CALIFORNIA
Highways
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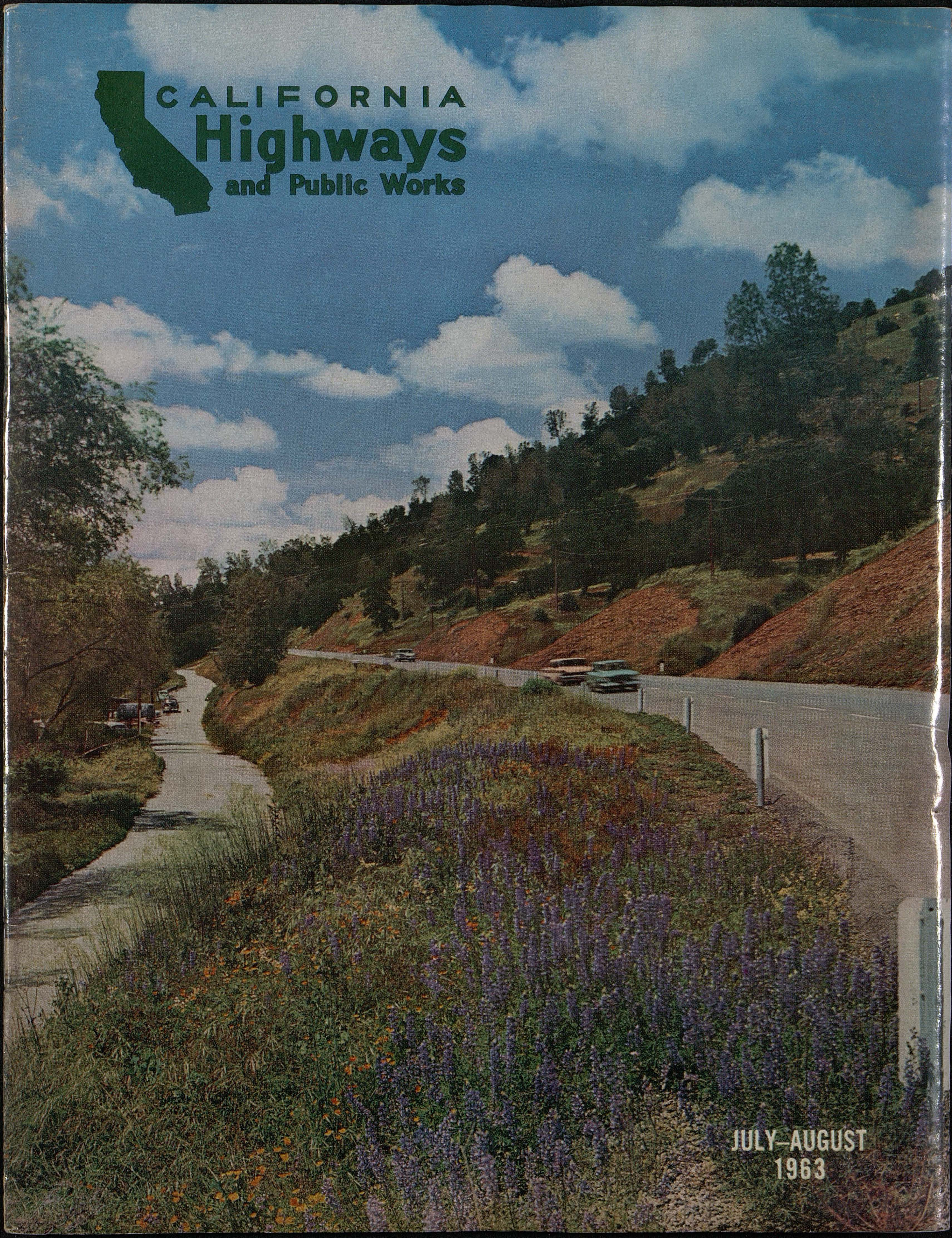

JULY–AUGUST
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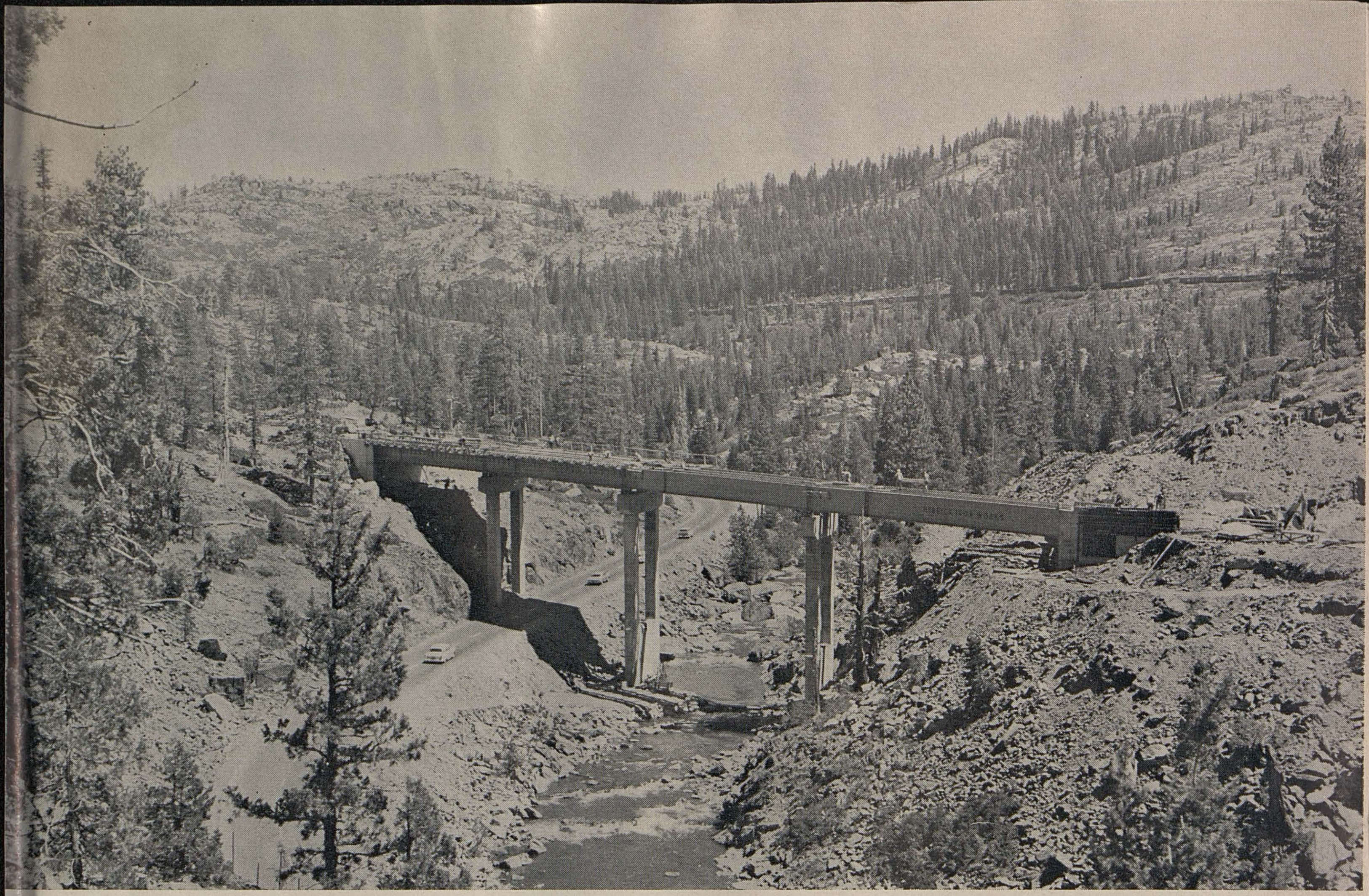
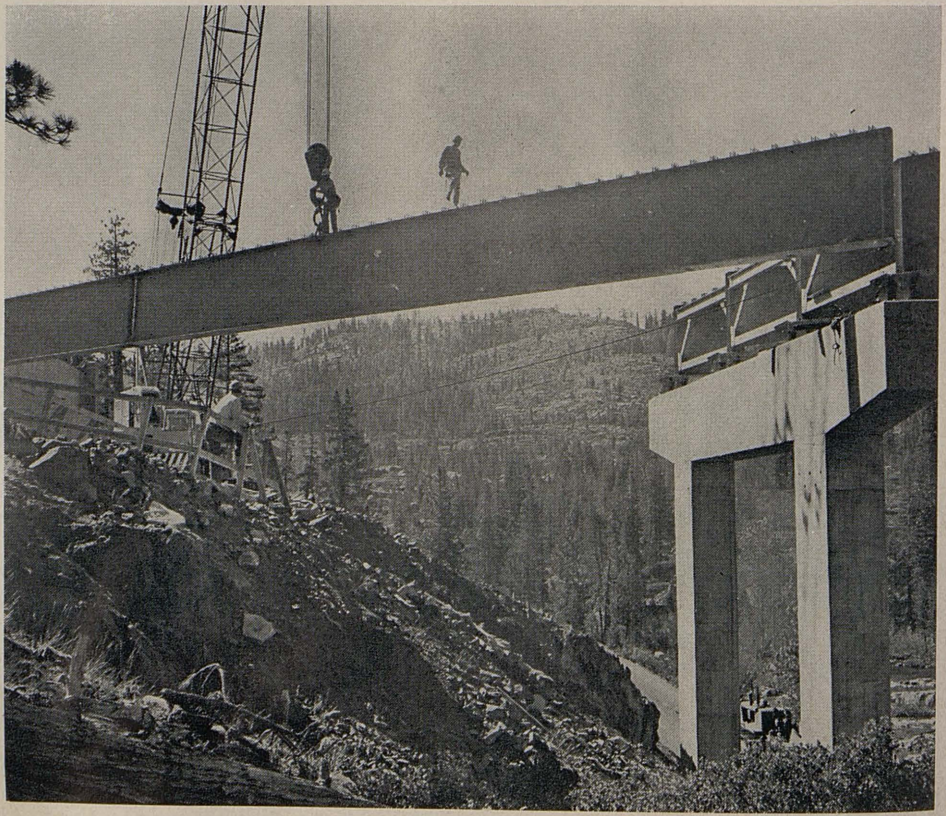
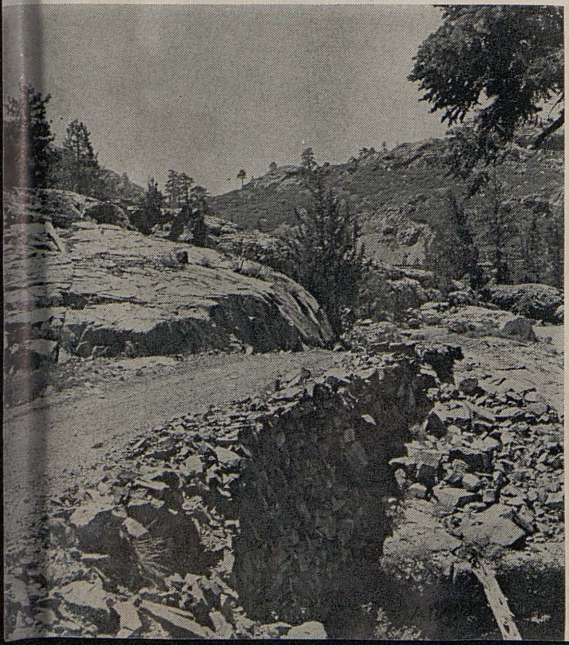


The three photos on this page show construction on a section of Interstate 80 (old U.S. 40) in the vicinity of Cisco Grove, and below, a shot of the first cross-Sierra route, portions of which can still be seen near the present highway. The bridge across the Truckee River here will carry four lanes of traffic. This work is part of one of the few remaining contracts underway which will make the road four lanes all the way to the state line.





California Highways and Public Works

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

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FRONT COVER: When a section of Sign Route 49 (Mother Lode Highway) near Jacksonville, south of Sonora, was realigned and constructed to modern standards in 1957 a portion of the old highway was left in place to serve local property owners. In the spring, with wild flowers in bloom, it offers a particularly inviting rest or picnic stop. Entrance is available to southbound traffic only. Photo by Bill Ruland.

BACK COVER: Featured this issue is the Vincent Thomas Bridge between San Pedro and Terminal Island. This will be Southern California's first suspension bridge. When photograph was made spinning of cables had been completed and steel deck structure was being raised into place. Photo by Robert J. Rose, California Division of Highways.

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Freeways Are Safer Highways

By J. C. WOMACK,
State Highway Engineer

Freeways are designed to carry large volumes of traffic expeditiously and safely. A freeway is a highway with all of the following characteristics:

1. There are separate roadways for traffic in opposite directions, and each roadway has two or more lanes.
2. Cross roads are separated in elevation from the freeway. There is no cross traffic, and no left-turning traffic, on a freeway.
3. There is no access between the highway and the roadside, except at specially designated entrance and exit roadways.
4. Traffic enters and leaves the main traffic stream at flat angles and at speeds near the speed of the main stream.
5. Curves are easy and grades are moderate.
6. There are no stop-and-go lights.

All of these features make it easier to drive and harder to have an accident on a freeway than on an ordinary road or street. Any highway that has all of these features is a freeway.

Most of the differences between freeways and conventional highways can be seen by comparing the accompanying photographs. Photo No. 1 shows U.S. 99 in South Sacramento where it intersected Fruitridge Road before the freeway was built. Photo No. 2 shows U.S. 99 where it intersects Fruitridge Road since the freeway was built. The traffic volume (vehicles per hour) is about the same as in Photo No. 1, although it does not look it. Photo No. 3 shows a cross road on a freeway where the plants have been in for a few years, and is more illustrative of the way a typical urban freeway looks.

Some persons have stated that freeways, such as those shown in Photos 2 and 3, are destructive of community values. In effect, they are stating that highways like the one shown in Photo 1 preserve community values.

However, certain community values, including life, limb, and property, are preserved by freeways to a much greater extent than they are by conventional highways. The freeway also does a better job of preserving the opportunity to visit and do business with other people in the area, conserving the cost of distributing food and the other things we buy, and conserving the amount of time it takes to go shopping or go to work in the morning. Furthermore, a freeway is the only kind of road that preserves the taxpayers' investment in the highway.

Why Freeways Are Safer

There is nothing mysterious about the reasons why freeways are so much safer than ordinary roads and streets. The characteristics that distinguish freeways from ordinary roads have a direct relationship to safety. Accidents happen in the following ways:

1. Cars collide headon when one of them crosses the centerline, or encroaches on the pavment reserved for cars going in the opposite direction.

Freeways have a "median" or divider strip which tremendously reduces the likelihood of crossing the centerline. The rate of headon collisions on undivided highways is 10 times as great as on freeways. The ratio is better than this on new freeways because the medians are wider and barriers are being erected on all the heavily traveled freeways where there is a likelihood of crossing the median.

2. Cars collide at right angles when one of them crosses the path of another at an intersection.

There is no cross traffic, nor left-turn traffic, on a freeway. In urban areas, intersections account for about two-thirds of all accidents on ordinary streets; even in rural areas, they account for 37 percent.

3. Cars collide when one of them makes a sudden turn into or from a driveway or parking space, and the driver of the other one doesn't see it in time.

HOW ACCIDENTS HAPPEN

1. Head-on collision.
2. Right-angle collision.
3. Collisions due to sudden turns into driveways.
4. Rear-end collision when fast car on highway collides with slow car entering or leaving.
5. Car spins off roadway, frequently on curve.
6. Car hits pedestrian in street.
7. Rear-end collision when car is stopped at signal.
8. Other rear-end collisions.

HOW FREEWAYS REDUCE ACCIDENTS

1. Opposing roadways are separated.
2. Separate levels—no cross traffic or left turns.
3. Access control—no private driveways.
4. Special slow-down and speed-up lanes.
5. Curves are easy.
6. Pedestrians cross under or over; fences.
7. No traffic signals.
8. Same rate on freeways.

PHOTO 1. U.S. 99 (Stockton Boulevard) at intersection with Fruitridge Road, 1960.

PHOTO 2. U.S. 99 freeway interchange at Fruitridge Road, 1963.

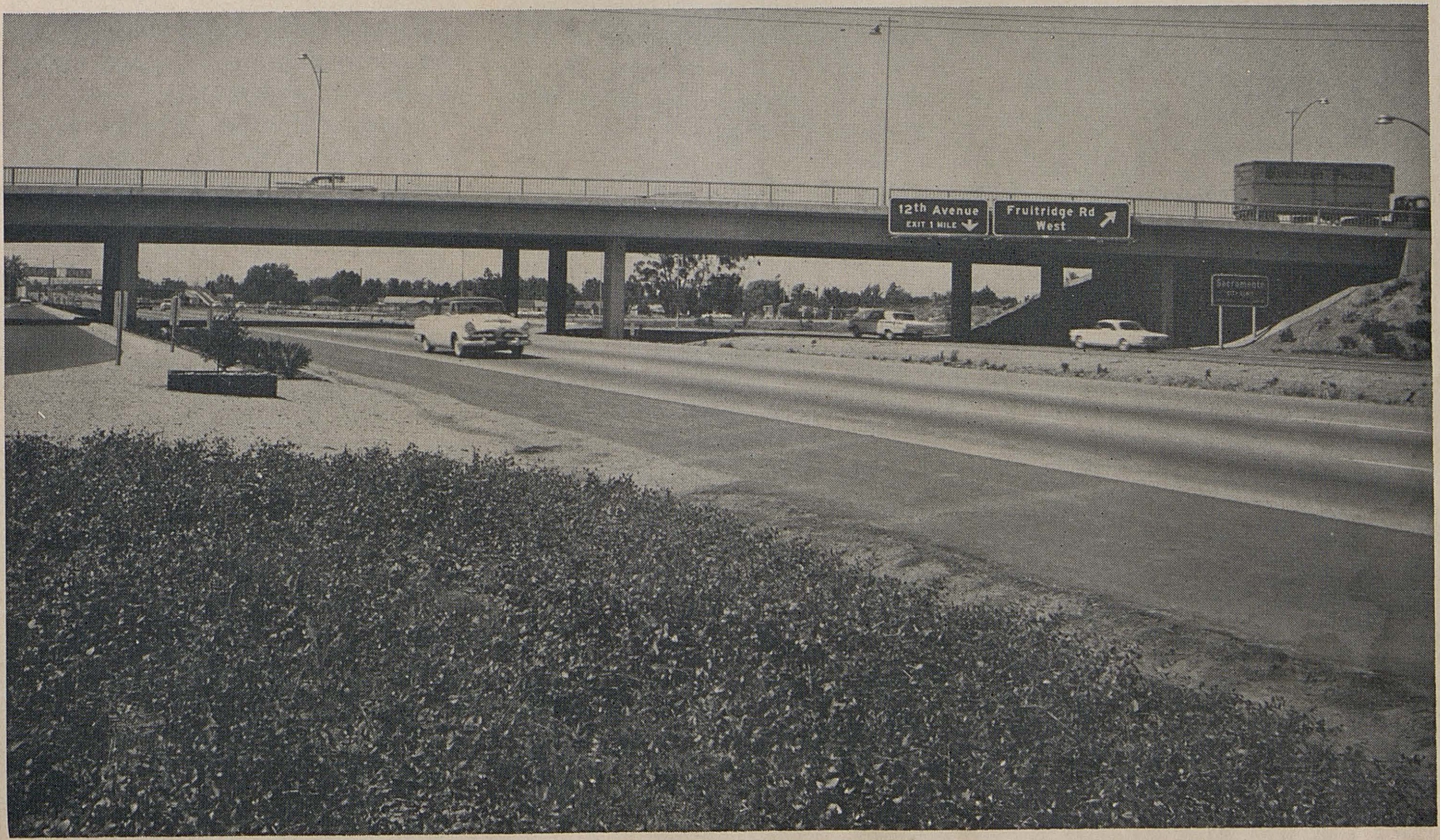


PHOTO 3. *Freeway similar to Photo No. 2, but with mature roadside planting.*

There are no driveways or parking stalls on freeways.

4. Cars collide when one slows down to turn into a cross street and the one behind it doesn't, or when one enters at low speed and the other, already on the highway, continues at high speed.

Freeways provide special slowdown lanes for cars leaving the traffic stream, and speed-up lanes for those entering the traffic stream.

5. Cars overturn or "spin" or drive off of the roadway all by themselves. Some investigators call these accidents "solos"; others call them "single vehicle accidents."

Freeway curves are easy and well marked; there are three times as many solo accidents per million vehicle-miles on ordinary rural state highways as there are on freeways. Even so, more than half of all fatal accidents on freeways are solos, which experienced drivers seldom have unless they indulge in foolhardy driving practices.

6. Cars strike pedestrians when pedestrians cross the street or play in the street.

Pedestrians cross freeways on overpasses, and freeways are fenced to prevent playing in them. It is illegal to hitchhike on freeways.

7. Cars run into the rear end of other cars waiting at a traffic signal.

There are no traffic signals on freeways.

8. Cars run into the rear end of other cars between intersections.

This is the one category of accidents that is just as likely to occur on freeways as it is on other roads, but statistics show that it is no *more* likely; the rate is just about the same.

Safety Record of Freeways

The preceding list of reasons why accidents happen more often on conventional roads and streets than they do on freeways is not theoretical; the facts, based on experience, bear them out: Freeways are much safer than their conventional counterparts in both rural and urban areas. Putting this into figures, the following statements can be made:

1. *Preservation of Property*

More than 130 accidents a day are being prevented by California freeways now in service.

The travel that took place on California freeways during 1961 would have generated 47,400 more accidents if it had taken place on conventional state highways in rural and urban areas. These 47,400 accidents that did not take place saved residents and guests of California millions of dollars in wrecked vehicles.

2. *Preservation of Limb*

More than 65 persons are saved from injury every day by California freeways.

A given amount of travel on urban area freeways produces less than one-third as many injury accidents as the same amount of travel on urban arterial highways. A given amount of travel on rural freeways produces one-half as many injury accidents as the same amount of travel on other rural state highways.

23,800 fewer persons were injured in California traffic accidents during 1961 than would have been injured if all the freeway travel had taken place on conventional roads and urban arterials.

3. *Preservation of Life*

Almost one life a day is being spared because of the freeways now operating in California.

In 1961 there were 306 fewer people killed in California traffic accidents than there would have been if all the travel then taking place on freeways had been obliged to use conventional highways and streets. This number will continue to grow in the future, because the freeway system is being expanded.

As shown in the chart on the following page, more than 2,000 lives have been saved since 1949 by California freeways.

* * *

In summary, a solid 14-year statistical record covering hundreds of thousands of accidents and billions of miles of travel shows conclusively that freeways are producing great savings in life, limb, and property.

Using California Traffic Safety Foundation values for accidents, California freeways in 1961 alone saved the motorist over $65,000,000.

Although these dollar values are large, they fade in comparison to the immense savings in anguish and human suffering that did not take place because of freeway development in California.

Construction Index Shows Slight Drop

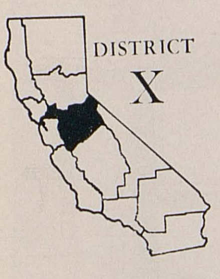
The California Highway Construction Cost Index for the second quarter of 1963 dropped to 243.7 (1940 = 100) which is 6.7 points or 2.7 percent under the first quarter of 1963.

The average number of bidders for this quarter averages 5.3 per project, a decrease of 1.0 under the previous quarter.

Napa River Bridge

Substructure Contract Completed in April

By G. D. GILBERT AND A. E. BACHER, Senior Bridge Engineers, and R. L. BOULWARE, Associate Bridge Engineer



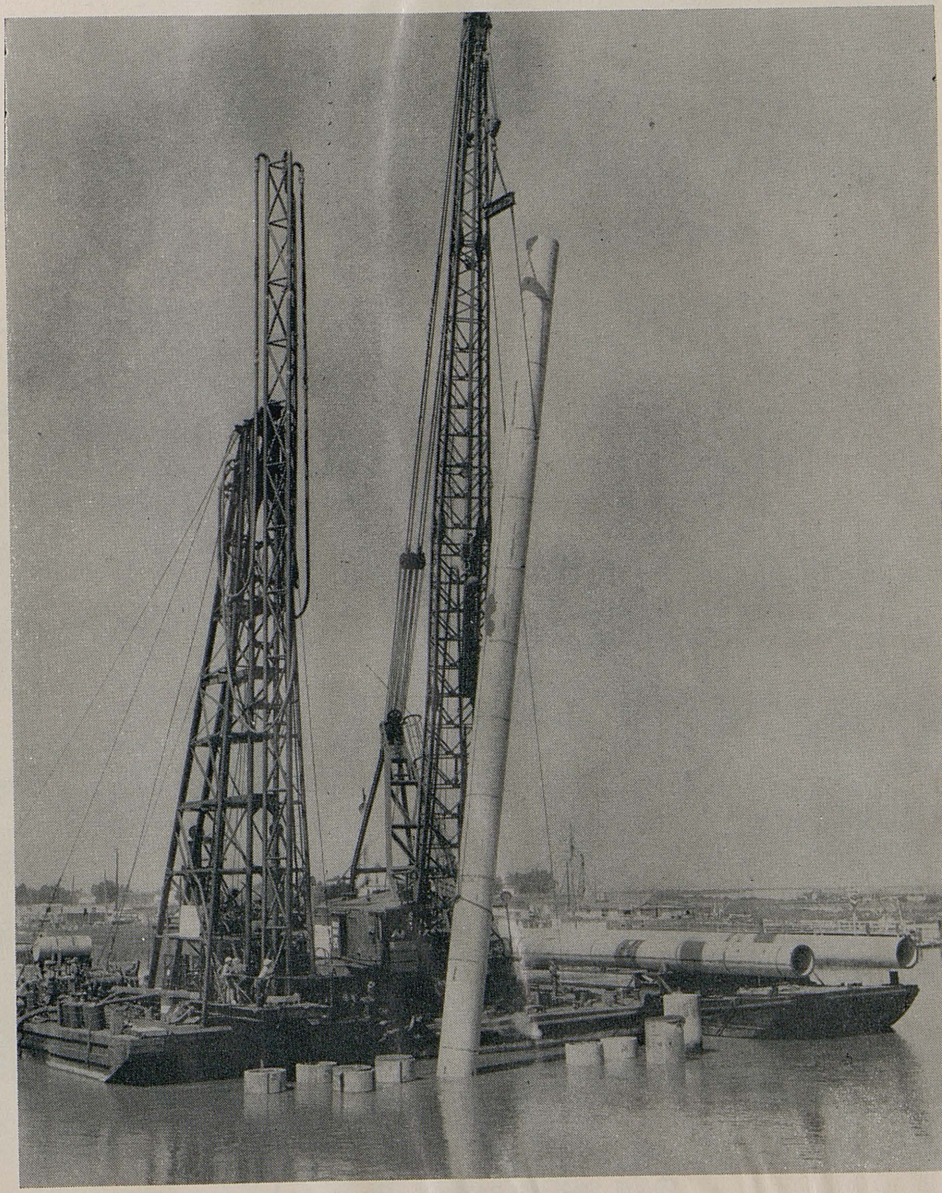
The substructure contract for the replacement of the existing Napa River Bridge at Vallejo was completed in April 1963. This is part of the modernization of the familiar Sears Point Cutoff which was built as a private toll road in 1927, by the Sears Point Toll Road Company.

The existing structure at the site is a two-lane, low-level causeway with a bascule span over the shipping channel. It was originally built completely of timber except for the steel bascule span and has been a source of constant maintenance expenditure for several years. There has been an average of 92 bridge openings per month during the past three years with a maximum of 173 openings during August 1962. An average of 13,000 vehicles a day cross the bridge with especially heavy morning and evening peak-hour volumes due to proximity of Mare Island Naval Shipyard.

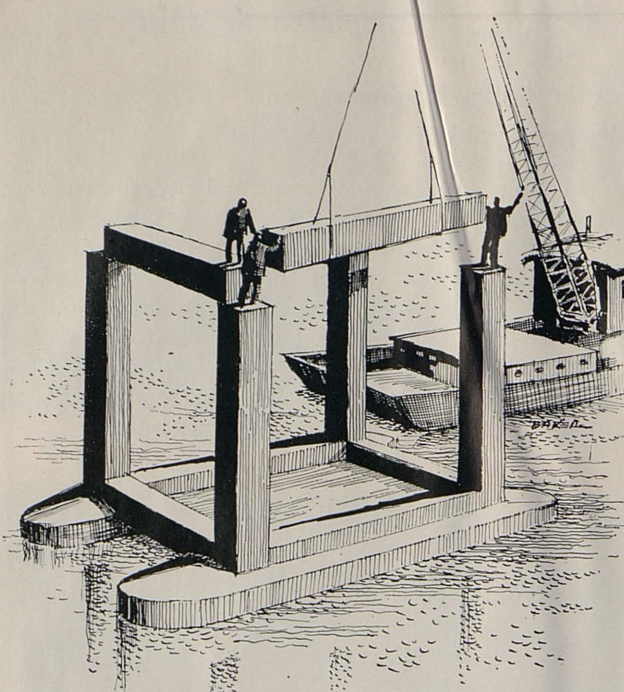
While river traffic is relatively light, tricky currents and a narrow opening (75 feet between fenders) at the channel span have resulted in frequent ramming of the existing structure by ships in the past. In the period of 1940-1954, a total of 45 collisions were recorded involving vessels striking the existing structure. Frequent heavy fog at the site is another complicating factor.

The replacement structure, a fixed high-level bridge over a navigation channel, will represent several innovations insofar as precast, prestressed concrete design is concerned for a highway structure in California; the use of 200-ton 54-inch prestressed concrete cylindrical piles, the precasting of portions of the piers, and the use of prestressed I-girders including a girder continuous over a pier support utilizing two-stage prestressing. Nearly all elements are designed as precast or prestressed concrete members.

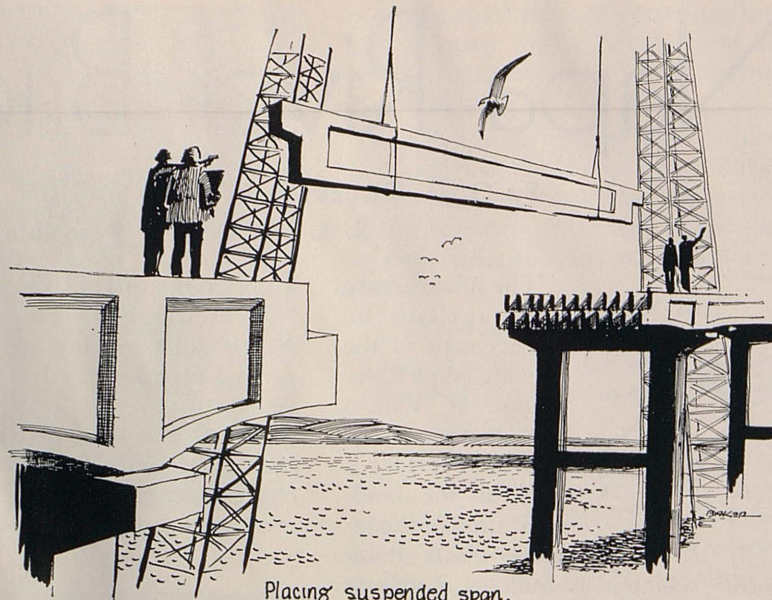
The channel is approximately 2,300 feet wide with a main navigation channel requiring 100-foot vertical clearance and 140-foot horizontal clearance. The total overall structure length is 3,280 feet, and it is 74 feet 4 inches wide, providing for four extra-width lanes of traffic, a 10-foot median, and a 5-foot sidewalk on the south side. The substructure contract included only the piers in the 2,300-foot channel and were constructed to the top of the footings only.



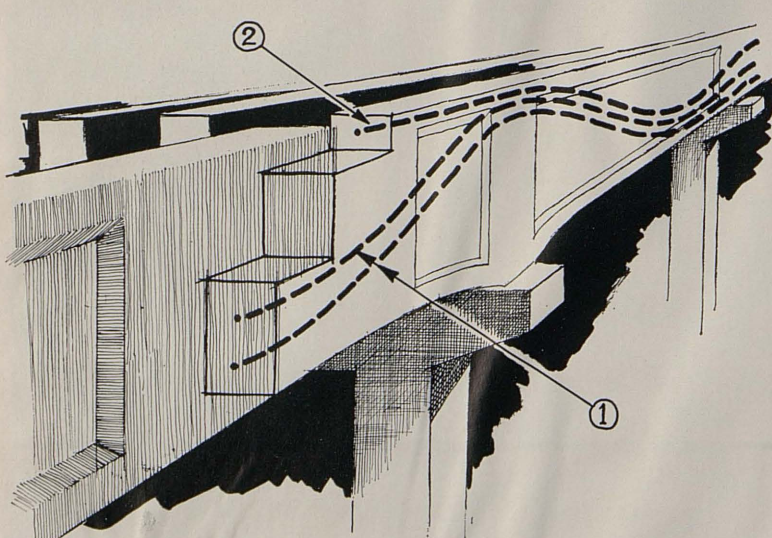
A 54-inch prestressed precast pile being placed. Note the jetting tower to the left of the pile.



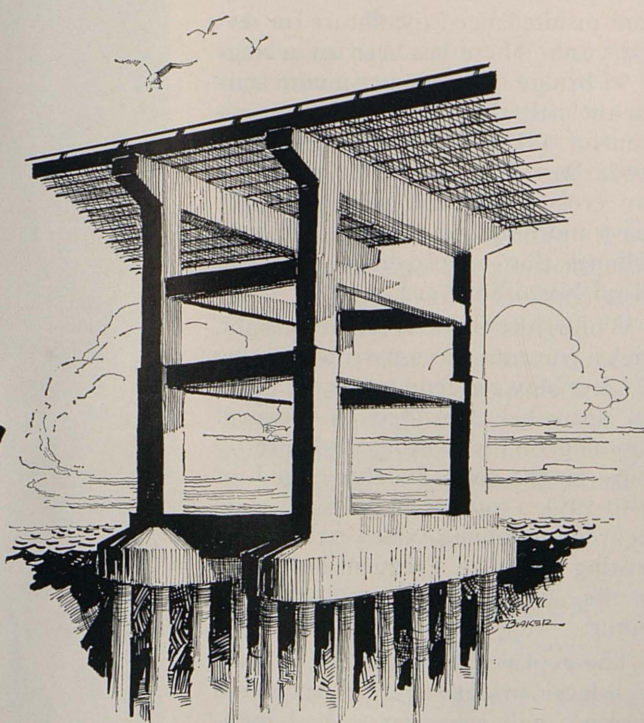
Placing precast strut.



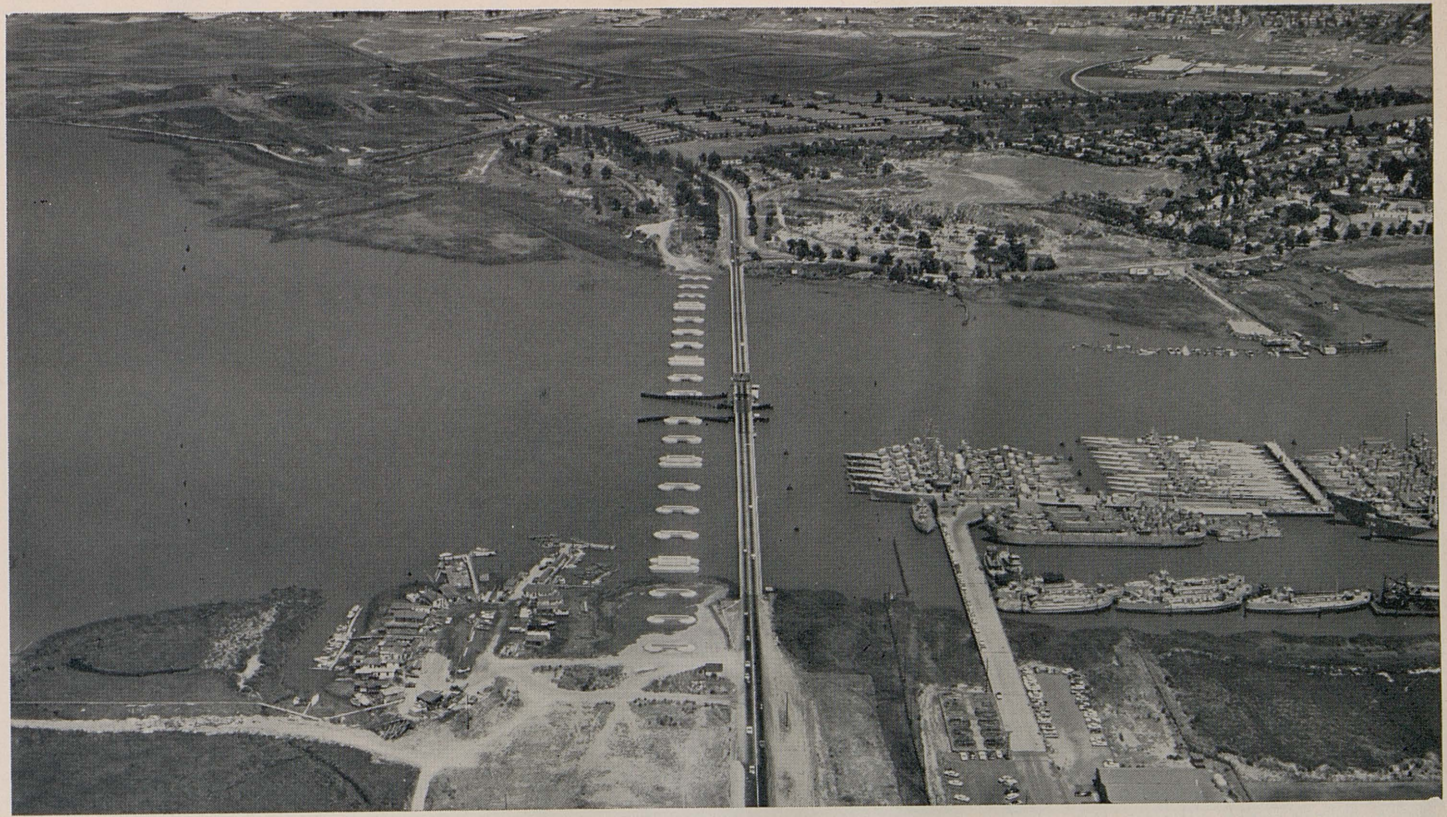
Placing suspended span.



