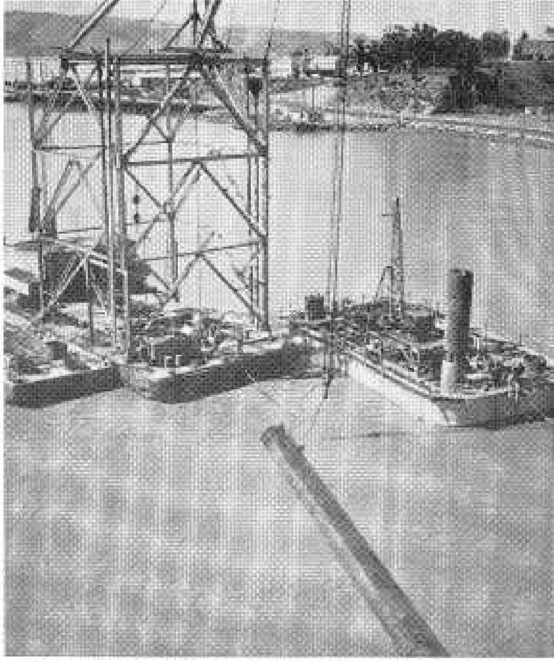
On the first Carquinez Bridge, piers were constructed of two 40 foot square footing blocks topped by a 30 ft. diameter cylinder. Each of these casissons was constructed of timber and held in position by a floating cage, which was in turn anchored in position. The caisson with its timber sides was sunk by adding concrete or weight on top and by excavating the material at the bottom, allowing it to gradually settle through the mud and gravel overburden until it came to rest on bed rock. The inside was then filled with concrete which became the foundations for the first Carquinez Strait bridge. The walls and excavating cells in the lower portion of these caissons were constructed of timber and after reaching bedrock the open cells were completely filled with concrete.

This was a slow, tedious and even hazardous process in the rather treacherous waters of Carquinez Strait.

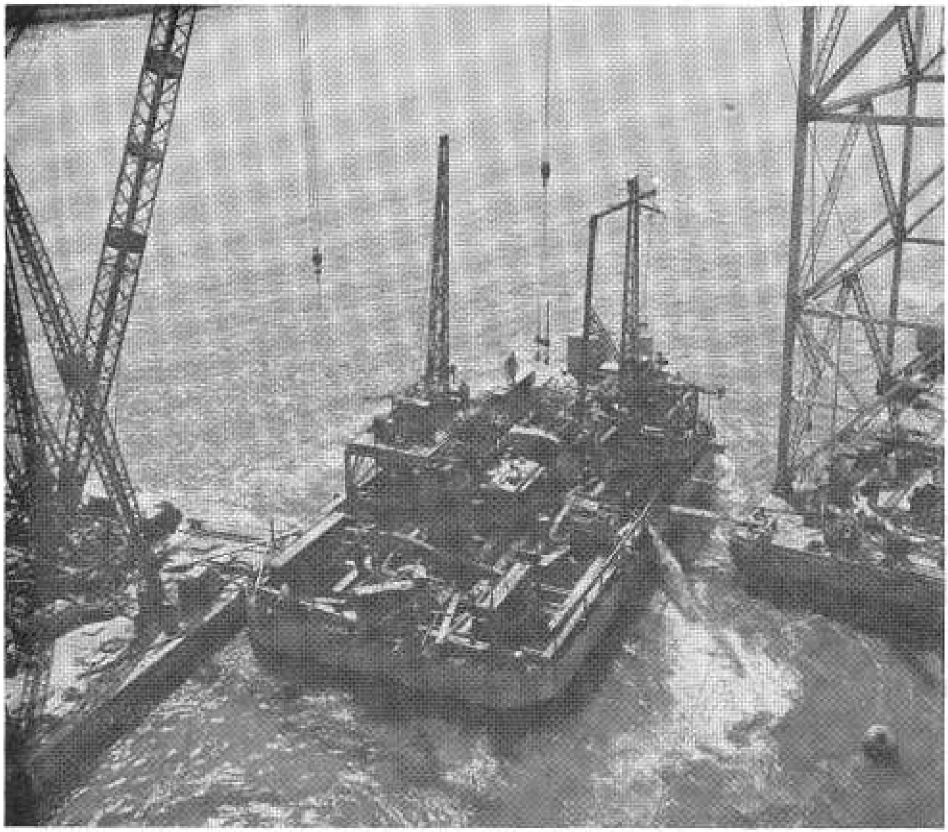
The Southern Pacific Company chose to use a somewhat different and perhaps a much safer method of pier construction. At each of their piers a ring 80 feet in diameter of steel sheet piles was driven and the interior filled with sand to an elevation well above high water. On each of these "sand islands", as the method is called, the bottom portion of the concrete pier was constructed. Through dredging chambers constructed in each pier, the material from under would be excavated and pier allowed to sink. Adding concrete at the top and excavating at the bottom, the pier would finally be brought to bear on bedrock at the bottom. While this method was much less hazardous it was very costly.

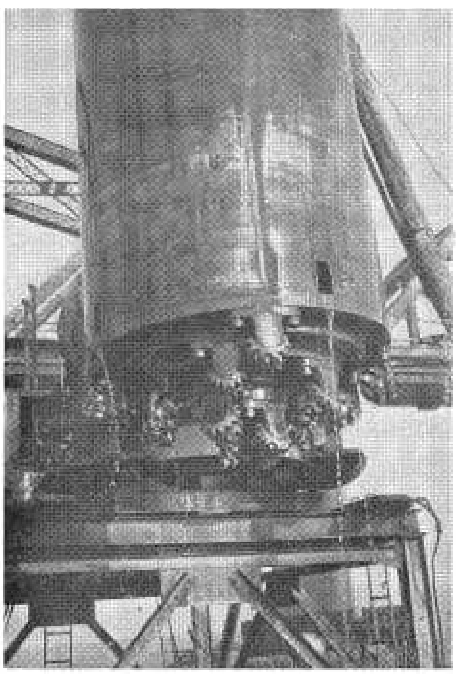
Improved Method Used

At the second parallel Carquinez Bridge (1955-58), an improved method was used which cost much less and still incorporates adequate safety features. This time the bottom 31 feet of the pier with its cutting edges was built in a dry dock and then floated into position where it was anchored. The concrete walls of the piers were then extended upward and as weight was added the pier sank through the water until it entered the mud line. At this point the timber bottoms to some of the 18 cells which had been constructed in the caisson would be removed and the mud excavated from under the caisson. Excavation and con-



PHOTOS RIGHT—The 6-foot-diameter steel caissons were fabricated at the Benicia plant of the Yuba Consolidated Industries and floated to the pier site (top) where they were picked up by the "Judy Ann," a floating crane (center) and placed in one of the pier cells (bottom).





PHOTOS ABOVE AND LEFT—In these pictures the drill rig and air lift pump are at work removing material from the inside of a caisson. The drill is made up of 12 gear like roller cones which cut into either the over burden or bedrock as they are rotated by the drill rig. Pressure on the rollers is adjusted as needed by adding or subtracting ballast in the steel shell which houses the rollers. An air lift pump picks up the excavated material and discharges it into the bay.

creting would thus continue allowing the pier to sink until bedrock was reached.

Pier construction at the Benicia-Martinez Bridge was planned with an entirely new concept in mind, making use of new ideas, new equipment and new methods of construction. (See May-June, 1960, issue of *California Highways and Public Works*.)

The footing was so designed that it could be built on shore and floated into place, anchored in position, and then through predesigned openings in the bottom of the pier lower steel caissons each six feet in diameter. The mud, sand and gravel from the interior of these caissons was then drilled and pumped out until the steel cutting edge had penetrated into the bedrock about two feet. At this point a 5 ft. diameter socket was drilled an additional five feet into bedrock. A heavy reinforcing cage was then placed in the drilled rock socket and extended 13 feet up into the caisson. The socket in the rock and the caisson were then filled with concrete which anchored the concrete filled steel caisson securely into the bedrock.

Placing of Caissons

The four-corner caissons were the first to be placed while the box footing was still in a floating position. After the four corner caissons were concreted in and anchored to bedrock, then heavy steel beams with hangar rods would be placed over the four corner caissons at high tide. As the tide receded the beams would come to rest on the four caissons. At this point the box footing would change from a floating condition to a supported condition. Water was then pumped into other cells of the box footing in sufficient quantity to act as a ballast and prevent the box footing from raising off the four corner supports at the next high tide.

With the footing thus supported on the four corner piles, the remaining six caissons were installed and anchored to the bedrock at the bottom and to the box footing at the top. The support of the box footing was then transferred to these six caissons and the beams and hangar rods removed from the four-corner caissons. These caissons were then anchored to the footing by placing concrete in the cells. The footing at this stage became supported for the first time by all 10 caissons.

Construction from this point on was more conventional and consisted of placing the concrete slab over the top of the footing block and then extending up 90 to 130 ft. with a concrete shaft to form the seats for the steel trusses.

Rapid Construction

There are 9 of these piers and the average time to construct each one was about three months. This is a rather rapid rate for deep water pier construction and it is therefore believed that this method will have extensive applications in future deep water bridge construction where conditions are favorable or similar to those encountered at the Benicia-Martinez Bridge. Yuba Consolidated Industries, Inc., who are the contractors for both the substructure and superstructure have done an excellent job of sinking these caissons and should complete the foundation work about four months ahead of their contract time schedule.

The design and fabrication of the steel trusses like the design of the foundations made use of new materials and new fabricating techniques. The Carquinez and the Benicia-Martinez Bridges are the first two major bridge structures to make use of new high strength steels and to use welding as a means of fabricating truss members.

The truss spans at Benicia-Martinez are 528 feet between supports. This span length is much smaller than the 1,100 foot span at Carquinez but nevertheless is sufficiently long to make any reduction in the weight or dead load pay excellent dividends. The use of a newly developed high strength steel in the trusses reduced the amount of steel required and thereby reduced the amount of weight to be supported by the trusses. In addition the truss members were fabricated by welding rather than by riveting which resulted in additional savings in weight. High strength bolts with gusset and splice plates were used at the joints to fasten together the welded members entering the joint.

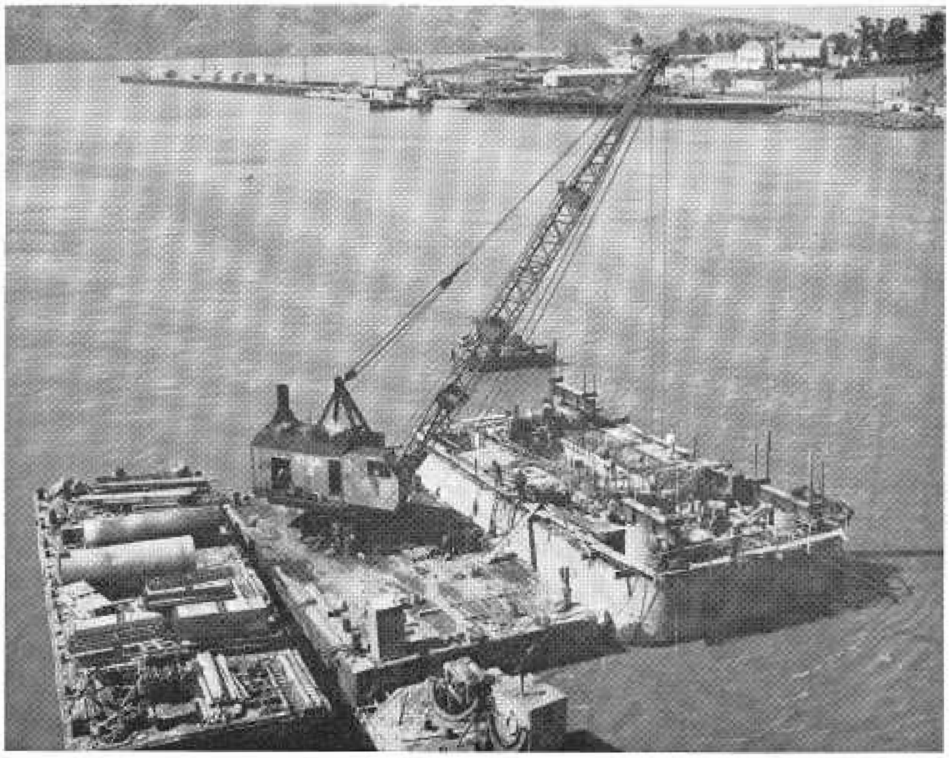
Three Types of Steel Used

As was done in the design of the Carquinez Bridge, three types of steel were used in the makeup of truss members. Two grades of these steels carried the American Society of Testing Material's designation A7 and A373 for the usual structural grade and A242 for the higher strength low-alloy steel. The exceptionally high strength steel is referred to as T-1 by the manufacturer. The following table shows the comparative tensile strength of these steels:

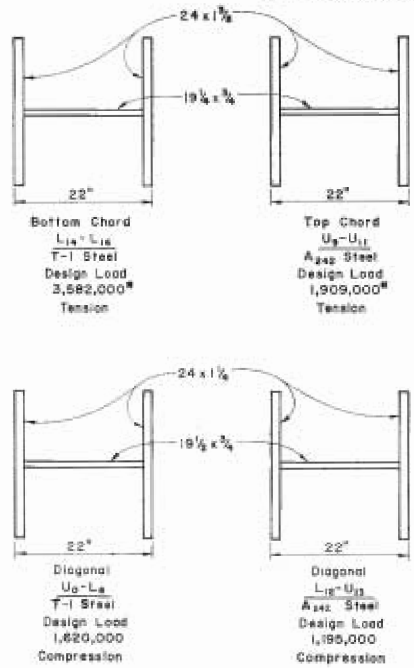
Type	Allowable Tensile Stress
A7 and A373	18,000 p.s.i.
A242—up to ¾" thick	24,000 p.s.i.
over 1½" thick	22,000 p.s.i.
T-1—all thicknesses	45,000 p.s.i.

The choice of steel for each member was based on maintaining minimum plate thicknesses. That is, T-1 steel was used until the minimum plate thickness requirements governed, then A242 steel was used. The same criteria governed the choice between A242 and A7. Unfortunately A242 steel loses efficiency in the thicker plates as can be seen from the above table of allowable tensile stresses.

Since all members were fabricated by welding, it was possible to provide



In this picture heavy steel beams are being placed over the four corner caissons. When these beams are in a predetermined position, the box footing is allowed to seat itself and hang from the beams as the tide goes out. At this point the footing changes from a floating to a supported condition and vertical or horizontal movement is no longer detected.



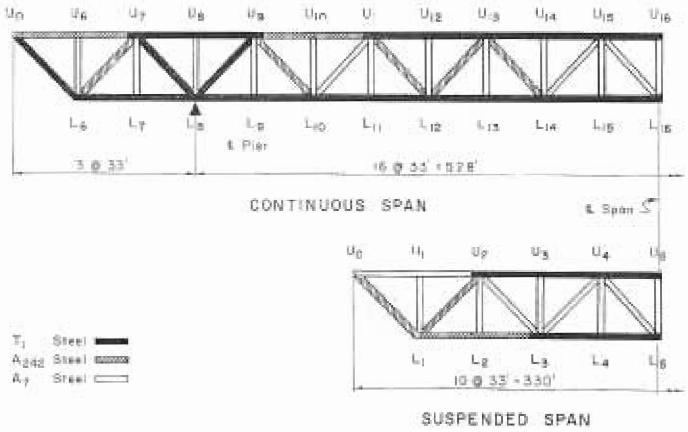
TYPICAL TRUSS MEMBER MAKE-UP

This sketch illustrates how the truss members were fabricated by welding 3 plates together. The two top tensile members are the same size and weight yet the one fabricated from T-1 steel has almost twice the capacity of its A242 steel prototype, demonstrating how use of extra high strength steel saved a considerable tonnage of metal.

a very economical means of compensating for loss in net section caused by bolt holes at the joints. For instance in tension members fabricated from T-1 steel, the flange plates were increased in thickness at the joints for a distance one foot outside the gusset plate, at which point a butt weld was made. For tension members fabricated from A242 steel, the flange plates at the joints were made of the higher strength T-1 steel to compensate for the loss in section, and the two types of steel were butt welded together about one foot outside the joint. These new design procedures making use of welded truss members saved worthwhile amounts of steel in the tension members of the truss. Large amounts of steel were also saved by using extra high strength T-1 steel wherever practicable. For instance, it is estimated that 7,168,000 lbs. of T-1 steel in the trusses replaced 12,320,000 lbs. of A242 steel.

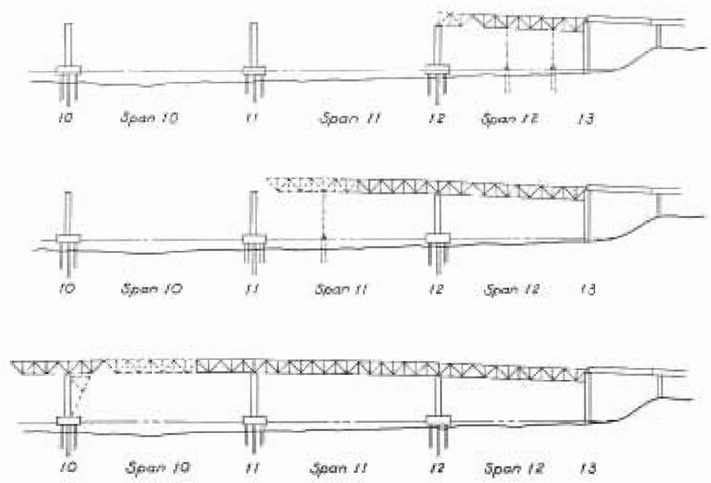
Price Difference Small

The three types of steel used carry different price tags but the differential price between the various grades of steel is sufficiently small to result in

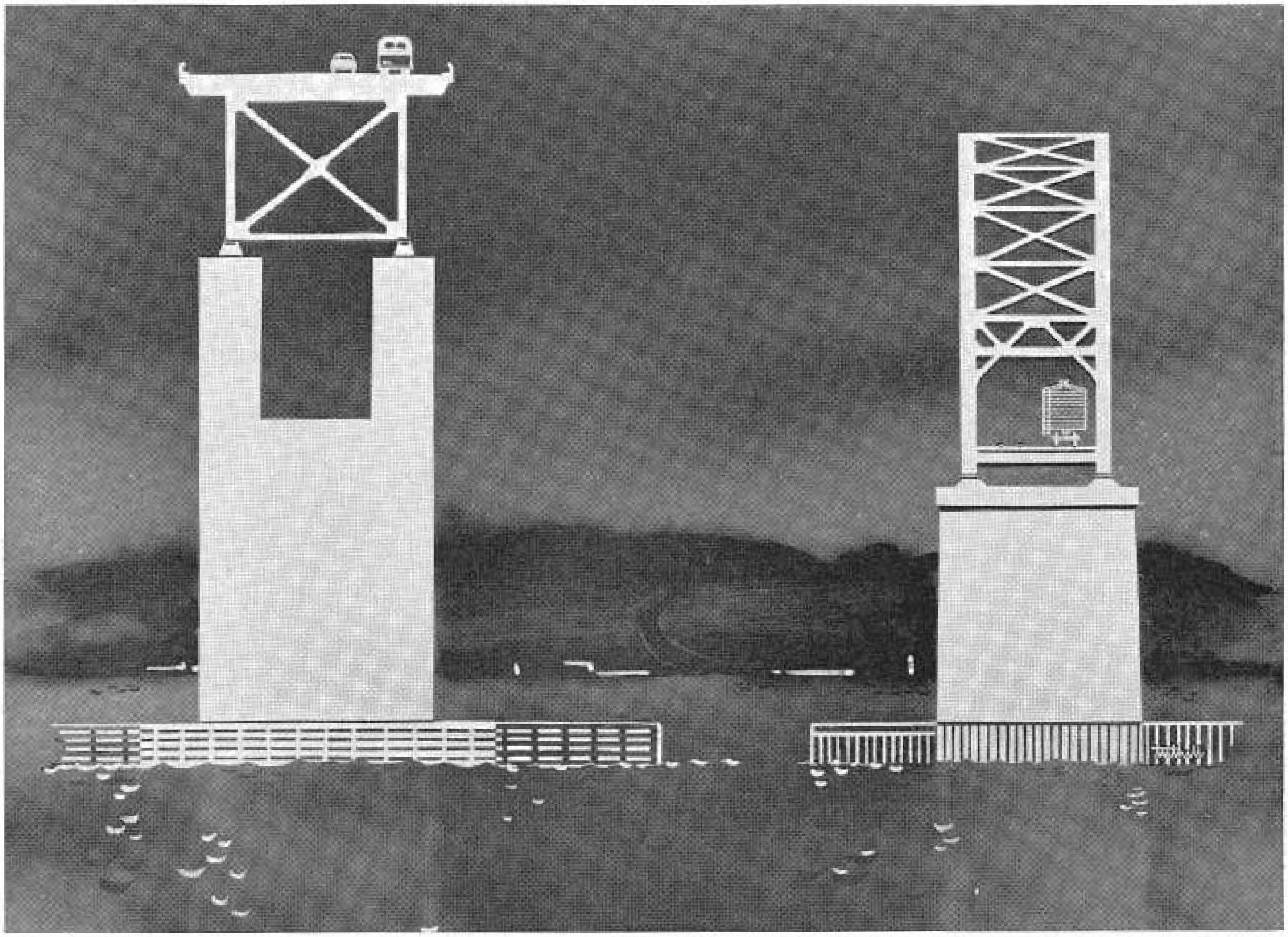


BENICIA-MARTINEZ BRIDGE

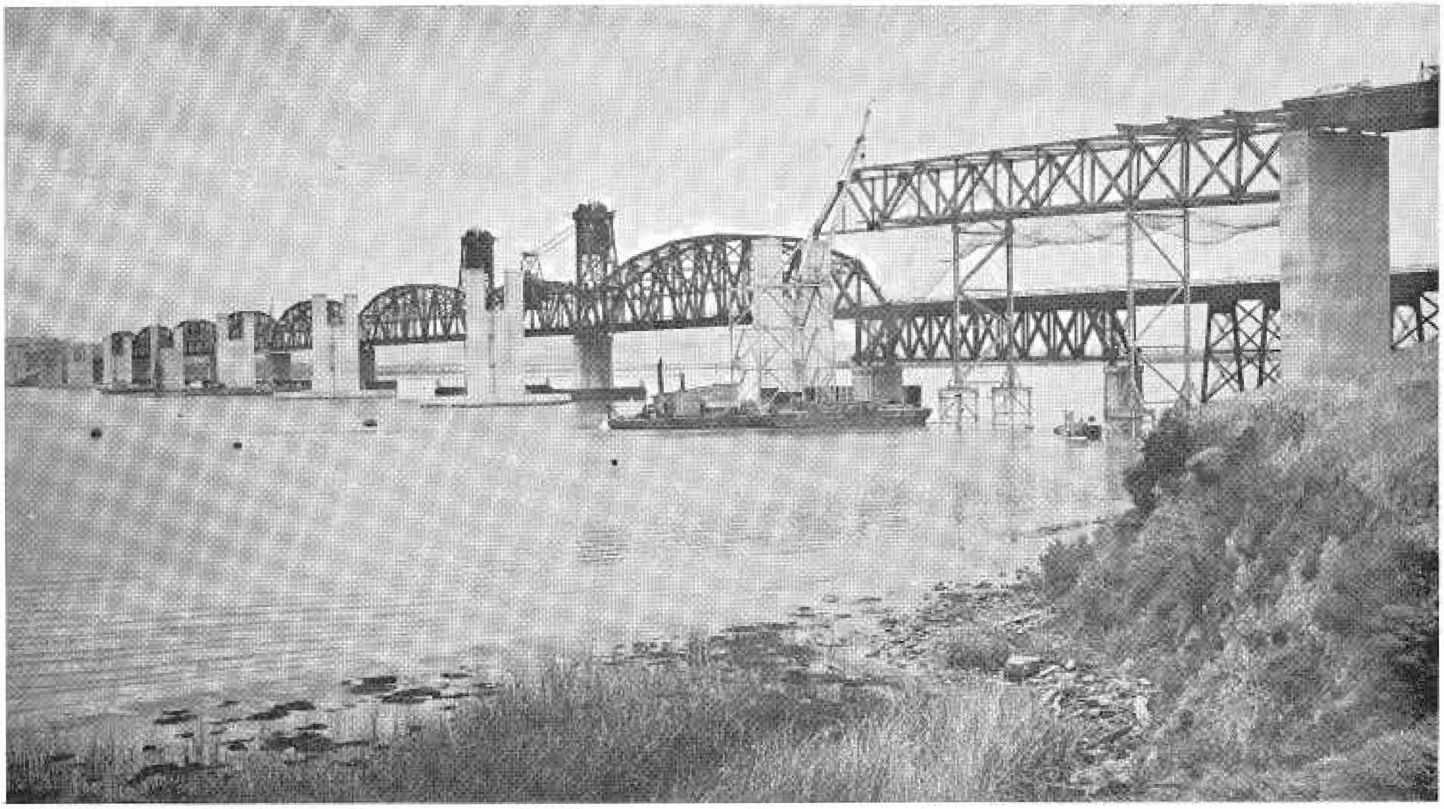
Truss layout showing the location of the 3 types of steel used in the trusses. The 10 truss spans which measured 4,884 feet were designed for maximum duplication, there were 24 half suspended spans and 16 half continuous spans as shown above, making for considerable duplication in the fabricating shop.



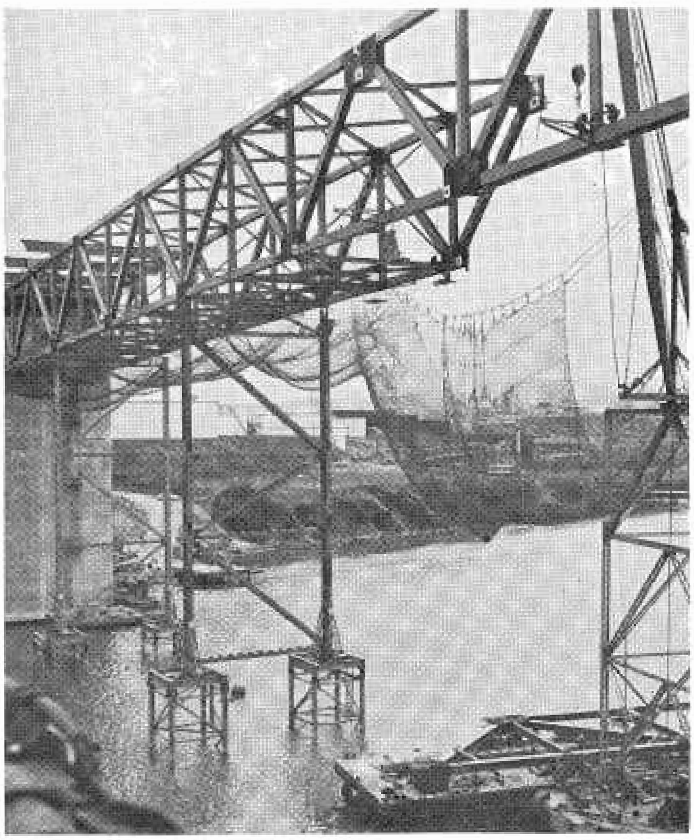
Sketch Showing Truss Erection Procedure. Two temporary erection bents were used in the erection of Truss Span 12, the first to be erected. Truss Spans 3 to 9 inclusive will use one temporary bent and Truss Span 10 which is over the navigation channel will not use any of the temporary bents in the water but will use one inclined bent at Pier No. 10.



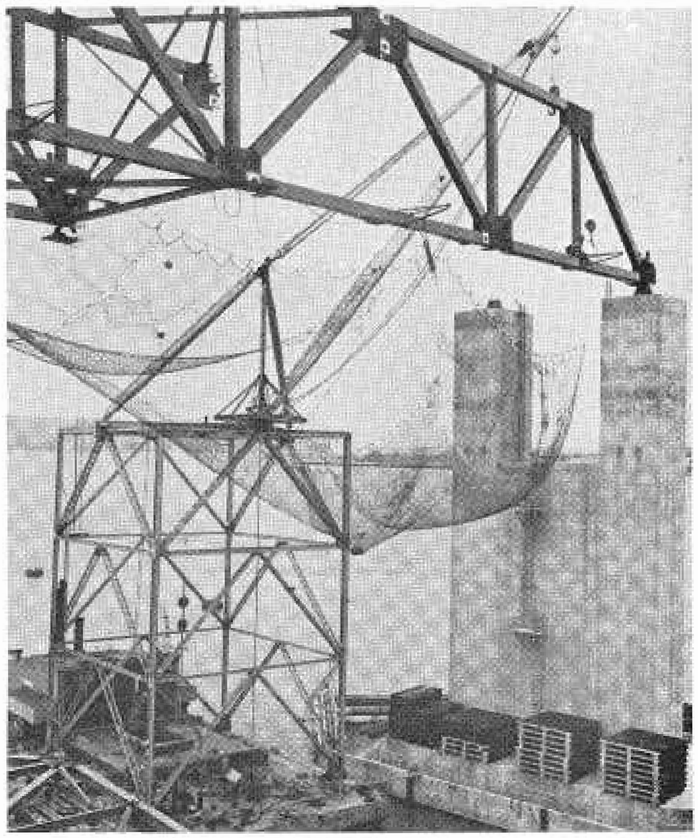
This sketch shows the relation of the new highway structure to the existing Southern Pacific Co. Bridge and the relative height of the highway deck above the water level. Maximum vertical clearance at the navigation channel between low steel and water is 138 feet on the highway bridge and 70 feet on the railroad bridge. The railroad bridge requires a vertical lift span for the passage of river traffic. Highway traffic will be about 178 feet above water at the highest point.



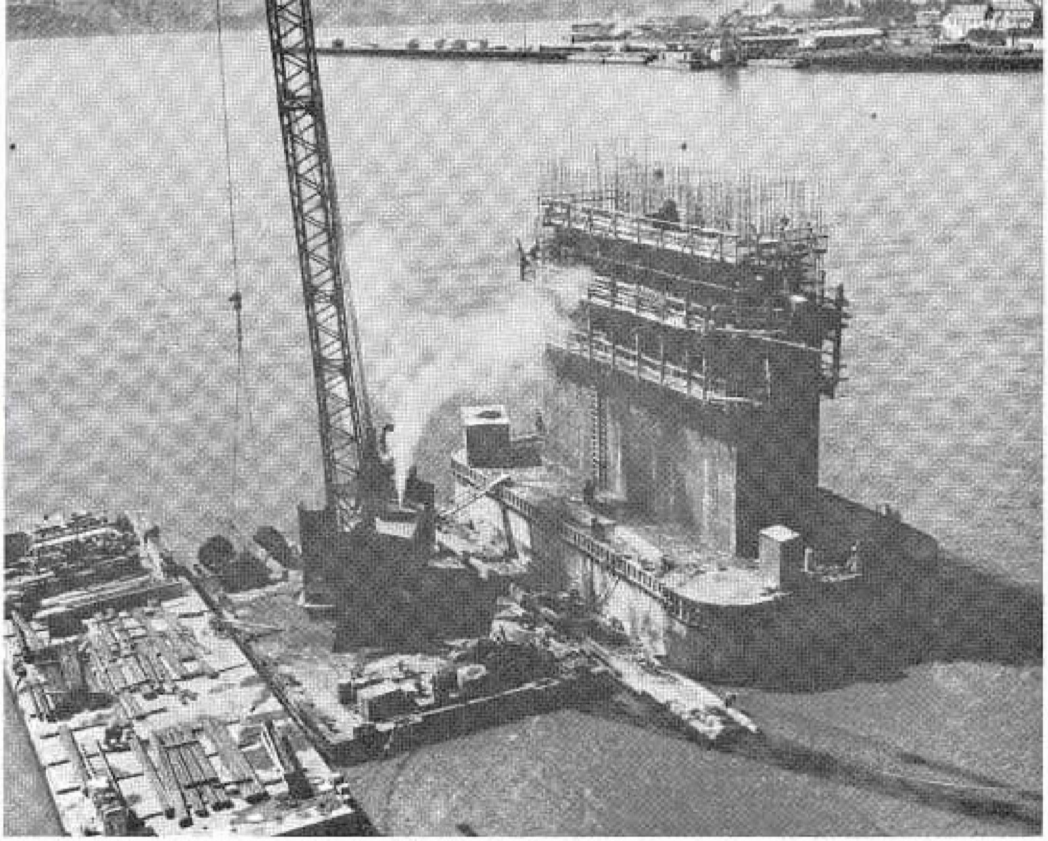
The highway bridge in the foreground commences to take shape. Nearly all of the piers are in place and ready to receive the steel trusses. Start of steel truss erection in Span No. 13 can be seen to the right.

