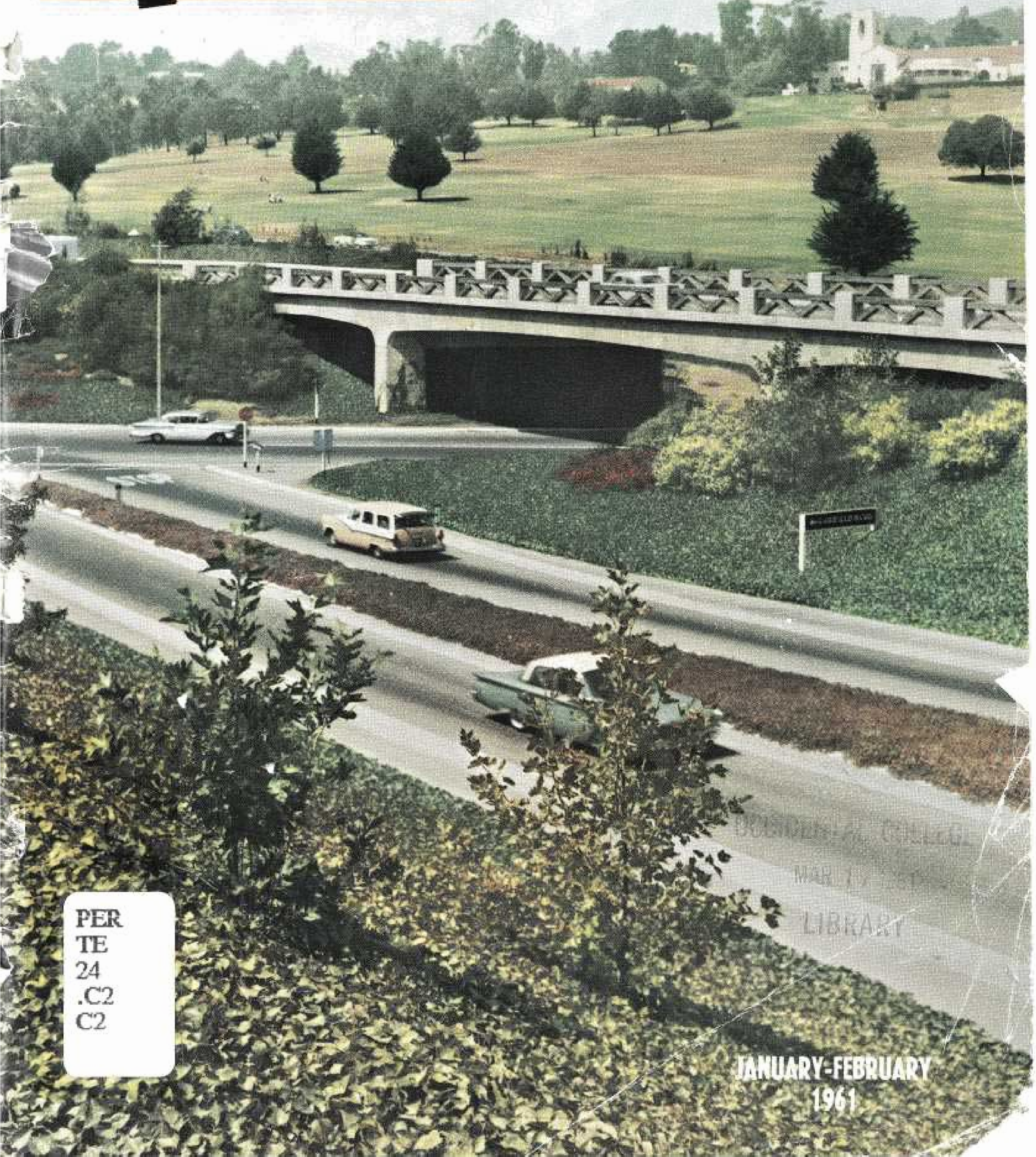
CALIFORNIA
Highways
and Public Works



JANUARY-FEBRUARY
1961

The Pasadena Freeway—And Others

"The Freeway System Is a Persuasive Example of the Need for Adequate Metropolitan Planning"

(Reprinted from the Los Angeles *Times* editorial page, Dec. 31, 1960)

People who drive the Pasadena Freeway probably never give a thought to its age; they may even think it has been there as long as the Arroyo Seco, which parallels it for about five miles.

Yet the Pasadena Freeway (it used to be called the Arroyo Seco Parkway) is only 20 years old, and the pretty Rose Queen who cut the ceremonial ribbon in December, 1940, participated in the anniversary celebration the other day looking hardly a year older.

The Pasadena was the first of the freeways, the prototype of the Southern California system. It was a compromise of plans and counterplans; it has bends in it that would get a present-day highway engineer burned for heresy; and withal—as its 70,000 daily drivers will testify—it still is the pleasantest short freeway haul of the developing system. One of the reasons that it is almost ulcer-proof, despite the flowing script of its reverse curves, is that the great trucks have been rigorously excluded from it. Its access roads belong to a more innocent era, when cruising speeds were farther from the sound barrier, but the Pasadena Freeway has risen above its disabilities and serves its 70,000 daily cars almost as well as the 27,000 it was designed for.

Neil S. Petree remarked at the anniversary celebration that another 20 years of freeway development lies ahead. The system presumably will catch up with the population 40 years after the bank of the arroyo was paved.

If this remark feeds the fires of impatience, it should not. For it is quite likely that the first 20 years of freeway building were the most trying, and that the improvements from now on will be fast and striking. Within five years there will be some operating additions to the network which will radically change the traffic patterns of the metropolitan area—and for the better.

Critics of the system have been premature and unjust. They began to find fault with the system before it was a system. They could prove to anyone who would listen that the Hollywood Freeway's regular jams showed the freeway plan would not work. This was like complaining of a new power plant's capacity before all the generators were installed. The wonder is that the Hollywood Freeway has served so well.

Within the next year the loop of the Golden State Freeway will be in operation, crossing the Pasadena, S Bernardino and Santa Ana Freeways and ending at t Harbor Freeway until it is continued to Santa Monic The effect of this loop on the Hollywood Freeway may be startling. The truck traffic which has plagued it will mostly flow naturally into the other route and the traffic through the central city will ease.

Much has been said about the need for adequate planning for the metropolitan area. The freeway system, it seems to us, is a persuasive example of the usefulness of such planning. The critics forgot that the grander the plan the longer the period of execution. The freeway system could not have been put together instantly even if the funds (it is a pay-as-you-go project) were always available, although the Southern California network might be several years ahead of its present schedule if there had always been enough money.

It will never be a perfect system—what system is? But it will be an achievement of much forethought by government agencies and groups from the state to the neighborhood level. It would be folly to scrap the grand plan now with the argument that the inadequacy of the parts precludes the adequacy of the whole.

If that argument were acceptable, all metropolitan planning would be futile. Worse than that, planning would make chaos more chaotic, because the critics of a plan usually have another plan to impose on the one they are rejecting, like those birds that return annually to build a new nest on last season's rickety remains.

California Highways and Public Works

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FRONT COVER—Example of highway landscaping on U.S. Highway 101 at Cabrillo Boulevard interchange, Santa Barbara. Planting was completed in fall of 1957; includes ivy and iceplant ground covers, acacia, lantana, bougainvillea, and Japanese creeper. Trees in foreground are native sycamores which eventually will add vertical elements to composition. A series of articles on California roadsides begins on page 2.

Photo by Jack Meyerpeter

BACK COVER—Concrete piles for the first section of the Santa Monica Freeway march westward from the almost completed East Los Angeles interchange, the completed bridges of which span the Los Angeles River in upper center. Major street which crosses photo diagonally and over river and railroad tracks at upper right is Olympic Boulevard.

Photo by Robert Rose

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California Roadsides-I

State's Highway Planting Policy Has Grown Out of Special Problems of Terrain, Climate, Changing Pattern of Traffic

THE ROADSIDE policy of any agency is bound to be strongly influenced by local conditions and attitudes. In the Middle Ages in England, there was a law requiring that all trees and shrubbery be removed for a distance of two hundred feet on either side of major travel routes, because they gave cover where highwaymen could lie in wait.

Conversely, many European countries have planted roadside trees for centuries, probably for delineation and dust control as much as shade. The frugal Europeans, mindful of their land shortage, often used fruit trees which were harvested by nearby inhabitants. Today, with the greatly increased motor traffic in Europe, this harvesting no doubt creates serious traffic hazards.

In parts of the United States where there is plentiful summer rainfall, highway landscaping is relatively simple. Shrubs and trees are usually already present. If not, they can be planted and grown with little maintenance except removal of weeds while the plants are small. Roadside grasses will stay green without watering, and can be kept mowed for a parklike appearance.

> Editor's Note: This, the first in a series of articles on landscaping and other roadside problems on the California State Highway System, covers the background of today's policy and practices. Future articles will cover implementation of the policy, maintenance problems, and the division's fund of knowledge of plants.
>
> The series has been prepared by John Robinson of the Public Information Section with the assistance of various staff members concerned with planning, planting, and maintenance of roadsides.

California Climate Difficult

In California, and those other western states which have Winter-wet, Summer-dry climates, landscaping is much more complicated and expensive. In much of California there is no rainfall at all from about mid-May until mid-October—sometimes not until late November or even December. Few trees and shrubs can live through such a long drought, especially when that drought season is also the hot season. Yet California today has thousands of miles of clean, attractive roadsides with handsome planting and pleasant vistas.

It has not always been that way. In the 1880's and 1890's most roads in most states were morasses in wet weather, choking dust pits in dry.

The "good roads" movement began to gather momentum toward the turn of the century, but maintenance of such roads as existed all too often merely consisted of passing over the road with a grader once or twice yearly. Sometimes the sides were ditched. There was little road money and many taxpayers literally worked out their road tax.

With virtually no subgrade, vehicles would sink to their axles in mud in the rainy season, so it was desirable to dry the roads as quickly as possible in the spring. By mid-summer, of course, these same roads were impossibly dusty.

Photo at left, taken about 1905, shows "Winters-Davisville Oiled Earth Road" (Yolo County). Roadside trees are black walnuts planted some time in the last century. This section is no longer state highway but trees are still there as shown by recently taken photograph at right.

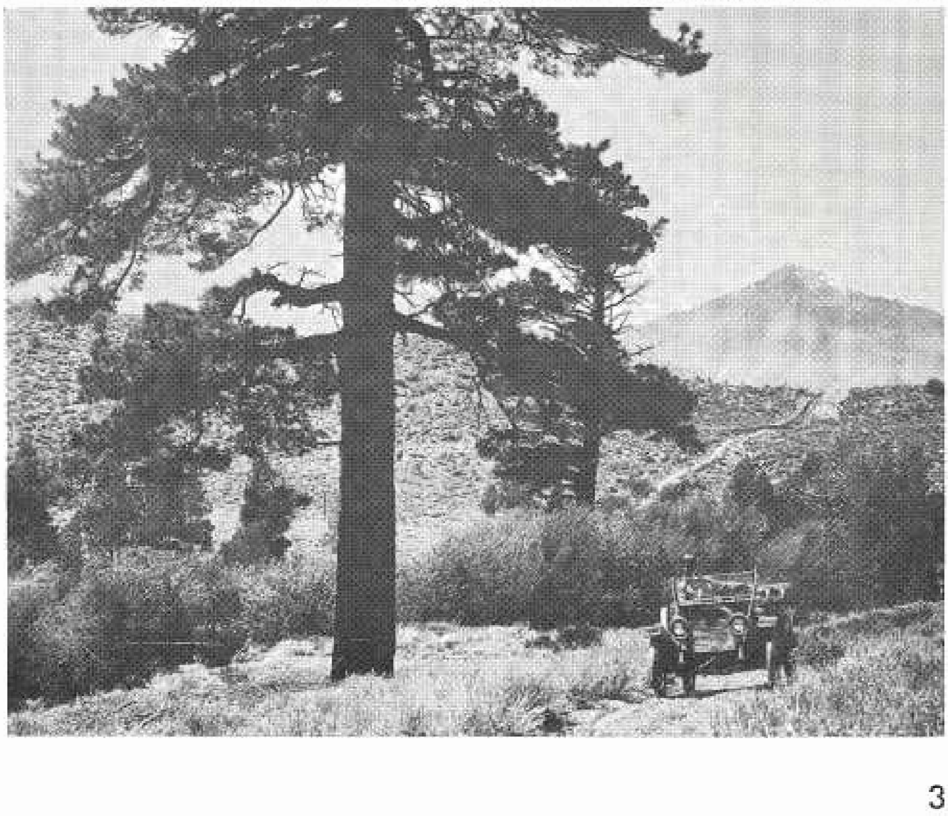
Early vintage Cadillac (note right-hand drive) plows through mud of US 101, El Camino Real, about 1912, in Ventura County. In summer this same section would be impossibly dusty. It was paved in 1915.

Sprinkling became popular, and as more money was available, most counties bought one or more sprinkling wagons. When California's first Highway Commission inspected all the county roads of the state, the members commented time after time, in the 1895-96 report, on this problem of keeping roads from getting neither too wet nor too dry.

Tree Planting Recommended

Speaking of Los Angeles County, they said, "The planting of trees of a deciduous nature along the sides of the highways should be inaugurated. Trees of this character should be planted so that their foliage may shade the roadway during the heat of summer, while during the wet winter months their barren limbs offer no obstruction to the rays of the sun, which remove all excess moistures. The further development of sprinkling should be carried on as rapidly as available funds will permit." (At

Below: This type of road, actually a wagon track following contours, was landscaped by Mother Nature.



In early days of road expansion, cuts were made steep to save money, but savings were lost when slides became serious problem in wet season. Above is ridge route about 1915.

that time it cost about $75 per application to sprinkle a mile of road, the cost varying with the availability of water.)

The Commissioners recommended roadside trees for virtually all the counties, and the comment on San Joaquin County is typical: ". . . rainfall renders the roads impassable during the rainy season on account of mud, while the unrestricted action of the sun during the summer months makes the grinding of the roads into dust a certainty." San Joaquin County, of course, was not better nor any worse than the others.

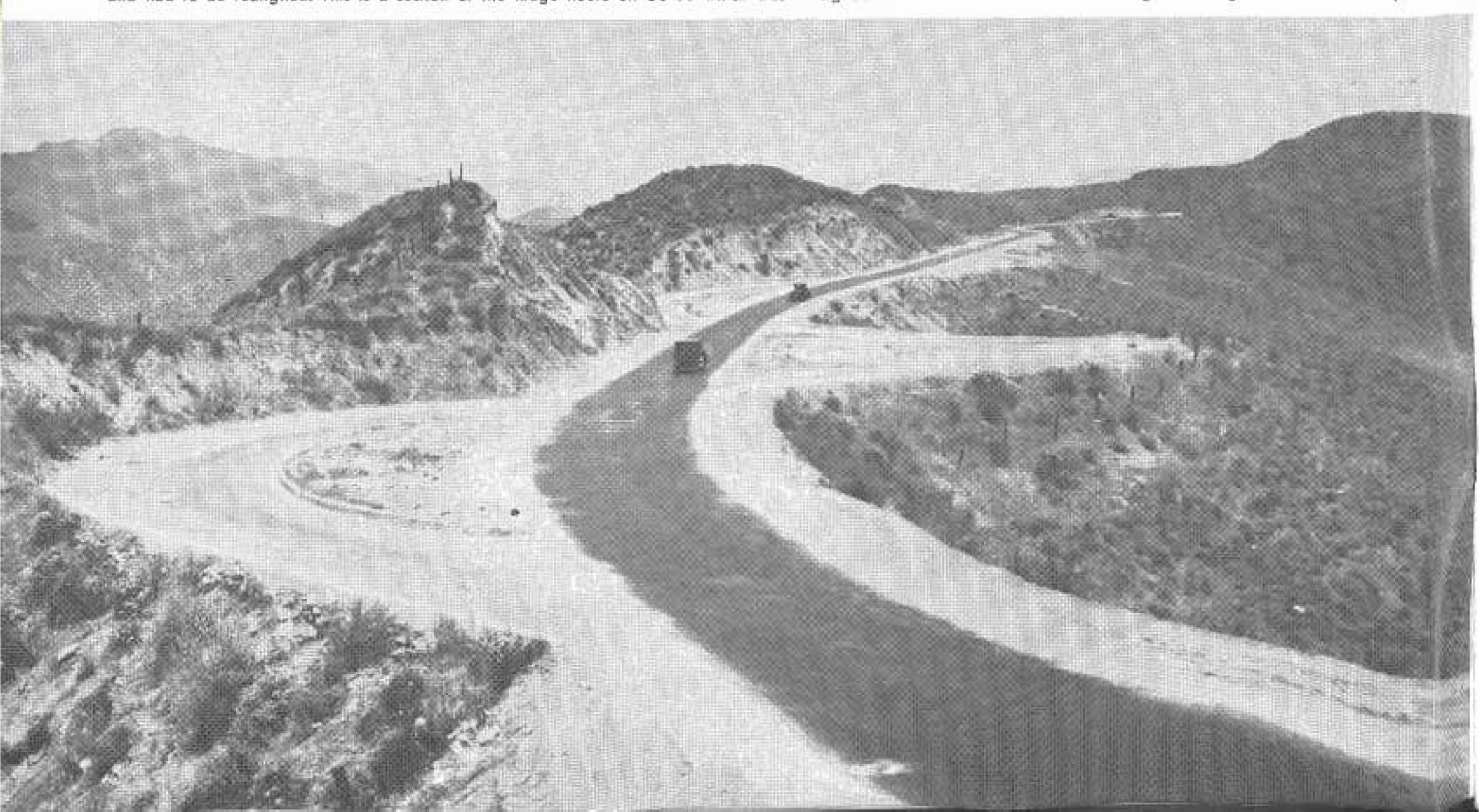
This report bore fruit and many of our older roadside tree plantings date from about 1900. Some of the old curving rights-of-way may still be seen marked by double rows or trees in fields near present roads, a new alignment some time in the past having left them stranded like oxbow lakes of a river.

Road Oil and Trees

With the introduction of oil for road surfacing a few years later, roadside trees seemed less important. At that time, it appeared oil would control the dust problem. But this was a temporary attitude, for road oiling was expensive and there wasn't enough money to treat all the new roads being opened up after the invention of the automobile. Furthermore, many maintenance men insisted trees were helpful, oil or not. Actually, the Highway Commission continued an active roadside tree planting program for another thirty years—and might still be pursuing it had not traffic speeds made the roadside tree a hazard.

Even by the early 1900's the automobile, beginning to be seen occasionally on the highways, was creating new standards and needs. County road commissioners complained that their roads theretofore had been built to withstand the cutting action of iron tired wagons and animal hooves, but that the automobile tire sucked the surface off the roads, causing pockets and ridges rather than ruts. This sucking action, and the suction of the vacuum created in the wake of the faster

Below: With improved design and increased speed of the motor car, the old short radius curves and contour-following roads developed high accident records, and had to be realigned. This is a section of the Ridge Route on US 99 which was realigned in late 1920's. The old reversing-curve alignment shows clearly.



moving vehicles, made the dust problem worse.

After California's first Highway Bond election in 1910 provided funds for a network of state owned roads, the Commission began to think of planting from more than a maintenance point of view. Voices were beginning to be raised asking for road beautification and scenic highways. By this time, the automobile was the dominant factor in road planning although it was still essentially a novelty and luxury for most people rather than the everyday necessity it has since become.

The Sunday Driver

There were taxis and buses and trucks, of course, but most people used their cars for pleasure. The "Sunday Driver" was king. He liked to make pleasant drives at 20 or 25 miles per hour along shaded roads, preferably those roads which had places to turn out and look at a view, or to stop and picnic. On any "nice" Sunday in those days picnic parties could be seen scattered through the rural areas at likely spots near the highway, their cars pulled up beneath a roadside tree.

All this "pleasure driving", this "going for a drive", precipitated another Gold Rush. Myriads of roadside businesses catering to the motorist began to develop. With a few dollars to buy wieners and rolls, any sort of primitive stove, and a day's work with scrap lumber and canvas, a man could go into business. Almost every farmer had a vegetable "stand". The cities were encircled at easy driving distances by "roadhouses".

This fierce competition for the motorist's dollar developed a roadside nightmare. An enthusiastic entrepreneur might place crudely made signs every hundred yards for a mile in either direction from his place of business, only to have a newly arrived competitor intersperse between the first signs a new series of bigger, uglier and more blatant ones. Many of the structures were worse than the signs. Gasoline service stations of wire and burlap were not uncommon. As early as 1912 the California Federation of Women's Clubs was working for signboard control and roadside cleanup.

A resurfacing job going forward on another stretch of US 99, near Wheeler Ridge south of Bakersfield, about 1922. Note young roadside trees, planted about 1920. Due to lack of experience of planters, many trees planted in those days were not adapted to climate and soils.

Also in 1912, the Highway Commission adopted a resolution recommending the protection of timber growing near the roads in the forest districts "to enhance the scenic beauty and attractiveness through wooded portions of California". Landowners were urged to deed 100-foot wide strips of standing timber with right-of-way grants. (In the early 1920's, the Lagoon Lumber Company of Humboldt County actually gave the Highway Commission 25 miles of right-of-way 80 to 100 feet wide, with timber, for U. S. 101 between Trinidad and Orick.)

Roadside Problem Threefold

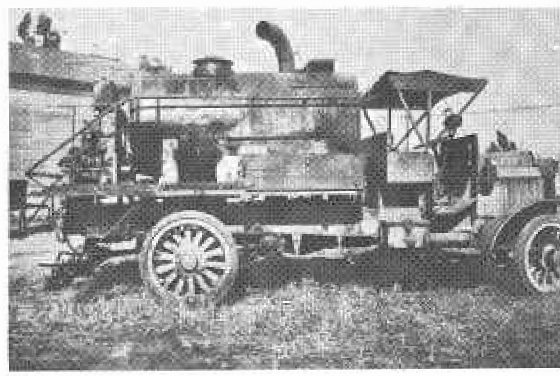
By the time of the U. S. entrance into World War I in 1917, it was apparent that there were three areas of action in dealing with the roadside problem.