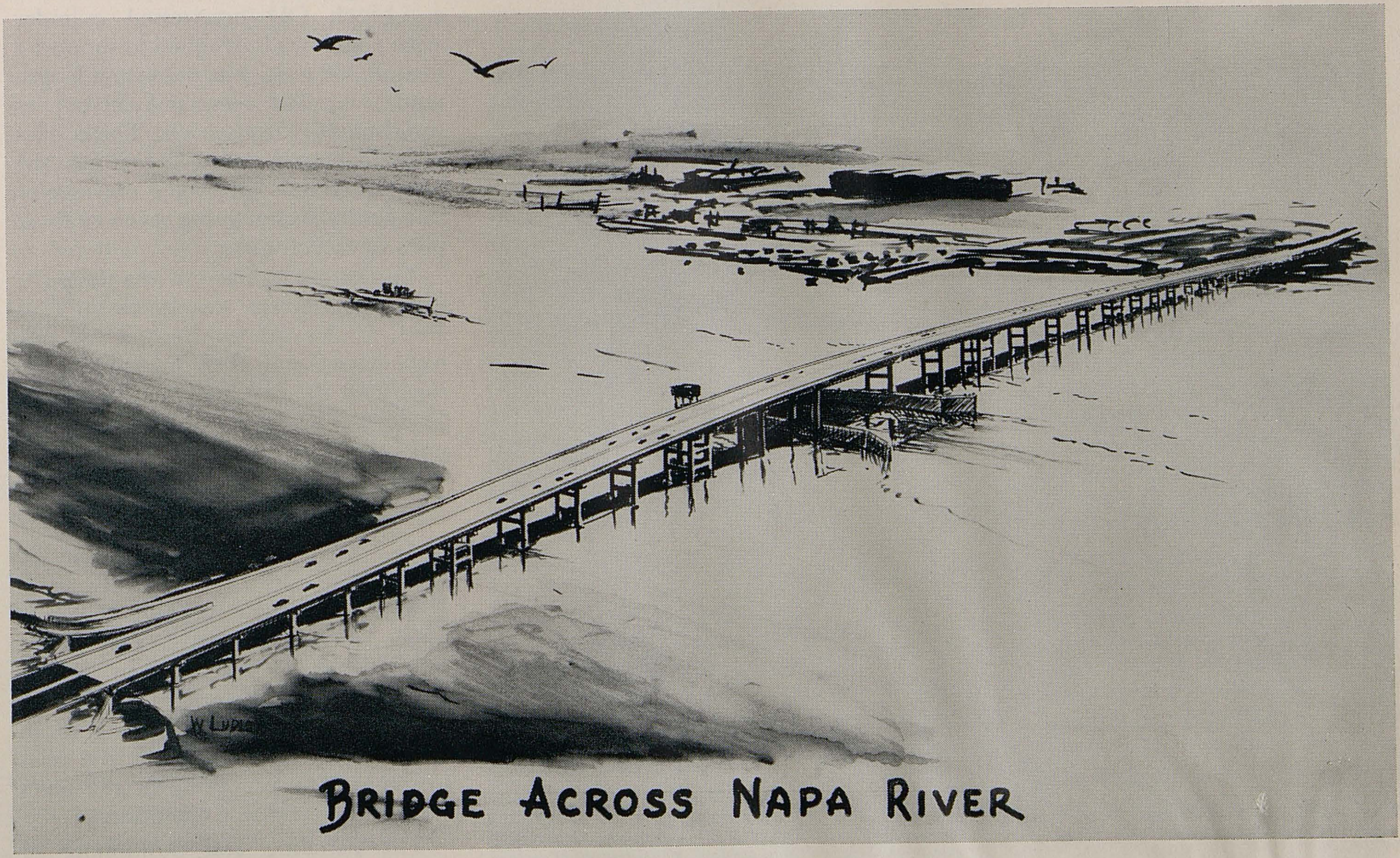
Approximate cable paths, continuous girder.
① 1 ST. STAGE PRESTRESSING
② 2 ND. STAGE PRESTRESSING



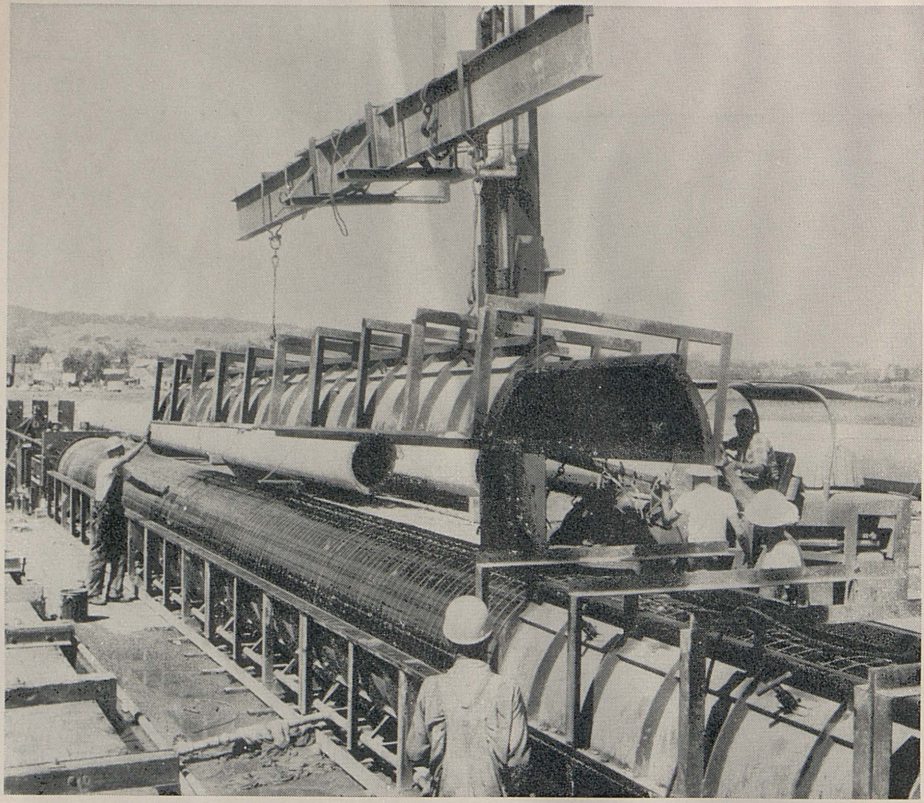
Tower showing 54" prestressed piles.



An aerial view of the project looking eastward. The substructure is to the left of the existing bridge. A portion of the Mare Island Shipyard can be seen right center.



This artist's sketch shows how the bridge will look after it is completed.



Steel forms used for casting the 54-inch pretensioned piles are being set prior to concrete placement.

Looking east from the shore of the Napa River channel. The existing bridge is at the right edge of the photo.

Construction

The site, near Vallejo, has extremely poor foundation material to a depth of 80 feet, consisting of very soft blue clay layers intermixed with silt layers. Site foundation conditions vary considerably. At the easterly end two piers are founded on spread footings at a relatively shallow depth. The bearing strata dip sharply to the west and by midriver are overlain by soft deposits up to 80 feet in depth. Under these conditions, it was necessary to use a pile new to California experience for the foundation of the river piers.

As with any major river crossing, numerous problems not encountered in ordinary highway and bridge work presented themselves. The expected problems were augmented by the site conditions and a six-foot daily normal tide.

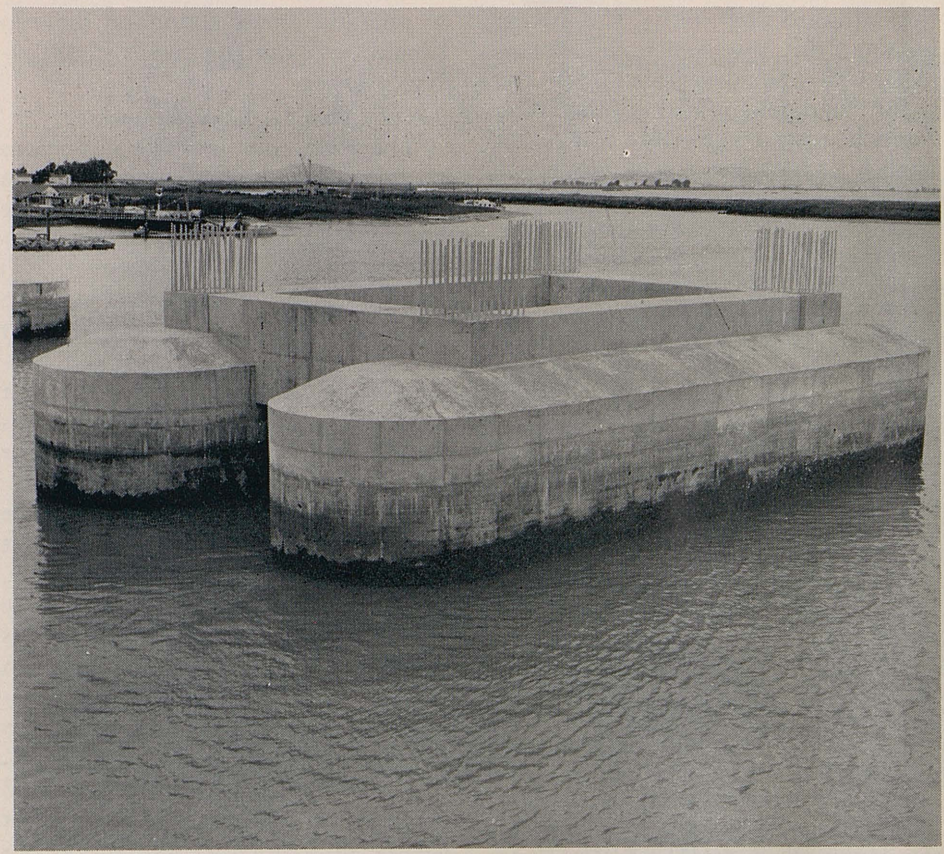
The pile selected, although used previously in other states, is believed to be the largest driven pile ever used in California. The Contractor chose to use a pretensioned pile, though post-tensioning of precast units made by a centrifugal process was optional. It is a 54-inch OD prestressed cylinder with 5-inch walls designed to support a load of 200 tons. The maximum length used was 122.5 feet, and these piles weighed 49½ tons each. These piles are driven open ended 20 feet into the bearing strata. Each pier consists of two footings containing seven of these piles in each footing.

To test the validity of the design, a test pile contract was let in July of 1961. Under this contract, a test pile was driven and then loaded to 300 tons with the test load being held for 10 days. The results of this test were satisfactory and a contract for the substructure was let in March 1962.

Driving Piles Difficult

The driving of these large piles was, at best, difficult. The piles were set in a hole, prejetted through the soft upper layers to within 20 feet of the specified tip, and then driven the last 20 feet. A minimum of 30 minutes, and in some instances, as long as an hour was required to drive the piles to grade. The prejetting of the holes was in itself, a major operation.

The handling and positioning of these large piles took a relatively long



This photo shows the completed Tower 11 footings and struts.

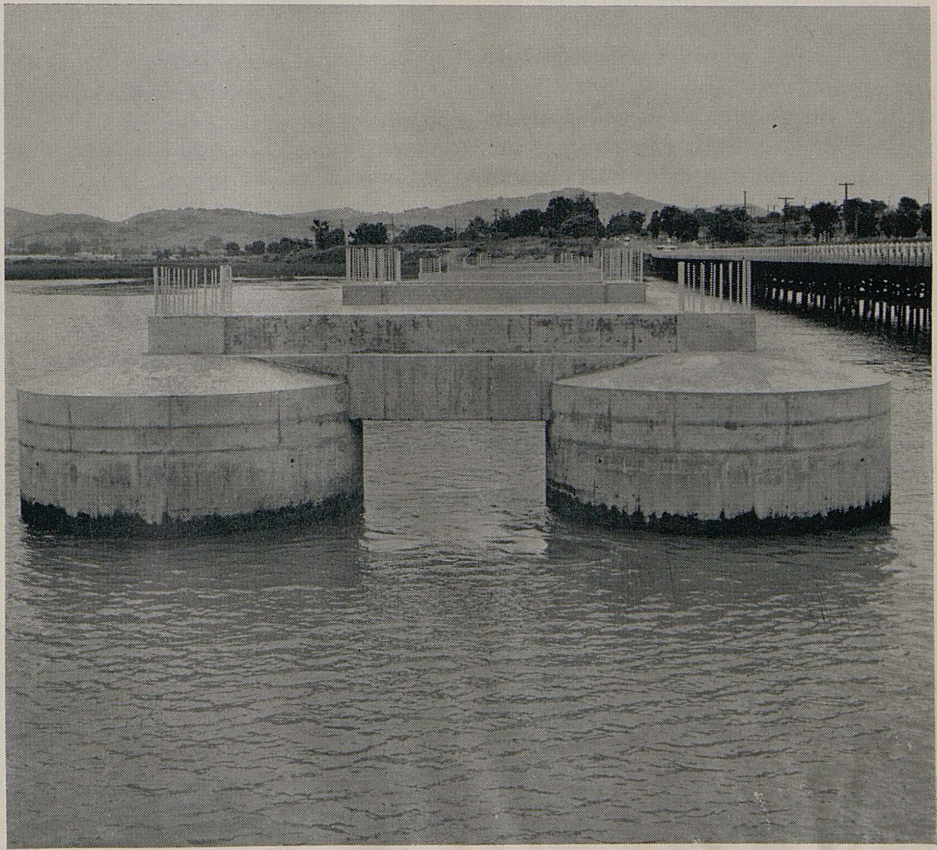
time. The total operation of positioning the jet tower, prejetting, lifting, positioning, setting and driving the pile took from two to four hours. An average of 2½ piles in place per driving day was achieved. The pile-driving hammer used was a 24,000-pound differential-acting hammer delivering 50,200 foot-pounds of energy per blow.

The contractor, Pomeroy-Gerwick, fabricated the 54-inch piles at their Petaluma plant and barged them to the site. The piles were cast three at a time in steel forms especially designed by the contractor. External vibrators were attached to the steel forms and proved very successful in providing a uniformly homogeneous pile section. After casting, the piles were steam cured for 24 hours. The forms were then stripped and the piles moved to a holding bed for additional water curing. By the end of the contract, the contractor was casting three piles every other working day with the required concrete strength of 6,000 psi being achieved in about six days.

Footing Rings

At each footing, a footing ring extends downward 8½ feet from the bottom of footing. This places the bottom of the footing ring just below the estimated lowest low tide water surface. The footing itself is an 8-foot-thick cylinder placed on top of the 8½ footing ring, capped by a 2-foot-thick truncated cone and surmounted by a 3-foot-high column stub. A spandrel beam spans between the two footings. At low tide, the pier substructure presents a massive appearance. The four tower piers are even more massive and substantial in appearance.

The footing rings were designed to be either precast or cast in place at the contractor's option. He elected to use the precast option. These precast rings are used to enclose the piles and to provide a form to cast the piles, ring, and footing into one integral unit. To further reduce the open-water concrete placement the contractor also precast the spandrel beams.



Looking east at the substructure. Pier 15 is in the foreground.

The top four feet of the piles were filled with concrete. Since mean higher high water was approximately at the bottom of footing elevation it became necessary on a few occasions to place this concrete at night due to unfavorable tidal conditions during the day. The tower footing rings were placed in two sections with a tremie seal joint. Since the minimum tides always seem to arrive after dark, inspection of these joints usually required after-hours work.

The underlying material on the west bank of the river is very unstable. One survey hub set to establish the centerline of pier for the first pile driven on the west bank was found to have moved 0.9 foot after pile driving for that pier was completed. Fortunately, no survey hub was considered good for more than a few hours in this area.

Pier Location

In order to accurately establish the location of the various piers, a large quadrilateral was established prior to the beginning of the work. Since the west bank area was known to be unstable and the test pile was only approximately 250 feet from the west shore, the test pile was selected as an oversize survey "hub" for one corner of the quadrilateral. Another point was set on the bluffs overlooking the east shore, and the other two points were set some 2,000 feet upriver. One of these was on a dike on the west shore and the other on a point of a bend on the easterly shore. All sides of the quadrilateral were measured by geodimeter. In addition, several other survey and check points were established across the existing bridge. It is estimated that at least two man-months were saved by this procedure as compared to the more conventional triangulation procedures. From the basic points thus established, all piles were located by turning angles with a theodolite.

Inasmuch as it was frequently necessary to climb up onto a completed pier for survey purposes, the surveyors became accomplished at the art of securing a line to column dowels, 12 feet above the water at low tide, using a homemade grappling hook thrown from a rowboat. Since pile driving was stopped by only the worst weather, this was sometimes accomplished in a driving rain. Even the worst landlubber among the state forces became a reasonably competent small boat man before the work was completed.

Once the basic quadrilateral was established, triangulation was extensively employed. With the aid of the electronic computer, all of the necessary angles to set piles, center of footings, etc., from various points were rapidly and accurately precalculated. It is estimated that one more man, computing angles full time, would have been required if the electronic computer service had not been available.

Design

The Napa River channel is approximately 2,300 feet wide with extremely poor foundation conditions. Since large costly footings would be required to resist the longitudinal seismic forces, with conventional pier design, the alternative of connecting several spans to a single pier to resist the longitudinal forces of the combined spans was adopted. These piers were designated "towers" and are actually two piers, 30 feet apart, tied together by means of struts. Only five towers are required to resist all of the longitudinal seismic forces.

The footings of each bent are designed to carry the direct loads and are also capable of resisting the transverse forces that could result from an earthquake. The use of the 54-foot 200-ton piles provided a design that met the structural requirements for the unsupported pile of this length. The point of fixity of the piles was assumed to be 18 feet below the mud line or one-third the length of the pile below mud line, with the lesser length being used for design. Group I and VII loadings and unsupported lengths were the governing factors in the design of the piles.

The tower and pier details are detailed to provide for precasting the struts. The columns will be cast in place. Though consideration has been given to a precast alternative, the cap will be cast in place, since its size and weight precludes any satisfactory precast alternative. The forms for the cap can be supported on the strut beneath so that the construction of the cap should not pose any major construction problem.

West Extension Necessary

The extremely unstable conditions at the west end have necessitated a 300-foot structure extension of the westerly portion of the original design. Lightweight backfill material will be used at abutment 1 to reduce the backwall pressure on the abutment. At the present time there is an overburden of approximately 10 feet at abutment 1, placed under a previous district contract, which will further stabilize the material in this area. Hundred-ton pretensioned concrete piles will be used for structure support of this westerly portion of the bridge.

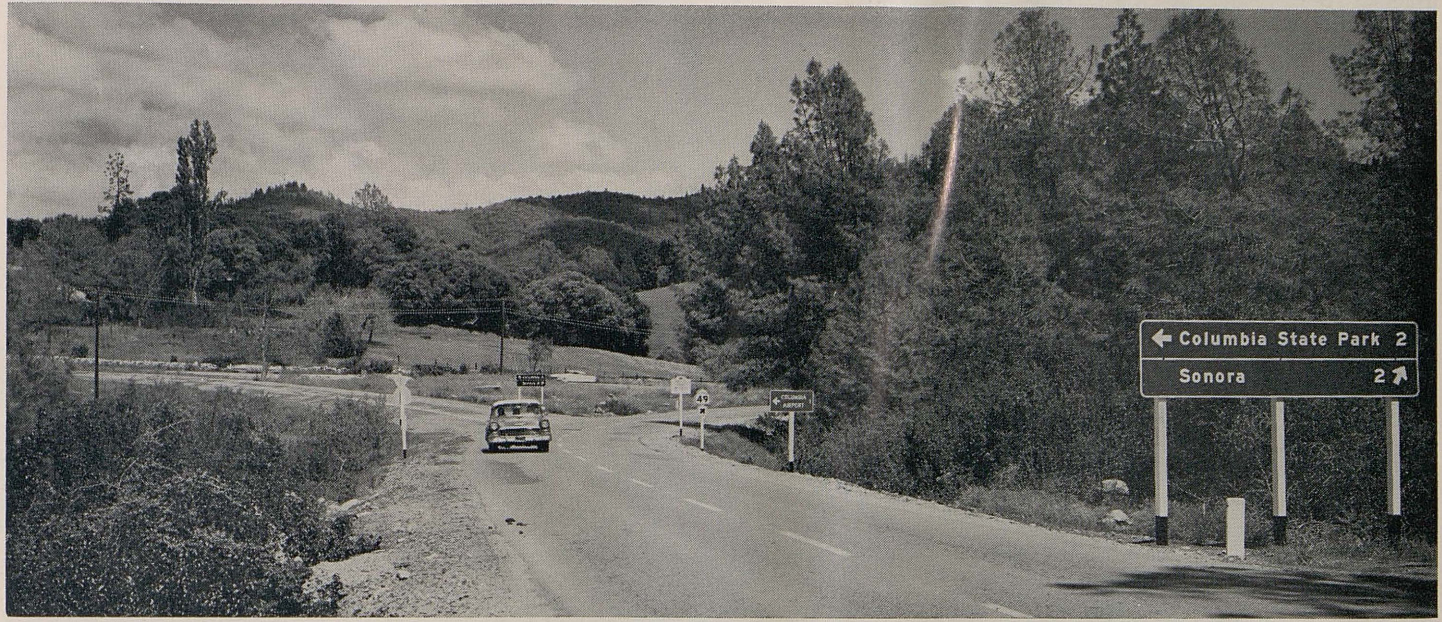
The superstructure details include spans of precast prestressed I-girders except for a small portion of cast in place T-beam at ramp A. The composite slab is being made continuous for live load over the pier supports. There are a total of 100 120-foot, 182 100-foot, 10 140-foot, and 20 144-foot precast prestressed girders, and 51 30-foot precast girders. The 20 144-foot girders, which carry the 140-foot suspended span, are being designed for two-stage prestressing. Since these 144-foot girders are continuous over a support, with a great variation in design conditions from the time of casting and initial stressing to the final design loading with live load, it was necessary to consider this sequential type of prestressing. The girders will be brought in by barge.

The combination of prestressed design concepts in the Napa River bridge is considered to be a good example of the use of prestressed design in bridge construction.

R. L. Boulware was resident engineer on the substructure contract. Design was under the supervision of G. D. Gilbert and A. E. Bacher.

The substructure cost was approximately $2,200,000. The superstructure will cost an additional $4,400,000 (estimated), and $1,300,000 will be required for construction of approaches and related work. The latter projects have not yet been included in the state highway budget, but if funds are made available they could be completed by some time in 1966.

Highway Through History



Route 49 Retains Scenic Quality as Construction Projects Make It Pleasanter and Safer to Travel

BY NORMAN DEUEL
Information Officer

Taken from south to north, as state highway routes are usually described, State Sign Route 49 stretches a sinuous, scenic and history-laden 289 miles from a junction in Mariposa with Sign Route 140, the all-year highway to Yosemite Park, to join U.S. Highway 40 Alternate at Vinton in Plumas County.

Technically, the route extends southward another 27 miles from Mariposa to a junction with Sign Route 41 at Oakhurst, Madera County. This section is now a county road (Boot Jack Road for the most part) and passes through such picturesquely named places as Nipinnawasee and Ahwahnee. It is not now signed or maintained by the State but eventually will become a part of Sign Route 49.

The number "49" was assigned to the route in 1933 in recognition of its historic significance in linking the mining camps of the Gold Rush days. The shield which carries the number (and the numbers of all state sign routes) is in the shape of a miner's spade.

Scenic in fact and mostly unspoiled by the burgeoning growth of California in population and motor vehicles, most of Sign Route 49 came under the protection of law by the enactment this year of Senate Bill 1467, creating a scenic highway system. This is "a program by the State for the development of a state scenic highway system [as] a vital part of the all-encompassing effort which the State must make to protect and enhance California's beauty, amenity, and quality of life." The bill was signed into law by Governor Brown on July 15.

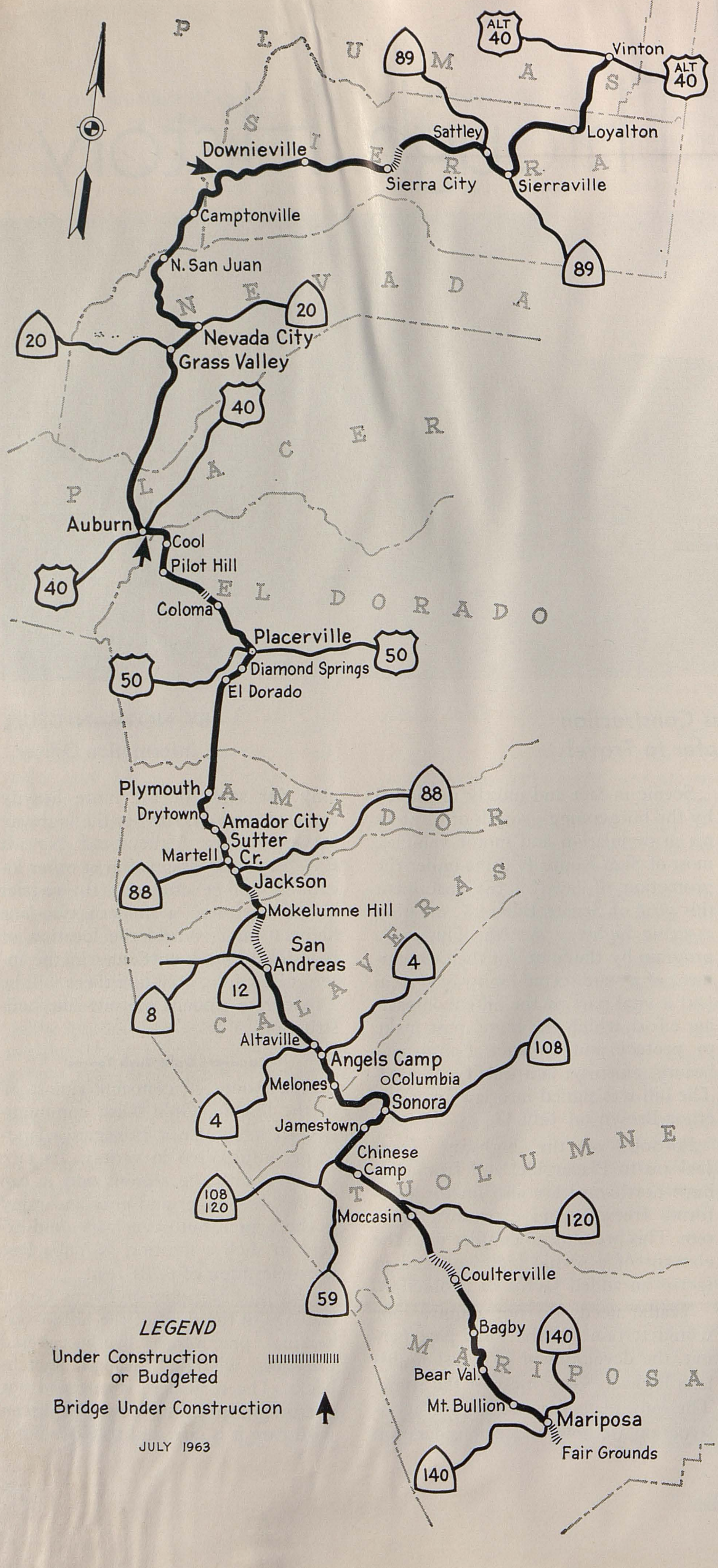
Portions of the highway, from Jackson to Placerville, and from Auburn northward are also on the California freeway and expressway system. This presents no conflict with the concept of a scenic highway, and in fact is an added factor of protection.

Traffic needs do not require, nor would terrain for the most part permit, the development of a fast multilane highway over most of the route. The only plans for full freeway construction are now under consideration only for some of the more heavily traveled sections, such as the highway between Grass Valley and Nevada City. Freeway designation at other locations will be used only to restrict unsafe access to a modern two-lane highway and control the location of roadside business entrances in the interest of safety, although there will be a moderate amount of four-lane construction.

Connects Gold Rush Towns

Sign Route 49 connects almost all of the historic Gold Rush communities. In its course it traverses a landscape unsurpassed in variety. Its face changes with the seasons and it can be hot in summer and cool and rainy in the winter, but never very cold except in such a location as Yuba Pass at an elevation of 6,701 feet.

North of Mariposa on Bagby Grade it clings to the sides of the hills, overlooking precipitous brush-covered canyons, winding through switchbacks. The road here is surfaced but narrow, steep and winding. But driven with care it is safe, and traffic is light.



There are little valleys in the foothills, too, where sheep and cattle graze in season when the grass is green. During this time wildflowers are plentiful on the hillsides. Farther north is evergreen country of pines and firs, more canyons and swift-flowing streams.

The highway crosses all of the important rivers draining the Sierra Nevada Mountains—the Merced, Tuolumne, Cosumnes, American, Bear and Yuba Rivers.

In these areas it is an up-and-down highway. One engineer wrote in *California Highways and Public Works*, January-February 1953:

"Indeed, the highway may be described as consisting of an alternating series of stream crossings and ridge crossings. Across one river—up the opposite ridge and down the other side —up a second ridge and down again— and so on. At times the motorist may believe the distance he is traveling up and down exceeds that in the horizontal direction. Many of the rivers are in deep canyons, and the problem of road building is made more difficult because heavy mountain-type construction is often necessary."

Hydroelectric Development

The abundance of water has brought hydroelectric development, some of which is visible from the highway and nearly all of which affects the plans of the highway builder.

Sign Route 49 passes the Moccasin Creek power plant of San Francisco's Hetch Hetchy water supply system and at Melones crosses the upper arm of the reservoir formed behind Melones Dam on the Stanislaus River.

The highway links the communities of the southern mines, Coulterville, Sonora, Columbia (just off the route), Angels Camp, San Andreas, Jackson and Sutter Creek; and Placerville, Coloma, Auburn, Grass Valley, Nevada City and Downieville of the northern mines.

Now a recreational pursuit for the occasional weekend or vacationing gold panner, mining as a major endeavor ceased many years ago. But in many communities signs proclaim that if the price of gold were raised it would become again a profitable industry.

In Mariposa near Highway 49 is the oldest courthouse in continuous use in California. It was built in 1854, and is still functioning.

Bagby Grade, north of Mariposa, offers spectacular views of brushclad canyons where the driver must negotiate grades and switchbacks. Some lookout points are provided.

An ancient locomotive once used in the Mary Harrison mine seems to have a pensive regard for evidence of more modern transportation as it overlooks construction for relocation of Sign Route 49 near Coulterville.

There still remains the evidence of past intense activity. Near Sutter Creek, Amador City and Jackson the tipples of deep hard rock mining may be seen. Along miles of the highway near streams are the gravel beds upturned for placer mining and between Camptonville and Downieville is the canyonlike remnant of the Depot Hill hydraulic mine.

The evolution of what is now Sign Route 49 is obscure in its early days. But we can be sure that a trail, first blazed by men afoot and on horseback, linked what were the most important producers of California's wealth more than 100 years ago.

Its development into a wagon road came slowly but surely. Records show that as recently as 1905 there were relatively few miles of county roads clearly developed as such in the various counties of the State. Right-of-way was seldom definite, and property owners were apt to shift the roads to suit their purposes.

1909 Bond Issue

Development of Sign Route 49 as a state highway can be more definitely documented. The start came in 1909 when the Legislature authorized a bond issue of $18,000,000 to start a state highway system which would link the various county seats and integrate road transportation in California.

Largest segment of Sign Route 49 to become a state highway and eligible for improvement with proceeds of the 1909 bond issue was that between Auburn and Downieville. Another was from Mountain Pass, near Chinese Camp, to Sonora.

In 1921 the Legislature made part of the state highway system that section of the highway from Auburn to Sonora through Placerville, Jackson, San Andreas and Angels Camp and named it the Mother Lode Highway. That name has since been applied commonly to all of Sign Route 49.

Other sections of the road were brought into the state highway system in 1921 and 1929. In 1953 the segment from Sierraville to Vinton was added, upon completion of its construction by Sierra and Plumas Counties; and in 1959 the southerly extension to Oakhurst was put in on a "future" basis.

Recent Construction

Improvement of Sign Route 49 as a state highway was necessarily slow in the early years but with gradually increasing funds available many important changes in the highway have taken place. Construction has been limited mostly to short sections of the highway to improve narrow portions, ease steep grades and sharp curves, or to remove bottlenecks through such historic towns as San Andreas and Jackson without altering their character. A traveler who revisited the highway after a lapse of, say, 10 years would find the changes striking. Certainly he would find it safer.

During the last five years there have been several important projects in Mariposa County. A modern two-lane highway was built from just north of Mariposa to Bear Valley at a cost of $1,100,000. This was completed in 1960. Portions between Bear Valley and Coulterville were improved in stages between 1958 and 1961 at a cost of $275,000.

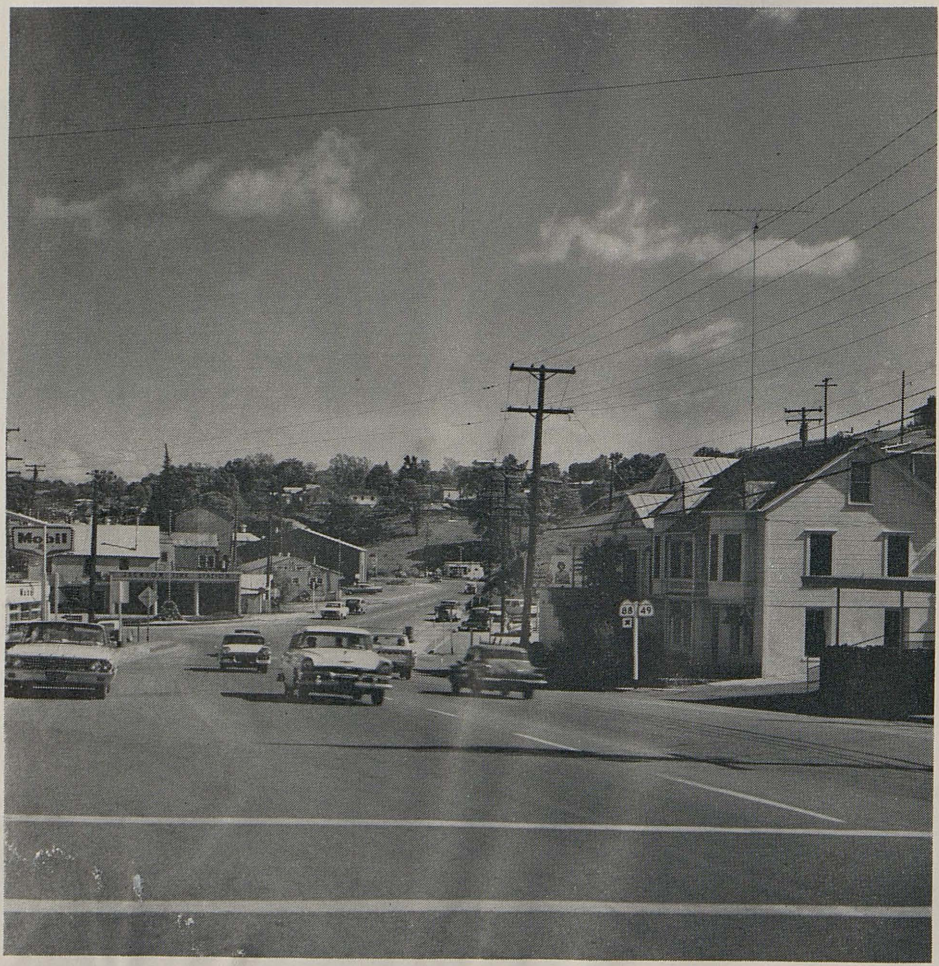
In El Dorado County the highway was realigned in 1960 for 2.4 miles from 0.2 mile north of Pilot Hill to 1.0 mile north of Hastings Creek at a cost of $186,300. In 1962 the realignment work was extended south for 1.6 miles and a new bridge built across Hastings Creek at a cost of $353,900; and in the same year realignment was continued to 0.9 mile south of Greenwood Creek, a distance of two miles.

In 1961 the Bear River bridge on the Placer-Nevada county line was re-


The sign "Eagle Cotage" [sic] at Columbia State Park is not mispelled. It means that cots once were available there for miners. At the left is the rebuilt Masonic Hall, used on occasion by lodges throughout the State. The original building was destroyed by fire.


Sign Route 49 offers an occasional stretch of straight highway through oak-studded countryside. This scene is near Jacksonville in Tuolumne County.

Sign Route 49 once made right-angle turns through the crowded main street of Jackson (above). Now a bypass a few hundred yards away provides free-flowing traffic (below).



placed on new alignment at a cost of $237,000.

In Nevada County, 1958 saw the construction of a two-lane expressway for 7.3 miles from the Bear River (Placer county line) to 1.5 miles south of Rattlesnake Creek.

In Sierra County in 1961 and 1962 the highway was reconstructed or resurfaced for 10 miles between Sierraville and Loyalton at a cost of $214,000. A bridge was replaced in Sierraville in 1962 at a cost of $50,000.

Current Construction

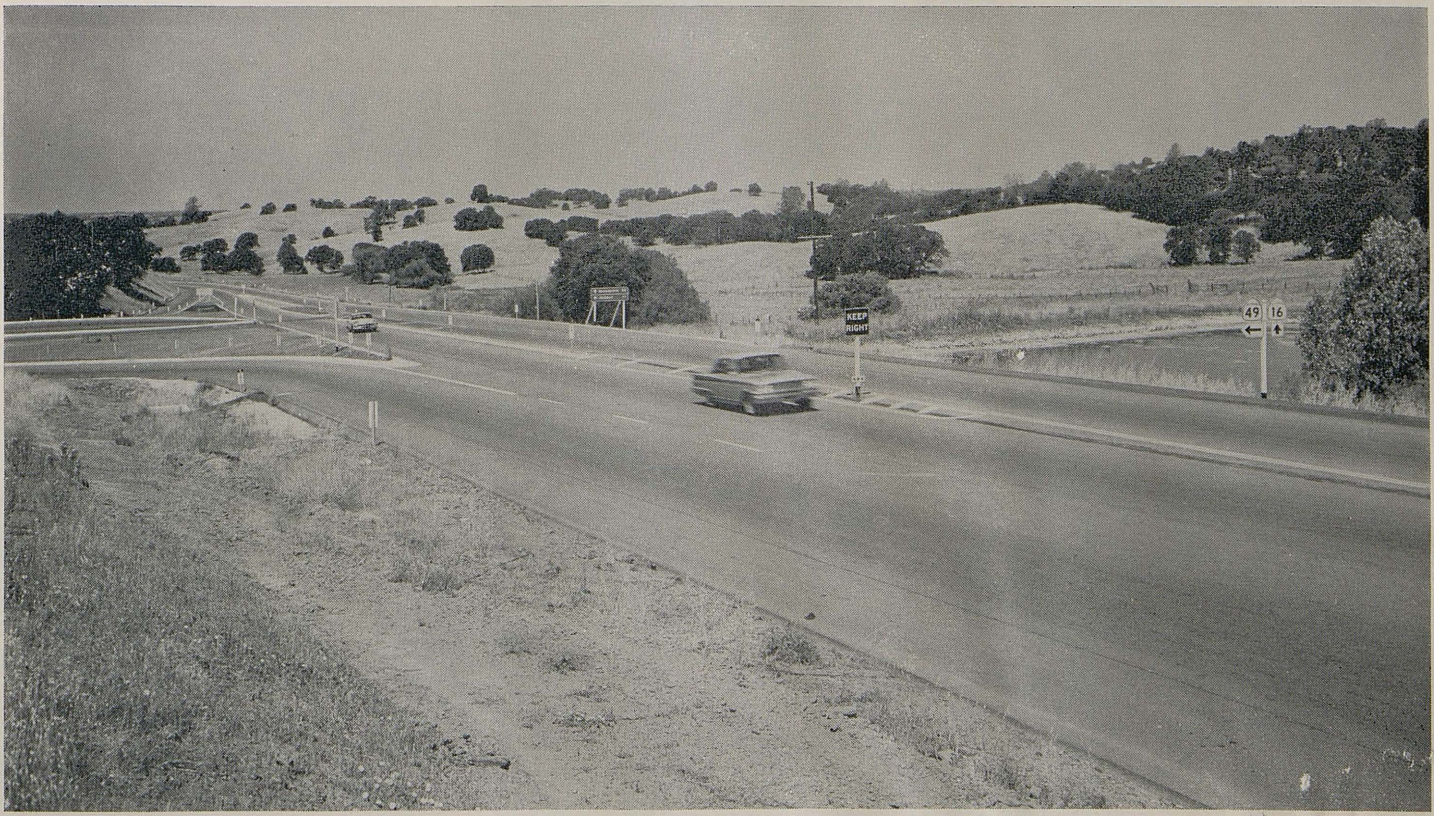
A start on improvement of the road south of Mariposa is underway with a federal aid secondary project for grading and base between Mariposa and the county fairgrounds at a cost of $302,000.

Six and a half miles of the highway between 1.5 miles south of Coulterville, and the Tuolumne county line is being relocated at a cost of $1,055,000, with completion of grading and paving scheduled for the end of this year.

The first stage of relocating the highway between Sign Route 12 and Mokelumne Hill, grading and the construction of two bridges, is underway at a cost of $1,210,000.

Bids were opened May 29 for the new east Auburn underpass, including

Relocation of Sign Route 49 in the vicinity of Sutter Creek is under study to relieve traffic congestion without affecting the historic buildings along the principal street.



The highway has been made safer by channelization and widening of once hazardous intersections. This is the intersection of Sign Routes 49 and 16 north of Drytown, Amador County.

Coloma State Park preserves ancient buildings erected following James Marshall's discovery of gold in the American River in 1848. There are picnic facilities and pleasant spots in sun or shade. Highway 49 is just beyond the rustic fence.

A new bridge over Hastings Creek and a section of realigned modern two-lane highway north of Coloma were completed in 1962.

0.2 mile of four-lane highway, with the low bidder offering to do the work for $266,511.