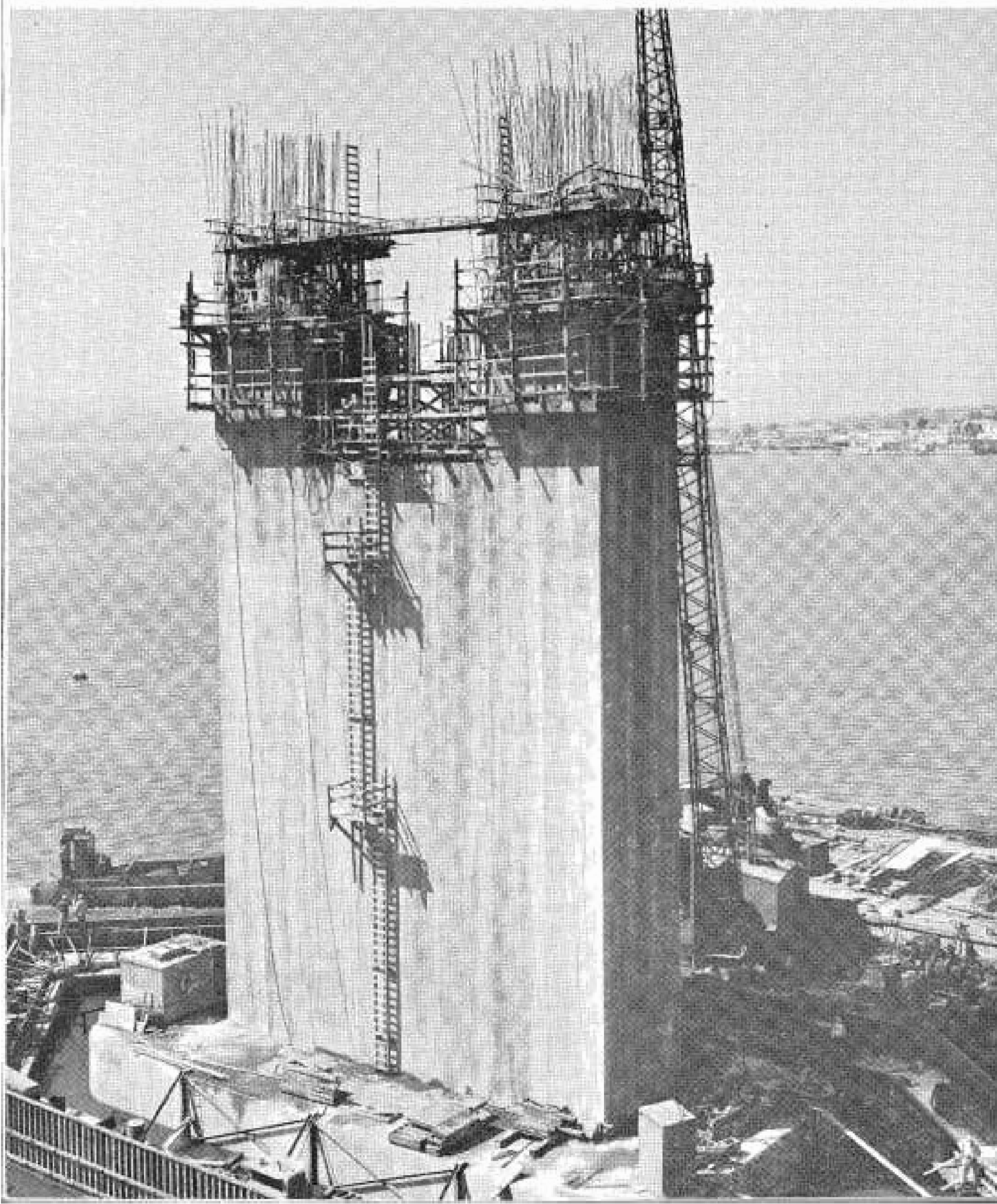


Steel erection on Span No. 12, the first truss span to be erected, is shown with the two temporary erection bents in place. One 4-panel section of the far truss remains to be lifted in place to complete the span.



This sketch shows the "Judy Ann", a heavy floating erection crane. This crane was used by the contractor to erect the Richmond-San Rafael Bridge. Safety nets are used to protect the ironworkers.





substantial cost savings by using the highest grade of steel practicable for the particular member in question.

The successful bid price per pound for the three grades of steel was as follows:

A7 and A373	18.57¢
A242	21.74¢
T-1	34.48¢

Erection of the steel trusses was started in May, 1961 and it is expected that the steel erection and concrete slab construction of the Superstructure should move along quite rapidly.

The truss erection method used by the Yuba Consolidated, Inc., makes use of temporary bents supported by steel H piles, as shown in the accompanying sketch of erection procedure.

Two of these bents were used in the erection of Span 13, the first truss span to be erected. Only one falsework or temporary bent will be used in each of the remaining spans.

Temporary Bent Omitted

Span 11 which is opposite the Southern Pacific Company's vertical lift span must be kept open at all times for river navigation. The temporary erection bent will therefore be omitted in this span and the truss will be erected by cantilevering out 13 panels from Pier 11 until it reaches the 4 panel section supported by an inclined temporary bent at Pier 10.

Where the cantilevered portion joins with the supported portion, the deflection will be as much as 8′-6″ and the two sections will be brought together by using hangar rods and jacks. The remainder of the spans from Pier 10 will be erected in the same manner as Span 11 using one temporary bent.

The total project involves seven contracts as follows:

... Continued on page 30

PHOTOS LEFT—After completion of the box footing the cellular concrete stem of the pier, which rises about 100 to 130 feet above the footing, is started. The concrete stem is poured by the "slip form" method. The "slip form" method is a continuous 24 hour per day operation in which the form is jacked up at the rate of above 10 inches per hour. As the concrete at the bottom sets up and develops strength and hardness, the form is jacked free and the concrete stands exposed and unprotected. It required approximately 5 working days to pour each stem from the footing block at the bottom to the truss supporting surface at the top.

Vallejo Freeway

Latest Survey Shows Marked Decline in Accident Rate

By CHARLES A. PIVETTI, District Traffic Engineer

THE PROBLEM of mounting traffic accidents is causing increasing concern throughout the nation. Consequently, any data indicating a trend towards reduction in accident frequency is welcome news.

Freeways save lives. This has been substantiated by reports from all over the United States indicating that freeways are from two to five times as safe as conventional streets and highways. Studies of accident records before and after conversion of city streets to full freeway show a trend in accident reduction ranging from around 7.5 to 1.5 accidents per million vehicle miles.

Statistics compiled for the California State rural highway network for the year 1959 show a statewide accident rate on highways other than freeways of 2.39 accidents per million vehicle miles whereas the rate on freeways was only 1.00 accident per million vehicle miles.

A review of accident records for that portion of U.S. 40 passing through the City of Vallejo offers substantial evidence that development to full freeway is the most positive and predictable approach to accident reduction that the highway engineer may employ.

BEFORE—This is a scene from the U.S. 40-Benicia Road intersection in Vallejo prior to construction of the freeway.

AFTER—An aerial of the State Route 74 Separation (foreground) and Benicia Road Overcrossing (background) following construction of the freeway.

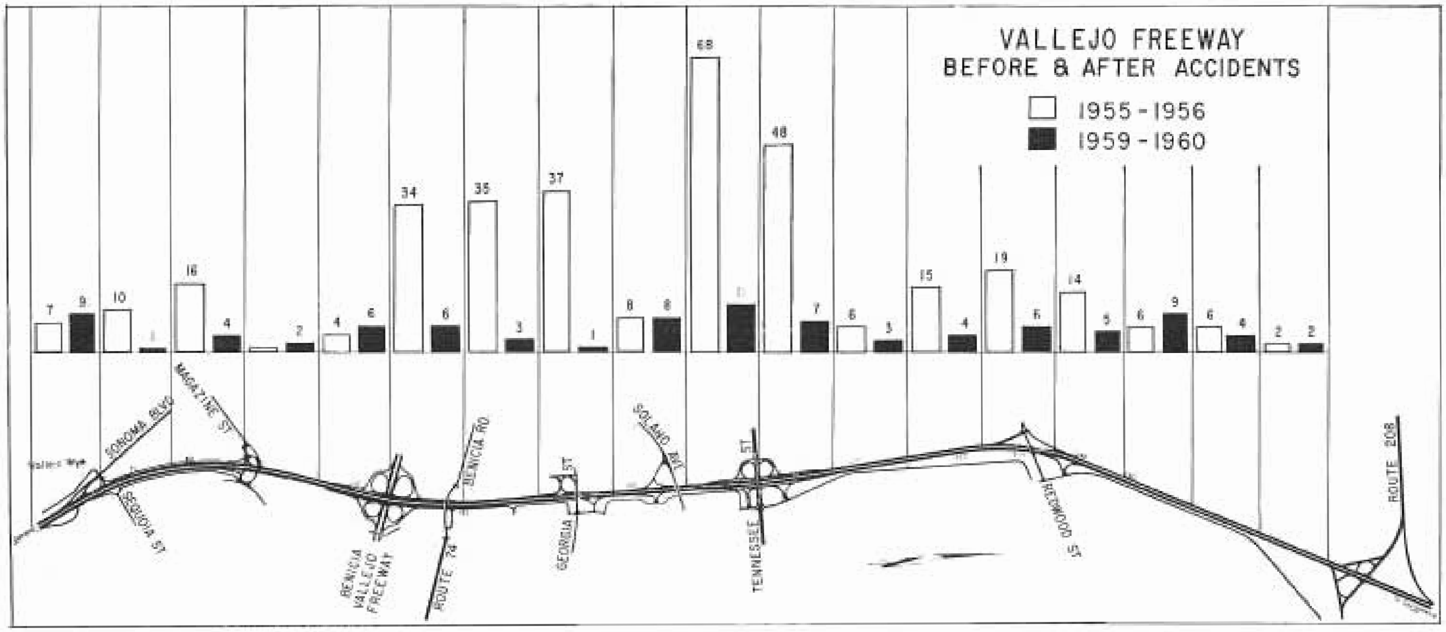
Accident Rate High

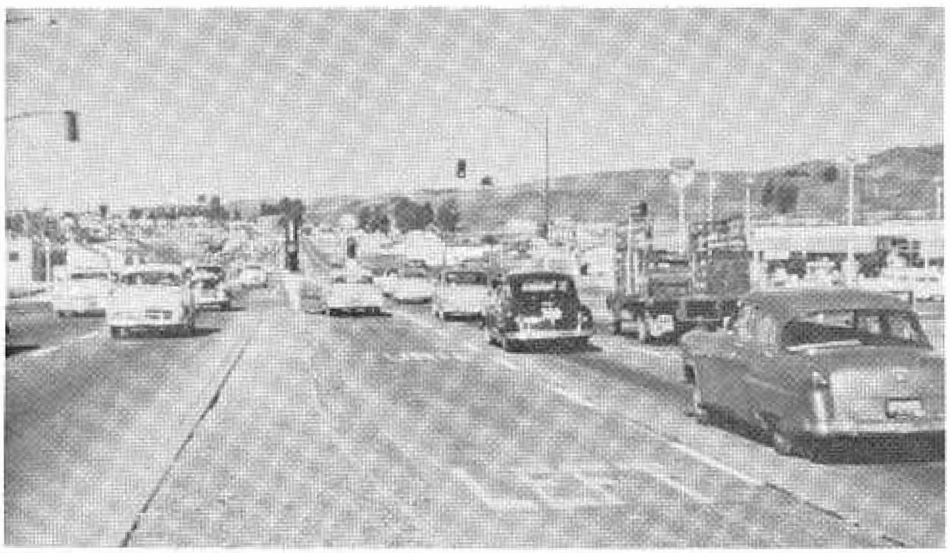
Prior to construction to full freeway, U.S. 40 through Vallejo had five of the most accident-prone intersections in District X. Despite constant attention and continuing attempts to reduce accidents through channelizing intersections and signalizing with expensive, interconnected signal systems, the 4.5 miles length of expressway with intersections at grade experienced 336 traffic accidents during 1955 and 1956. In these two years there were 99 accidents involving personal injuries and 4 accidents involving fatalities.

During 1957 and 1958 Vallejo's section of U.S. 40 was converted to full freeway.

The first two years of full freeway operation, 1959 and 1960, revealed a 73% reduction in accidents—*245 fewer accidents than during the two years preceding construction.* Of the freeway's total of only 91 accidents as compared to the expressway's 336, only 29 involved personal injury and only 2 involved fatalities.

The accompanying chart graphically illustrates the before and after picture for each quarter mile of the Vallejo Freeway. In addition to the observations by quarter-mile, the before and after study showed that replacing one intersection with a separated interchange reduced accidents from 34 in 1956 to 4 in 1959. At another intersection, replaced by an interchange, accidents were reduced from 16 in 1956 to 1 in 1959.





BEFORE—The intersection of U.S. 40 with Georgia Street in Vallejo prior to the building of the freeway.

AFTER—A view of the same section of U.S. 40 following completion of the freeway.

Four Increases Explained

Only four of the quarter-miles shown on the chart indicate increases in the actual number of accidents. One is a portion where prior operation simulated freeway operation since there were no grade crossings, and one contains the easterly approach to the Carquinez Bridge Toll Plaza. None of the four is particularly significant since the magnitudes are small, being in the order of 7 to 9, 4 to 6, etc.

Also, it should be pointed out that the reduction in number of accidents was concurrent with a substantial increase in traffic volume. The average daily traffic volume increased from 22,000 vehicles in 1956 to 29,000 vehicles in 1960. This means that the reduction in accidents per million vehicle miles is proportionately greater than the reduction in the actual number of accidents: the 1955-56 rate was 4.75 accidents per million vehicle miles, the 1959-60 rate was 1.07. This represents a reduction of 78% which indicates the freeway to be more than four times as safe as the expressway it replaced.

From these general observations of Vallejo Freeway accident experience, it appears quite obvious that this freeway has provided motorists with tremendously increased safety as well as savings in vehicle miles and operating minutes.

Corona Bypass

Riverside Freeway Now Continuous for 24 Miles

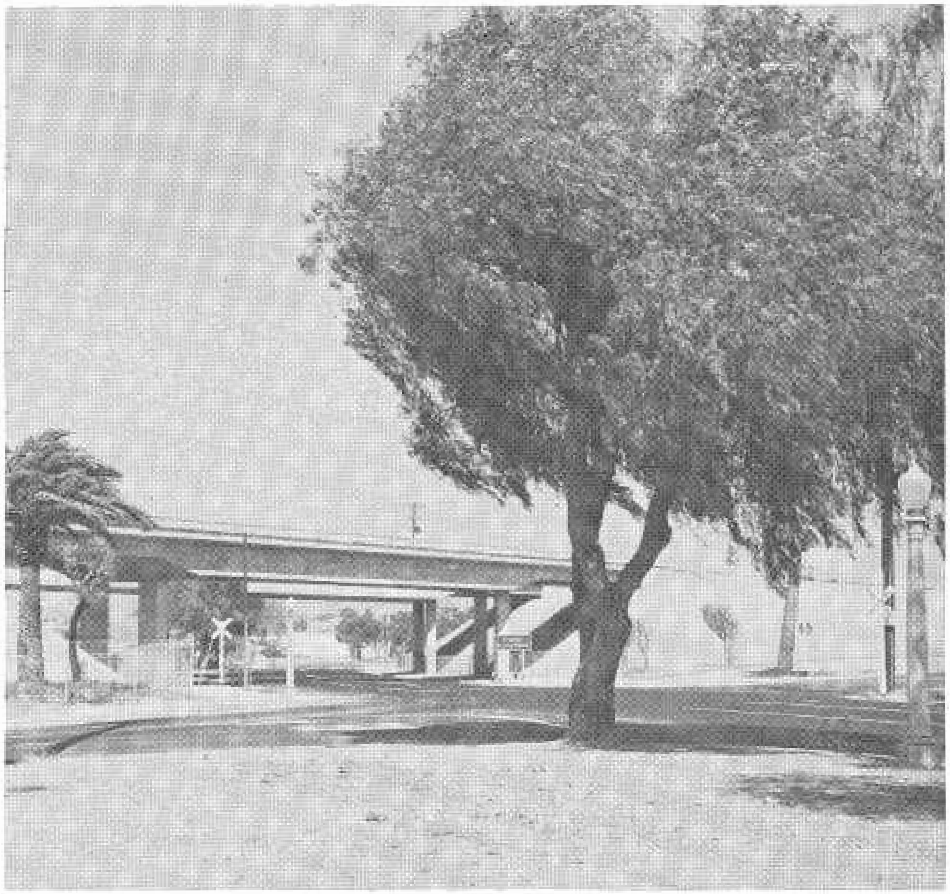
By W. H. CRAWFORD, District Construction Engineer

A $9 million, 7.7-mile section of the Riverside Freeway near Corona was opened to traffic April 6, 1961, in impressive ribbon-cutting ceremonies, attended by State and local dignitaries, on the deck of the Magnolia Avenue Overhead near the east end of the project.

The unit of freeway opened begins one-half mile west of Corona and ends at La Sierra, to the east.

Corona's Mayor A. J. Velthoen presented a certificate of appreciation to the construction firm of Fredericksen and Kasler, which built the freeway link. The mayor commended the firm for its work and attitude toward the public during the construction period.

Construction of the new freeway section began in January, 1960. It runs north of the former highway, State Sign Route 18 and U.S. 91. It passes west of the community of Home Gardens between Riverside and Corona, and runs north of the business district of Corona along what was formerly Second Street.

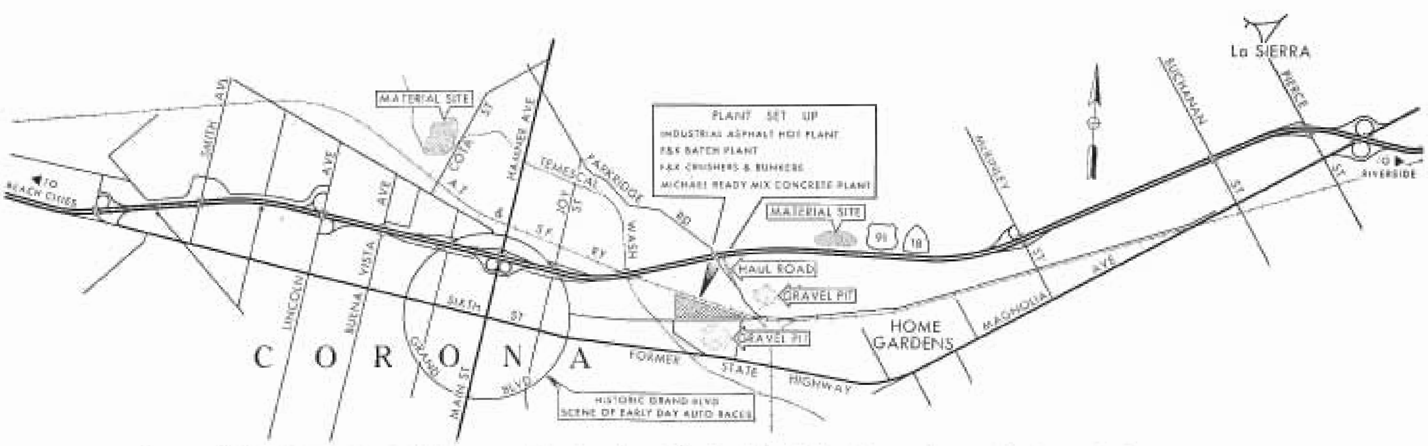


The Grand Boulevard Undercrossing with historic Grand Boulevard passing underneath. Existing trees were preserved wherever possible.

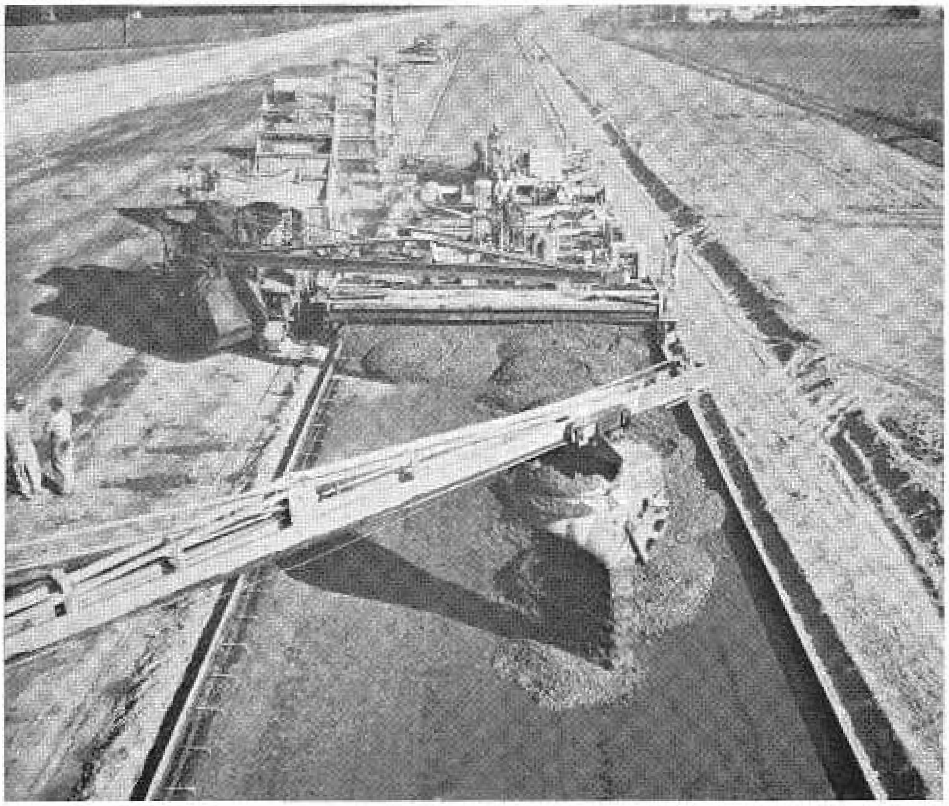
The Circle

Although the freeway bypasses the business district of Corona, it has one feature in common with the former highway—it also crosses the historic circular street known as Grand Boulevard.

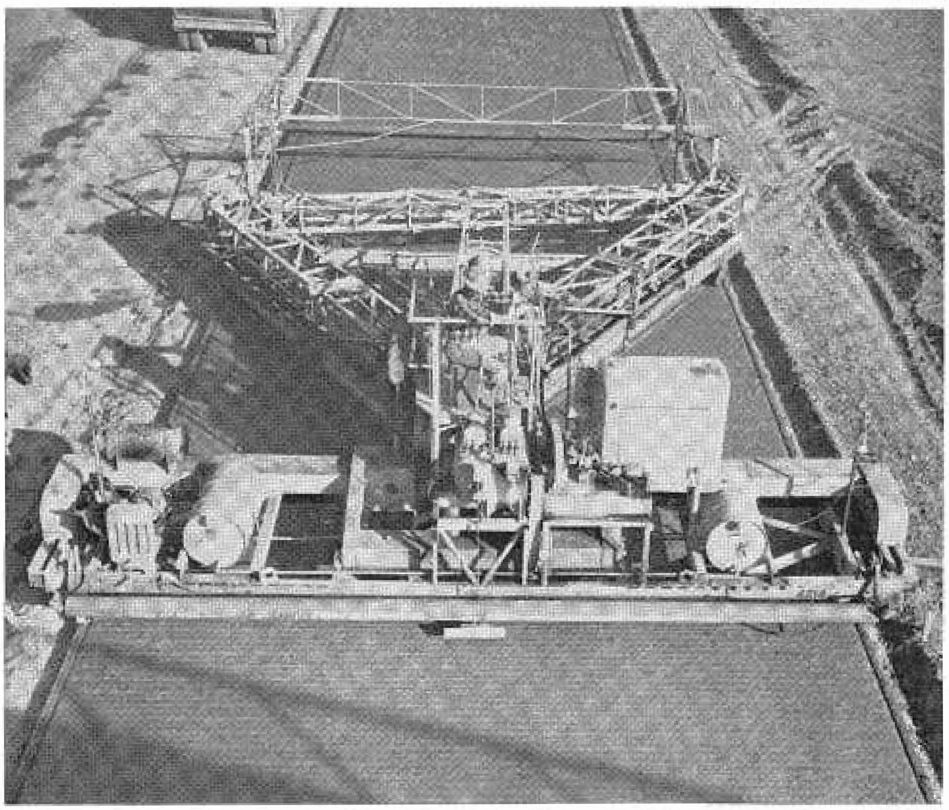
In 1866, the city founders decided that a perfect circle, divided into four quarters, would provide the main arteries of the city they named "Co-



A map of the freeway through Corona which also shows the location of the plant and material sites used during construction.



Corona Freeway Construction. A paver deposits concrete on cement-treated subgrade between slide forms for 24-foot-wide pavement. Following are a spreader, two finishing machines and a float.



A float makes the first of three passes over a section of concrete. Radial floats are left open, allowing excess concrete to be retained at the edges of the slab to be picked up on the backward pass when the radials are closed. On the third pass, machines drag the float, smoothing the surface and wiping out the herringbone pattern caused by oscillating floats.

rona". The boulevard, as originally constructed, has a circumference of three miles and a width of 60 feet. For more than forty years the boulevard was unpaved, and the ladies and gentlemen in their horse-drawn carriages serenely promenaded the ever-turning avenue; equestrians used it as a bridle path; the loop became an integral part of the then quiet life of the small orange belt city.

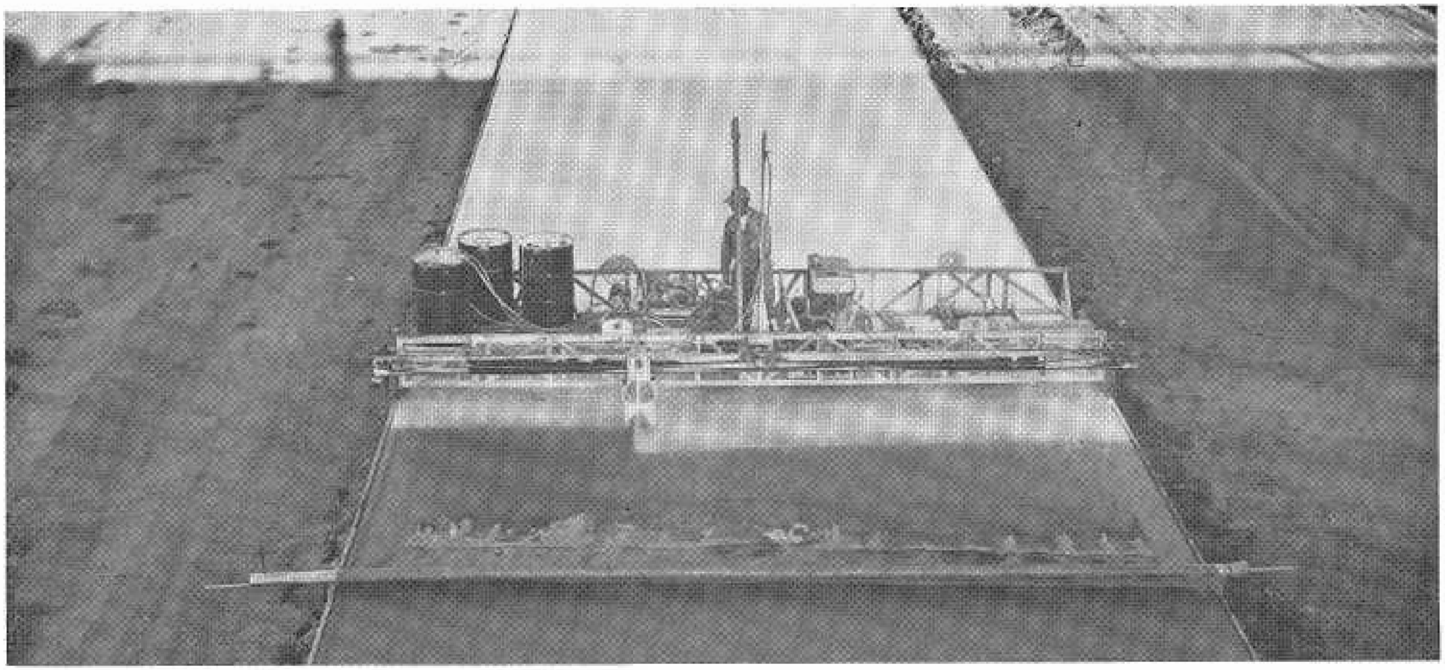
Those quiet times were gone and the horse-and-buggy days were over by the advent of the automobile and the development of racing cars. The potential of this circular avenue as a race track was recognized and, about 1910, the 60-foot roadway was given an asphaltic surface and Grand Boulevard became the first big car race track of the West. Such racing greats as Barney Oldfield, Bob Burman, Ralph DePalma, Eddie Rickenbacker, Earl Cooper and Eddie Pullen roared over the course at nearly 100 miles per hour. As many as 75,000 eager fans would gather in the City to witness the racing events which were held during the years of 1913, 1914 and 1916.

Big car racing on the track was curtailed during World War I and was never resumed in the same style. Today, Grand Boulevard is a well-developed, four-lane roadway, permitting any who might so desire to tour the circle and retrace the route of the racers of bygone times.

Saves 20 Minutes

The construction of the bypass project completes this section of the Riverside Freeway to full freeway standards for a total distance of 24 miles, from its terminus at the junction of the San Bernardino Freeway east of Colton. The remaining section of Riverside Freeway in Riverside County, between this project and the Orange County line, is a four-lane divided expressway. Plans are now being prepared to convert this 3.8-mile section of expressway to a six-lane full freeway.

The Corona project is the sixth unit of the Riverside Freeway in Riverside County to be constructed and opened to traffic since 1955. Construction of the various units has been continuous, following soon after establishment of

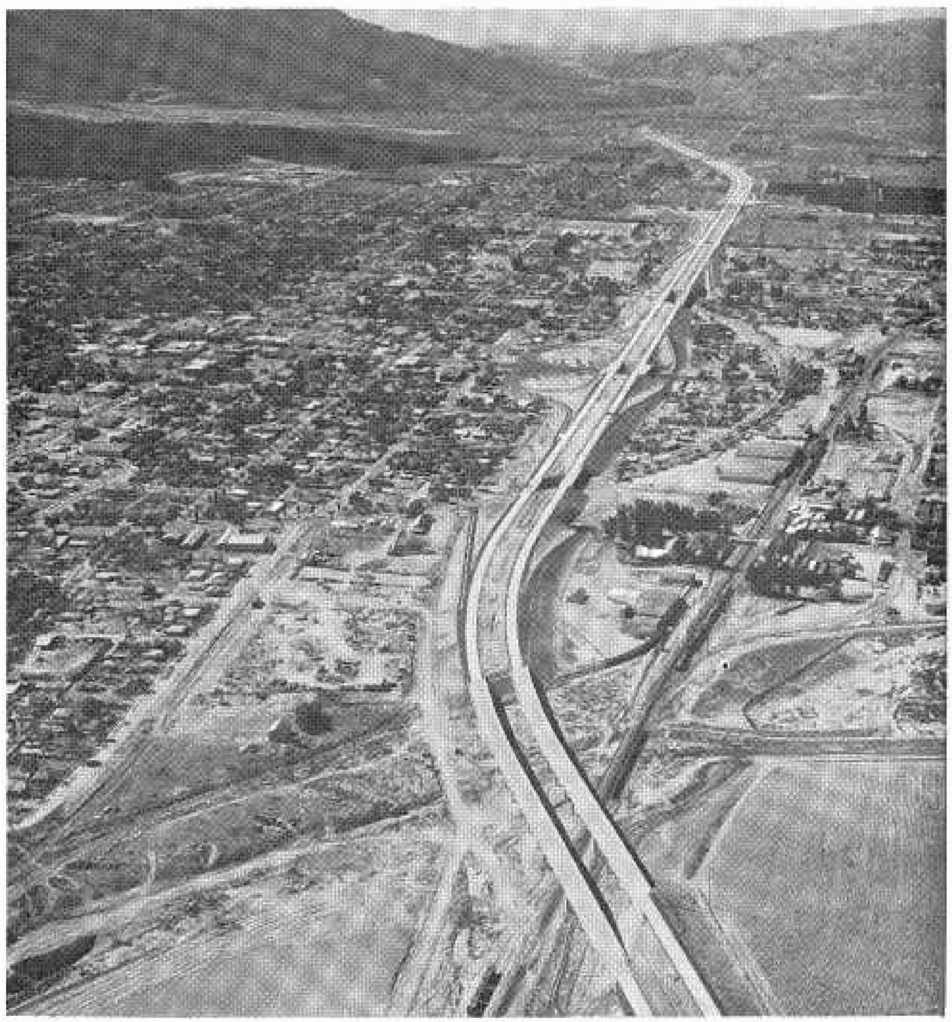


Applying white curing compound to completed pavement. The burlap drag across the pavement (foreground) marks the beginning of the next section of pavement being finished by the float (see previous photo).

freeway routings and development of plans. The first public hearings to decide freeway routings were held in Riverside, November 6, 1952, and in Corona, March 29, 1956. The Riverside Freeway was officially named by the California Highway Commission in October, 1957.

With the addition of the Corona project to the other completed construction on the Riverside Freeway, the devious routing of U.S. 91 and State Route 18 through Corona, Riverside and Colton has been eliminated. The improved routing on the freeway is one-half mile shorter than the old alignment of U.S. 91 and driving time has been reduced by 20 minutes. This improvement will be particularly noted by drivers who travel between the interior valleys and the beaches and by the coast-to-mountain recreational traffic. Based on present-day traffic volumes, it is estimated the traveling public using the Riverside Freeway will realize an annual saving of $7,000,000 because of this reduced distance and travel time. Three railroad grade crossings are eliminated.

The Corona project consists of a four-lane divided highway, with provision for future widening to eight lanes with a 22-foot minimum width of median. The through lanes were constructed of Portland cement con-



Looking westward through Corona with the Temescal Wash Bridge and Overhead in the foreground.

Lineup for the Corona Road Race on Grand Boulevard, November 26, 1914. Photo by H. E. Roberts.

crete over cement-treated subgrade. The ramps and loops were paved with asphalt-concrete over cement-treated base, and frontage roads and streets were paved with asphalt-concrete on untreated base.

SAND HILLS

Continued from page 17 . . .

load will provide approximately 23 to 26 cu. yds. of compacted embankment. The rated capacity of the machine is 24 cu. yds. struck, but the scrapers were extended 22″ by splicing in steel plates. Sideboards were added on top, increasing the capacity by about 25%.

The embankments are constructed several feet wide on the northerly side, as the prevailing winds erode and carry away considerable amounts of sand from the slopes during construction. Most of this sand is deposited on the leeward side.

Attempts to reduce erosion by watering during windy periods are usually effective, although expensive.

It is planned to blanket slopes most subject to wind erosion with a gravelly material. It is estimated that such treatment will cost about $0.25/sq. yd. Asphaltic emulsion or resin solution treatment of blow sand is also planned. During a day of high north winds, several feet of unprotected embankment may be eroded on the windward side, with a heavy deposit on the lee. Southerly winds appear to be of less velocity and only small amounts of sand are returned during periods of south winds.

All borrow material is pre-wetted in the pit area by means of sprinkler systems. Water was obtained from the All American Canal which generally parallels the project. Water is pumped by three 185 HP pumps through two 6-inch water lines to the pit area, each pump producing up to 1300 gal/min. Up to 1,500,000 gallons of water per day is sprinkled in the pit areas. Approximately two-thirds of the water applied to pit areas fails to reach embankments due to evaporation and percolation losses. The contractor applied additional water to embankments by means of water trucks equipped with large oversize tires (17.00 x 20.00 22 ply). Optimum moisture content of the blow sand, as determined by the California Impact Compaction Test, is approximately 12% of the dry weight of the sand. Tests indicate that the moisture content of the sand, a few minutes after saturation is rarely in excess of 5% due to loss by percolation.

Compaction Easily Achieved

Embankment relative compaction of 100%+ is easily achieved by routing of hauling equipment. Outer edges of embankments are compacted by a track-laying tractor or by sprinkling with water.

Success of the existing highway through the sand dunes and the anticipated success of the present construction depends upon the fact that the dunes, while moving, do not increase in height. The road, therefore, is built on embankment over the tops of the dunes. The increased velocity of the wind over the smooth pavement, combined with the action of passing vehicles, keeps the road clean even during the heaviest sand storms. A deposit of sand was recently observed on the low side of a 4% superelevated curve. It is anticipated that this condition can be corrected by covering a wide adjacent area with a gravel blanket. The median of this four-lane freeway will also be covered with a gravel blanket.