The first and oldest part of the problem was the one of *roadside trees*. These were essentially part of the maintenance program.

The second part of the problem was *roadside clutter and signboards*.

The third part of the problem was *highway beautification*, a broad term which even today can mean either conservation, functional planting, or expensive landscaping.

For many years the only part of the three-sided roadside problem given



Two early types of road oilers. Horse drawn vehicle (below) used about 1913 was gravity flow, would only work in warm weather. Motorized model (above) had heater and pump. Both required a driver and an operator who rode seat in rear.

Early photograph (about 1930) of Mexican fan palm roadside tree planting in Riverside shows success of adapted variety.

much attention was the tree program. Drivers like shady avenues. Also, the dust problem was by no means conquered. A report from District IV as late as 1917, complains about the condition of the heavily traveled road through the Santa Cruz Mountains to the popular Santa Cruz beaches. "This route", the report says, "was constantly worked up into deep dust under the many wheels" so that a large portion of maintenance funds had to be spent on sprinkling.

In 1918, the Highway Commission accepted maintenance of all trees on the state highways, whether they had been planted by private individuals or not. Soon after this a working agreement was made between the Highway Commission, the State Board of Forestry, and the Department of Landscape Architecture at the University of California at Berkeley.

This group, known as the Tree Planting Committee, was to develop a plan for highway beautification over the entire state highway system, and advise the counties on their tree problems as well. One outgrowth of the plan was the establishment of a state nursery on a 30-acre tract near Davis, with the Division of Forestry administering it. At about this time, also, the Highway Commission hired arboriculturist W. F. Glendenning as its first full time employee in charge of roadside trees and road beautification.

Nursery Releases Trees

In 1921, the State Nursery released its first trees. A total of 7600 black walnut, European sycamore, Lombardy poplar, American elm, and black locust were turned over to civic groups for roadside planting.

Although civic groups were by then doing the major portion of the tree planting, it was no longer done in whatever fashion the owner of the abutting property wished. To plant roadside trees, a permit was required from the Tree Planting Committee. A planting plan was issued with the permit, and a highway survey party staked the area.

No trees were allowed within 100 feet of road intersections, within 200 feet of railroad crossings, or within 75 feet of inside curves. Trees were planted 100 feet apart on alternate sides of the roadway, which gave an apparent interval of 50 feet. Holes for planting had to be 3 feet deep and 3 feet in diameter, the tree supported by a stout stake and protected from animals by a wire guard.

Plantings cost about $1 per tree unless there was hardpan to be broken. Sometimes a contract was let for the plantings, sometimes they were done by public spirited individuals. In Orland 350 citizens once turned out and planted seven miles of trees in one day.

Part of the agreement was care of the trees for a year. Later this was changed to a cash deposit to cover one year's maintenance. After the first year the Highway Commission accepted responsibility for care and replacement. In general, about 80% to 90% of these plantings survived.

Trees Aid Maintenance

The tree program got further support in the early 1920's when the Highway Commission established a test road at Pittsburg, Contra Costa County. One part of the program showed the great deterioration hard surfaced roads suffered when exposed to the daily cycle of temperature extremes between noon and night. (The highway engineer's rule of thumb says that temperatures of 100° F. on a clear day mean as much as 140° F. at the pavement, depending on the type of surface, when the road surface is in the full sun.) Shade trees greatly reduce these surface temperatures.

Further evidence for the trees was developed through studies of a section of road in Imperial County which was planted to Long Beak Eucalyptus (*E. camaldulensis*). This section had required less maintenance and was in better condition than its adjacent treeless sections. The studies showed that not only had the trees shaded the surface and lessened the temperature extremes which often buckled the pavement in nearby unshaded areas, but also that the roots had sought the moisture beneath the roadbed and reduced sub-pavement water—the maintenance man's enemy.

In 1922, the State nursery released 60,000 young shade trees of various species, and the commission's planting plan proceeded on a systematic basis, adding about 100 miles of trees each year. In 1924, seven new water tank trucks were purchased for use in various districts, and the budget for maintenance of more than 100,000 trees was $41,000.

Nevertheless, constantly increasing traffic was already threatening the program. In February, 1924, the Commission said, "Until the requirements for widening state highways can be more definitely determined, tree planting is not being encouraged. It has been found almost impossible to protect young trees in many places where it has been necessary to lay new and wider pavements."

New Planting Policy

In 1927, a new tree planting policy was adopted, requiring that plantings allow for a much wider right-of-way. Great numbers of trees had already been and still were being planted, however, and the Division of Highways was now maintaining nearly 700 miles of them. New varieties were being tested, and there was consideration of the conflict between the trees and public utilities, such as telephone and power lines.

Despite this continued activity, the peak of roadside tree planting as a maintenance measure had passed.

Faster moving traffic and more of it required ever wider roads which either eliminated the trees or brought them dangerously close to the traffic. Wherever the trees were too close, motorists could not seem to avoid them, and "he hit a tree" became an all too common epitaph. Even today records of the Division of Highways traffic section show that such accidents include only about 1½% of the state total, but account for more than 4% of the fatalities!

Number two in the three parts of the early days roadside problem was dealing with signboards and roadside clutter.

Signboards Uncontrolled

As early as 1915 a signboard law was added to the statutes. It began "No sign, picture, transparency, advertisement or mechanical advertising device may be placed upon or over any state road or highway without a permit . . . and, if so erected shall be a public nuisance . . . " This law, however, only controlled signs on the right-of-way. There was no provision in the body of the law for control of a sign that was not on public property, such as a sign just inside a farmer's field, even though it was fully visible to the motorist and intended for his eyes.

Almost twenty years were to pass before an effective control could be established. Women's groups, conservationists, automobile clubs, newspapers, the Highway Commission, and many other groups called for action. The more farseeing of the signboard companies were also in the fight, for not only was the business getting a bad name, but an uncontrolled glut of signing would tend to defeat its own purpose.

In November 1928 the California Highway Commission adopted a resolution on the subject of signboards, in which civic organizations were encouraged to induce outdoor advertisers to discontinue certain objectionable practices. The resolution also pointed out that no law had yet been enacted in California which effectively controlled advertising signs on private property adjacent to public highways.

The first local zoning ordinance in California had been passed as far back as 1885 in Modesto, but it could not be enforced until it was fought through the State Supreme Court. The idea of any sort of control over private property was new and untried. Many other variations of the idea of zoning control were enacted in other communities throughout the country in the years ensuing, but it was not until 1926, in the case of the city of Euclid, Ohio, versus Ambler Realty Co. that a U.S. Supreme Court decision upheld the principle of comprehensive zoning.

Shortly after this the California Planning Act of 1929 stipulated "Any county, city, town, or township may make and enforce within its limits all such local, police, sanitary and other regulations as are not in conflict with general laws . . . to conserve and promote the public health, safety and general welfare." This act also said all counties must, and cities might, create a planning commission.

The judge in a Minnesota case said, "It is time the courts recognize the aesthetic as a factor in life. Beauty and fitness enhance values in public and private structures." A judge in a New York signboard control case said "Beauty may not be Queen, but she is not an outcast beyond the pale of protection or respect. She may at least shelter herself under the wing of safety, morality or decency."

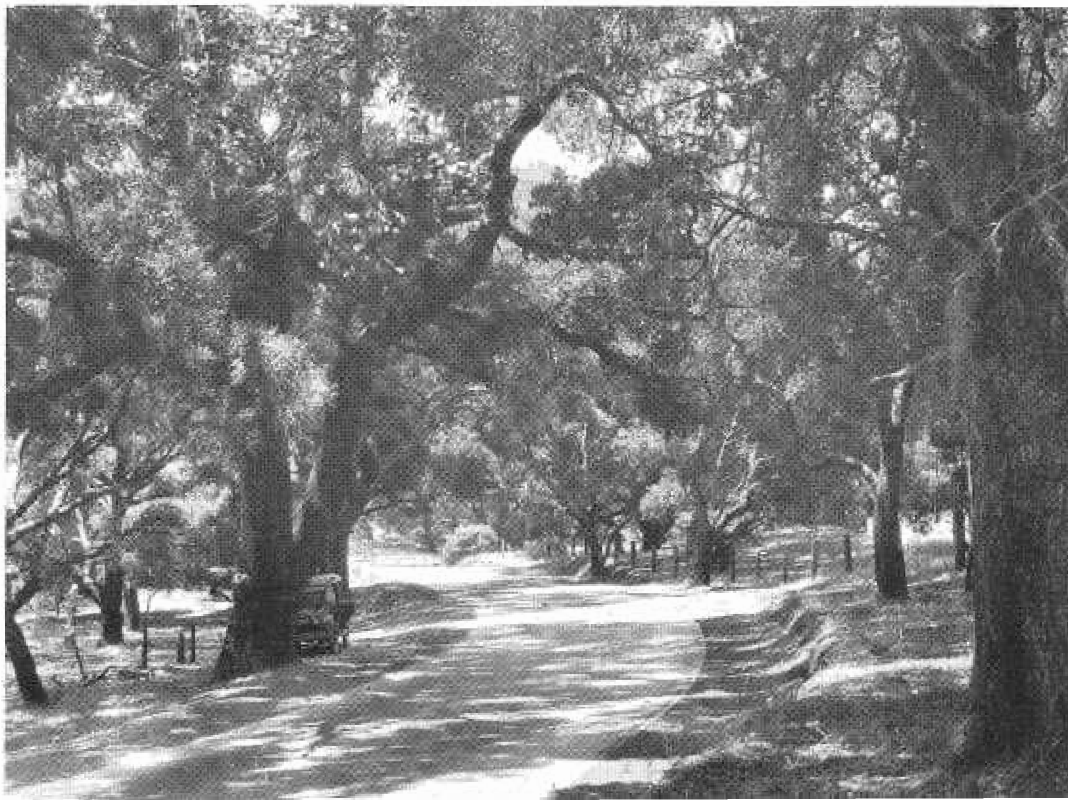
Outdoor Advertising Act

In 1933, the Legislature passed the Outdoor Advertising Act which, with some changes and additions, is still in effect today. This law requires the licensing of all those engaged in the signboard business, and, exercising the state's police power, requires permits and conformance to certain standards, by all signboards visible from a public road outside city limits, whether located on private property or not. Minor exceptions are allowed, such as a sign located at a place of business, or a realtor's sign on a piece of property.

Signs cannot imitate official warning, stop, or danger signs, nor can they have red or blinking lights which might confuse drivers. No signs or structures may be placed within 300 feet of an intersection, within 500 feet of the inside of curves, nor in any position where they might divert or impede a drainage channel in time of flood. The law empowers the Director of Public Works, or his agent, to enter private property to remove or destroy illegal signboards if necessary.

Legal action prevented the Division of Highways from implementing the new law immediately. A company in Oakland obtained a restraining order pending court action and sued the Director of Public Works, attacking the

Below: Sylvan beauty marked this winding section of US 101 in Santa Barbara County, as seen in mid-1920's photo below, but it would be a nightmare to drive with today's cars and traffic.



Modern freeway section of State Sign Route 1 south of Santa Cruz. Simple roadside planting treatment here functions well for slope control, also blends roadside attractively into surrounding terrain.

act as unconstitutional on the ground it was double taxation and deprived persons of their property without due process of law.

On May 23, 1934, Superior Court Judge Fitzpatrick of San Francisco ruled for the Department on both counts, and there was no further contest of the act's legality. The decision had far-reaching effects, as a number of other states had such laws which had not been tested in court for constitutionality. Still other states were contemplating such laws.

Highway Beautification

The third part of the highway roadside problem—highway beautification—got little more than lip service for many years. When highway development in California began the roads were narrow, and built along the natural contours of the terrain. Such a road was a very minor, undisturbing element in the landscape.

Furthermore, although the need for roads was urgent, there was little money for construction, let alone beautification. In reading the 1896 report, it is obvious the commissioners were speaking of trees as maintenance tools, much as they might have discussed a road grader. (They did castigate the litter bugs of the 1890's who left dead horses and cows on or near the highways.)

It was not until 1912, two years after the State Highway System had come into being, that there was any discussion of road beautification. This was the year the Commission voted the resolution suggesting "landowners be encouraged to leave timber uncut for a considerable distance on both sides of the state highways. . . ."

Many landowners of the time did pledge that the timber on each side for a distance of 100 feet would not be cut. These agreements were voided later on, of course, when the state began buying right-of-way outright, rather than to continue to depend on the older easement sort of agreement in which the owner often made a number of stipulations.

When the route was selected for the Redwood Highway about 1915, the Commission wanted to buy 600 feet of right-of-way on each side of the route through the giant redwoods, but was unable to finance such a huge land purchase. When critics later complained because the huge trees were not protected, the Commission explained it had not been financially feasible and added, ". . . at that time the possibilities of the cutting off of the timber for many years, if ever, appeared very remote, but unexpectedly, with the opening of the state highway, a number of camps were installed for the cutting of the redwood trees into railroad ties and grapestakes. Some time intervened before friends of the redwoods awakened . . ." (and could take steps to save the remaining trees).

For the two decades after 1912, the attitude toward highway beautification was in this vein—primarily conservation of existing scenery through which the road traveled. Positive action was rarely advocated, except in the case of trees. Tree planting was constantly urged by garden and women's clubs, service groups, and other civic minded bodies. In many cases the groups actually did the work, and this program, with the roadside cleanup program, was their major roadside beautification effort for many years.

Trees and Traffic

About 1932, a number of things coincided to change this situation. As already stated, the tree program itself was faltering because of accidents involving trees, road widening, and realignment. In 1931, the State Assembly adopted a resolution requiring the Division of Highways and the Division of Beaches and Parks to report to the Assembly by January, 1933, progress being made on road beautification. The two divisions were to ". . . supply a definite leadership in the matter of roadside beautification . . ."

To a considerable extent, this resolution was a response to the new federal aid policy which was requiring that ½ of 1% of federal aid highway funds be spent on road beautification. This policy, (with the allowance later raised to 1%), remained in effect until approximately the beginning of World War II.

Another factor in the early 30's was the depression and the "make work" programs of those days. Drains, drinking fountains, guard walls and vista points were built of ornamental

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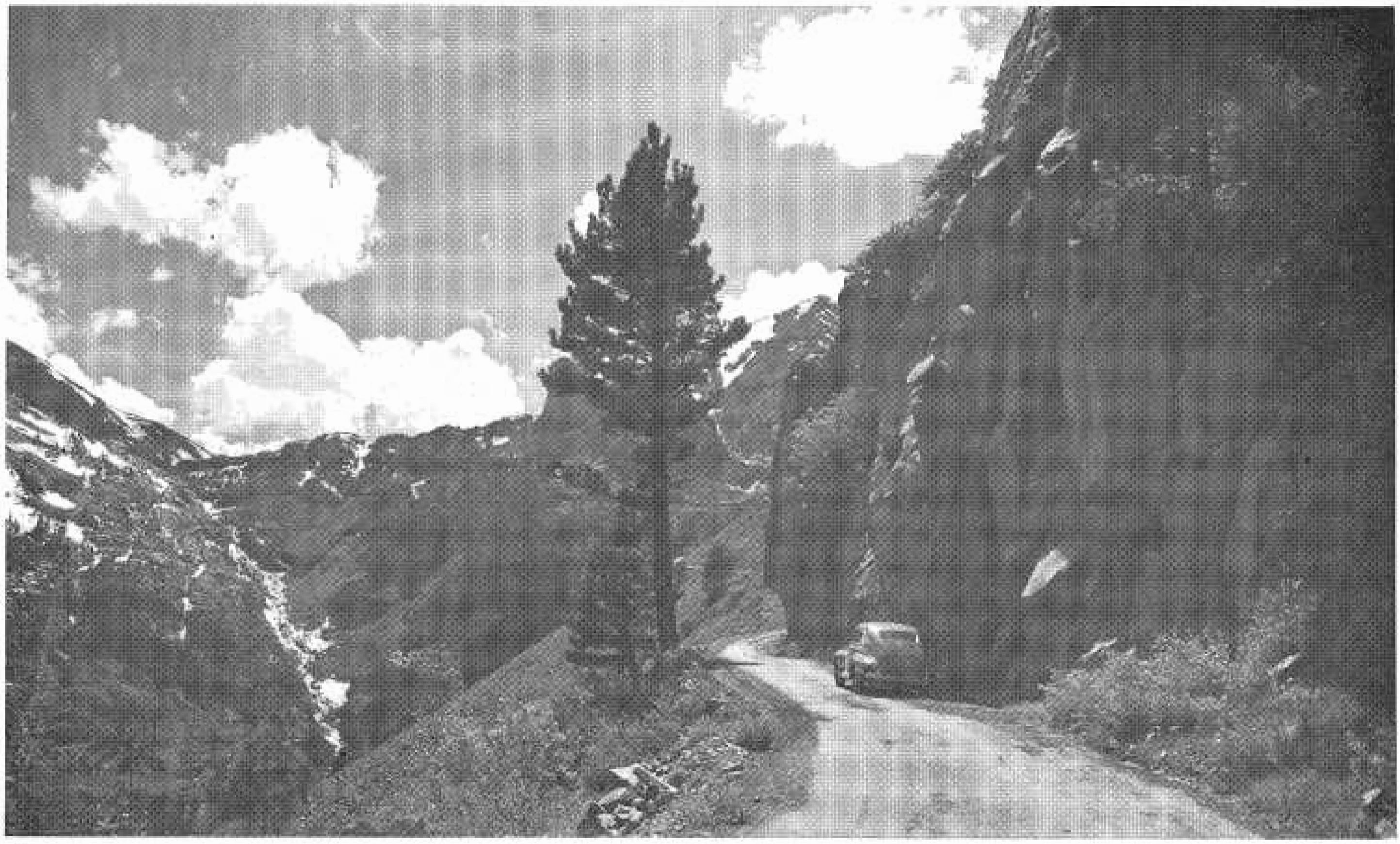
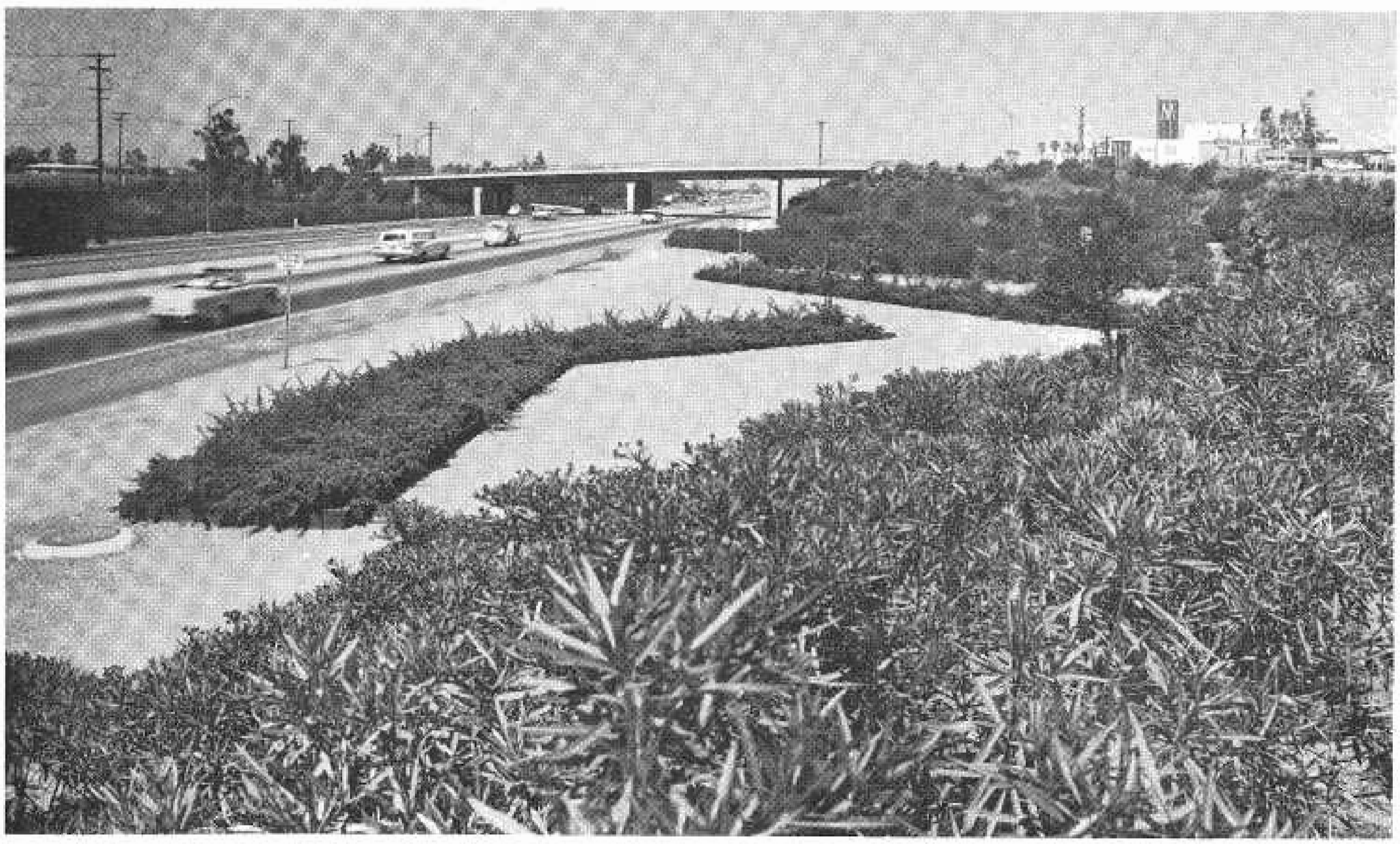


These two greatly contrasting roads are both California state highways. Above is a Sierra Nevada road photographed in 1941, now widened and resurfaced, but essentially the same today. Below is San Bernardino Freeway in the vicinity of Covina, with modern landscaping treatment.