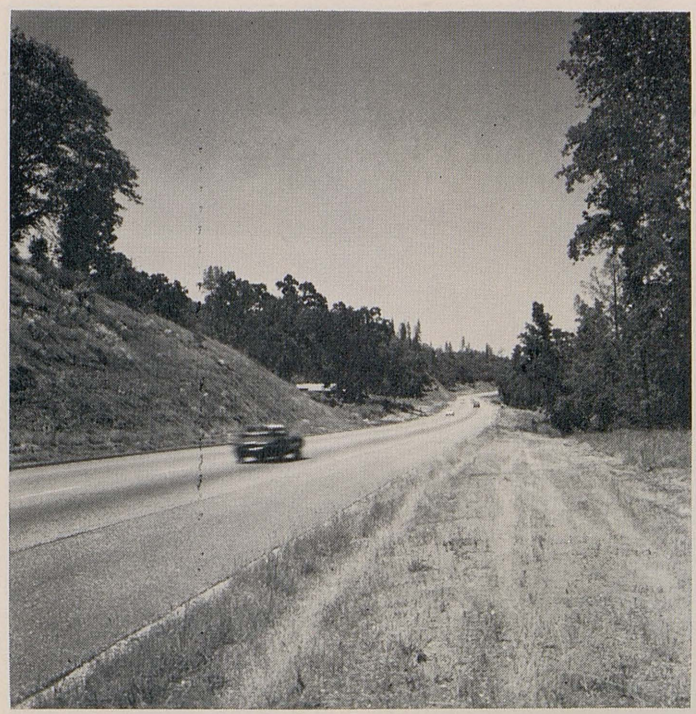
Reconstruction is underway between 0.8 mile south of Greenwood Creek and 0.4 mile north of the South Branch of the American River, a distance of 1.4 miles. The contract is for $97,460 and the estimated completion date is this fall.

A new bridge over the North Fork of the Yuba River in Sierra County, plus new approaches on new alignment will cost $242,195, but probably will not be completed this year. Traffic meanwhile is using a temporary structure which was built at a cost of $35,500 as a temporary substitute for the flood-damaged old bridge.

The biggest contract, for $1,388,640, in the northern sector of Sign Route 49, is for 3.9 miles of two-lane expressway between 0.7 mile east of Sierra City and Bassetts. This could be completed late this year, depending on weather.

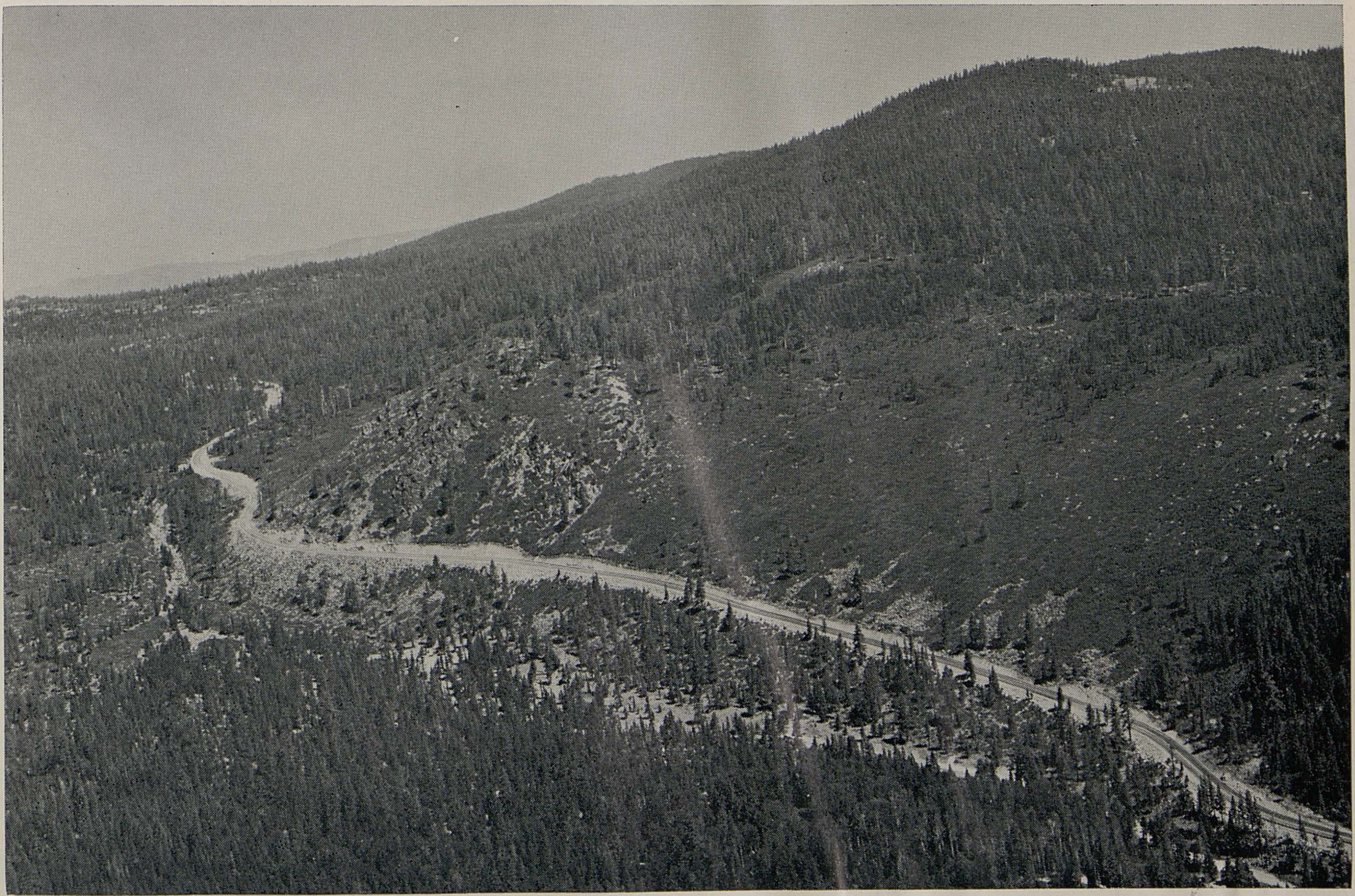
Projects Budgeted

Amador County—Reconstruct and widen between Calaveras county line and 1.3 miles north, $850,000. (Bid opening July 24.)



A section of modern two-lane expressway speeds the traveler between Auburn and Grass Valley.

North of Nevada City the highway crosses the gorge of the South Fork of the Yuba River and rises again beyond the tumbling waters.



Sign Route 49 passes through rugged country between Sierra City and Bassetts, where 3.9 miles of two-lane expressway is under construction. It will cost $1,388,640.

Downieville, the county seat of Sierra County, nestles along the Yuba River and was named after the leader of the first gold discovery party in the county.

Calaveras County—Pave between Sign Route 12 north of San Andreas and Mokelumne Hill, 6.5 miles, $600,-000. (Bid opening August 21.)

Nevada County—Widen portions between 1.5 miles north of the South Fork of the Yuba River and North San Juan, $50,000.

Sierra County—Widen portions between Bassetts and Yuba Pass, $100,-000.

Planning for the Future

The specific location of Sign Route 49 has been determined by the Highway Commission for the major portion of the highway between the Mariposa county line and Yosemite Junction, which will require realignment due to the construction of the Don Pedro Dam. Actual development of detailed design on this section of road depends upon an agreement to be entered into with the irrigation districts as soon as their plans for Don Pedro Dam have been accepted by other agencies.

Between Sonora and San Andreas realignment in the vicinity of Melones Dam depends on final decision regarding dam construction.

A recommendation for a route relocation in the vicinity of Sutter Creek has been submitted to the State Highway Commission, and the commission has held a public hearing on the matter. It is still under consideration.

Preliminary planning is underway on the section between Central House and the El Dorado county line. The final location depends on the construction of the proposed Nashville Dam.

The final location in El Dorado County, from the Amador county line to about six miles north, is also contingent on construction of the Nashville Dam. From that point north to the American River near Coloma, route studies have been made and a public hearing held.

Another dam construction problem affects the route between Cool and Auburn in El Dorado and Placer Counties, where future route adoption and construction are contingent on a firm

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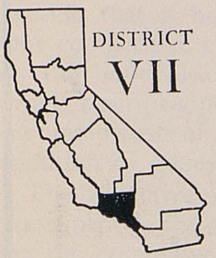
Freeway Impact

Santa Ana Project Saves Users $7,000,000 in 5 Years

By STUART L. HILL, Headquarters Right-of-Way Agent

[Editor's Note: This article is a reprint of a talk given by Mr. Hill before the Associated Chambers of Commerce of Orange County on April 18, 1963, in Santa Ana. Data of this nature are gathered continuously by the Right of Way Department as a part of route planning and as vital information to the real estate appraisal process.]



I can point right now to any individual in this room and say, "You live within four miles of the Santa Ana Freeway." My chances of being correct would be better than 60 percent—because that's the percentage of

SAN CLEMENTE BENEFITS FROM FREEWAY PROJECT

By RAYMOND F. LAW, Information Officer, District VII

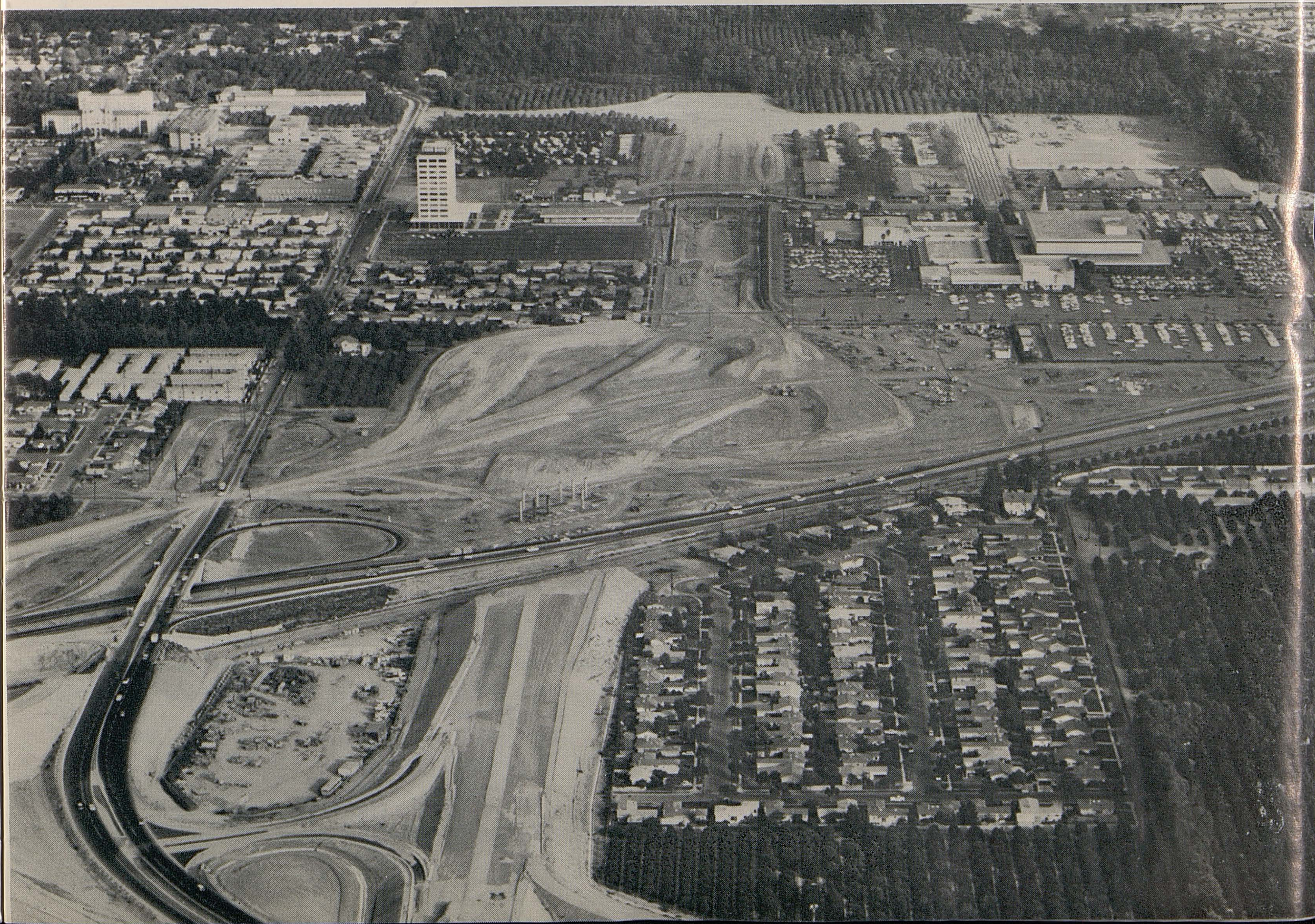
San Clemente, a seaside town of 11,000 population midway between Los Angeles and San Diego, is known to all who have traveled the Pacific Coast Highway along the coastline of Southern California. It is a convenient place to break a journey for fuel, refreshments or a visit to the beach.

The community's great natural assets are its climate, the quiet beauty of the Santa Rosita Hills sloping down to the Pacific, and beaches where swimming, fishing and surfing are at their best. Just north of the city is Doheny Beach State Park, and at the southern end is San Clemente Beach State Park. This environment, which led to the town's founding, has shaped the course of its development as a quiet residential community.

Before the San Diego Freeway (Interstate 5) was completed through San Clemente late in 1960, some residents expressed apprehension as to the effect

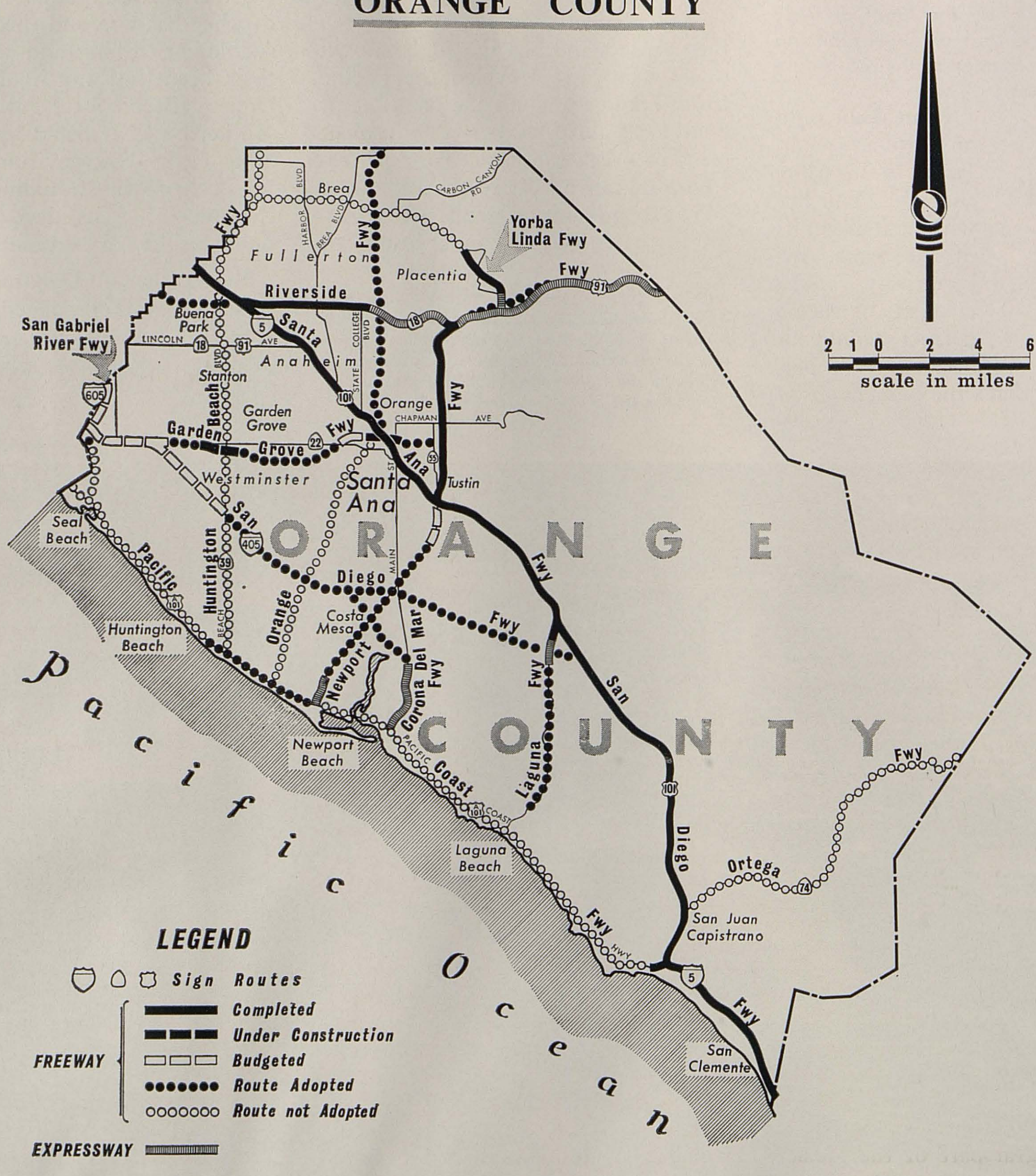
. . . Continued on page 27

PHOTO BELOW. Santa Ana-Garden Grove Freeways interchange. Garden Grove Freeway under construction. Santa Ana Freeway running diagonally across picture. Bullock's—Fashion Square is located to the right and the Union Bank Building to the left of the Garden Grove Freeway.



CALIFORNIA FREEWAY AND EXPRESSWAY SYSTEM

ORANGE COUNTY



county residents who live within that distance.

The Santa Ana Freeway cost the taxpayers of California $35 million. Since the opening of the Irvine Grade Separation in 1958 this freeway has saved the traveling public over $7 million in transportation costs. The average person commuting from Santa Ana to Los Angeles saves more than $50 every year.

This is one of the primary reasons that the freeway was built in the first place—to reduce transportation costs. Freeways are a means of helping free enterprise cope with the fantastic expansion that is being required of it. Our competitive economy is founded on the basic idea of constantly improving our products—of lessening the economic costs of production and distribution of goods and services.

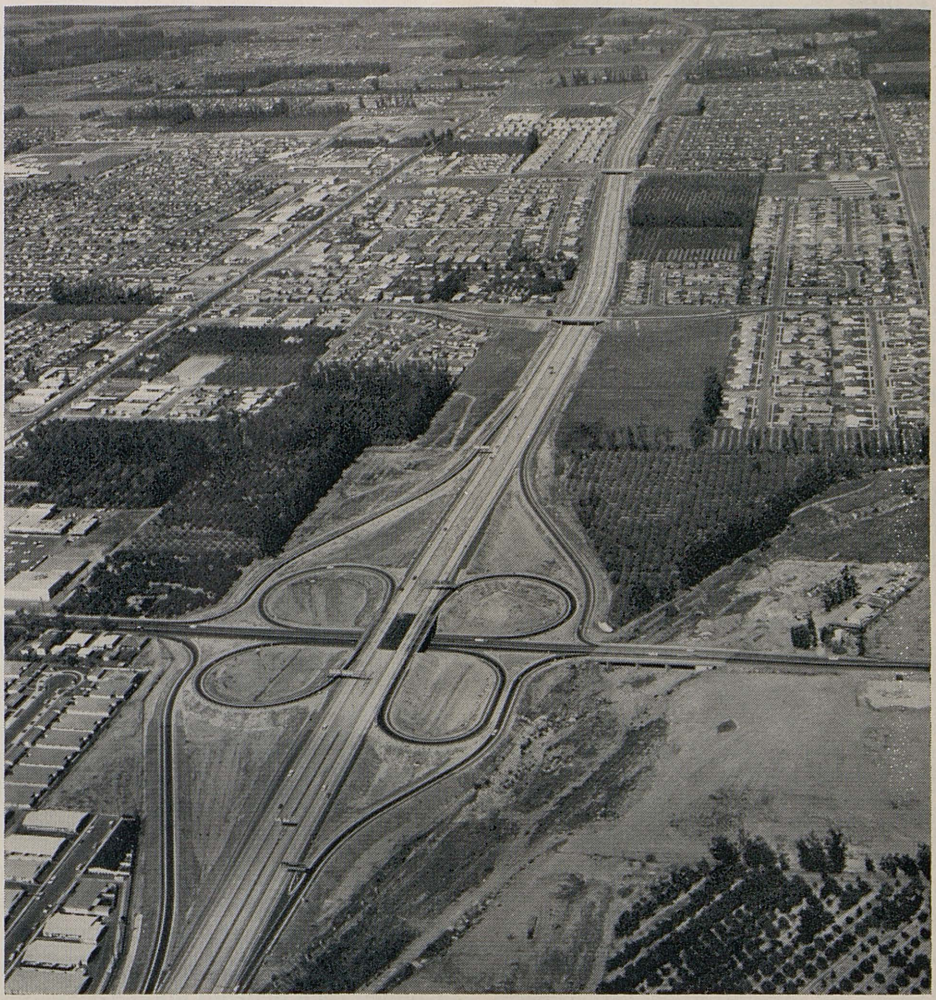
The objective of a highway improvement is the same. The $50 saving the commuter realizes is called a "user-benefit," and his saving plays an important role in the location of freeways.

Other Benefits

However, the reduction of transportation costs has other benefits. For example, take the case of a merchant located near a new freeway in the suburbs. The freeway reduces the cost of delivery to his store, since a competitive trucking industry will pass on any savings it makes to the merchant. The merchant, in turn, improves his competitive position since he can sell more gods at less cost. The trucker's "user-benefit," then, is ultimately reflected in the increased business activity of the merchant and lower prices to the consumer. This effect is defined as a "nonuser benefit."

There are other, more far-reaching effects, however. The freeway is not merely a ribbon of concrete running across a former orange grove so someone else in Los Angeles can save time and money going to Newport Beach. The freeway—any transportation system—is an integral part of the local, regional and national economy. Almost all economic activity today is predicated upon the cost of distributing goods.

Let's say, for example, in a hypothetical community that, for any piece of property to be developed industrially, transportation costs dictate that the plant must be located within three miles or ten minutes from the central business district. You want to locate a plant in this community. You find that there are only ten parcels of vacant land available for what you can afford within that time-distance requirement.



Newport Freeway (Chapman Avenue in foreground), showing residential development.

But now a freeway is constructed. Suddenly, property five miles from the central business district is only ten minutes away. What happens? The value of the property five miles away suddenly increases. Its use has changed. Whereas before, it was farmland, or residential, it can now be used for industry. The reduction of transportation costs by freeway construction increases the supply of land which is available with certain time-distance requirements. It increases the value of the land in the suburbs through a change in potential use.

Impact and Change

This is impact. Impact is a change; generally a change in the economic activity of the area. This is the impact of freeways on Orange County. By reducing transportation costs—the time-distance ratio—rural property has become available for urban uses. This, too, is a "nonuser benefit."

But—let's look a little further. In this community, where before there were ten parcels of land available, there are now twenty. Twenty parcels of land competing for the same market. If you double the supply and not the demand, you certainly aren't increasing the aggregate value of all *twenty* parcels. The owners of the first ten parcels may have to reduce their asking price. So, maybe, despite an increase of land value in the suburbs, there is actually a decrease in aggregate land values.

This would be good for the buyer—but not so good for the ten original sellers.

But the community we have described is theoretical. This effect is logical—but it isn't real. It doesn't happen like that. Land values in Los Angeles have *not* been decreasing to compensate for the increase in values in Orange County. The supply of land for specific uses has increased—but so has the demand.

Insatiable Demand

The insatiable demand for urban land in Southern California during the past 20 years characterizes the socioeconomic changes that have been taking place.

Thirteen years ago Orange County had no freeways—little manufacturing—few cars—no Disneyland. Less than 200,000 people lived here then. Taxable retail sales in the county were about $200 million per year.

Today there are nearly 60 miles of freeways in the county. Retail sales, last year, probably exceeded one *billion* dollars, and 900,000 people live here. In just a few years both population and retail sales have increased nearly five times. Today, among *all* counties in the United States, Orange County ranks 22d in automobile registration. And, best of all, today you have Disneyland. In 1955, when Disneyland opened, taxable retail sales made their biggest percentage jump of the decade.

Was all this possible without the Santa Ana Freeway? Yes, of course. The freeway, itself, didn't cause these changes. But, they really weren't possible on the same scale, under the same conditions and in the same short period of time. Most of you have made many of your past decisions based upon the freeway's existence. Without it, you really wouldn't be doing the same things you are today. Accessibility—transportation was a key consideration when the location of Disneyland was determined.

I am sure you're all familiar with that old saw—if you build a better mousetrap, the world will beat a path to your door. The Santa Ana Freeway is like that better mousetrap.

Attracts Shoppers

Nearly 50 percent of all retail business in Santa Ana comes from at least 20 miles away. A prominent businessman in this community told me that shoppers come from as far away as San Diego to shop at Fashion Square. That's because of the freeway—or because the freeway has relieved congestion on secondary roads.

Every Sunday, the Los Angeles newspapers carry ads describing new subdivisions in Orange County. First they are described in terms of accessibility.

The growth of Orange County in the last few years has been almost directly dependent upon the Santa Ana Freeway. People followed the freeways out of Los Angeles into the county. But the freeway wasn't built with a deliberate intent of having some sort of impact on Orange County. It really wasn't built *for* Walt Disney, as a sort of driveway to Tomorrowland. The growth of Orange County in the last few years is a result of population pressures and of economic pressures, exploding out of Los Angeles, funneled down the Santa Ana Freeway and into Orange County.

The impact of freeways on Orange County then depends upon extraneous factors—events that take place outside of the county. In the past 13 years 6½ million people have been added to the population of California. Two and one-half million of them in Los Angeles County. Freeway construction has just barely kept pace with the population expansion and the demand for improved transportation facilities.

The freeway opened the door for the urbanization of Orange County; people flooded in; industry and commerce followed, and the demand for land kept pace with the increasing supply. In the hypothetical community where before there was only one bidder for the twenty parcels, there are now two, three or four.

Future Acceleration

But we can't confine impact to a point of time. The changes that have been going on in the past may be accelerated in the future. By understanding some of the characteristics of freeway impact we can peek into the future—say, 1980. Anticipating future changes is the only way sound business decisions can be made.

By 1980 there will be 65 million more Americans than today; a total of 245 million. Eleven million will be crowded into the Los Angeles metropolitan area—which includes Orange County. Orange County's population will triple; it will be some place between 2 and 2½ million. There will be as many people in the Orange County of 1980 as there were in Los Angeles County in 1940. Nearly 2 percent of all the suburban dwellers in the entire nation will be living in Orange County.

Today the county has a population density of 795 persons per square mile. In 1980, there will be over 3,000 per square mile. In 1960 the average density of *all* urbanized areas in the nation was 3,750 persons per square mile. Fullerton, Anaheim, Buena Park and Santa Ana, in 1980, will have densities of over *7,000* persons per square mile. Nearly all of the usable land in the county will be urbanized.

If you, at this moment, feel inclined to say Stop! Stop! Who needs all the people? I would like to call two things to your attention. First, somehow—in a manner that seems incomprehensible, historically, population increases are always associated with either the development of "civilization" or significant advances in technology. There seems to be some relationship between our rapid advances in technology and our anticipated population increase. The addition of 65 million people in the United States by 1980 seems to be inexorable—we can't stop it. These people must be absorbed someplace—they must have jobs, housing, schools.

One Look Will Convince

Second, if you really feel like putting barricades around the county, visit someplace in the country where there is no growth. There are several states in the United States, indeed there are several counties in California, where population is declining—the youth are migrating—the economy is faltering or is stagnant. One look will convince you that standing still is not an acceptable alternative to the pains

Disneyland, showing relationship with Santa Ana Freeway.

of growth. Especially when growth does bring with it economic prosperity.

The State Legislature and the Division of Highways has been making plans for 1980 since before 1960—not only for Orange County—but for the entire State.

If all freeway construction in Orange County were to stop now—and no new freeways were to be constructed before 1980, the Santa Ana Freeway would become a hopeless snarl. All of the transportations savings—the user-benefits—and a great deal of the nonuser-benefits would be lost. For example, today on the Harbor Freeway at the four-level interchange the traffic exceeds 200,000 cars per day. At the Eighth Street offramp it is 175,000 cars per day. The Harbor Freeway is, as you know, an eight-lane freeway in the downtown area.

If no other freeways were built in Orange County, in 1980 traffic on the Santa Ana Freeway—*a six-lane freeway*— would be 150,000 cars per day—clear down to Anaheim. Harbor Boulevard—a four-lane road—could be carrying as many as 70,000 cars per day. The Pacific Coast Highway would be worse. Traffic *throughout* Orange County would resemble traffic in downtown Los Angeles during the peak rush hours. This county would be slowly strangled by traffic. The industry and commerce that moved into the county during the 50's and 60's could be expected to move away in the 80's. People who commute to Los Angeles to work would be forced to move out or face a drive of over four hours each day. Eventually, perhaps, some equilibrium could be reached—but in the meantime, home owners and businessmen would have lost tremendous sums of money as the value of their investments declined in direct proportion to the exodus.

Picture Is Conjectural

This gloomy picture is, of course, purely conjectural. It won't happen. The State Legislature, several years age, adopted the statewide master plan for state highways and planned 14 freeways for Orange County. The Santa Ana Freeway is but a part of an integrated, interdependent transportation system. This system, not individual freeways, is the most important factor in the future of Orange County. Without it, the county will strangle; with it, other growth plans in the county become feasible.

There are 14 freeways planned—with a total length of nearly 250 miles. Sixty miles of freeways and 20 miles of expressway are now built. To date the Division of Highways has spent $140 million in the county on freeways. By 1980 the figure will exceed $670 million. This does not mean, however, that there will be wall-to-wall concrete in Orange County. This system will take up *less than* 2 percent of the county's land area and it will provide for a more intensive development of the remaining 98 percent.

The most significant impact of freeways—as we described—is the suburbanization of industry and commerce. Not only in Orange County but all over California and the United States. Through a more efficient transportation system industry and commerce have burst the bonds that held them to the central city. When plants become obsolete it is economically feasible to relocate them in the suburbs. The improvement of the transportation system also has meant that labor has become more mobile—the location of a plant in the immediate vicinity of the labor market no longer is an absolute necessity.

Parking Areas Provided

In the suburbs industry and commerce spread out and provide large parking areas for people who have become willing to drive some distance to these facilities.

In 1980, industry will take up over 35 square miles of the county's land. Today they use six square miles. There will be at least 165,000 people employed in manufacturing in 1980. Today, there are 50,000. Besides the defense-oriented industries, the county offers excellent growth potential in fabricated metal products, machinery and electrical products, chemicals, drugs and allied industries, textiles and apparels, paper and allied products and boat building. The greatest industrial expansion will undoubtedly be along the coast from the Irvine Ranch to

Huntington Beach, Westminster and Seal Beach—more or less along the San Diego Freeway.

Annual retail sales in 1980 will be nearly $6 *billion* compared with the $1 billion of today. Four hundred thousand persons will be engaged in commercial enterprises. Today, there are 70,000. Instead of 20 square miles devoted to commerce, there will be 80 square miles. Tourism will contribute its share to the county's growth—the annual income from tourism will increase from $100 million today to $300 million in 1980. As the county economy expands, the county will become more and more self-sufficient. Trade and finance activities will find it more profitable to locate here—in proximity to the markets which they hope to serve. A much larger percentage of the residents will be working in the county, and the tendency to buy goods outside the county will be greatly lessened.

Without the past industrial and commercial expansion, many of the improvements made in county services and facilities would have been impossible—flood control, schools, libraries. A bedroom community does not provide a tax base which is adequate for the development of the community unless tax rates are prohibitive. Lacking further industrial and commercial expansion, Orange County could, in 20 years, become a giant slum—with wholly inadequate police, fire and educational facilities.

1980 Projection

The industrial and commercial expansion that I have projected for 1980 is hypothetical. But it *can* happen. The freeway system provides part of the basic requirement for it to happen. But it is even more essential for the community to create the basic environment that will attract that industry and commerce.

Therefore, when we discuss the impact of freeways in Orange County, we are really talking about a freeway system that is yet to be. We are really talking about the future suburbanization of industry and commerce. Hughes, North American, The Broadway, Fashion Square, to name the more obvious, are just the forerunners of tomorrow. Many much smaller, and even some larger, enterprises will find themselves in Orange County tomorrow because of the freeway system.

It is characteristic of our economy —our civilization—that everything is mutually interdependent. You can single out many individual factors as primarily responsible for our present condition.

The other night, for example, on TV there was a short commercial on plumbing facilities. Think, they said, of where we would be today without modern plumbing facilities.

The whole structure of our civilization is built upon a network of interdependencies such as this. Freeways are just one of the essential ingredients. They have impact—or benefit—far beyond their original intention because of the interrelationship with the rest of our economy.

Earlier, I said that the Santa Ana Freeway was not really Walt Disney's driveway to Tomorrowland. It isn't. The freeway system is *Orange County's* driveway to Tomorrowland.

The freeway system is one of your economic tools—just the same as a lathe, a good foreman, an advertising sign. It is up to you to use that tool in the most efficient manner.

Today, we are planning for 1980. Are you?

Maintenance Super Retires in Fresno

After serving the State Division of Highways for 30 years, Lyle Stanley, maintenance superintendent in District VI, retired on June 28, having held his present position since 1950.

LYLE STANLEY

A native of Missouri, he came to California at the age of 10 and attended school in Sanger. His working years began at age 16, and included experience with a lumber company, as a mixerman, pipemaker, truckdriver, and road work foreman for Fresno County. When he began work with the Division of Highways —District VI—in 1933, he worked as a grader operator. In 1938 he was promoted to bridge foreman, in 1950 to highway maintenance superintendent.

Principal highways over which Stanley had maintenance jurisdiction are State Sign Route 41 north of Fresno to the Yosemite Park boundary; U. S. 99 north of Fresno to the Merced county line, and State Sign Route 180 west of Fresno to Dos Palos.

Right-of-way Agent Harvey Smith Retires

Harvey B. Smith, supervising right-of-way agent in District IV, retired on August 30 after a career of 32 years in public service, 18 of which were with the Division of Highways in San Francisco.

HARVEY B. SMITH

Smith was born and brought up in Hope, North Dakota. In the fall of 1917 he moved with his family to Inglewood in Southern California where he graduated from high school. He attended the University of California at Los Angeles, and after a period of private employment he started in public service with the County of Los Angeles.

In 1942 Smith enlisted in the Army. He began his right-of-way career with the State in October 1945 when he was appointed assistant right-of-way agent in District IV. Since then he has held various positions in the district right-of-way section, including 14 years in charge of the appraisal department, and at the time of his retirement was supervising right-of-way agent—administration.

CONFERENCE ANNOUNCED

The sixteenth California Street and Highway Conference has been scheduled for January 30-February 1, 1964, on the Berkeley campus of the University of California. Announcement came from the university's institute of transportation and traffic engineering, which annually sponsors the conference for state, city and county engineers.

SAN CLEMENTE

Continued from page 21 . . .

it would have on their way of life. They were interested in preserving the town as a good place to live and in maintaining businesses devoted largely to serving the motoring public.

Now, nearly three years later, it is clear that the community has benefited from improved transportation. The freeway has been responsible in large measure for a great expansion in home building as more and more people have decided to live in San Clemente and drive to work in Santa Ana, 26 miles away, and other industrial centers of Orange County. Business is generally better, a new civic center on the hillside overlooking the ocean was occupied last December, and travel on city streets is easier and safer with through traffic moving on the freeway.

City Founded in 1925

San Clemente was founded in 1925 by Ole Hansen, a successful real estate developer from Seattle, who envisioned a quiet village with Spanish atmosphere where he and other retired persons could "view the sea from the porch as the breakers roll in, with the setting sun tinting the restless waters."

He discovered and acquired five miles of undeveloped ocean frontage, sold beachfront lots for $500 each, with a down payment of 20 percent in cash, and got the town started. In order to create the Spanish atmosphere he wanted, building restrictions required that homes and business buildings have red tile roofs and white stucco walls. Lavish plantings of geraniums, bougainvillea and other colorful flowers completed the picture. Streets, parks and other public improvements were given Spanish names, reminiscent of early California.

San Clemente has no smog, and due to its location with respect to the surrounding terrain, and the prevailing ocean breeze, there is a minimum of fog and haze. Because of the tempering effect of the ocean, the summers are cool and pleasant, with an average yearly maximum temperature of 77 degrees, and the winters are moderate, with an average minimum of 57 degrees. Records show there is sunshine 342 days a year.

The town was incorporated in 1928, when the population was only a few hundred. There was no industry, and business was chiefly devoted to serving the residents, many of them retired persons.

U.S. 101 Is Main Street

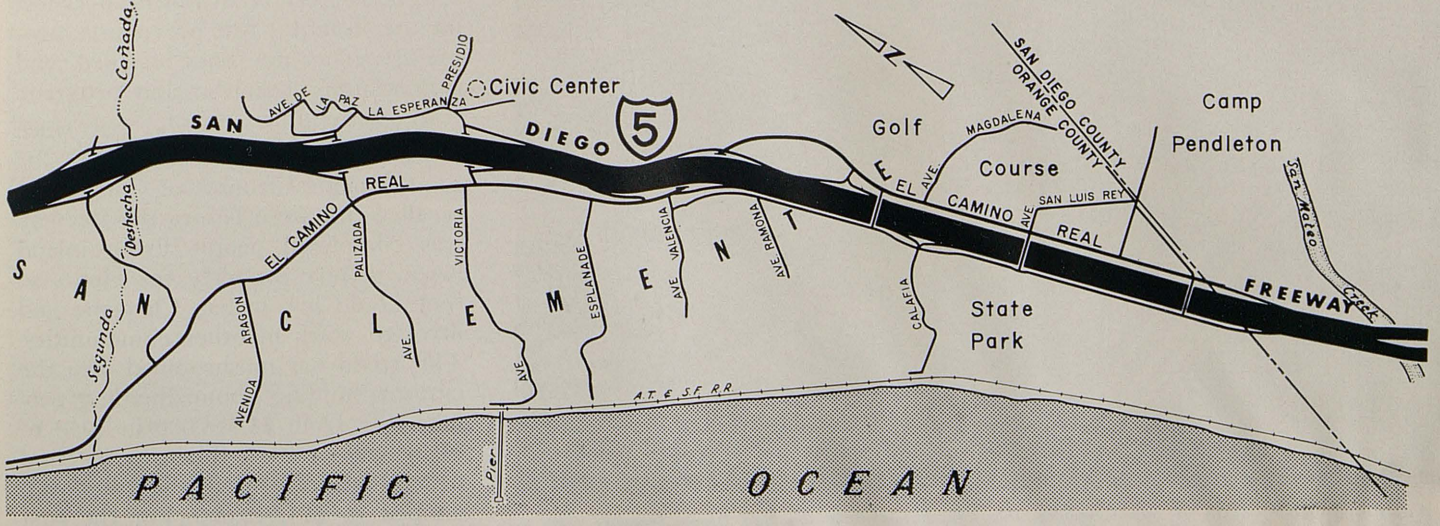
U.S. Highway 101, principal north-south coastal route of the state highway system, formed the town's main street, El Camino Real. In time service stations, cafes and other businesses were established to meet the needs of highway travelers, who came in larger numbers each year as Southern California continued to develop.

In 1940 San Clemente had a population of 479, by 1950 this had increased to 2,009, and in 1960, the year the freeway came, the total was 8,527. A special census taken January 15, 1962, showed a population of 9,550, an increase of 325 percent since 1950. This gain reflected the growth of Orange County as a whole, which was 225 percent for the same period. The San Clemente Chamber of Commerce estimated 11,000 in mid-1963, and has projected 14,500 for 1965, and 20,000 by 1970.

For several years, while the freeway was being discussed, planned and built, there was speculation as to its effects on the community. What would happen to the tourist business when drivers could zip through town at 60 miles an hour? Would the town lose its quiet, semirural character? And would the freeway deface the cherished beauty of the hills?