BRIDGE PROGRESS

Continued from page 24 . . .

(1) Foundation contract Main Bridge by Yuba Consolidated Industries, Inc.	$5,769,000
(2) Superstructure Main Bridge by Yuba Consolidated Industries, Inc.	8,500,000
(3) Solano County Freeway approach by Fredricksen & Watson Construction Co. This contract includes the Administration Building and Toll Plaza and the approach freeway from bridge end to North Benicia City Limits.	4,200,000
(4) Right of Way Clearance Contract by Fredrickson & Watson Construction Co. This contract is for work in the Benicia Arsenal relocating existing buildings, storage yards, and other facilities within the highway right of way.	$1,025,000
(5) Contra Costa County Freeway by Peter Kiewit Sons Company Includes freeway approach work from the bridge end to a connection with the Arnold Industrial Highway Route 106.	4,700,000
(6) Widening Escobar and Howards Streets by Gallagher & Burke This contract provides for a connection from the freeway to the center of Martinez at Alhambra and Berrellessa Streets.	425,000
(7) The Toll Collection Equipment by American Electronics, Inc. Taller Cooper Division This contract provides for the installation of toll collection equipment in the toll booths and administration building.	194,000

These contracts are all timed to be completed for opening the bridge to traffic by the summer of 1962.

87.4 MILLION DRIVER LICENSES

A total of 87.4 million motor-vehicle operators licenses were in force in the United States during 1960.

The estimate, prepared by the U.S. Bureau of Public Roads, was 3.4 percent higher than the 84.5 million total in force during 1959. There were 1.20 licensed operators per registered motor vehicle.

Traffic Striper

New Machine Now in Service Has Flexibility and Ease of Control

By J. J. KELEHER, Associate Equipment Engineer

The painted center stripe, probably the most used and abused phase of our highway system, is taken pretty much for granted by most of the motoring public. Upon reflection, however, most would agree that, despite its lowly position, it probably exercises a greater influence for safe driving than any other device used on the highway today.

This continuing influence is maintained only by a rigid program of maintenance, and a continuing search for better ways to carry the message of safety to the millions of motorists and pedestrians that use our highways and streets.

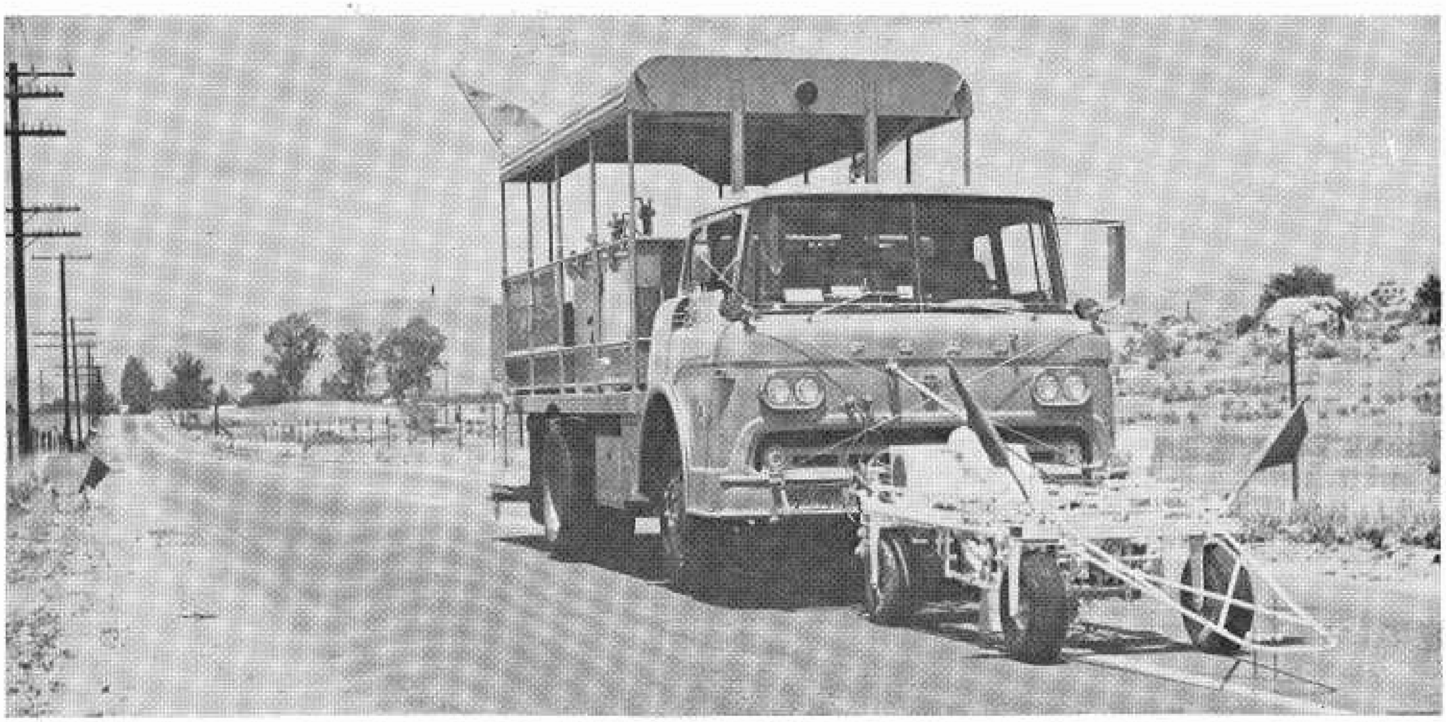
The program of striping is an item of considerable importance in highway maintenance, not only from the dollar angle, but in the planning required in the job itself. This must include such problems as traffic, temperature, weather conditions and many other factors. It is a job demanding a high degree of skill, patience and fortitude on the part of the operator who works under some of the most hazardous conditions to be encountered in highway maintenance.

Seek Better Methods

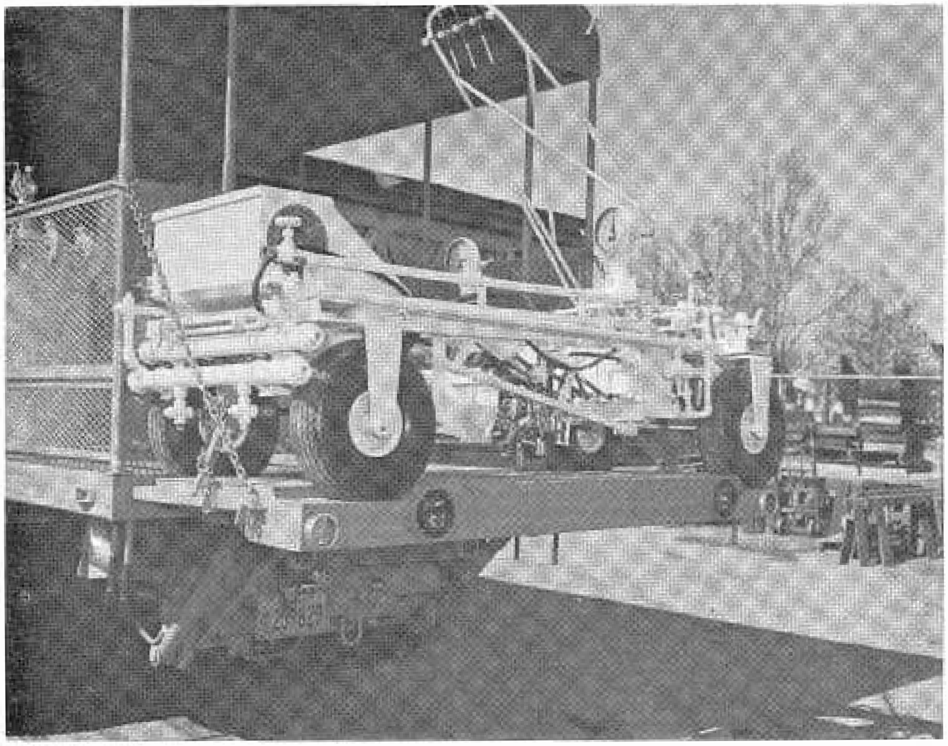
The Equipment Department of the California Division of Highways, in conjunction with the Maintenance Department, is constantly seeking improvement methods and equipment for a safer and more economical approach to the many and varied jobs to be done. In most instances suitable equipment can be purchased on the open market, and we prefer this method of obtaining it. But when specialized equipment is not available, then the Equipment Department is called upon to design and construct whatever is required to do the job. Traffic marking equipment is presently included in this category, but private manufacturers are making rapid advances in this field and should soon be in a position to supply the market.

The needs of the Division for traffic striping have been under constant study with the idea of developing better machines that would accommodate themselves to all of the various types of roadways that make up our highway system. Two years ago, in cooperation with the Maintenance Department, work was undertaken on a new model that would place the operator in the truck cab, and paint more miles of stripe at a lower cost per mile. An article published in the January-February 1960 issue of *California Highways and Public Works* described the prototype of this machine.

Since then, testing and improving of the original model have progressed to the stage where we now have in service a machine that embodies all the basic features originally planned, plus some additional improvements which add to the flexibility and ease of control.



This high crown secondary road presents no problem to the new striper with its narrower tread.



The striper unit is readily loaded and transported on the modified hydraulic tailgate.

Safety for Operator

At the request of the Maintenance Department, primary importance was attached to placing the operator in the truck cab. This was not only because of the operator's vulnerability to accident while being seated in front of or behind the truck, but to help relieve him of the stress and discomfort that has always accompanied his exposed position while operating this type of equipment.

Operation is now controlled entirely from the operator's seat in the truck cab. The cycling device is powered from the truck and consists of a proximity switch with relay, energized intermittently by a rotating mass of ferrous metal mounted on a non-metallic disc. Full compensating controls are provided to meet any standard cycle or stripe pattern desired. Broken stripe may be lengthened or shortened, advanced or retarded, or suspended completely in either phase of the cycle through the operation of micro switches located on the dash. The amount of advance or retard, or the suspense operation is clearly indicated on a specially constructed dial indicator located in front of the operator.

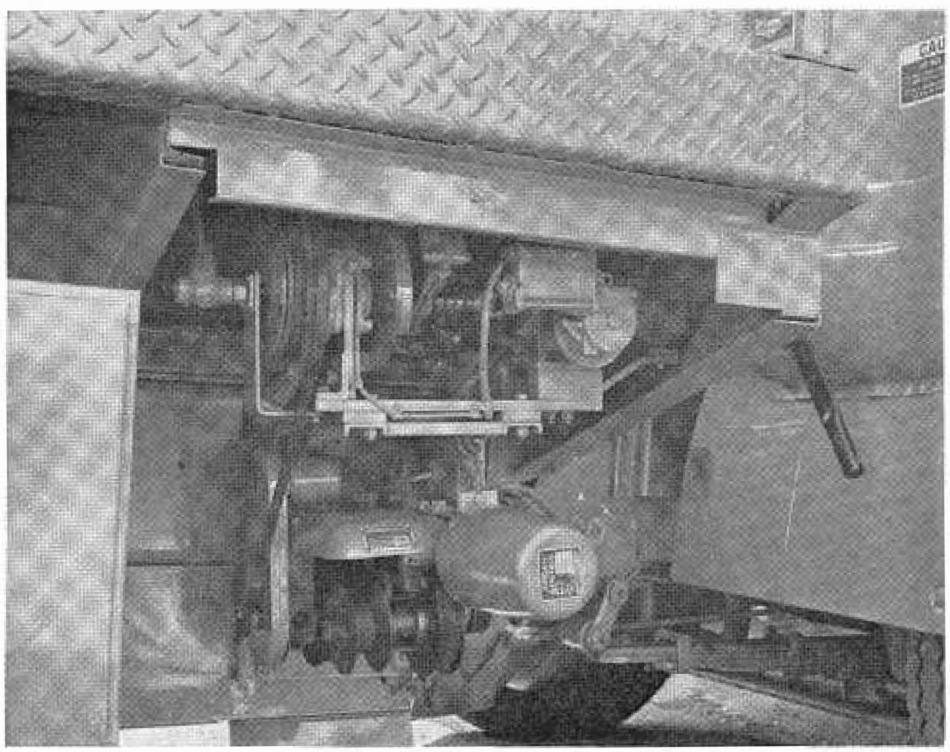
A battery of 12-volt D. C. solenoid valves is used to control the air flow to the paint guns and beaders. Two standard paint guns revamped to give a common outlet (nozzle) are mounted on each side.

Pattern Can Be Selected

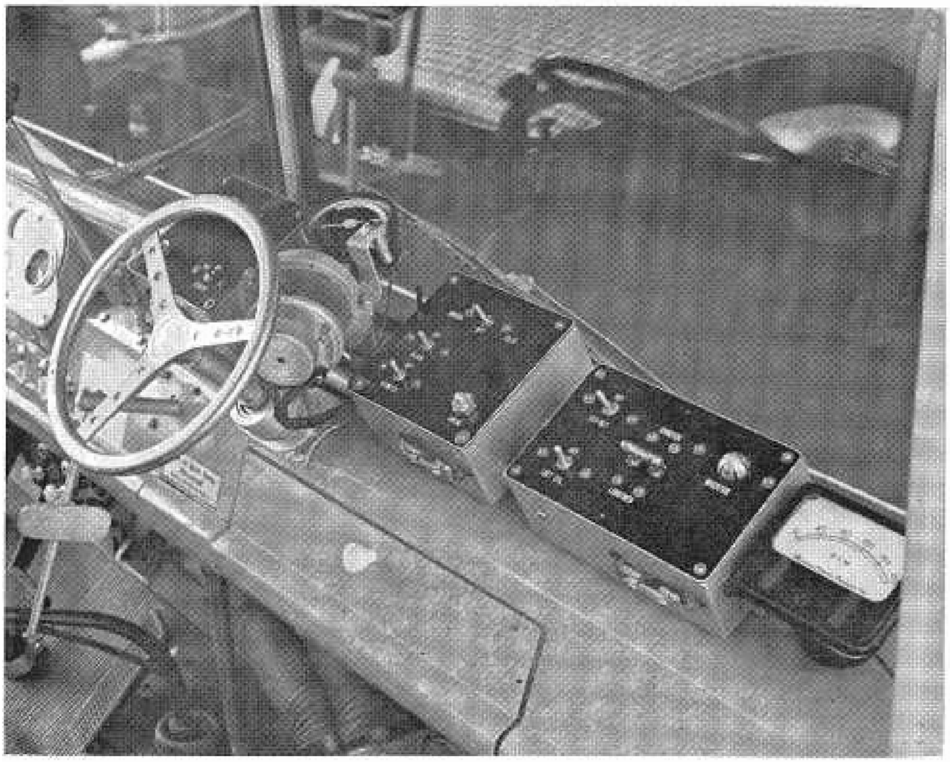
This makes a very satisfactory arrangement when yellow and white paints are being used. The operator has only to select the pattern required (broken or solid), and the appropriate color is automatically selected and applied with no noticeable contamination.

The sulky or carriage consists of a simple frame supported on four low-pressure tires and designed to afford the operator full view of the paint guns without having to take his eyes from the road ahead. It is free to float and pivot within the length of the bumper to negotiate some of the sharper curves of the mountain areas without running over the stripe.

The coordination of effort that is required between the truck operator and the operator of the sulky is made less critical through the use of a device that reflects the movement of either unit in relation to the other. A target mounted on a nylon cable moves across the lower section of the windshield in direct relation to the movement of either vehicle so that coordination is maintained by use of witness marks placed on the windshield.



The cycling mechanism is mounted under the body behind the cab.



Cab interior showing the control panels. Steering and controls of the unit can be handled by one man.

Advantages Over Old Model

All these are obvious advantages over the old model where the operator is required to steer, manipulate valve handles for pattern changes, match the existing stripe and frequently check the operation of the guns located beneath his feet, while during his leisure moments he may contemplate the unhappy possibility of meeting the all-too-frequent driver who insists on taking his half of the road from the middle.

As a result of the article previously mentioned, we have had numerous requests from other states for plans and specifications. Australia has manufactured several of the older-type units from our plans and is now operating them. Representatives from their various highway departments have visited here in the past year and requested data on the new machine when completed. This information will be forwarded to interested parties in the near future.

Reports from the districts that have used this new model are favorable. The machine should cost less than the older model. With better controls, less operator fatigue from operation, and better safety for the operator, the cost per mile of stripe should be reduced. With these advantages, the new model will rapidly replace the operator-driven sulky models presently used.

It's the Collier Tunnel and Thomas Bridge

Two of the current construction projects on California State highways have new official names as a result of action of the 1961 Legislature.

By adopting Senate Concurrent Resolution 74, the Legislature designated the tunnel now under construction at Hazelview Summit in Del Norte County, near the Oregon line, on U.S. 199 as the "Randolph Collier Tunnel." This project has been described in two recent articles in *California Highways and Public Works.*

The Legislature also adopted Assembly Concurrent Resolution 131, designating the toll bridge now under construction between San Pedro and Terminal Island in Los Angeles County as the Vincent Thomas Bridge.

Division Approves New Sign Routes

Four new state sign routes and two changes in previously designated routes have been officially approved by the Division of Highways since January, 1961.

New state sign routes are as follows:

State Sign Route 84 in San Mateo and Alameda counties, extending from the junction with State Sign Route 1 at San Gregorio to the junction with U.S. 50 (Interstate 5W) near Livermore. The route passes through La Honda, Woodside, Menlo Park, Fremont, Newark, Sunol, and Livermore, and extends across the Dumbarton Bridge.

State Sign Route 68 (Salinas-Monterey Highway) in Monterey County, extending from State Sign Route 1 in Monterey to U.S. Highway 101 in Salinas.

State Sign Route 59 in Merced County, extending from the junction with State Sign Route 152 at the Red Top Wye, seven miles east of Santa Rita Park, to Snelling. The new route passes through Merced.

State Sign Route 154 in Santa Barbara County, extending from Surf to the junction with U.S. Highway 101 west of Santa Barbara. The new route passes through Lompoc, Buellton, Santa Ynez and San Marcos Pass and was formerly the western half of State Sign Route 150 connecting Surf and Santa Paula.

Changes in existing routes are as follows:

State Sign Route 108 in Stanislaus, Tuolumne, and Mono counties, now extends from Modesto through Yosemite Junction near Sonora to Sonora Junction (U.S. 395 Junction). The change causes SSR 108 to coincide with SSR 120 between Oakdale and Yosemite Junction. Previously SSR 108 extended from Yosemite Junction to Sonora Junction.

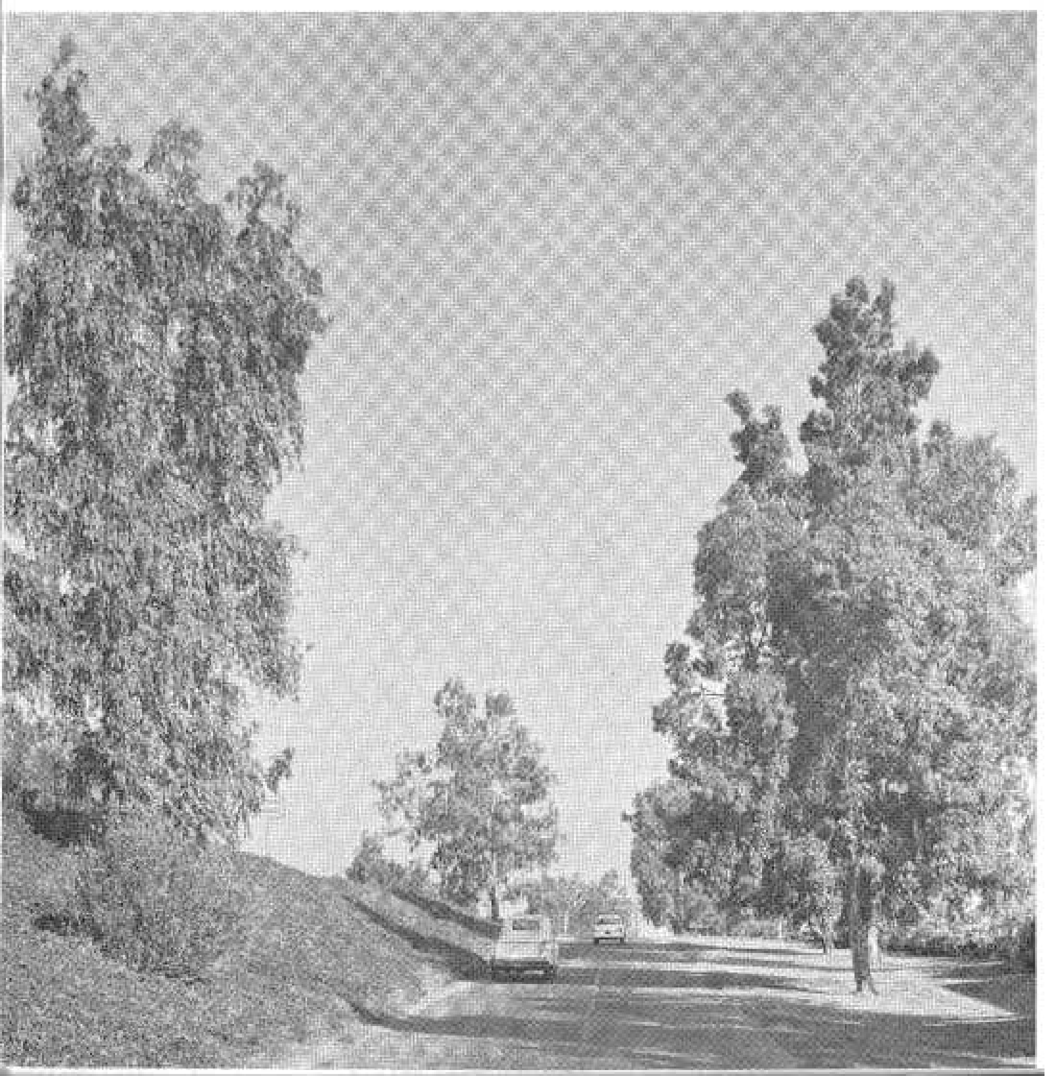
State Sign Route 150 in Santa Barbara and Ventura counties, now extends only from the junction with U.S. Highway 101 east of Carpinteria to the junction with State Sign Route 126 in Santa Paula.

California Roadsides—4

EDITOR'S NOTE: This, the fourth and last, in a series of articles on landscaping and related roadside problems on the California State Highway System, covers the choice of plants used for planting on California roadsides, and the reasons why. The four articles in this series, plus a list of most used trees, shrubs, and ground covers, will be made available to interested persons as a reprint booklet under a single cover.

The series has been prepared by John Robinson of the Public Information Section with the assistance of various staff members concerned with planning, planting, and maintenance of roadsides.

BELOW—U.S. 99 on-ramp in Kern County has lawn, oleander, vinca and honeysuckle on slopes. Trees are eucalyptus camaldulensis (rostrata), one of the most useful eucalypts.



As has been pointed out in the preceding articles of this series, the cost of creating artificial environments for plants is too high to be warranted except in special cases, so their ability to survive the environmental conditions on California roadsides must be the major factor in choosing them. The working list of plants and trees used by the Division of Highways Landscaping Section today represents an accumulation of more than 30 years experience in choice of trees and plants for growth under difficult and varying conditions.

Actually, this experience started more than 60 years ago when the first extensive plantings of roadside trees in California began, but many organizations did the planting and records are sparse. We know little about the plantings that failed, but some of these early plantings are magnificent trees today. Fragmentary sections of these old plantings can be seen where they have survived the rigors of the years.

In the Central Valley huge blue gum eucalyptus, native black walnuts, sycamores, and a few oaks and elms still remain of these old plantings. In the Mother Lode country ancient black locusts, Chinese tree of heaven, and Lombardy poplars are accepted as part of the "gold country" scene. In southern California there are fine old peppers, black acacia, cottonwoods, silk oaks, palms, and of course the omnipresent blue gum. Very old plantings of olives may be seen occasionally in the vicinity of old missions and homesteads. Today almost all these species have been superseded for highway purposes because they have some defect in their habit such as slow growth, brittleness, or they require excessive maintenance.

A second surge of roadside planting began in California in the period within the few years on either side of 1915. These plantings in most cases were spontaneous local community efforts, with choice of species too often made by some individual with a fond memory of a romanticized home town location like Fairmount Park in Philadelphia or Mount Vernon in Virginia. The concept of the highway right-of-way at this time also was a vague and tenuous thing which allowed adjacent property owners considerable say on road side matters. In the old type agreements a property owner might have a clause stipulating the variety of tree to be planted!

Even of these later plantings, no one today can say with any certainty how many were wasted, but in 1918, when the Highway Commission took over all the trees along state highways, many unsuccessful plantings had to be replaced. For instance, young trees had been planted in the few inches of topsoil over hardpan without breaking the hardpan. Some of these trees were growing only an inch or two a year. In many places virtually the entire planting had died because the species chosen could not survive through the arid California summers. Still other plantings had to be removed because they were too close to the roadways.

A state nursery at Davis was established so that adequate supplies of young trees would be available. In 1921 a total of 7,600 black walnut, European sycamore, Lombardy poplar, American elm, and black locust were made available. Increasingly large numbers were released each year and by 1927 the Highway Commission could say it had taken over or planted 60,000 trees on state highways.

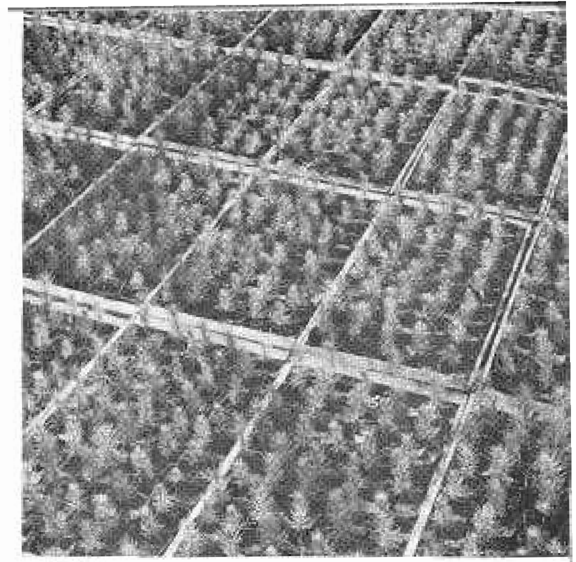
In addition to the above varieties, trees being planted in the valleys included blue gum, red gum, olive, Carolina poplar, silver maple, Arizona ash, and valley live oak. Redwoods, live oaks, maples, walnuts, gums and sycamores were being planted along the coast. In the deserts the trees being used were black locust, Arizona ash, blue gum, red gum, black acacia, and athel (tamarix articulata).

Little work was done with shrubs until the middle of the 1920's, when a movement for beautification of entrances to cities gathered impetus. Tree and shrub groupings were planted at the outskirts of cities, both on county roads and state highways. Plantings also were made near and on the slopes of the many railroad underpasses which were being built at this time.

As the highways became ever wider and straighter, the search for methods of stabilization of the growing number of cuts was intensified. One of the first laboratories for this work was the scenic highway in the Angeles Crest and Crest Drive area above Los Angeles and San Bernardino.

This was a new section of road, built on the side of steep mountain slopes, and necessarily the construction left a number of scars on the mountainsides to be covered. Many of the new cuts and fills were unstable in wet weather, with resultant maintenance problems.

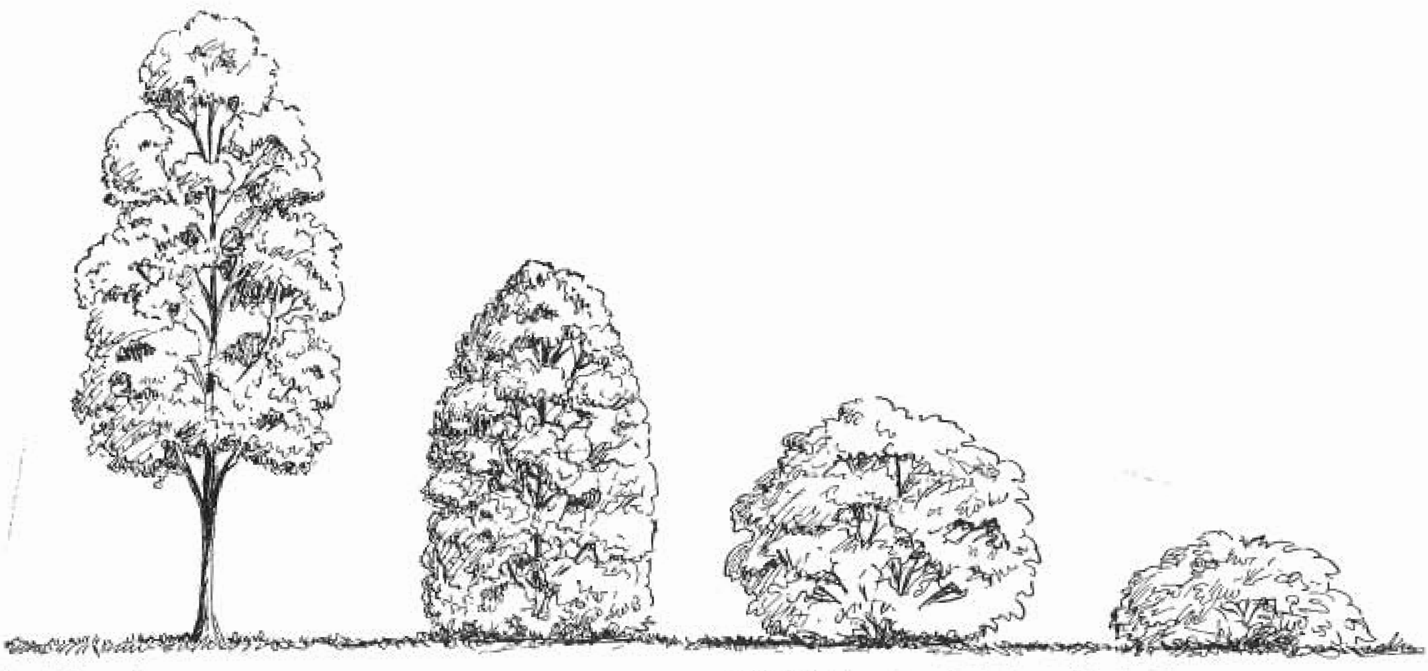
Although many agencies were experimenting with plants to hold cut and fill slopes, there was no way to hold the soil long enough to get growth started. All sorts of elaborate arrangements of brush, wire, wattles, and wooden frameworks were tried. H. Dana Bowers, who was then the entire landscaping section, personally visited some of these new slopes when rain was falling. He noticed that where old grass stems were mixed in disturbed soil, and where the surface was compacted, erosion did not easily begin. The grass kept the water from forming into streams and gullying.



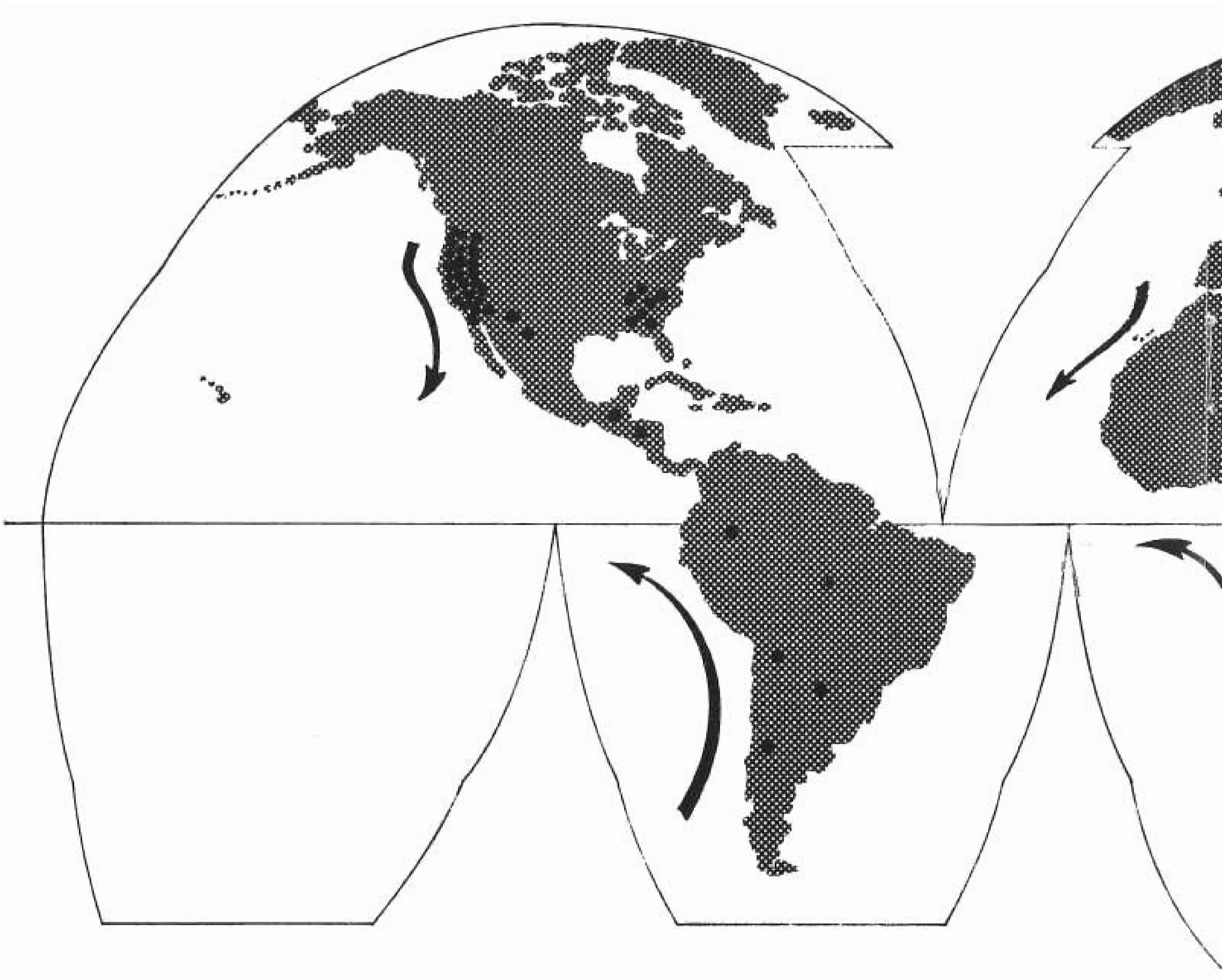
Seedling scotch pines in flats in state nursery.

From this study grew the present practice of working straw into all new fill slopes to hold the soil preparatory to planting or for natural revegetation. The steeper slopes, however, still must be held by some mechanical means until the plants are thoroughly rooted.