CALIFORNIA ROADSIDES

Continued from page 8 . . .

rock. Ground covers, shrubs, and trees, were planted on slopes and at grade separation to prevent erosion and improve appearance.

In the 1930's also, the automobile had come a long way from the chugging, slow-moving vehicles of the 1900's. The new highways being built for faster moving traffic no longer meandered along the hillside contours. They traveled in wider, more sweeping curves for better sight distance, and with the straighter alignment, both vertically and horizontally, cuts and fills were much greater.

Slides Expensive

Not only were all these cut slopes unsightly, they were also difficult to maintain. Slides often dumped earth on the highways or undercut the fill sections, so that crews were kept busy clearing dirt away and restoring the roadway. Some districts found slope maintenance was getting the lion's share of their maintenance budgets.

Hence virtually all of the slope and cut plantings were for erosion control rather than job beautification, although the latter was usually a by-product. State Arboriculturist H. Dana Bowers (now Supervising Landscape Architect of the Division of Highways) wrote in 1932: "With few exceptions all roadside work done under the category of 'beautification' might well be called 'protection' or 'conservation', for aside from the fact that the roadsides are improved in appearance by such work, the important economic factor is not to be disregarded. Evergreen ground covers planted on slopes that tend to erode, and along roadsides to force out the natural weeds and grasses that constitute a fire hazard when dry, result in an enormous saving of labor and expense."

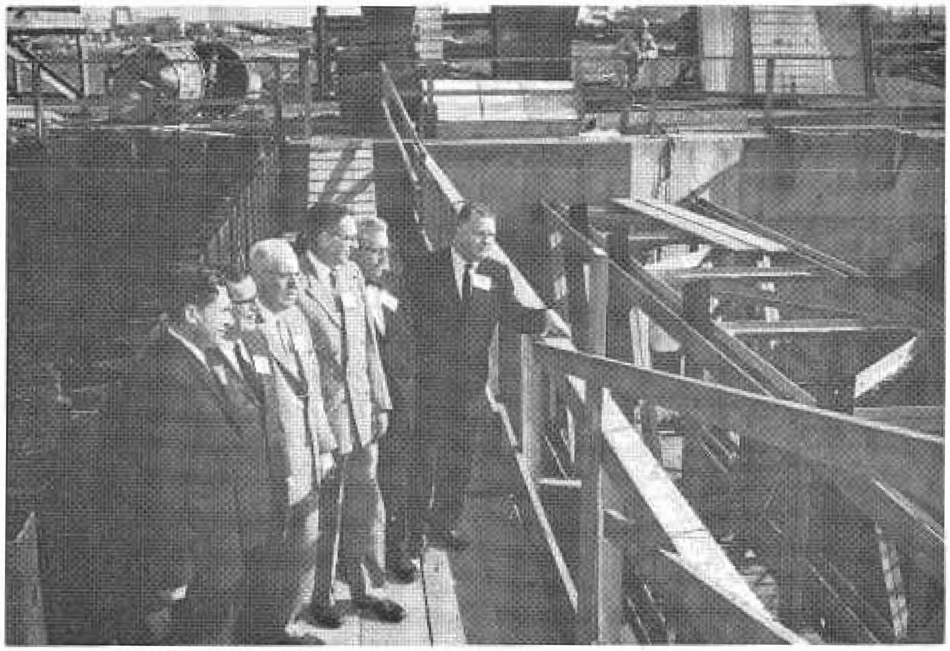
These words were written more than 30 years ago, but they remain the heart of State highway roadside planting policy today. Functional planting is still paramount, although even the simplest example of it contributes some beauty, and although reasonable expenditures for planting of the landscape-beautification type have been made for many years and are still being made.

How today's roadside planting policy is implemented, the initial and upkeep costs involved and the reasons for them will be discussed in forthcoming articles.

A joint meeting of the California Highway Commission and State Park Commission was held on January 25 in connection with highway and park planning at Emerald Bay, Lake Tahoe.

The San Francisco-Oakland Bay Bridge recently experienced frost on the upper deck during the early morning hours. It is the first time in its history that it has been necessary to spread sand in limited areas as a protection against skidding.

FOUR CONGRESSMEN INSPECT INTERSTATE PROGRESS



Members of the congressional delegation and the State Department of Public Works inspect the graving dock in Alameda for casting sections of the Webster Street Tube now under construction. Left to right are: Representatives John J. McFall of Manteca, Jeffery Cohelan of Berkeley, George P. Miller of Alameda, John F. Baldwin, Jr. of Martinez, and Frank Chambers, chief deputy director, and Robert B. Bradford, Director, both of the State Department of Public Works.

Four members of the California congressional delegation, including two members of the House Committee on Public Works, received a briefing on the state highway program and and a report on Interstate planning and construction progress on November 15, followed by an inspection tour of San Francisco Bay Area freeway projects.

The Congressional participants were Reps. John F. Baldwin, Jr., of Martinez, Jeffery Cohelan of Berkeley, George P. Miller of Alameda and John J. McFall of Manteca. Reps. Baldwin and McFall are members of the Committee on Public Works.

After being briefed by State highway officials in the San Francisco District office, the legislators boarded a bus for a guided tour ofthe MacArthur Freeway (US 50) construction in Oakland. At the resident engineer's headquarters on this Interstate project they were shown the various testing devices and procedures used to make certain that all aspects of the job conform to approved standards and specifications.

The Congressmen also visited the site of the Webster Street Tube project in Alameda and the graving yard where the tube sections are precast. This is a Federal-Aid Urban project.

The tour concluded with an inspection of recent and current work on the Nimitz and Bayshore Freeways.

Carson Spur

Public's Patience Eases Job Of Widening on Highway 88

By J. L. NICHOLAS, Resident Engineer

ON AUGUST 10, 1960, without ceremony or fanfare, another project in the program of realigning and widening of Highway 88 was completed. The section involved in the project is 58 miles east of Jackson, and lies between 7,000 and 8,000 feet in elevation, and extends from the Carson spur in Amador County to a point 0.2 mile east of the Alpine County line with an overall length of 2.09 miles. At this easterly end of the project stands the old Kirkwood Inn which has been a landmark in this area since 1856.

The contract for the job was awarded on June 16, 1959 to Carey Bros. Construction Co. of San Anselmo, and work was started immediately.

Probably the biggest problem on the the project was the passage of traffic through the job while construction was going on. There were no parallel roads within many miles which could be used as a detour. The Contractor was allowed to close the road for periods of 2½ hours during the day beginning at 7 A.M. and ending at 6 P.M. The 6 P.M. limit was later extended to 9 P.M. to allow the Contractor a longer working day. The road was open for traffic all day on weekends and holidays, however.

Notices Printed

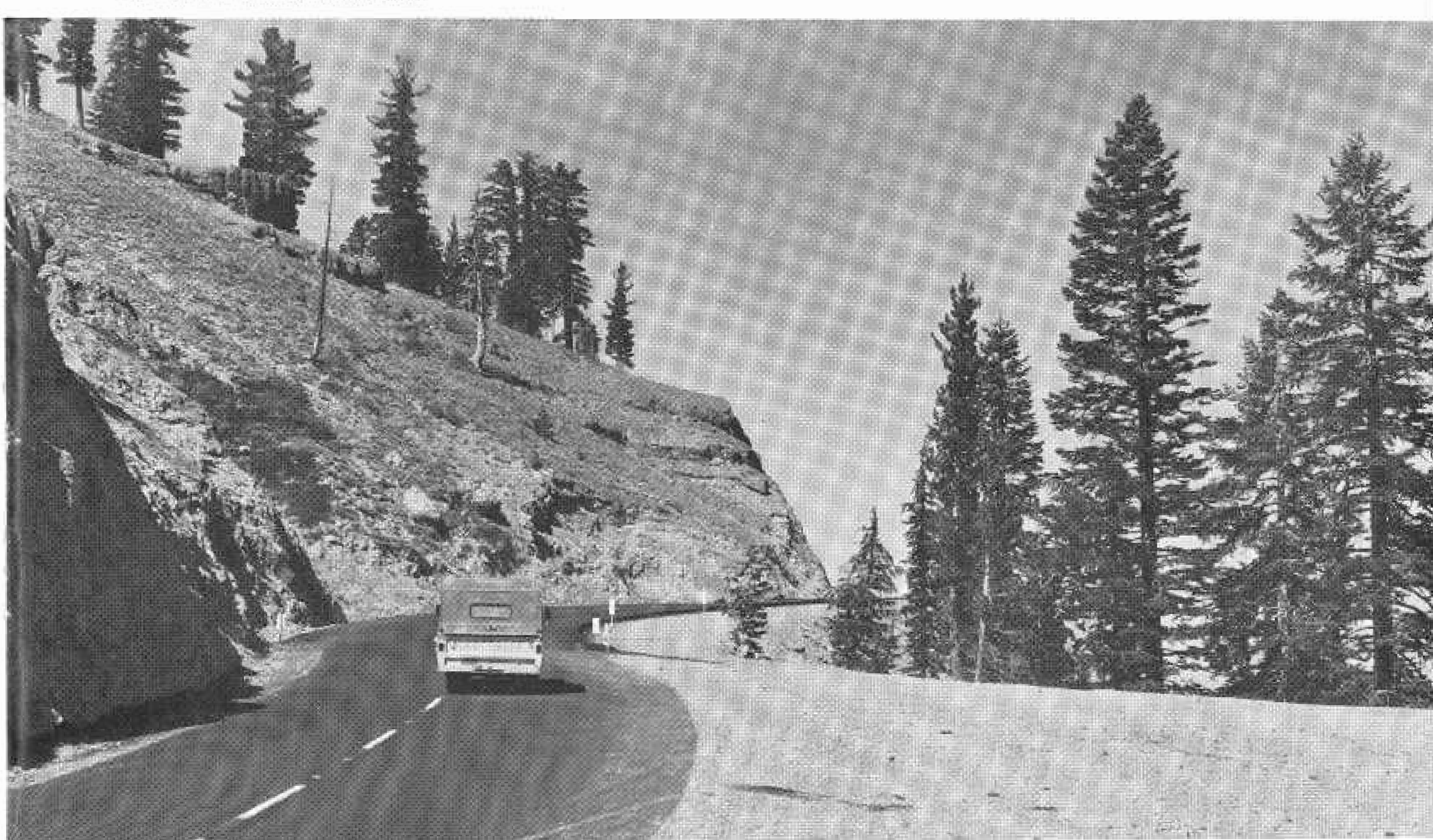
To keep the traveling public informed of the road conditions and the closing time, there were notices printed in various newspapers throughout the area; and, also, handbills with the closing schedules were distributed to various agencies, service stations, motels and hotels for distribution to tourists planning a trip over Highway 88. The Amador County Chamber of Commerce also printed handbills with closing schedules and items of interest regarding the road and distributed them as did the State.

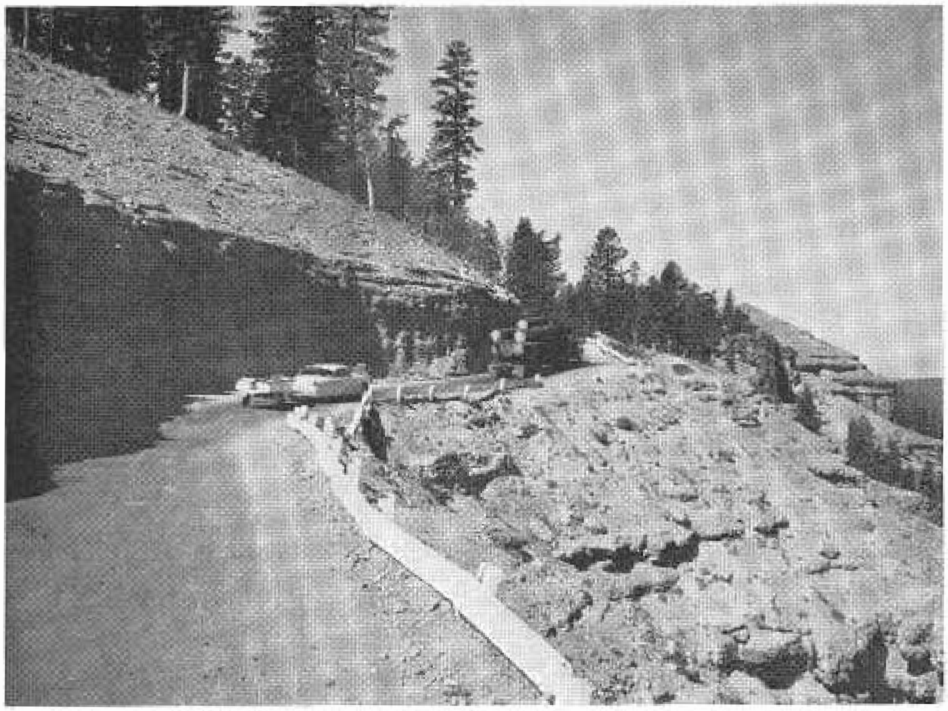
Large signs were also placed at various locations within a radius of 50 miles of the project indicating the road being closed and also the closing schedule.

Even though it was sometimes necessary to delay some motorists for the full 2½ hours, there was hardly any complaint heard about this inconvenience. The State also provided sanitary rest facilities at each end of the project for the public's convenience.

The bulk of the roadway excavation on the job was within a few hundred feet of the Spur and the material was hauled for embankment throughout the whole job.

A view of Carson Spur, looking westward, following completion of the widening project.





A view of the highway around Carson Spur before construction was started.

Work Is Suspended

When the clearing, grading, drainage work and other minor items were completed, it was so late in the fall of the year that it was impractical to attempt placing the base rock and paving the project. The work was suspended until the spring.

Material for the base rock and the paving material was processed at a Forest Service materials pit in Hope Valley and hauled to the job, approximately 14 miles in distance.

There was no difficulty encountered in completing the project.

The route of which the Spur project is a part is of some historical interest in the State. The old emigrant trail established by Kit Carson over the Carson Pass approached the Spur but, because of the impassable terrain of that particular area, the trail turned to the south at the east end of Capels Lake (now known as Twin Lake) and extended to the higher ridges past Emigrant Lake and bypassed the Spur. The trail continued past the south side of Silver Lake and eventually came back to the now existing road near Tragedy Springs. This was a popular route for many settlers attracted to California during the Gold Rush of 1849.

Originally A Toll Road

In 1852, a group of business people from the Mother Lode area and the Stockton area obtained a toll road franchise and sponsored work to excavate a bench across the Spur and build a road from Capels Lake to Tragedy Springs. It is believed that the toll road was not a paying venture but, the franchise lasted for approximately 13 years.

Succeeding this franchise, several local groups operated and maintained the road until post offices were established at Kirkwood Inn and Silver Lake. When the post offices were opened, Alpine and Amador Counties assumed the maintenance and reconstruction work on the road.

In 1911, the State Legislature passed an act establishing the Alpine State Highway and, since that time, the State has assumed the maintenance and construction work.

It is said that the first toll road over this area was the route of the famous Pony Express Riders during the first six weeks of their history. It was the route of hundreds of settlers coming into the San Joaquin and Sacramento Valleys.

A section of the new reconstructed highway in the vicinity of Carson Spur. Mosquito Lake is on the far side of the road.

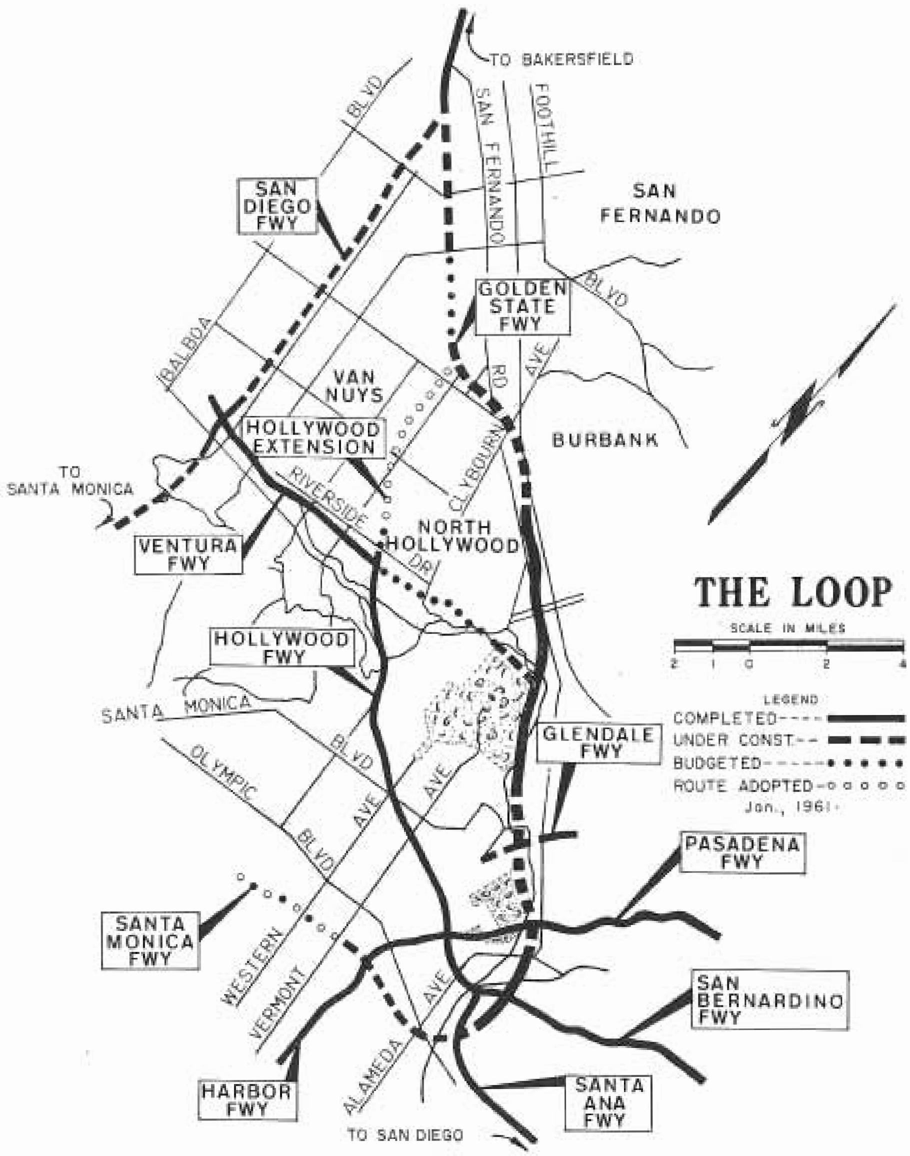
The most hazardous winter road surface condition is ice near or at the freezing temperature.

Loop Progress

L.A. Freeway Completions Will Bring Traffic Relief

By A. L. HIMELHOCH, District Engineer—Operations

MORE than a year has elapsed since the appearance in *California Highways and Public Works* (September-October, 1959) of an article entitled "Freeway Loop" by Lyman R. Gillis, then District Engineer and present Assistant State Highway Engineer on Headquarters staff. In the intervening months great strides have been made in the development of the freeway loop, both as to projects completed and opened to traffic and projects awarded and budgeted for construction. It is the purpose of this sequel article to take up where the first left off, by relating the progress made so far in closing the loop.



The name "Freeway Loop" has been given to a combination route formed by portions of the Santa Monica and Golden State Freeways, circling downtown Los Angeles on the south from junction with the Harbor Freeway at Venice Boulevard east to the East Los Angeles Interchange at Seventh and Soto Streets; thence northwesterly across the San Bernardino, Pasadena and Glendale Freeways to Lankershim Boulevard in the San Fernando Valley (see sketch map). In this discussion the freeway loop will be said to extend beyond Lankershim Boulevard as far north as the San Diego Freeway junction near the San Fernando Reservoir. The total distance via the loop from the Santa Monica-Harbor Freeway interchange to the Golden State-San Diego Freeway junction is 28.69 miles.

As of January, 1961, there were 10 projects under way along the loop: four on the Santa Monica Freeway between Vermont Avenue and the East Los Angeles Interchange, totalling $31,179,717; one at the East Los Angeles Interchange, totalling $10,326,600; and five on the Golden State Freeway, totalling $47,988,900. The 1961-62 State Highway Budget contains an additional $6,200,000 for construction on a final Golden State Freeway project, bids for which will be opened this year. Previous budgets had financed such completed projects as bridge structures across the Harbor Freeway at Venice Boulevard and the Los Angeles River and adjacent railroad tracks near Olympic Boulevard on the Santa Monica Freeway ($5,510,000); and portions of freeway between 6th Street and Pasadena Avenue and between Glendale Boulevard and Burbank Boulevard on the Golden State Freeway ($22,189,000).

Santa Monica Freeway Viaduct

The east-west portion of the loop is formed by the Santa Monica Freeway connecting the Harbor Freeway and points as far westerly at Vermont Avenue with the Santa Ana Freeway. Eventually, of course, the Santa Monica Freeway will terminate at the Pacific Coast Highway in Santa Monica. The current contracts provide for continuous viaduct structure in a highly industrialized and densely traveled section of Los Angeles some 17 blocks south of the Los Angeles Civic Center. Taken individually from west to east, the contracts in progress break down as follows: Vermont Avenue to Oak Street, 1 mile, awarded to the Guy F. Atkinson Company on December 23, 1960, for $4,897,617; Oak Street to Main Street, 1 mile, awarded to the Griffith Company on July 11, 1960, for $9,682,000; Main Street to Hooper Avenue, 1.2 miles, awarded to the Griffith Company on May 17, 1960, for $7,295,300; Hooper Avenue to 8th Street, 1.1 miles, awarded to the Griffith Company on March 23, 1960, for $9,304,800. The total length of the viaduct section, which ends at Hoover Street, is 4 miles and is scheduled for completion in 1962.