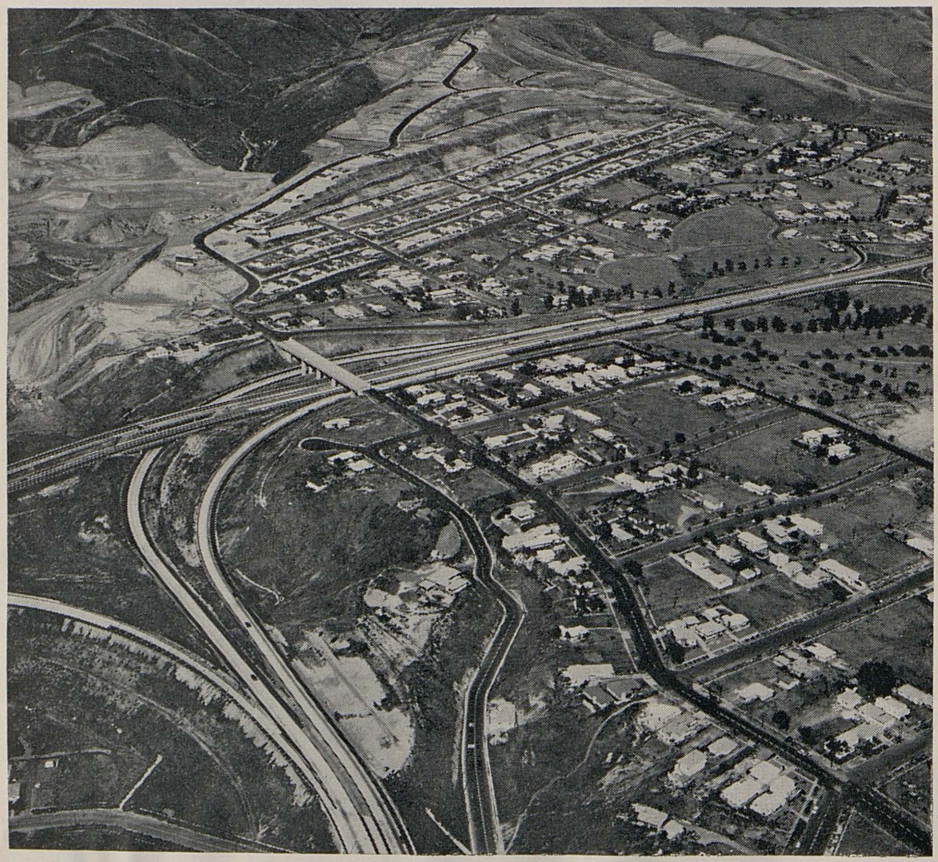
As recalled by Postmaster John Phillips, who was president of the Chamber of Commerce in the late 1950's, most people wanted the freeway, even at the time its effects were uncertain. Traffic on the main street often was congested, especially on weekends, and the town "had become a bottleneck," Phillips said. People were anxious to get through traffic off the street, but there was a difference of opinion as to the freeway location. Opinions were divided between those in favor of the location close to the business district, as opposed to a route farther up the hillside.

"I was opposed to the location that was selected," said Phillips, "but I think most people now like the present arrangement."



A map of the San Clemente area showing location of the freeway.

Hillside properties above the older section of the city are being developed in San Clemente since the San Diego Freeway was completed through the area.



In Capistrano Beach, north of San Clemente, this interchange links the San Diego Freeway (left to right) with the Pacific Coast Highway at Serra Junction.

Traffic Relief

After the freeway opened, through traffic no longer clogged the main street, and residents found shopping easier and safer. But some businesses that depended entirely on highway trade suddenly found themselves becalmed. Estimates vary as to the number that closed. Some say only three or four, others recall perhaps a dozen, including a cafe and some small service stations.

Councilman George F. Eyre, formerly the mayor, takes this view: "The freeway does a service to the city. As to adverse effects, it separated the men from the boys. It put people out of business who never should have been there in the first place, and put people in business who should be in business."

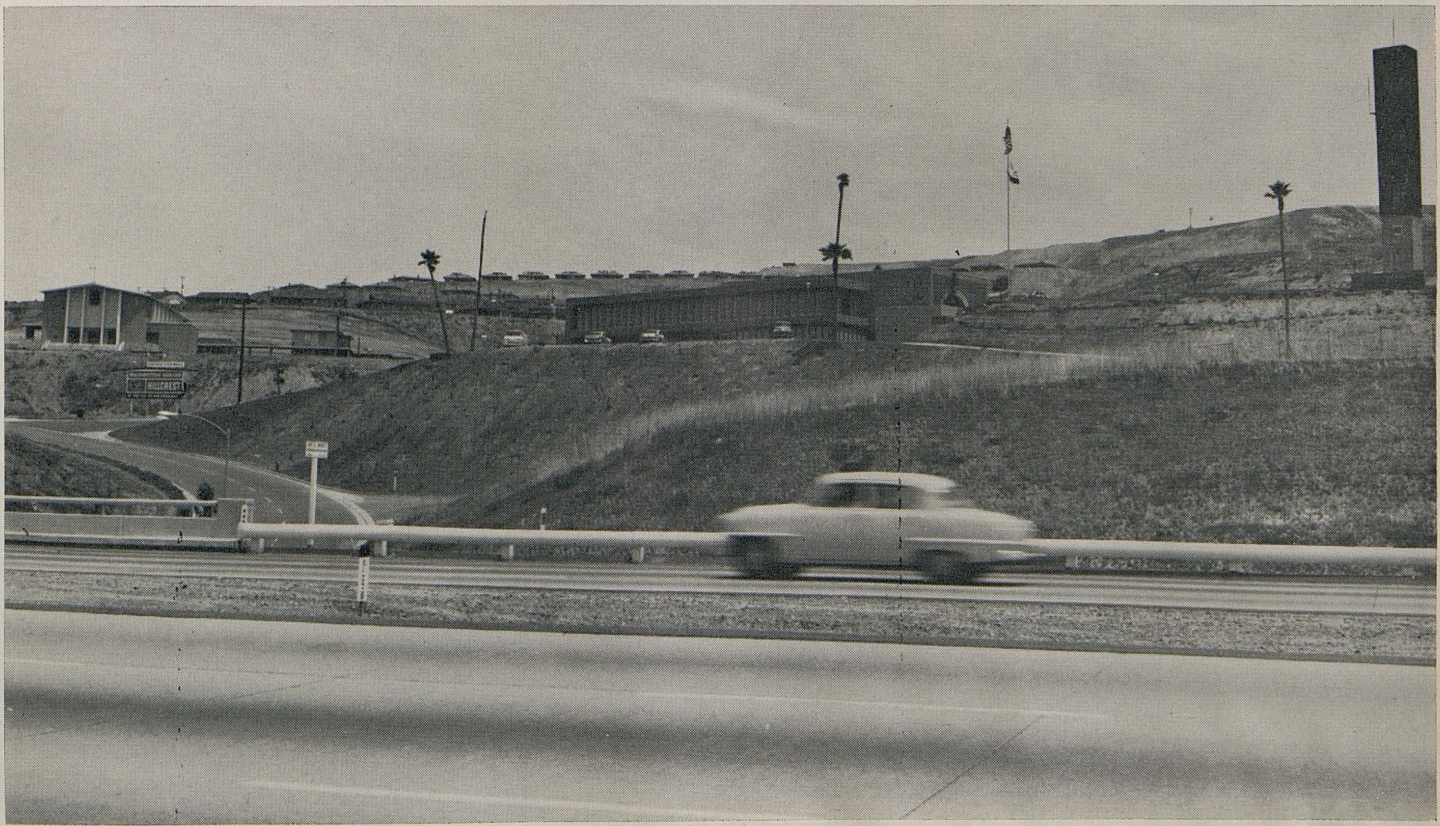
Asked further about detrimental effects of the freeway, he answered: "Who says it was detrimental? Maybe what we experienced was the depression. There is no doubt about the benefits of the freeway to San Clemente."

Benefits Cited

A year ago, when the city was nearing the end of the transition period that followed the opening of the freeway, City Manager Daniel L. Evans declared he was "sold on the freeway." He referred to the city's annual report which listed such accomplishments as city services provided for an average tax cost of $64.75; reduction of city debt; improvements at the city's Beach Club and at the municipal golf course; new streets; a safety record of no lives lost on the beaches; fire prevention program; new water lines installed, and a continuing beautification program.

Boyce Middleton, who has since retired as secretary-manager of the San Clemente Chamber of Commerce, recalled that even before the freeway was completed people living inland began to buy property for homes so they could live in San Clemente and drive to work in other communities. This trend has mushroomed into the current building boom. Building permits rose from $3,716,000 in 1960 to $4,567,000 in 1961. Then, with good transportation assured, the 1962 total jumped to $13,920,000. For the first five months of 1963 the permits issued

As the traveler approaches San Clemente from the north via the San Diego Freeway, signs remind him to watch for offramps in case he wishes to stop for gasoline, a meal or a bit of sightseeing in the picturesque seaside community



San Clemente's new civic center, housing police, fire and other departments of city government, overlooks the San Diego Freeway, business district and ocean from its hillside location. At left is recently completed church. Many new homes are being built in this area.

As the San Diego Freeway passes through the City of San Clemente it takes through traffic off the streets, yet is close enough to the business district to provide excellent local transportation service.

San Clemente's 18-hole municipal golf course not only provides recreation for residents and visitors from nearby Camp Pendleton, but puts some $30,000 a year into the city treasury. A salesman calls on industrial firms in all parts of Southern California to line up tournaments. The San Diego Freeway brings the players from distances that would have been discouraging in the prefreeway days.

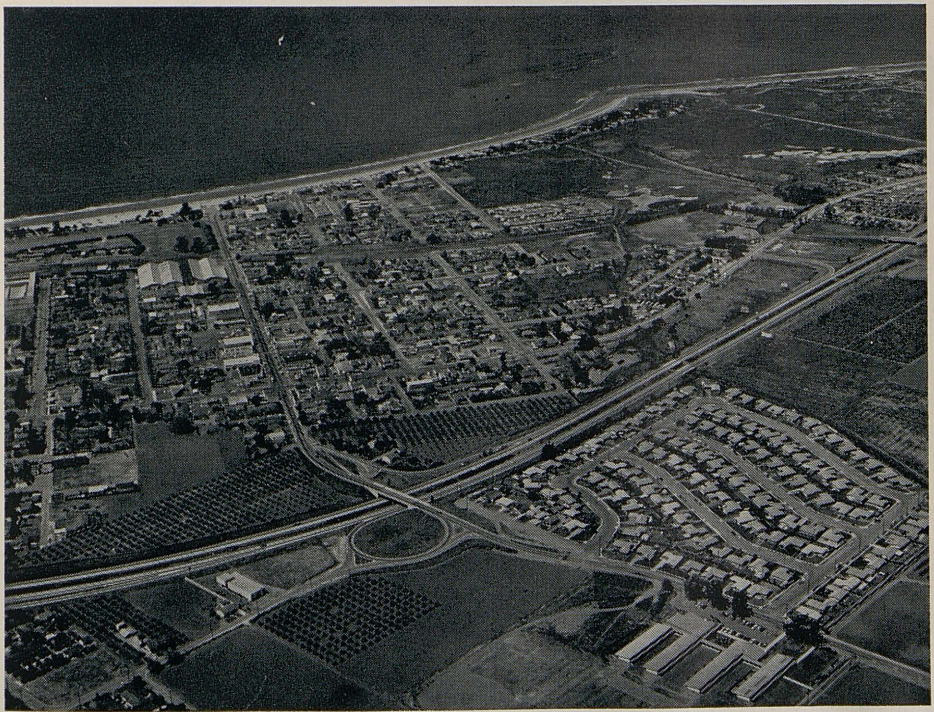
amounted to $7,836,000. At midyear the chamber of commerce estimated that 1,400 homes were under construction or ready to start.

City 5 Miles Long

San Clemente, as it developed along both sides of the old Pacific Coast Highway, is five miles long. It starts four miles south of the junction of U.S. Highways 101 and 101-Alternate at Capistrano Beach, and its southerly limit is the Orange-San Diego county line. The San Diego Freeway as it passes through the city is only one or two blocks from the main street and slightly above it on the hillside. It is so landscaped that its traffic is hardly seen or heard from the street, and the shrubbery beautifies the hills where new homes are being built.

The most northerly on and off ramps are at Avenida Pico, leading to an area which is planned for light industry. Proceeding south, the next ramps are at Avenida Palizada, center of the business district. Other access points are at El Marino, Avenida Cordoba, at the point where the freeway crosses over El Camino Real (the main street), and at the southern city limit. Underpasses and overcrossings at a number of the principal streets enable traffic to move freely between the beach side of the city and the hillside areas. An underpass and short drive up the hill give direct access to the civic center where the police, fire and other city departments are located.

Since the San Diego Freeway came to San Clemente in November, 1960, through traffic, especially heavy on weekends and holidays, no longer clogs the main street, and residents are able to drive freely in the business district.



Well-located overcrossings and ramps facilitate the movement of traffic between the older part of San Clemente, lying between the freeway and the beach, and recently developed areas on the inland side of the city.

Most of the new commercial development has been on Avenida del Mar, which leads from El Camino Real to the hearth of the beach area and the municipal pier. The chamber of commerce, which formerly occupied quarters with the city offices in a converted garage, now has its own building on El Camino Real.

Community Values

Community values accruing to San Clemente from the San Diego Freeway, as expressed by civic leaders and by anonymous residents queried at random, may be summarized as follows:

Traffic congestion on El Camino Real and other city streets has been relieved. Through traffic, now on the freeway, no longer has to move through five miles of streets. Residents drive easily from their homes to shopping districts and the beach.

The rate of population growth has been accelerated.

Large areas are being developed for residential purposes.

. . . *Continued on page 70*

Negative Scribing

New Instruments and Film Increase Accuracy, Neatness

By JOE GAGE, Senior Delineator, District III

Negative scribing is a method of preparing copy for the reproduction of maps and plans in lieu of producing tracings by conventional drafting methods. It is well established in many private firms and public agencies which have a continuing need for high quality copy with emphasis on utilization of the many and varied advantages of modern reproduction techniques.

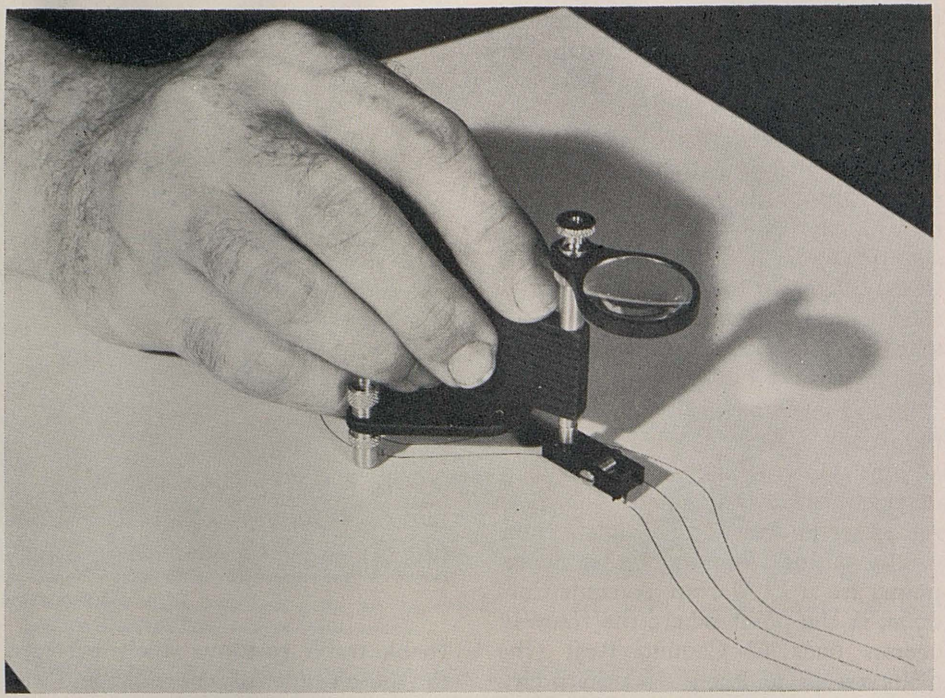
In District III, Marysville, we have recently investigated the application of negative scribing to one phase of the overall reproduction demand, that is, to the copying of photogrammetric maps for advanced planning, design, and rights-of-way.

Standard Procedures

Standard photogrammetric procedures for making maps involve the use of a stereoscopic plotter to compile planimetric and topographic detail from aerial photographs onto a map sheet. The plotter operator does this by continuous observation, interpretation, measurement, and recording directly from the three-dimensional stereoscopic model formed by the overlapping photographs. The product of this operation is a photogrammetric map manuscript—an original drawing in pencil.

The material on which this manuscript is rendered is made of polyester film of the mylar type. Although very tough and stable, it is quite abrasive and does not lend itself to good pencil take without a certain amount of rework. Also, neatness varies between individual operators. In short, the manuscript does not always meet the requirements for good reproduction.

Several methods have been tried for the preparation of good, readable copy without altering the inherent accuracy of the manuscript. But, without a doubt, scribing produces quality copy superior to that of any other drafting technique.



Scribing with a swivel cutting tool.

Scribing with a sapphire-tip cutting tool.

The scribing principle is very much the same as drafting. The only difference is that opaque material is removed instead of applied as with pencil.

Coating Is Transparent

Scribing film is also a mylar-type polyester film, but with a semiopaque emulsion on its surface. This coating is sufficiently transparent to allow tracing on a light table from copies under it, but yet filters out the intense arc light, except for scribed lines, when used as a copy negative.

The opaque emulsion is removed with special scribing instruments which have precut points ranging from 0.00025-inch to 0.03-inch line width. These produce a negative from which sharp, clear contact film reproductions can be made showing the most intricate details.

The instruments are numerous in types and styles. The points are much the same as phonograph needles made of carboloy steel or with sapphire tips, resulting in extreme accuracy and consistency of line weights. This is especially useful when fine lines are needed to show congested contours in mountainous areas.

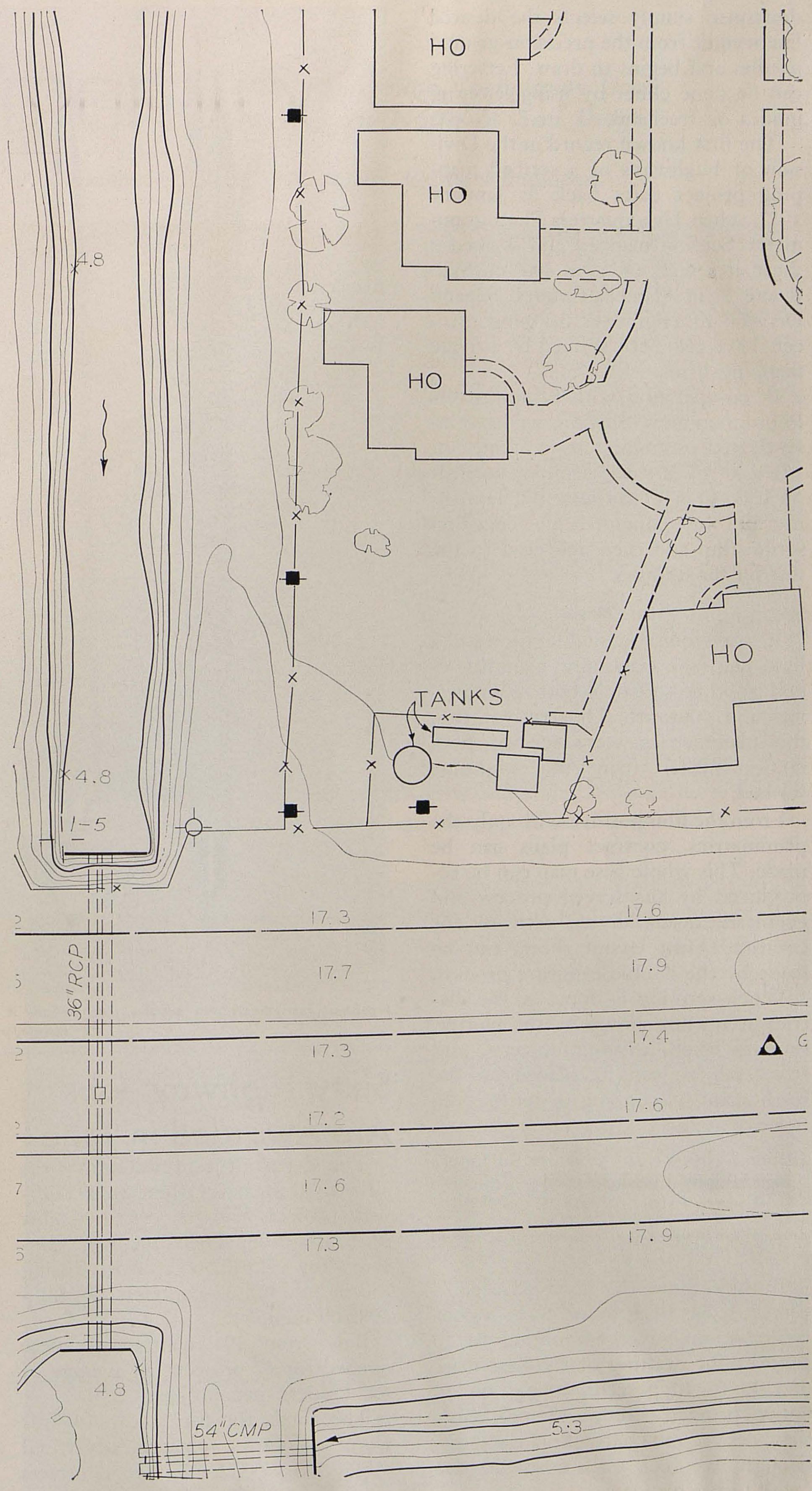
The steel needles have to be held vertically and can be used freehand. The sapphire tip can be used the same as the steel; however, it is not necessary to hold the needle vertically when used freehand to obtain a clean, sharp line. These can be used exactly as a pencil for lettering and line work.

Corrections or Changes

Corrections or changes are made by simply painting out an area with a special opaque compound and rescribing. Tedious dashed lines can be drawn as a single line, then dotted with the fluid to make a uniform broken line as desired.

A scribed drawing has no comparison in reproduction. There is not the density of ink or pencil to worry about and line weights made needle sharp are still reproducible.

Training the draftsman to scribe is far less extensive than training him to do neat ink or pencil work. The worries of ink splatters, line density, pencil weights, and smears and smudges do not have to be considered. The



A print from scribed copy. Scale is 1 inch to 50 feet.

draftsman simply selects the desired line weight from the precision-ground needles and begins to draw. Lettering can be done either by using lettering guides or freehand.

The first known record in the Division of Highways of a scribed mapping project dates back to January 1957, when Headquarters Photogrammetry Section mapped and scribed a sheet at a scale of 1″ = 400′ on Sign Route 21 in Alameda County. Several Division of Highways mapping projects have also been scribed by private mapping firms.

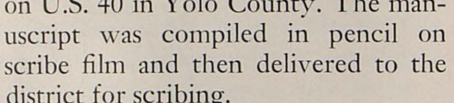
In co-operation with Headquarters Photogrammetry Section, we have investigated scribing at a scale of 1″ = 50′ on a small mapping project on U.S. 40 in Yolo County. The manuscript was compiled in pencil on scribe film and then delivered to the district for scribing.

Base Map

It was found desirable to have a base map showing only planimetrics and another showing both planimetrics and contours. To arrive at this, the planimetrics were scribed first, copies made, then the contours scribed.

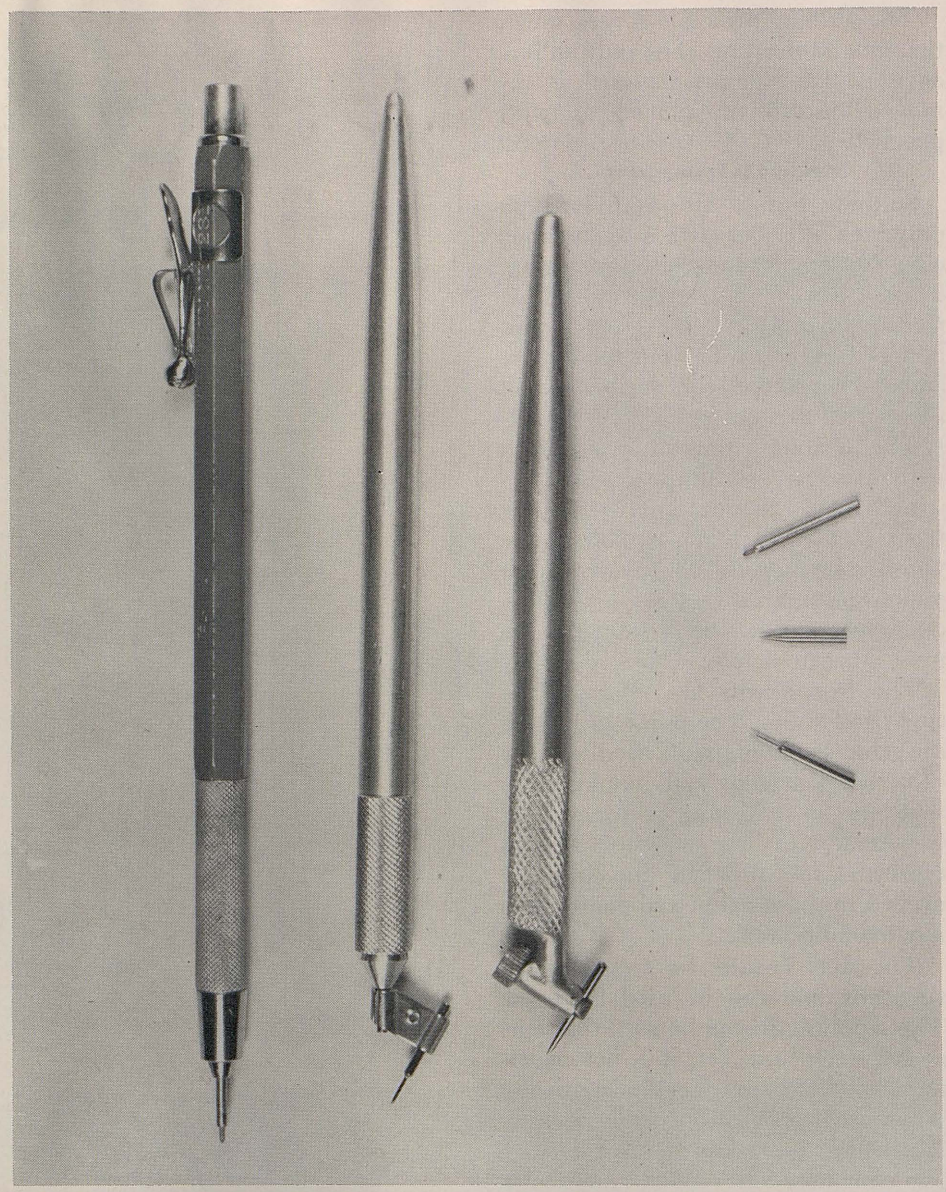
From the film positive with only the planimetrics, contract plans can be made. This whole base map can be reproduced by the screen process and geometric details drawn with ink for contrast. Then layout sheets can be made by the double exposure process.

When scribing is done by the district, items not shown by the plotter, such as labels, existing culverts, and street names, can be placed on the manuscript by scribing or on the film positive in ink.



An enlarged diagrammatic cross section of scribed film.

In the scribing this district has completed, it has been found to be a considerable timesaver amounting to 10 percent for drafting of the base map, and 30 to 40 percent savings on an entire project through the right-of-way, design, and contract plans stages—enough, we feel, to warrant its use on all future projects.



Freehand instruments and needles. Top needle is sapphire tipped; middle needle, carboloy; bottom needle, plain steel.

Sixty Highway Jobs Are Awarded in June

The department of Public Works advertised for bids in June on 49 highway projects with an estimated cost of $23,257,100. There were 60 contracts for $34,872,600 awarded during the month and 32 contracts for $30,298,200 completed.

Bids from 191 contractors were opened for 47 projects, an average of 4.1 bidders per project.

The totals for fiscal year 1962-63 were as follows: projects advertised —545, for $353,163,700; contracts awarded—501, for $286,514,400; contracts completed—564 for $387,642,800.

Bids were received from 2,772 contractors on 523 projects, an average of 5.3 bidders per project.

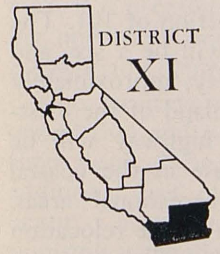
1,083 PLANS CHECKED

The schoolhouse section of the Division of Architecture checked and approved the plans and specifications and supervised the construction on 1,083 primary, secondary and junior college projects during the fiscal year which ended June 30. The projects ranged from $10,000 alteration jobs to the construction of multimillion-dollar junior college plants.

Fill Settlement

New Foundation Techniques Used At Lagoons North of San Diego

By R. F. KOCHER, H. C. CHISHOLM and G. A. SMITH, Resident Engineers



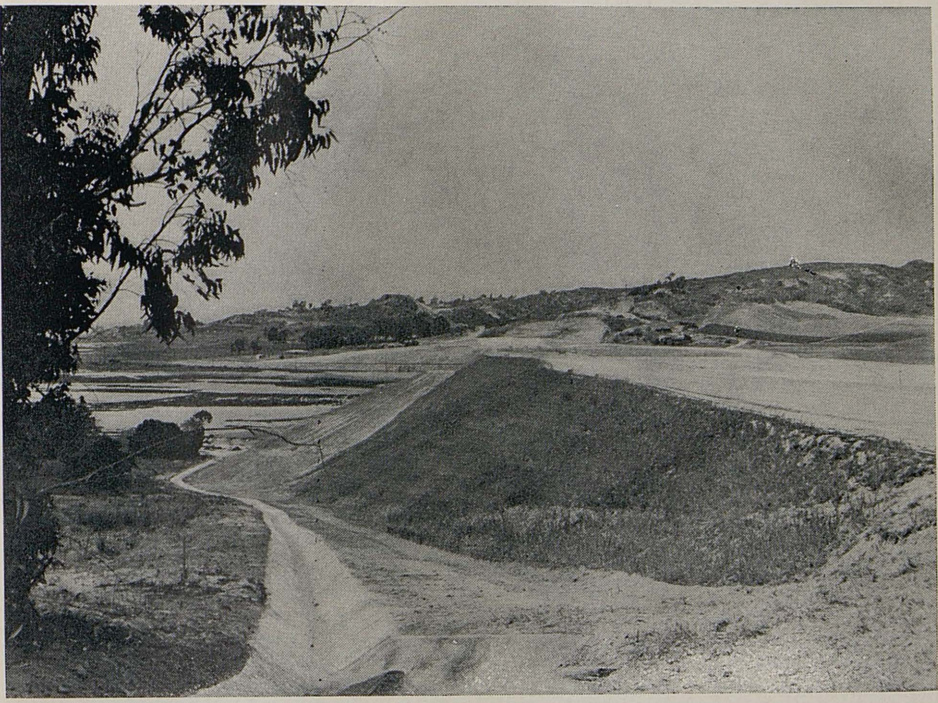
San Diego, with a population of 617,000 is now the third largest city in California. There is an additional 550,000 population in adjacent communities. This rapidly expanding metropolitan area is located in the extreme southwest corner of the State. This unique location contributes to transportation problems since traffic is limited on the west by the Pacific Ocean, on the south by the international border and to the east by mountains, deserts and vast distances. The greatest volume of commodities and numbers of people are transported upon highways to the north.

The major arterial highway to the north is Interstate 5 (U.S. 101), a very important part of the interstate highway system. Interstate 5 within San Diego County is a part of the only interstate highway to traverse the entire length of the State.

U.S. 101 for the 35-mile distance between San Diego and the southerly terminus of the freeway through Oceanside and Carlsbad generally consists of a four-lane divided highway passing through the City of Del Mar and the communities of Solana Beach, Encinitas, Cardiff and Leucadia. Not long ago these were small beach communities; however, now they are important suburban residential areas of the greater San Diego complex.

Traffic congestion, particularly at the numerous intersections and at traffic signals in these communities, occurs with regularity. Numerous accidents, too many of which were fatal, have taken place on this section of highway and have resulted in considerable public reaction.

The accident rate on the existing highway has been increasing with the volume of traffic. The 1962 A.D.T. was 33,900 vehicles a day. Traffic vol-



The settlement fill at the San Elijo Lagoon showing the strut on the left side.

Another view of the fill at the San Elijo Lagoon showing the strut to the left.

ABOVE PHOTO. Aerial of the San Elijo Lagoon showing the surcharge fill and struts looking north. BELOW. Another aerial of the San Elijo Lagoon fill taken higher up and looking south along the coastline.

ume in 1954 was 25,500 vehicles a day. The 1954 rate was approximately twice that of 1946, the year that study, discussion and planning for improvement or relocation of this portion of U.S. 101 was started after World War II.

Relocation Is Best Answer

Engineering studies concluded that the best answer to the problem was relocation of this portion of 101. The planned relocation will be a six- and eight-lane full freeway, approximately three-fourths mile inland of the existing road. The old highway will be retained for local use in the coastal communities and recreational areas. Eventual completion of the relocation will remove the last traffic signal on the coast highway between downtown San Diego and Los Angeles. Construction will be divided into approximately 15 projects, over a period of five to six years.

Three projects, representing a cost of $\$4\frac{1}{2}$ million, have been completed to date and work on another project, anticipated to cost $2 million, started recently. The primary objective of these completed projects was the construction of fills through poor foundation areas. The new alignment is intersected by several coastal valleys that are close to sea level elevation. The combination of ground water and fine-grained sedimentary soil makes these areas poor foundation for the roadway embankments.

Ten years ago, various sections of the freeway between Oceanside and Carlsbad were built through poor foundation areas "from the ground up." Foundation treatment of these unstable foundation areas consisted of dragline removal of unsuitable material to depths of four to six feet. The resulting trench was backfilled with suitable material. Embankment was then constructed in a normal manner, up to and including paving.

Improved Methods Developed

Since that time, improved methods have been developed for the treatment and handling of poor foundations. The treatment of the fill foundations on the just completed projects was completely different from that previously used in this area. Embankments on these projects have been constructed directly upon the original ground without any prior treatment. The weight of the embankment is used to force excess moisture out of the foundation soils, with a resultant consolidation and increase in strength of the "in place" material. A large portion of the consolidation occurs during construction operations; however, it is necessary to delay final paving operations until this consolidation is essentially complete.

The "waiting period" between fill completion and paving may be up to three years, during which time several additional feet of consolidation may occur. Consolidation of the foundation soils is paralleled by settlement of the fill. Total settlement on some of the work completed is anticipated to be as much as seven feet. Acceleration of the settlement rate is obtained by placing a "surcharge" or additional height of fill above the planned grade elevation. This surcharge is removed prior to final paving operations.

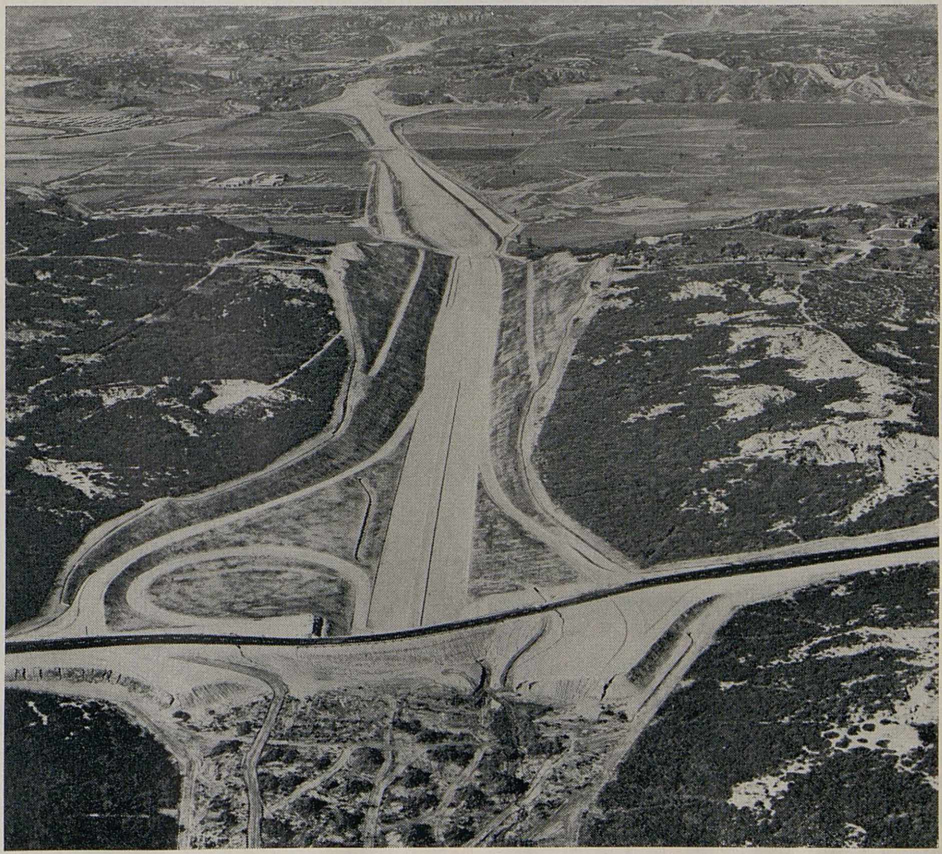
Some Hazards

There are some hazards to the "ground up" approach, necessitating the application of carefully controlled construction procedures.

The construction of a high fill upon a structurally weak foundation soil increases the possibility of a foundation failure during the construction period. A saturated clayey foundation soil may be squeezed out laterally by the weight of the fill. This displacement would cause the fill, or portions thereof, to go down and possibly sideways. The original ground beyond the toe of the fill would rise or "heave." A "mud wave" may be formed under such conditions. Since this lateral movement or flow is a form of plastic flow, a major shear failure can result if the deformation occurs in large size.

The results of such shear failure may be disastrous. Complete loss or at least differential settlement of the fill, cracks and voids in the fill, and heave damage to adjacent property may occur. In some cases, complete removal and/or reconstruction of the fill could become necessary. To reduce the possibility of failure, the specifications of the completed con-

The 4,000,000-cubic-yard settlement fill across the San Dieguito River Channel showing the left strut.



Second contract, after completion, looking north. Fourth Street is in the foreground, the future Via de la Valle interchange in the background. The fill across San Dieguito Valley, upper portion of the picture, is to be completed under the current contract.

tracts provided for several protective features.

One provision was that fill placement could not exceed a certain rate. This rate varied according to the conditions encountered. On two of the projects, where very poor foundation soils were found, the rate was two feet in height during any seven calendar days. On the third project where somewhat better foundation soils were encountered, the rate permitted was three feet per seven days.

A structural feature, used to guard against foundation failure, was the construction of a low fill adjoining and contiguous with the main fill. This low fill is known as a "counterpoise" but commonly referred to as a "strut." The ballast or counterweight action of this strut resists lateral movement of the foundation soils.

The application of "rate" and "strut" features does not preclude all possibility of failure and there are economic limitations to their use. An excessively slow but safe "rate" would delay work completion. Overwide or oversize "struts" represent a waste of fill material and the purchase of additional right-of-way, both of which increase cost.

Continual Check

During construction operations, it is one of the many responsibilities of the resident engineer to continually check for signs of instability in the fill foundation. Should this checking indicate the established "rate" and "strut" provisions are not adequate to assure stability, additional measures must be taken immediately.

One such measure could be temporary discontinuation of filling, with work permitted to resume when consolidation of foundation soil had advanced to the point where it would support the weight of additional fill.

Another method would be the widening of struts.

Checking for signs of instability in fill foundations is done in several ways. Lateral movement in the foundation may be detected by "heave stakes." These stakes, of known original location and elevation, are set in the original ground at the toe of the fill. Periodic checks of the stake elevation and location are made. Any displacement of the stake from its original position indicates relative movement of the foundation.

A rapid and inexpensive method of checking displacement is the use of the "inclinometer." This device, recently developed by Arthur Root of Headquarters Materials and Research Laboratory, consists of a flexible plastic tube driven vertically into the original ground at the toe of the fill. Any subsurface movement of the soil will put a relative amount of curvature in the tube. The presence and magnitude of curvature may be established by "sounding" with metal rods of various lengths lowered into the tube. The curvature of the tube is indicated by the longest length rod that may be lowered to the bottom of the tube.