At first these were day labor jobs, and the straw was worked into the soil with shovels. Later as the scope of the work increased, the erosion control work was handled by contractors, and a sheepsfoot roller was used to force it into the soil. This type roller was not very satisfactory, as the broadened tips on the sheepsfoot



Sketch shows idealized versions of most useful types of trees and shrubs for roadsides planting. Trees should be upright in habit, fairly light in form, without branches which spread out and obscure vision. High and medium screen shrubs, as well as lower ones used for ground cover, should all hug ground outward from trunk to keep weed growth down.



Black dots indicate place of origin of approximately one hundred trees, shrubs and vines commonly used for planting on roadsides in various parts of California. Much the largest number of plants comes from Mediterranean type climates, or steppe climate areas close by. Note that great sections of the earth are

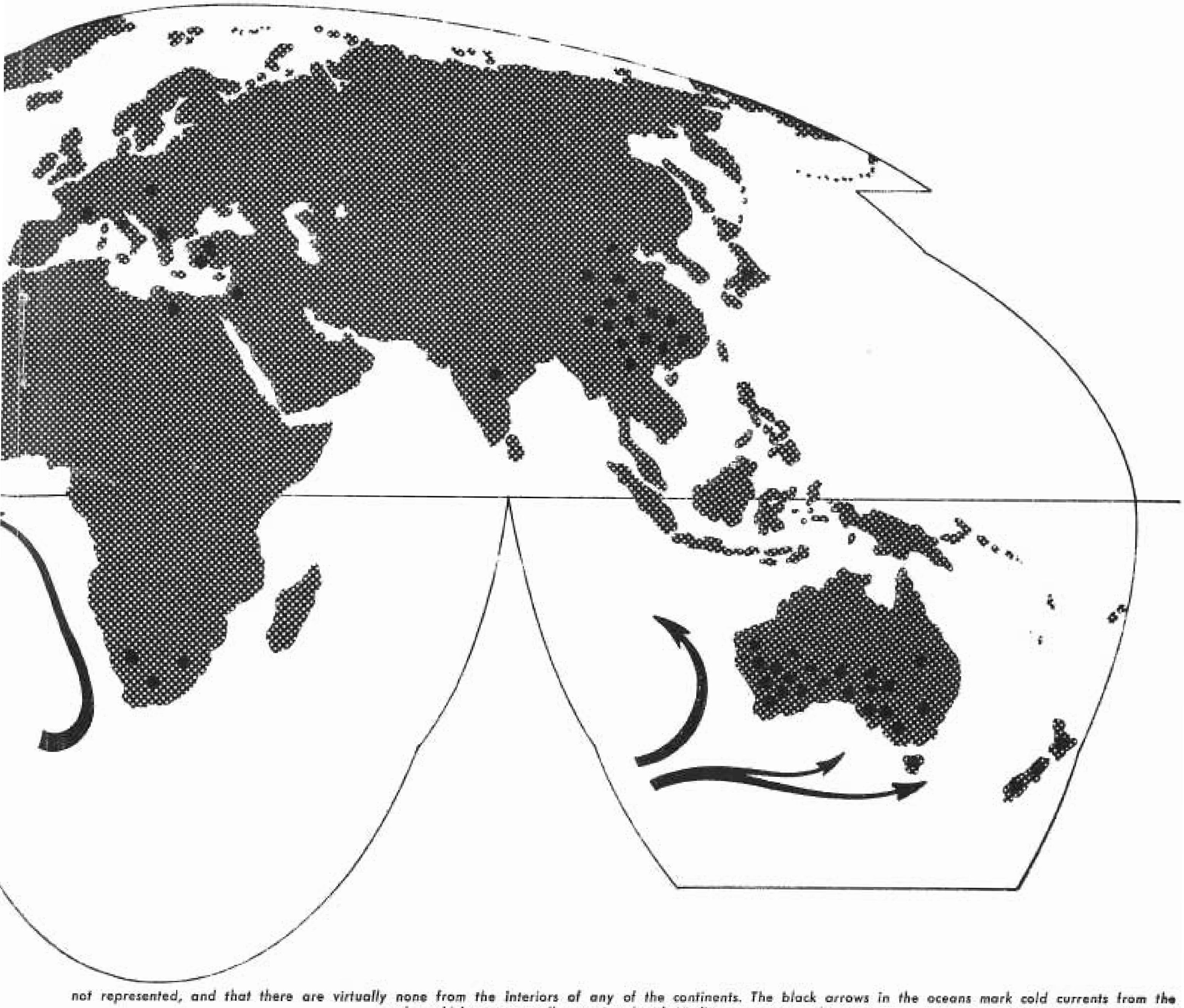
pulled much of the material out again. A modified form with smaller points was tried, but this left pits in which water collected. Eventually the special roller used today was evolved from a design by Landscape Contractor Bailey Justice. This is a roller similar to a sheepsfoot, but with what are essentially thick disks extending from it parallel to its direction of movement, instead of the peg shaped extrusions of the sheepsfoot.

The Division of Highways began to acquire real experience with shrubs with the onset of the depression of the 1930's. Much highway beautification sprang from depression "make work" programs, and Federal highway money grants during this period specified a certain small percentage was to be spent on landscaping.

By the early 1930's also, plants were being used for functional planting. The virtues of ice plant as a bank cover had been discovered, and studies of ground covers for fire control and weed control were well along.

Experiments with true xerophytic plants—that is, plants which are highly drought resistant—proved disappointing. Although they survived under very dry conditions, they became dormant during the summer and dried out to such an extent they became a fire hazard.

At that time, even as today, there was considerable public pressure to plant "natives" along the highways. This is not always practicable. Most of California's native plants have adapted themselves to one particular climate or condition and are unhappy under other conditions. Dozens of species of ceanothus, for instance, grow in the state, each species adapted



not represented, and that there are virtually none from the interiors of any of the continents. The black arrows in the oceans mark cold currents from the poles, which are generally associated with Mediterranean type climates.

to one locality. But of these many species of ceanothus, only three or four are useable. The same thing is true of the manzanitas, which have almost as wide a variation of types in the state as do the ceanothus.

As an example of the problems of using "natives," the Federal Government's experience in 1957 with the slopes in the vicinity of the new Air Force Academy in Colorado may be cited. About a thousand ponderosa pine seedlings, native to the area, were planted on a south-facing slope which got the full effect of the sun's rays. Because of the southern exposure, watering through the summer was contracted to give the baby pines a fair chance. In supplement to this watering, 1957 turned out to be the heaviest rainfall year on record, yet fewer than 3% of these seedlings survived the first year.

At the time these were planted, several thousand other ponderosa seedlings were planted on nearby north-facing slopes, but received no care. Survival among these trees was better than 90%.

Residents of California and other semi-arid states will see this effect of north and south exposure demonstrated many times where the land is hilly. Northern slopes will often be covered with dense growth, while southern ones will have only thin carpets of dried grasses and a few, scattered, wizened shrubs.

Obviously, the simple term "native" is misleading. The state has many local climates, resulting not only from exposure, but also from latitude, from nearness to or distance from the ocean, and from altitude, to list a few of the determining factors. Comparable combinations of these factors are apt to occur in only limited areas of the earth's surface.

To test the value of California natives for roadside use, experimental native plantings were made a number of places on the southern part of State Sign Route No. 1, which travels along or close to the ocean, and enjoys the climate modifying effect of moist ocean winds. Gaviota Canyon, Carmel Hill before the freeway was built (and recently replanted to natives), and the expressway just south of Santa Cruz are three of these sections where natives were used successfully. An inland area in the vicinity of the Devil's Gate Dam, in the San Gabriel Mountains, was also successfully planted to natives.

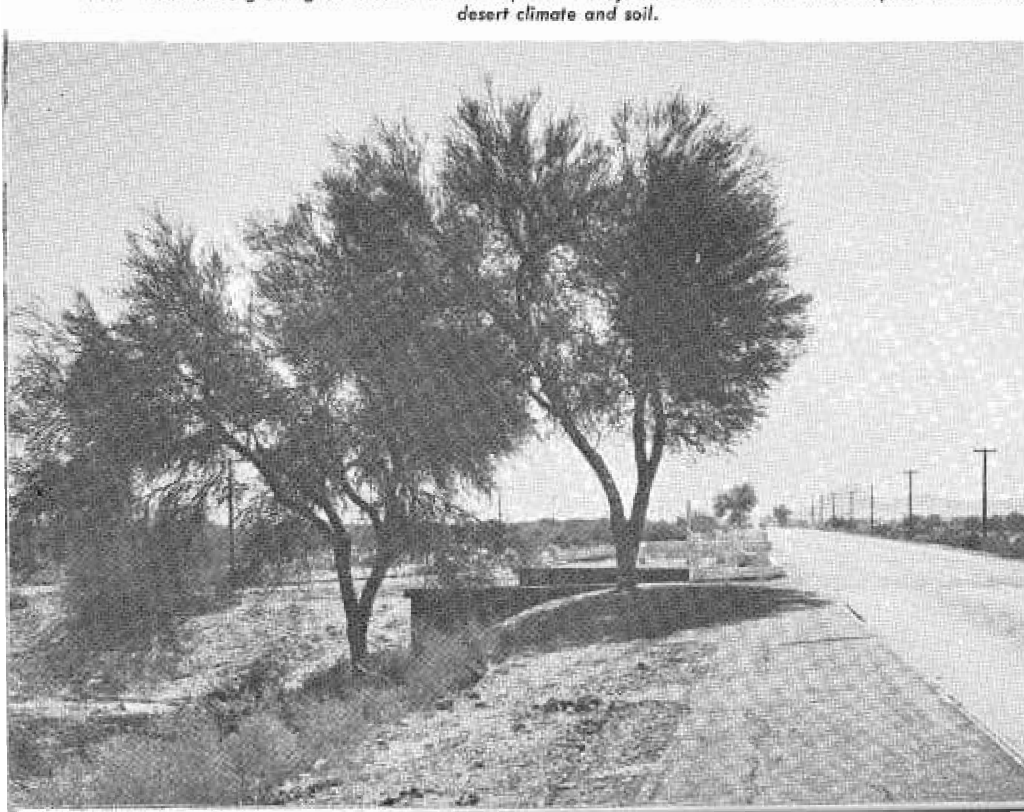
Many of these plantings still survive, and are very attractive today. Some of the shrubs have died out, but have been replaced by "volunteer" plants from windblown and birdborne seeds. On the other hand, results with California natives in the median of today's divided highways have been often indifferently successful, occasionally dismal failures, since the surplus of run-off water in any median is a drainage problem.

A constantly recurring request to the Division of Highways is for the planting of California Poppies, lupine, and other wild flowers. These flowers are still being planted on new construction whenever conditions are right, but they normally do not survive long. The first year they make a brave show, but quickly disappear after that, as the coarser grasses crowd them out.

One of the more difficult jobs from which valuable experience was gained was the planting of the San Francisco Bay Bridge approaches. On the Oakland end the fill was sand dredged from the bottom of the bay, and many truckloads of topsoil and manure had to be imported to make it suitable for planting. Before planting, young shrubs and trees had to be acclimated in a semi-exposed location for several months, otherwise they would have been rapidly burned to the ground by the force of the salt-spray laden wind.

Some non-coastal trees were planted such as incense cedar, Atlas cedar, and coast redwood which, despite its name, is rarely found in exposed coastal locations. These survived if protected by more hardy varieties. Lawson cypress from the Northwest failed completely. In the most exposed locations the shrubs and trees that survived were three of the hardiest California natives – Monterey cypress, western elderberry, and baccharis. Two melaleucas, (nesophila and armillaris), pittosporum crassifolium and the Australia tea tree also proved very resistant to drenching with salt spray. Ice plant ground covers stood the difficult conditions well, seemingly completely indifferent to the salt.

Palo Verde trees growing on U.S. 99 in the Imperial Valley. These are native trees adapted to this true desert climate and soil.



When the Pasadena Freeway (then called the Arroyo Seco Parkway) was built in Los Angeles the depressed sections were in cuts with steep slopes in order to save right-of-way costs. This freeway became a test section for ground covers, of which every available variety was planted to determine its suitability.

Few proved suitable. Wild strawberry, rosa wichuriana, and vitis capensis were not vigorous enough to compete with the rampant weed growth. Bougainvillea and climbing roses did well but did not smother out the weeds. Virginia creeper was also a vigorous grower, but deciduous in winter. Honeysuckle developed beneath its green surface masses of dead, woody stems which would catch fire in the afternoon even if watered that morning!

Morning glory was inconsistent. In some places it would grow poorly, in others rampantly climb upon itself until it was grown up into great humps and mounds, with much dead wood underneath. Ivy geraniums did not live long enough to be worth the trouble of planting. Hypericum required too much water. Nepeta hederacea failed miserably in the southern California climate.

Surprisingly, a small planting of mesembryanthemum croceum did well on unfertilized, decomposed granite. Vinca periwinkle was not satisfactory on slopes, although in other locations it has proved very valuable. The best cover was the common English ivy, which was used extensively for several years. Recently it has been supplanted by the Algerian ivy, which grows faster and has a more glossy leaf surface. Another very successful ground cover on this freeway was lantana sellowiana.

A study of the California Division of Highways preferred plant list will show that more than 90% of the plants used in roadside planting are native to Mediterranean or steppe climates. This is not a planned result, but is an empirical one learned during 30 years of trial and error. It is no accident these Mediterranean plants have come to the fore, because they are adapted to California almost as well as the truly indigenous ones. Conversely, many California natives are planted in these other Mediterranean areas of the world.

California is called by geographers a "coldwater coast," or "Mediterranean," climate, which gradually shifts into a "sub-tropical steppe" climate inland and to the south. Only about 2% of the earth's surface enjoys a Mediterranean type climate, and these areas are found where prevailing westerly winds blow across cool ocean currents onto the land—in other words, always on the western side of continents, and near the middle latitudes. Mediterranean type climates are found in California, Chile, on the west and south coast of Australia, and at the southern tip of Africa, as well as in a deep penetration into the Afro-Eurasian land mass around the sea which gives the climate its name. Mediterranean climates are characterized by dry summers and even temperatures the year round.

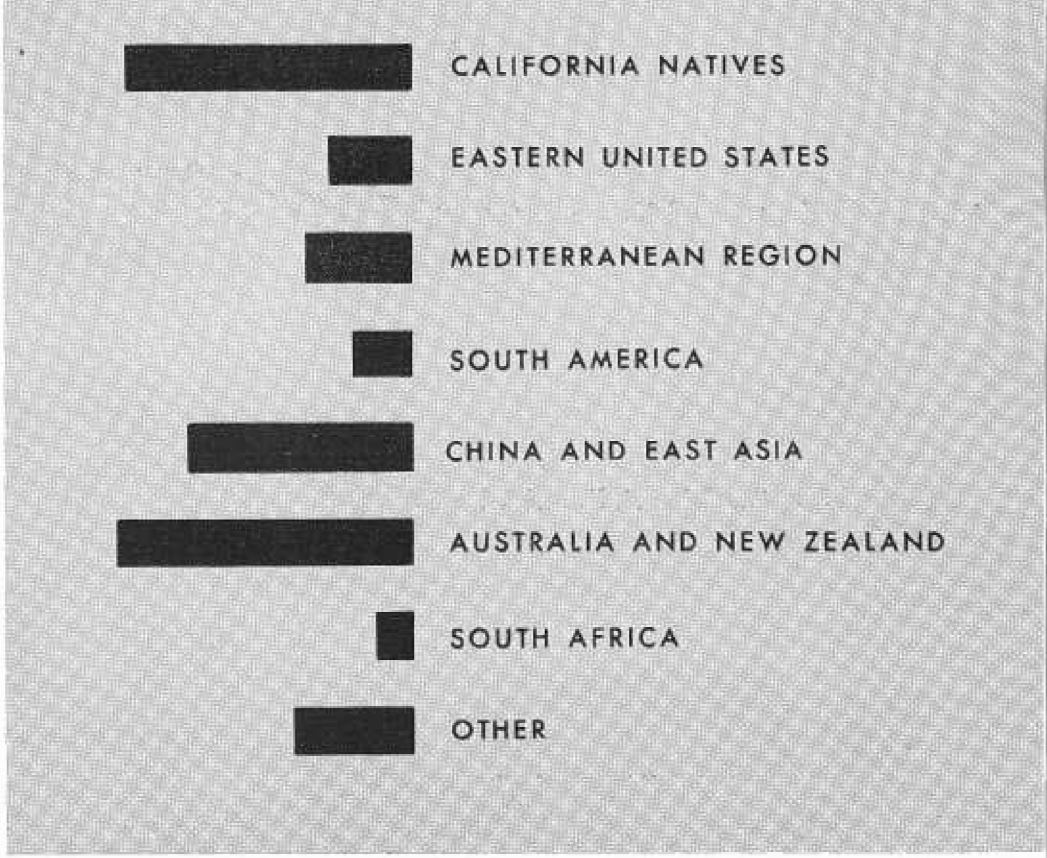


Chart shows relative number of trees, shrubs, and vines used in California roadside plantings from various parts of the world.

Mediterranean climates are inevitably accompanied in the interior and on the equator side by the sub-tropical steppe climates. These climates are dryer, with hot, dry summers. Winter rainfall may vary greatly from year to year, but it is never heavy. Such climates are found in the southern Central Valley of California, Lower California peninsula, and north Africa.

Naturally, over the years, botanists and plant scientists have imported the best plants from all over the world which are adapted to these climates. The hardiest of these, after years of study and testing, have been adopted for use on California roadsides. The plant list used today by the Landscaping Section is a mixture of American and foreign plants, often used in cosmopolitan combinations.

Despite occasional public criticism that an insufficient number of California shrubs and trees are used, the Landscaping Section has more than 30 California natives on its list, as well as a few more from adjacent Southwest areas, such as the Mexican fan palm, and the Arizona cypress. Actually, California is the heaviest represented area on the list. Furthermore, in a survey of several Division of Highways landscape architects and landscape maintenance supervisors, four California natives were unanimously chosen to be included in the twelve plants voted most useful for highway planting in this state. These were California toyon, coast redwood, California sumac, and the palo verde.

The second largest group of plants and trees, totaling about 25 in all, comes from Australia and New Zealand—mainly the former. These are the bottlebrushes, the pittosporums, the tea trees, but most important, the acacias and the eucalypts. Fast-growing, drought resistant, frost hardy over much of the State, generally insect free, evergreen and graceful, these exotics from the Antipodes have taken to California conditions as though they were native.

Another group of plants on the preferred list, almost a score, in fact, comes from eastern China and Japan. Some of these plants are steppe-born, some are developed from centuries of oriental gardening. Perhaps the greatest gift from this area is the pyracantha, which, like the Australian plants, also takes to California like a native. (One common pyracantha, coccinea, comes from southern Europe, but this is not generally used on roadside plantings). Two very useful vines, the Japanese creeper and Halls Japanese honeysuckle are native to east Asia. This area also gives us the camphor tree, the ginkho, forsythia, crepemyrtle, and the Pfitzer juniper.

A smaller group of plants, about 10 altogether, comes from the shores of the Mediterranean. This region's most important contribution can unreservedly be said to be the oleander, which the Division of Highways has planted by the hundreds of thousands. Other good imports from this region are the carob, pomegranate, Algerian ivy, and the Aleppo pine.

A few old favorites from non-Mediterranean Europe have proven able to exist in the California climate without excessive care. One of these that has proven very useful as a ground cover, particularly at interchanges, is the vinca, or periwinkle, which made such a poor showing on the Arroyo Seco plantings. This is a very hardy ground cover. Its first cuttings were no doubt brought to California in sailing ships around Cape Horn. Patches of it can be seen many places in the state around old home sites where the buildings long since have fallen into rubble.

Seven trees from the eastern U. S. are in constant use in the planting plans today also. These are the Southern magnolia, liquidambar, pin oak, tulip tree, scarlet oak, catalpa, and thornless honey locust. Tested year after year, these have all proven hardy, reasonably fast growing, and ornamental. Because they are native to a year-round rainfall climate, they all require considerable watering until they are well established.

Except for these few trees and a scattering of shrubs from places such as India, Central America and tropical South America, the rest of the list is made up of miscellaneous Mediterranean or sub-tropical steppe trees and shrubs. It should be noted that only a single shrub from the eastern U. S. has proved satisfactory on roadsides in California, the Carolina cherry.

Of all the imports from the various continents, and excepting the oleander, those from the New Zealand-Australia archipelago would be the hardest to get along without. Among the tea trees, bottle brushes and pittosporums are found species which grow in the most impossible locations—on high, arid, windswept ridges, along the beds of dry rivers, and almost in the surf of the Pacific where they are constantly drenched with salt-spray. The acacias we use, all of which are native to Australia, are legumes, which make them particularly adapted to California's normally nitrogen-thin soils.

We especially thank Australia for the eucalypts. Although very few of the many hundreds of native Australian species of this tree have been imported, their mark on the state's landscape has been tremendous. In fact, many people think the eucalyptus a California native.

The first experimental plantings of eucalyptus in California toward the end of the last century were almost exclusively blue gum (e. globulus). There is hardly an older farm home in the valleys of the state that does not have at least one of these trees. Because of their fast growth and great size, these trees are popularly supposed to be much older than they are.

In the early 1900's experimental commercial plantings of this tree and a few other species were made many places in the state as a new and highly promising source of timber. Perhaps as many as two million acres were planted. For various reasons the plantings did not prove commercially feasible. Eventually it was realized the native conifer forests were the best timber producers for California, and this only where soil and rainfall were favorable.

Blue gum is not used on roadsides today because it gets too big, its constant leaf drop and bark sloughing is untidy, and its brittleness requires constant maintenance lest its big branches fall into the highway. Because of blue gum's bad characteristics, the entire family of eucalypts has gotten a bad name, and it is not unusual to run into local prejudice when the smaller and better behaved varieties are planted in an area.

The eucalypts used on the highways are the smaller species which have proven just as hardy and adaptable as the blue gum, but do not have the avaricious root system, nor the shedding habits of the larger species. The dwarf blue gum, a rounded, compact tree almost shrub-like in habit, is used extensively for screens. Lehman Eucalyptus or Bush Yate as it is called in Australia, is another excellent low growing variety. Its globular shape and low, spreading branches make it very desirable from a maintenance man's standpoint. Some of the Mallee varieties are being used in recent plantings as decorative shrubs.

Among the tree forms Camaldulensis is better behaved than blue gum. Rudis is used extensively. Polyanthemos and sideroxylon are two excellent smaller varieties for structure delineation and similar uses. These are varieties which have been selected as outstanding after many years experience with them. Dozens of other varieties would probably do just as well if they were available in quantities from the nurseries.

Obviously, the "native" plant for use in planting on California roadsides is the one which can survive conditions which are as difficult as any plant anywhere could be subjected to. Some of them must live where salt spray is continuously coating their leaves, others in a true desert climate. Plants which have evolved to survive in these conditions are the ones that must be planted, as the creation of artificial environments is prohibitively expensive on a statewide basis.

This is the final article on California Roadsides. A reprint booklet is being

New Tree Planting Program Authorized

SACRAMENTO, JUNE 30—The inauguration of a new program of planting and replacement of trees along existing and newly constructed freeways was announced today by State Director of Public Works Robert B. Bradford.

The tree planting program, which will be in addition to the landscaping and functional planting carried on by the Division of Highways for many years, won the prompt and enthusiastic endorsement of Governor Edmund G. Brown.

Bradford said that the new tree planting policy was recommended by State Highway Engineer J. C. Womack and approved by the California Highway Commission. The first allocations for tree planting projects are expected to appear in the State Highway Budget for the 1962-63 fiscal year which the Commission will adopt this fall.

Cost of the tree planting will vary from $100 to $2,500 a mile, depending on the areas involved.

"The tree planting will be particularly valuable," Bradford said, "where a freeway traverses a rural area in which many existing trees have had to be removed from the right of way during construction."

The new program envisions the planting of trees that will fit into local conditions and will not involve maintenance beyond watering them for a year or two.

made of the four articles, plus a supplementary list describing nearly 100 plants and trees. This list is made up of the most useful of these plants and trees as developed over the past 30 years, and describes their habit, adaptability, good and bad points. The list has been compiled in the hope it will be of assistance to communities elsewhere in California and other places in the world with similar Mediterranean and sub-tropical steppe climates.

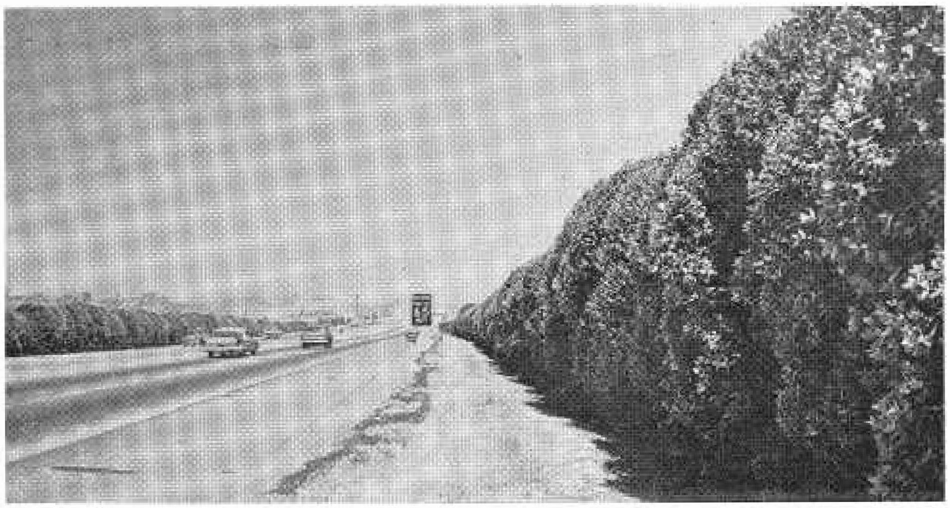
Doubtlessly there are a number of other plants which could be added to the list—certainly some which are unknown to the Division of Highways landscape architects, and others with which it has not been practicable to experiment. This is not surprising, since botanists have classified more than 120,000 different species of higher order plants in the earth's plant kingdom.

The list then is not to be considered a comprehensive inventory of all the hardy, rugged plants which might be used in difficult situations such as are found along our state highways in California. Rather it is an offering to be added to the literature on such plants. Insofar as possible it records the cumulative experience over a number of years of a number of Division of Highways landscape architects.

For those who refer to this plant list, it must be kept in mind the plants used on California roadsides must satisfy very difficult requirements. Ideally, they must be drought-resistant, adaptable to various kinds of soil, able to take heat and exhaust fumes; preferably be fast-growing, evergreen, and spread their branches close to the ground for weed control. Very few trees and shrubs meet this set of specifications, but in the interests of avoiding montony, a number which approach the ideal are used.

The list is divided into separate sections for trees, shrubs, and vines and/or ground covers. Each of the sections is divided into two groups—those most desirable and a list for second choice or specialized use. Especially satisfactory plants are marked with one or two asterisks, the two asterisk ones being the best.

Hillside in the Santa Cruz area planted with native Monterey pines. These fast-growing native trees are ideal for this climate and will quickly bind the slope.



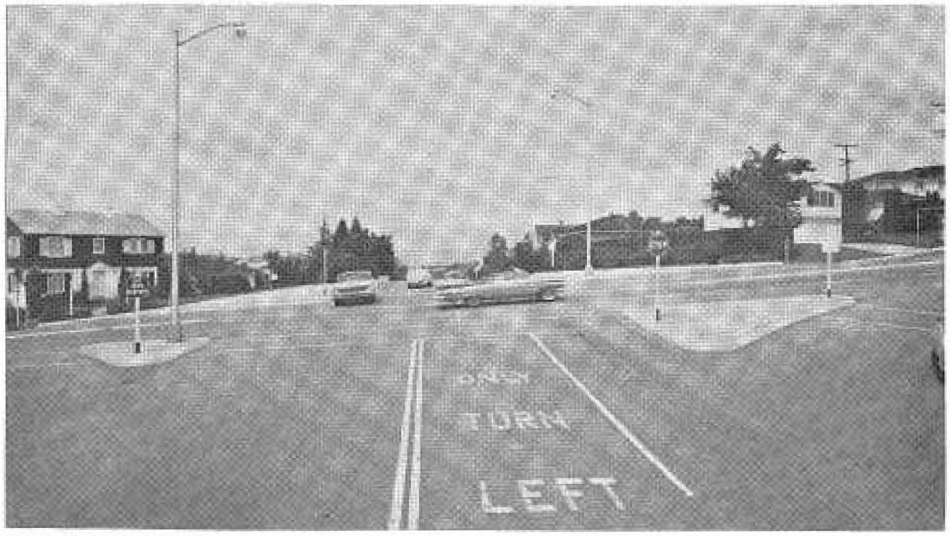
Screen plantings of dwarf blue gum (Eucalyptus globulus compacta) on Nimitz Freeway in Alameda County. Hardy, evergreen, dense and fast growing, this tree is almost as valuable as the oleander.

Hollywood Freeway in Los Angeles area. Algerian ivy has proved one of the best vines for this type of slope planting, if sprinkling is provided. Screen at top is Japanese privet. Trees are catalpa and liquidambar, both of which will become much more significant in the overall design as they grow larger.

San Mateo Streets

Major Progress Made Under Six-Year Program

By N. B. SMITH, City Engineer, HAROLD PORTER, Assistant City Engineer, JOHN GARD, Office Engineer, and LOUIS FAVRE, Construction Engineer, City of San Mateo



Channelization of the intersection of Parrott Drive and Alameda De Las Pulgas in San Mateo was designed with provision for future traffic signals when needed.

Since 1955 the City of San Mateo has engaged in an enlarged program of resurfacing and reconstructing city streets. This program includes both major city streets and the ordinary city streets. Some normal construction projects requiring acquisition of right of way and complete roadway reconstruction have been completed. However, the emphasis has been on resurfacing not only to improve the riding quality of the streets, but also to strengthen the structural section of the roadway.

A complete study of all of the streets in the city was made and the ones in poorest condition were listed for reconstruction the first year. This same idea has been repeated each year, and at the present time there are no really bad streets in San Mateo. Many are excellent and the remainder are in good condition. In order to obtain the best results, the program has included reconstruction of broken curb and gutter and construction of improved drainage facilities immediately prior to the resurfacing.

A large amount of this preparatory work is done by the city maintenance crews. However, as much as is reasonably possible is included in the contract. In addition to the preparatory work mentioned above, a heater planer is used to trim the edges of the old asphalt pavements adjacent to the concrete gutters. This permits a better joint and a better looking finished roadway upon completion of the resurfacing.

Larger Contracts Economical

Another basic consideration in our program has been to do this work in one large contract. This has resulted in better prices and has required less paper work and has been handled more readily by the inspection department.

The City of San Mateo now has a land area of approximately 10 square miles. There are 49 miles of major streets and 110 miles of secondary streets. In addition, there are 12½ miles of state highways and freeways within the city limits.

Since World War II, San Mateo has experienced typical California growth with many new subdivisions and a considerable mileage of new streets. However, some of these are now 14 to 15 years old and are requiring some maintenance or reconstruction.

In planning this resurfacing program, the city has worked closely with the various utility companies so that any underground work could be accomplished prior to the new surfacing. Plans have been changed several times to permit underground construction. Once resurfacing plans were revised to permit construction of several miles of 24″ water mains, at other times, to allow the gas mains and service to be reconstructed. In many

BEFORE—A broken curb, gutter and driveway prior to reconstruction.

AFTER—The curb, gutter and driveway following reconstruction and resurfacing of the street.

East Hillsdale Boulevard, recently resurfaced, serves as San Mateo's major traffic connection between El Camino Real (U.S. 101) and the Bayshore Freeway (U.S. 101 Bypass).

cases these latter are as old as the streets and may be too small as well as in poor condition.

Beginning in 1955, the City placed approximately 8,800 tons of plant mix asphalt on the major and ordinary city streets. In 1956, 23,000 tons were placed; 1957, 23,000 tons were used; 1958, 20,600 tons were used; 1959, 7,200 tons and in 1960, 24,000 tons were used. Prices on the small contracts ranged from $6.41 to $6.80 per ton, whereas, on the larger contracts, the prices have varied from $6.06 to $6.19 per ton. This price of $6.06 per ton was the bid price in 1960 which we considered very favorable in view of the general increase in prices from year to year. The tonnage resulted in over 59 miles of newly resurfaced streets out of a total of 160 miles in the City.

Specifications Conform

The city's specifications conform largely to the State Division of Highways specifications for dense grade plant mix pavement. The contract items consist largely of raising manholes, planing and trimming the edges and the tonnage. Skeleton drawings are prepared showing the widths of the streets, the exact area to be surfaced, the edges to be trimmed and the manholes to be raised.

Specifications are written so as to reserve the right to increase or decrease the amount of tonnage to be furnished by 20% without a change in the bid price. On several occasions blocks have been added to the original contract and in a few cases, a street has been deleted where underground improvements were necessary and could not be made ahead of the resurfacing.

All of the work described above has been paid for with gas tax funds except work by the city forces. This work by the city forces would need to be done even if there were no resurfacing program, but by coordinating it with our resurfacing program, whole areas are put in first-class shape. The city forces make repairs to sidewalks and driveways and repair storm drains without any argument over quantities or eligibility for gas tax. Likewise, a large amount of detailed measuring and inspecting and survey work is eliminated.

In addition to resurfacing and reconstructing described herein, the City has had several other construction projects paid from gas tax during these same years. Other street department activities have been paid from city funds, such as traffic signals, signs, and traffic painting, sweeping and lighting. Likewise, subdividers have paid for new streets in new subdivisions. On this basis the gas tax funds have been adequate and as far as can be foreseen, it will be possible to maintain good streets throughout the city. In addition the city anticipates accumulating some gas tax funds to help pay for a large grade separation structure that is needed.

Structures

Twelve bridges were required. Interchange ramps were constructed at Maple Street, Lincoln Avenue, West Grand Boulevard, Main Street, East Grand Boulevard, McKinley Street, and Pierce Street. West Grand Boulevard Overhead and Temescal Wash Bridge and Overhead carry traffic over two railroads and Temescal Wash. Separation structures serve local traffic on Smith Avenue, Buena Vista Avenue, Parkridge Road and Buchanan Street.

All bridge structures are reinforced concrete and vary in length from 82 feet to 1,054 feet. The longest bridge, Temescal Bridge and Overhead, is a reinforced concrete T-beam and pre-

. . . Continued on page 69

Merging Traffic

North Sacramento-Elvas Freeway Interchange Is Subject of Study

By LEONARD NEWMAN, Associate Highway Engineer

RECENTLY there has been an increase of interest in the theory of freeway traffic flow throughout the country. Several theories have been advanced as to necessary conditions of traffic flow which will permit maximum number of vehicles per unit time past a given point.