Taken as a whole, the Santa Monica Freeway portion of the loop lists an impressive array of major construction quantities, among them 2,300 colums of varying dimension, 93 acres of bridge deck surface, 17 miles of concrete cast-in-drilled-holes piling, 270,-000 cubic yards of structure concrete, 1,600 tons of structural steel, 43,000 tons of reinforcing steel, 620 tons of miscellaneous steel, 26½ miles of bridge railing, and 832 precast, prestressed concrete girders 50 to 95 feet in length.

Crosses 38 Streets

The 8-lane viaduct structure crosses 38 city streets at a height of 20 feet, with greater height clearances at railroad separations, the Harbor Freeway Interchange and the Los Angeles River Bridge. Ten streets will be dead-ended and 4 relocated, with all streets remaining open to traffic during construction. The east and west roadways will be separated by a 3-foot concrete barrier railing supporting a translucent light-diffusing fiberglas shield designed to reduce nighttime headlight glare. The over-all separation between roadways will measure 17 feet including median and shoulder area, with 8-foot outside shoulders. Mean width of the structure, taking into account the distribution roadways, will be 145 feet. Bridge decks will be poured to a standard 6½ inch thickness.

The stilt-like millipede structure has required an enormous quantity of tubular steel falsework for the pour work, amounting to 14,000 frames of from 4 to 6 feet in height, which if laid end to end would stretch 75,000 feet. The cost of these temporary supporting structures was $500,000. Equally impressive in the building of this massive bridge has been the labor force of approximately 1,000 contractor's and Division of Highways' personnel.

The contractor's resourcefulness in carrying out a multi-million dollar freeway project of this complexity was demonstrated in a mobile pouring unit of his own manufacture, which in effect was a travelling conveyor machine. By means of hopper and "elephant trunk," it was able to transfer ready concrete from stand-by transit trucks to the head of the column form for the pour. This method of direct delivery resulted in considerable time savings. Normally, it would require an hour's time to pour a single 20-foot column; however, in utilizing the so-called "travelling elephant" the contractor cut the entire operation to less than 15 minutes per column.

Problem Is Solved

An apparent problem, ingeniously solved by the contractor, was encountered in initial clearing operations with the presence of a large amount of concrete building slabs and foundations within the freeway right of way. This material, amounting to 80,000 tons, had to be removed before construction could start. What could have proved to be a troublesome disposal problem was solved in the following way: The contractor set up crushing plants at three sites, where the concrete rubble, after it was broken up by truck-mounted pavement breakers and ripper-equipped bulldozers, was hauled and reduced to aggregate size for base material and then incorporated into the ramp fills and frontage roads.

The Santa Monica Freeway viaduct structure will allow limited space for storage or parking within State right of way beneath the completed super-

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Cast-in-hole Piles Used on Loop Job

By CHARLES E. MAREK
Senior Engineering Geologist

About three years ago, the question was asked, "Why not use one 4′ diameter cast-in-drill-hole friction pile to carry the equivalent load of a number of smaller diameter piles?" This question was taken under consideration by the Bridge Department of the California Division of Highways for use at the proposed Santa Monica Freeway Viaduct in Los Angeles, linking the Santa Ana and Harbor Freeways.

The first problem was to determine whether the geologic conditions at the site were suitable for this use. Borings were made to a maximum depth of 85 feet. The material encountered was silty sand with some lenticular bodies of cobbles. The bearing values of the foundation material ranged between one ton per square foot near the surface to over five tons per square foot below a depth of forty feet. Borings were made twice the depth of the estimated pile lengths to assure that stable material existed below the pile tips. The absence of ground water led to the conclusion that cast-in-drill-hole piles could be used.

Pile Lengths Vary

Design loads averaged 450 tons per pile. Pile lengths averaged 40 feet and varied with the column load and the shear strength of the soil. Piles were designed with a safety factor of at least two against shear failure. Extensions of the piles above ground serve as columns of the same diameter.

Due to the unusual use of piles in this manner and size of loads, test loads of at least twice the design load were required to prove the adequacy for the location and depth.

A simple and fast method of pile loading was needed. It was decided to load the test pile using hydraulic jacks working against a reinforced concrete reaction beam. Two 48″ anchor piles were placed to a depth of 45 feet on either side of the test pile (20′ center to center). The reaction beam was cast between the anchor piles over the test pile. The beam was 9.5′ high, the

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LOOP PROGRESS

Continued from page 14 . . .

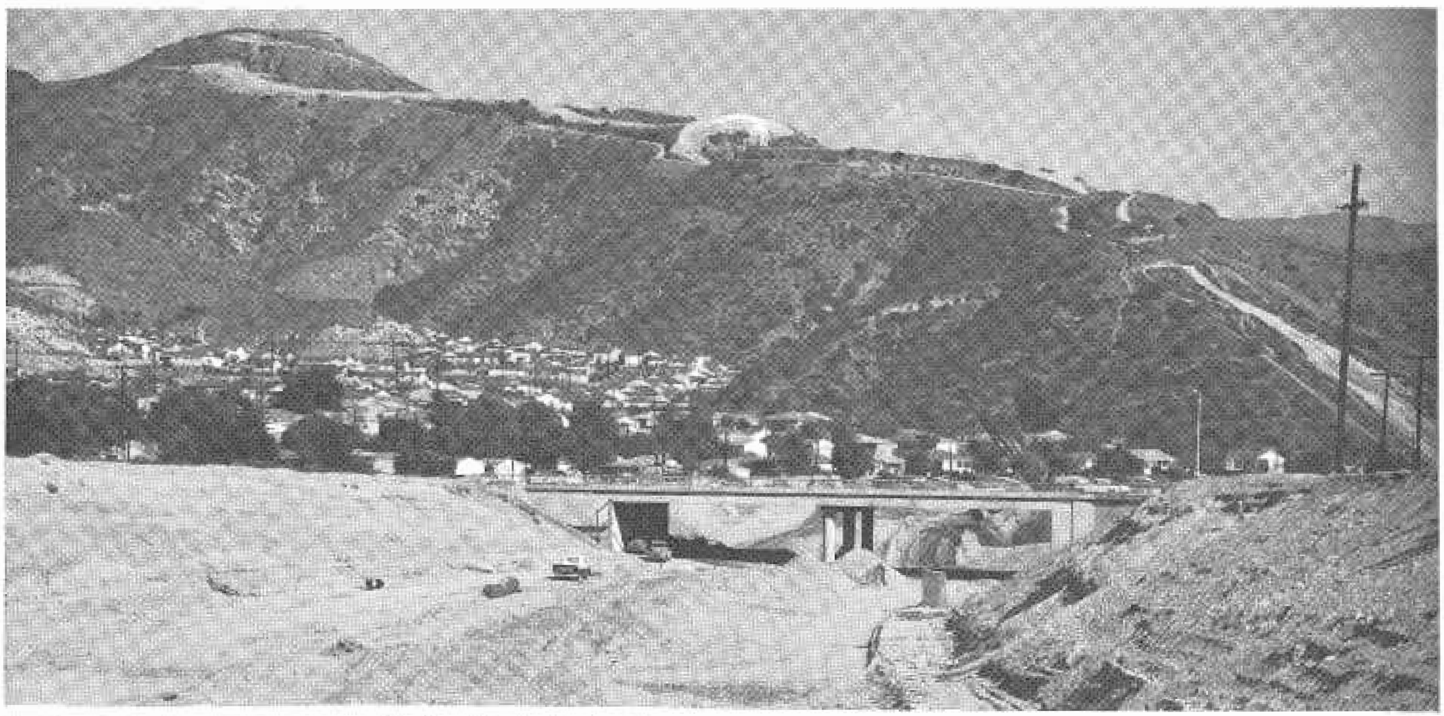
structure. Under the present contract the storage area is being graded and chain-link fenced with gate access from adjoining streets. With completion of construction, these areas will be available to lease for public parking and other approved uses, thus converting what would otherwise be lost area to a useful and revenue-producing facility.

The Santa Monica Freeway viaduct section leads directly into the 135-acre East Los Angeles Interchange, bounded by 6th and 8th Streets and Boyle Avenue and Lorena Street. This immense project has been under construction since May 1, 1959, by Peter Kiewit Sons' Company under $10,-326,000 contract scheduled for completion in April or May, 1961. It is at this location that the Santa Monica, Santa Ana, Pomona and Golden State Freeways will converge in an interchange complex of 32 single and double bridges and 2 miles of 2- and 4-lane roadway with as many as 27 lanes in cross section.

Contractor's personnel and state engineers study a model of the East Los Angeles interchange. The model is in a plexiglass case located at the job site. Left to right are: Dave Roper, Resident Engineer; Norman Barnes, Contractor's Project Superintendent; Louis Steele, Senior Resident Engineer; Tom Kelly, Heavy Equipment Superintendent, and Jim Crayne, Bridge Resident Engineer.

Some of the major quantities utilized in the construction of this interchange were 13,500,000 lbs. of reinforcing steel, 4,235,000 lbs. of structural steel, 63,000 cubic yards of bridge concrete, 23,000 cubic yards of paving concrete, and 1,500,000 cubic yards of roadway excavation.

The first order of work called for the detour of such heavily traveled city streets as Boyle Avenue and Soto Street adjacent to the project. As a matter of fact, detouring and traffic rerouting was a constant difficulty faced by the engineers, going hand in hand with normal construction. The Santa Ana Freeway, carrying an average daily traffic of 118,974 motor vehicles at Indiana Street, was peri-



A section of the Golden State Freeway under construction at Roscoe Boulevard.

Looking east along the cleared route of the Santa Monica Freeway from Vermont Avenue. The bridge structure (top center) crosses the Harbor Freeway.

Looking east along the Santa Monica Freeway viaduct construction connecting the Harbor Freeway and the East Los Angeles interchange (upper left) at the Santa Ana Freeway. Structure (top left) is the bridge across the Los Angeles River.

odically closed to traffic during the off-peak morning hours to allow the erection of huge structural steel girders spanning it. The closures, sometimes affecting all 8 lanes of the freeway, necessitated detouring of traffic over city streets. With heavy traffic loads on both streets and freeway, the restricted construction area and the tight transitions in timing, scheduling of operations was an exacting task.

As the working area was prepared, such utilities as water, gas, telephone, telegraph and electrical lines were relocated and kept in service while the bridge structures were built, at which time they were either incorporated into or adapted to the new structures. Grading operations could then follow for ramps and structures, for the interchange and for the future Pomona Freeway. Footings for a Pomona Freeway bridge were also placed. Storm drain and sewer work followed as working space became available. A storm drain from Hollenbeck Park Lake to the Los Angeles River, a 69-inch reinforced concrete pipe, was built and jacked under the Santa Ana Freeway to handle storm overflow from the lake.

Construction plans called for the completion of the easterly portion of the interchange first, so that traffic has had the use of certain completed ramps to and from the Santa Ana Freeway for some time now. These are the 8th Street outbound on-ramp, the Euclid Street outbound off-ramp, the Euclid Street inbound on-ramp, and the Soto Street inbound off-ramp.

Model Constructed

It is rarely that an engineer can visualize the fruits of his labor before a project is built, but this is true, in a special sense, of the East Los Angeles Interchange. As an aid to designers and traffic engineers, an exact scale replica (1 inch equals 50 feet) of the future interchange was built by the Division of Highways Bridge Department in Sacramento and later put on public display in Los Angeles, after which it was moved to the job site and housed in a building at Boyle Avenue and Opal Streets. It was of material assistance to the contractor and engineers in affording an overall projection of the job and in studying the relative elevation of roadways, traffic and scheduling problems. The model also proved interesting to visiting engineers and the general public.

Golden State Freeway

The north-south portion of the loop, and its longest leg, is formed by the Golden State Freeway. Until the East Los Angeles Interchange connection is built, the Golden State Freeway terminates presently at 6th Street and Boyle Avenue at Hollenbeck Park. From 6th Street to Pasadena Avenue the freeway is completed, including the interchange with and a realigned section of the San Bernardino Freeway. This 2.5-mile section built under two contracts amounting to $7,778,000 was opened to traffic on March 18, 1960.

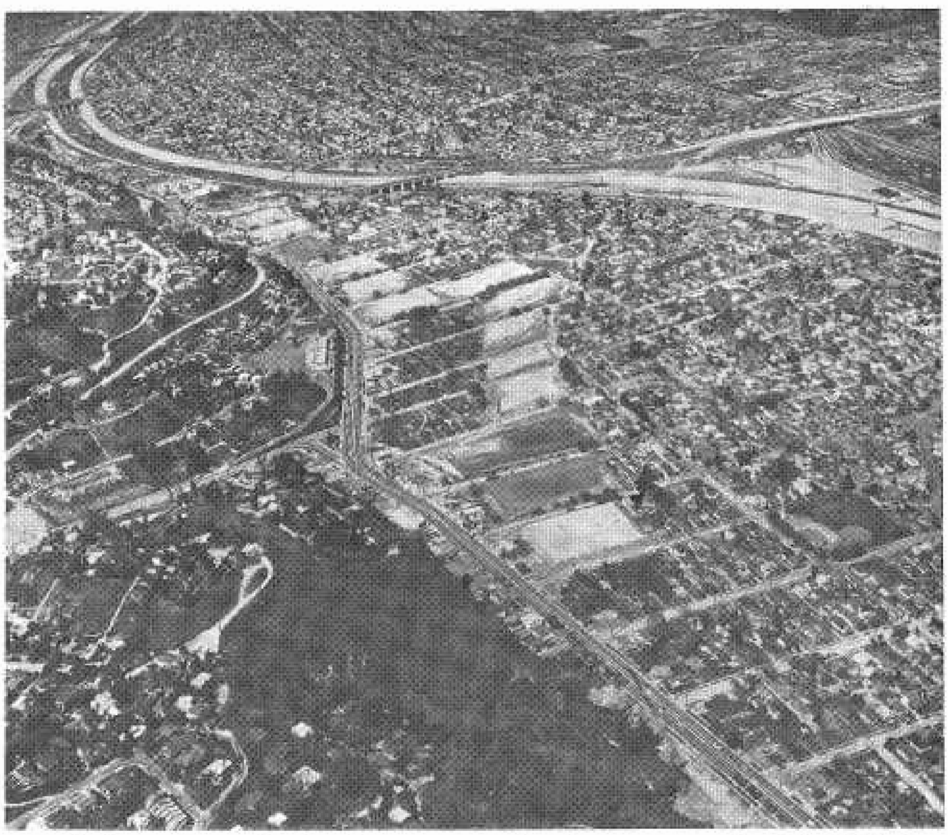
Pasadena Avenue to Arnold Street

From Pasadena Avenue to Arnold Street, a distance of 1.7 miles, the Golden State Freeway is under $10,410,000 contract to Vinnell Corporation, Vinnell Constructors and A. S. Vinnell. Work started on May 11, 1960, and the estimated completion date is February, 1962. The project also provides for interchange with the Pasadena Freeway.

Part of this interchange is the Elysian Viaduct, a 2,480-foot bridge crossing the Los Angeles River, the Southern Pacific Railroad yard, the Arroyo Seco Channel and the Pasadena Freeway. This structure has 12 miles of supporting pile, 168 columns averaging 32½ tons of concrete each, 10 acres of bridge deck surface, 5,900 tons of structural steel, 2,675 tons of reinforcing steel, 22,900 tons of concrete and 2 miles of steel barrier rail. Columns are 4 feet in diameter and 16 to 18 feet in height. Longest of the steel girder spans, 175 feet, are over the railroad. The viaduct will pass over the Pasadena Freeway at a height of 21 feet and over the Los Angeles River bed at a height of 55 feet. South of the viaduct two bridges will carry the Atchison, Topeka and Santa Fe Railroad and the Union Pacific Railroad over the Golden State Freeway.

Construction began with relocation of utilities, sewers, and storm drains. It was also necessary to relocate a large facility of the Fuller Paint Com-

The East Los Angeles interchange, looking northeast. The dark roadway in the foreground is the Santa Ana Freeway.



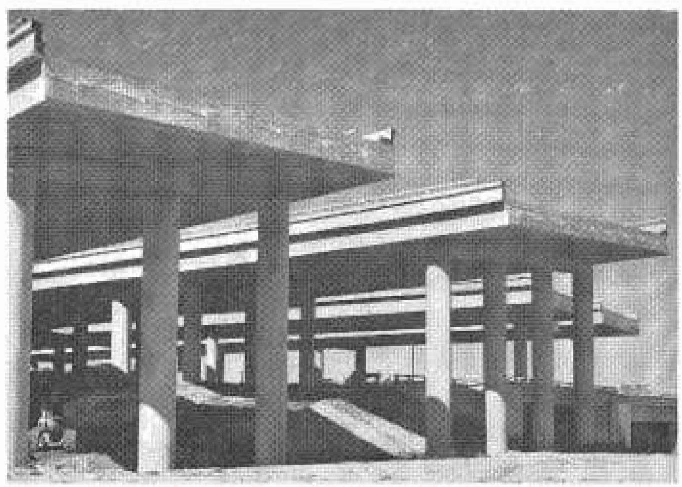
An aerial showing fill stockpiles (whitish squares, center) placed prior to construction of the Golden State Freeway as an economical way of utilizing free surplus materials in advance of actual need.

pany. In an exchange of property, 7 of the company buildings were moved to a new, graded site. At Humboldt Avenue, on the southerly end of the job, a sewer syphon was constructed 40 feet below grade to connect with existing lines. A city dump, abandoned since 1931, was uncovered within the right of way and 375,000 cubic yards of unsuitable material removed from the job site. This task was complicated by ground water seepage and the necessity of installing pumping equipment over a 3-month period while 2 shovels scooped out the debris. There was sufficient suitable on-site material, 678,000 cubic yards, for fill replacement in the dump area as well as for the subbase, base, and structure backfill.

Some traffic detouring has been necessary on the Pasadena Freeway in connection with construction of the interchange facility and connecting roadways. Temporary ramp closures have been in effect on the outbound freeway at San Fernando Road in order to permit driving of piles, pouring of footings, columns and caps, and erecting of steel for the Elysian Viaduct. Some lane closures are anticipated for the inbound freeway at Cypress Avenue. At this latter location, old bridge abutments will be removed in shoulder and median areas, the Pasadena Freeway widened to accommodate inbound and outbound ramps from the Golden State Freeway, and the southbound off-ramp from the Pasadena Freeway extended to Avenue 26. Closures have been re-

A crane with a hopper and elephant's trunk pours columns for bridge structures on the Golden State Freeway-Glendale Freeway interchange.

Completed interchange roadways at the East Los Angeles interchange.

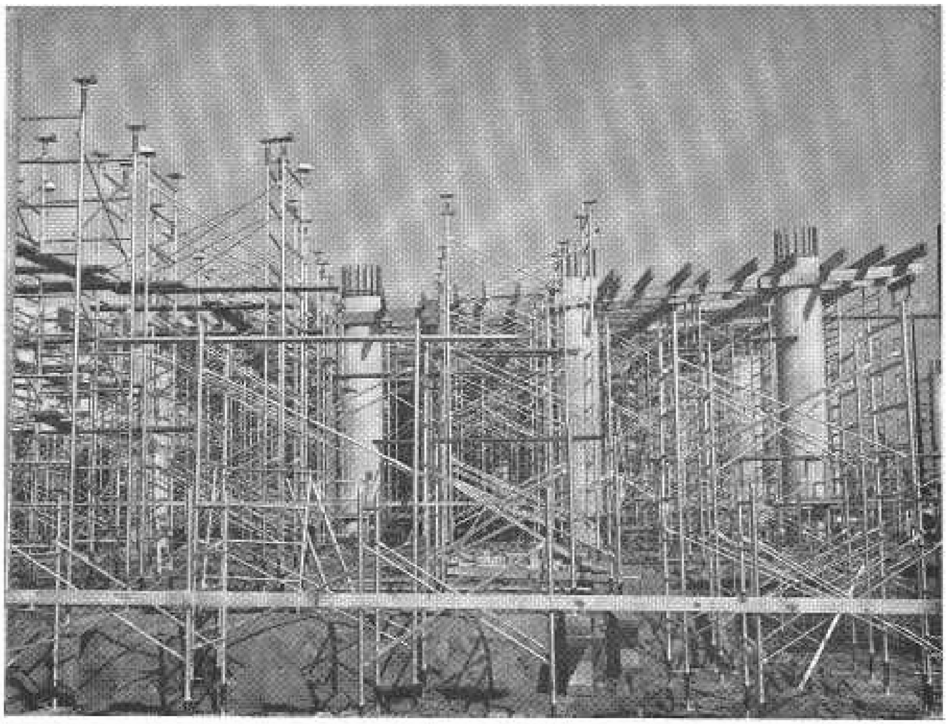


The Loop viaduct will connect to these bridge structures which were constructed over the Harbor Freeway under a previous contract.

stricted to off-peak hours in order to minimize interference with traffic.