Valuable Instrument

One of the most valuable instruments, used to detect conditions that could contribute to foundation failure, is the piezometer. This apparatus is used to measure the hydrostatic pressure beneath an embankment. Should the rate of placing the fill be relatively greater than the escape capabilities of water in the foundation soils beneath the fill, an increase in hydrostatic pressure will result. If this pressure becomes excessive, failure may occur. There is little hazard where the foundation soil is coarse grained, because the water can be forced out rapidly. Major hazards are with fine-grained soils, where the smaller soil pores do not permit rapid escape of the water.

Actual construction began on the first of the projects through poor foundation areas of U.S. 101 in August 1961. This $2,400,000 project, awarded to Peter Kiewit Sons Co., consisted primarily of the construction of two bridges, 3,400,000 cubic yards of roadway excavation and 61,000,000 station yards of overhaul. The project was 3.24 miles in length and was located just east of the communities of Solana Beach, Cardiff and Encinitas.

The contractor's "dirt spread" consisted of six LeTourneau-Westinghouse B Tournapulls, with tandem scrapers. Two D-9 caterpillar tractors were used to push load. D-8 tractors were used to rip the cuts prior to loading. Fill material was spread with a Bege land leveler and compacted by a Wagner self-propelled compactor and by routing hauling equipment across the fill. This "dirt spread" averaged 14,000 cubic yards of roadway excavation per 7½-hour work shift. The average payload of the tandem scrapers was approximately 45 cubic yards. The contractor had to con-

The north bridge cone embankment at Batiquitos Lagoon.

struct a working platform across soft and yielding original ground prior to hauling through these areas. This platform was built by dumping and then dozing the materials into place.

In addition to a two-foot "rate" requirement, this project provided that certain fills would be built to elevations of 50 and 25 feet, respectively, above original ground, at which time no further work was permitted for a period of 60 days in one case and 180 days in the other. At the end of these delays, fill construction was permitted to resume. This special treatment applied to areas where the surface elevation of the original ground was up to five feet below water level of two lagoons and where very poor foundations existed.

Settlement Rate Checked

The rate of fill settlement was periodically checked during the work. At San Elijo Lagoon, this settlement was very uniform and appeared to be directly related to rate of loading. No "mudroll" or "heaving" was apparent and it appeared that moisture in the foundation soil was readily exuded.

At Batiquitos Lagoon, the settlement of the fill was very rapid but appeared nonuniform. Differential settlement occurred at the south end of the lagoon and random cracking of the fill occurred during the 180-day "delay" period. At the end of the waiting period, fill operations continued as planned. The cracks were covered by normal filling operations. There is no evidence that the newer upper portion of the embankment is

The fill across Batiquitos Lagoon under construction, looking north from Encinitas. The City of Carlsbad is in the far background.

conveyor belts rated at 140 cubic yards per hour capacity by the manufacturer, was capable of supplying a volume of concrete much greater than the amount a normal deck finishing crew could handle.

The contractor was represented on the project by Angelo Weir, super-

viously discussed project. Both projects were built concurrently and many of the conditions encountered were similar.

Roadway excavation was removed from two large cuts on this 2.54-mile project. One cut contained 3,000,000 cubic yards within 40 stations, or an

The settlement fill across Batiquitos Lagoon, strut in the right foreground.

weekly. Settlement was fairly rapid and uniform, and appeared directly related to rate of loading. Piezometers indicated no excessive hydrostatic pressures. Inclinometers indicated no appreciable displacement or "heaving" at the toe of the embankment. All devices and observation, in fact, indicated that the fill rate of 3 feet per seven days, and the designated "struts" were adequate safeguards.

A portion of the project was "surcharged" to accelerate settlement and a portion was not constructed to final grade because it was anticipated that the ultimate fill height of 90 feet at this location would place such a large weight upon the foundation that failure could result. Construction of this fill will resume, on a separate contract, after a one-year "waiting period" during which consolidation and resultant strengthening of the foundation will continue.

The embankment at the south side of Batiquitos Lagoon. Note the "heave stakes" at the top of the embankment.

The contractor's force on this project was basically the same as on the first contract. Roger Kocher was the Division of Highways resident engineer.

Third Project

The third U.S. 101 project was awarded to the contractor, Earl Brown and Earl Brown, Inc. This project, constructed at a cost of $583,000, is 1.83 miles in length and is located southeasterly of Del Mar. The work consisted of 640,000 cubic yards roadway excavation, construction of frontage roads and major drainage facilities.

The contractor used Caterpillar DW-21 and 631 motor scrapers, push loaded by Caterpillar 660 and 630 tractors. Compaction was accomplished by routing the hauling vehicles and by a 10,000-gallon water wagon. The "dirt spread" on this project handled 8,000 to 10,000 cubic yards of roadway excavation daily.

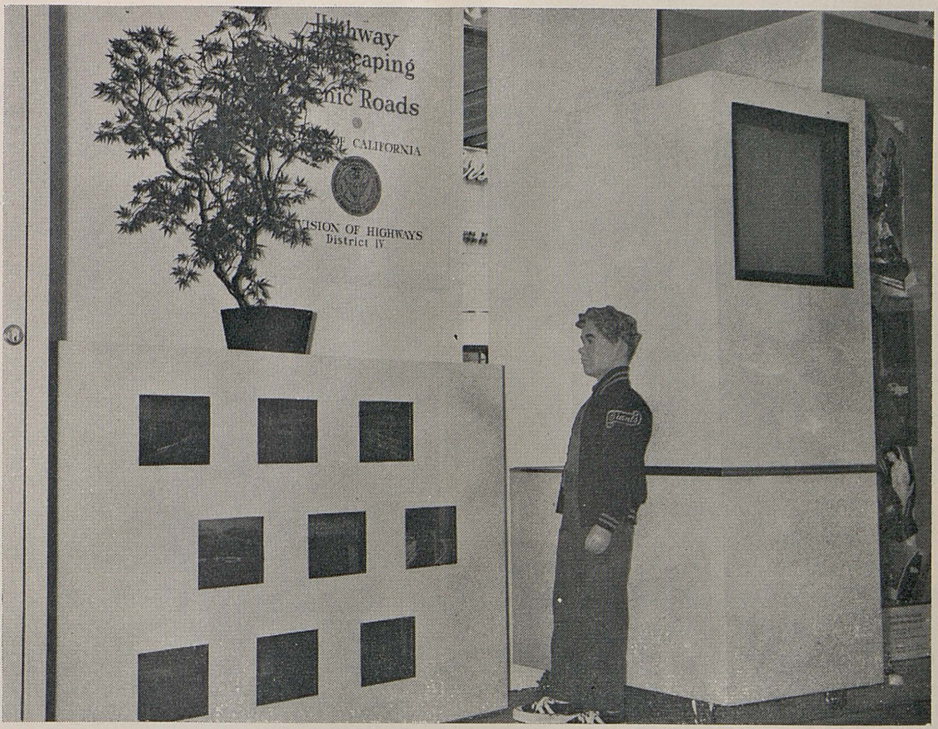
Similar conditions to those encountered on the two previously discussed projects were found.

This project constructed fills over the Sorrento Valley slough, thus basically completing those portions of U.S. 101 relocation that crossed areas of poor foundations. Resident Engineer for the Division of Highways on this project was Henry C. Chisholm.

The fourth contract, which is just commencing, will encompass the limits of the second and third contracts recently completed. Approximately half of this $1,800,000 project will be bridge work. The plans provide for structures at Via de la Valle, San Dieguito River, Fourth Street and Carmel Valley Road, plus a multiple box culvert just south of Carmel Valley Road. Construction is by R. E. Hazard Contracting Co. and W. F. Maxwell Co. and includes grading and paving frontage roads plus completing the surcharged fill across the San Dieguito River Valley.

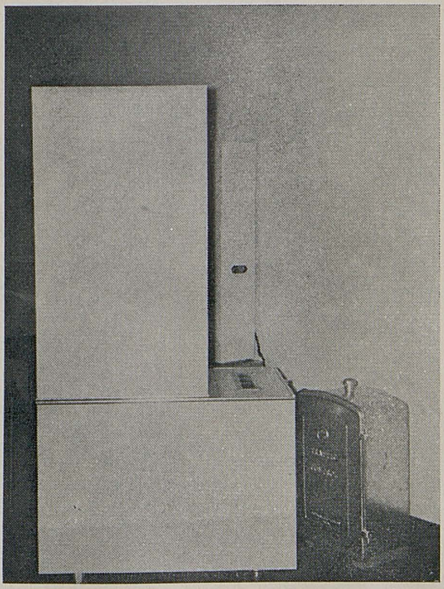
The first paving contracts on the relocation are set for advertising in late 1963.

The early construction of the fills across the potentially unstable lagoon areas should result in a facility constructed on well-stabilized embankment, at a minimum cost.

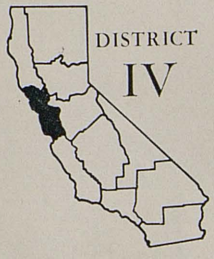


Designed to display colored transparencies of highway landscaping, scenic roads, planning steps, etc., nine windows of box to left are activated either in sequence or all at once by electronic programing. (This is photo of exhibit in use in department store display window. Maintenance procedure has simply been daily visit to make sure no lights burned out.)

District IV Develops Effective New Technique For Illustrating Highways



Side view of device at right in top photo. Inside lower unit, under grill, is slide projector holding 80 slides which are projected in screen (see photo above, upper right) by series of mirrors. Slides also are changed electronically, and suitable titles can be interspersed between pictures.



Ingenuity in District IV has produced two excellent audio-visual aids for displaying color transparencies either as a small independent exhibit, or in combination with other elements in a large exhibit. Both are planned to use the psychology of a changing series of photos to attract attention with movement.

Captions on these photographs explain how each of the units operates. The large transparency dislay has already been used effectively in a large San Francisco hotel, and in a display window of a large department store. Plans and instructions for building similar units can be made available by District IV to other interested districts.

National Highway Week

The National Highway Week exhibit at Los Angeles International Airport.

In California the third annual National Highway Week, May 26–June 1, 1963, was far more extensively observed than either of its predecessors.

Unfortunately, despite Governor Edmund G. Brown's exhortation in his National Highway Week statement to "make our driving worthy of our highways," the observance was marred by an unusually high total of fatal accidents during the Memorial Day weekend.

The long-range results of National Highway Week, on the other hand, were clearly on the plus side. Through the media of the press, radio, television, speeches, graphic displays and informative "handouts," hundreds of thousands of Californians, perhaps more, were enabled to learn a great deal about the progress and problems of their state highway system.

Local, Statewide Progress

The State's press, as it has in the past, gave widespread "play" to National Highway Week, with emphasis not only on local and regional highway progress but also with extensive mention of the statewide picture. A 17-page news release citing the highlights of recent, current and budgeted freeway construction and other improvements, as listed by State Highway Engineer J. C. Womack, was widely used. This release showed that as of the end of May 1963 California had:

—Increased its mileage of full freeways by 214 miles in the past year, of which 54 miles were converted from expressway standards by replacing crossings at grade with separation structures. The State now has 2,584 miles of multilane divided highway in operation, of which 1,187 miles are

Undersecretary of Commerce Clarence D. Martin is shown speaking at the dedication of a portion of the San Diego Freeway in southwestern Los Angeles during National Highway Week. The signs in evidence in the crowd refer to an interchange on an adjoining project.

full freeway. Another 400 miles of freeway and expressway are under construction.

—Completed, placed under construction, or under engineering design a total of 2,048 miles of its 2,177-mile segment of the national interstate highway system.

—Expended or obligated, according to latest figures of the U.S. Bureau of Public Roads, a total of $1,422,800,000 on interstate system projects, far more than any other state.

—Adopted routings for 6,537 miles of access-controlled highways, or 53 percent of the 12,400-mile freeway-expressway system established by the Legislature in 1959.

In most areas of the State the various district offices of the Division of Highways supplemented the statewide report with detailed reports of highway developments on a county-by-county basis. Maps showing regional freeway progress were published by several of the larger metropolitan dailies.

Editorials Take Note

Several newspapers took editorial note of the observance.

"Progress is born in the wake of prosperity," said the San Bernardino *Sun*. "And prosperity travels modern highways and freeways that provide convenient and swift transportation.

"California's superior highways and freeways did not come by chance. Men of vision—desiring that the Golden State become the most productive and prosperous member of the union—planned our great system of highways and freeways. Their foresight has paid rich dividends. Not only is California the most populous state, but it also possesses the potential to become a veritable empire of prosperity in the immediate years ahead."

The San Luis Obispo *Telegram-Tribune*, after citing examples of statewide and area highway improvement, concluded its editorial:

"California's major highway system is something to be proud of, and we heartily agree with the division's spokesman that the past year has been one of remarkable progress."

In the northern part of the State, the Red Bluff *Daily News* commented on its major local project as follows:

Carlos Apablasa (left), design engineer in the Division of Highways District VII office, is interviewed by news commentator Alejandro Nervo on Spanish-speaking TV Channel 34 in Los Angeles during National Highway Week.

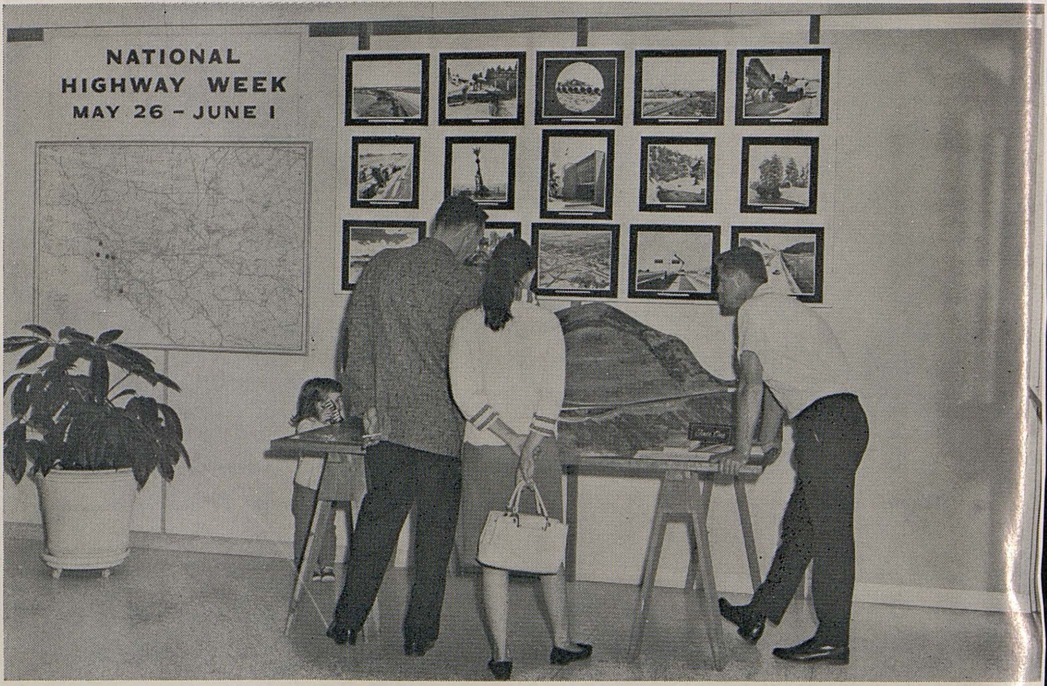
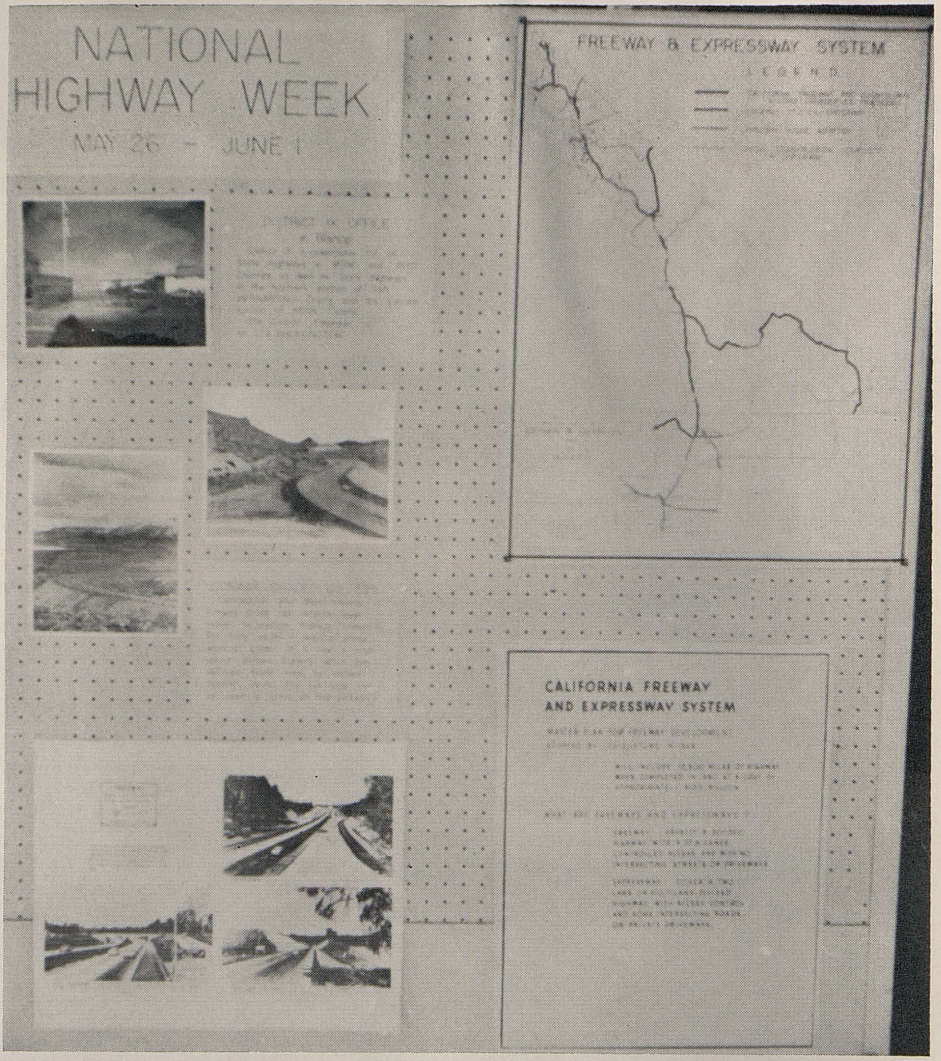


PHOTO ABOVE. K. G. Corbin, delineator with the Division of Highways District VIII office in San Bernardino (right), explains the "Crestline Interchange" model to passengers waiting in the Ontario International Airport lobby.

BELOW. Freeway system exhibit in the San Luis Obispo Public Library.



Display in the front window of a store in Bishop prepared by the District IX staff in observance of National Highway Week.

"This spring with work underway on the bridges that will be the most important part of the Red Bluff Freeway (Interstate 5), there are still some people that feel that it will have a depressing effect on our city's economy.

"But if they will take time to analyze what has happened in other communities they will realize the meaning of Mr. Womack's remark: 'The benefits of properly planned freeways to small and medium-sized cities are becoming more and more obvious. Local traffic makes better use of both the freeway and the local streets, local business is enhanced, and community planning can go ahead on a sound basis.' "

The first six pages of the 16-page "weekend" section of the May 25 San Mateo *Times* were devoted to an article by Vera Graham spelling out in words and pictures the current and projected freeway progress in San Mateo County and saluting the engineering staff of District IV.

Special Events

Although the most extensive observance of the week took place in District VII, where a special Southern California National Highway Week Committee was headed by former Highway Commissioner Robert E. McClure, Santa Monica editor-publisher, there were special events in many parts of the State where the first two versions of the week had received relatively little attention.

In addition to the hundreds of news articles, there were numerous displays and exhibits, talks to service clubs, and, in Redding, even a church sermon.

The exhibits generally featured photographs and maps of highway construction, plus some special activities such as route planning, aerial surveys and landscaping.

Favorite Locales

Public libraries, airports, and Division of Highways district offices were favorite locales for exhibits, as well as local store windows. Among the libraries co-operating were the Kern, Fresno and Inyo County Libraries, and the San Luis Obispo Public Library. There was an extensive exhibit at the Los Angeles International Airport and another at the Ontario International Airport. Downtown windows and commercial lobbies in Los Angeles, San Francisco, Bishop and Stockton carried exhibits.

The District VII observance was highlighted by the dedication ceremonies on May 28 for a key section of the San Diego Freeway (Interstate 405) in the Inglewood area, signalizing the completion of a 41-mile section of this freeway from San Fernando to Long Beach. U.S. Undersecretary of Commerce Clarence D. Martin was the featured guest at the freeway dedication and at the luncheon which followed.

Other Features

Other features of the Los Angeles observance, in addition to the airport display, were two unusual television shows. On one, Elmer Peterson, KNBC newscaster, showed color slides of landscaped freeways made available by Los Angeles Beautiful; and on another, a member of the District VII staff was interviewed in Spanish on Station KMEX.

Through co-operating gasoline dealers the Division of Highways made 150,000 freeway progress maps available to Southern California motorists, with a description on the back of the state and regional long-range freeway plans. The National Highway Week Committee, representing a variety of organizations, also issued news releases and other literature.

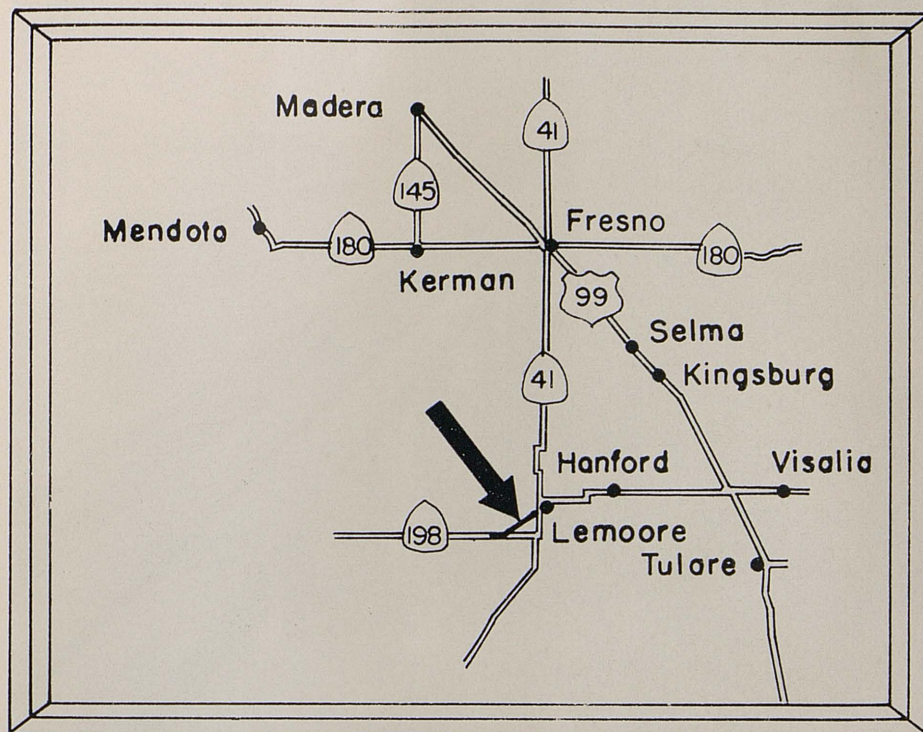
Lemoore Project

Activation of Naval Air Station Advances Freeway Schedule

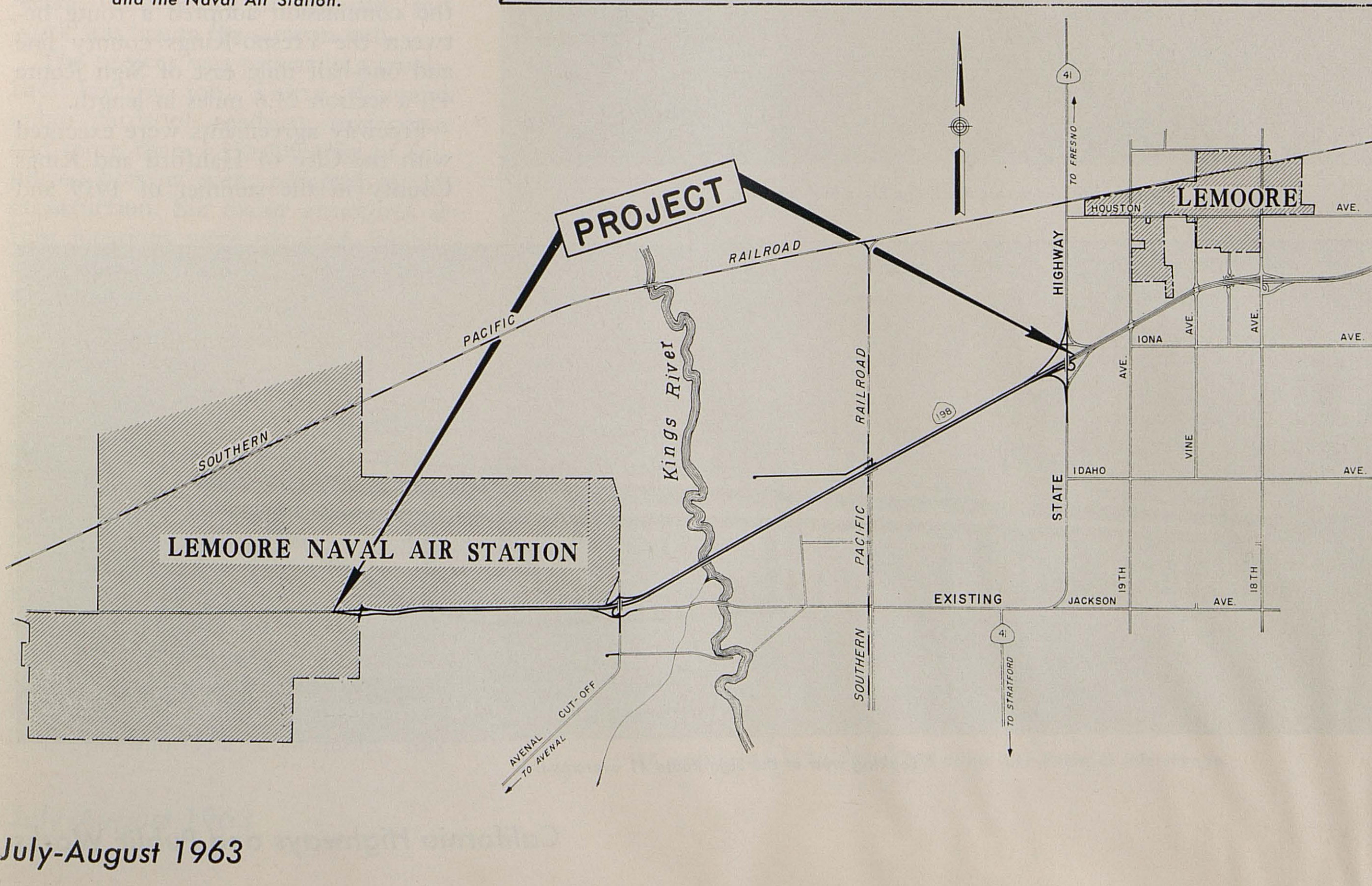
By THOMAS S. ASHLEY, District Advance Planning Engineer, and WILLIAM L. GILFILLAN, Resident Engineer

A flight of Navy jets zoomed overhead as Public Works Director John Erreca cut the proverbial ribbon officially dedicating the first freeway section to be built in Kings County. This is a section of Sign Route 198, 6.5 miles in length between the main gate of the Lemoore Naval Air Station and Sign Route 41 near the outskirts of the City of Lemoore about 40 miles south of Fresno.

Erreca praised the efforts of local citizens and representatives in state government from that area in pushing the project. The opening ceremonies,



These two maps show the general location of the project (right) in relation to neighboring cities and (below) its specific location between Lemoore and the Naval Air Station.



The twin bridges across the Kings River looking west.

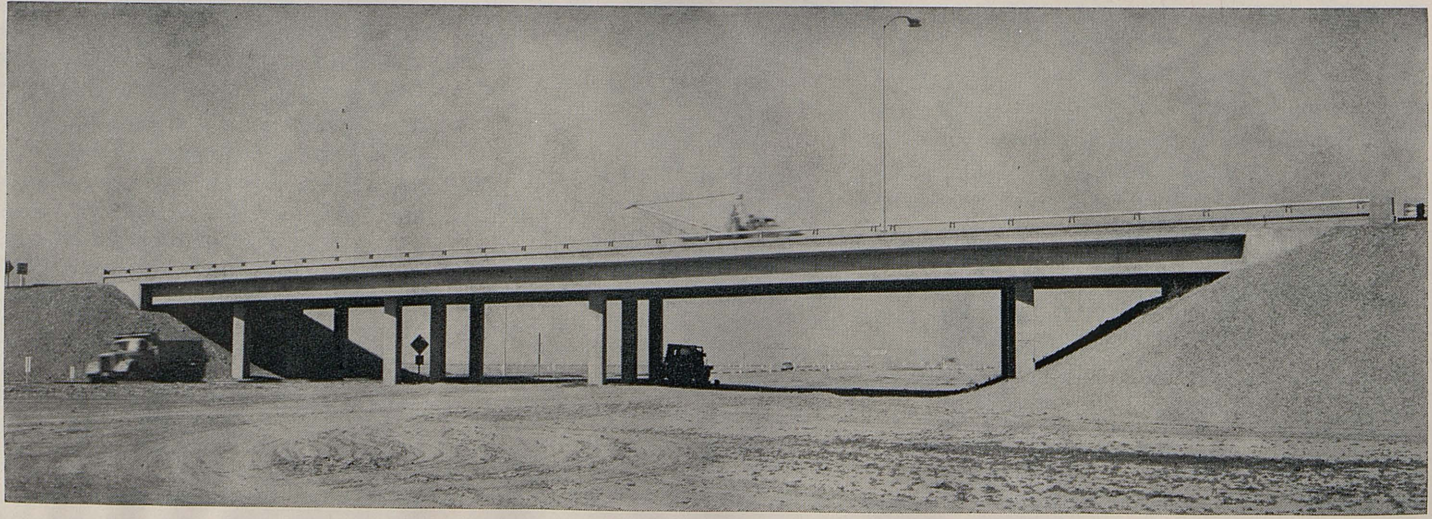
held June 14, were sponsored by the Committee of Twelve, a Kings County citizens group which was instrumental in speeding up the programming of the project. Lemoore's mayor, Arthur DeRadd, was the master of ceremonies.

Planning Started in '53

Planning for the improvement of Sign Route 198 began back in 1953. At that time it was believed the improvement of only the section east of Sign Route 41 was essential. Later, when it became apparent the Navy would build an air station to the west, these limits were revised.

After origin and destination surveys were completed and informal conferences were held with local officials, a public hearing was conducted in June 1957. Because some issues were introduced at this hearing requiring additional study, another public presentation of new facts was made two months later. In November the board of supervisors asked for a delay in route selection until a North Kings County area general plan could be completed. The following year plan studies were ended and a third hearing was held in Hanford September 4th, this time before the California Highway Commission. A month later the commission adopted a route between the Fresno-Kings county line and one-half mile east of Sign Route 43, a section 21.6 miles in length.

Freeway agreements were executed with the City of Hanford and Kings County in the summer of 1959 and



Looking west at the Sign Route 41 overcrossing.

plan preparation began soon after. It was obvious that, with the rate of financing normally available to Kings County state highway construction, the project would have to be divided into construction units of reasonable contract size. Because of anticipated traffic demand to be generated upon completion of the air base, the portion between the main gate of the air station and Sign Route 41 was given top priority. Preparation of right-of-way appraisal maps was begun in October 1959 and the construction plans were completed in July 1961 for this construction unit.

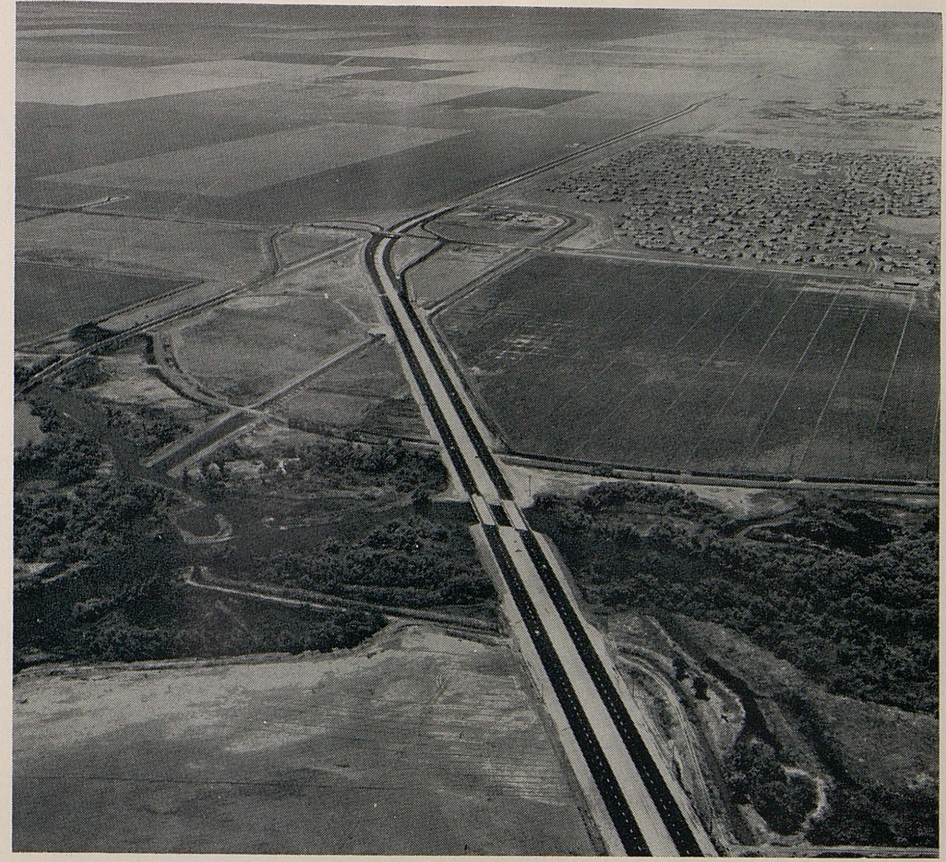
As late as 1960 it had been determined that, due to other pressing projects in the district, a major construction project on the freeway for Sign Route 198 in Kings County could not be financed until the 1963-64 fiscal year. However, in 1961, considering the fact that activation of the air station was scheduled for July of that year, the California Highway Commission decided to advance the project and amended the 1961-62 state highway budget by awarding $3,000,000 for construction.

Contract Is Awarded

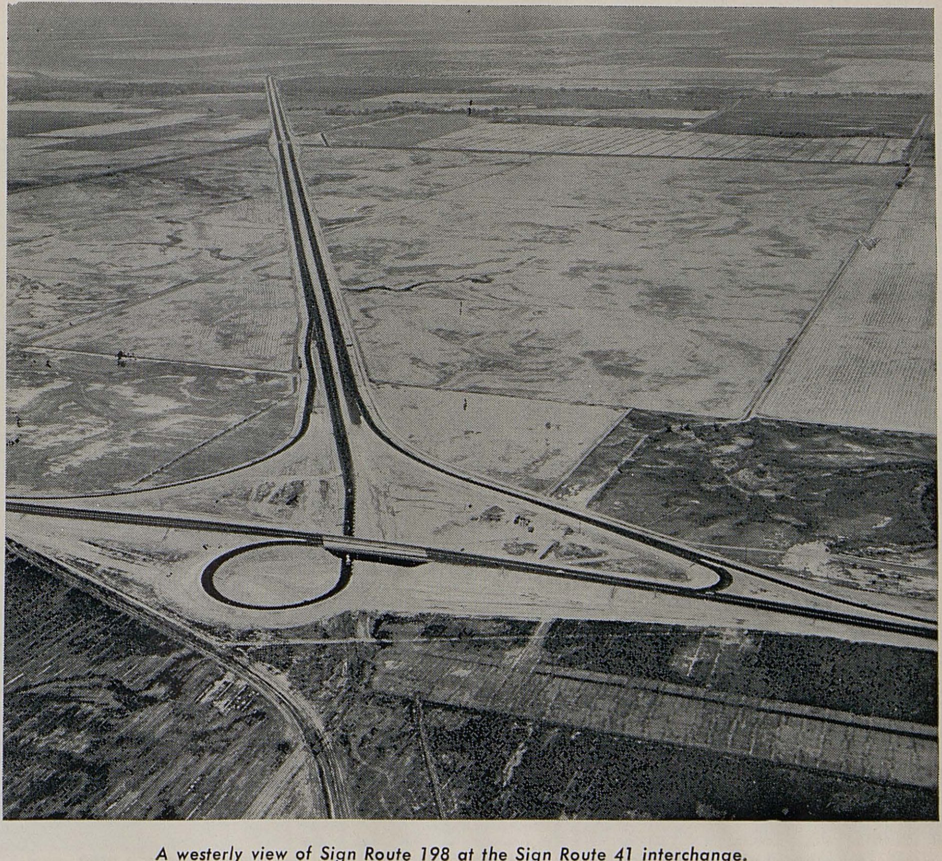
The construction contract was awarded in December 1961 to Miles-Sierra Contractors of Merced and work was begun the same month.

The project was primarily a truck-haul borrow job. Thirty thousand cubic yards of roadway excavation and more than 1,550,000 tons of imported borrow were required in the construction. Six major structures at four locations were required, including parallel bridges at the crossing of the Kings River.

A comparatively simple uniform structural section consisting of three inches of asphalt concrete over six inches of Class "A" plant-mixed cement treated base, all over a uniform layer of eight inches of aggregate subbase material was used throughout the entire freeway portion of the project. The plant-mixed cement treated base feature of this design was the only item unique to the district in that this was the first District VI project requiring a plant-mixed base. The contractor elected to use a 400-ton-per-hour pugmill-type continuous mix

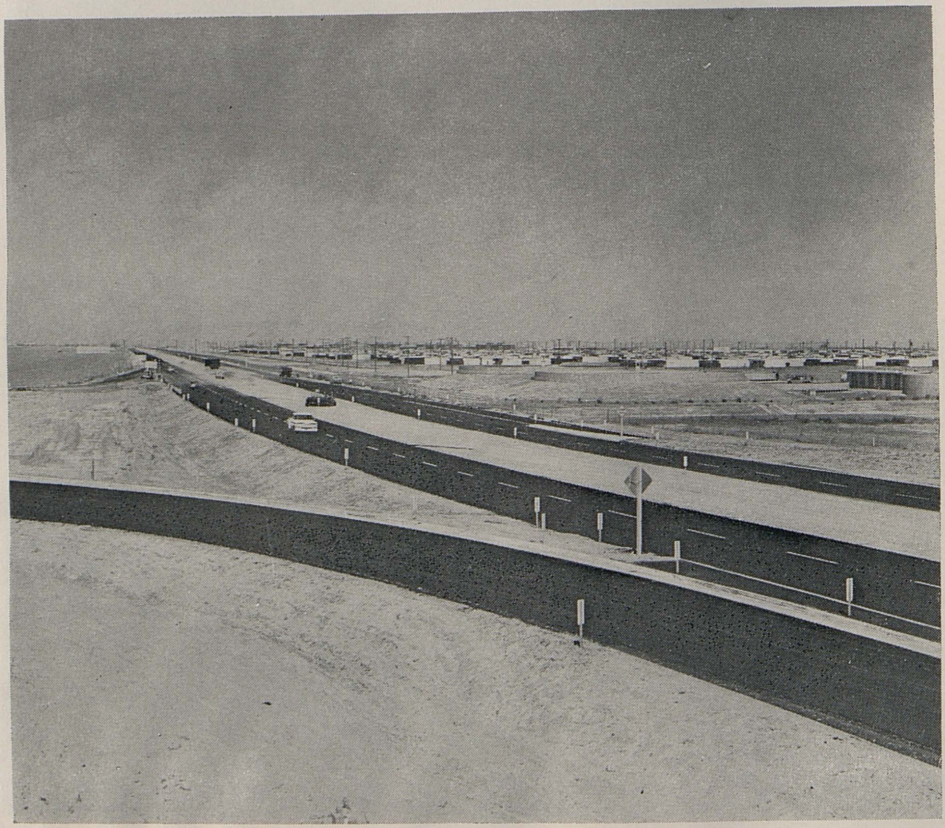


Looking west along Sign Route 198. Part of Lemoore Naval Air Station is in the upper part of the photo. The Kings River is in the foreground.