Many researchers say that maximum volumes at a particular location can be attained only with smooth steady flow at some constant speed, in the range of 17 to 35 MPH (a state in which demand would have to be exactly equal to maximum capacity). Once a breakdown occurs, as illustrated by stop-and-go driving at or just before the bottleneck, this school contends that capacity through the bottleneck is greatly reduced because density is high and speed is low. Diagrams of the kind shown in Figure A are used to demonstrate this theory.

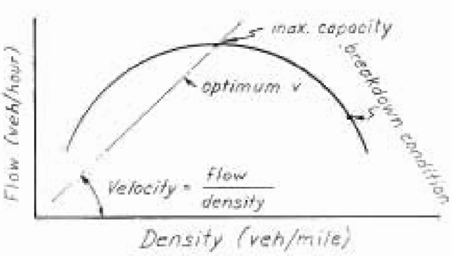


Figure A

Another theory says that the greater the delay the greater the flow. The theory is that maximum output cannot be attained without a steady demand, and in order to supply the steady demand, a queue is necessary. See Fig. B. This approach implies that highest flows are obtained under queuing or stop-and-go driving conditions, rather than with smooth steady flow.

In order to test these theories and to gain additional traffic flow information, a small-scale study was made of a merge of two freeways (four lanes merging into two lanes) in the Sacramento area. The conditions of the site were such that the location of congestion is identifiable, and output traffic flow and input flow (demand) could easily be determined. Absolute demand was known because the backups from the merge did not extend to

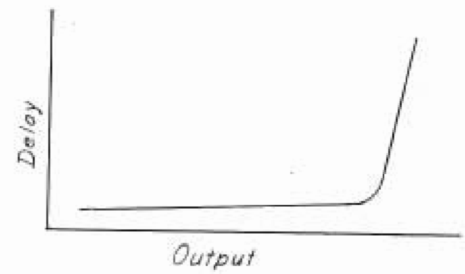


Figure B

the point where input flows were observed.

In summary, results of the study show that:

1. Flow at the merge for significant time periods was not reduced after queues developed. On the other hand, the output flow dropped immediately when the queues were dissipated.
2. As long as there is some queue, the output rate remains approximately the same regardless of length of queue.
3. During queueing, at average approach speeds of 10 MPH with a density (both speed and density actually measured on the ground) of 139 vehicles per mile per lane, the output rate at the merge was 61.5 vehicles per minute or 1840 vehicles per hour per lane.*

These results, along with other observations made in California, generally fail to substantiate the theory that high output volumes cannot be maintained under stop-and-go driving conditions. On the contrary, it supports the contention that high volumes cannot be maintained for significant time periods *without* some congestion or stop-and-go driving. This is because the queue formation reduces the number and size of random gaps which always occur in the traffic stream under free-flowing conditions.

Flow-Density Curve

A diagram such as shown in Figure A is essentially correct if it is drawn for a location on a freeway upstream of a bottleneck. But the breakdown condition on the flow-density curve represents only the effects of a downstream bottleneck and does not have any bearing on the actual capacity characteristics of the freeway.

For example, if a curve were drawn for the Elvas approach in this study, it would probably hold. In other words, the Elvas approach output of 31.5 vehicles per minute at a density of 139 vehicles per mile is very low compared to a normal 2-lane capacity of 60-70 vehicles per minute. The real reason only 31.5 vehicles per minute can travel the Elvas approach is not because of a high density but because an additional 30 vehicles per minute are entering the two lanes at the downstream merge. The point is that the two lanes at the merge have a capacity of 61.5 vehicles per minute and the fact that the Elvas approach volume rate is at a density of 139 vehicles per mile and 10 MPH average speeds is irrelevant.

If observations were made just downstream of the bottleneck, the flow-density curve would not take the same shape as in Figure A. Maximum flow would be reached and the curve would stop at that point—there would be no sharp downward swing toward zero flow. There never is a breakdown condition (stop-and-go driving) downstream of the bottleneck (at the end of a merge or top of a grade).

* This is not withstanding the fact that the merge is too short—dropping 2 lanes in 800 feet. It is possible that higher flow and capacity would result from a longer taper. Other studies indicate that the taper should be at least 1200 feet for merging from four lanes to two. It should also be noted that a downstream on-ramp introduces an additional volume rate of 192 VPH, making a total of 1936 VPH per lane.

Looking south showing the merge of the Elvas and North Sacramento Freeways and the Arden Way interchange, which was the subject of this study.

Curves as shown in Fig. A have led to misinterpretation as to freeway capacity by persons not realizing that these curves depict a mathematical relationship of traffic flow to speed or density, but do not differentiate clearly between cause and effect. They do not necessarily reflect the traffic-carrying capabilities of the freeway where there are more lanes upstream of the bottleneck than there are downstream.

The data collected do tend to support the theory that the longer the time lasts during which queueing occurs, indirectly increasing delay, the greater the output over this length of time will be.

Site and Data Collection

Fig. C and the photograph show the location of the section observed and the geometric conditions at the merge. The site about 4 miles northeast of the center of Sacramento is the merge of the North Sacramento Freeway (U.S. 40) and the Elvas Freeway (U.S. 99). It handles the outbound commuter peak. Both are 4-lane freeways and they join into a single 4-lane freeway (a portion of this freeway is currently being widened to 8 lanes).

Continuous counts were recorded by minute at the three points indicated on the drawing:

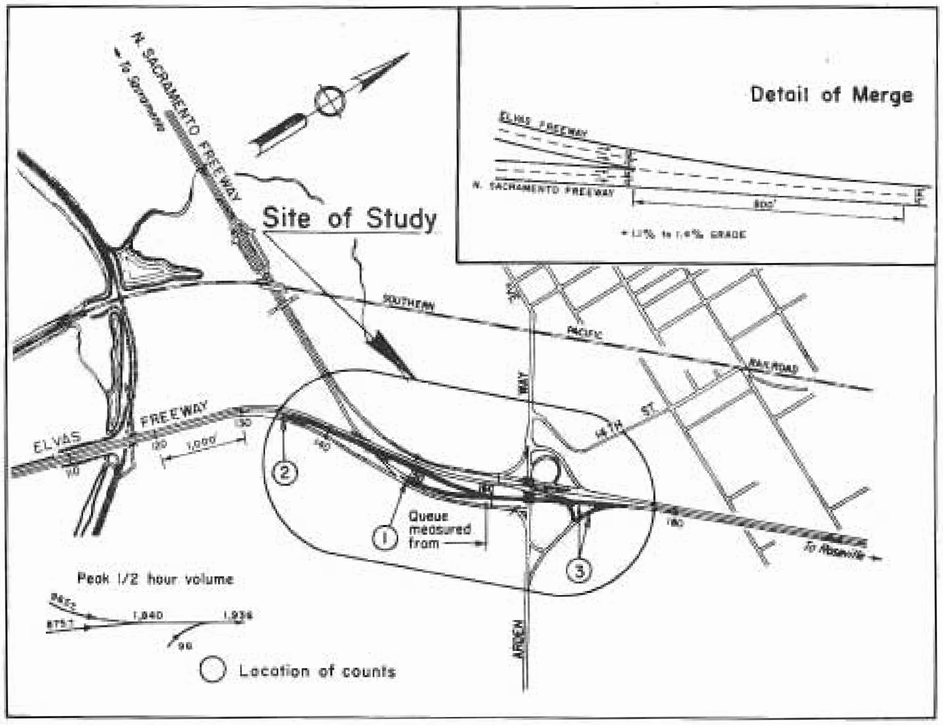


Figure C

1. Input volume from the North Sacramento Freeway
2. Input volume from the Elvas Freeway
3. Output volume of merge and input from the eastbound Arden Way on-ramp. The maximum volume on the freeway occurs at this point. About ½ mile downstream, an off-ramp reduces the freeway volume by 700 vehicles per hour.

The input volumes were recorded far enough upstream (2,500 feet on the left branch and 1,000 feet on the right branch) to minimize the possibility of the queue extending beyond the observation points.

Description Recorded

Along with the counts made at the three observation points, description of traffic flow was recorded, as was formation and length of queue. Determining the tail-end (upstream) of the queue was done subjectively but in practice it was relatively easy within the required limits as there was always a visibly distinct change in density and speed at the end of the queue. The end of the queue was not necessarily where vehicles came to a complete stop, but where there was an abrupt change of density or speed such as from 30 MPH to 5 or 10 MPH.

Queues were measured from the nose of the merge (see Fig. C). Even though there may have been instantaneous stoppages or congestion in the merge area proper, this was not recorded as queuing. Only when stoppages extended to the nose was queuing recorded.

Two men were used at each count location, one for continuous counting and one for recording and observation of traffic conditions and queuing. The entire section under observation was visible from the three observation points.

Counts were not classified by lane and type of vehicle nor were speeds obtained at the observation points although sample travel times between selected points were obtained during varying traffic conditions. Approximately 1 to 1½% of the traffic is trucks and buses.

Results

Data collected on March 9, 1961 are presented in Fig. D. Traffic flow was typical for peak hour operation in the middle of the week.

Between 4:40 and 4:54, traffic was generally free-flowing (except for the period 4:45 to 4:47—a vehicle stopped in the merging area to let a passenger off, causing considerable congestion. The minute following this stoppage had the highest volume observed during the study.) Speeds approaching the merge during the beginning of the free-flowing period averaged between 55-60 MPH, and at the merge and beyond averaged 40-45 MPH.

Between 4:54 and 5:10, there was congestion at the merge with some stop-and-go driving. Most vehicles applied their brakes at the merge. However, no queuing developed during this period. Speeds at the input observation points remained high. There was some congestion at the downstream entrance ramp, but this congestion seldom, if ever, backed up as far as the freeway merge being studied.*

At 5:10, queues developed on both approaches to the merge, primarily on the Elvas approach. The longest back-up on the North Sacramento approach was only about 250 feet and demand on this approach quickly dropped to the point where there was no more queuing.

The longest back-up on the Elvas approach reached 1,700 feet and occurred at 5:21. Queuing ended at 5:36 and free-flow resumed.

During the peak ½ hour period from 4:54 to 5:24, 1,840 vehicles went through the merge, at an hourly rate of 3,680 (or 1,840 per lane). During this same period, the ramp added 96 vehicles (192 VPH). This resulted in a total downstream volume of 1,936 vehicles in one-half hour, or 1,936 VPH per lane.

Capacity Analyzed

The minute-output volumes show that traffic volume rates over significant time periods do not drop when demand increases to the point where back-ups develop. Under free-flowing conditions (between 4:40 and 4:50),

* However, this ramp traffic and traffic weaving to an off-ramp (700 VPH) ½ mile downstream prevents high-speed, free-flowing operation downstream of the freeway merge studied. This may have had some effect on the merge studied since the physical length of a bottleneck may affect its capacity, i.e. if the bottleneck is short, traffic may be willing to drive through it with shorter gaps.

there are high volume rates obtained for a minute now and then, but these rates are not maintained since low volume minutes also occur due to random fluctuations in demand. In fact, if it were not for these low periods, operation would not remain free-flowing.

High volumes require a constant demand, thus guaranteeing that there will be no periods of low volume.

Apparently the capacity of this particular merge over extended periods is about 61.5 vehicles per minute or about 3,700 VPH regardless of whether demand just equals or is in excess of capacity.

It is interesting to note that between 5:20 and 5:35, output at the merge is slightly reduced even though there is still a queue of vehicles on the Elvas Freeway approach. This can be explained by the fact that the demand on the North Sacramento approach drops to 24.5 vehicles per minute and apparently because of the physical configuration of the merge, the vehicles approaching on the Elvas Freeway cannot take full advantage of the lesser demand on the other approach. Therefore, the capacity of the merge when only the Elvas approach was fully loaded was 59 per minute as against 61.5 per minute when both approaches were fully loaded.*

* There are several hypotheses that might explain why the Elvas approach vehicles could not take full advantage of the greater number of gaps in the North Sacramento Approach:

1. The method of striping (see Fig. C) encourages each approach to merge separately into a single line. Perhaps if lane striping were carried through on the Elvas, higher volumes could be attained.
2. The Elvas approach is on a curve while the North Sacramento is essentially on tangent.
3. The possibility that with other merging conditions being equal the vehicle on the right has a psychological advantage in merging primarily because of better visibility.

Delay and Queuing

If the period between 4:54 and 5:09 is taken as normal and a period of little or no delay, then delay caused by the subsequent excess of demand (reflected in queuing) can be determined. During the normal period, speeds on the approach to the merge averaged about 45 MPH. At the merge itself, speeds were low and some instantaneous stoppages occurred. But no queuing developed.

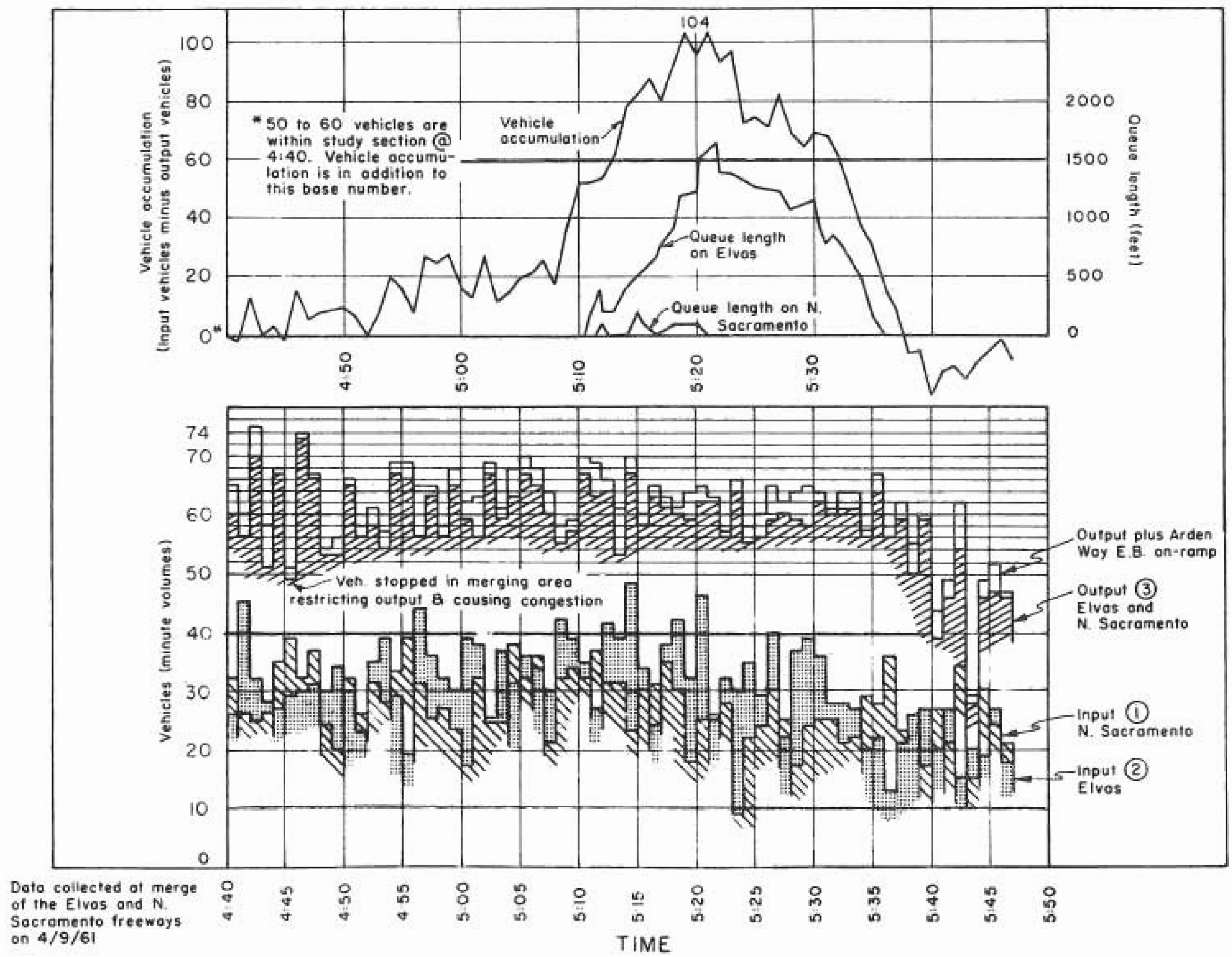


Figure D

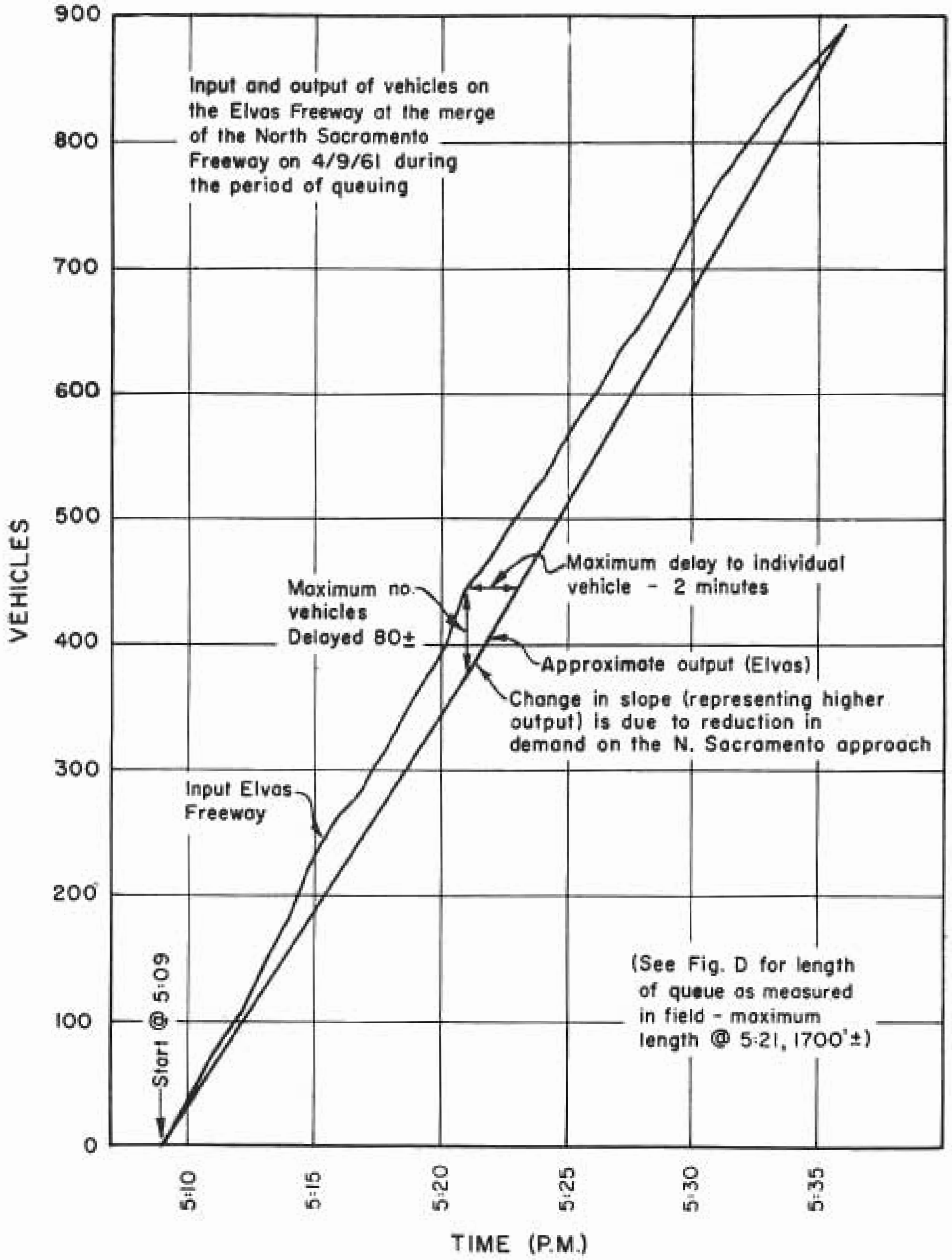


Figure E

The major delay occurred on the Elvas approach. The delay on this approach leg can be analyzed as follows:

The distance between the nose of the merge and the input observation point on the Elvas was 2,500'. Therefore, at a volume demand rate of 33 per min. @ 45 MPH (which was the case during the 4:54-5:09 period), vehicle spacing averaged 120 feet.

At this spacing, there would be about 21 vehicles in the Elvas approach leg during the normal flow period. Eighty additional vehicles had entered the section when the back-up reached its peak (1,700'). At that time there were about 100 vehicles within the section, of which about 90 were in the queue (the other 10 would be approaching the queue in the 800-foot distance between the tail of the queue and the observation point). Assuming an equal number of vehicles in each lane, the average density in the back-up would be 38' per vehicle, or 139 vehicles per mile in each lane.

Travel Times Measured

Sample travel times were measured for vehicles in queue to travel 800 feet. The average time was 55 seconds (about 10 MPH) as against a normal travel time of about 12 seconds. Therefore, the delay in an 800-foot queue was about 43 seconds per vehicle. The maximum delay occurred for the vehicle that arrived at 5:21 (queue length of 1,700') and it amounted to 92 seconds, or about 1½ minutes. The average delay for each vehicle arriving during the period of queuing would be half the maximum amount (this assumes a uniform queue buildup and disappearance which actually, from Fig. D, was not the case). Since about 900 vehicles arrived during the period of queuing, the total delay was 690 vehicle-minutes.

Fig. E shows a theoretical way of computing this delay which checks the above calculations fairly well. The actual accumulation of output and input vehicles is plotted against time. Delay (vehicle-minutes) is the area between the two curves. The vertical distance between curves represents number of vehicles delayed at any point in time. The maximum is about 80 which is approximately the same as arrived at in the above calculation and occurs at the same time. The horizontal distance between curves represents delay to an individual vehicle. The maximum is about 2 minutes as compared to the calculated maximum of 1½ minutes.

Control Device Book Completely Revised

Copies of the new Manual on Uniform Traffic Control Devices for Streets and Highways are now available and may be purchased for $2 each from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

The new manual contains the first complete revision of standards for the design and application of signs, signals and markings since 1948. The revised standards reflect changes in driving conditions and technical advances in control devices and practices in recent years. The publication is expected to spur uniformity and modernization throughout the country.

Nicasio Road

Construction of Dam Requires Relocation of F.A.S. Highway

By ARTHUR T. KNUTSON, Construction Engineer, Marin County

Work was completed on April 25, 1961 for the relocation of the northwesterly 1.4 miles of the San Geronimo-Nicasio Road in Marin County, the last step in providing a traversable road to replace portions of the Marin County Road System inundated by construction of the Nicasio reservoir.

The San Geronimo-Nicasio Road is a portion of Marin County Federal-aid Secondary Route 1278, which begins at U. S. Highway 101 three miles north of San Rafael, proceeds westerly along Lucas Valley Road for 10.9 miles to the San Geronimo-Nicasio Road, thence northerly through the historic old town of Nicasio and terminates at the Point Reyes-Petaluma Road 5.3 miles from Point Reyes. This road furnishes an alternate route from U. S. Highway 101 to Point Reyes with little interference from local traffic. Traffic using this portion of the route is a combination of heavy-truck traffic from Point Reyes and San Geronimo, local traffic and weekend recreationers. Present Average Daily Traffic is 570 with an expected ADT of 1300 by 1980.

In November, 1959, the Marin County Board of Supervisors entered into an agreement with the Marin Municipal Water District for the relocation of 4.7 miles of roads which were expected to be inundated by the construction of an earth fill dam on Nicasio Creek 5 miles from Point Reyes.

Agreement Reached

The agreement was reached after extensive legal proceedings in which the water district attempted to condemn the county roads. The Superior Court and the District Court of Appeal ruled in favor of the water district. The case was then appealed to the State Supreme Court, which ruled that county roads and rights of way are owned by the people of the State of California and are held in trust for them by the county.*

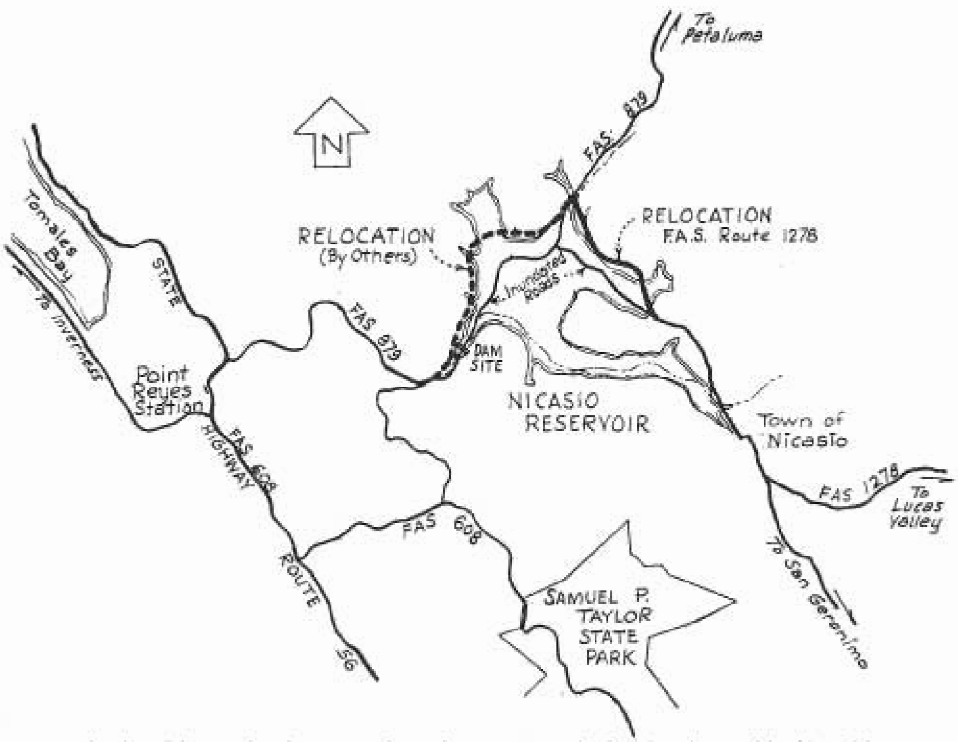
The Supreme Court held (*County of Marin* v. *Superior Court*, 53 Cal. 2d 633; 2 Cal. Rptr. 758) that the county roads could not be condemned by the water district because of the provisions of Code of Civil Procedure Sections 1240.3 and 1241.3, which provide that "property appropriated to the use of any county . . . may not be taken by any . . . water district, while such property is so appropriated and used . . ." The Supreme Court also stated that the Legislature has forbidden the condemnation of F.A.S. roads by the State's assent to the provisions of the Federal Highway Act. Projects such as these must be accomplished by a mutual agreement to relocate affected roads to acceptable standards of design and construction.

Increasing Demand

In order to meet the increasing demand for water, the Water District had been counting on use of the Nicasio Reservoir to collect the 1960-61 rainfall. As water contained in Water District facilities was reaching a dangerously low level and legal action had delayed start of construction on the relocated roadways, it was imperative to complete the relocations at a date as early as possible, to enable full use of the new reservoir.

The project was divided into two portions: A 3.3 mile relocation of the Point Reyes-Petaluma Road to be contracted out by the Water District and under inspection and control of the Marin County Department of Public Works, and the 1.4 mile portion of the San Geronimo-Nicasio Road from the newly relocated Point Reyes-Petaluma Road southeasterly toward the town of Nicasio to be handled as a Federal-aid Secondary project by Marin County.

The Point Reyes-Petaluma portion of the relocation involved cuts up to 155 feet and submerged fills up to 65 feet with 760,000 cubic yards of excavation. The contract was awarded to Cherf-Sandkay & Cheney; work began on May 1, 1960 and paving was completed on November 1, 1960.



The dotted line in the above map shows the Nicasio Road relocation discussed in this article.

* The attorneys for the State Department of Public Works filed an amicus curiae (friend of the court) brief in support of the position of the County of Marin.

Plans for the San Geronimo-Nicasio portion of the project, FAS 1278(3), were prepared by County. This project was advertised by the State and the contract was awarded to W. H. Stecker of Burbank. Work commenced on August 8, 1960.

Grading Completed

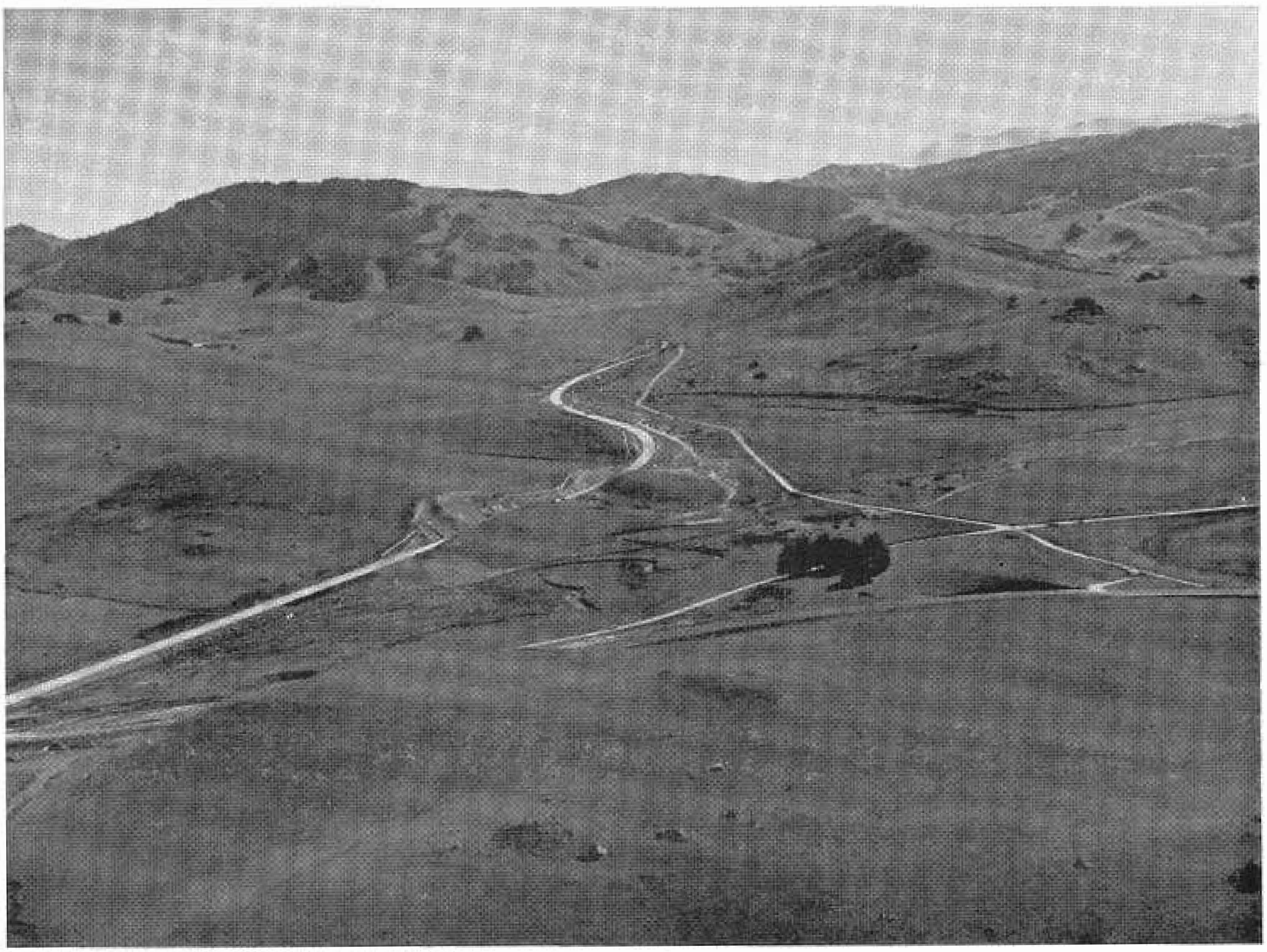
Mass grading was completed prior to the first rains, which fortunately were extremely late. However, placing of select material and aggregate base were completed between rains.

Several construction difficulties arose. One problem was caused by a 70 foot cut through Franciscan sandstone interbedded with black shale, which, upon excavation, showed bedding planes with a dip of approximately 1¾ to 1 and a strike parallel to roadway centerline. The design cut slope was 1:1, with one 20-foot bench at 40 feet above profile grade, resulting in a number of slides of a block nature. It is intended to overcome this difficulty, when of a block nature. It is intended to overcome this difficulty, when the roadway is widened to 4 lanes, by utilizing 2:1 cut slopes at this location.

Another difficulty was the use of local, creek-run sand and gravel deposit of marginal quality for the production of Class 2 Aggregate Base material. The source of material had been used in the past and it was known to have marginal Sand Equivalent and "R" values. The special provisions were written to require a Sand Equivalent of 35 by which it was hoped either to discourage the use of the marginal material or to require the installation of washing facilities. The contractor elected to use the marginal material, crushing and washing it. The material proved to be of lower quality than the contractor expected, and 3,910 tons of the aggregate base material as delivered to the grade were below specification in regard to Sand Equivalent and marginal in regard to "R" value. This problem was resolved by the contractor adding sufficient Portland cement at his own expense to correct this deficiency. The cement was placed with a spreader at the rate of one percent by weight of the aggregate and mixed with three passes of a mixer.

Road Inundated

After the existing road was inundated in February 1961, traffic was



An easterly view of the Nicasio Road relocation, an F.A.S. project. The old highway will be inundated when the reservoir behind Nicasio Dam is at its highest level.

A northerly view of the Marin Water District's Nicasio Dam and rerouted section of Nicasio Road (FAS Route 879). The reservoir behind the dam is not yet full.

routed through the new construction which had received the first lift of aggregate base. With the approach of drying spring weather paving of the project was commenced on March 31, and continued to completion on April 25.

The project was designed on a 142 foot minimum right-of-way with limited access, providing for an ultimate 4-lane divided freeway. A design speed of 60 M.P.H. was used, and initial construction provided two 12-foot travel lanes and two 8-foot shoulders on a 40-foot all paved section. Portions of the road lying on submerged fills required special attention to drainage facilities and slope protection for wave action.

Net contract payment was $242,-619.98. Federal-aid Secondary and State Highway Matching Funds totaling $100,000 were used; and the remainder was contributed by the Marin Municipal Water District.