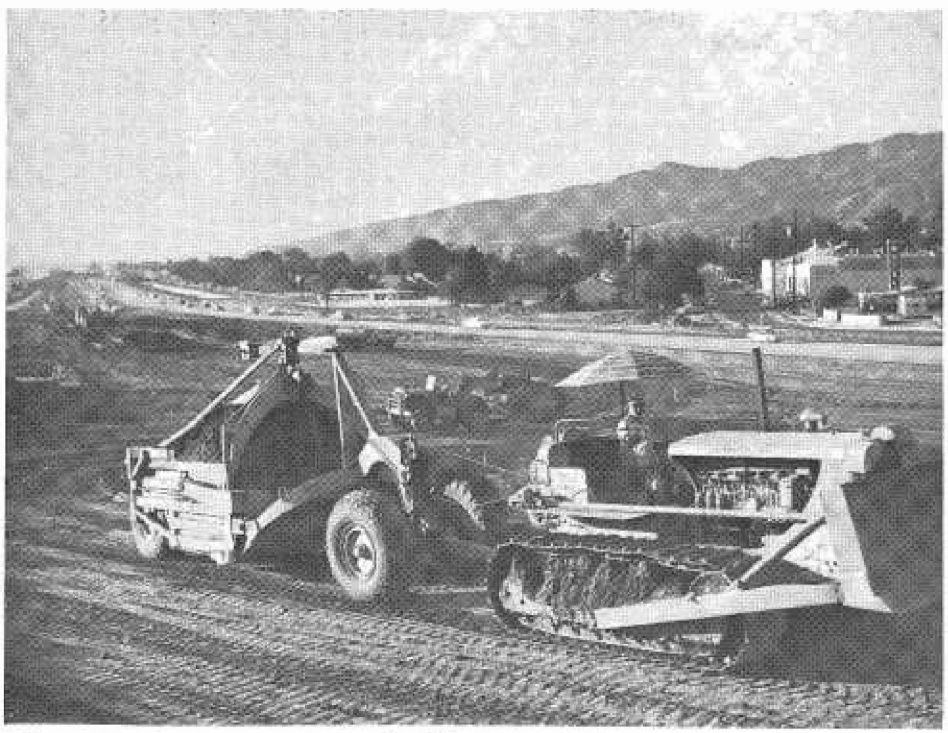
Arnold Street to Glendale Boulevard

The Arnold Street to Glendale Boulevard section of the Golden State Freeway, which connects with the previously discussed job to the south, has been under $12,404,200 contract to the Guy F. Atkinson Company since April 20, 1960. The length of the job is almost three miles and the estimated completion date April 1962. A ¾-mile section of the Glendale Freeway and interchange facilities with the Golden State Freeway is part of this project and will complete the Glendale Freeway from just north of the Los Angeles River to Riverside Drive. (An adjoining $2,325,800 contract on the Glendale Freeway will extend it another .8 mile south from Riverside Drive to Glendale Boulevard. This project should also be completed in April 1962.) The major construction quantities are as follows: 2,700,000 tons of imported borrow (1,500,000 tons of which are being obtained locally, adjacent to the freeway at Riverside Drive and from Hollingsworth Pit, a haul of approximately five miles), 233,000 square yards of concrete pavement, 1,150 tons of structural steel, 8,000 tons of reinforcing steel for bridges, 567,000 cubic yards of roadway excavation, 18,000 lineal feet of chain-link cable-reinforced median barrier fence, 1,200 lineal feet of double blocked out metal beam barrier, 8,000 lineal feet of metal beam guard railing, 16,000 lineal feet of barrier railing for bridges, 35,000 lineal feet of chain link right of way fence and 68,000 cubic yards of concrete for bridges.



A side view of the complex of tubular steel falsework used on construction of the Santa Monica Freeway viaduct.

The entire project calls for 11 bridges plus the 8-bridge composite Glendale Freeway Interchange, which will have 12.7 miles of supporting pile, 69 columns ranging from 4 to 8 feet in diameter, 20 to 60 feet in height and averaging 58 tons of concrete each, 14 abutments and 6½ acres of deck surface. Bridges are of the reinforced concrete box girder, reinforced concrete slab and welded plate girder types. Roadway grades are such that a minimum 15-foot clearance is provided over Riverside Drive.



Earth moving and grading operations on the Golden State Freeway near Burbank Boulevard. Northbound freeway (center) is already in use.

Fill Material Stockpiled

This Golden State Freeway section was used to stockpile embankment fill prior to letting of the actual construction contract. This economical practice is becoming more widespread throughout the District, wherever excess excavation may be had in advance of construction needs and where space is available to compact and store it according to State specifications and at no cost to the State. In this instance, fill in the amount of 600,000 cubic yards from other sources was stockpiled in the right of way, resulting in a savings to the public of an estimated $300,000.

The first order of work was the realignment of 1.5 miles of Riverside Drive between Arnold and Blimp Streets, with other frontage road construction, which is now completed. The bridge work is now 50% completed.

In conjunction with routine freeway construction, a 2,000-foot 72- and 84-inch reinforced concrete outfall pipe was built from the interchange along Allesandro Street to empty into the Los Angeles River, providing both freeway and local street drainage. Also, there was considerable revision of the existing sewer system and 6, 8 and 10 inch pipes were laid over a distance of 6,000 feet. Seven sewer pipes were located under the freeway and reinforced by concrete. One, a brick arch, was protected against the added weight of the roadway by a subterranean slab on piles.

In carrying out his schedules, the contractor has averaged more than $500,000 per month.

Glendale Boulevard to Burbank Boulevard

From Glendale Boulevard the Golden State Freeway is completed and open to traffic as far north as Burbank Boulevard. This 6-mile section was built previously under separate contracts: Ash Avenue to Los Angeles River, 2.2 miles, completed in September 1957, at a construction cost of $4,753,000; Los Angeles River to Glendale Boulevard, 2.5 miles, completed in January, 1958, at a construction cost of $5,418,000; and Alameda Avenue to Burbank Boulevard, 1.3 miles, completed in August 1959, at a construction cost of $4,240,000.

Burbank Boulevard to Roscoe Boulevard

Current contracts on the Golden State Freeway resume at Burbank Boulevard, with this section extending four miles north to Roscoe Boulevard. Work started under $8,830,400 contract to Ukropina, Polich and Kral on March 5, 1959 and completion is anticipated by June, 1961. Paving operations are currently under way.

The major construction quantities include the following: 1,000,000 cubic yards of roadway excavation, 380,000 tons of base materials, 56,000 tons of blacktop, 149,000 cubic yards of concrete, 15,000,000 lbs. of reinforcing steel, 18,000 lineal feet of storm drain pipe, and 21,000 lineal feet of sewer pipe.

A 3.7-mile storm drain channel has been an important feature of construction, since it more or less parallels the freeway alignment. Its point of origin is La Tuna Canyon south of Sunland and it empties into the Los Angeles River near Victory Boulevard. A $2,00,000 Los Angeles County Flood Control District and U. S. Army Corps of Engineers improvement, financed jointly by these two agencies but constructed as a part of the freeway contract, it courses in open and covered channel partly within the freeway right of way and passes under 5 channel bridges. These are located at Buena Vista Street, Cohasset Street, Hollywood Way, Lanark Street and Glenoaks Boulevard. The drainage facility is of the box type and its rectangular section measures approximately 30 feet wide by 14 feet deep. This combined use of space in a cooperative project is a fine example of cooperation between public agencies at State, County and Federal level, which results in great savings to the taxpayer.

Other work under this contract included relocation of Glenoaks Boulevard for a distance of 1¼ miles, and construction of the Burbank Boulevard Overhead, a concrete box girder bridge costing $800,000, spanning the Southern Pacific Railroad and Lake and Flower Streets, financed jointly by the City of Burbank, Southern Pacific Railroad and Los Angeles County.

Base materials and roadway excavation were obtained from the job, from a State-owned borrow site located on Glenoaks Boulevard. This source provided 750,000 cubic yards of roadway excavation and 250,000 cubic yards of subbase and base materials.

Stage Handling of Traffic

Because of the paralleling and overlapping of the new freeway alignment over the existing route for the first mile of the contract, it was necessary to construct the storm drain channel and freeway in stages while handling approximately 45,000 motor vehicles daily.

Prior to any freeway construction it was necessary to build three separate detours to handle traffic while portions of the Burbank Western Flood Control Channel were constructed. Two detours were required near Burbank Boulevard and one was constructed near the Front Street-San Fernando Boulevard junction.

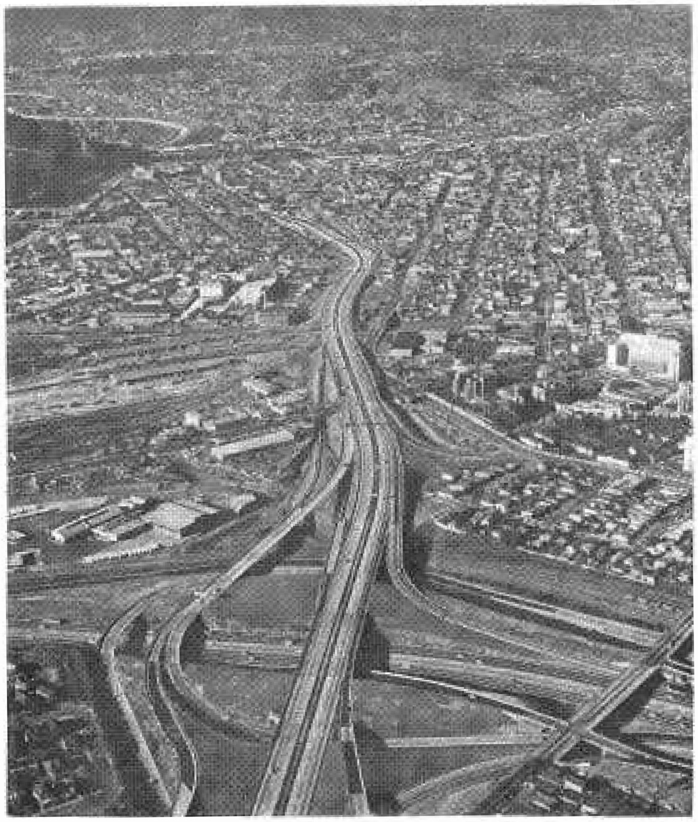
About a half-mile of the northbound freeway from Burbank Boulevard to San Fernando Boulevard has been completed and is now carrying two-way traffic so that the southbound portion of the freeway can be completed.

A final staging of traffic will be necessary when the southbound freeway is opened to traffic, in that a four-lane two-way temporary ramp connecting the northbound freeway to surface streets at San Fernando Boulevard will be removed to permit completion of the northbound freeway in this area.

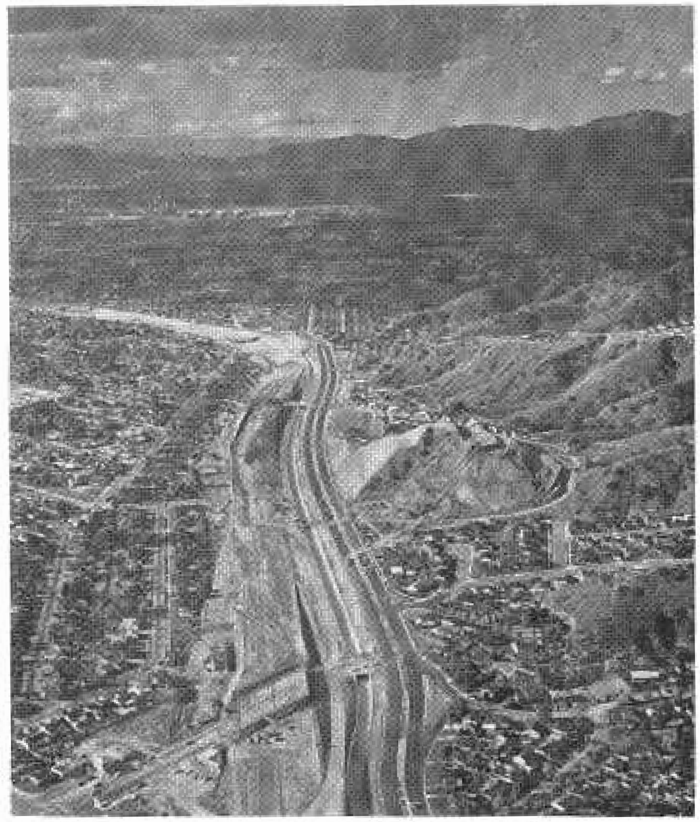
Roscoe Boulevard to Lankershim Boulevard

The Roscoe Boulevard to Lankershim Boulevard section of the Golden State Freeway, covering a distance of 2 miles, has been under construction since December 1, 1959, by B. J. Ukropina, T. P. Polich, Steve Kral and John R. Ukropina, under $3,718,500 contract, tentatively scheduled for completion in June, 1961. Construction quantities include 50,000 cubic yards of concrete, 830,000 cubic yards of roadway excavation, 2,300,000 lbs. of structural steel, and 3,900,000 lbs. of reinforcing steel. This project will have 7 bridges, 1 pedestrian overcrossing and 1 pumping plant. Work began with routine clearing and grubbing, followed by utility relocation and frontage road construction. Bridges and frontage roads are now completed with paving operations scheduled to start in mid-February.

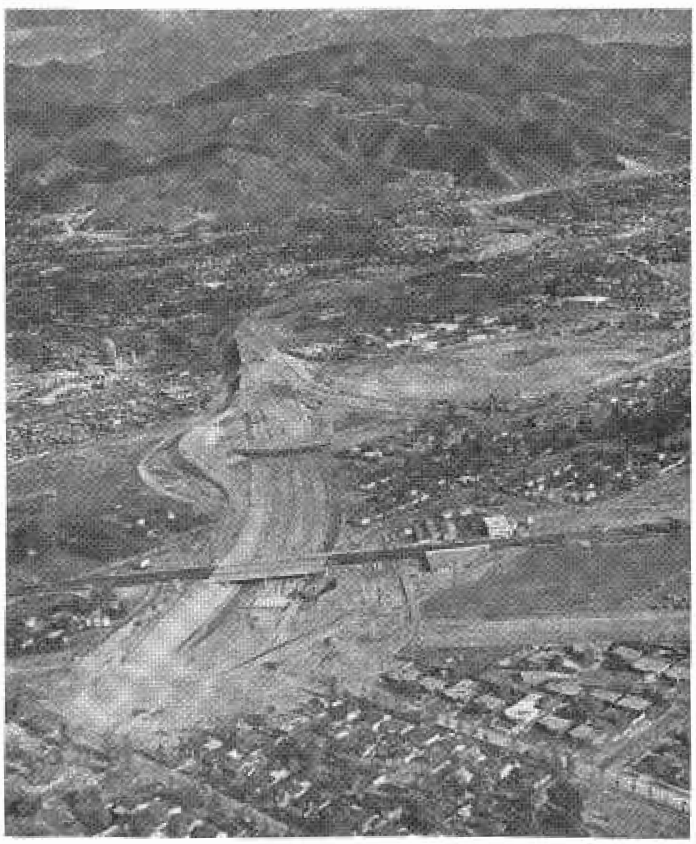
The single outstanding engineering feature of this project is the Sun Valley Overhead located between Penrose Street and Tuxford Avenue, which carries the freeway over San Fernando Road and the Southern Pacific Railroad, and measures 511 feet end to end. It has 5 spans of 20 steel girders



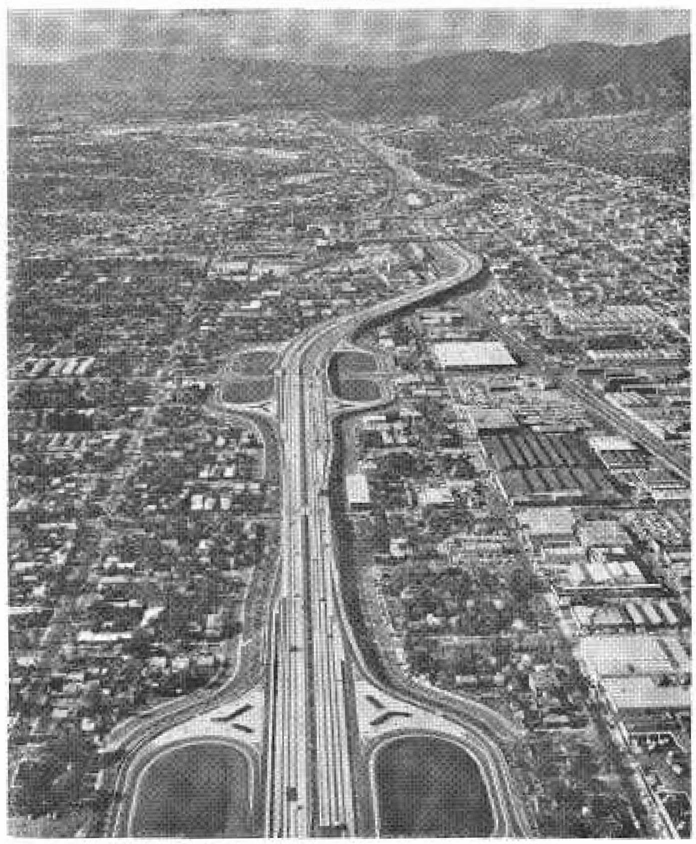
Looking northward over the Golden State Freeway-San Bernardino Freeway interchange. The Los Angeles County General Hospital is at right center.



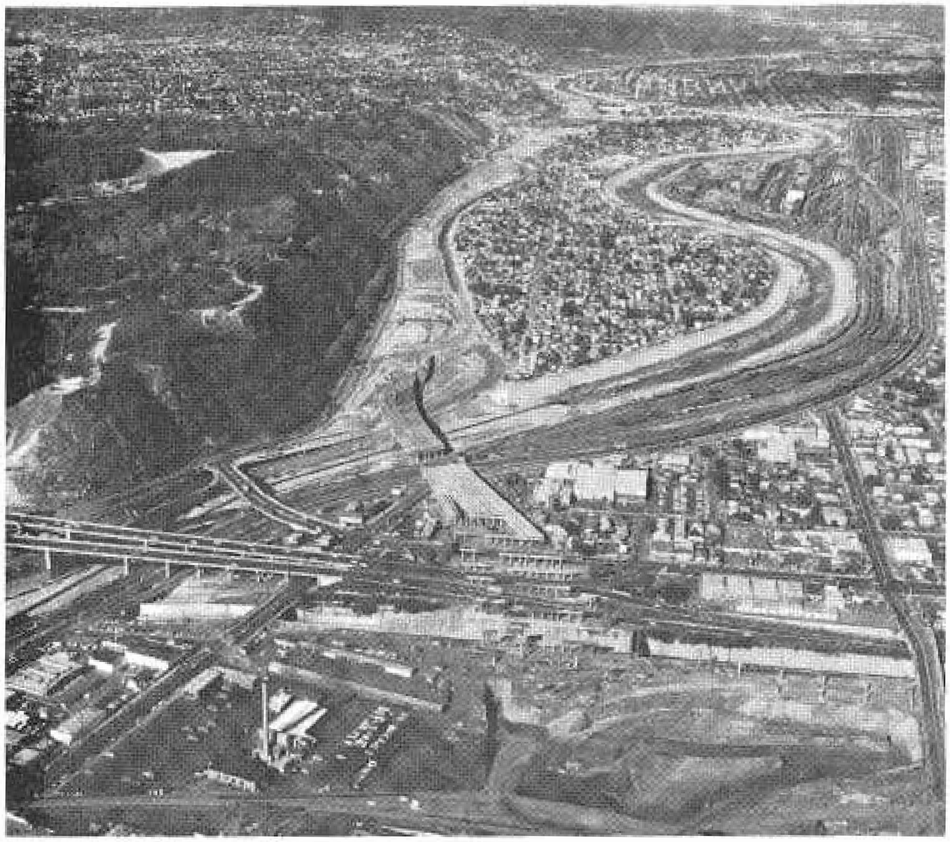
Looking north along construction in progress on the Golden State Freeway from Hollywood Way.



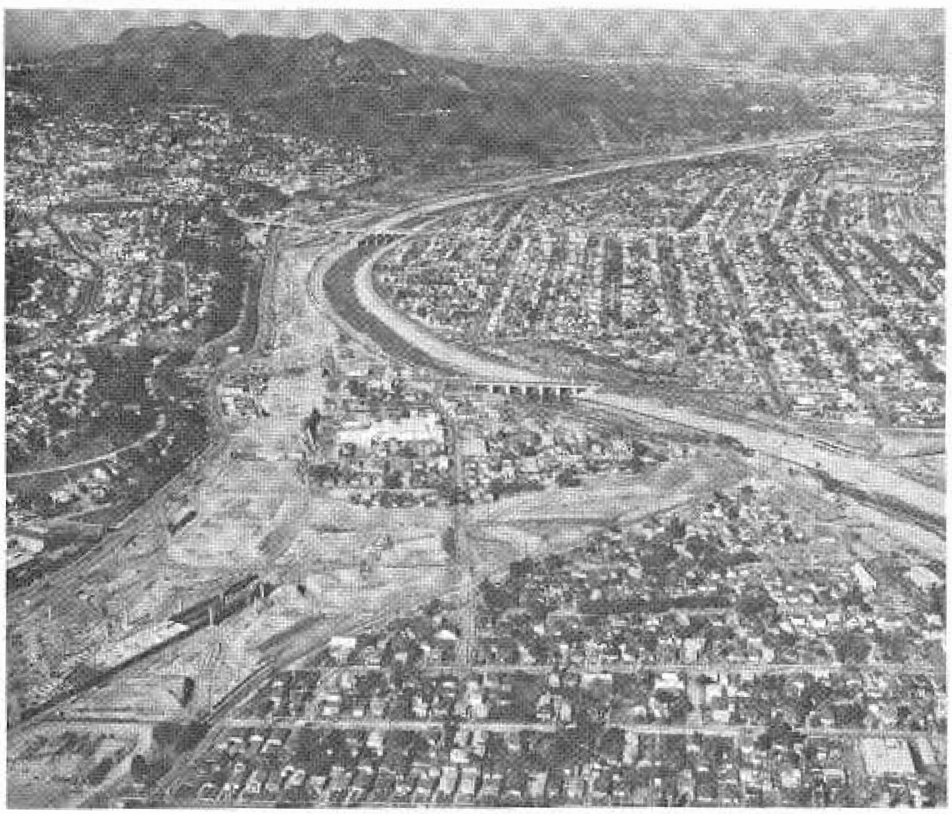
Golden State Freeway construction at Lankershim Boulevard (bridge in foreground).