A westerly view of Sign Route 198 at the Sign Route 41 interchange.

Approach to the entrance of the Lemoore Naval Air Station.



A westward view of the Sign Route 198 freeway and the Naval Air Station residence area.

plant fed directly from bottom-dump trucks to small holding bins which gave him only 25-ton reserve of each size aggregate. Both the plant and quality of mix were, in general, trouble free and produced a very satisfactory, uniform product when placed on the roadbed.

Superintendents Listed

Project superintendent for the contractor was J. M. Martin of Bakersfield. The State's bridge representative was Matt Segal and the construction engineer was J. M. McDowell.

Total construction cost was about $3,000,000.

The next freeway project on Sign Route 198 is scheduled to begin sometime this fall. Plans call for the construction of a four-lane freeway and expressway 10.4 miles in length between Sign Route 41 and 11th Avenue in Hanford.

Other state highway projects in Kings County will follow soon. A two-lane expressway on Sign Route 41 between the Kings River and Elkhorn Avenue has been budgeted and work should begin by the end of the year. About 27 miles of four-lane Westside Freeway (Interstate 5) will course through the county by 1972.

Contract Awarded on Bridge Substructure

A $12,626,402 contract for the substructure work of the future high-level spans over the navigation channel for the San Mateo-Hayward Bridge was awarded to Pomeroy-Gerwick-Steers, San Francisco, on July 5.

The substructure contract is a major unit of a long-range $70,000,000 project to increase the bridge's capacity, presently two-lanes.

The concrete trestle portion of the bridge east of the navigation channel is being reconstructed to four lanes under a $13,250,000 contract, and will be widened to six lanes when traffic requires. The high level portion will be constructed initially to six lanes.

Aerial Inventory

Large-scale Aerial Photos Aid Traffic Engineering

By THOMAS N. TAMBURRI, Assistant Traffic Engineer

(*Editor's Note:* This paper was presented at the 1963 meeting of the Highway Research Board in Washington, D.C.)

Synopsis

In the fall of 1960 and the spring of 1961 the Los Angeles area district and the San Francisco area district of the California Division of Highways were supplied with a 1″ = 200′ scale aerial photographic inventory of most of the existing freeways in those areas. This initial inventory on 348 miles of freeways then existing in these two areas was of an experimental nature to determine whether large-scale aerial photography would be useful for traffic engineering applications such as studies of accident prone locations, determining vehicle paths, and studies of signing problems.

Introduction

The photographs in the Los Angeles area were taken between April 25 and May 12, 1960, and the material was accepted by the Division of Highways on August 18, 1960. The photographs in the San Francisco area were taken between December 22, 1960, and March 23, 1961, and accepted on May 18, 1961. In each case the materials obtained were two sets of 9-inch by 18-inch contact prints on double weight semimatte paper at a nominal scale of 1″ = 200′, two sets of photo index maps, and all negatives. A typical contact print is shown in Figure 1.

The work was done as two separate contracts. The contractors were supplied with 1: 24000 scale USGS quadrangle maps showing flight lines and locations to be photographed. The contracts required vertical aerial photography taken with a camera having a nominal focal length of 24 inches and a negative size of 9 inches by 18 inches. The 18-inch axis was oriented along the flight lines giving a coverage of 1,800 feet wide by 3,600 feet along the highway. Overlap of at least 15 percent was specified.

At interchange locations where ramp terminals were located more than 700 to 800 feet from the flight lines, additional coverage along the crossroads were obtained.

Total cost, excluding engineering by the Division of Highways, for the 348 miles flown was $7,130.40 or $20.49 per mile.

Photos Widely Used

The photographs have been enthusiastically accepted and are being used in a wide variety of ways. Some of these uses include traffic engineering studies, research studies, design, planning, maintenance, project review, programing of improvements, and communications.

Traffic engineers of the California Division of Highways use the photographs to study accident-prone locations, to determine vehicle paths in relation to various geometric features, and to study signing problems. The photographs have also been used to de-

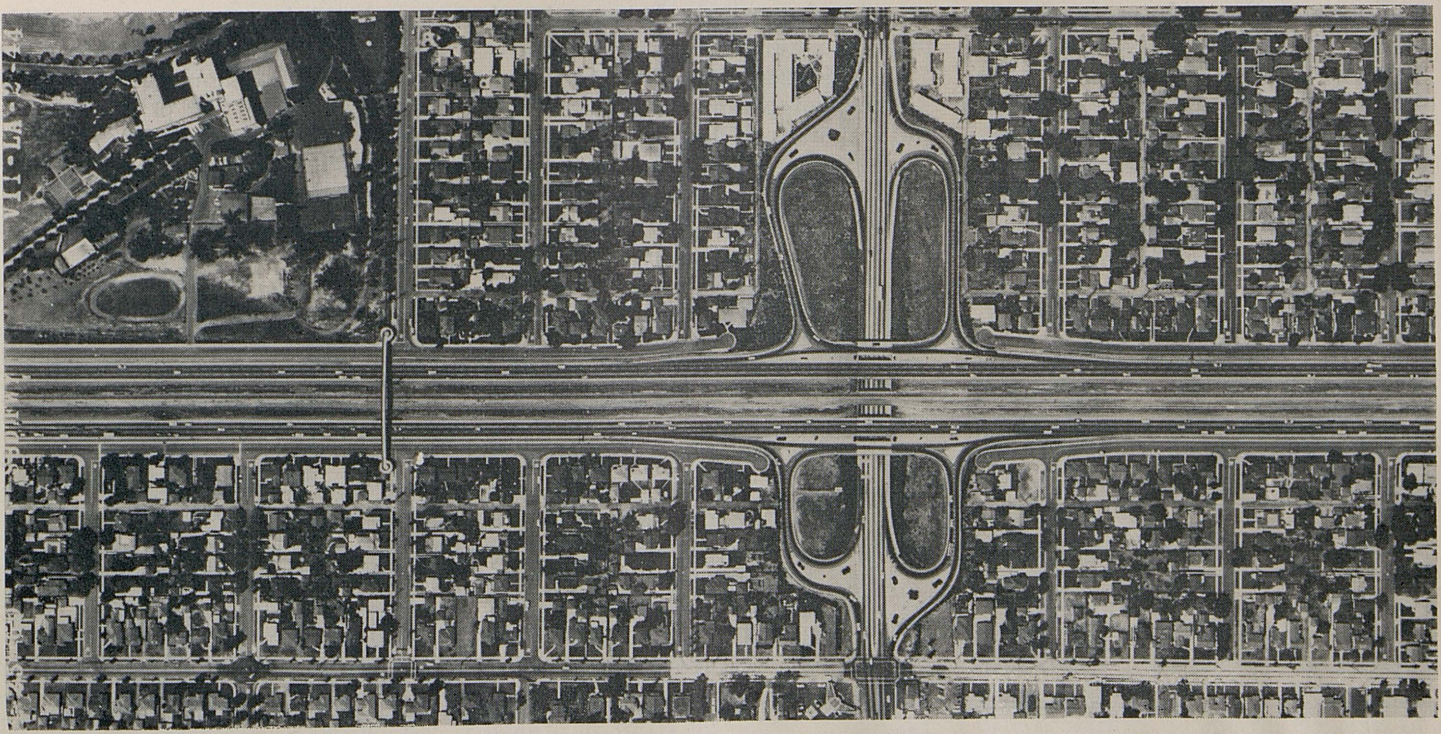


FIGURE 1. An aerial photo of a freeway location before identifying data has been superimposed.

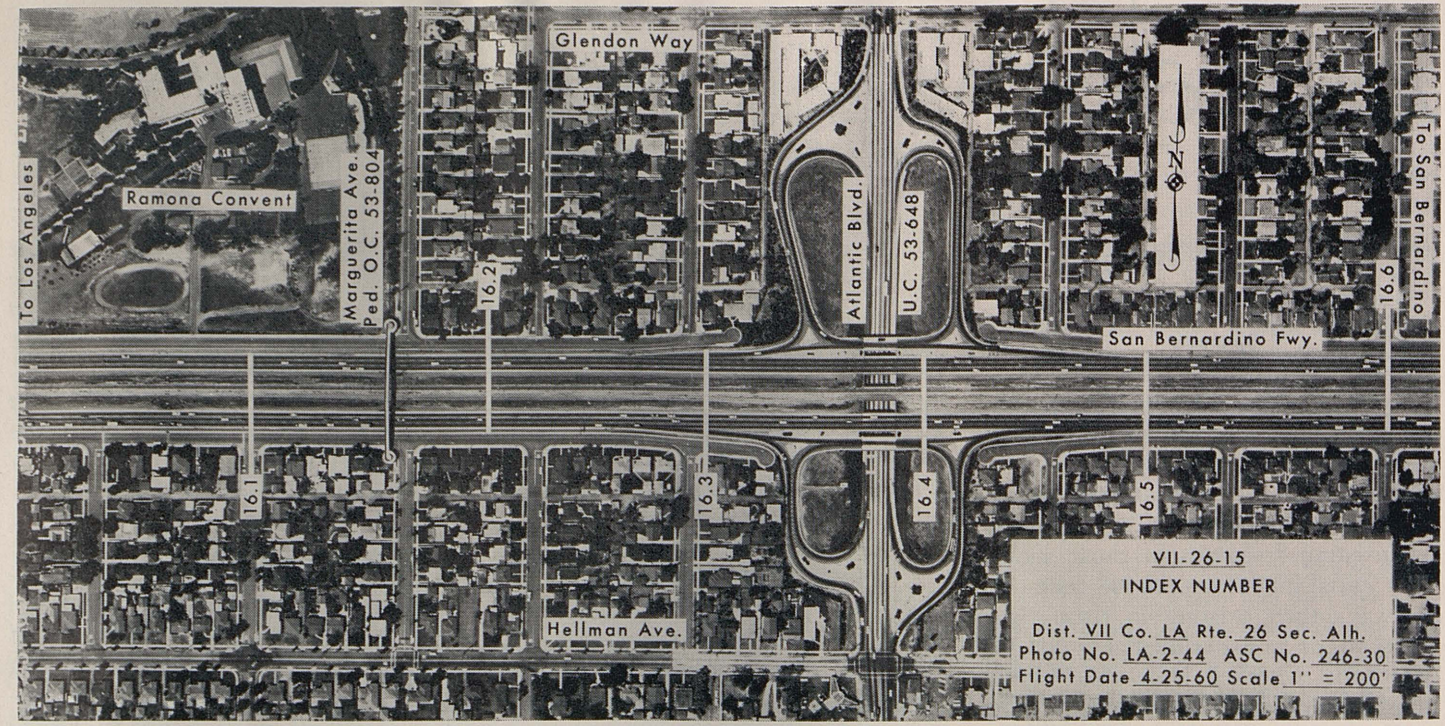


FIGURE 2. A print of the same photo (previous page) after mileposts and other data have been added for accident-locating purposes.

termine the location to place pavement markings at interchanges and at intersection of ramps with surface streets, thus reducing the amount of fieldwork normally required. Further, the photographs permit parking studies and studies regarding striping, signing, median barriers, illumination, and traffic control, with a minimum amount of fieldwork and review. In addition, the photographs either eliminate or reduce the research ordinarily required into old plans, cross sections, and records for the above-mentioned traffic studies and for planning locations for traffic-counting stations.

The 9-inch by 18-inch contact prints have been reproduced in a variety of forms and scales to be used as exhibits in various reports. The unretouched reproduction is used to show existing conditions. Proposed changes have been shown by delineating the recommended change in ink or colored pencil on the reproduced print.

Convenient and Accurate

The photographs are a convenient and accurate inventory of existing facilities and as such they have been found valuable in planning and programing needed improvements. The photographs are more effective than maps in helping private citizens and technical staffs of local agencies in identifying properties and in visualizing improvements. The public in general, and especially property owners and developers seeking information, are favorably impressed by the fact that these photographs are available and by the efficient manner that the engineer can communicate with the public with the aid of the photographs.

The San Francisco area district office has utilized the photographs to produce base maps in planning an im-

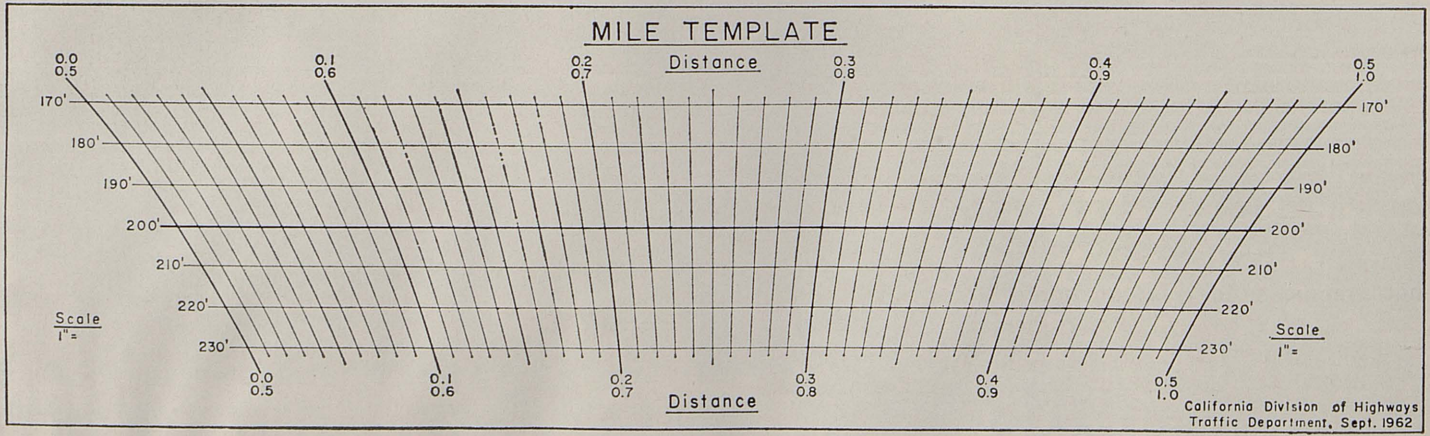


FIGURE 3. The transparent variable overlay scale.

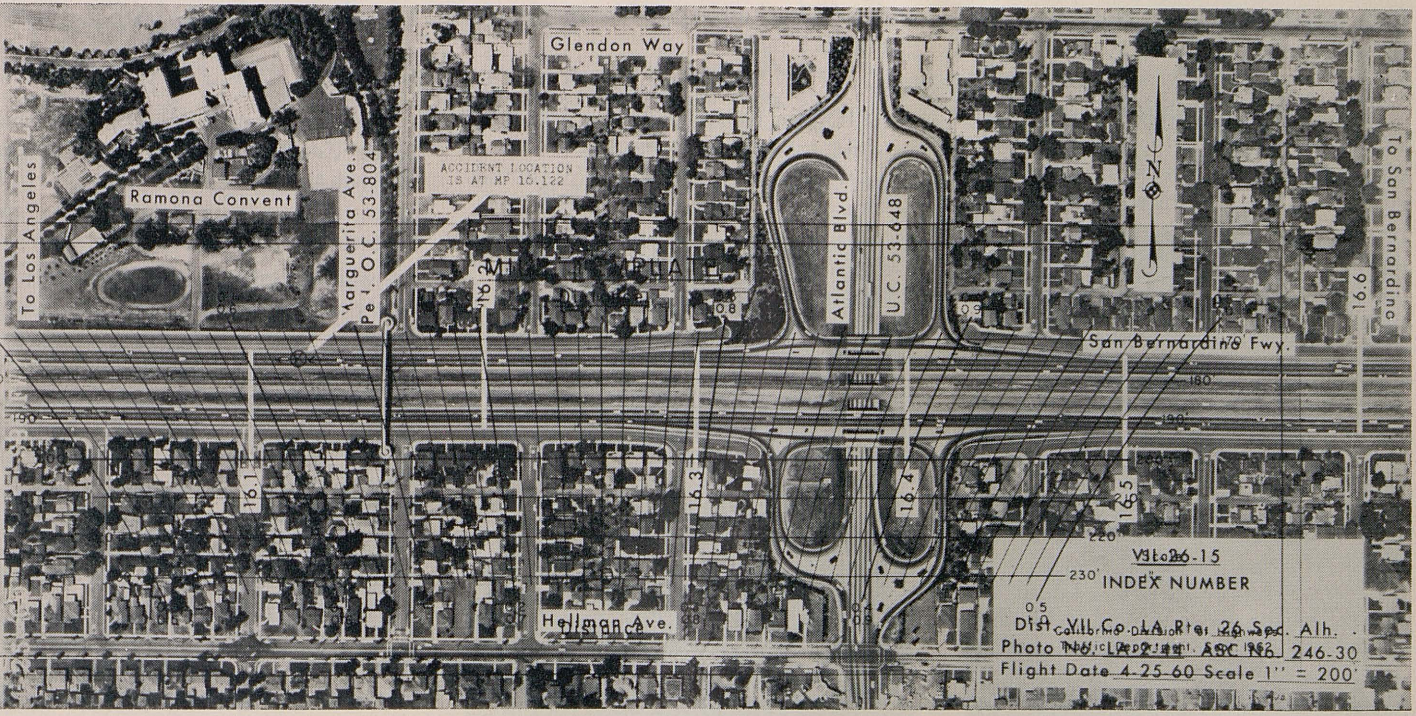


FIGURE 4. The same photo (previous page) with overlay scale superimposed to determine the location of an accident.

provement to an existing freeway. This freeway is located in the City of San Jose on relatively flat terrain. A great deal of development has taken place along the right of way since the freeway was initially constructed so the contract plans ("as builts") were of little value for making a base map to plan the revisions required.

Scale Maps Prepared

In cases such as this, it is customary to obtain photogrammetric mapping. This would have required several weeks. To expedite the preparation of the needed base maps and to reduce costs, the district prepared 1″ = 100′ scale maps using the 1″ = 200′ scale photographs. Known distances between easily identified features along the freeway, such as ramp noses, bridges, and culverts, were used to determine the exact amount each photograph should be enlarged to produce the 1″ = 100′ scale photographic base maps on sensitized polyester film. The amount of enlargement varied from photograph to photograph since photographic scale is a function of flight height, ground relief and camera tilt. The resulting base maps, however, were reasonably close to the desired scale of 1 inch equals 100 feet along the freeway although scale in the transverse direction was not necessarily the same nor uniform.

Although the finished product was not as accurate as that which could have been obtained from photogrammetric mapping, it was sufficiently accurate and detailed for the purpose of planning the additional lanes required and for the preliminary design of modifications to the existing interchanges. Photographic mapping will be obtained for the detailed design of the widening project. The total time to produce the base maps from the photographs was 10 days.

Maintenance Use

The photographic inventory also has many useful applications in the maintenance field. The photographs are very helpful in analyzing drainage problems by locating existing facilities, spotting controls, and to determine corrective measures. They are used in discussing numerous other field problems between office and field personnel. The aerial photograph eliminates the need of specially prepared sketches to illustrate the discussion.

In relinquishing old highways to local authorities and in drawing up maintenance agreements with local agencies, the photographs have been helpful in verifying details shown on plans or maps and in extending coverage beyond the limits of existing plans and maps. The photographs help to point up logical limits by showing such controls as fences, roads, curbs, drainage way, landscaping limits, and other geographic, topographic, and physical features.

Another application by the Maintenance Department is in issuing permits for encroachments and for transit of extralegal loads. The photographs expedite investigations and decision making on such applications by showing the degree and type of occupancy in the vicinity of the requested permit, and by showing other relevant factors such as driveways, traffic control devices, bridges, signs, and other restrictive controls.

Other Uses

Researchers conducting studies on speed, capacity, and safety have found the photographs useful. In a research project regarding wrong way driving incidents on freeways, the aerial photographs have been very helpful in reconstructing the event and the path traversed by the vehicle to determine points of wrong-way entry. Diazo prints of the contact prints are also being used to outline and to codify data of various geometric elements of each interchange in a study to relate accident rates to freeway design details.

Still another application being investigated is the use of photographs to pinpoint the location of individual accidents. Two locations totaling approximately 50 miles of U.S. 40 (Interstate Route 80) between San Francisco and Auburn are being used as a pilot study. Multilith prints of the photographs have been furnished to the California Highway Patrol. A copy is attached to each accident report by the officer after he indicates the location and the type of accident on the print.

The multilith prints are obtained by a screening process of the semi-matte photograph original. The prints are relatively inexpensive. In quantities of 100 or more the cost is approximately three cents each. Before making the multilith masters, identifying prominent landmarks, cross streets, milepost points, north arrows, and directions to nearest towns are added to the photographs. (Figure 2.) The accident location can then be quickly obtained using a transparent variable overlay scale. (Figures 3 and 4.) An ordinary scale cannot be used since the photograph scale is not necessarily 1 inch equals 200 feet; varies from photograph to photograph; and varies within a photograph due to camera tilt, flight height, and relief. It is hoped that this special scale will simplify the task of determining the accident location. This is now done by computing the milepost using distances from physical objects measured and recorded in the report by the officer. Thus far, however, there has been insufficient experience with this application to determine its efficiency. Also, there is evidence that the patrolmen are having difficulty in locating the accidents accurately on the photographs.

There has been some demand to increase the scale, obtain wider coverage, and extend coverage to all major highways (conventional highways as well as freeways). Doubling the scale to 1 inch equals 100 feet would increase costs approximately 75 percent. The cost of eliminating scale distortions would be prohibitive. It is felt that neither the larger scale nor a more accurate scale is necessary for the general applications that these photographs are used.

Summary

Although the original experiment was designed to determine how useful large-scale aerial photography could be for traffic engineering studies, engineers in most other fields of highway engineering soon found applications in their own specialties. These applications include the fields of traffic engineering, research, planning, programming, design, maintenance, and public relations.

The experiment has been so successful and demand has been so great that coverage will be extended in the near future to all freeways in the State. It is planned to maintain this coverage on a current basis by annually photographing improved, modified, and new sections of freeways.

HIGHWAY THROUGH HISTORY

Continued from page 20 . . .

decision to build the proposed Auburn Dam on the North Fork of the American River.

From south of Grass Valley to three-fourths mile east of Nevada City, 7.2 miles through the two towns, a freeway route has been adopted and construction plans are nearing completion. The whole project is estimated to cost some $6,000,000, and the first unit, which will run 3.3 miles from near the east city limit of Grass Valley to east of Nevada City, will require about $4,000,000. Most of the right-of-way has been acquired, but construction money has not been budgeted.

Advance studies for the nine miles in Yuba County from the Yuba River to northeast of Camptonville, have not yet been started. This portion was built in the 1930's by the Bureau of Public Roads and still is one of the better portions of the highway.

Advance planning calls for correction of substandard alignment at various points west of Downieville; replacement of the bridge at Downieville; reconstruction and widening on a route adopted in 1960 between Bassetts and Yuba Pass; widening on a new but as yet unadopted alignment between Yuba Pass and the junction of Sign Route 89 and further reconstruction between Sierraville and Loyalton.

Matt Fredericksen Retires on July 1

Matthew Fredericksen, Assistant Office Engineer in charge of Project Control with the Division of Highways, retired July 1 after 35 years of state service.

Fredericksen's engineering career with the division began in 1928, working on surveys and construction in Northern California. This included the survey of the Feather River Highway location (U.S. 40 Alternate) in Plumas County, and the survey made for the Eagle Lake Road between Susanville and Bieber—an 80-mile survey completed in the record time of eight months.

MATT FREDERICKSEN

Following this he was resident engineer on some of Northern California's largest highway construction projects, among which was the highway relocation around Shasta Dam Reservoir from 1938 to 1942, involving approximately 16 miles and an expenditure of about $2 million. This relocation involved some of the heaviest grading connected with highway development at that time.

Since 1942 Fredericksen has held his present position in Division Headquarters in Sacramento, entailing contract administration and supervision, contract progress records, and various fiscal matters.

Fredericksen was born in Poulsbo, Washington, where he attended grade and high schools, going on to the University of Washington at Seattle. His training also included three years of law through LaSalle Extension University. During the 10 years prior to his employment by the Division of Highways, Fredericksen was engaged in survey and construction work on highways and railroads in Idaho and Oregon. He had also served in World War I.

He is affiliated with the Masons, and Alpha Tau Omega fraternity. Fredericksen is married and has a daughter.

Permeability Test

Compaction, Water Studies Made on Asphalt Pavements

By ERNEST ZUBE, Supervising Materials and Research Engineer

Introduction

In constructing a stable and durable asphalt concrete pavement, two important steps are necessary. First, the mixture must be correctly designed; and second, it must be properly compacted.

In the design of the mixture such factors as gradation of the aggregate, particle shape characteristics and surface texture, absorption of asphalt by the aggregate, and optimum asphalt content are important considerations. In the laydown operations, temperature of the mix, type of compaction equipment, and air temperature are of paramount importance.

If, in the finished pavement the void content is high, particularly when the voids are interconnected, the passage of air and the admittance of water will adversely affect the durability and ultimate life of the pavement mixture. The entrance of air into a permeable pavement contributes to the rapid hardening of the asphalt binder primarily through oxidation and evaporation. This article deals primarily with the compaction and its influence on water permeability of asphalt concrete pavements.

Evidence Is Collected

Over the years, the Materials and Research Department has collected a great deal of evidence which indicates that many asphalt pavement failures are attributable directly to the presence of excessive amounts of water which entered the pavement structure after construction. We have noted that pavement from failed areas often contains colloidal fines in the intimate part of the mix and particularly in the lower course of the asphalt pavement. This is caused by a pumping action resulting from deflection under heavy loads. The infiltration of fines from muddy water into small cracks of the pavement mixture will considerably reduce the cohesion of the mixture and also prevent any possibility of the cracks "healing" under traffic action during summer temperatures.

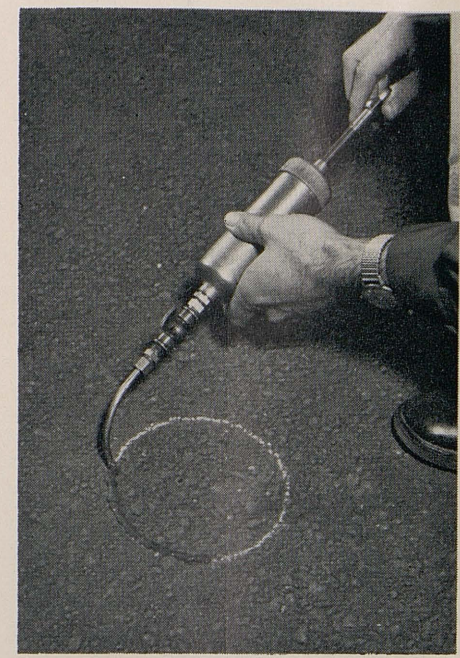


FIGURE 1A. Forming grease ring.

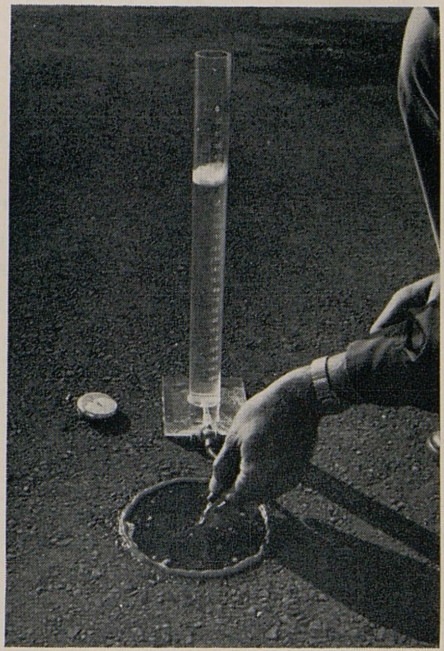


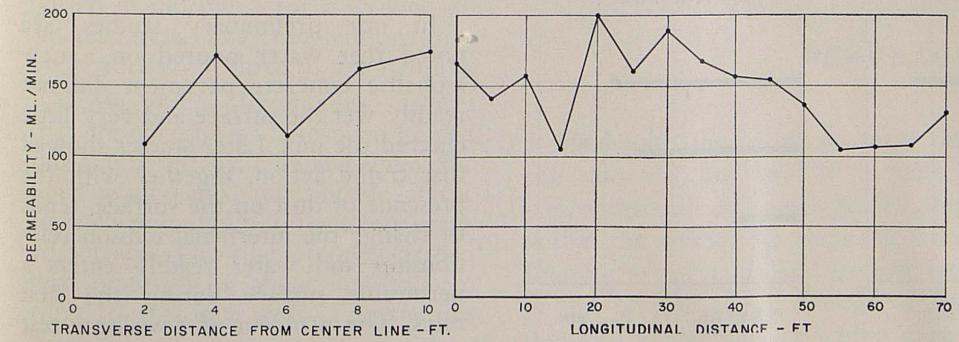
FIGURE 1B. Applying water solution to pavement surface.

It is the general assumption that the permeability of the compacted pavement and its durability are more or less proportional to the percentage of air voids. This statement should be accepted only in a general sense. Certain size dimensions of the individual voids and the lack of interconnection of the voids could produce a pavement of relatively high void content and a low permeability. In other words, low density does not necessarily indicate high permeability. In this case, it is to be expected that the hardening of the bituminous binder will progress at a relatively slow rate.

One other important phase of the permeability-void-durability relationship which should be stressed is that the above statements are generally true when the same asphalt and aggregate mixture is used. On the other hand, it should not be overlooked that the source or method of manufactur-

FIG. 2

VARIATION IN AVERAGE PERMEABILITY AFTER SPREADING AND ROLLING A SINGLE LOAD OF MIX



ing the bituminous binder may far overshadow the effects of permeability and air voids as far as durability of the pavement is concerned.

Minimum Compaction Specified

In order to guard against excessive voids of the pavement, many organizations specify some minimum relative compaction of the finished pavement; the percentage of relative compaction being measured against some standardized laboratory compaction or in some cases against theoretical density. In order to determine this relative compaction, it has been necessary to obtain samples of the compacted mixture by chipping out blocks or obtaining a core.

Although both methods have been used with some degree of success, each has definite drawbacks. In breaking out a block, the compacted mixture is very often disturbed, which may lead to erroneous results in the specific gravity determination. When obtaining cores by drilling, water is introduced into the specimen and considerable time is required to dry the core at low temperature. This causes some delay in determining relative compaction results.

A review of existing methods and our field studies indicated that if a physical check on compaction during construction was to be possible, a rapid method of measuring relative compaction of pavement mixtures was needed. The purpose of this report is to present our studies as they relate compaction and water permeability of asphaltic concrete pavements and to discuss the factors that influence the permeability during construction and service life of the pavement. A simple test method has been developed which is equally applicable to new or existing pavements.

Test Method

In our preliminary studies, we noted that water poured on a new asphaltic concrete pavement did not readily wet the surface and very little entered the mix. Later studies showed that traffic action, together with the presence of dust on the surface, tends to change the interfacial tension relationship and water readily enters a permeable surface during the first rains. The problem of devising a test

TABLE A

Permeability of Pavement Immediately After Construction Compared With Moisture Content in Pavement After Winter Rains

Permeability measurement date	Permeability (ml./min.)	Sample date for moisture	Percentage of moisture—pavement
Dec. 1956	10	March 1957	1.37
	10		1.50
	15		2.50
	35		2.96
	55		3.10
	105		2.69
	112		2.18
	170		3.14
	610		3.37

Average percentage of moisture in paving mixture during construction = 0.2%.

TABLE B

Rolling Studies

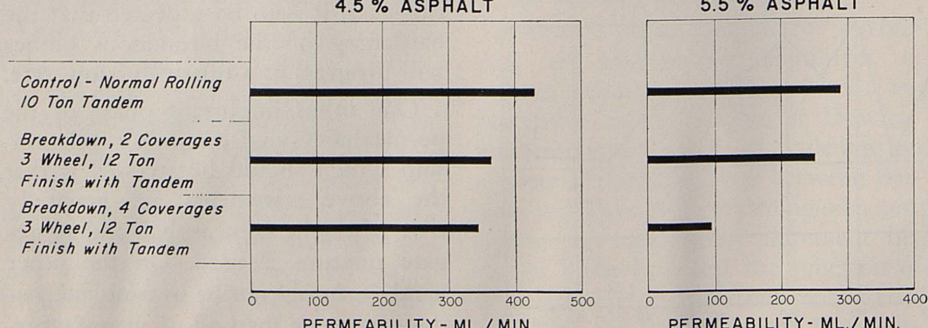
Project E

Paving date	Mix type	Test section number	Lane	Course	Type of rolling	Average rolling temperature (°F)	Average 24-hour permeability (ml./min.)
June 1960	2½" max.	A	Passing	Base	Breakdown, 1 coverage Finish with tandem	278 160	227
		B	Travel	Base	Breakdown, 1 coverage Finish with tandem	298 168	162
		B-1	Travel	Base	Breakdown, 1 coverage Pneumatic, 1 coverage Finish with tandem	281 176 155	155
		B-2	Travel	Base	Breakdown, 1 coverage Pneumatic, 3 coverages Finish with tandem	289 168 155	135
	¾" max.	1	Passing	Surface	Breakdown, 1 coverage Finish with tandem	218 163	352
		1-1	Passing	Surface	Breakdown, 1 coverage Pneumatic, 1 coverage Finish with tandem	215 174 138	183
		1-2	Passing	Surface	Breakdown, 1 coverage Pneumatic, 3 coverages Finish with tandem	214 164 142	147
		2	Travel	Surface	Breakdown, 1 coverage Finish with tandem	243 160	179
		2-1	Travel	Surface	Breakdown, 1 coverage Pneumatic, 1 coverage Finish with tandem	254 166 152	136
		2-2	Travel	Surface	Breakdown, 1 coverage Pneumatic, 3 coverages Finish with tandem	250 164 139	77

FIG. 9

AVERAGE PERMEABILITY VALUES OF A SECTION CONTAINING DIFFERENT ASPHALT CONTENTS.

PROJECT N



for permeability of the surface was solved by the addition of a small amount of detergent to reduce the surface tension of the water used in the test. On a number of jobs involving a relatively impermeable base, such as cement-treated base, the values obtained by this method show good relationship between permeability and the moisture content found in the mix following rains. (See Table A.)

The method is detailed in Test Method No. Calif. 341. The general technique was originally developed in connection with seal coat studies and has been in use by this department for the past seven years.

Briefly, the test is performed by forming a small reservoir by means of a "grease ring" or dam around a previously marked 6-inch circle on the pavement, Figure 1A. The ring may be easily placed with a grease gun using ordinary cup grease, or it may be formed in one operation by a special gun. The ring grease is sealed to the surface by running the finger around the outside edge of the grease. A graduated cylinder containing the test solution and equipped with a drain tube is placed beside the ring.

Area Kept Moist

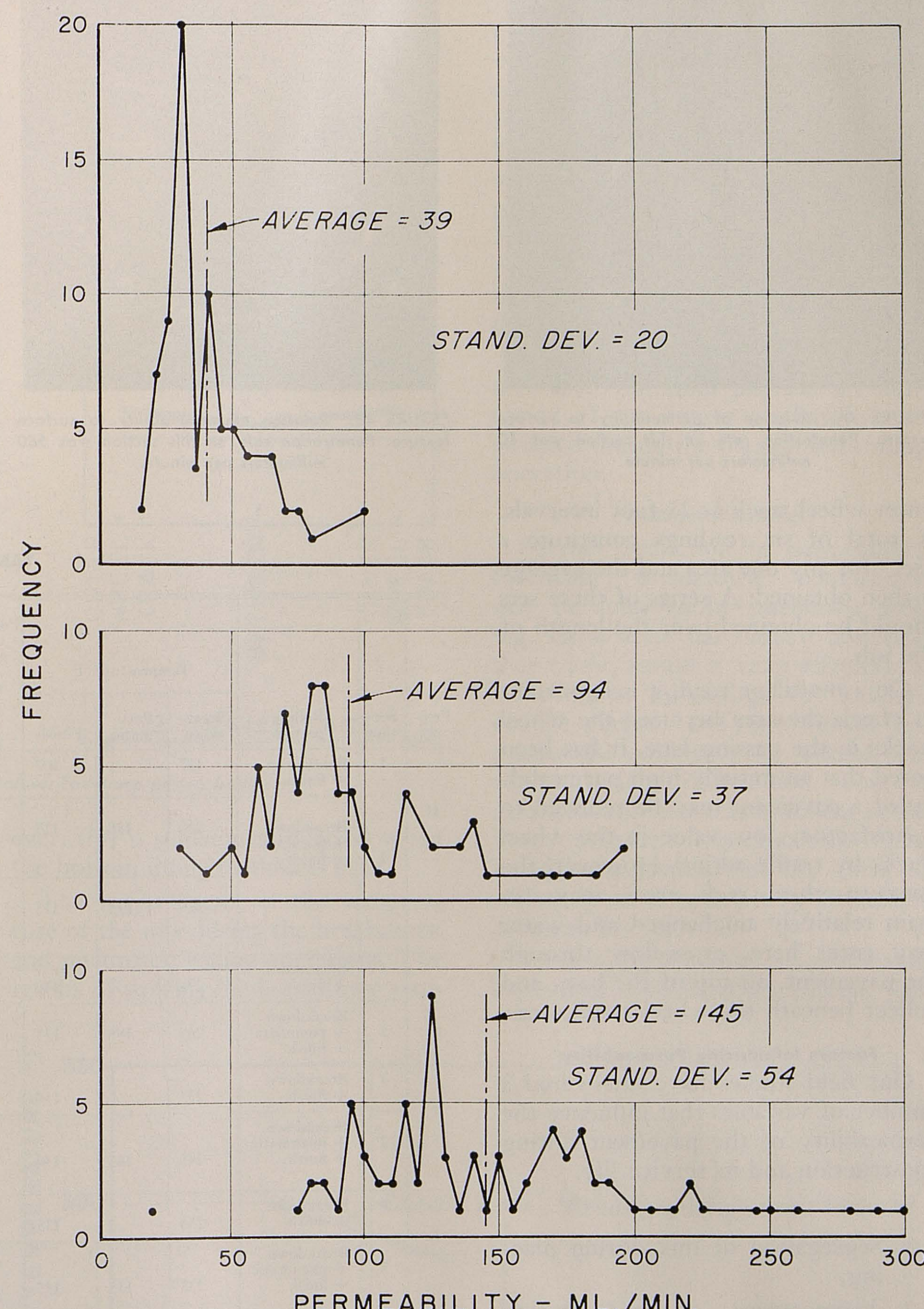
The operator feeds the solution into the area within the ring, starting a stopwatch at the start of flow of the liquid from the graduate, Figure 1B. The area within the ring is kept moist during a test period of two minutes. The film of liquid in the ring should only be thick enough to present a glistening appearance. In other words, the water is fed in only as fast as it is absorbed by the pavement and the test is conducted under zero pressure. At the end of the two-minute period the total solution used is divided by two and the permeability reported in ml./min.* for a six-inch-diameter circle. The complete test may be performed in three to five minutes.

Dense graded bituminous surfaces that are covered with an open graded mix are tested by chipping away the open graded mix, just outside of the six-inch ring, down to the dense graded surface. The ring of open graded mix removed is about one-half to three-fourths inch wide. This annulus is filled with the grease to form the seal and the permeability is determined through the open graded mix within the area of the ring. We have found it necessary to perform the test in this manner, since removal of all the open graded surface with a chisel within the ring area tends to seal the underlying surface with a glaze of asphalt and results in erroneous readings.

Successive tests are performed in the inner wheel track, midway between the wheel tracks, and in the

FIG. 3

VARIATION IN PERMEABILITY AFTER SPREADING AND ROLLING A SINGLE LOAD OF MIX FROM THREE TEST SECTIONS ON THE SAME PROJECT



* Millimeters per minute.