The design and construction engineering was performed by the County of Marin, under the direction of Marvin W. Brigham, Director of Public Works. Construction was performed by W. H. Stecker, with Phil Oppenheimer, Superintendent; and the riprap, base, and paving were subcontracted by E. A. Forde Company with Orville Cooper, Superintendent. James F. Wiese of Marin County was Resident Engineer.

S.M.-H. Bridge Section Will Be Four-Laned

The State Department of Public Works has awarded a $13,278,590 contract for construction of 4.5 miles of four-lane concrete trestle to replace the easterly portion of the present two-lane San Mateo-Hayward Bridge.

The trestle will traverse the non-navigable portion of San Francisco Bay and will be at the same height above the water as the present trestle and immediately adjacent to it along the north side.

Plans call for construction of a two-lane trestle along the north side of the present structure.

James Robert Smith

James Robert Smith, 37, Senior Right-of-Way Agent for the State Division of Highways in Sacramento, was drowned on June 9th while on a fishing trip in the Blue Hole area of Salt Springs Reservoir on the Mokelumne River.

James Robert Smith

Smith was Chief Analyst of the Division's Land Economic Studies Section. Readers of *California Highways and Public Works* know him as the author of several recent articles on the effect of freeways on adjacent lands.

He was national secretary of the Land Economic Studies Committee of the American Right-of-Way Association.

A native of Pittsburgh, Pennsylvania, Smith attended grade and high school in San Diego, California, and graduated cum laude from San Diego State College.

Smith joined the State as a Research Assistant with the Department of Finance in 1949 and became a Junior Right-of-Way Agent with the Division of Highways in 1950 in the San Diego office.

He transferred to Sacramento as Chief Analyst of the Land Economic Studies Section in 1957.

Smith served as an aerial gunner with the U.S. Air Force during World War II.

He is survived by his wife, Anna, daughter, Susan and his mother, sister and two brothers.

Smith was a member of the Commonwealth Club.

Maintenance in VII

District's Program Grows to Meet Needs

By W. D. SEDGWICK, Assistant District Engineer

THE District VII Maintenance Department, as of December 31, 1960, had 23 regular maintenance crews, 17 landscape maintenance crews, 2 fence repair crews, 3 tree crews, a trash collection crew, a bridge crew, a signal and safety lighting crew, a sign crew, and a striping and stencil crew and an electrician to maintain underpass drainage pumps.

The maintenance program is shifting continually from normal maintenance experiences on conventional highways to new freeways, most of which are either planted for erosion control or are fully landscaped.

Total expenditures by maintenance forces or of maintenance funds during the 1959-60 fiscal year were as follows:

General Maintenance	$1,910,643
Storm Damage and Specific Maintenance Work Orders	3,025,313
Maintenance Fund Contracts	12,867
Total Maintenance Funds by Maintenance Forces	$4,948,823
Maintenance Expenditures by Other Than Maintenance Forces	95,841
Maintenance Expenditure by Cities	864,881
Total Maintenance Funds Expended	$5,909,545
Total Other Than Maintenance Expenditures by Maintenance Forces	948,074
Total Maintenance Department Program Expenditures	$6,857,619

Maintenance problems vary from near desert conditions in Antelope Valley to snow removal up to 8,000-foot levels on the Angeles Crest Highway, and from traffic volumes of from 110 cars a day on Decker Canyon Road to between 175,000 and 200,000 cars a day on the Hollywood and Harbor Freeways. With traffic requiring all the lanes at all times during the normal work week, several maintenance items such as striping and patching bridge abutment settlements have to be accomplished on Sunday mornings between daylight and church time.

One of the maintenance operations which indicates an appreciable change is that involving loss reports. There are so many more light standards, miles of guard rail, signs and signals to knock down that the increase is continuous as indicated by the following tabulation:

Fiscal Year	*Total Cost of Repairs*	*Costs Collected or Collectible*	*Costs at State Expense*
1955-56	$155,346	$96,654 (62%)	$58,692
1956-57	167,971	110,949 (66%)	57,022
1957-58	167,800	107,582 (64%)	60,218
1958-59	220,493	147,441 (67%)	73,052
1959-60	255,281	167,913 (66%)	87,368

There were only 28 chain link divider loss reports during the period July, 1959 to July, 1960 which amounted to a total cost of $3,670. Since that time additional miles of fence have been placed, and the District now has approximately 12 miles of chain link divider fence. Two fence crews are employed full time repairing these fences and request has been made for additional personnel in order to keep up with the damages. The length of chain link divider will increase appreciably in the very near

Author Retires After 32 Years of State Service

William D. Sedgwick, Assistant District Engineer of District VII, State Division of Highways, in Los Angeles, retired in July after 32 years with the State.

He was in charge of the maintenance of all State highways in Los Angeles, Orange and Ventura Counties, an area which includes a major portion of California's freeways. He was the developer of a vacuum trash collector which has greatly facilitated roadside cleanup.


W. D. Sedgwick

Sedgwick joined the Division in Sacramento as an office assistant on Federal aid projects in 1929. Prior to that time he had been employed by the U.S. Bureau of Public Roads.

From 1930 to 1932 he was resident engineer on several highway jobs in Central California after which he was appointed Assistant Maintenance Engineer in District X, Stockton.

Sedgwick served with the U.S. Navy Civil Engineers Corps during World War II and was stationed in the American and Pacific Theaters. He left active service with the rank of Commander in 1946 to return to the Division of Highways as Maintenance Engineer in District I, Eureka. In 1949 he was transferred to District VII to head the maintenance program there.

A native of Manitowoc, Wisconsin, he attended grade and high school in Creswall, Oregon. He holds degrees in electrical and civil engineering from Oregon State University.

He is a member of Sigma Tau engineering fraternity, the American Society of Civil Engineers and the American Public Works Association. He was promoted to Captain in the U.S. Naval Reserve in 1955.

Following retirement, Sedgwick and his wife plan a European tour during which they will visit their son, Clyde, a first lieutenant with the U.S. Forces in Germany.

Slide Removal Operations. A bulldozer gathers the loose rock into piles.

future, as there is a total of 77 more miles of chain link divider fence that is either under construction or budgeted for construction. Doubtlessly, these fences have saved many lives; however, the repair and replacement of damaged fence has increased the work load of maintenance forces.

Annual repair costs of guard rail including cleaning, painting, non-loss and accident loss items amounted to $120,200 in 1958-59 and increased to $140,633 during the 1959-60 fiscal year.

The sign situation is also an indication of increased requirements as a comparison between fiscal years will bear out. In fiscal 1955-56 new sign installations and general maintenance numbered 30,901 individual items. In fiscal 1959-60 this number rose to 39,007.

Striping, Pavement Markings

Besides taking care of the necessary restriping and pavement markings on old pavements, maintenance crews accomplish all the new striping and markings as the various contracts are completed. This requires close coordination with the resident engineers in order to have the temporary and final striping done just prior to opening each new section to traffic. Besides the new construction, new stripes have to be placed on the resurfaced portions each year under the light surface treatment program.

The sign and striping program by expenditures increased 18.63% from $612,571 in 1958-59 to $726,693 in 1959-60.

Signals and Lighting

Although one might think that the replacement of conventional highways with freeways would reduce the work to be done by maintenance crews, the following tabulation indicates otherwise.

This program, on the basis of expenditures, went up to 12.22% from $808,380 in 1958-59 to $907,203 in 1959-60.

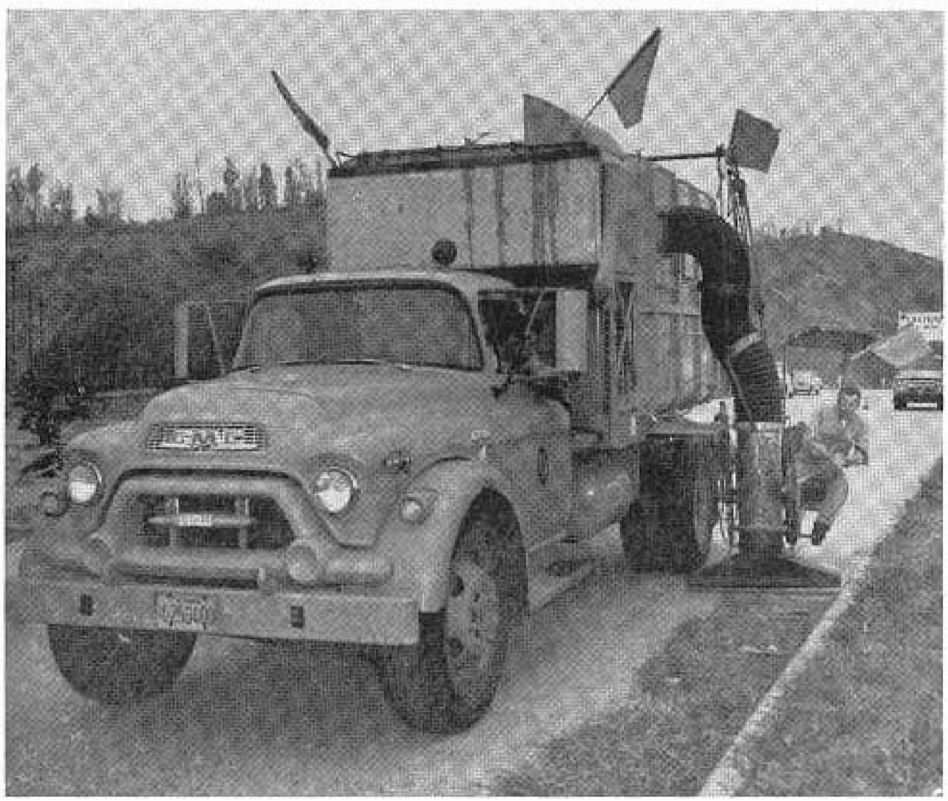
Sweeping, Trash Pickup

Cleanup problems are on the increase in District VII. With nearly 15% of maintenance man years given to this task, it becomes a major opera-

	1956	*1957*	*1958*	*1959*	*1960*
Illuminated Signs	312	333	445	488	585
Fluorescent Tubes for Above Signs	1,716	1,832	2,448	2,684	3,180
Safety Lighting Fixtures	4,650	4,895	5,373	5,690	6,743
Fixed Time Controllers	372	381	379	356	358
Signalized Intersections	691	741	752	760	798
Traffic Actuated Controllers	319	360	373	404	440

Slide Removal Operation. The rock is then loaded into trucks for removal from the site.

A highway maintenance crew removes debris from an overturned truck on a freeway.



The vacuum trash collector of the type developed by the author is shown in operation.

tion. Combined cost totals for State and city maintained State Highways during two sample budgetary years stress the seriousness of the litter problem. During 1955-56 $661,024 was spent, during 1959-60, $723,079, with indications that these totals will rise in succeeding years.

Maintenance Personnel

In order to take care of the rapidly moving freeway program, as conventional highways are being replaced by these new landscaped facilities, there is continual need for a greater labor force. Maintenance personnel in 1955-56 totaled 393, in 1959-60 the total was 578. It is anticipated that a corresponding percent increase in personnel requirements will continue through the coming fiscal year and extend at least into the 1962-3 fiscal year.

Oiling Program

The District VII allotment of maintenance oiling program funds was $133,350. This work was started by Maintenance forces in July soon after the completion of the last annual traffic census. The program consisted of emulsion slurry seals, sand seals and flush seals using SC-2 liquid asphalt, heater planer removal of excessive asphalt and corrugations from asphalt concrete pavements, reprocessing road mixed asphaltic pavements and extensive patching.

The District's recommendations for the 1961-62 fiscal year thin blanket and deferred seal coat program, which were prepared by the Maintenance Department last summer, have been approved by the California Highway Commission for a total of $518,400. This program, which is principally made up of 1-inch asphalt concrete blankets or resurfacing, contributes in a great measure to the high standard of condition of our asphaltic pavements as well as to reduction in the amount of traveled way patching.

Bridges

The maintenance of bridges, underpass pumping plants, maintenance buildings and facilities is also big business.

The cost of maintenance and repairs to some 1,200 bridge structures last year was in the neighborhood of

$40,000. During the past year an electrician was added as full time attendant for preventive electrical maintenance for the pumps on 33 underpasses. These pumping plants represent an investment of $1,000,000.

Maintenance Stations

The cost of maintenance and repairs to 40 permanent maintenance establishments was about $25,000. Thirty-one of these permanent facility locations are used directly in conjunction with normal highway maintenance while nine are for the landscaping crews in the metropolitan area. In addition to these permanent facilities there are four on temporary basis and two landscape facilities that are leased. Two landscape facilities which are presently under construction will release one of the leased facilities.

The cost of expanding existing stations and the addition of one complete new facility will be over $600,000 this year.

The demand for additional winter sports facilities near the Los Angeles metropolitan area is justifying the construction of the $295,000 new maintenance station at Wrightwood so that the Angeles Crest Highway may be reopened as soon as possible after each storm and the roadway kept sanded to keep it safe for traffic.

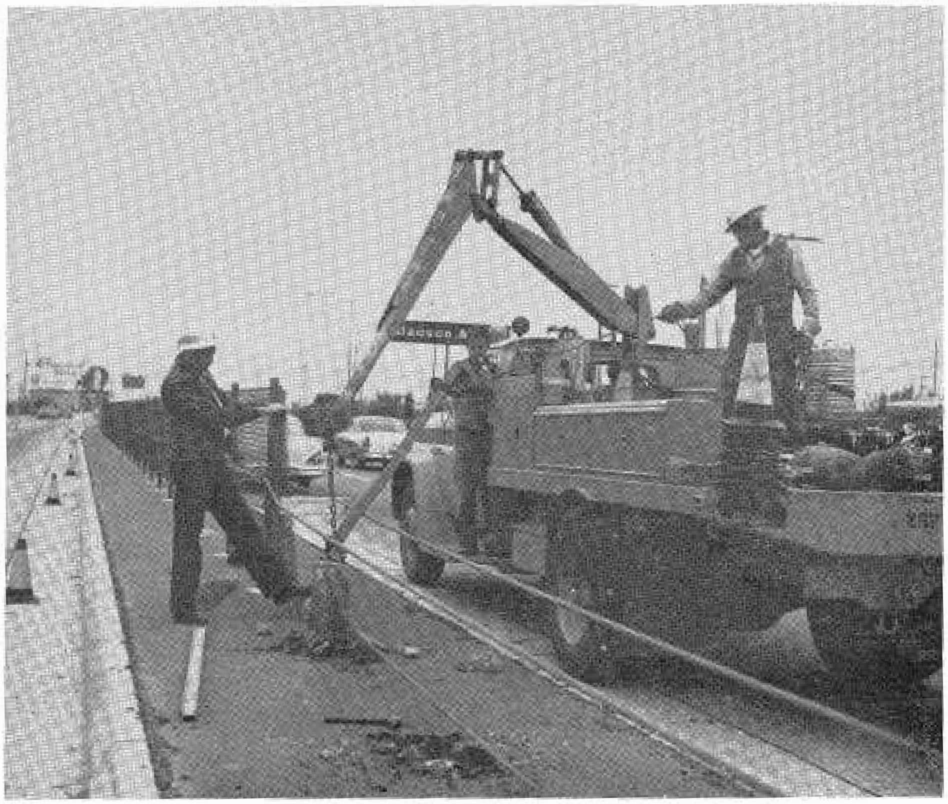
Maintenance in Cities

A highway maintenance agreement is negotiated with each city having operating State highways within its boundaries. This agreement is a legal document, duly executed by City and State and remains in effect until superseded, amended, or terminated. The agreement defines the terms, the degree, and the scope of maintenance and sets forth the manner in which it shall be performed.

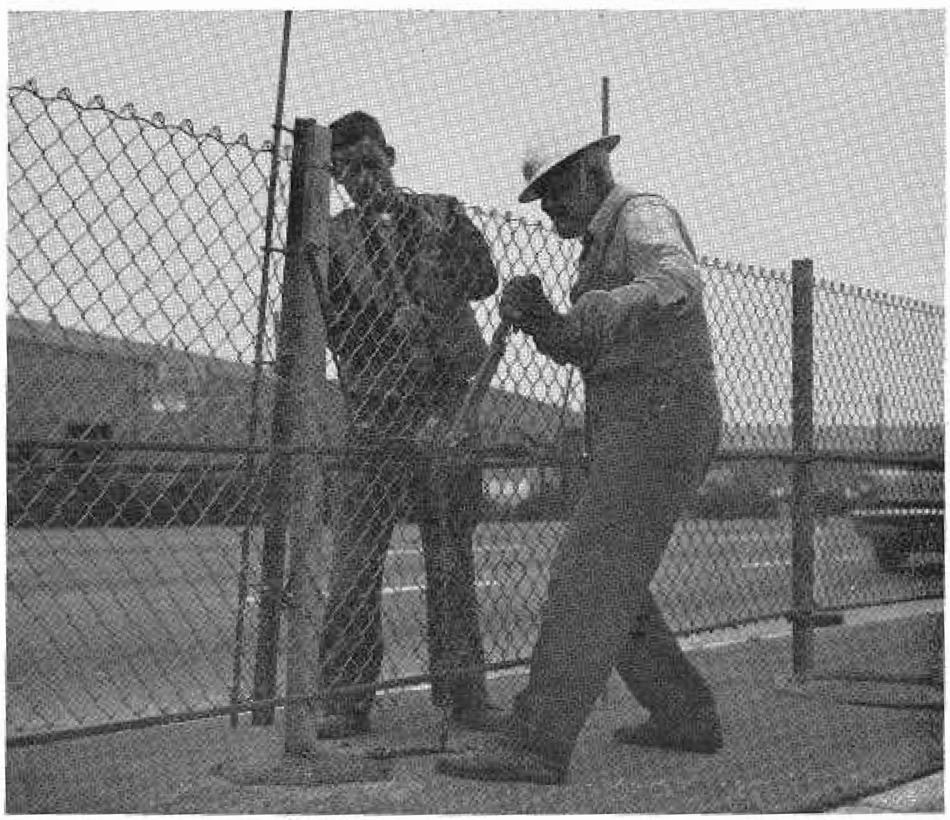
Under the highway maintenance agreement, cities bill the State monthly for the actual cost of work performed on State routes. The bills are reviewed and audited by the Maintenance office before being forwarded to the Accounting Department for scheduling.

Maintenance Equipment

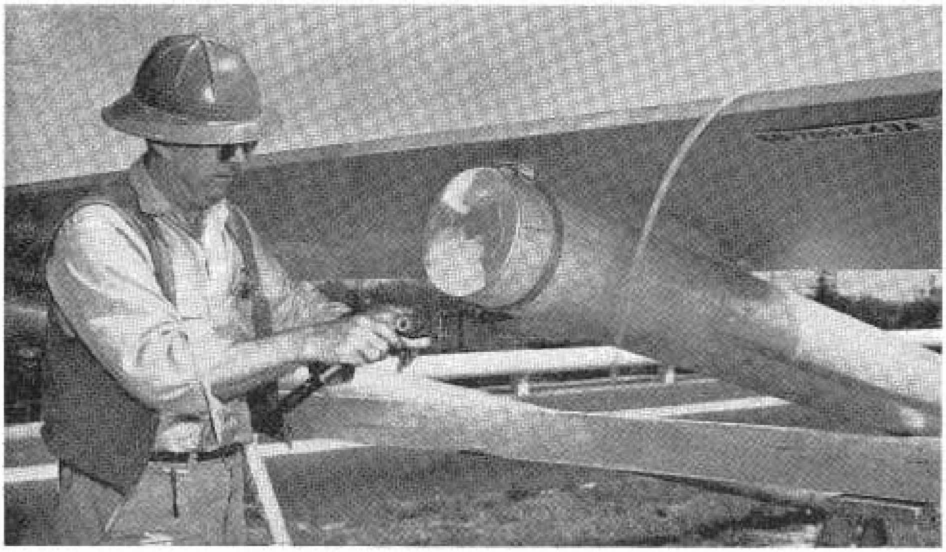
The District VII Maintenance Department presently has 568 pieces of equipment assigned to its operations.



A crew removes a damaged post prior to replacement of a new section of fence.



Members of the maintenance crew tighten up the reinforcing cable in the replaced section of fence.



A maintenance worker fastens a large freeway sign to a post with steel bands.

Following assembly, the crew raises the sign and secures the posts in the ground.

Street light and signal maintenance crews are using 33 units, the landscape personnel have 81 of these units assigned to their operations, signs and striping crews 34, and the other 420 units are standard maintenance equipment. Of these 420 items, there are 93 pieces of snow removal and pavement sanding equipment.

For the 1961-62 fiscal year, 20 additional units will be required for the landscape program, and 16 units will be required for a new maintenance station at Wrightwood.

Communications

The District VII radio and teletype facilities, although an integral part of the Maintenance Department, may be considered as the actual nerve center of the entire District.

Its facilities include eight 2-way land stations, 2 repeater stations, 185 mobile and portable radio units, 3 teletype machines, 3 telephone recording devices, telephones, Sig-alert and Conelrad units and a Micro-wave Radio and Relay System.

The District office communications center now operates on a 24-hour, 7-day a week basis and is staffed by 7 Division of Highways trained radio dispatchers. The outlying land stations are located in the various Highway, Shop and Signal Laboratory offices and are also operated by fully trained highway personnel. The relay stations are situated on surrounding mountain peaks and provide maximum radio coverage for the area.

These facilities are always available to immediately handle all types of emergencies, whether it be slides, accidents, road closures, snow, ice, fires, floods or highway damage of any type.

Permits

Transportation and encroachment permits are issued in accordance with policies that protect the invested rights of the traveling public. This control also restricts encroachment work that would conflict with present facilities or future highway development plans. There are 26 people curently employed in the permit section. Engineering costs for inspecting encroachment permit work is chargeable to the permittee, except for permits issued to other governmental agencies.

'TEMPUS FUGIT' CORNER

The following items appeared in the July 1936 issue of *California Highways and Public Works.*

Contest Winner

The Tower Bridge spanning the Sacramento River at Sacramento won second place in Group B (bridges costing between $250,000 and $1,000,000) in the annual national competition held in New York by the American Institute of Steel Construction, Inc., for the most beautiful bridge built during the past year. * * *

The old bridge, built in 1910 at the same location, had long been an eyesore to the people of the State who entered Sacramento from the west. M Street, the Pennsylvania Avenue of California, runs directly into the State Capitol, which is flanked by the new Capitol Extension buildings and Capitol Park. It was unimpressive to say the least to have such an antiquated structure as the gateway to the beautiful capitol buildings and grounds. When the need for a new bridge became an absolute necessity due to traffic requirements, popular sentiment demanded that every effort be expended to design a structure which would be unexcelled in architectural and engineering beauty and thus conform to its natural setting.

Old Sacramento

Jibboom Street grade separation and bridge approach project in Sacramento, now under construction, is another instance of the cooperation of State, city and Federal government * * *.

The name "Jibboom Street" recalls to old Sacramentans an earlier day when Jibboom Street or Water Street, now a part of the Southern Pacific Railroad yards, fronted on the Sacramento River and provided a place of business for commercial fishermen to tie up their boats and display their wares.

New Format

California Highways and Public Works changed its format from 6½ x 9¾ inches, which size it had been since Nov. 1927, to 8½ x 10¾. Its predecessor, *California Highways* (1924 to Nov. 1927) was 9 x 11, as was the original *Highway Bulletin*, published in five issues between 1912 and 1916.

Drivers to Fair Can See New Road Work

"Pleasure driving" to California's State Fair, held annually in Sacramento, will be especially enjoyable this year due to state highway improvements on traveled roadways and the planting of adjacent highway right-of-way areas.

Visitors to the 1961 California State Fair and Exposition, to be held August 30 through September 10, will find that roadway and landscaping improvements have been made on portions of all of the state highways normally used to reach the capital from all points of the compass.

Drivers taking U.S. 40 from the San Francisco Bay area will travel on freeway and expressway all the way except for two four-lane undivided sections north of Vallejo, and the Yolo Causeway section just west of Sacramento. Work is under way to make the entire route freeway and expressway, and a new Yolo Causeway may be seen under construction to the driver's right as he nears the capital.

On U.S. 50-99 between Stockton and Sacramento, fair visitors will encounter long stretches of freeway complete with planting in varying stages of growth. Construction work may be observed along the Stockton bypass, but it is not anticipated that the work will interfere with normal traffic flow.

En route from Auburn to Sacramento, freeway and expressway speeds may be used throughout, except for a short stretch between Marconi Avenue and Arden Way in Sacramento. In this area new lanes are being added in each direction. The construction area will be marked for reduced speeds.

Between Placerville and Sacramento several sections of new highway will be encountered, but normal freeway and expressway speeds may be maintained since construction work will be over a new alignment.

Visitors from Marysville using State Sign Route 24 will not encounter construction work as improvements on this route have been completed.

Visitors who attended the fair last year will be pleasantly surprised at the progress of the planting along most of the state highways. A special display at the fair will show the various types of planting utilized by the Division of Highways. The display will be located in the outdoor education area opposite the Hall of Flowers.

MAINTENANCE VII

Continued from page 56 . . .

Encroachment and transportation permits of all types issued by the District in 1959-60 amounted to 5,872 and 21,251, respectively.

Landscape Maintenance

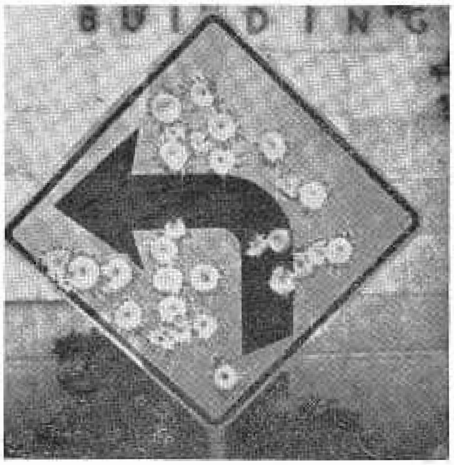
The cost of maintaining landscaped areas is primarily pre-determined by the type of planting, the value and use of adjacent property and the type and speed of traffic. A fully landscaped area through the Bel Air section of the San Diego Freeway or the Hollywood Freeway would require a much higher degree of maintenance than would the pasture land adjacent to much of the Long Beach Freeway.

Maintenance methods and costs are dependent upon many conditions. Natural conditions such as climate, soil, grade, proximity to other jobs and types of plant materials, added to man-made conditions such as irrigation systems, chemicals, equipment and mulches all affect maintenance of landscaped areas. Fortified weed oils are being used to control young weeds in areas mass planted to trees and shrubs, thus eliminating costly hand weeding.

A reduction in maintenance costs has resulted from planting native or drought-resistant plants where watering can be reduced or eliminated after several years of tank-truck watering. As plantings mature and accomplish their purpose, maintenance is reduced, and a portion of the personnel is shifted to other jobs.

Sign Vandals Waste Tax Money

Survey of State's Eleven Highway Districts Shows Cost Approximately $300,000 Annually



Directional sign with 39 bullet holes in it had to be replaced after two weeks service at cost to county of $18.37. Such cavalier treatment of all state's signs would require about $50,000,000 annually for maintenance.

One Highway District says of this sign, which had been in place less than two months, and was found with 85 bullet holes in it: "Many of the bullets passed clear through the sign in such a way that they crossed busy Highway 41 from Fresno to Yosemite at a point about 30 feet beyond the end of a high cut. The shooter had to have stood in the position where he could not possibly see traffic approaching this point through the cut. Thus it appears possible, by considering reaction time, that a car could have driven into the line of fire between the time the shooter squeezed the trigger and the time the bullets crossed the road."

In order to get specific information on sign vandalism in California, the State Highway Engineer recently queried all districts in the state on their experience with this problem. The response was very informative, and showed that the cost to the taxpayer of this wanton destruction was even higher than previously had been supposed.

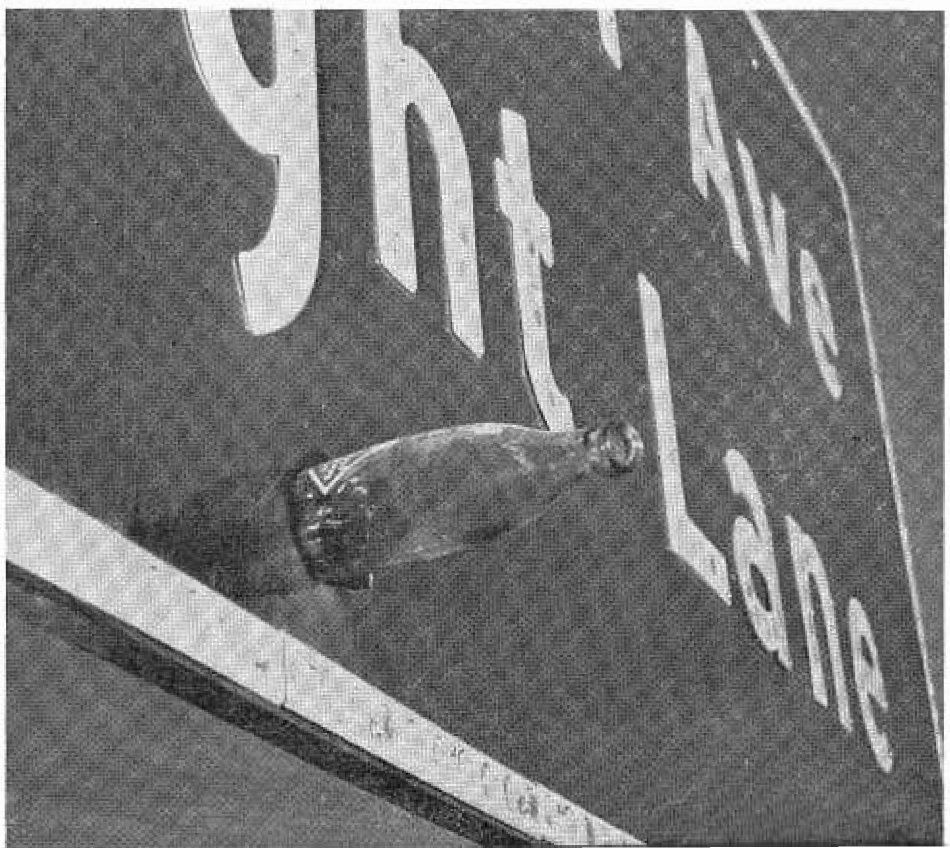
Responses to the questionnaire show that it costs between $275,000 and $325,000 each year to repair or replace official signs destroyed or damaged by vandals. This figure is for state highways alone, and does not include damage to signs on city streets and county roads. (Fresno County, for instance, estimates its costs for vandalism at $10,000 yearly.)

"This senseless destruction of warning, regulatory, and directional signs continues to be a serious problem," State Highway Engineer J. C. Womack said. "Repairs are expensive, and in some cases there have been tragic accidents because a sign was stolen or destroyed."

In 1960 California had about 220,000 signs in its state highway system, costing anywhere from fifteen dollars up to many thousands. About one-sixth of these must be repaired or replaced each year. In the greater Los Angeles area alone eight to ten trucks and crews spend every Monday replacing knockdowns, many of these intentional. This is in line with the findings of the survey which showed the major source of damage in metropolitan areas is smashing and breaking signs with a vehicle. There is also considerable damage from thrown objects, and many instances of deliberate bending of signs have been encountered.

As might be expected, there is less damage from gunshots near cities. Where urban shooting laws are not enforced, however, signs suffer at the hands of marksmen with small calibre weapons and air guns. Even the pellet from an air rifle will destroy the enamel coating on a sign, exposing the metal to rust and eventual deterioration.

RIGHT—Some youths think it sporting to attempt to make pop bottles stick into the larger freeway signs by throwing these missiles from fast moving cars. Repairs are expensive, but misses are worse, for they create broken glass hazard on the roadway or might kill unlucky bystanders. (Fresno Bee photo).



Actual removal or theft of highway signs is common, particularly around college towns. In the same vein, it was almost impossible to keep "Pismo Beach" signs in place when this town was being mentioned on a popular comedy program.

Sometimes epidemics of malicious mischief aimed at highway signs seem to run through juvenile groups. Last year 33 warning and directional signs were removed from U.S. 466 between Paso Robles and the Estrella River. These later were found lying discarded in the Salinas and Estrella Rivers. A more costly series of incidents occurred in the Atascadero vicinity, when many signs were knocked over by vehicles.

There is less damage to signs on freeways, presumably because heavy, fast-moving traffic makes vandalism difficult. One freeway construction project in the Los Angeles area was the scene of several thousand dollars in sign damage, however, when children invaded the right-of-way just before the section was opened to traffic.

Occasionally, signs are removed and hidden by individuals who object to them.

In a ranching area, a stop sign was removed and replaced eight times before a highway superintendent early one morning traced a trail of high-heeled boot tracks through wet grass to a nearby canyon, and found all eight signs.

About $75 is needed to replace this two-post city limit sign carelessly destroyed by "muscle men."

San Joaquin County replaced the stop signs at one intersection 20 times in 18 months. On one instance, not only were the signs removed, but the posts were piled in the middle of the road and burned.

A man in Santa Cruz County was jailed for malicious mischief for removing a stop sign because he got "sick and tired of stopping at that sign 25 times a day" while trucking produce to a packing plant.

At least one fatality can be attributed to the unauthorized removal of a stop sign as a Halloween prank.

In rural and mountain areas heavy damage results from rifle and shotgun blasts, particularly during hunting seasons.

A few years ago maintenance crews installed 16 turn-out signs on a mountain section of Sign Route 168 in Fresno County. The next day 13 of these signs had to be replaced because of gunshot damage.

One sign in a desert area was blasted to useless wreckage by a shotgun 30 minutes after it had been installed—a half-hour life for a $15 sign.

Some target shooters aim at signs from moving cars. Highway maintenance superintendents reported that a single car will sometimes pass through an area and leave up to 35 shooting-damaged signs.

Reconstruction of the line of fire often shows the bullets from a high-powered rifle passed across the highway, in such a way that occupants of vehicles rounding a curve or coming over a rise would be seriously endangered. At other times buildings in the vicinity were in the line of fire.

In one highway district the sign foreman found a sign badly shot up near a rural store. The angle of the bullet holes through the sign indicated that it could only have been shot at from the porch of that store. Nevertheless, the proprietor disclaimed any knowledge of the shooting, and even said he had never heard any gunshots, although he lived in the back of the store. He was told the seriousness of damaging signs and that particular sign has never been damaged again.

Although damage from gunfire is more common in rural areas, other malicious acts are also committed.

One district's accumulation over a few months period of shot-up, bent, and smashed signs.

Vandals throw rocks at signs or deliberately ram them with vehicles. Outright theft is frequently reported. "Show-offs" and "muscle men" prove their virility by bending metal signs with their hands.