Looking north along a completed section of the Golden State Freeway in the Burbank area from Western Avenue (bottom).



The Elysian Viaduct and Pasadena Freeway interchange on the Golden State Freeway. Note columns and steel already placed. Winding through the photo at right is the Los Angeles River.



The Golden State Freeway-Glendale Freeway interchange. The Glendale Freeway will enter from the right across the Los Angeles River.

each and the longest span is 123 feet. Total weight of the girders is 1,375 tons.

When opened to traffic, this freeway section will have temporary connections to Lankershim Boulevard until the Golden State Freeway is extended north to Osborne Street.

Lankershim Boulevard to Osborne Street

On October 25, 1960, the California Highway Commission voted $6,200,000 for construction on the Golden State Freeway between Lankershim Boulevard and Osborne Street, a distance of 2.4 miles. This project, the last to be financed on the loop portion of the Golden State Freeway, will be advertised for construction sometime during 1961. Four hundred working days have been assigned to the completion of this freeway section, which will have 3 pedestrian crossings, bridges at 6 locations and 1 pumping plant.

Osborne Street to San Fernando Road

Bids were opened on January 5, 1961 for the most northerly end of the loop on the Golden State Freeway, between Osborne Street and San Fernando Road (junction with the San Diego Freeway near the San Fernando Reservoir).

Construction is now in progress under $12,625,800 contract to S. A. Healy Company and C.K.F.M. from funds made available in the 1960-61 State Highway Budget. The Golden State Freeway portion of this contract measures almost 6 miles of pavement, with the remaining mileage being on a 4-mile link of the San Diego Freeway south to Nordhoff Street, where retaining walls and pedestrian crossings will be built in conjunction with placement of excess fill for future freeway construction under separate contract. This double project will be completed in 600 working days from date of contract approval.

Within the aforementioned limits, the following structures will be built on the Golden State Freeway: pedestrian undercrossings at Kagel Canyon Street, Pierce Street, Filmore Street, and Chamberlain Street; undercrossings at Terra Bella Street, Van Nuys Boulevard, Paxton Street, Fox Street, Chatsworth Drive, San Fernando Mission Boulevard, Rinaldi Street and

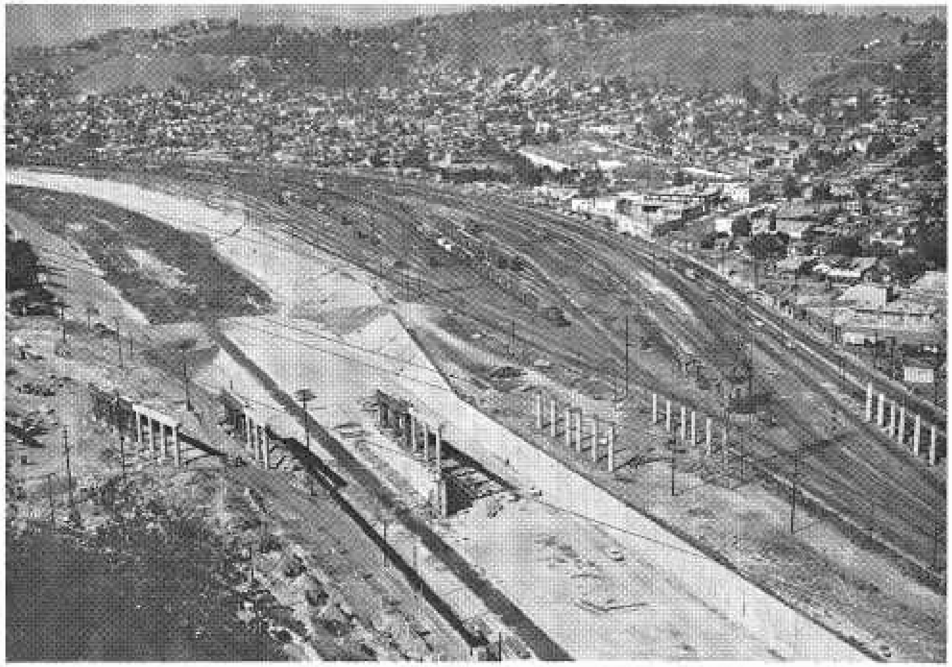
Roxford Street; bridges at Pacoima Wash and East Canyon Channel; Mission Separation and Overhead; and the San Diego Freeway Separation. In addition, 8 retaining walls will be constructed.

The job calls for the following representative major quantities: 6,125,000 cubic yards of roadway excavation, 315,000 square yards of concrete pavement, and 8,516,000 lbs. of bar reinforcing steel.

Completion of the Golden State Freeway at this location will terminate the loop at San Fernando Road. Of course, the Golden State Freeway has been completed to largely expressway standards north of this point via the Ridge Route to the Kern County line and has been in use for a number of years. In terms of the loop, public traffic will have the use of a major 8-lane north-south facility from the north San Fernando Valley to the Harbor Freeway south of the Los Angeles Civic Center. In the next few years as more gaps are filled in the District's freeway system, an increasing number of new loops and alternate routes will circumscribe and cross the megalopolis of Los Angeles and vicinity and will more efficiently serve the present 6,900,000 residents and 3,650,000 motor vehicles in Los Angeles, Ventura and Orange Counties. The freeway development program, particularly on the Santa Monica and Golden State Freeways and on other Interstate routes, is accelerated by the Federal Interstate program, which finances 92% of the cost of these freeways.

Traffic Benefits

To provide adequately for the mounting volume of vehicular traffic, any large urban area, such as Los Angeles, requires some form of a freeway system, be it rectangular, radiating, circumferential, or a combination. Furthermore, this system should be well integrated with the local street system in order to provide optimum traffic service. It is not uncommon to find city streets almost devoid of traffic in the vicinity of a newly opened freeway. Until recently, estimates of future traffic on proposed freeways were in part predicated on traffic diverted from city streets.



Columns across the Los Angeles River and adjoining railroad tracks prior to erection of steel girders. This is the Elysian Viaduct section of the Golden State Freeway.

With more freeways being opened to traffic, diversion from the existing freeways will take place. This diversion will affect the commercial vehicles in perhaps a different amount than the passenger vehicles. On the other hand, construction of additional freeway facilities and the improvement of existing ones generates new traffic. Freeways are popular and as such will always attract an appreciable number of users; so that while new alternate routes will provide relief to congested areas, such as the "slot" in the Los Angeles Civic Center, no freeway will ever be without traffic.

To date, the Santa Ana and Hollywood Freeways have provided one of the best routes for commercial vehicles entering the Los Angeles Metropolitan area by way of the Ridge Route (U.S. 99) and Sepulveda Boulevard. With the completion of the Golden State Freeway through the San Fernando Valley and into the East Los Angeles interchange area, an even more direct route will be created.

The Golden State Freeway, although not intended strictly as a commercial truck route, will carry a higher than average percentage of commercial vehicles, many of which now use the Hollywood Freeway. The Santa Monica Freeway will provide the much needed route to points west.

Although commercial traffic will not disappear entirely from the Hollywood Freeway, it is anticipated that enough will be diverted to provide noticeable relief and increased capacity for passenger vehicles.

With the completion of the loop, it is reasonable to expect that about 15 percent of the existing traffic on the Hollywood Freeway will be diverted. The loop will also benefit the existing city streets because of the improved conditions on the freeways which will attract traffic from the crowded paralleling city streets. As the freeway network is expanded, alternate routes will allow for traffic adjustments which will further reduce congestion and delay.

SQUEEZE AND S-T-R-E-T-C-H

Expansion and contraction of the San Francisco-Oakland Bay Bridge is a continuous process which could amount to a variation as great as 10 feet from the hot summer to a cold winter. It is amply protected from such stresses, however, because its expansion joints can accommodate a change of more than twice the normal amount.

CAST-IN-HOLE PILES

Continued from page 14 . . .

width of piles, and contained about 40 yards of reinforced concrete (see *Figure 1*). The test beam was designed for 1,200 tons to be applied at the center of the beam.

The test pile was loaded in 50-ton increments in order to plot the normal expected settlement.

Settlement Is Checked

At 500, 900 and 1,150 tons the loads were removed to check the estimated permanent settlement (see *Figure 2*). Rebound readings were taken to determine permanent settlement under these loads. At 500 tons the pile rebounded to 0.105″ with a total settlement under load of 0.195″. At 900 tons (double design load held for 60 hours) the pile rebounded to 0.45″ with a total settlement of under load of 0.55″. Since the pile was designed to have a settlement of ½″, under double design load, the test proved the pile to be of satisfactory design.

Pile Is Tested

In order to determine the ultimate bearing capacity of the pile, an attempt was made to fail the pile. At a load of 1150 tons there was slow continuous movement, indicating the applied load exceeded the shear strength of the soil. A safety factor of 2½ was indicated.

Where the geologic conditions are such that this pile can be used (no ground water, and material that does not cave when drilled, see *Figure 3*) large diameter cast-in-drill hole piles may find many uses in future construction.

On this project, a savings of nearly 50 per cent was made over conventional multiple pile footing type foundations.

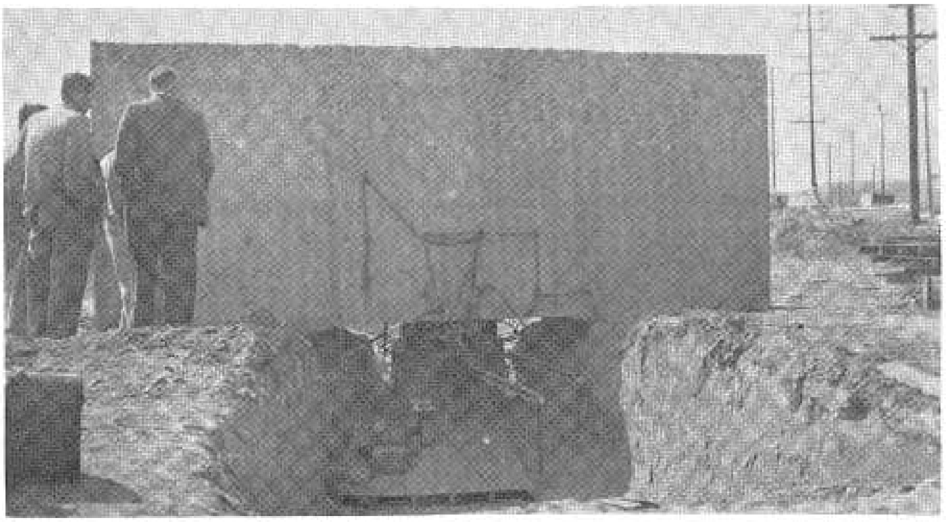


FIGURE 1. A test pile was loaded using hydraulic jacks working against a reinforced concrete reaction beam.

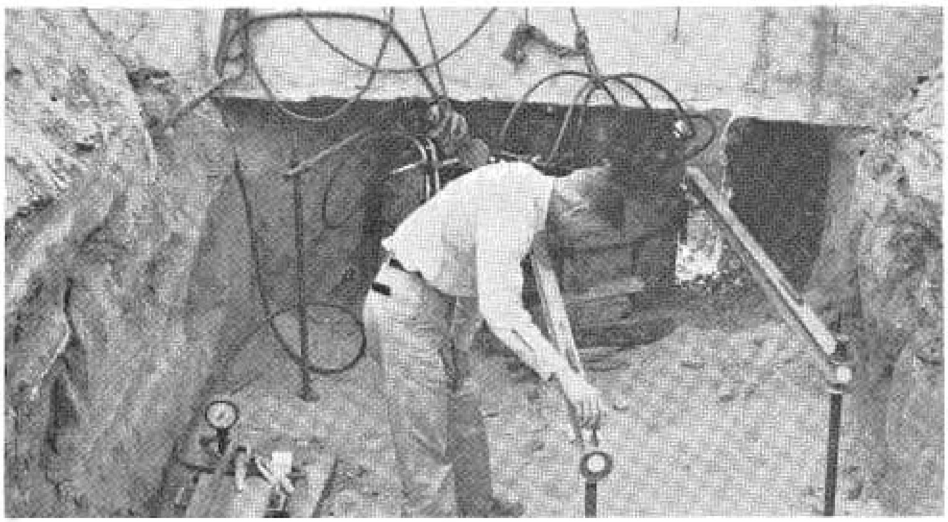


FIGURE 2. The test pile was loaded in 50-ton increments and the settlement checked at 500, 900 and 1,150 tons.

FIGURE 3. Geologic conditions must be right for the pile to be used; namely no ground water, and material that does not cave in.

HRB HOLDS MEET

Nearly 3000 engineers, economists, planners and highway officials attended the 40th Anniversary Meeting of the Highway Research Board held in Washington, D.C., during January. The Board is a unit of the National Academy of Sciences—National Research Council.

Tube Report

Webster Street Underwater Tunnel Will Be Completed by Fall, 1962

By GEORGE A. GREENE, Resident Engineer
and E. G. POMEROY, Assistant Resident Engineer

THE NEW underwater Webster Street Tube providing two additional lanes of traffic under the Oakland Inner Harbor, between Oakland and Alameda, will be opened in the fall of 1962. The graving dock and construction yard are shown in the accompanying plate, "Plan–Graving Dock" have been provided for exclusive use on this contract.

The underwater portion of the tube will be 2400 feet long and will consist of 12 separate reinforced concrete segments each 200 feet long with an outside diameter of 37 feet, 30-inch shell thickness, rectangular collars 45 feet wide by 43 feet high at each end, and each weighing about 5700 tons with a submerged displacement of 7200 tons.

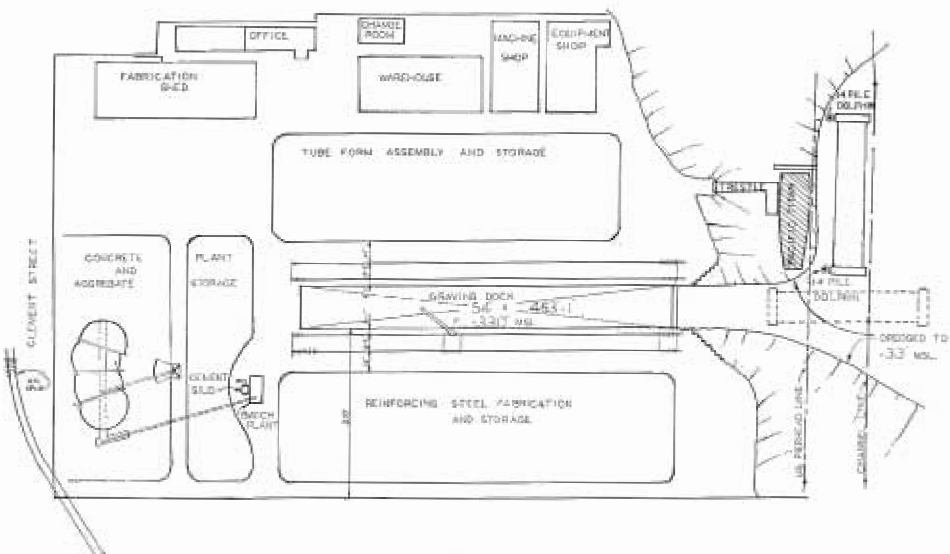
The casting of tube segments began in July, 1960, ten months after bids were opened in September, 1959, and four segments were completed by January, 1961. The casting of the remaining eight tube segments will be completed by October, 1961. The operation of sinking the segments to position and hooking them together is expected to begin during April, 1961, and be completed by January, 1962.

First Used in 1928

Since the completion of the Posey Tube only ten other underwater tubes have been completed using the method of sinking surface prefabricated sections in an underwater dredged trench; first used for a highway tube under the Oakland Inner Harbor in 1928.

Because of the comparative rarity of the "surface prefabricated section–

This picture shows the casting yard and the equipment used in constructing 12 precast tube segments, which cost a total of $4,440,000 when delivered to the right-of-way and ready for sinking into position. The amount of the Division of Highways construction contract is $16,641,000, and the contractor has invested about $800,000 in constructing the graving dock and about $300,000 in tube forms. Two segments are constructed at the same time in tandem and launched by flooding the dock and removing the gate. A construction cycle requires about 10 weeks, and a high tide of more than five feet is required for launching. The segment nearest the water is covered with timber lagging installed to protect the waterproofing, while the other segment shows the black waterproofing. (Photo by Aero Photographers)



PLAN – GRAVING DOCK

The eleven-acre construction yard is located in Alameda at Stanford and Clement Streets, and on the Oakland Inner Harbor opposite the eastern end of Government Island.

dredged trench" type of tube construction, the contractor has been required to conduct his own investigations and to submit his proposed construction methods and engineering calculations to the Bridge Department for review. The contractor's development and planning period required about one year and over 300 pages of working drawings and 400 pages of engineering calculations have been submitted for information and review.

Contract work began October 12, 1960 at the Alameda portal building. The unstable, constantly moving, soft bay mud south of the estuary has required careful planning and complicated construction procedures. The cofferdam and building sections are shown on plates "Floating Tube in Drydock," "Alameda Portal Building Section," and "Pump Sump and Weephole Detail."

The cofferdam construction, pile driving, and concrete subbase seal required six months construction time. The building construction below the ground line and cofferdam removal required another six months construction period. Total working time of 15 months was necessary to complete building concrete. The water level inside the cofferdam was lowered as the excavation proceeded.

Mud Is Removed

Ten feet of interior fill and mud were removed before excessive sheet piling wall deflections and local ground settlement outside the cofferdam indicated the necessity of interior cofferdam bracing. The first and second levels of the interior bracing grid were installed before excavating to third level of bracing. Excavating was interrupted at lower levels for the installation of cofferdam bracing. After the interior bracing at minus 29.5 feet was installed, the contractor filled the cofferdam with water before continuing to excavate. When the cofferdam was flooded the mud was rising in the bottom at an estimated rate of one inch per day, and the ground surface outside the cofferdam had settled about three feet.

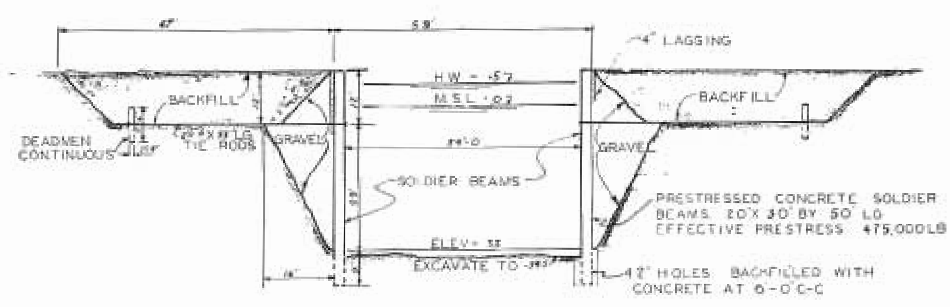
Additional ground settlement outside the cofferdam during the 6-month building construction period below the ground level increased the total ground settlement to about five feet. The additional settlement is attributed to the increased weight of the ground resulting from loss of bouyancy when the ground water table was lowered by draining into the cofferdam.

The Alameda portal building is supported by 124, 12-inch diameter, seven gauge steel pipe piles filled with concrete which extend 78 feet into the mud below the foundation concrete. The piles were 130 feet long when driven by a 6,500-pound, double-acting, steam hammer with 52 feet of pipe extending above cut-off elevation, to the water surface. A pile load test of 90 tons for 60 hours produced an acceptable permanent settlement of .065 inches in the bearing load test pile, and less than .001 inch of pull out on each of the anchor piles under 45 tons uplift.

Bottom Is Stabilized

After pile driving was completed the cofferdam mud bottom was stabilized and sealed with a pressure relieved type Class "A" concrete subbase seal. The subbase concrete was placed under water by tremie tubes over 1½ feet of rock filter blanket. The average thickness of the subbase concrete was 3.7 feet with a minimum of 1½ feet and a maximum of 4.5 feet. The hydrostatic uplift pressure under the subbase was relieved by pumping wells and weep holes cast in the tremie concrete and extending through the filter blanket.

After the cofferdam was dewatered, one 4-inch pump was adequate to remove leakage water and prevent uplift on the concrete subbase. The weep holes were capped and covered with the leveling course concrete and waterproofing. The basement slab of the building was 4′–6″ thick reinforced



EXCAVATED SECTION OF DRYDOCK

The contractor had a choice of facilities in the construction of the 12 precast tube segments. They could be built in the dry in a dry dock or dredged basin or on skidways. He elected a graving dock, a section of which is here shown.

concrete, making a nine-foot total thickness of concrete below the basement floor level. The thick concrete building walls and floors are necessary to provide weight, in order to resist buoyancy forces and prevent the building from floating.

Bracing Removal Difficult

The removal of the cofferdam grid bracing was complicated by the high earth pressure on the sheet piling. The grid bracing at Elevation −29.5 feet was removed after filling the space between the building basement slab and the cofferdam with gravel topped with one foot of concrete. When the interior bracing was removed, the gravel and concrete backfill resisted movement of the sheet piling and transmitted the pressure loads to the building foundation.