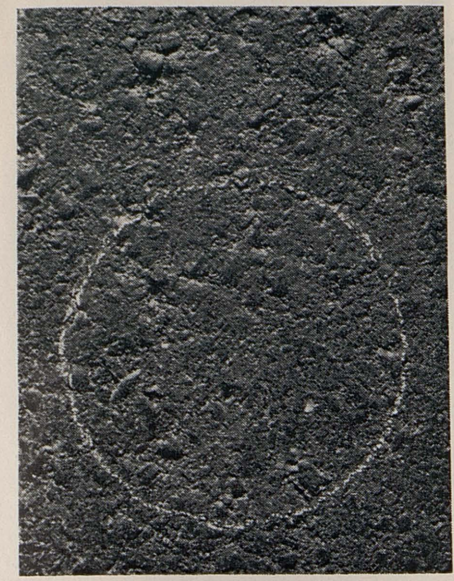


FIGURE 4A. Relation of permeability to surface texture. Penetration rate on this section was 10 millimeters per minute.

FIGURE 4B. Relation of permeability to surface texture. Penetration rate on this section was 580 millimeters per minute.

outer wheel track at 25-foot intervals. A total of six readings constitute a "set" for any one area and the average is then obtained. A series of these sets should be obtained over the length of the job.

On a multilane road, it is important to check the area between the wheel tracks in the passing lane. It has been noted that an initially high permeability of a pavement may be reduced to a satisfactory low value in the wheel tracks by traffic action. However, the between-wheel-track areas may remain relatively unchanged and water may enter here, cross-flow through the pavement, on top of the base, and collect beneath the wheel track areas.

Factors Influencing Permeability

Our field studies have uncovered a number of variables that influence the permeability of the pavement during construction and its service life.

Some of these variables are:

1. Segregation of mix during placing.
2. Temperature of mix during breakdown rolling.
3. Temperature of mix during pneumatic rolling.
4. Weight of breakdown roller.
5. Tire or contact pressure of pneumatic roller.
6. Ambient temperature during placing of mix.
7. Void content of the compacted mix.
8. Amount of traffic prior to winter rains.

Even though every effort is made to maintain uniform construction procedures, individual permeability test values may be still quite variable.

On one project the variations in a single load of mix were determined by taking readings every five feet in a longitudinal direction and every two feet transversely. This was performed for three separate loads of mix in different test sections. The average values for one load of mix are shown in Figure 2. The frequency of values for an individual load in each of three different test sections is shown in Figure 3. The results indicate an increasing spread of values with increasing per-

TABLE C

Project	Section	Rolling pattern	Temperature °F Breakdown	Temperature °F Pneumatic	Temperature °F Finish	Pneumatic contact pressure (lbs./sq. in.) from Bros. chart	Permeability (ml./min.) 1–3 hours after rolling	Percentage reduction by pneumatic rolling	Remarks
H	1	Breakdown + finish	187	--	107	--	156	--	
	2	Breakdown + pneumatic + finish	220	128	115	68	113	28	Breakdown and pneumatic temperatures low; pneumatic contact pressure high
			220	178	115	68	77	51	Breakdown temperature low; pneumatic temperature and contact pressure high
I	1	Breakdown + finish	278	--	140	--	64	--	
	2	Breakdown + pneumatic + finish	263	188	131	62	46	28	Low permeability after breakdown
I	1	Breakdown + finish	253	--	130	--	386	--	
	2	Breakdown + pneumatic + finish	245	163	130	76	143	63	Breakdown and pneumatic temperatures high; pneumatic contact pressure high
K	1	Breakdown + finish	235	--	135	--	628	--	
	2	Breakdown + pneumatic + finish	235	135	135	34	507	19	Breakdown and pneumatic temperature low; pneumatic contact pressure low; permeability high
L	1	Breakdown + finish	250	--	140	--	288	--	
	2	Breakdown + pneumatic + finish	250	143	140	39	228	21	Breakdown temperature high; pneumatic temperture and contact pressure low
M	1	Breakdown + finish	243	--	140	--	149	--	
	2	Breakdown + pneumatic + finish	255	140	115	64	59	60	Breakdown temperature high; pneumatic temperature low; contact pressure high

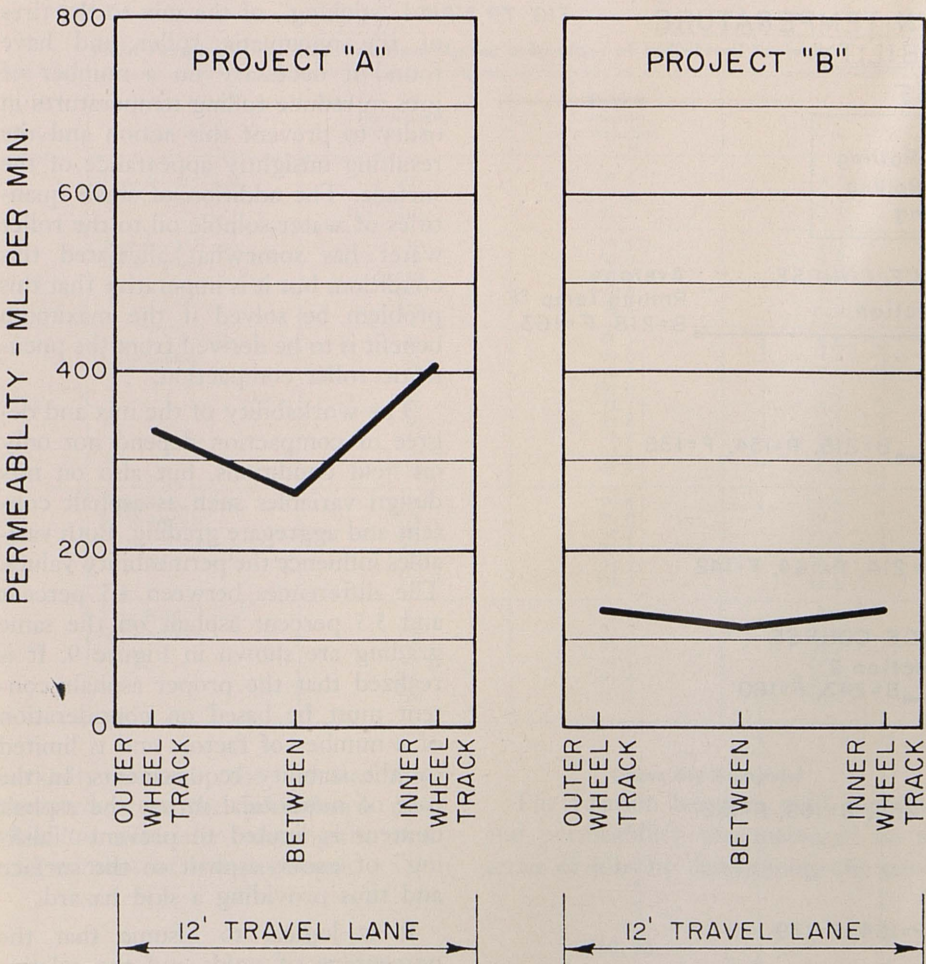


FIGURE 5. Average permeability values. End-dump paving method.

meability, with the spread being greatest for values above the average. It is necessary to obtain a sufficient number of readings to insure a reliable average reading, if it is desired to evaluate compaction by the permeability test.

Visual Inspection Inadequate

It should also be pointed out that permeability cannot be estimated by visual inspection of the surface appearance, with the possible exception of obvious rock pockets. Figures 4A and 4B illustrate the large variation in permeabilities for the same general surface texture on a particular project.

The method of placing the mixture may influence the permeability values transversely, across the lane, as shown in Figure 5. In the normal paving procedure with end dump trucks, the initial permeability is generally higher in the future wheel track areas, probably due to some segregation of the mixture near the edges by the lateral distribution device in the paver. However, this is sometimes reversed when the bottom dump method is used.

The major factor is the temperature of the mix during the breakdown and pneumatic rolling operations. The results of varying the breakdown temperatures are shown in Table B and Figures 6 and 7. Permeability values for base and surface courses having different gradings and asphalt contents, but rolled with the same equipment are shown in Figure 6. The reduction in permeability with increase in breakdown temperature is very definite for both types of mixtures. The importance of this factor is further indicated by results shown in Figure 7. The average permeability value after completion of high temperature breakdown rolling in Section 2 is almost as low as the complete rolling schedule in Section 1 where breakdown temperatures were much lower.

These results indicate that the permeability test does provide an indication of the degree of densification attained during the breakdown rolling operation.

Pneumatic Rolling

Further reduction in permeability following breakdown compaction may be achieved by pneumatic rolling. Experience has clearly indicated that traffic action is very effective in achieving a "tightening" or "sealing" of the surface and one reason for pneumatic rolling is to obtain this action during construction. The requirement for pneumatic rolling in the 1960 Standard Specifications was based on evidence that this form of rolling is an effective way to reduce permeability.

Some typical results of permeability-rolling combination studies ob-

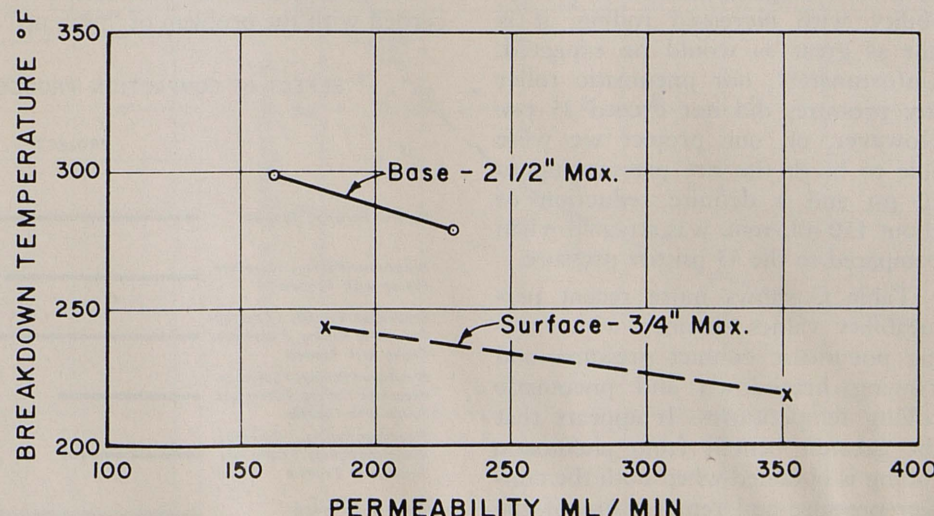
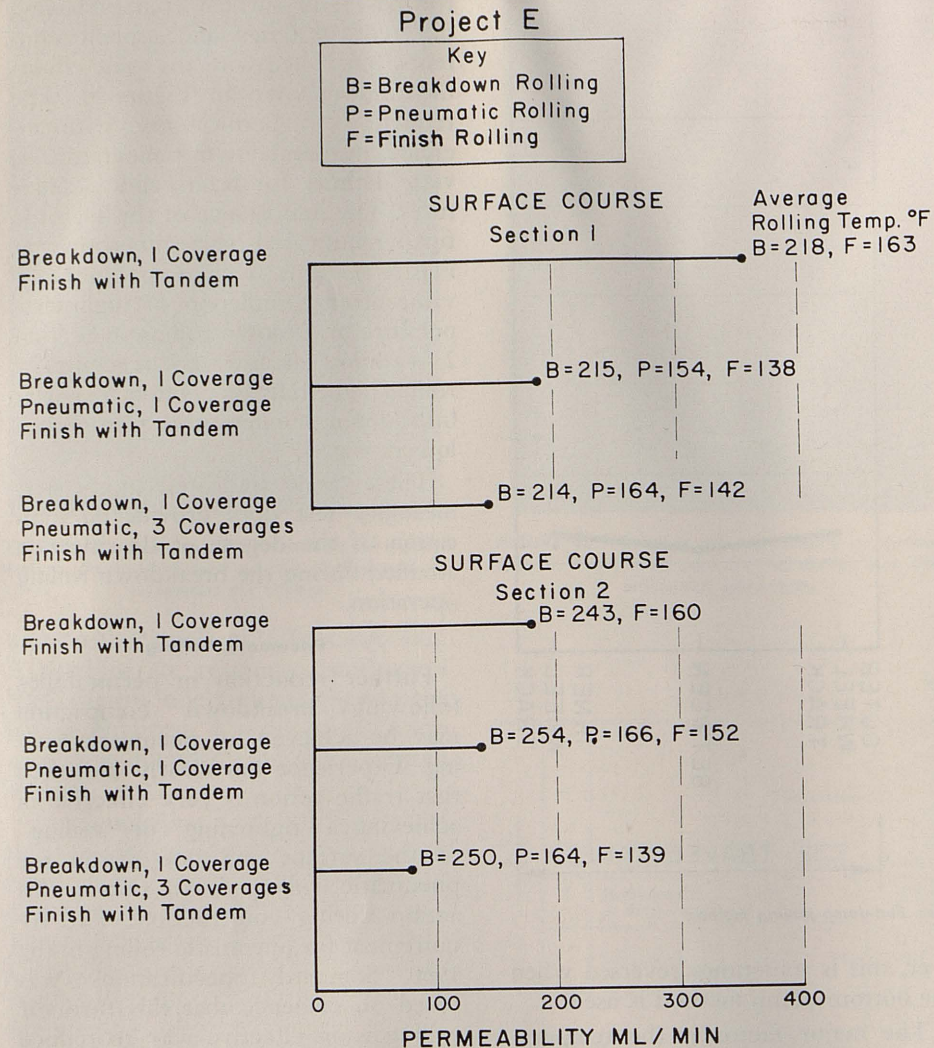


FIGURE 6. Effect of breakdown temperature on permeability. Project E.

FIG. 7

EFFECT OF BREAKDOWN TEMPERATURE ON PERMEABILITY



tained under our 1954 Specifications are shown in Figure 8. Although we note an average reduction in permeability with increased rolling, it is not as great as would be expected. Unfortunately, our pneumatic roller tire pressures did not exceed 35 psi. However, on one project we were able to boost the tire pressure up to 50 psi and a definite reduction of about 150 ml./min. was attained when compared to the 35 psi tire pressure.

Table C shows more recent permeability values obtained with varying pneumatic contact pressures and varying breakdown and pneumatic rolling temperatures. It appears that the greatest benefit from pneumatic rolling is obtained when both the contact pressure and temperature of the mix are fairly high and when the permeability after breakdown is in the 100 to 400 ml./min. range.

Construction forces have been concerned with the problem of "pick up" and "sticking" of the mix to the tires of the pneumatic roller and have found it necessary on a number of jobs to reduce rolling temperatures in order to prevent this action and the resulting unsightly appearance of the surface. The addition of small quantities of water-soluble oil to the roller water has somewhat alleviated this condition, but it is imperative that this problem be solved if the maximum benefit is to be derived from the pneumatic roller compaction.

The workability of the mix and degree of compaction depend not only on field conditions, but also on mix design variables such as asphalt content and aggregate grading. Both variables influence the permeability values. The differences between 4.5 percent and 5.5 percent asphalt on the same grading are shown in Figure 9. It is realized that the proper asphalt content must be based on consideration of a number of factors and is limited by the stability requirements. In the case of noncritical mixes, the asphalt content is limited to prevent "flushing" of excess asphalt to the surface and thus providing a skid hazard.

It is logical to assume that the percentage of voids and the relative compaction should be related to the permeability values immediately or shortly after construction. As pointed out earlier, the permeability is a function of the number of interconnected passageways in the pavement and will vary depending on factors involved in design and construction. Further, the "sealing" of the surface by pneumatic rolling and traffic action may

FIG. 8 EFFECT OF COMPACTION PROCEDURES ON PERMEABILITY VALUES

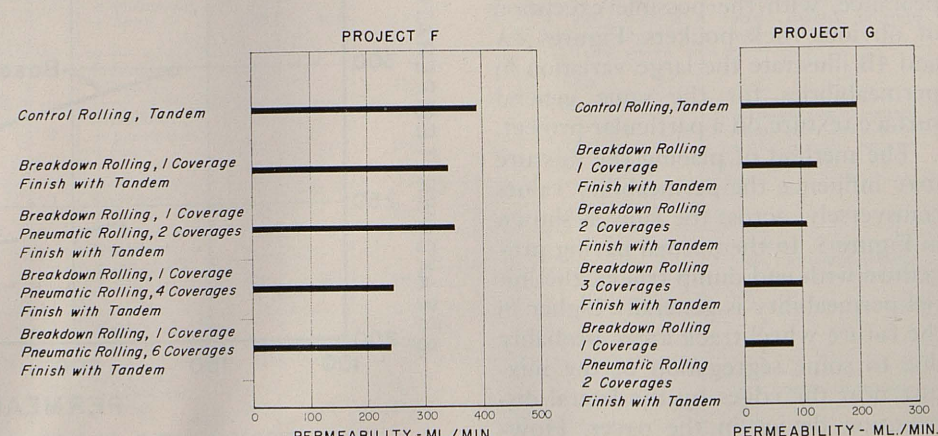


TABLE D

Field Permeability, Void Relationship for a Number of Individual Projects

Project	Type ol mix	Permeability (ml./min.)	Percent relative compaction	Percent voids
N	Type A—¾'' max. 4.5% asphalt	200	97.4	8.8
		230	97.0	9.0
		510	93.5	12.3
	Type A—¾'' max. 5.5% asphalt	30	98.3	4.5
		70	97.0	5.8
		250	93.2	9.5
		250	94.5	8.2
		550	92.8	10.1
G	Type A—¾'' max. 5.2% asphalt	15	98.3	5.0
		15	99.6	3.5
		35	98.3	5.0
		35	100.0	3.3
		40	98.3	5.0
		50	98.8	4.5
		55	97.4	5.8
		70	97.4	5.8
		80	97.9	5.4
O	Type B—¾'' max. 4.3% asphalt	150	96.4	9.6
		175	96.0	10.0
		175	94.2	11.6
		195	93.8	12.1
		210	94.2	11.6
		300	94.2	11.6
H	Type B—¾'' max. 5.0% asphalt	55	95.0	8.9
		150	93.3	10.6
		190	93.7	10.2
		265	91.1	12.6
		340	93.4	10.1
		520	90.3	13.4

markedly reduce the permeability measured after the breakdown pass while not materially reducing the total void content of the pavement.

Cores Are Removed

The relation between void content and permeability was measured on a series of jobs by determining the permeability 24 hours after completion of rolling. Cores were then removed from areas of different permeability values and the density and percentage of relative compaction were determined, with 100 percent relative compaction assigned to a laboratory compacted specimen. Results are shown in Table D and Figures 10 and 11. The curve for the void-permeability relation indicates that there is no serious change in permeability up to about 10 percent voids. However, even small increases in void content above this figure show a marked increase in permeability. A similar relationship is found when the percentage of relative compaction falls below 94 percent, Figure 11.

As will be shown later, the permeability of pavements laid during the summer paving season show a marked decrease due to traffic action. This decrease is not accompanied by any pronounced reduction in void content since only the uppermost portion of the surface course is "sealed" by this action. However, pavements laid in the late fall cannot be expected to "seal"

FIG. 10

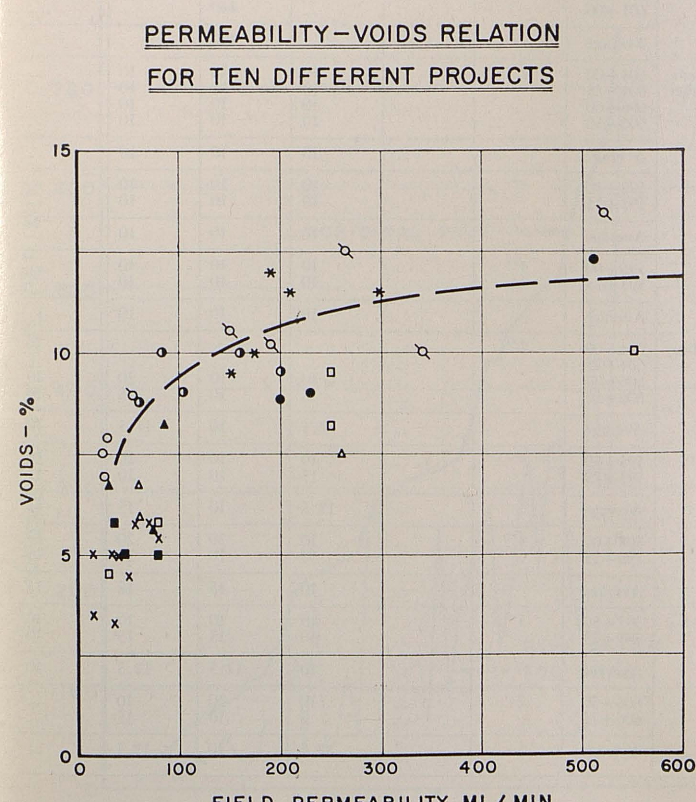
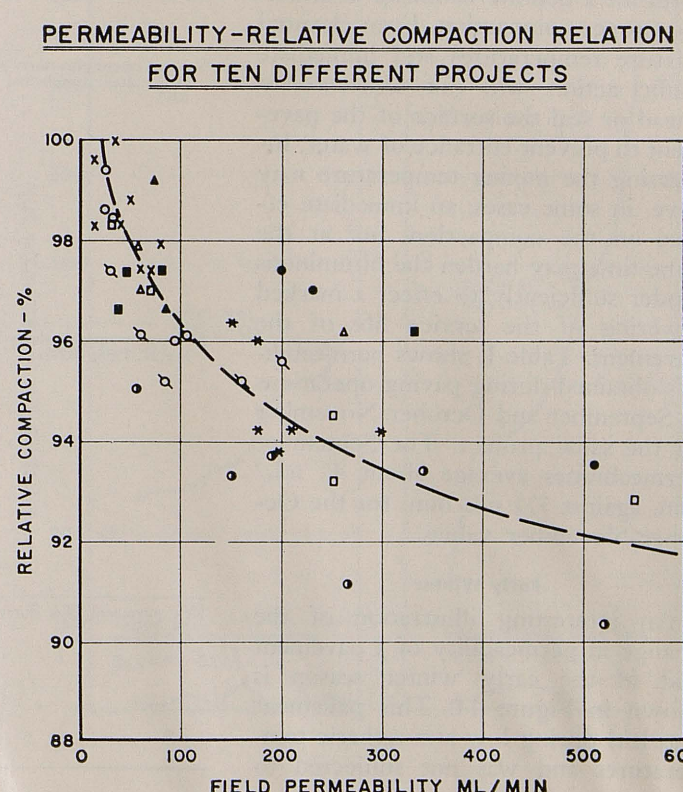


FIG. 11



prior to winter rains. The void-permeability curve clearly indicates that excessive water may enter the pavement if compaction procedures during construction are not effective in reducing the void content to a safe level.

Reduction Pattern

There is a reduction in permeability during at least the first 24 hours after completion of rolling, Figure 12. This is best accounted for on the basis of "cold-flow" of the binder since the test section was not subjected to any traffic. It is reasonable to infer that a number of original interconnected passageways are sealed by the slowly continuing movement and adjustment of the asphalt binder.

The importance of traffic action is shown in Figure 13. This striking reduction in the permeability of all areas of the roadway to a very uniform and low level has been found on a number of jobs during the early summer and subjected to traffic during warm weather. In contrast on another job, paved in December, we found no reduction in the initially high permeability values until the following summer.

During the late fall and winter paving, the lower atmospheric temperatures are a definite handicap in attaining proper compaction. Even elevated mixture temperatures and immediate traffic action will not satisfactorily knead or seal the surface of the pavement to prevent entrance of water. Increasing the mixing temperature may have, in some cases, an immediate effect on the compaction, but at the same time may harden the bituminous binder sufficiently to effect a marked lowering of the service life of the pavement. Table E shows permeabilities obtained during paving operations in September and October-November on the same project. The September permeabilities average about 47 ml./min. against 371 ml./min. for the October-November values.

Early Winter

An interesting illustration of the change in permeability of a pavement laid in the early winter season is shown in Figure 14. This pavement was laid during low atmospheric temperatures and was not subjected to

TABLE E

Average Permeability Values for a Pavement Constructed During Changing Climatic Conditions

Paving date	Atmospheric temperature range during paving		Average permeability (ml./min.)
	Maximum	Minimum	
September	87	51	47
October-November	56	35	371

TABLE F

Reduction in Permeability Values Following Application of a Slurry Seal

Project Q

Test condition	Station	New pavement thickness	Permeability (ml./min.)				
			Travel			Passing	
			Shoulder	O.W.T.	B.W.T.	B.W.T.	O.W.T.
New pavement immediately after construction, November 1957	603+00	2″	310	70	110	270	--
	603+25		--	100	130	140	--
	604+00		260	90	90	320	--
	606+50		230	90	100	270	--
	608+00		400	270	340	320	--
	Average		300	124	154	264	--
	589+00	3″	--	--	--	700	--
	590+00		--	--	500	480	--
	591+00		--	--	320	440	--
	591+89		--	--	400	500	--
	592+00		--	--	420	490	--
	593+00		--	--	360	--	--
	593+50		--	--	--	500	--
	594+00		--	--	360	350	--
	Average		--	--	393	494	--
	596+00	4″	--	--	250	--	--
	597+00		--	--	230	--	--
	598+00		--	--	500	--	--
	599+00		--	--	350	--	--
	600+00		--	--	750	--	--
	601+00		--	--	440	--	--
	Average		--	--	420	--	--
New pavement plus slurry seal immediately after completion, November 1957	604+00	2″	--	10	10	10	--
	604+25		--	10	10	10	--
	606+00		--	10	10	10	--
	606+50		--	10	10	10	--
	Average		--	10	10	10	--
	593+50	3″	--	10	10	10	--
	593+75		--	10	10	10	--
	Average		--	10	10	10	--
	598+00	4″	--	10	10	10	--
	598+25		--	10	10	10	--
	Average		--	10	10	10	--
New pavement plus slurry seal, February 27, 1958, 18″ rain	604+00	2″	--	--	--	--	--
	604+25		--	--	--	--	--
	606+00		--	10	10	20	10
	606+50		--	5	10	15	10
	Average		--	7.5	10	17.5	10
	593+50	3″	--	10	10	20	15
	593+75		--	15	10	10	15
	Average		--	12.5	10	15	15
	598+00	4″	--	10	20	20	15
	598+25		--	10	10	10	15
	Average		--	10	15	15	15
New pavement plus slurry seal, May 28, 1958	593+50	3″	--	10	10	10	10
	593+75		--	10	15	15	10
	Average		--	10	12.5	12.5	10
	606+50	2″	--	10	10	10	--
	606+75		--	5	10	15	--
	Average		--	7.5	10	12.5	--

CHANGE IN PERMEABILITY VALUES FOLLOWING FINAL ROLLING. NO TRAFFIC

PROJECT G

FIG. 12

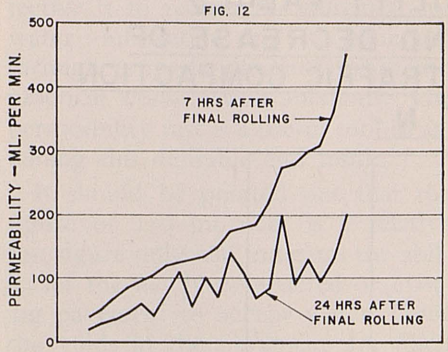
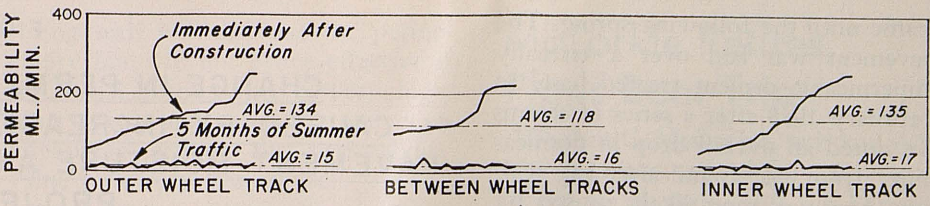
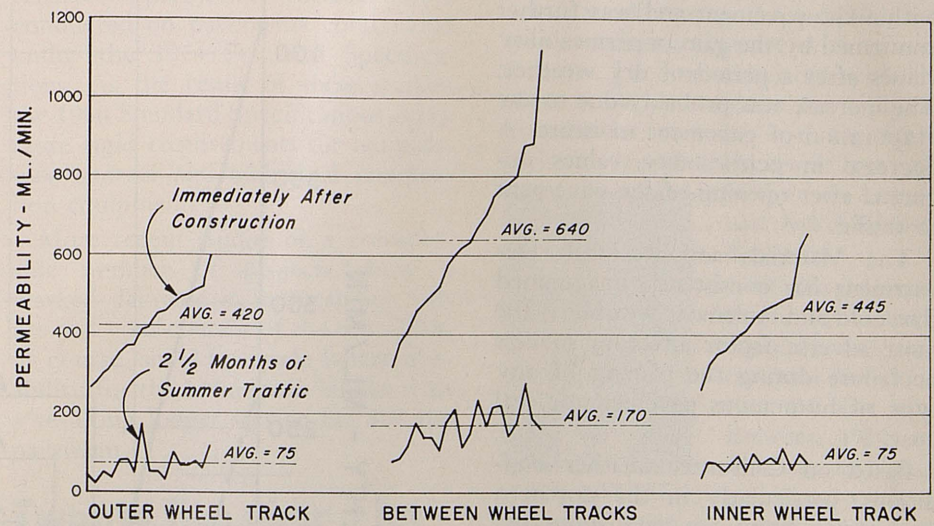


Chart right. FIGURE 13. Change in permeability of travel lane after summer traffic.



PROJECT G



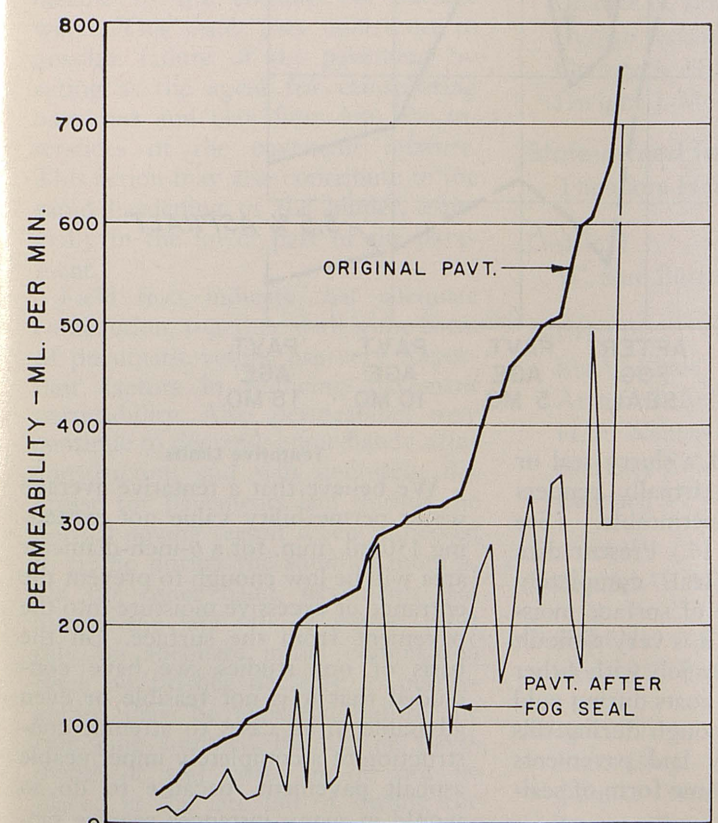
PROJECT P

FIG. 15

FIG. 16

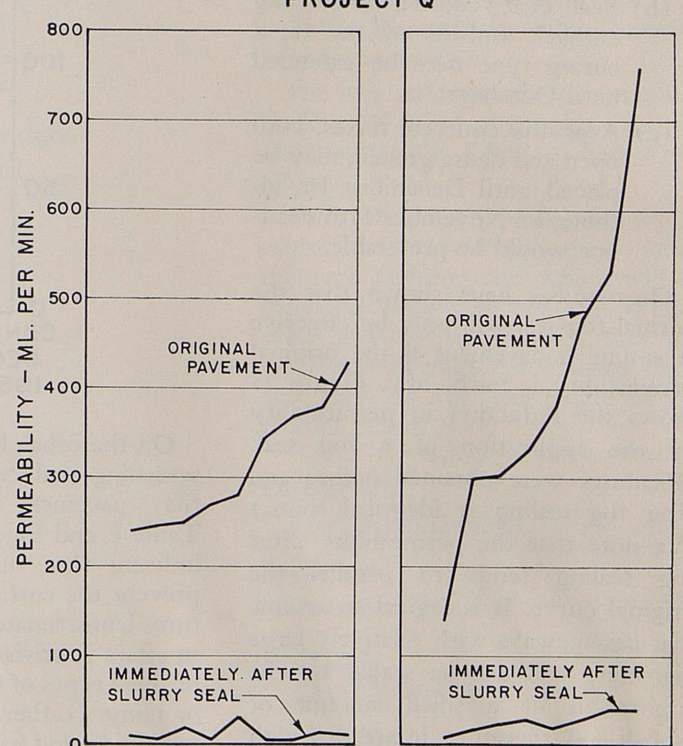
CHANGE IN PERMEABILITY VALUES AFTER APPLICATION OF A FOG SEAL

PROJECT N



REDUCTION IN PERMEABILITY VALUES FOLLOWING APPLICATION OF A SLURRY SEAL COAT

PROJECT Q



traffic until the following spring. The pavement was laid over a virtually impermeable cement treated base. In February 1958 after a series of storms we noted an overall drop in permeability from that found after fog sealing. This was most likely caused by entrance and entrapment of rainwater within the pavement and was further confirmed by the gain in permeability values after a period of dry weather. The increase was probably due to the evaporation of pavement moisture. A decrease in permeability values occurred after opening of the pavement to traffic.

The Materials and Research Department has consistently maintained that cold and inclement weather is the most adverse factor affecting success or failure during the placing of any type of bituminous pavement or seal coat.

Based on California weather conditions, particularly in the northern part of the State, we have suggested the following tentative schedule for placing bituminous pavements or seal coats:

(a) Seal coat construction using emulsified asphalts should be terminated by September 15th.

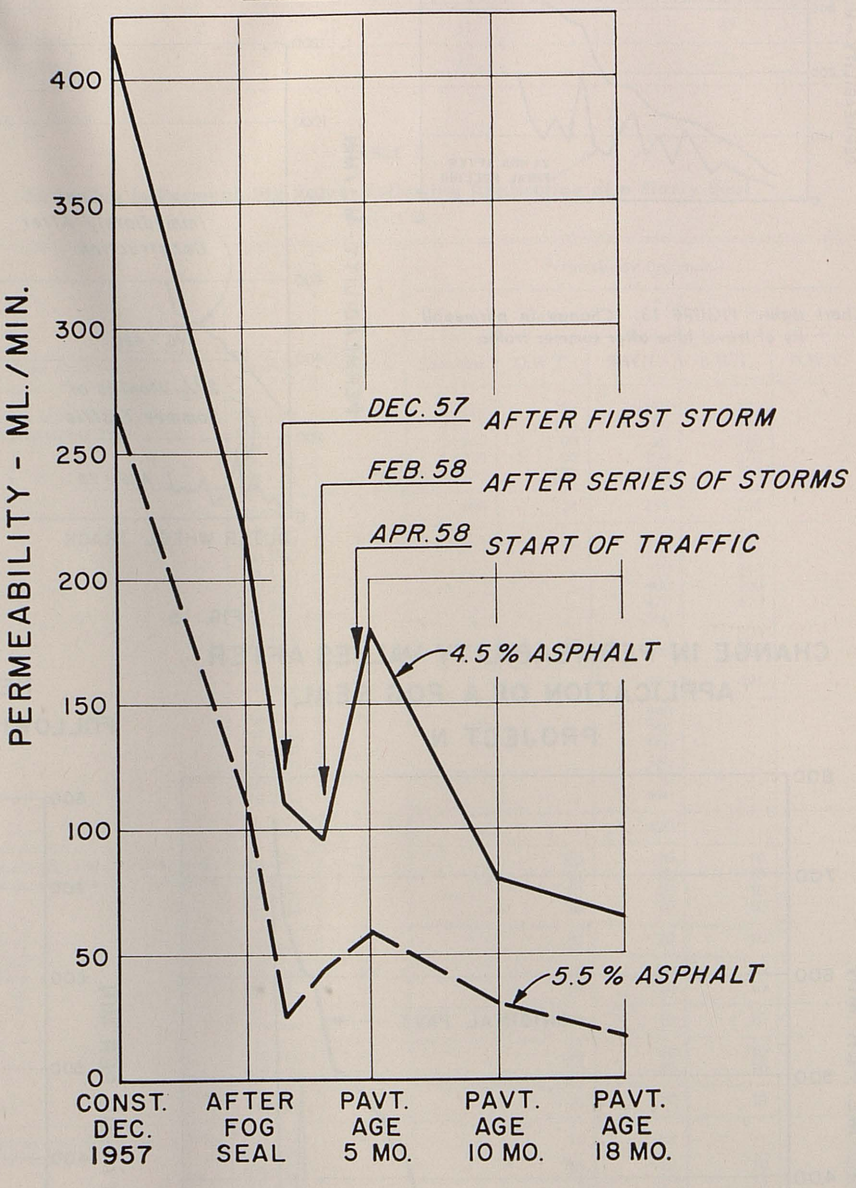
(b) Seal coat construction using cutback asphalts of the rapid curing type may be extended until October 15th.

(c) Asphaltic concrete mixes, both open and dense graded, may be placed until December 1st, although a November 15th deadline would be preferable.

Our studies have shown that the normal fog seal will only be effective in sealing a pavement if the original permeability is fairly low. Figure 15 shows the reduction in permeability by the application of a fog seal. (Readings were obtained before and after fog sealing at identical spots.) We note that the permeability after fog sealing tends to parallel the original curve. It is logical to assume that passageways with relatively large diameters will not be sealed by the application of a small amount of asphalt and, therefore, in areas of high permeability no real improvement will be noted.

FIG. 14

CHANGE IN PERMEABILITY VALUES CAUSED BY INCREASE AND DECREASE OF PAVEMENT MOISTURE AND TRAFFIC COMPACTION PROJECT N



On the other hand, a slurry seal or screening seal coat virtually renders the pavement impermeable. (See Table F and Figure 16.) Present data indicate that such seals completely prevent the entrance of surface moisture. Unfortunately, it is very difficult to attain a satisfactory job with either of these types of seal coats during cold or rainy weather although during this paving period newly laid pavements are most in need of some form of sealing.

Tentative Limits

We believe that a tentative average water permeability value not exceeding 150 ml./min. for a 6-inch-diameter area will be low enough to prevent the entrance of excessive moisture into the pavement from the surface. On the basis of our studies, we have concluded that it is not feasible or even advisable in all cases to attempt construction of a completely impermeable asphalt pavement, because to do so would in many instances require sacrificing other qualities of importance equal to the water problem. Our objective is to reduce the potential for water infiltration to a minimum through properly designed mixes and practical construction methods. The permeability test is a useful tool in attaining this desirable end result.

It should be pointed out that the figure of 150 ml./min. is a relative test figure only and indicates the ability of the newly compacted or existing pavement to accept water. Once the voids in the pavement are filled with water the amount of any additional water admitted depends on the permeability or porosity of the base material.

Conclusions

A simple and rapid test method for measuring the tendency of surface water to enter an asphaltic pavement has been developed.

This test can be used during actual construction to give an indication as to the effectiveness of compaction operations.

The results of field studies clearly indicate that pavements, even of the so-called dense graded mixtures, have been constructed that are quite permeable to the entrance of surface water. This water may contribute to possible failure of the pavement by acting as the agent for transporting base dust and clay fines into the interstices of the pavement mixture. This action may also contribute to the rapid hardening of the binder, especially in the lower part of the pavement.

Field tests indicate that adequate compaction, together with some form of pneumatic rolling are very important factors in reducing pavement permeability. Also, permeability may continue to decrease immediately after construction and will definitely decrease for pavements laid during the normal paving season when subjected to traffic during the summer months. On the other hand, pavements laid during the late fall or winter must rely on adequate initial compaction since no further decrease in permeability may be expected before the following summer. Bituminous pavements or seal coats should not be placed in the late fall or during the winter months.

Fog seals will decrease the permeability but will not prove effective if the initial permeability is very high. Slurry seals and screening seal coats effectively reduce the permeability value to a very low figure.

Some of the early studies involving relatively permeable surfaces were conducted on pavements constructed under the 1954 Standard Specifications. As the result of these studies, the 1960 Standard Specifications carry more rigid requirements for temperature control and additional compaction equipment.