Most citizens are surprised to learn the expense of highway signs and their maintenance. When travel to the site and labor is considered, the simplest sign repair costs at least $5. When major repairs must be made, or signs must be replaced, the cost is anywhere from $15 to $400 for the smaller signs. (The big signs on the freeways may cost as much as $20,000, but vandals rarely can get to them).

Willful destruction of highway signs in California is a misdemeanor punishable by a maximum $500 fine, six months in jail, or both. An increasing number of judges are meting out strict punishments to violators. The Shasta County supervisors in 1960 passed a resolution offering a $200 reward for information leading to the conviction of anyone who maliciously destroys any public road appurtenance in that county.

When three boys in the San Joaquin Valley were caught vandalizing and removing highway signs a rural justice of the peace sentenced them to repair all the damaged highway signs on a fifty mile stretch of road. They labored three full days under a hot August sun carrying out the sentence.

Some authorities feel the answer to the problem is strict punishment such as this whenever possible, others feel education is what is needed to stop this practice which, in effect, wastes the gasoline tax paid by many thousands of California drivers each year.

Three Long-Time Architecture Employees Retire

Three veteran employees of the State Division of Architecture retired during June and July. They are Ernest Aeppli, senior structural engineer in Sacramento with 31 years' state service; Robert C. Younger, senior architect and assistant to Assistant State Architect A. F. Dudman in Sacramento, 25 years; and H. E. J. "Woody" Woodhams, district construction supervisor in Los Angeles, 39 years.


Ernest Aeppli

Aeppli joined the Division in 1929. Two years later he transferred to the Bridge Department of the Division of Highways.


Robert C. Younger

Aeppli designed the first concrete box girder bridge constructed by the State of California. He was also the first to design a light-weight box girder frame bridge with counterweighted abutments.

During World War II Aeppli was senior bridge engineer on construction of the Alaskan Highway and was awarded a certificate of merit for his services.


H. E. J. Woodhams

In 1947, he returned to the State Division of Architecture as a senior structural engineer. He handled the structural design of the division's first thin shell structure, the flower show exhibit building at the Santa Barbara County fairgrounds.

A native of Switzerland, Aeppli is a civil engineering graduate of the Swiss Federal Polytechnic Institute of Engineering in Zurich. He came to the United States in 1921 and until 1929 worked for various consulting engineers and architects in San Francisco.

Aeppli and his wife, the former Hedy Klee of Zürich, have two daughters and four grandchildren.

Younger first came to work for the Division of Architecture in 1925 as an architectural draftsman. He left state service in 1936 to work for several private architectural firms in the San Francisco area.

During the early years of World War II he was an instructor in drafting and mathematics at Cal Poly in San Luis Obispo. Afterwards he was in private practice in San Carlos and Redwood City.

He returned to the Division of Architecture in 1950 and shortly afterward was appointed as assistant to Dudman to aid with the coordination of design functions.

Younger was born in Sacramento where he attended grade and high school. He graduated from the University of California at Berkeley in 1924.

Younger is a World War I veteran, having served in the Signal Corps from 1917 to 1919.

Younger and his wife, Margaret, have two daughters and a son and three grandchildren.

Woodhams started work with the Division in 1922 in the Sacramento area. Subsequent assignments as inspector took him to many parts of the State including Los Angeles in 1926, Chico State College in 1927, Napa in 1929, San Quentin in 1933, Whittier in 1934 and San Diego in 1938. Between 1939 to 1955 he was stationed in Camarillo, Tehachapi and Bishop. He transferred to Los Angeles in 1955. His assignment for the past three years has been as construction supervisor on State Building #2 which houses the Los Angeles Office of the Division of Architecture.

Woodhams was born in Livingston, Montana, and went to grade and high school in Los Angeles. He received his B.A. degree in architecture from the University of California at Berkeley in 1922.

Woodhams is a veteran of World War I.

Maintenance Expert Paul Harris Retires

Paul M. Harris, assistant chief of the District VII Maintenance Department, State Division of Highways, in Los Angeles, retired in July after 31 years of state service.


P. M. Harris

Harris joined the Division in 1930 as a member of a survey party in the Mother Lode area of District X. He worked on construction projects in District V (San Luis Obispo) and District IX (Bishop) from 1931 to 1932, after which he was transferred to District VII.

From 1934 to 1940 he was in charge of asphalt concrete plants in District VII after which he was appointed Assistant Maintenance Superintendent at Santa Monica.

During World War II he served as a captain in the U.S. Army Corps of Engineers.

He returned to the Division in 1946 and was promoted to Assistant District Maintenance Engineer in 1948. He was named Maintenance Engineer in charge of administration for the District VII in 1956.

Harris was born in St. Ignace, Michigan. He attended grade school there, high school in Oceanside, California, and holds a degree in mining engineering from the University of Arizona.

Between 1926 and 1930, when he joined the State, he served successively as a private mining engineer, Assistant City Engineer of Oceanside and Assistant Surveyor of San Diego County.

He is a member of the American Public Works Association, the American Society for Metals and a charter member of the California State Employees Association.

Following retirement, Harris plans to work as a private consultant on mining and water development projects.

He and his wife, Lucy, have a daughter, Diane.

Excavation work will start soon on the Caldecott (Broadway) Tunnel on Sign Route 24 in Oakland.

Bond Issue

Final Payment Made on State's 1909 Road Bonds

In 1909 the California Legislature authorized, and in 1910 the people approved at the polls, a bond issue of $18,000,000 for a trunk line system of State highways. It was the first of three such bond issues (the others were initiated in 1915 and 1919) constituting the principal means of State highway financing prior to the enactment of a gasoline tax in 1923.

On July 1, 1961, the State Controller made the final semiannual payment, consisting of $400,000 on the principal and $8,000 in interest, on the 1909 State Highways Act.

The total interest paid on the $18,000,000 bond issue, according to Controller Alan Cranston, has amounted to $18,204,200.

Source of Funds

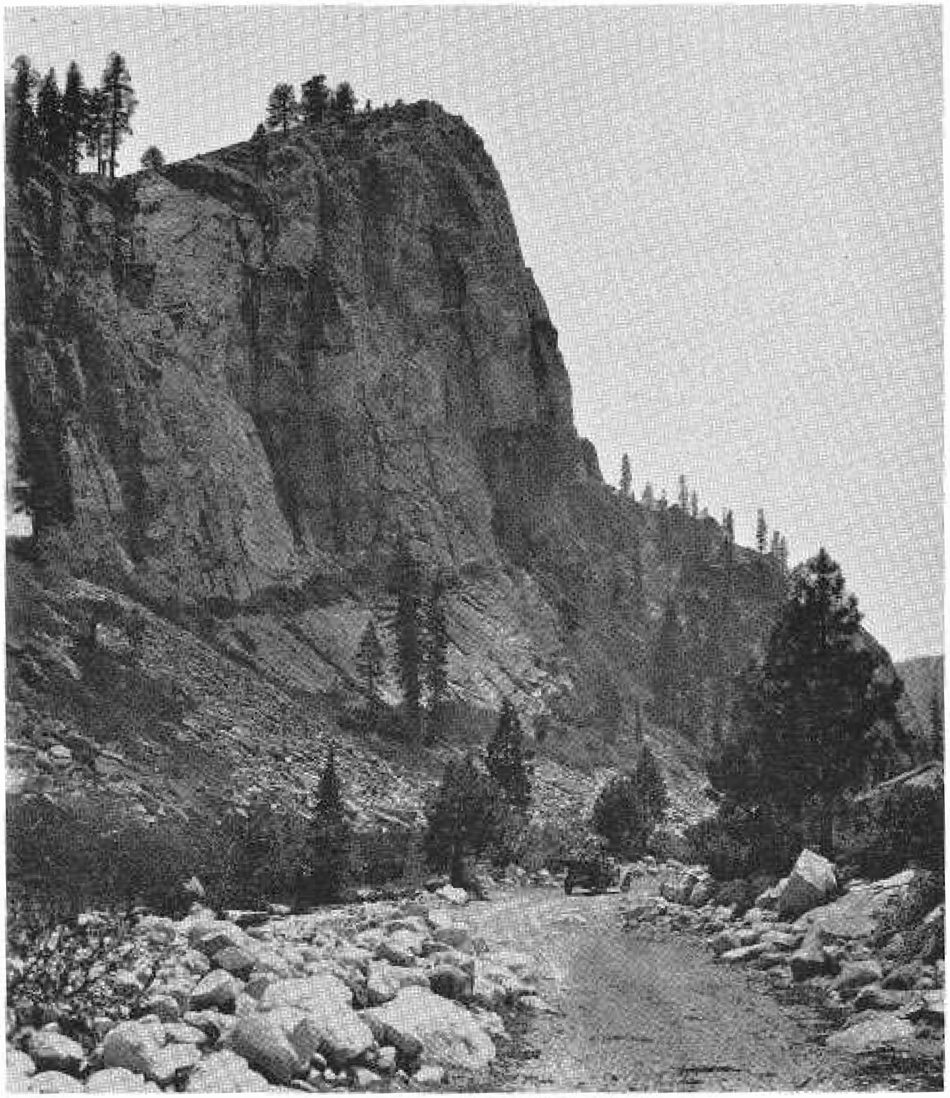
Source of the funds for redemption of the bonds and payment of interest was, at first, the State General Fund; except that between 1915 and 1920 the interest payments were charged to the respective counties on the basis of the highway expenditures within their boundaries.

Since 1935, the bond issue repayment money has come from the Motor Vehicle License Fee Fund. This is the fund fed by the "in lieu" ad valorem tax on motor vehicles, paid annually at the time of registration or renewal. Except for a small amount for expenses of administration and the redemption of the old highway bonds, this fund is divided between the cities and counties of California and is made available for their use in the same manner as locally collected taxes.

The first bond issue had its political and financial vicissitudes, but it survived them all and paved the way for more popular bond issues in succeeding years.

Majority Was Slight

To begin with, despite a conscientious campaign to "get California out of the mud"—featuring photographs of cars mired to the running boards on rural roads—the bond issue mustered only slight majority at the polls. The statewide vote was 93,297 in favor and 80,509 against. In Los Angeles County the bond issue was voted down by three to one, but it carried in San Francisco by about the same margin.



U.S. 50 in the High Sierra near the base of Lovers Leap. The time: 1912.

The $18,000,000 bond issue, bearing 4 percent interest, also proved hard to market. Only $4,280,000 in bonds were sold publicly. The remainder, $13,720,000 was sold to the counties. The counties purchased them, in the words of the Highway Commission's First Biennial Report (1918), "because otherwise the work could not have gone on".

The 1917-1918 Biennial Report shows that 1,263 miles of State highways had work accomplished on them by June 30, 1916, including about 323 miles graded but not yet paved.

The State Department of Public Works has awarded a $538,000 contract for construction of a new bridge over Tunitas Creek on State Sign Route 1 south of Half Moon Bay in San Mateo County.

Freeway Routes

Sacramento, Bay Area Locations Approved

Freeway route problems of long standing were resolved by the California Highway Commission in May and June with the adoption of freeway routes in Sacramento and in the Hayward-Union City-Fremont area of Alameda County. The Commission also adopted a routing for a portion of a new freeway in Contra Costa County which will eventually extend from Sign Route 24 near Walnut Creek to Sign Route 4-24 near Pittsburg.

Sacramento County

The Sacramento routes are for the east-west and north-south freeways in and adjacent to the city. They were recommended by State Highway Engineer J. C. Womack and coincide with the recommendations of a City of Sacramento core area study report.

The route for the east-west freeway extends 3.9 miles between U.S. Highway 40 at Westacre Road in Yolo County and 34th Street in Sacramento. It crosses the Sacramento River in the vicinity of W Street and runs between W and X Streets to 29th and 30th Streets, where there will be an interchange with a previously adopted freeway route connecting the South Sacramento and Elvas freeways. It then swings northerly to 34th Street in the vicinity of T Street.

The north-south freeway route is 16.7 miles long between Vallejo Way near the Sacramento River and the Sacramento River at Elkhorn Ferry, where it connects with a previously adopted route for the Westside Freeway extending to Woodland.

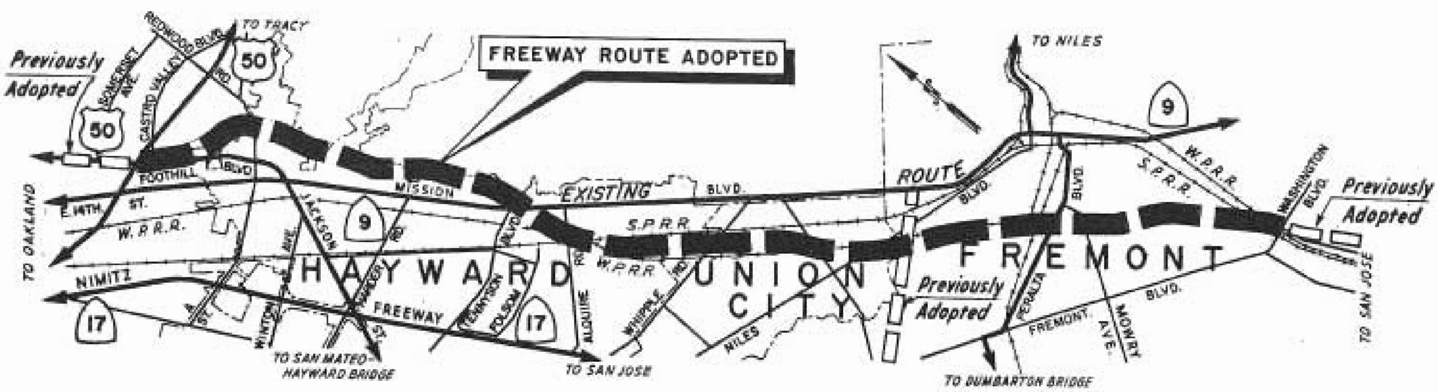
A public hearing on the Sacramento area routings was waived by the City Council of Sacramento and the Sacramento and Yolo County Boards of Supervisors.

Alameda County

The route in Alameda County, adopted after more than two months of follow-up study after a public hearing by the Commission in Hayward, will provide for 14 miles of freeway on Sign Route 9 through the Hayward-Union City-Fremont area.

The adopted route in general is that recommended by Womack, with the major exception of the portion through South Hayward and Union City. In this area the Commission adopted a line near the Southern Pacific and Western Pacific Railroad lines, rather than the line recommended by Womack, which would have traversed the Dry Creek Ranch property which has been offered by its owners as a regional park.

The Commission indicated its preference for the route between the tracks was based not only on preserving the proposed regional park but

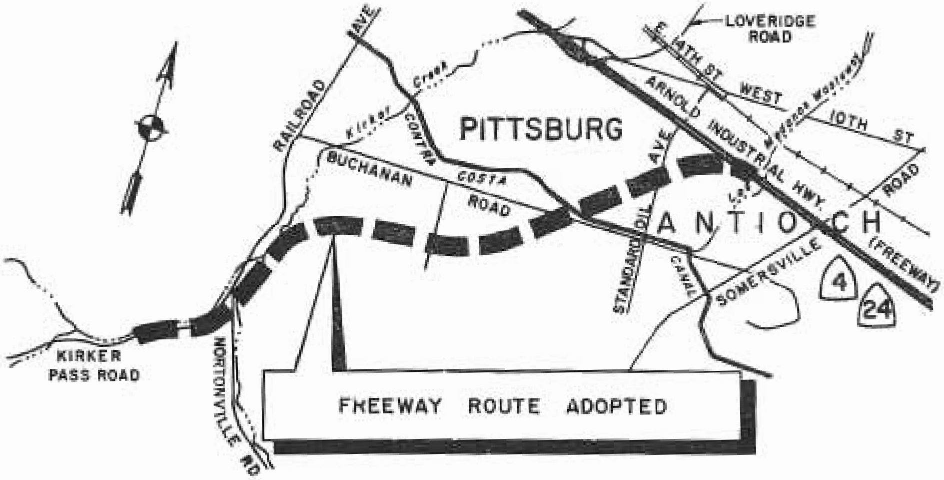


also on better local traffic service and other factors.

Contra Costa County

The Contra Costa County routing is the first section of State Highway Route 256 to be studied for location and adopted as a freeway. This route, none of which has been constructed, was adopted by the Legislature in 1959 and will connect Sign Route 24 near Walnut Creek and Sign Route 4-24 near Pittsburg.

The adopted route extends easterly from Kirker Pass Road west of Nortonville Road to Sign Route 4-24 (Arnold Industrial Highway) just west of the Los Medanos Wasteway. It is 4.2 miles in length.



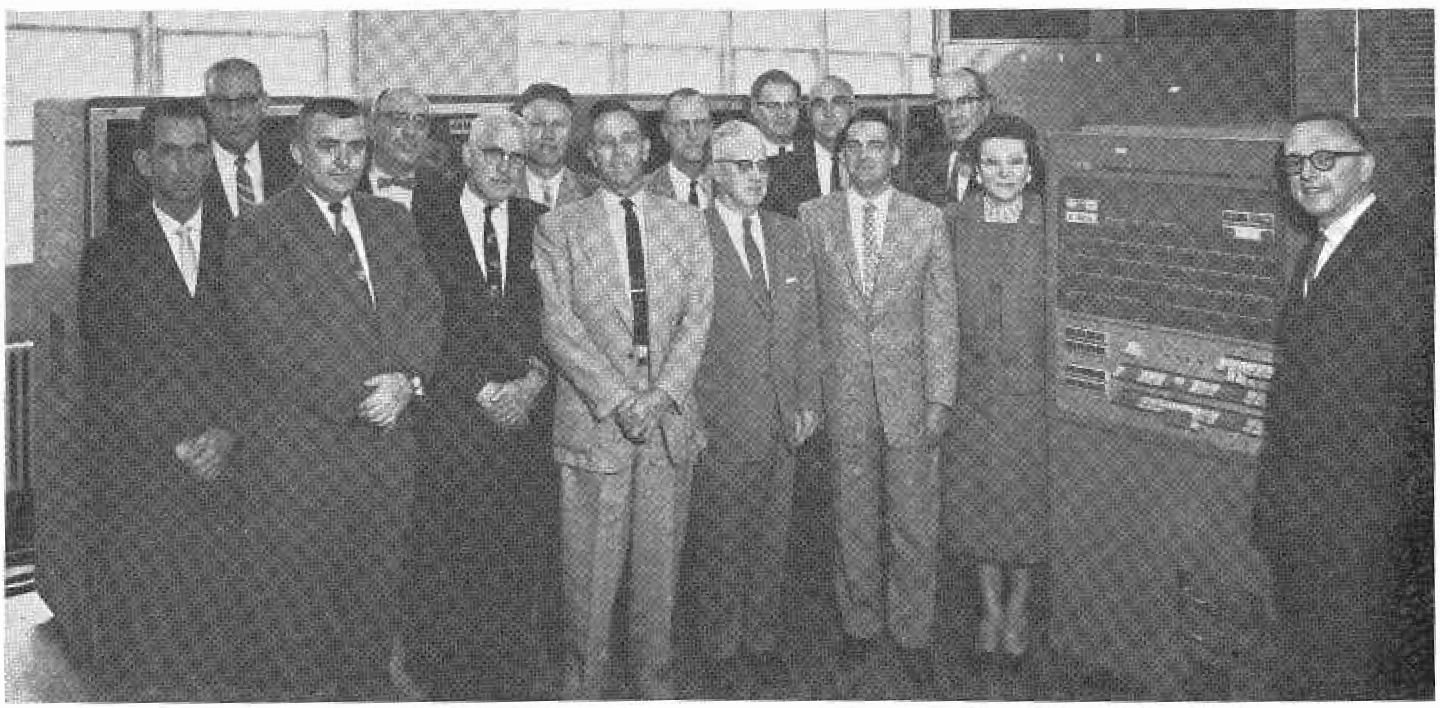
Construction Costs Rise in 2nd Quarter

An upturn in the California Highway Construction Cost Index took place during the second quarter of 1961. The index now stands at 252.8, an increase of 23.2 points or 10.1 percent over the first quarter of 1961.

The higher index reflects increases in materials and wages which have occurred in the construction industry, and is also affected by projects in California's mountainous areas, where difficult conditions tend to increase price averages. A project on U.S. 40 in the Sierra Nevada Mountains and another project in Kern County in the Tehachapi Mountains were bid at higher-than-average prices.

The number of bidders per project during the second quarter dropped from 6.1 to 5.3.

HIGHWAYS ACCOUNTING PERSONNEL STUDY NEW DATA SYSTEM



Headquarters and district accounting personnel met in Sacramento recently for final briefing and discussion of the accounting procedures which went into effect July 1, 1961. The agenda covered the conversion from the previous accounting system to an automatic data processing system. Included was a tour of Headquarters' Data Processing Center. In the above photo, Andrew Schoellkopf, Assistant Comptroller, Department of Public Works (extreme right) explains some of the new electronic equipment to (front row, left to right): N. Christopulos, District VII; Don Williams, Headquarters Office; W. J. Reilly, District X; W. J. Elliott, Jr., District XI; C. C. Waterman, District VIII; Ben Stebbins, District I; Mrs. M. P. Mayerle, District IX; (second row), C. West, Toll Bridges; Paul Cowgill, District IV; Robert Mihills, District V; J. P. Williams, District II; O. Soennichsen, District VI; Tom Akins, Bridge Department; and Ray Rusk, District III.

Talking About Highways — *Comments from Here and There*

The following quotes and comments about highways appeared recently in various California newspapers or were taken from other sources:

Feared Freeways—Now Cheers Them

Los Angeles Times reporter Art Ryon recently looked into the effects of freeways on various Southern California communities and came to this conclusion:

"They have been a boon to almost everyone."

Ryon talked to officials and business leaders in cities where freeways have been built.

"From Ventura Boulevard in Studio City, from El Monte, from Buena Park, from Santa Ana, from San Clemente, from Carlsbad and Oceanside, from Camarillo, and from Gorman high on the Ridge Route, the report is the same:

" 'We were worried about the freeway at first, but now we're thankful they put it through.' "

* * *

El Monte

"El Monte was notoriously stubborn about the San Bernardino Freeway slicing through its boundaries. . . . By various legal processes, it actually held up completion of the freeway—which it called a 'Chinese Wall'—for several years.

"So what has happened?

"In the year immediately after the freeway construction in 1956, new building valuation tripled . . ., population increased 18.5 per cent in two years, and although traffic on Garvey and Valley Boulevards dropped 36 per cent, business establishments on those by-passed highways — stores, cafes, bars and even service stations—all showed a marked increase in business."

* * *

Studio City

"Gerry Gillard, president of the Studio City Chamber of Commerce and owner of a children's shop on Ventura Boulevard, 'by-passed' by the Ventura Freeway, put it succinctly:

" 'As far as traffic is concerned, the boulevard is nothing like it used to be. This has hurt some service stations and motels—but not much. However, it has helped the shops and the fact that business is good is evident from the fact that there is a lot of new commercial building out here.

" 'No more trucks. And customers can find a place to park. As far as my store is concerned, people used to order by telephone, and we had to deliver. Now, they come to the store.' "

* * *

Buena Park

E. F. Bernard, manager of the Buena Park Chamber of Commerce, felt that the Santa Ana Freeway through the city has "solidified" the community.

" 'Some people on the old highway were hurt,' he says, 'but most of them moved to new locations. The freeway, which we feel is an asset, caused a great increase in population, and as a result the established business houses . . . are doing more business than they ever did. And we are getting two large new shopping centers which, I am sure, would never have been located here if it were not for the freeway.' "

* * *

Santa Ana

" 'Our statistics show,' reports Frank Gelinas, manager of the Santa Ana Chamber of Commerce, 'that 46 per cent of the retail business here comes from at least 20 miles away. That is because of the freeway—or because the freeway has relieved congestion on the secondary highways.' "

* * *

San Clemente

Mrs. Jean Stivers of the San Clemente Chamber of Commerce said that they were "scared" about the recently completed freeway bypassing the community.

" 'But—and this is a funny thing—the freeway is up above, and it gives people a wonderful view of our pretty little town and, as a result, we actually are having more foot traffic into the Chamber of Commerce by people asking questions about San Clemente than we've ever had before.' "

* * *

Camarillo

"Although U.S. 101 used to be that community's main street, the bisecting freeway has caused property values to go up and 29 new commercial structures have been built along the old highway, now readily accessible to residents of the community and surrounding areas. Gross retail sales in Camarillo since the freeway have increased 5.66 per cent compared to the average increase throughout Ventura County of 4.86 per cent."

* * *

Summing Up

Ryon quoted J. A. Mellen, planning director of the City of Glendale, in summing up his findings:

" 'I know of no instance,' Mellen declared, 'where the community has not benefited economically from the finally constructed freeway alignment . . .' "

* * *

Wonder of California

From an editorial in the *Santa Monica Evening Outlook:*

"The building of the Los Angeles Freeway System has been necessarily slow because of the enormous difficulties and costs involved. Consequently, existing freeways have become overloaded and people with little knowledge of the program have hastily concluded that the State Highway Engineers and the Highway Commission are fighting a losing battle in building freeways. Especially critics from other parts of the country have delighted in talking about the terrible traffic conditions in Los Angeles . . .

"The facts provide an eloquent answer to those ill-informed critics. One fact is that even with our Los Angeles Freeway System only partly completed, we do a better job in this county of moving great volumes of traffic than is done in almost any other

THE READER SURVEY—A THANK YOU FROM THE EDITOR

During May, 1961, the State Highway Engineer asked the California recipients of *California Highways and Public Works* (exclusive of Department of Public Works employees) for their reaction to a proposal to establish a subscription charge for this publication. The proposal was contained in a Concurrent Resolution previously adopted by the State Assembly and at that time under consideration by the Committee on Transportation of the State Senate. The survey was made at the request of the Committee on Transportation.

The response to the survey was gratifyingly prompt and heavy. Approximately 60 percent of those who receive a publication by mail returned the survey postcards. While a great many people indicated a willingness to pay, it was nevertheless evident that there would have been a substantial reduction in circulation if a charge were established.

On June 13, the Senate Committee on Transportation declined to take favorable action on the resolution.

The survey was of considerable value. The cooperation and interest of the majority of readers who responded so promptly and in such large numbers was deeply appreciated. The comments written on the postcards were helpful, as were the letters which quite a few readers took the trouble to write—practically all of them constructive in approach. And it was of course gratifying to receive a substantial expression of willingness to pay a subscription charge for an official journal which has historically been available free of charge to interested persons.

The pattern of reader interest revealed by the survey was in general one of the citizen and taxpayer desirous of keeping informed on statewide highway progress and on the use being made of his tax dollars. There were a few suggestions for changes in content; but the prevailing attitude appeared to be in favor of the publication's long-established policy of carrying both technical and general-interest articles.

In summary: there is no further consideration being given at the moment to establishing a subscription charge for *California Highways and Public Works;* and the Division of Highways is most grateful to readers on the mailing list for their cooperation.

L. S. K.

Right-of-Way Agent Edward King Retires

Edward F. King, Senior Right-of-Way Agent for the California Division of Highways in Los Angeles, retired on July 10 after 23 years of State service.

Edward F. King

King was in charge of right-of-way acquisition in the west half of Los Angeles County and all of Ventura County where some 10 million dollars worth of property for highway and freeway construction is bought annually.

King was born in Omaha, Nebraska, where he attended grade and high schools. He also holds a degree from Loyola University of Law in Los Angeles.

King was in private land acquisition and development in Nebraska, Montana and Califoria until 1929 when he went to work for the City of Los Angeles doing land appraisal and right-of-way work. He joined the Division of Highways in 1938.

King served in the U.S. Navy during World War I.

He is a member of the American Legion and the Los Angeles Athletic Club and is a charter member of the American Right-of-Way Association in Los Angeles and charter member and first president of Chapter 101 of the California State Employees Association.

King plans to tour Europe after which he will devote his time to golf and developing some mining claims and properties he owns in the Death Valley area and in Arizona.

There are 2,671 miles of multi-lane divided highway in operation or under construction in California.

Talking About Highways

Continued from page 66 . . .

metropolitan area in the world. And the second fact is that when the entire freeway network is completed . . . , freeway driving time will be materially reduced throughout the entire area.

"In the not distant future our metropolitan system of freeways will be recognized as one of the wonders of California and as a model for other big metropolitan areas whose motorists would also prefer to drive their own cars to and from their work if they could."

Banning Freeway Worry Unfounded

Reporting in the *Palm Springs Desert Sun,* Ken Reich wrote of new prosperity in Banning as a result of the freeway there:

" 'Banning didn't start to grow until that freeway went in. The freeway has been a wonderful blessing.'

"So spoke Mrs. Lena Klein, head of the Banning Board of Realtors. Residents of the Pass city weren't always talking that way.

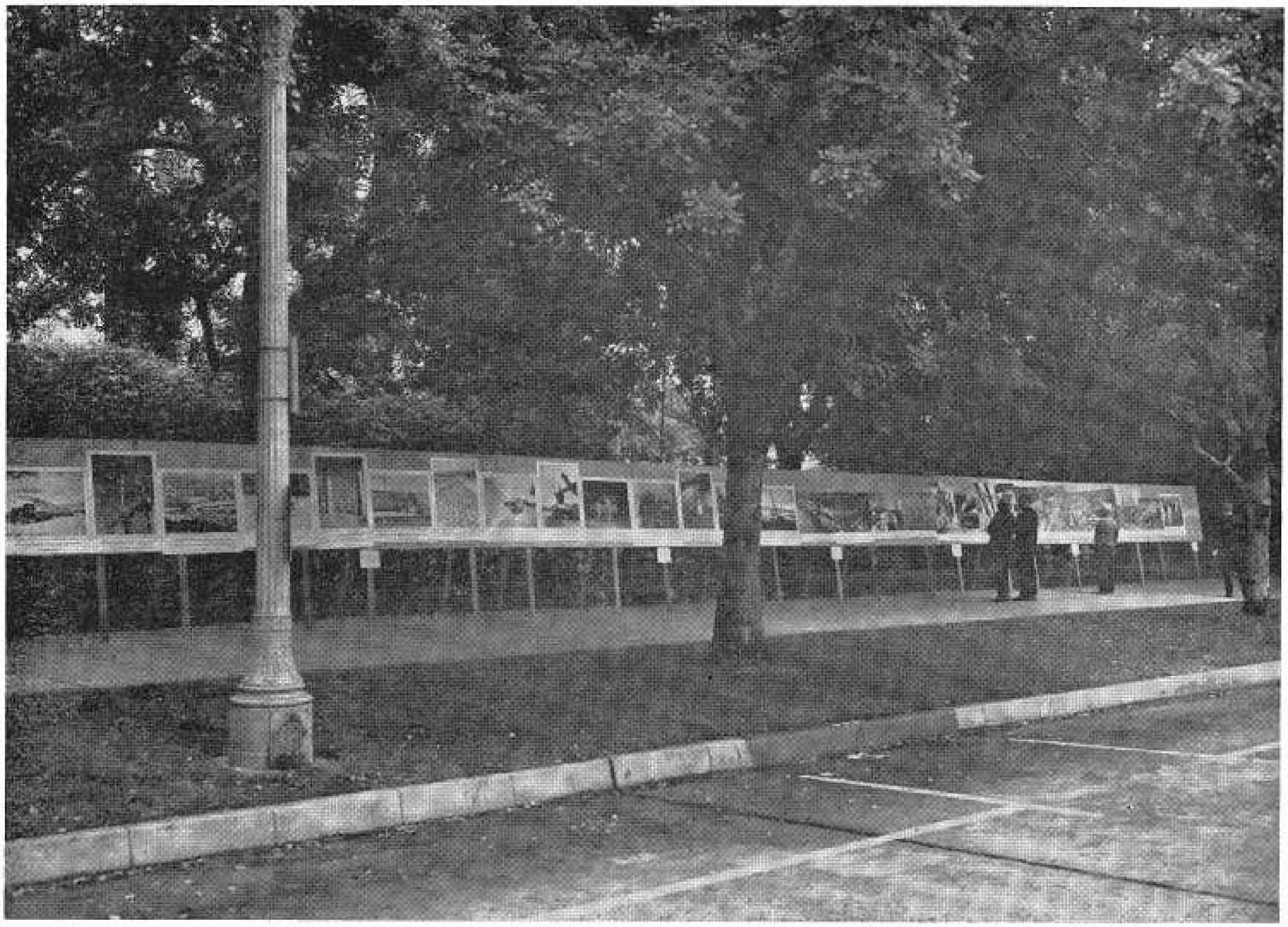
"When the freeway carrying (U.S.) 60-70-99 traffic around the city opened July 1, 1955, there was considerable uneasiness in Banning and some were quick to predict that its days of prosperity were over.

"Now, six years later it is evident they are only beginning."

Reich reported that community leaders inaugurated a "smooth-running coordinated operation" to attract new business and industry. This campaign has met with success. The city's population has increased. Even motels along the old highway "are now doing as much business as ever."

"In short," Reich concluded, "Banning is prosperous and confident of the future, which is a far cry from the pessimism of 1955."

FREEWAY EXHIBIT AT PASADENA DIAMOND JUBILEE



District VII, State Division of Highways, participated in Pasadena's Diamond Jubilee celebration by exhibiting a series of 33 enlarged photographs illustrating the planning and building of freeways. The display, set up in the Civic Center Plaza, was a feature of State and County Day, May 22, a part of the week-long observance of the 75th anniversary of Pasadena's incorporation, sponsored by the Pasadena Municipal Employees Association and the Pasadena Board of City Directors. Hundreds of interested visitors saw the photographs, which were 36 inches square, and many asked for freeway literature, which was supplied by Raymond F. Law, Assistant Information Officer.

Simatovich Retires; Johnson Named Richmond-San Rafael Bridge Head

Walter F. Johnson, senior bridge engineer, California Division of Highways, has been assigned as resident manager of the Richmond-San Rafael Bridge, succeeding A. P. Simatovich, who has been in charge of operation and maintenance of the toll facility since it was opened to traffic in September, 1956.

Simatovich has left State service after more than 15 years of work in bridge design, construction, and operation. He was associated with the Richmond-San Rafael project on design since its inception in 1950, and served as resident engineer during the construction phase beginning in 1953.

He is a native of San Francisco and was graduated from Stanford University in 1930. Before entering State service in 1946 he worked on bridges and forest highways with the U.S. Bureau of Public Roads and in other engineering activities for other Federal Government agencies.

Johnson, the new bridge manager, is a native of San Jose and a graduate of Oregon State College. He served with the Army Engineers in the Pacific Theater, then was office engineer for a dam construction project in Idaho.

Since joining the Division of Highways in December, 1947, as a junior civil engineer in the bridge department, he has held a variety of bridge construction and design assignments. For the past four years he has concentrated on special research studies.

California has 1,200 miles of freeways operating or under construction.