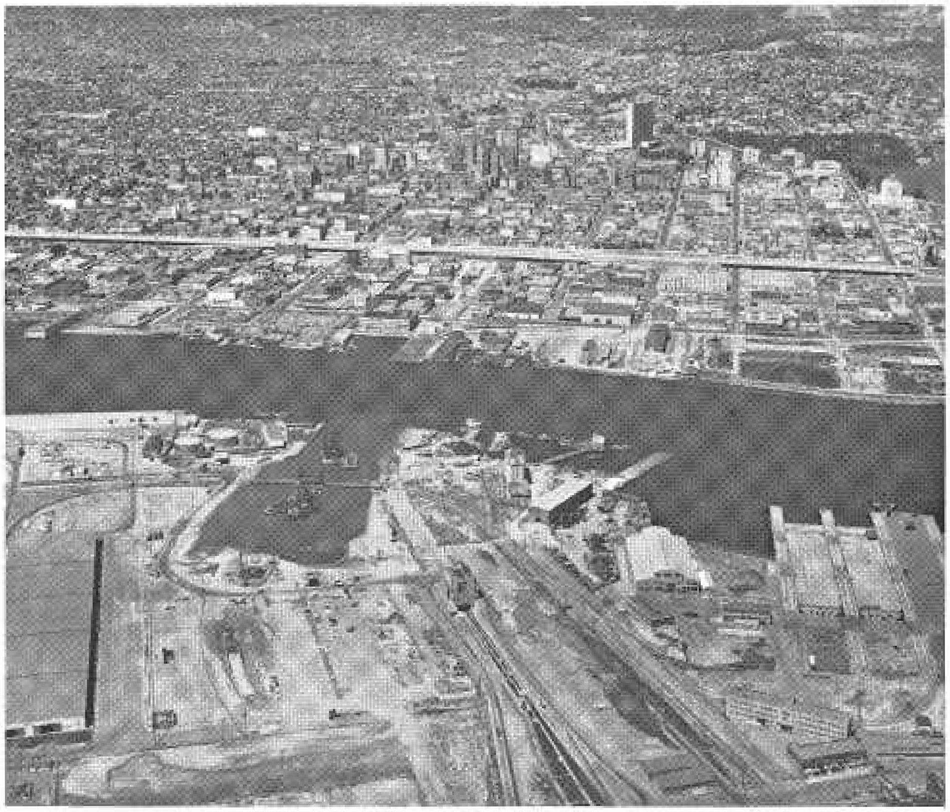
The remaining four layers of grid bracing remained in place, and the contractor constructed the reinforced concrete structure around the braces.

Upon completion of the building exterior walls and interior concrete bracing members, the four layers of steel bracing grid were removed as the waterproofing and backfilling proceeded. The roadway opening in the building wall adjacent to the first precast segment is closed with a watertight bulkhead to prevent flooding the building when the first segment is floated into position.

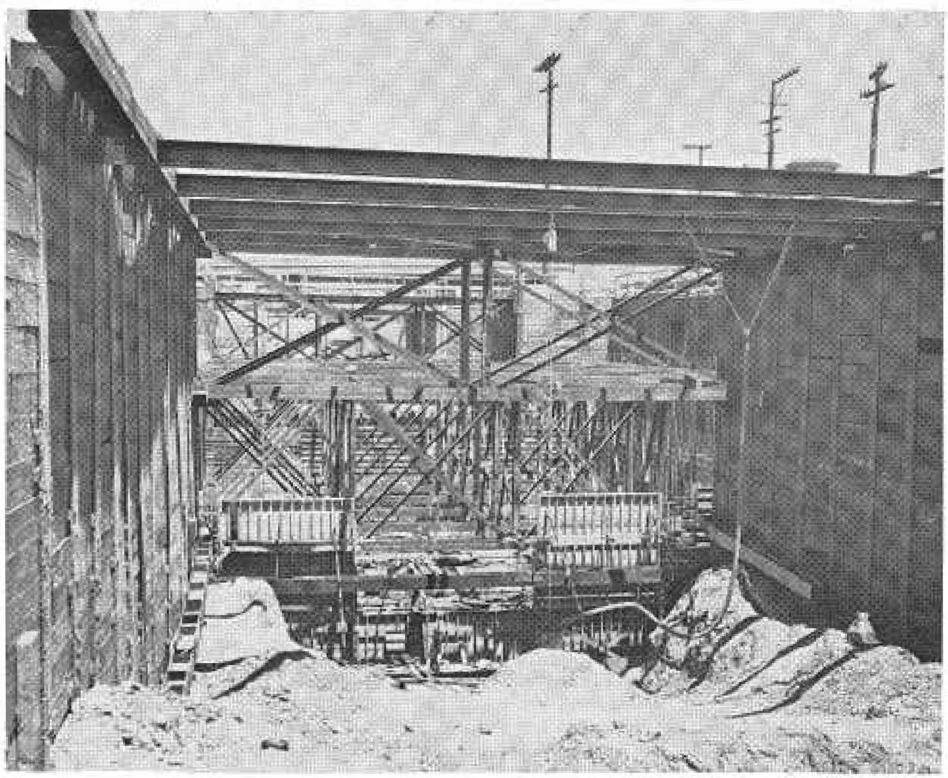
Installation of the building bulkhead was also complicated by the necessity for balancing the cofferdam earth pressures and transferring the cofferdam bracing forces to the building walls. The plan used was worked out by the contractor's engineers, and involved a sequence of eleven separate steps.

Oakland Foundations Favorable

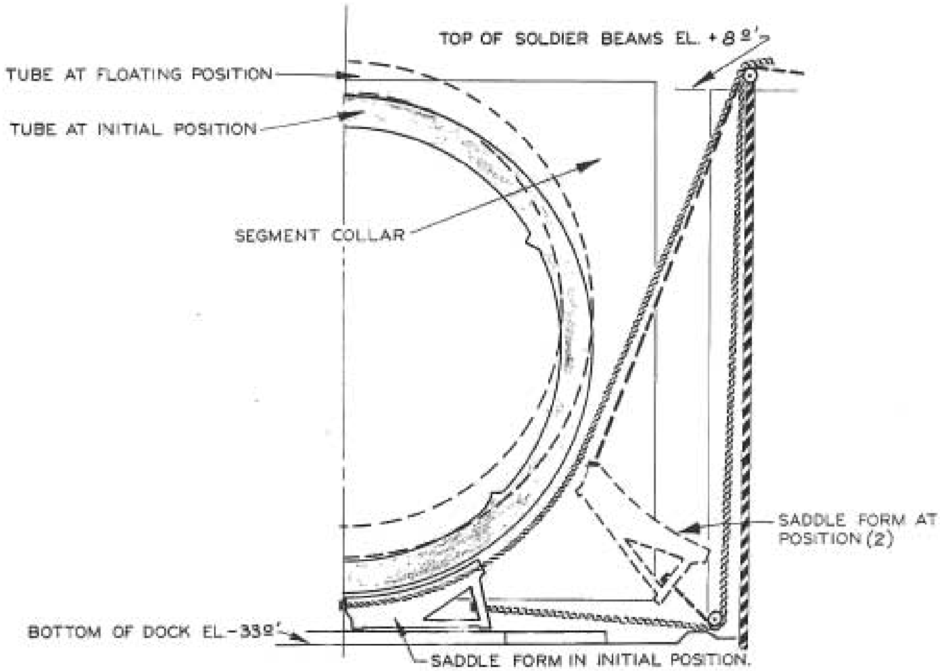
In contrast to the difficult soft mud conditions in Alameda, the foundations in Oakland are very favorable, consisting of dense sand with binder but still permeable enough to permit passage of water. The excavation for the Oakland portal building was shored with 18WF105# steel soldier beams placed vertically extending 11 feet below grade in predrilled holes at 5′-6″ centers along the excavation line and driven to grade by a pile hammer. Timber lagging consisting of 4″x12″ were placed horizontally between the



General location of the tube and the project. Note temporary lift bridge on the railroad shoofly. The soft mud is quite unstable and an excavation 450 feet wide is required to provide a stable underwater trench 60 feet deep and 40 feet wide at the bottom.

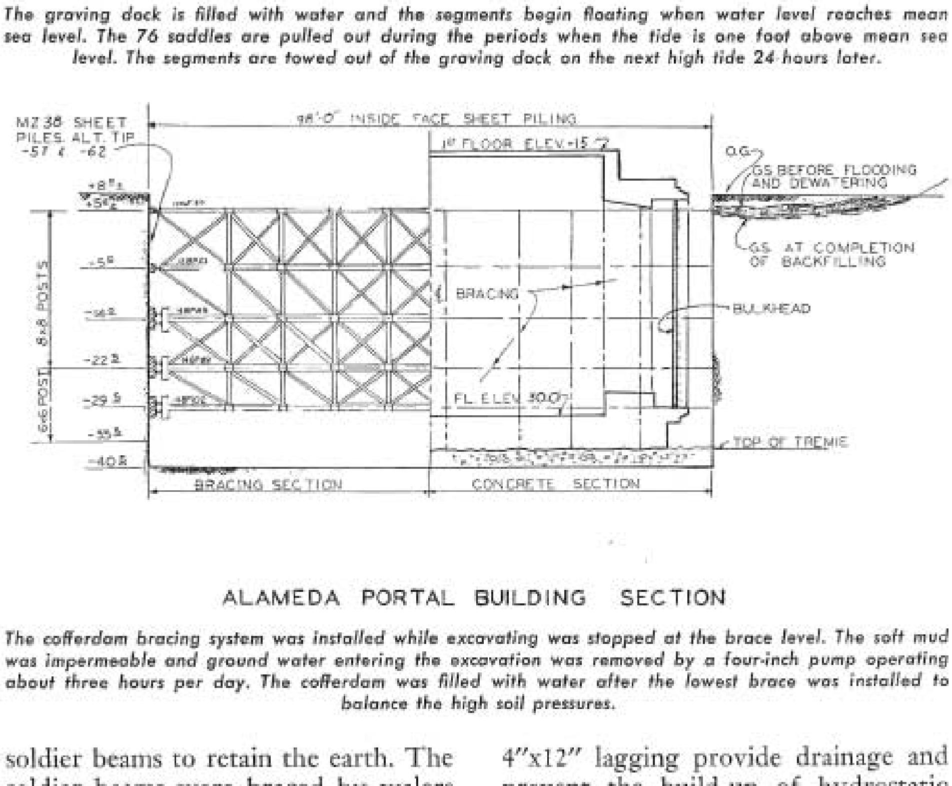


This picture of the Oakland Portal Building excavation shows the vertical steel beams and timber lagging used to prevent ground movement outside the hole. Ground water drains through the lagging and the wall pressure is greatly reduced. A pumping well in the foreground is used to lower the ground water.



FLOATING TUBE IN DRY DOCK

The graving dock is filled with water and the segments begin floating when water level reaches mean sea level. The 76 saddles are pulled out during the periods when the tide is one foot above mean sea level. The segments are towed out of the graving dock on the next high tide 24 hours later.



ALAMEDA PORTAL BUILDING SECTION

The cofferdam bracing system was installed while excavating was stopped at the brace level. The soft mud was impermeable and ground water entering the excavation was removed by a four-inch pump operating about three hours per day. The cofferdam was filled with water after the lowest brace was installed to balance the high soil pressures.

soldier beams to retain the earth. The soldier beams were braced by walers placed 10 feet and 28 feet below the ground surface and strutted by transverse bracing trusses at eleven-foot centers. The ground water surface was lowered in stages to a maximum of 40 feet in Oakland by pumping from a sump excavated in the bottom of the cut. The openings between the 4"x12" lagging provide drainage and prevent the build-up of hydrostatic pressure behind the shoring.

The precast tube segments are being cast in a specially constructed graving dock located in Alameda, two miles upstream from the tube right of way. The graving dock was constructed in a stiff clay foundation with very little inflow of ground water. An underdrainage system and weep holes through the dock floor slab relieve hydrostatic uplift forces. One hundred and forty seven prestressed concrete soldier beams were used to construct the drydock as shown in the accompanying plates, "Plan-Graving Dock" and "Excavated Section of Drydock."

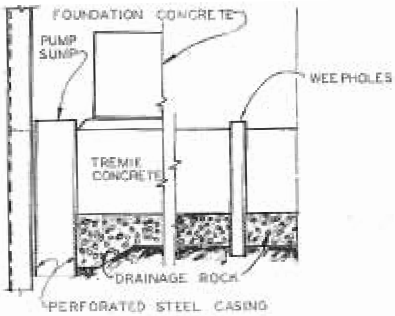
Plant Output Described

The concrete batch plant has a maximum output of about 100 cubic yards per hour and is located at the Casting Yard. All coarse aggregates pass through vibrating finish screens installed directly over the batch bunkers. Aggregates, cement, and admixtures for the precast tube segments are batched directly into 7-cubic-yard transit mixers for mixing and transporting to the forms, with a maximum haul of 800 feet.

Concrete used in the exterior walls of the portal buildings and cast-in-place tube is hauled by dump trucks in 3½-cubic yard batches to one of two transfer plants located on each side of the Estuary and then delivered to the forms by 7-cubic-yard transit mixers. A water-reducing retarder admixture of the hydroxylated carboxylic acid type and an air-entraining agent are being used. The retarding admixture is being used to extend the plastic period of the freshly mixed concrete until succeeding layers can be placed, permitting the additional layers to be internally vibrated together. The tube segment concrete is revibrated by external form vibrators. The retarder also densifies the concrete, provides additional workability, and increases the strength by 600 pounds per square inch after 72 hours. The air entraining agent is used to offset the densifying properties of the retarder, and is permitted because it also increases impermeability and workability.

Weight Reduced

The use of 4% entrained air reduces the weight of the precast segment about 220 tons, permitting the segment to float one foot higher when launched, thus extending the available working time for launching during high tide. The contractor is required to furnish freshly mixed concrete with a minimum unit weight of 147 pounds per cubic foot, and in addition four



PUMP SUMP & WEEPHOLE DETAIL

The use of a pressure relieved seal permitted a seal of average thickness of about four feet, whereas 25 feet of tremie concrete would be required without the pumping system. The drainage rock permits the underwater seepage to flow to the pump sump and weepholes and also supports the tremie concrete on the soft mud bottom.

precast segments are specified to have concrete with a 152 pounds-per-cubic-foot unit weight. The 147 pound weight can be supplied using 4% air; however, less than 4% entrained air is used in the 152 pound weight concrete.

The maximum size of coarse aggregate being used on the precast tube segments is 1½" because of the difficult placing and reinforcing bar congestion at some locations. The 2½" size aggregate is also being used in foundations and heavy sections.

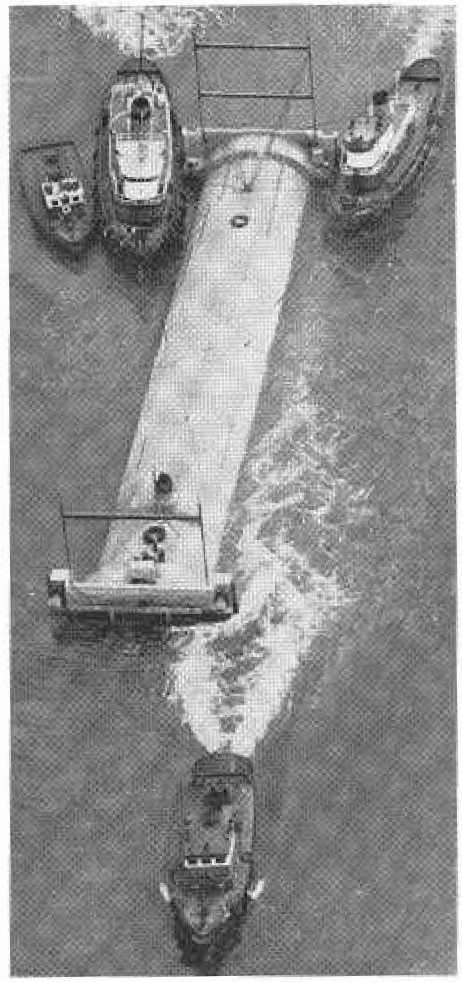
The concrete for the precast segments is placed in three separate operations. The invert, or portion of the shell below the roadway slab, consisting of about 830 cubic yards, is placed first. The roadway deck slab consisting of 230 cubic yards is placed next, and the permanent tube shell is completed with the placing of 1,600 cubic yards in the overhead section of the arch, making a total of about 2,750 cubic yards per segment.

Measurements Made

Concrete temperature measurements were made by thermacouples placed at the center of the 30-inch tube concrete arch shell. The outside of the tube barrel was exposed, but below the ground level in the graving dock, and the ends of the segment remained open during the water curing period. Air temperatures varied from 55° to 75°F and the water in the estuary was 62°F. The mixed concrete was placed at a temperature of 74°F, one day later the concrete temperature was 105°F, second day 91°F, third day 80°F, fourth day 73°F, seventh day 66°F and was 62°F twenty days later when measurements were stopped.

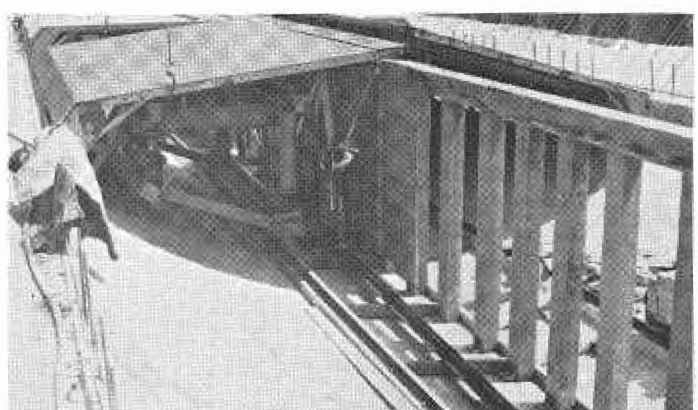
After the tube concrete placement is completed, the segments are waterproofed. The waterproofing consists of four moppings of type B waterproofing asphalt and three layers of glass fabric applied after the concrete is primed with an asphaltic cut-back primer. The exterior waterproofing on the segment is protected from possible damage by 2"x12" timber lagging.

The segments are prepared for floating by plugging the ends with temporary bulkheads. A temporary reinforced concrete Tee-beam bulkhead closed the ends of the duct space under the roadway slab. The planking is caulked and covered with asphalt and glass fabric membrane water-

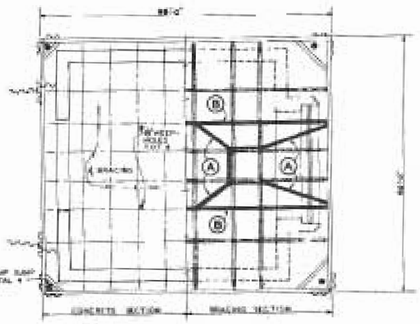


Tube segment being towed. The floating segment has about 8 feet of the 37-foot outside diameter exposed. The 5,700-ton segment requires 34 feet of water for towing and can only be moved during the high tide period. Eighty tons of water ballast is required in the stern in order to float the segment level. Note towers for locating the submerged segment and access hole near the front, which will be 50 feet to extend above the water surface on some segments. The generator on the front provides electricity for the interior lights and pumps. (Photo by Russ Reed)

A view of the tube reinforcement and the interior invert form.



The roadway deck form is being lowered into place and a portion of the longitudinal left open for the construction of a steel transverse bulkhead after completion of the deck concrete.



ALAMEDA PORTAL BUILDING PLAN SECTION

The battered struts A were installed to permit the removal of struts B which obstructed the circular correction concrete forms at the joint with precast segment No. 1. The pump sump was extended above the backfill and the cofferdam water level maintained below the floor slab until sufficient concrete was in place to overcome buoyancy forces. The installation of the watertight bulkhead in the building at joint was quite complicated, requiring a sequence of strut removal, partial bulkhead construction, and backfilling in four cycles.

proofing covered with 1″ of gunite. The open ends above the roadway are closed by 6″x12″ timber horizontal planking supported by 36 WF steel beams placed vertically.

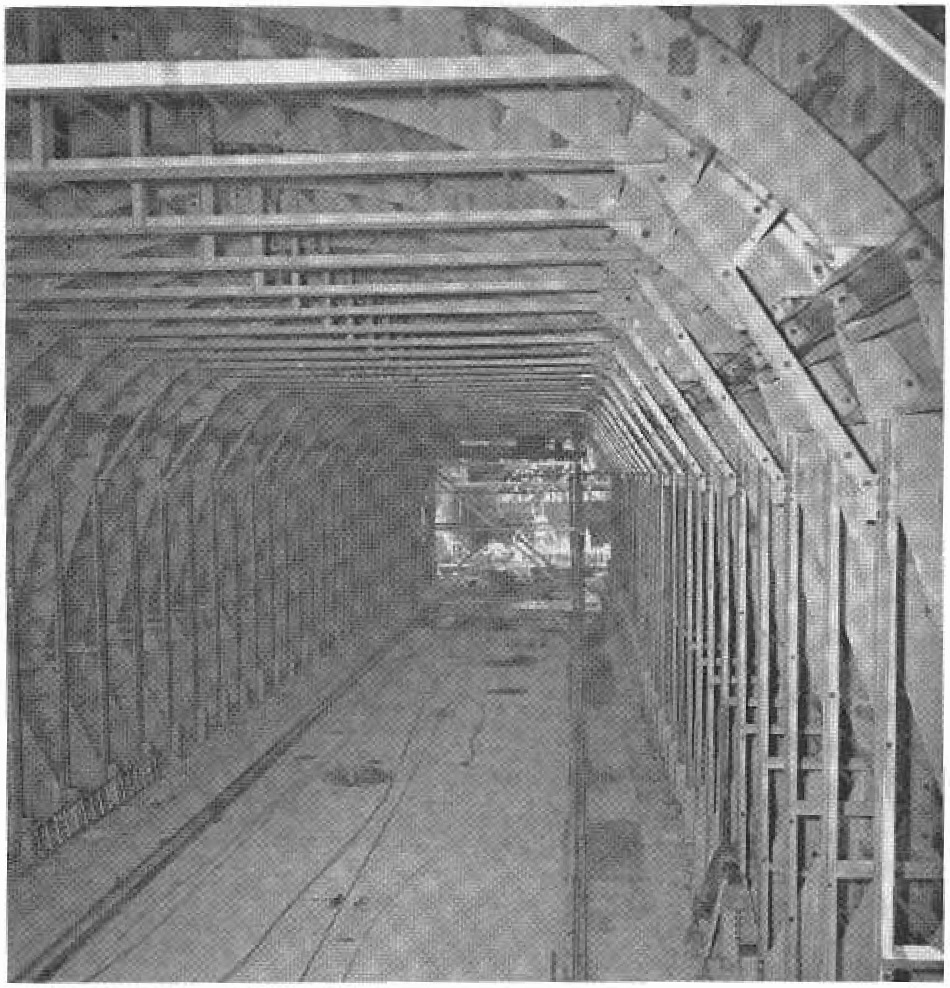
Segments Are Ballasted

Ballasting of the segments is required to provide proper flotation characteristics, to permit lowering into place, to help hold the segment in position on the temporary supports, and to bed the segment into a permanent sand foundation bed.