More recent studies on a considerable number of projects show a marked decrease in permeability values and void content of the mix. This, of course, should provide better durability for the bituminous binder with a resulting longer service life for the pavement.

Twenty-five-year List

The following employees received their 25-year awards during April, May and June:

Headquarters Office
Charles G. Beer
Lyman R. Gillis
George A. Hill
Dwight J. Morrow

State-owned Toll Bridges
Theodore Hubbard

District I
W. Sam Burrows

District III
Ida V. Chase
Arthur C. Kehm
H. E. Nahhas
Clarence E. Walters
Leonard V. Wood

District V
Charles W. Dana

District VI
Harold E. Breckenridge

District VII
Edith Berg
John D. Groff
Maxine Thacker

District VIII
Freda Reed Dunbar

District IX
Dorothy Vellom

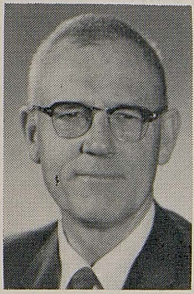
District X
John Christensen

District XI
Vernon H. Hamby
Glenwood L. Richardson

McCorkle Retires, Plans Boat Trip

Nathan C. McCorkle, assistant planning engineer, retired July 11 after a career of 34 years with the Division of Highways.

His work during the last 10 years was in a liaison capacity with various districts. He was associated with the route studies and design for highway projects in most parts of the State, including many of the major freeways in the Los Angeles and San Francisco Bay areas.


N. C. McCORKLE

McCorkle was born in Seattle April 12, 1902, and received his education in that city. Between 1920 and 1930 he had engineering assignments covering the Pacific Coast from Alaska to the Mexican border. He joined the Division of Highways as a draftsman in Bishop and transferred to Sacramento in 1931. He moved to Eureka in 1936 where he served for three years as resident engineer on highway construction projects.

McCorkle and his wife, Dorothy, have three children.

He is a member of the American Society of Civil Engineers and the Commonwealth Club of San Francisco.

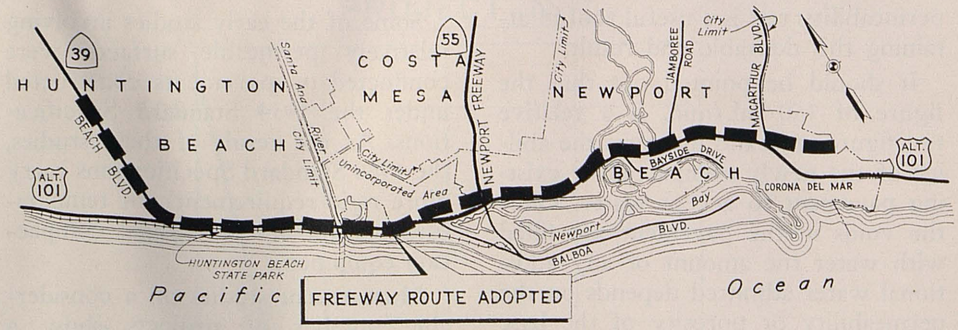
The McCorkles are planning a cruise on a 34-foot auxiliary ketch they are building and which will be launched some time this fall. With a crew of one or two to assist, they will sail down through the Panama Canal and then up the east coast of the United States.

New Routes

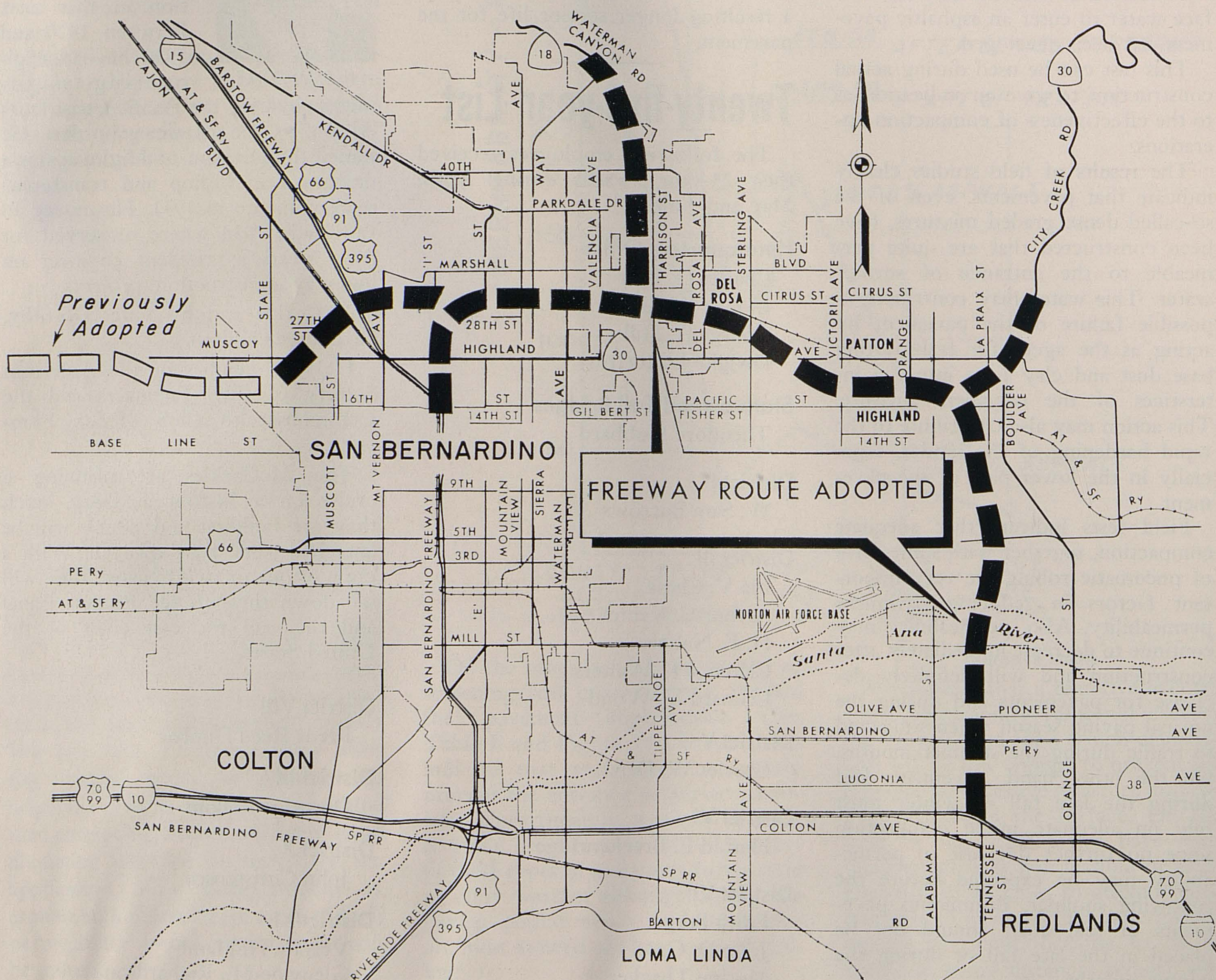
Freeway Network Adopted In San Bernardino Area

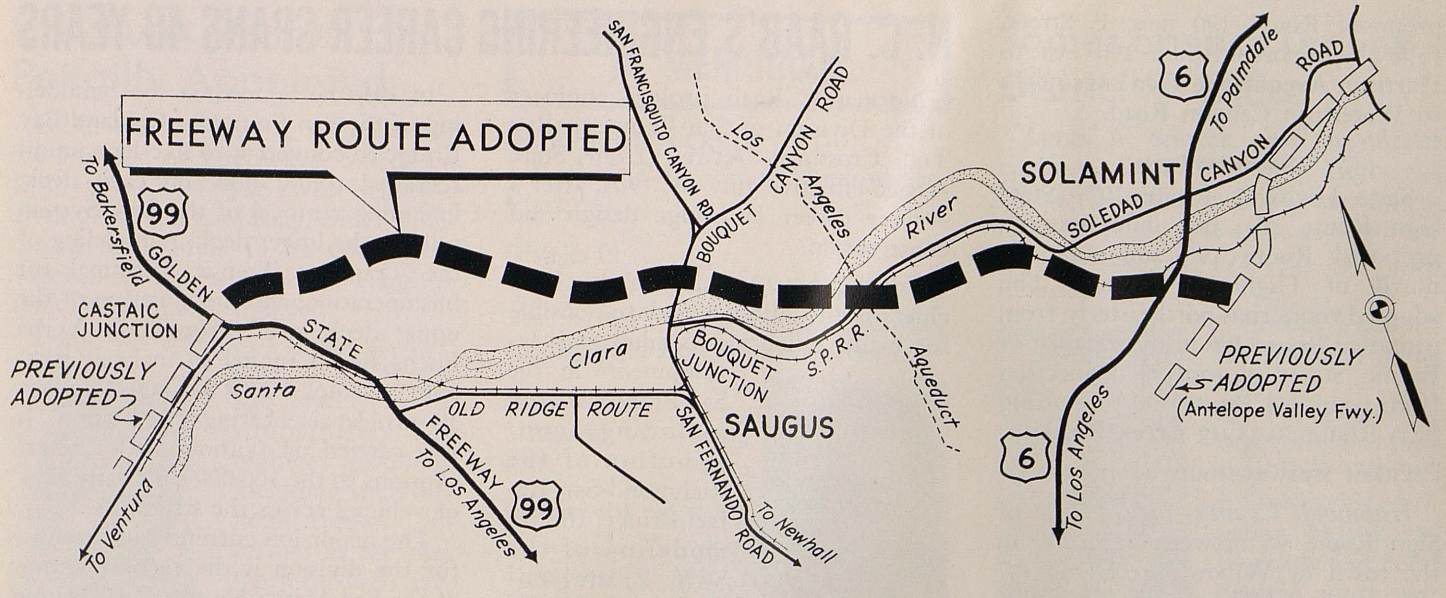
The California Highway Commission adopted eight freeway routings at its May and June meetings, including a routing for the Pacific Coast Highway in the Newport Beach-Huntington Beach-Costa Mesa area and routings for a freeway complex in and near San Bernardino.

The routing for the Pacific Coast Highway extends 10.2 miles between 0.8 mile south of MacArthur Boulevard, southeast of Newport Beach, and north of Adams Avenue in Huntington Beach.



The route generally follows the existing highway except for a slight inland shift in the Newport Beach area. In adopting it by a five-to-two vote the commission overruled a recommendation for a route farther in-





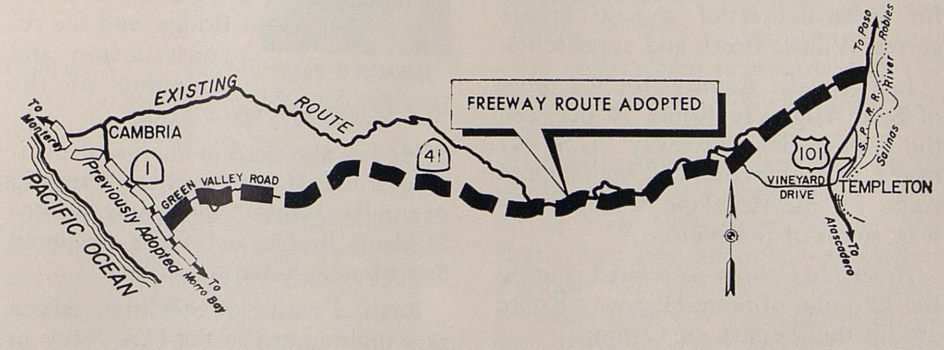
land submitted by State Highway Engineer J. C. Womack.

Three Highways Involved

Three state highways are involved in the San Bernardino area action. The adopted routes are as follows:

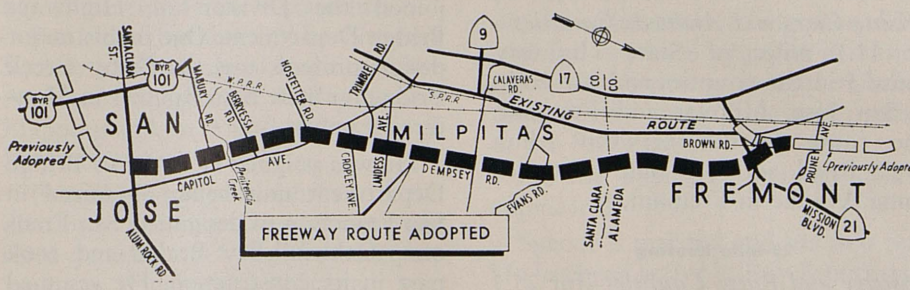
State Highway Route 190, 12.4 miles between State Street in Muscoy and U.S. Highway 70-99 (Interstate 10) in Redlands. From State Street the adopted route swings north of State Sign Route 30 (Highland Avenue) and runs easterly generally parallel with 30th Street to Del Rosa Avenue. It then swings southeast, crosses Highland Avenue east of Sterling Avenue, and continues eastward to La Praix Street. From there it runs almost directly south to Redlands, and terminates at the Interstate 10 Freeway.

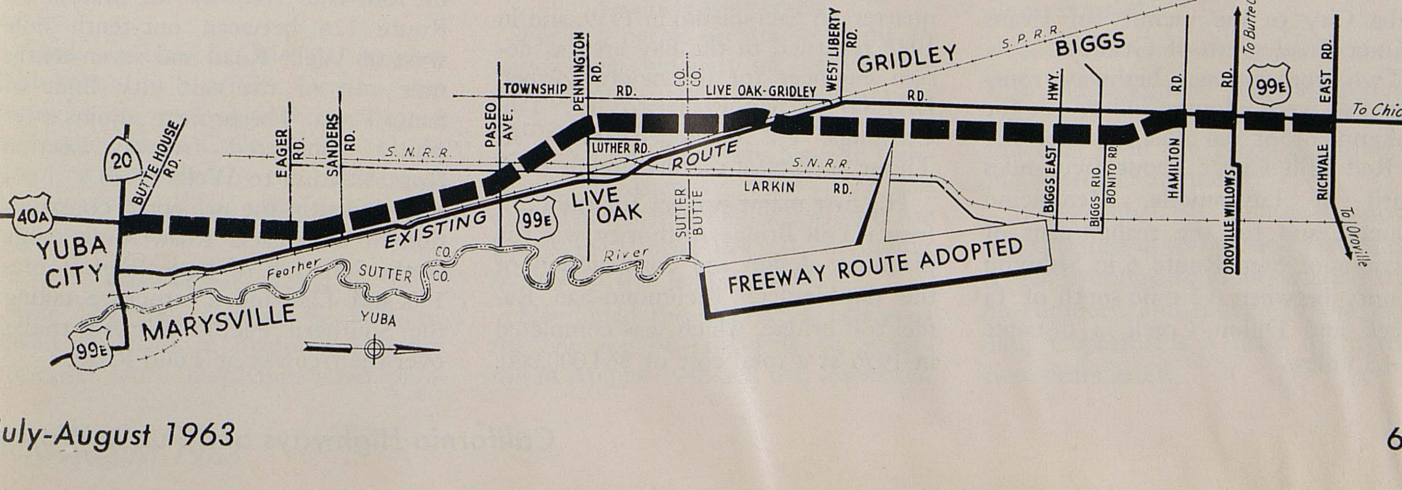
State Highway Route 43 (Sign Route 18), four miles between the San Bernardino Freeway at 16th Street and the adopted route for



Highway Route 190, and between the adopted route for Highway Route 190 and Waterman Canyon Road.

The adopted route for Highway Route 43 runs north from the San Bernardino Freeway at 16th Street to





proposed Route 190 near E Street, follows proposed Route 190 east to Harrison Avenue and then runs north to Waterman Canyon Road.

Connecting Route

State Highway Route 207 (State Sign Route 30), one mile between proposed Route 190 and 0.2 mile north of Highland Avenue. The adopted route runs northeasterly from proposed Route 190 in the vicinity of Pacific Street to form a connection from proposed Route 190 to existing Sign Route 30 (City Creek Road).

Other freeway route adoptions:

Humboldt County—for 0.7 mile of Sign Route 96 between U.S. 299 in the town of Willow Creek and 0.7 mile northerly. The route will provide for construction of a new bridge across Willow Creek and approaches.

Los Angeles County—for 9.4 miles of State Highway Route 79 between the Golden State Freeway (U.S. 99) near Castaic Junction and the adopted route for the Antelope Valley Freeway south of Solamint.

Riverside County—a revised routing for 1.7 miles of State Highway Route 193 in the vicinity of Corona.

San Luis Obispo County—for 26.1 miles of Sign Route 41 between Sign Route 1 near Cambria and U.S. 101 near Paso Robles.

Santa Clara and Alameda Counties—for 11.1 miles of State Highway Route 5 in the counties and the cities of San Jose, Milpitas and Fremont. The route extends between Alum Rock Road and 0.4 mile south of Prune Avenue in Fremont.

25-mile Routing

Sutter and Butte Counties—for 25.3 miles of U.S. Highway 99E from Yuba City to the vicinity of Evans Reimer Road south of Gridley.

Two conventional highway routings also were adopted. They are for realignment of 0.6 mile of U.S. 101 at Red Hill Curve about two miles south of Laytonville, Mendocino County, and for the realignment of portions of Sign Route 6 in Siskiyou County between 0.2 mile south of Ti Creek and Dillon Creek, a distance of 4.3 miles.

N. C. RAAB'S ENGINEERING CAREER SPANS 40 YEARS

Norman C. Raab, projects engineer of the Division of San Francisco Bay Toll Crossings, retired from State service effective July 31, 1963, after a 40-year career in bridge design and construction.

For the past 12 years Raab has been chief of the division and responsible for major toll bridge studies and developments in the San Francisco area, including construction of the Richmond-San Rafael Bridge, the remodeling of the San Francisco-Oakland Bay Bridge, and the reconstruction and widening of the San Mateo-Hayward Bridge.


NORMAN C. RAAB

He has also been in charge of planning studies for a Southern Crossing of the Bay south of the San Francisco-Oakland Bridge and for a proposed San Francisco-Marin crossing.

Raab, a native of Stockton, served as a midshipman in the U.S. Navy in World War I and was graduated from the University of California in 1921. He received his M.S. in Engineering there in 1923, and soon afterward joined the Division of Highways Bridge Department. One of his major design projects was the Bixby Creek Bridge on State Sign Route 1 in Monterey County.

He was assigned in 1931 to a Bridge Department unit being organized in San Francisco to design the San Francisco-Oakland Bay Bridge and took part in its construction. He resumed bridge design work in Division Headquarters in Sacramento in 1939, and in 1948 returned to the Bay area as design engineer for the newly formed Division of San Francisco Bay Toll Crossings. He succeeded Ralph A. Tudor as chief of this division in 1951.

His first major project for the California Toll Bridge Authority was the planning, design and construction of the double-deck Richmond-San Rafael toll bridge, which was completed in 1956 at a total cost of $64,000,000.

In 1958 he undertook the remodeling of the San Francisco-Oakland Bay Bridge to convert it to five-lane unidirectional traffic flow on each deck, including removal of the Key System rails on the lower deck; remodeling of the Transbay Transit Terminal for bus operation; and the lowering of the upper deck level through the Yerba Buena Island tunnel to make it passable for trucks. This $35,000,000 overall project is nearing completion. It was carried on without major interruptions to the 100,000-plus daily flow of vehicles across the structure.

The major job currently in progress for the division is the reconstruction of the San Mateo-Hayward toll bridge to provide four lanes of traffic instead of two on its long trestle section and to replace the existing two-lane lift span with a high-level fixed span carrying six lanes of traffic. Most of the trestle work has been completed and the substructure contract for the high-level span was awarded on July 5. Total cost of the overall project is estimated at $70,000,000.

In addition, Raab has directed several bridge planning studies in the Bay area as called for by the Legislature. His most recent study projects were an updating of previous studies on a proposed Southern Crossing and a traffic study in connection with proposals for a San Francisco-Marin County crossing.

Raab and his wife live in Berkeley. They have two daughters and nine grandchildren.

LARGE CONTRACT AWARDED

The State Department of Public Works has awarded a $6,480,000 contract for grading and paving 8.5 miles of four-lane freeway on State Sign Route 126 between one-tenth mile west of Wells Road and seven-tenths mile east of the east city limit of Santa Paula. The project adjoins a recently completed freeway section from Ventura to Wells Road.

Included in the project is construction of an Acacia Road Interchange at the junction of State Sign Routes 150 and 126, and a structure taking the Southern Pacific railroad tracks over the freeway at Todd Road.

L. L. Funk Retires; Pengilly Appointed

L. L. Funk, planning engineer for the Division of Highways, retired on July 1 after a 34-year career with the division, which has brought him widespread recognition in his profession. Succeeding him is Dana G. Pengilly, assistant planning engineer.

Funk was appointed planning engineer in 1959 and had statewide responsibility for highway planning, including such difficult freeway locations as the network through Sacramento, Beltline Interstate 805 in San Diego and Beltline Interstate 280, an extension of Junípero Serra Freeway south of San Francisco.


L. L. FUNK

Was Task Force Chief

Prior to becoming planning engineer Funk was chief of a task force which planned the route of Interstate 5, the Westside Freeway, California's longest stretch of interstate highway, extending from Wheeler Ridge south of Bakersfield to Woodland.

Funk was appointed photogrammetric engineer for the division in 1956. In 1959 he won the national Talbert Abrams Award "for authorship and recording of current and historical engineering and scientific developments in photogrammetry."


DANA G. PENGILLY

Funk was born in Chicago, attended high school in Sheridan, Oregon, and received his civil engineering degree at Oregon State College in 1921. He was first employed by the Division of Highways in 1923 as a draftsman in its Dunsmuir office.

Rejoined State in 1931

He left state service in 1925 to spend six years in mapping and tax appraisal work involving aerial photography. In 1931 he re-entered Division of Highways work in San Luis Obispo, advancing to the position of assistant district engineer—planning, before his transfer to Sacramento.

Funk is a member of the National Society of Professional Engineers, the American Congress of Surveying and Mapping and the American Society of Photogrammetry.

Pengilly has been a member of the division's Planning Department staff since January 1958 and for the past year was Funk's chief assistant.

Service in South Pacific

He is a native of Stockton and an engineering graduate of the University of the Pacific. He spent a year with the U.S. Corps of Engineers in construction of military bases in California, and then 3½ years as an aircraft maintenance officer with the Air Force in World War II, including service in the South Pacific.

He joined the District X office of the Division of Highways in Stockton in August 1946 and was associated with the design of freeway and expressway improvements to U.S. 50 and U.S. 99 in San Joaquin, Stanislaus and Merced Counties.

In November 1955 he was promoted and transferred to Division Headquarters in Sacramento as an assistant traffic engineer, and moved to the Planning Department a little more than two years later.

IN MEMORIAM

Headquarters Office

Katherine G. Foote, Intermediate Clerk.

District III

Jesse E. Colt, Highway Engineering Technician I; John Benson, Highway Landscaping Leading Man, retired.

District IV

Martin W. Judge, Highway Foreman.

District VII

Donald W. Bamford, Highway Maintenance Man II; Raymond E. Hylton, Highway Maintenance Man III.

District X

Harold R. Nelson, Highway Maintenance Man III.

District XI

John M. Jaynes, Engineering Aid II; Edward W. Shedaker, Highway Foreman; Arnold H. Lenox, Engineering Aid II.

James Spence Leaves District IV Office

James A. Spence, assistant district engineer of the Division of Highways District IV office in San Francisco, retired on July 1. He came to work for the division in 1929 at San Luis Obispo.


JAMES A. SPENCE

Spence was born at Elko, Nevada, and received his civil engineering degree from Montana State College. Following his graduation he did exploration and flood control work for the United Fruit Company in Guatemala after which he returned to the States and worked with the U.S. Corps of Engineers.

After joining the State Division of Highways in 1929 Spence was transferred two years later to the San Bernardino area where he was resident engineer on various highway construction jobs. He was assigned to the San Francisco-Oakland Bay Bridge staff in 1933, first on triangulation and surveys, later on construction.

Spence joined the District IV office in 1937. From 1940 to 1942 he was district right-of-way engineer. Since 1942 he has been engaged in various phases of highway design including most of the major freeway projects in the San Francisco Bay area.

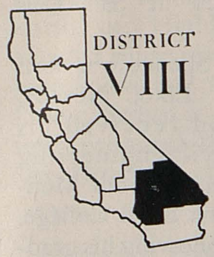
He was appointed assistant district engineer in 1949.

Spence is married and has two sons. He has been active in Boy Scouts serving both as committeeman and explorer counselor.

District Library

San Bernardino Office Forms Reference Unit

By ALICE VAN BOVEN, Assistant Highway Engineer



The District VIII Library, located in the district office building in San Bernardino in a room 16 by 13½ feet, contains bookcases occupying 24 feet of wall space, a reading table, and comfortable chairs. It is strictly a reference library for highway employees.

The card catalogue lists about 1,300 books and pamphlets, all classified in the Dewey decimal system. The library contains books and pamphlets on highway engineering (the majority of the books are in this category), general engineering, mathematics, surveying, hydrology and other sciences, administration, supervision, management, legal matters, area planning, drafting, and a few other miscellaneous subjects.

Approximately 50 different magazines are received by the library regularly. A few are kept on permanent file, such as those published by the State, the Bureau of Public Roads, American Association of State Highway Officials, or the Highway Research Board; the others are placed on the shelves for from 6 to 12 months. When these are discarded, they are sent to the supervisor of elementary education in the local public schools office, as teachers often use them in classroom work.

A small looseleaf notebook is maintained to aid the engineers in finding magazine articles on subjects they need. From this, the supervisor of drafting service can quickly find articles on scale models; the Production Control Department can find articles on the critical path method in a number of magazines without looking through scores of magazines piled on the shelves; the Maintenance Department can quickly refer to articles on the use of epoxies; the Traffic Department can find a list of recent articles on traffic control or traffic planning. Before the semiannual clearing out of magazines to be discarded, the most pertinent articles of interest to our engineers are cut out and preserved in a notebook.

Nancy Strong, Library Assistant, and William Kraisosky, newly appointed junior civil engineer from Walla Walla College in Washington, consult reference material in the District VIII library.

Typical requests of employees using the library are: a specifications writer who needs information from the ASTM Standards; a construction engineer who works with landscaping and needs information on California weeds and ornamentals; a research analyst who needs information from old biennial reports; a senior engineer looking for an article in an old volume of ASCE Transactions or Highway Research Board Proceedings; a traffic engineer who needs to see an ENO reprint or an old ITTE Street and Highway Proceedings; an engineering aid studying for the highway technician exam checks out a Construction Manual or a Planning Manual; a newly hired aid I checks out a surveying text; a man studying for the EIT borrows a book on strength of materials; a right-of-way man comes in to look up the meaning of terminology used on an old Spanish land grant or a legal matter; a steno reads a pamphlet on letter writing; an engineer preparing for the RE exam borrows one of the books that can be taken to the exam; a delineator refers to old issues of our "Profiles" or the news organ from some other district; some spend their "break" periods in the library.

Much of the material available in the library is supplied by the State, such as publications of the Highway Research Board and others. Some material is donated by the publisher. In order to obtain needed study material not available through either of these sources, some employees organized a Highway Engineers' Club, with dues

SEVEN PROMOTED BY DIVISION OF ARCHITECTURE

The State Division of Architecture has announced the promotion of seven of its employees to fill vacancies and to further the division's rotation plan.

Clarence T. Troop, formerly Area III construction supervisor, has been appointed chief construction supervisor for the division, a new position responsible for the manning, staffing, administration and co-ordination of construction service for the division.


CLARENCE T. TROOP

Merle A. Ewing, schoolhouse structural engineer for Area II, has been appointed chief structural engineer (schoolhouse), a new position in charge of the division's schoolhouse section which checks and passes on the safety aspects of private architects' plans for public school buildings erected throughout the State. He will also continue to direct Area II's schoolhouse activities in north central California.


MERLE E. EWING

Responsiblity for the functions of both the new positions had been under C. M. Herd, chief construction engineer for the division. However, following Herd's retirement on April 30, a reorganization plan was put into effect abolishing the chief engineering post and splitting it into two positions.


N. G. GATOURA

Taking over Troop's Area III construction supervisory duties in Los Angeles is N. G. Gatoura, district construction supervisor, districts 1 and 2, Napa.

Lawrence L. Dushkin, construction supervisor at Pacific State Hospital, district 5, moves north to take Gatoura's place.

The division also appointed Richard T. Casey, general construction supervisor six years, Sacramento, as construction supervisor in charge of Area I with headquarters in the Oakland State Office Building.


RICHARD T. CASEY

He succeeds Thomas M. Curran, 12-year holder of the job, who retired April 1. Construction Area I comprises the coastal and bordering counties from Monterey to the Oregon line.


SIDNEY PAULE

To fill Casey's general supervisory post, Sidney Paule, supervisor of construction district 5, Los Angeles County, has been shifted to the Sacramento headquarters.

Charles Blackburn, a construction supervisor at the Pomona campus of California State Polytechnic College, has been promoted to supervisor of district 5, succeeding Paule. His headquarters will be in the Los Angeles State Office Building.

LIBRARY

Continued from page 68 . . .

of one dollar annually. The club has supplied the library books which can be taken to the RE examination, other useful study material, and also library book covers. Books have also been donated by persons who have retired.

The convenience of having all books and pamphlets collected in a library saves time for employees needing to use the material. This compensates for the time spent by the employee classifying and cataloguing the books and pamphlets, keeping the shelves in order, checking the books in and out, and aiding employees in finding what they need.

Stanley Retires From City-County

J. N. Stanley, senior highway engineer in the City and County Projects Section of the State Division of Highways, retired on June 30. He had been with the division 34 years.

A native Californian, Stanley was born at Carrville, Trinity County, and attended grade and high school in Magalia and Oroville, Butte County.


J. N. STANLEY

He served with the 21st Infantry, U.S. Army, from 1918 to 1921 and received an appointment to the U.S. Military Academy at West Point.

He resigned from the Academy in 1922 and for the next seven years did engineering work for private lumber companies, the Idaho Highway Department and the Butte County Road Department.

He joined the California Division of Highways in 1929 and spent most of the next 17 years in District IX as inspector, designer and resident engineer on highway projects.

These included location of the Lone Pine-Death Valley Road through the Argus, Panamint and Funeral Ranges, resident engineer on the Conway Summit (U.S. 395) and Tioga Pass (State Sign Route 120) routes, and location of defense access roads in eastern California during World War II. Stanley also handled much of the preliminary work which resulted in the adoption and construction of the present highway over Monitor Pass in Alpine and Mono Counties.

In 1946 he transferred to District III in Marysville.

He was appointed assistant engineer of federal secondary roads at headquarters office in Sacramento in 1951 and put in charge of urban extension projects when the Division's city and county road sections were reorganized in 1962.

Stanley is a Mason and a member of the Elks Lodge.

Retirement Claims 26 More Employees

Headquarters Office

Victor L. Chertorisky, Associate Highway Engineer, 34 years; * Norman H. Heggie, Assistant Purchasing Specification Analyst, 35 years; George N. Webb, Principal Highway Engineer, 35 years.

Bridge Department

Floramay Hageman, Intermediate Account Clerk, 21 years.

District I

* Marie M. Clark, Intermediate Account Clerk, 8 years; Frank Faulkner, Highway Field Office Assistant, 30 years.

District II

James T. Smallen, Highway Mantenance Man II, 37 years.

District III

John Q. Adams, Highway Maintenance Man II, 29 years; Alvin E. Engraham, Highway Foreman, 32 years.

District IV

Leonard Campos, Groundsman, 3 years; Donald C. Milner, Associate Highway Engineer, 32 years.

District V

Silvio D. Binsacca, Highway Maintenance Man II, 31 years; Seldon N. Isham, Assistant Highway Engineer, 35 years.

District VII

Richard O. Berlin, Highway Maintenance Man II, 6 years; * Hazel M. Greeley, Delineator, 7 years; Mode E. Killingsworth, Highway Mantenance Man II, 31 years; Howard D. May, Highway Maintenance Man III, 30 years; Charles J. McCullough, Associate Highway Engineer, 26 years; Walter J. Sherman, Groundsman, 8 years; Thomas G. Sibley, Associate Right of Way Agent, 24 years; * Mildred S. Whiteley, Intermediate Account Clerk, 6 years.

District VIII

Herbert G. Gaffko, Reproduction Machine Operator, 7 years; Violet M. Tinker, Highway Field Office Assistant, 12 years.

District IX

John R. Daughdrill, Highway Maintenance Man I, 10 years.

District XI

Joe Minter, Highway Maintenance Man I, 11 years.

Shop 7

James F. Perkins, Automobile Mechanic, 14 years.

* Disability.

Big Bear Road Dated By Reader as 1923

The Editor
California Highways and Public Works
Sacramento, California

Dear Sir:

The January-February 1963 issue of your publication contained an article entitled "Big Bear Road" which described the widening of a section of this road to four lanes. The statement was made that the road was constructed in 1926.

The road was first constructed in 1922-23 by the Bureau of Public Roads with forest highway funds under a contract awarded to the Utah Construction Company. This contract, which extended from a junction with the Green Valley road on the west to Big Bear Lake dam on the east, provided for grading only. Mr. J. H. Obermuller, who later accepted employment with the California Division of Highways, was project engineer. I was a member of the construction engineering crew and during the two-year period the work was in progress became intimately acquainted with the portion you now refer to as the "Arctic Circle Section."

With the completion of the project in the fall of 1923 direct approach to Big Bear Lake from the west became possible without negotiating the tortuous "Snowslide Grade."

Yours very truly,

Eric E. Erhart
5038 5th Street N.
Arlington, Virginia

Ernest H. Sagehorn Retires on July 25

Ernest H. Sagehorn, associate bridge engineer for the California Division of Highways, will retire on July 25 after 30 years of state service.

His engineering career, beginning with his graduation from the University of California in 1927, has included varied roles in the planning, construction and maintenance of bridges.

He has also carried out specialized studies of precipitation and stream hydraulics in connection with bridge design. His chart of precipitation characteristics has become a basic reference in the planning of stream crossings throughout California.

For seven years before and during World War II Sagehorn served in the Civil Engineer Corps of the U.S. Navy, including duty in the South Pacific. He retired recently with the rank of commander.

Sagehorn has served on the board of directors of the Fair Oaks Recreation and Park District for the past three years.

SAN CLEMENTE

Continued from page 31 . . .

Highway business, which fell off when the freeway was completed, has been regained on a sounder basis.

Long-range city planning is proceeding with the assurance that lines of transportation are permanently defined.

More residents of nearby communities—San Juan Capistrano, Capistrano Beach and Dana Point—now come to San Clemente to shop.

Many people who work in Santa Ana, Costa Mesa, Anaheim and other areas of Orange County are acquiring homes in San Clemente because of the temperate climate and fast freeway transportation.

Landscaping of the freeway blends into the natural beauty of the area, and its signs carrying the Spanish place names emphasize the early California atmosphere so characteristic of the community.

San Clemente's chosen way of life is being preserved.

LEONARD HOLLISTER RETIRES; R. J. IVY APPOINTED

The retirement of Leonard C. Hollister, bridge engineer in charge of special projects for the California Division of Highways, and the promotion of Raymond J. Ivy to succeed him have been announced by State Highway Engineer J. C. Womack.

Hollister's responsibilities in the past eight years have included design and construction work on major toll bridges, including the parallel Carquinez Bridge, the Benicia-Martinez Bridge and the Vincent Thomas (San Pedro-Terminal Island) Bridge. He has also co-ordinated studies to date for the proposed San Diego-Coronado crossing.


LEONARD HOLLISTER

His total state service has covered 36 years, all of it with the Division of Highways Bridge Department.

Hollister was born in Pittsburgh, Pennsylvania, attended school in Sheridan, Wyoming, and was graduated with a B.S. in civil engineering from the University of Cincinnati in 1922 after serving in World War I. He engaged in bridge design work in Philadelphia, and came to California and the Division of Highways in 1927 as a junior bridge engineer.

He was in charge of bridge design units working on freeway and stream crossing structures throughout the state, including the Pasadena Freeway and the Four-Level Interchange in Los Angeles, the Sacramento River Tower Bridge and the first units of the elevated freeway through San Francisco connecting with the San Francisco-Oakland Bay Bridge.

The San Francisco project represented the first all-welded steel viaduct in the state. Other developments with which Hollister was identified in their earliest stages include the use of curved box girders and prestressed concrete girders; and the introduction of new lightweight alloy steel, employed on the Carquinez project.

He was promoted to principal bridge engineer and placed in charge of special projects, beginning with the Carquinez structure, in 1955. That job was completed in November, 1958, and was followed by the Benicia-Martinez Bridge which was opened to traffic in September, 1962. The Vincent Thomas Bridge, the first suspension bridge in Southern California, will be dedicated on September 28, 1963.

Hollister is a member of the American Society of Civil Engineers, the American Concrete Institute, and the Structural Engineers Association of California. He is the author of numerous engineering articles in professional publications and of a course for engineers on the moment distribution method of stress analysis.

Hollister and his wife Monica have a daughter, Mrs. Dorothy Jean Norris, of Milton, Florida.

Ivy, his successor in charge of special bridge projects, effective August 1, has been with the Bridge Department since his graduation from the University of California with a B.S. in civil engineering in 1931.

Ivy was born in Morgan County, Missouri, came to California as a child, and was educated in Stockton.

His first eight years with the Division of Highways were spent in bridge construction work in various parts of the state. Later he was engaged in bridge design, including the plans for the Terminal Island lift span bridge built for the U.S. Navy in World War II and some of the structures on the Nimitz Freeway in Oakland.


RAYMOND J. IVY

He also took part in the feasibility studies leading up to the State's taking over the San Mateo-Hayward and Dumbarton toll bridges in 1951.

Ivy served as a Navy officer in the Civil Engineer Corps in World War II, engaging in construction of airfields, hospitals and bases in the South Pacific; and in the Korean War, serving in Alaska and the Philippines.

When he returned to the Division of Highways in 1953, he was placed in charge of bridge maintenance. His responsibilities in this post included the inspection of the structural condition of all highway and stream crossings on the state highway system, currently numbering nearly 7,000.

Earlier this year Ivy was transferred to the position of bridge construction engineer for Northern California, from which assignment he moves up to his new duties.

Ivy is a member of the American Society of Civil Engineers and the University Club of Sacramento. He and his wife Caryl have a son, Frank, currently serving in the Navy.

Elbert C. Brown

Elbert C. Brown, 76, retired district engineer for the U.S. Bureau of Public Roads in California, died in Sacramento on June 26 after a long illness.

Brown retired in 1957 after 48 years of service with the government, 38 of them with the bureau.

Born near Clifton Hill, Missouri, Brown was a graduate of Missouri State University. He was chief bureau engineer in the State of Nevada for 14 years before opening the Sacramento office of the bureau in 1945.

His career began with work on the Shoshone Dam near Cody, Wyoming, in 1909. He spent seven years in the Philippine Islands building roads for the War Department. He was a captain in the Army Engineers during World War I.

Brown was a lifetime member of the American Society of Civil Engineers and Phi Kappa Psi and Tau Beta Pi fraternities.

He is survived by his wife, two sons and a daughter.

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Design and Materials Conference

The use of various items of drilling equipment was explained by Gifford Stafford, at right, to design and materials engineers from California counties in the course of a two-day meeting at the Division of Highways Materials and Research laboratory in Sacramento

Design and materials engineers from 26 California counties participated in two days of technical discussions and demonstrations at the Division of Highways Materials and Research Department laboratory in Sacramento May 23-24.

A total of 57 engineers were in attendance at the meeting, which was arranged at the request of the County Engineers Association.

The discussions covered various aspects of materials testing, including sampling and testing of aggregates, compaction tests, tests on asphalts, asphalt and concrete surfaces, base materials, and the inspection and release of materials at fabrication plants. Tours through the laboratory were conducted to illustrate the use of different types of testing equipment.

Materials and Research Engineer Francis N. Hveem of the Division of Highways moderated the discussions. Special presentations were made by Robert Latchaw, Contra Costa County construction engineer, on the traffic index for low volume roads; Joe Vicelja, materials engineer of Los Angeles County, on reflection cracking through asphalt concrete pavement; and William Garrison, Contra Costa County materials engineer, on lime-treated base materials.

Garrison and George Sherman of the Division of Highways were in charge of arrangements for the meeting.

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