Hydraulic Model

Energy Dissipator Tested In Los Angeles Laboratory

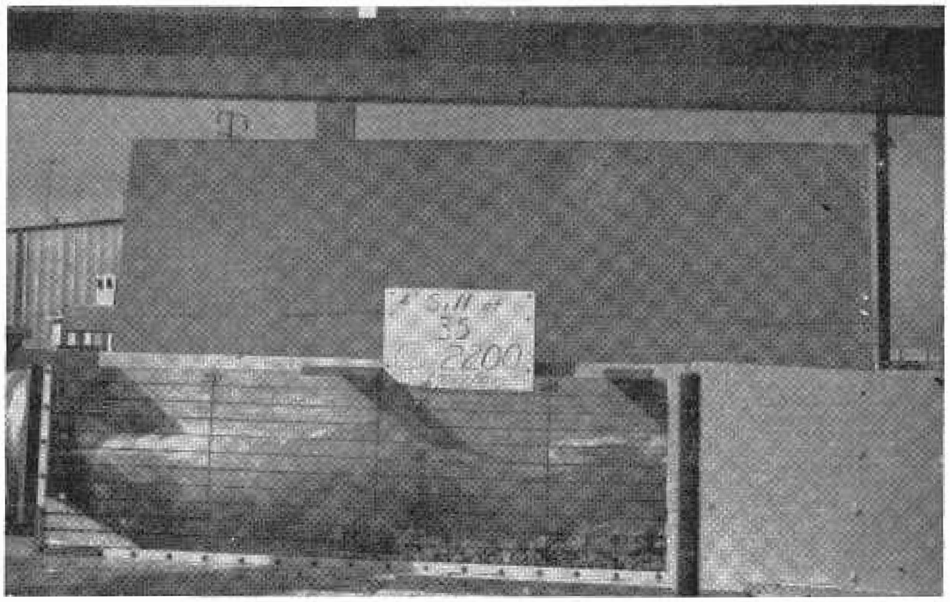
By A. D. MAYFIELD, Supervising Highway Engineer; K. E. McKEAN, Senior Highway Engineer; and A. B. SHURTLEFF, Associate Highway Engineer

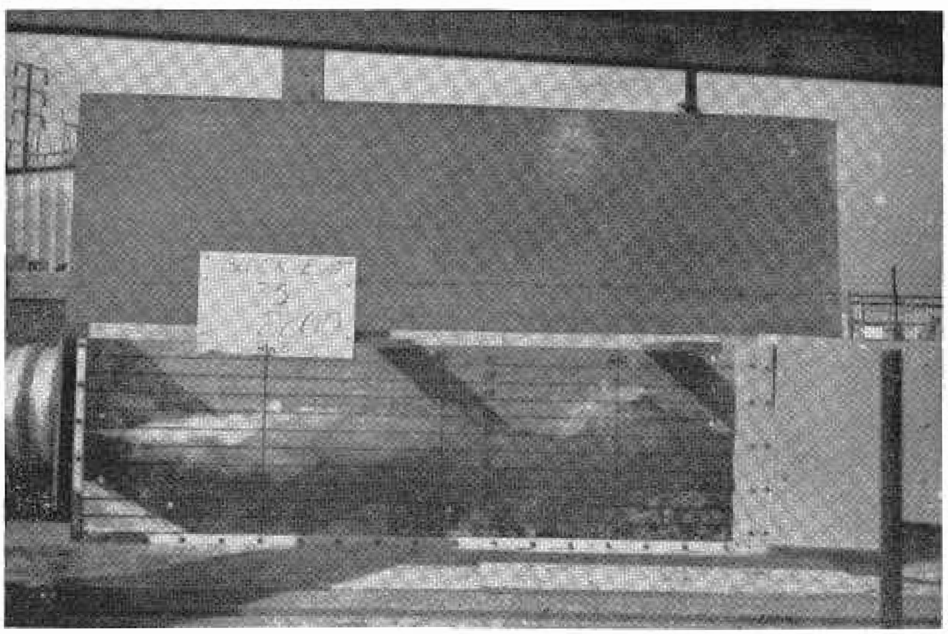
A HIGHWAY culvert can be defined as a grade separation passing runoff water under highway traffic. From an operational and maintenance standpoint, the ideal culvert would be one that retained the naturally established conditions of flow unchanged. This means that the size and shape of the stream, and also alignment, grade and roughness of the natural channel would remain unchanged. From a cost standpoint, such design criteria are unrealistic. Instead, culvert pipes, boxes, or arches, which have a reasonable culvert barrel section, are generally used.

Minimum-sized culvert barrel sections produce high outlet velocities which may cause serious outlet erosion and downstream damage to abutting property. To eliminate the damage, the high outlet velocities coming from the culvert are reduced by the use of a Hydraulic Energy Dissipator.

Studies Are Made

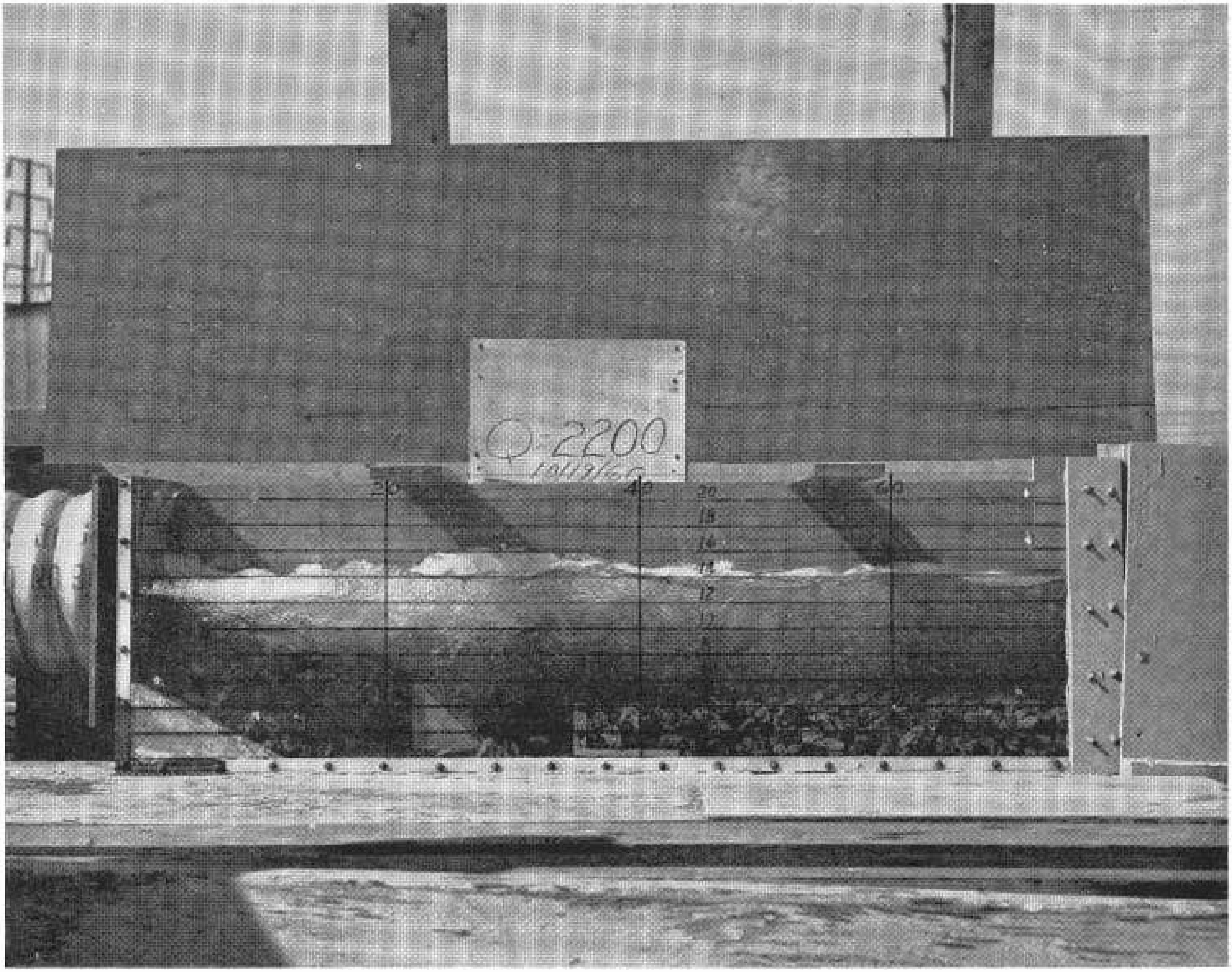
During the design of the Santa Paula Freeway (State Sign Route 126), it became apparent that the design of a Hydraulic Energy Dissipator should be considered for the culvert to be constructed under the freeway at Harmon Barranca, which is about three miles east of the City of Ventura. Studies indicated the fourteen-foot diameter field assembled plate structure would carry the flow that was expected to occur once in one hundred years, but velocities higher than the natural stream velocities could be expected to occur at the culvert outlet during times of high flow. The Barranca is an uncontrolled natural stream about fifty feet deep and has nearly vertical side slopes in the vicinity of the freeway crossing. Because the soil in the Barranca is an easily erodible, fine, sandy loam, it was decided that a Hydraulic Energy Dissipator should be designed to reduce the culvert outlet velocity to the velocity of flow expected in the natural stream.





The above photos show some of the different combinations of lengths and arrangements of appurtenances which were tested. Some 20 test runs were conducted with various quantities of flow and different dissipator lengths.

The Hydraulic Energy Dissipator design chosen was a Hydraulic-jump-type Stilling Basin, designed using the simple energy relationships. (See "Hydraulic Energy Dissipators" by Eleva Torski.) The structure proposed was



The model of the final Hydraulic Energy Dissipator chosen as a result of the tests. This final design, shorter and less complicated than the original prototype structure, will cost some $3,800 less.

a large, concrete stilling basin twenty feet wide, fifty-nine feet long, and fourteen feet deep. The cost of this structure was estimated at $12,600. After the theoretical design of the structure had been made, a model test of the structure was made to determine its hydraulic adequacy.

A wood and transparent plastic model of the dissipator was constructed from plans drawn by the District VII Drainage Section. (See accompanying sketch "Scale Model of Hydraulic Energy Dissipator"). The model of the Hydraulic Energy Dissipator was installed in the City of Los Angeles Hydraulics Laboratory at 3009 Northern Avenue, Los Angeles, by the laboratory personnel under the supervision of Howard D. Hopper. The actual testing was carried on under the supervision of A. B. Shurtleff and C. E. Dresser of the Division of Highways, District VII, Drainage Section.

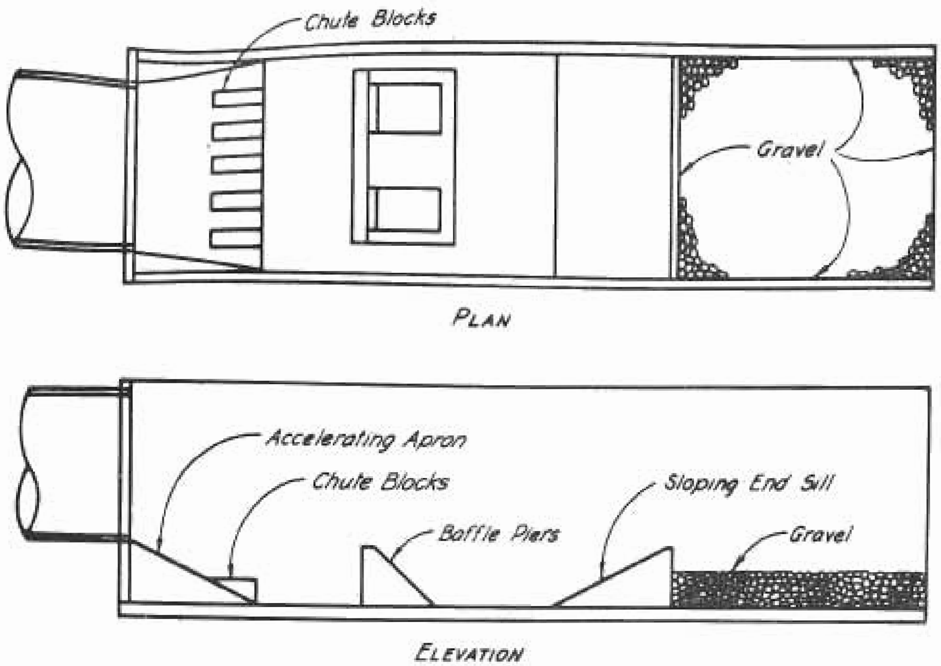
Testing Procedure

The testing procedure was designed to determine if the Hydraulic Energy Dissipator would:

(1) Reduce the outlet velocity of the culvert to that of the natural stream under various flow conditions;

(2) Minimize the tendency for the stream bed to erode downstream under various flow conditions.

The testing procedure was also planned to determine if it would be possible to reduce the cost of the Hydraulic Energy Dissipator by reducing the size and the amount of appurtenances. Accompanying photos show some of the different combinations of lengths and different arrangements of appurtenances which were tested. Some twenty different test runs were conducted with various quantities of flow and various combinations of dissipator appurtenances and different dissipator lengths. The model of the final Hydraulic Energy Dissipator design chosen to fulfill the two primary functions of the dissipator is shown in the accompanying photo. This final design was shorter and less complicated than the original design and is estimated to cost $8,800.



SCALE MODEL OF HYDRAULIC ENERGY DISSIPATOR FOR HARMON BARRANCA

A wood and transparent plastic model of the above dissipator was constructed from plans drawn by the District VII Drainage Section.

This means that there will be a savings in cost of $3,800 in the prototype structure as a result of the model testing.

Other Test Results

Some of the other test results for this form of dissipator structure that will be useful in the designing of Hydraulic Energy Dissipators for future culverts are as follows:

(1) The sloping end sill was inferior to the vertical end sill in preventing downstream erosion.

(2) The baffle piers were necessary to keep the erosion to a minimum at the outlet and of the Energy Dissipator.

(3) The theoretical calculations for the amount of energy dissipated by the dissipator were substantially correct.

(4) The chute blocks were not necessary.

(5) It was found the dissipator could be made much shorter than was calculated, using established criteria.

A full report on the Hydraulic Energy Dissipator model testing for Harmon Barranca is available for inspection at the Division of Highways, District VII, Drainage Section office.

Acknowledgment and thanks are extended to Mr. Swan and Mr. Doran of the City of Los Angeles, Bureau of Engineering, Storm Drain Division, for the use of the City's Hydraulic Laboratory for these model tests. Their cooperation and the cooperation of their staff was essential to the successful completion of these tests.

Car Registrations Up 3.3% for 1960

Motor-vehicle registrations in the United States totaled 73,895,274 during 1960, State agencies have reported to the U.S. Bureau of Public Roads. This is a gain of 2.4 million vehicles over the 1959 registrations. The 3.3 precent rate of increase is one-fourth less than the 4.3 percent increase of the preceding year.

The 1960 total included 61,682,036 passenger cars, 272,167 buses, and 11,941,071 trucks.

The State Department of Public Works has advertised $227,873,700 in highway projects since January 1.

San Mateo Streets

Continued from page 43 . . .

stressed box girder bridge, consisting of two parallel structures, composed of 15 and 17 spans.

The project included 1,615,000 cubic yards of roadway excavation. Much of the material was decomposed granite; however, several of the cuts contained very hard granite and other rock which required blasting.

The highest fill required by the contract, 37 feet, occurred on the two-mile-long embankment section through the city. Most of the excavation occurred between Parkridge Road and Buchanan Street, where cuts up to 100 feet in depth were made. In excavating these cuts, upwards of 400,000 cubic yards of hard rock and "tombstone" granite were blasted out.

It was necessary to import about 1,000,000 tons of material to complete embankment construction. The imported material was obtained from a source approximately one-half mile north of the freeway.

The specifications permitted the Contractor his choice of placing the concrete pavement in single-lane widths separated with a contact joint, or placing the concrete paving two lanes in width without a contact joint, but with a longitudinal sawed joint at the lane line. The Contractor elected to place the concrete pavement two lanes in width with one pass of the equipment train. The paving operation was started on the north roadbed at the west end of the project and progressed without interruption to the east end of the project, thence back on the south roadbed to beginning of project.

The paving train, barring the few breakdowns, traveled at the rate of about 500 feet per hour. Production was good, occasionally exceeding 2,000 cubic yards of concrete per day.

Transverse joints at 15-foot intervals, and the longitudinal joint at the lane line, were formed by sawing to a depth of two inches. The final profile index of the pavement, as determined by a California Profilograph, averaged 2.7 inches per mile.

General Superintendent was William Loy, Joseph MacDonald was Resident Engineer and Joseph Hoban was Bridge Department representative.

Bank Protection

Division Publishes New Reference Book

An illustrated reference book, *Bank and Shore Protection in California Highway Practice,* has recently been published by the State Division of Highways.

The book, a comprehensive examination of devices used to guard against erosion from streams, rivers and surf, is the product of research, field studies and committee work by the Division of Highways Joint Bank Protection Committee.

The committee was established by former State Highway Engineer G. T. McCoy February 15, 1959. It includes representatives of the Division's Bridge, Construction, Design and Maintenance Departments.

The long-term study covered "primarily the special treatment of banks of streams, lakes or tidewater and secondarily the treatment of highway embankment to prevent erosion by surface waters . . ."

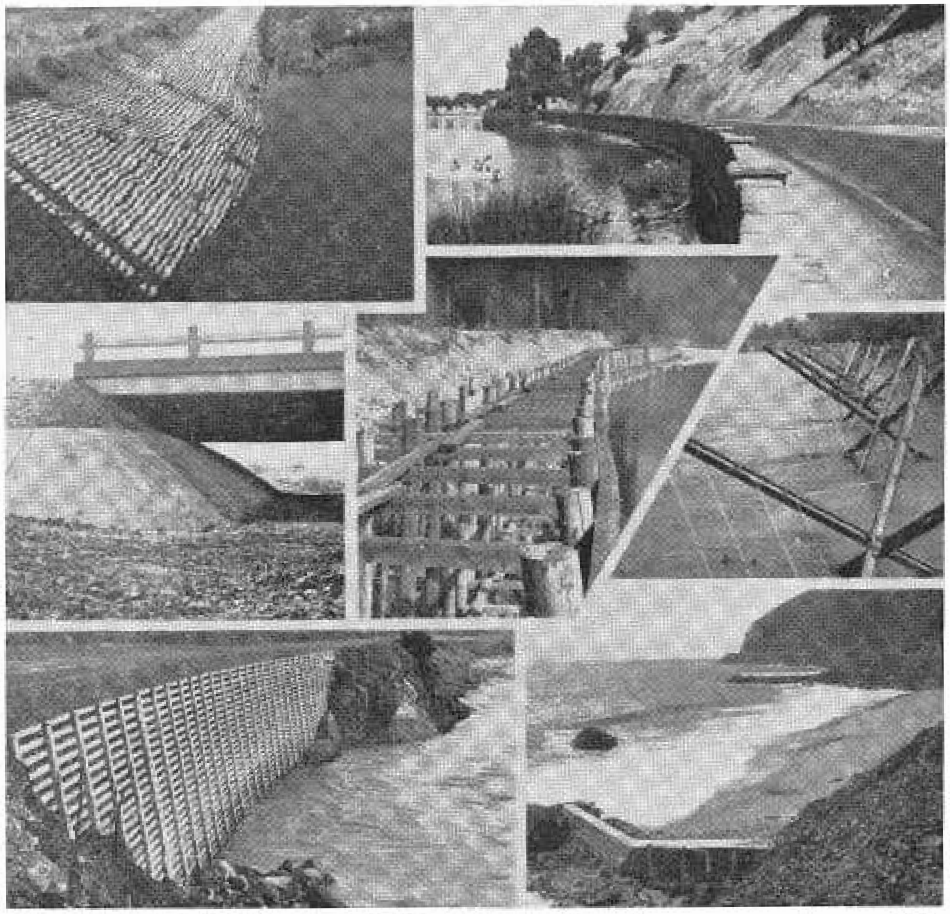
The 423-page report is divided into nine chapters. It contains nineteen tables, four design charts, 72 drawings and several hundred photographs including many old pictures of protection devices of former years.

There are also 21 general findings with respect to past practice and performance, and 14 general recommendations. Many of the recommendations have already been adopted by the Division of Highways as studies progressed.

Appended to the main report is an extensive bibliography listing 250 references; three early reports on bank and shore protection; and a list of abbreviations and definitions of special terms.

This first chapter outlines the background of the study and the procedures followed. It also contains a review of bank and shore protection devices used prior to 1949.

Hazards of erosion and hazards of location are covered in the second and third chapters. Various protective devices are classified in chapter four.



This photo montage of various protective devices against water erosion appears on the cover of the Division of Highway's new book on bank and shore protection.

Chapter five covers design principles for the four basic methods of dealing with the problem of waves or high-velocity stream flow attacking highway embankments—installing embankment armor, reducing the force of attacking water with such facilities as pile retards or permeable jetties, moving the attacking water away from the embankment, or moving the road away from the hazard.

Chapter six covers construction procedures. Planning is discussed in the seventh chapter, and chapter eight deals with maintenance of bank protection devices.

The final chapter stresses the importance of coordination between various departments in planning adequate bank and shore protection.

An interesting item in the appendix is a list of "landmark patents" for bank and shore protection devices dating back to 1870.

It is believed that the book will be helpful to engineers and other technicians who must be concerned with bank and shore protection in connection with various construction projects.

Copies may be ordered from the State Printing Division, Documents Section, Sacramento 14, California. Price is \$3.12 in California (includes tax), \$3.00 in other states and \$3.50 outside the United States.

Agreement Readied On College Building

The Trustees of the California State Colleges and the State Department of Public Works have entered into an agreement that assigns to the State Division of Architecture a substantial workload of planning, design, and construction supervision for the colleges during the next two fiscal years, according to Director of Public Works Robert B. Bradford.

Under the master plan for higher education, enacted by the Legislature last year, the new Board of Trustees has full control of the building program for the colleges starting July 1, 1961. The trustees had already established a policy of using the services both of the architecture division and of private architects whom it will employ by contract. The agreement for architecture division services runs until June 30, 1963 and may be extended from year to year beyond that.

In general, it gives the state architects and engineers the go-ahead on all college work they started before July 1, 1961, and, with a few exceptions, all of the college building projects in the 1961-62 Budget Act.

In announcing the agreement to the employees of the architecture division, Bradford commented, "In my opinion, this agreement provides two years within which the department and the division can show the new state colleges organization that the Division of Architecture can do a thoroughly satisfactory job for them. During this time, the division is assured of doing most of the state college work.

"I am assured by the trustees that they look forward to a friendly, productive, and continuing client-architect relationship with the Division of Architecture. Let me urge each person in the division to devote his best efforts to achieving this result."

The agreement establishes for the division a total current workload of about $120,000,000 beginning July 1, which includes state college work valued at $35,300,000.

During fiscal year 1960-61, $107,000,000 worth of projects were put under construction by the architecture division. Of this total $9,000,000 was performed by private architects under contract to the Department of Public Works. The balance of $98,000,000 is a production record for the division and represents both the largest amount of work completed in a fiscal year and the greatest production rate per employee.

Department Lists Recent Retirements

Headquarters Office

Ernest M. MacDonald, Principal Right of Way Agent, 30 years.

District VI

Joseph M. Stewart, Highway Equipment Operator-Laborer, 28 years.

District VII

Nellie G. Carney, Senior Account Clerk, 12 years; William M. Deamer, Highway Leadingman, 25 years; Leland W. Fisher, Junior Engineering Aid, 30 years.

District XI

Taft Macias, Highway Foreman, 26 years.

State-Owned Toll Bridges

Elmer E. Lien, Toll Collector, 10 years.

Shop 4

Lowell M. Kresky, Automobile Mechanic, 34 years.

IN MEMORIAM

District VII

Elmer W. Burroughs, Associate Right of Way Agent

District XI

John C. Gage, Engineering Aid II

NEW U.S. 60 FREEWAY

The State Department of Public Works has warded a $4,857,000 contract for construction of 5½ miles of freeway on U.S. 60 between Sunnyslope and Orange Street in the City of Riverside.

Department Members Win 25-Year Awards

DIVISION OF HIGHWAYS

District III

Gerry H. Brumund
Otto E. Claussen

District IV

Henry C. Suenderman
Manda Tessmann

District V

Fred C. Moore

District VI

Maurice E. True

District VII

Willard Brown
Marie Burrell
Charles Chacanaca
John S. Mackie

District X

John R. Burke
Raymond J. Geimer
Herman R. Jantzen
Edward L. Tinney

District XI

Roy Still

Bridge Department

Lloyd B. Dale
Jerrold M. Gayner
Jack Sylvester

Shop 8

Lawrence D. Sandoval

Headquarters Office

Laura D. Cameron

DIVISION OF ARCHITECTURE

Los Angeles

Bernard S. Harder

San Francisco

Douglas J. Murray

Sacramento

Henry R. Crowle
Robert C. Younger
James J. Grant

The State Department of Public Works has awarded a $403,000 contract for a new Colusa Basin Bridge on Sign Route 20 west of Colusa.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

DEPARTMENT OF PUBLIC WORKS

PUBLIC WORKS BUILDING — 1120 N STREET, SACRAMENTO

ROBERT B. BRADFORD . . . . . . Director
FRANK A. CHAMBERS . . . . Chief Deputy Director
T. F. BAGSHAW . . . . Assistant Director
JOHN H. STANFORD . . . . . . Assistant Director

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

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

DIVISION OF HIGHWAYS

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

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

Right-of-Way

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

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . District I, Eureka
H. S. MILES . . . . District II, Redding
ALAN S. HART . . . . District III, Marysville
L. A. WEYMOUTH . . . . . District IV, San Francisco
R. A. HAYLER . . . . . . District IV, San Francisco
E. R. FOLEY . . . . . . District V, San Luis Obispo
W. L. WELCH . . . . District VI, Fresno
A. L. HIMELHOCH . . . . . District VII, Los Angeles
GEORGE A. HILL . . . . . District VII, Los Angeles
C. V. KANE . . . . . . District VIII, San Bernardino
C. A. SHERVINGTON . . . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
J. DEKEMA . . . . District XI, San Diego
HOWARD C. WOOD . . . . Bridge Engineer
State-owned Toll Bridges

CALIFORNIA HIGHWAY COMMISSION

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

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

ROBERT E. REED . . . . Chief Counsel
GEORGE C. HADLEY . . . . Assistant Chief
HOLLOWAY JONES . . . . Assistant Chief
HARRY S. FENTON . . . . Assistant Chief

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

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

DIVISION OF ARCHITECTURE

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

ADMINISTRATIVE SERVICE

Headquarters Office

W. R. VICK . Principal Architect—Project Management
IAN LEE WATSON . Supervisor of Project Coordination
THOMAS CHINN . Supervisor of Scheduling and Control
HENRY R. CROWLE . . Administrative Service Officer
I. I. LEVINE . . . . Accounting Officer
W. F. PARKS . . . . . Supervisor of Office Services
JUSTIN DuCRAY . . . Division Management Analyst
FRANK B. DURKEE, JR. . . . . . Information Officer

Los Angeles Office

T. LEWANDOWSKI . Supervisor of Project Management
ALAN A. HIMMAH . . Administrative Service Officer

ARCHITECTURE AND ENGINEERING SERVICE

Headquarters Office

ARTHUR F. DUDMAN . . . Assistant State Architect
CARLTON L. CAMP . . . . . Principal Architect
EDWARD G. SCHLEIGER . . . . Principal Estimator
CLIFFORD L. IVERSON . Chief Architectural Draftsman
JOHN S. MOORE . . . Supervisor of Special Projects
GUSTAV B. VEHN . . . Chief Specification Writer
O. E. ANDERSON . . . . Principal Engineer
PRESTON ROCHE . . Supervising Mechanical Engineer
ANDREW LOUARGAND . Supervising Electrical Engineer
A. H. BROWNFIELD . Supervising Structural Engineer

Los Angeles Office

TOM MERET . . . . . . Assistant State Architect
JAMES A. GILLEM . . . . . . Principal Architect
CHARLES PETERSON . . Principal Structural Engineer
LESTER H. MULLEN . . . . . . Principal Engineer
C. W. RHODES . . Supervising Mechanical Engineer
LEONARD CHERNOFF . Supervising Electrical Engineer
ROBERT J. PALEN . . . . . . Supervising Estimator
R. J. CHEESMAN . . . Chief Architectural Draftsman
H. C. JACKSON . . . Supervising Specification Writer

CONSTRUCTION SERVICE—CHARLES M. HERD . Chief Construction Engineer

Area Structural Engineers
Schoolhouse Section

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

Area Construction Supervisors

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

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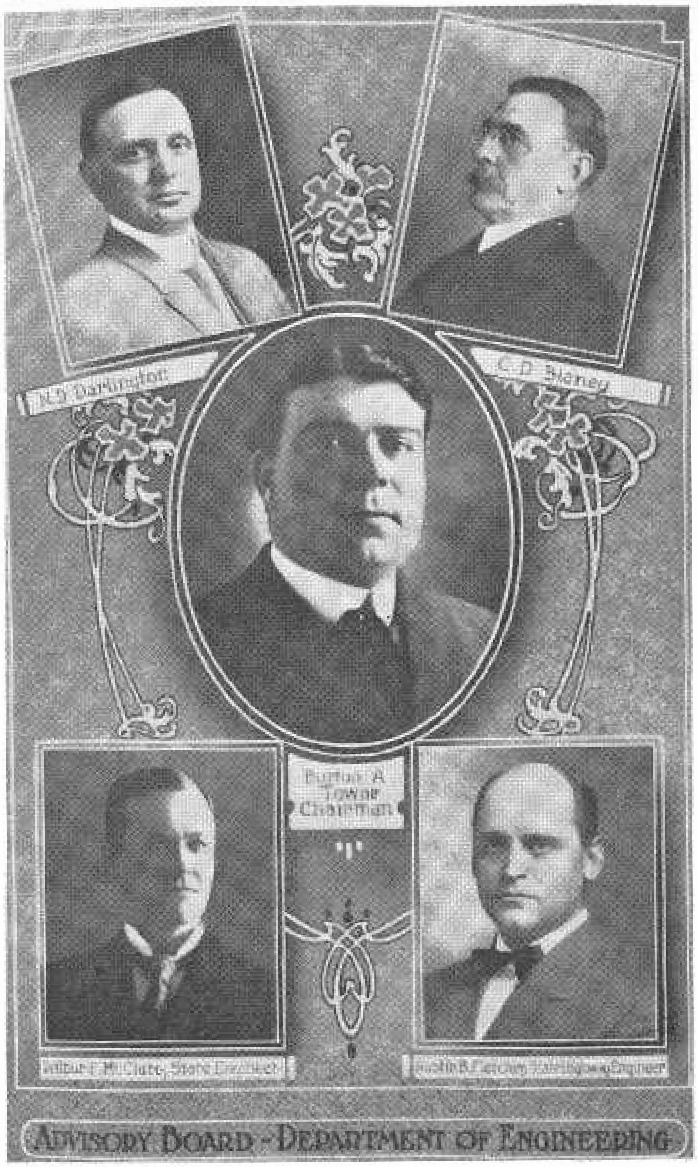
1911

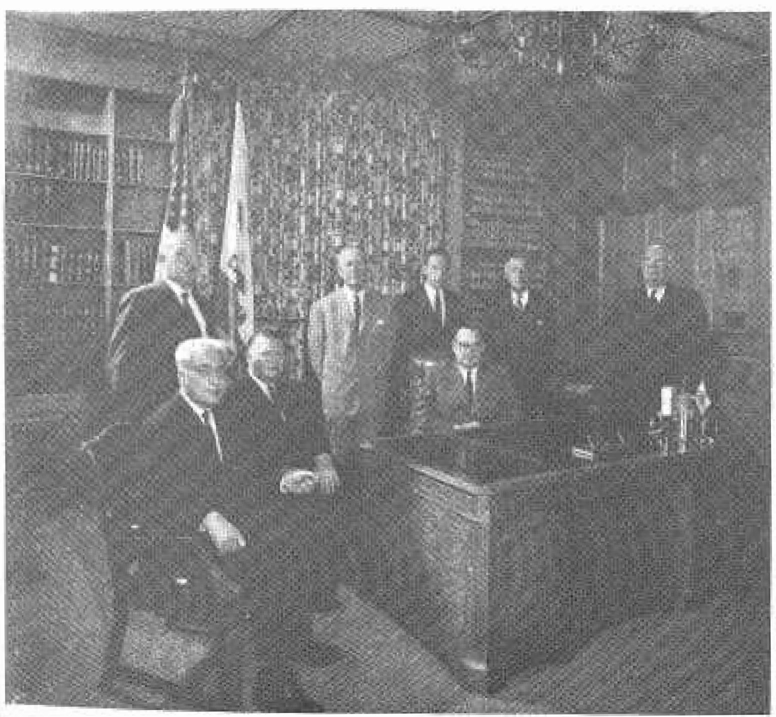
Sacramento, Aug. 9, 1911—"The newly constituted California Highway Commission, consisting of the three appointed members of the Advisory Board of the State Engineering Department of California, Mr. Charles D. Blaney of Saratoga, Mr. N. D. Darlington of Los Angeles, and Mr. B. A. Towne of Lodi, this day convened at the State Capitol at Sacramento and proceeded to effect permanent organization in accordance with the terms of that certain resolution on file with the Secretary of the Advisory Board of the Engineering Department, as follows: . . ."

The minutes of the first meeting of the California Highway Commission continue with the spelling out of the Commission's jurisdiction and powers as contained in the Advisory Board resolution. The principal tasks are defined as (1) responsibility for constructing and acquiring a system of state highways at a cost not to exceed $18,000,000 (as provided in the 1909 bond act) and (2) "to perfect such organization as they may deem necessary to carry on with celerity and efficiency" the work of creating this State Highway System.

The minutes further note that Room 118 in the State Capitol Building was assigned to the Commission as a temporary office; that Mr. Towne was elected Chairman of the Commission; and that W. R. Ellis was chosen as secretary. The minutes conclude:

"Following a conference with His Excellency Hiram W. Johnson, Governor, the Commission adjourned subject to the call of the Chairman."





1961

Conferences of the California Highway Commission with the Governor still take place from time to time. Here is a recent photograph taken in Governor Edmund G. Brown's study.

Seated, left to right, are Commissioner John J. Purchio, Chairman Robert B. Bradford, and Governor Brown.

Standing, left to right, Commissioners John Erreca, Arthur T. Luddy, Roger S. Woolley, Robert E. McClure, and Vice Chairman James A. Guthrie.