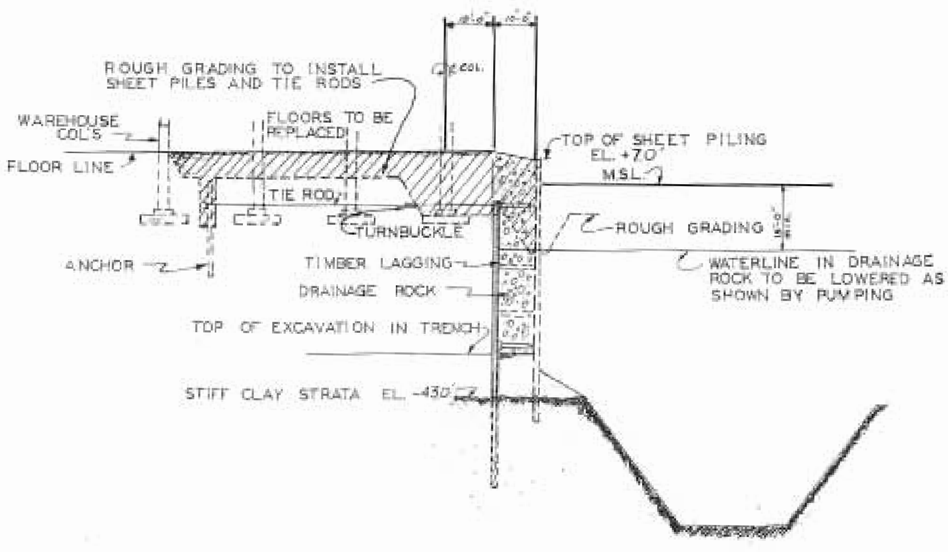
More than 2,400 tons of ballast will be added to the interior of the segments in order to complete the placing operation. It is estimated that about 800 tons of ballast will be obtained by filling the space under the roadway slab with water; another 1,000 tons of ballast will be added by placing about four feet of sand on the roadway deck; and the final 600 tons weight will be added by wetting the sand on the roadway.

The space under the roadway is divided into three watertight tanks by transverse bulkheads placed about 45 feet from the ends of the segment.

The segment can be balanced and the flotation angle controlled by changing the amount of water in the end ballast tanks. A perforated transverse bulkhead on the centerline will lessen the possibility of sudden surging of the water during the filling of the center tank.

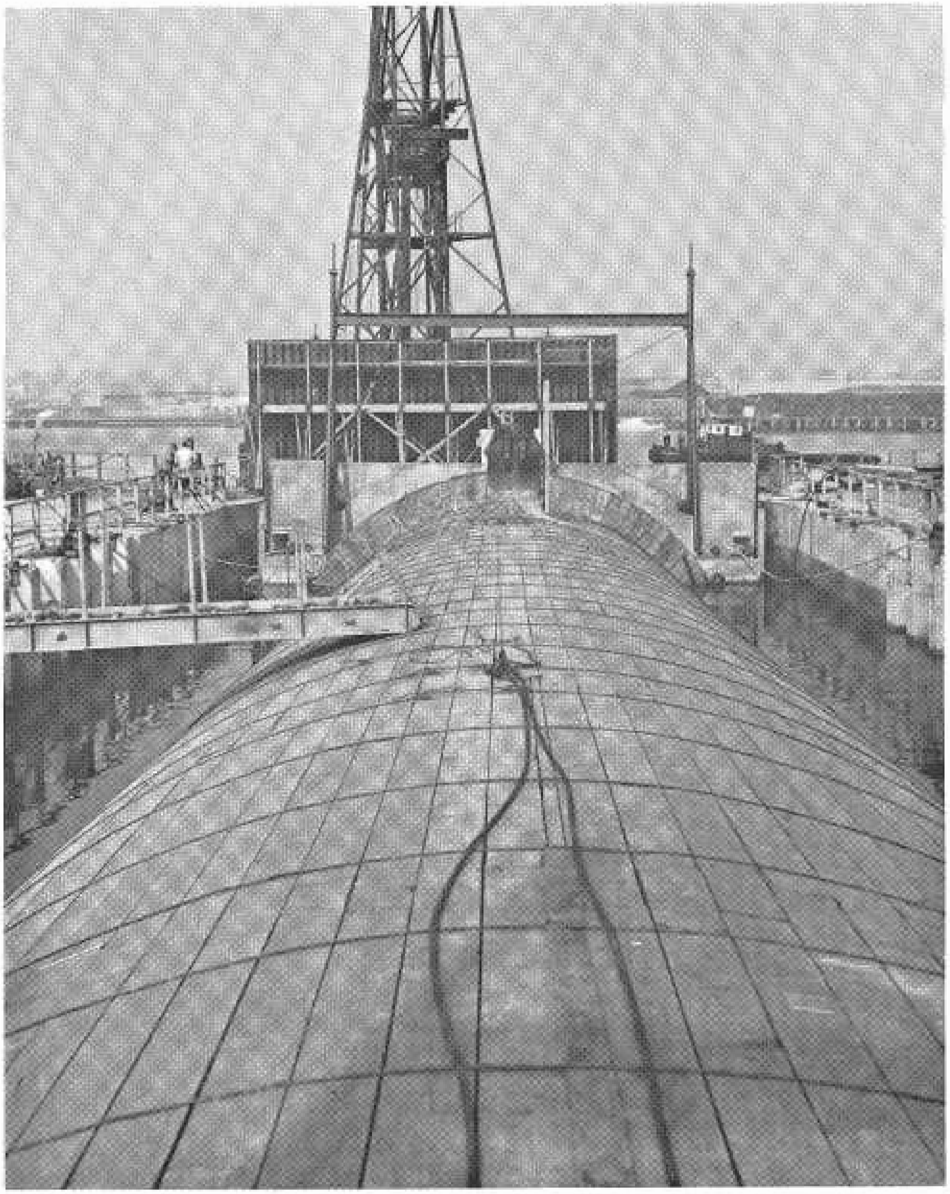


The interior tube forms are being fabricated in panels five feet long and handled in sections 20 feet long consisting of four panels bolted together. Screw jacks on the jumbo adjusts the forms to accurate elevations and pull them loose for stripping. It requires about two days to move the forms to the rear segment after curing is completed.



BULKHEADS AT HAZLETT WAREHOUSE

The bulkhead is about 180 feet long with a 25-foot extension around the corner of the building along Water Street on the Oakland Waterfront. The last segment of the precast construction will be placed in the underwater trench about 80 feet deep.



The 45-ton graving dock gate is lifted about 20 feet by a 75-ton floating derrick. Note the horizontal bracing girders which transmit the water pressure to the reinforced concrete entrance section which provides a door opening 50 feet wide. The access manhole may be seen in the center of the picture together with the pipes which will supply air, and discharge water from interior pumps. About 1,000 tons of sand will be lowered through the 20-inch "conning tower" to provide four feet of ballast on the roadway slab in order to sink the segment. The "conning tower" will be extended as required to about 10 feet above mean sea level. One of the pipes carries fresh air and electric wires, while the other is a discharge line for interior drainage pumps. Also note the sighting masts which will determine the position of the tube segment when submerged.

Bulkhead Designed

A bulkhead for protecting the Tidewater Oil Company facilities was designed, approved, and constructed before the dredging could begin. The floating dredger Holland began work in January, 1960. A shoofly lift bridge on a Southern Pacific Railroad track was also designed and constructed and opened to railroad traffic in April, 1960, after the railroad had completed installing derails and signals.

The longitudinal top bracing and the lift span of the bridge were removed by a 75-ton derrick to permit the dredger Golden Gate to begin work between the railroad shoofly and the Alameda Portal building.

A total of about 450,000 cubic yards of dredging was completed during the year.

The dredged trench for placing the precast tube segments ends in Oakland 40 feet south of First Street. The trench will be 100 feet wide and 80 feet deep between Webster Street and the remaining portion of the 3-story reinforced concrete warehouse.

The bulkhead shown in the accompanying plate, "Bulkheads at Haslett Warehouse" has been designed and constructed by the contractor to protect the building from damage.

Wells to Be Installed

Pumping wells will be installed in the drainage rock in order to maintain a constant ground water surface level about 15 feet below mean sea level. The constant ground water level will minimize the possible loss of ground under the building footings from ground water erosion, and will provide a horizontal compressive force on the ground under the footings resisting ground movement toward the open trench excavation. The bulkhead was installed during the fall of 1960 and all work inside the building has been completed. The Port of Oakland is spending about $825,000 to remodel the building, and it is planned to move their main offices into the upper floors of the building. Restaurants will occupy the ground and top floors of the building.

Other noteworthy accomplishments not described include $200,000 worth of railroad track, pipe line, cable and wire relocation work by subcontractors and utility companies.

More information on the construction and placing of the tube segments will be given in another article at a later date.

BIBLIOGRAPHY

Other articles concerning the Webster Street Tube may be found in:

Engineering News-Record, Oct. 20, 1960, page 43, Graving Dock construction.

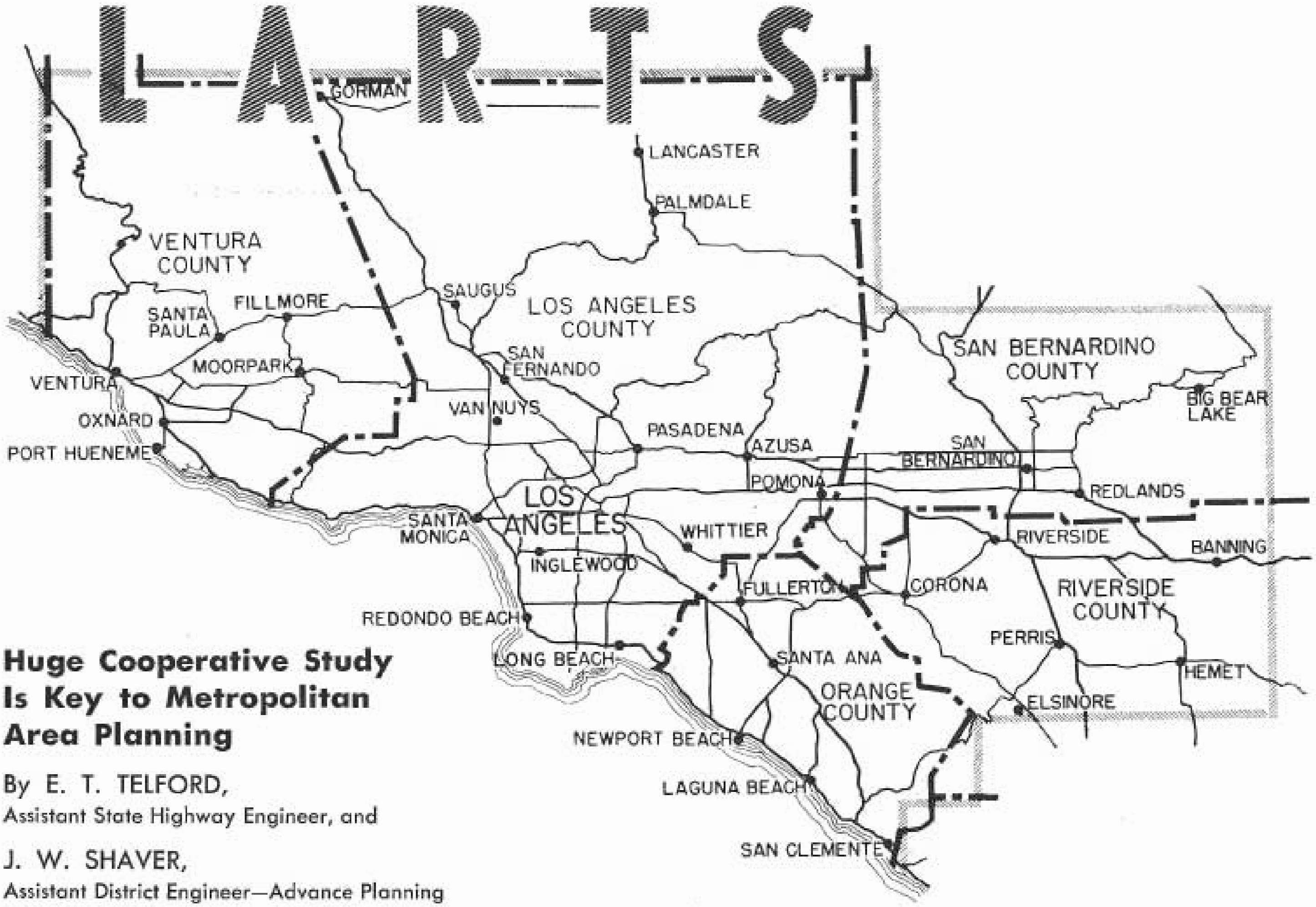
Western Construction, April 1960, unusual construction methods used.

Engineering News-Record, Oct. 8, 1959, page 59, contract bid prices.

Civil Engineering, April 1960, page 77—Tube design considerations.

California Highways and Public Works:
March-April 1960—Work starts, page 11.
November-Dec. 1959 — Navy Hanger Relocated.
Sept.-Oct. 1959—Tunnel lighting, page 43.

Braking distances on winter road surfaces are in the order of 3 to 12 times as great as those of bare pavement.



Huge Cooperative Study Is Key to Metropolitan Area Planning

By E. T. TELFORD,
Assistant State Highway Engineer, and

J. W. SHAVER,
Assistant District Engineer—Advance Planning

DISTRICT VII

On January 30, 1960, Mr. Robert B. Bradford, Director of Public Works, State of California, announced the start of the Los Angeles Regional Transportation Study. He stated,

"Perhaps the largest-scale major cooperative State and local transportation study ever conceived is now in the making. This is the transportation study covering all of Los Angeles, Orange and Ventura Counties, and the westerly, highly populated portions of San Bernardino and Riverside Counties. We are talking in terms of 8 million people and 4 million vehicles now, and an estimated 15 million people and 8 million vehicles in 1980.

"In carrying out this study, the State will again rely heavily on the same type of Advisory Committee of local officials which worked so well with the SCR-26 Report (Freeway System) and is working so well now on the SCR-62 Study (City and County Street and Road Needs). We are asking the County governmental authorities to appoint people to this committee who will not only review and evaluate the progress of the study, but who will also serve as a source of ideas. In addition to the counties, we hope to have on the Advisory Committee representatives of the Metropolitan Transportation Engineering Board, the Automobile Club of Southern California, the Institute of Transportation and Traffic Engineering, and others, with the Automotive Safety Foundation also being called on once again to supply technical advice and a broad perspective based on its nationwide experience."

List of Members

As a result of the request of the State Division of Highways, the following members were appointed by their governing bodies and organizations to the Advisory Committee:

Allen S. Koch (Chairman) .... Road Commissioner, County of Orange

Hugo Winter (Secretary) .... Los Angeles Metropolitan Traffic Association

Milton Breivogel .... Director, Regional Planning Commission Los Angeles County

John L. Curtis .... Senior Transportation Engineer Metropolitan Transit Authority

Prof. Harmer E. Davis .... Director, Institute of Transportation and Traffic Engineering University of California

Joseph E. Havenner .... Director, Engineering and Technical Services Automobile Club of Southern California

A. C. Keith .... County Surveyor and Road Commissioner County of Riverside

Merrill C. Lorenz .... Director of Public Works, County of Ventura

Martin A. Nicholas .... County Engineer County of San Bernardino

Lyall A. Pardee .... City Engineer City of Los Angeles

Newton H. Templin .... Road Commissioner County of Los Angeles

Fritz Zapf .... City Engineer, City of Pasadena Metropolitan Transportation Engineering Board

Alan M. Voorhees, Traffic Planning Engineer, a representative from the Automotive Safety Foundation, together with representatives of the Bureau of Public Roads, are members of the Technical Advisory Group. The Bureau has approved this study for financial participation of Federal Aid planning funds.

A preliminary phase of this study actually started in December, 1958, when the Los Angeles City Traffic Department under S. S. Taylor, General Manager, in cooperation with the State Department of Motor Vehicles, mailed out over 3 million postcard questionnaires with the 1959 registration renewal form. The City Traffic Department received a return of 1,400,000 and are in the process of coding 350,000 of these postcard questionnaires which contain information about work trips and trips for other purposes, time and distance of travel, and days of usage.

Cooperating Agencies

The Los Angeles Regional Transportation Study is being conducted under the general coordination of the California Division of Highways with the cooperation of the Bureau of Public Roads, the five counties of Ventura, Los Angeles, Orange, San Bernardino and Riverside, 117 cities in these counties, and several public and private organizations associated with transportation. Its purpose is to determine the transportation needs of the study area for 1960-65-70-75 and into the future for use in local and regional integrated transportation planning. This will be done by relating the movement of persons and goods to land use, utilizing modern high speed computers, and the latest land use and traffic model techniques.

Working within the framework of community and area-wide planning, the land use model will be used to project and distribute changes in population, employment and land development. The derivation of this model depends on the collection and analysis of data which can best be related to area growth, such as: distribution of past, present, and proposed land use, employment, population, land costs, topography, and the availability of water, sewers, highways, etc.

The traffic model is based on inventories of transportation facilities, determination of travel characteristics, and factors of land use that give the greatest accuracy in predicting travel and trip production. This model converts the information derived from the land use model to person and vehicular trips and assigns these trips to the network of freeways, major arterials, and collector roads by five-year intervals into the future.

Planning Assistance

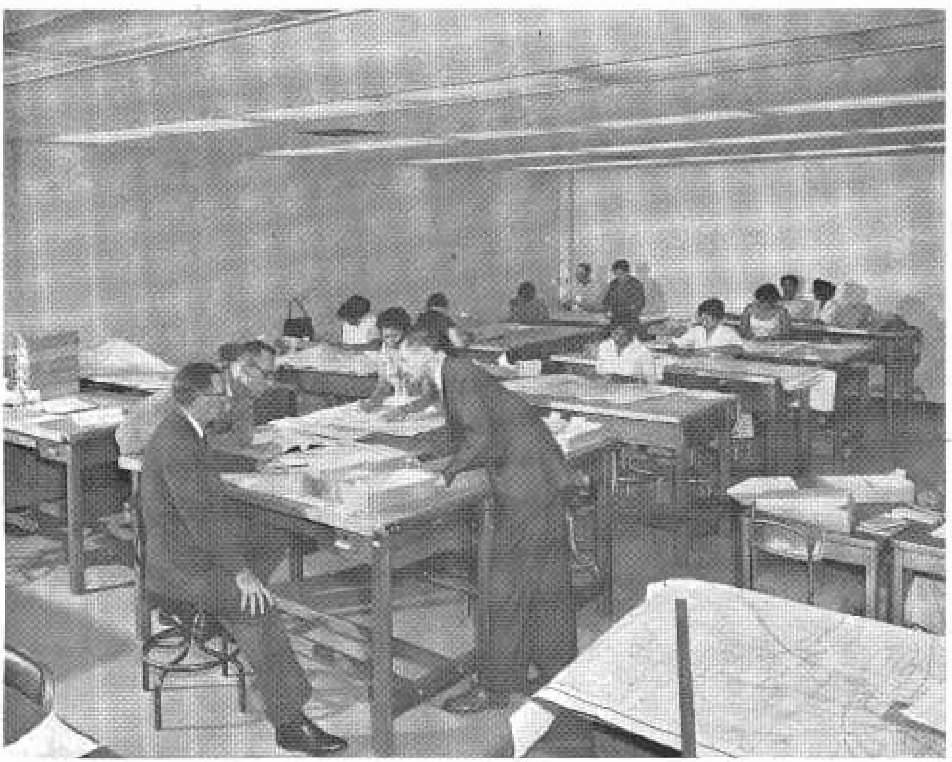
The LARTS Study is not only designed to give greater insight into the interrelationships between land use and transportation; but it also offers local and regional authorities the planning tools for objective evaluation, in terms of transportation needs, of their present and future planning—both as to its effect on local areas and on the region as a whole.

This study is intended to be a continuous planning operation utilizing new data at regular intervals and leading to greater refinements of study techniques. Although the first two-year phase of this study will be oriented toward vehicular travel, it is planned in subsequent phases to include the possibility of other modes of travel and any other likely innovation in the movement of people and goods.

As the study progresses and its potentialities for local as well as region-wide coordinated planning becomes evident, engineers, planners, public officials, and others will not only lend support, but will share a common realization that significant progress has been made toward a well-founded

LARTS Advisory Committee meeting in progress. Committee members seated around the table from left to right are: A. C. Keith, John MacDonald (substituting for Joseph Havenner), John Curtis, Milton Breivogel, Allen S. Koch (chairman), Hugo Winter (secretary), Fritz Zapf, Irving Mohar (substituting for Newton Templin), Lyall Pardee, Eugene Tidwell (substituting for Martin Nicholas), and Richard Sheridan (substituting for Harmer E. Davis). Standing left to right are George Hill, District Engineer, District VII, and John Shaver, co-author of the accompanying article. Seated on the right are Herschel Brown, Los Angeles City Engineering Department and Gibson W. Fairman, Planning Engineer, District VII.

Highway Planning Survey personnel interview outbound traffic for the LARTS study just north of Ventura on the Pacific Coast Highway.



Post card questionnaire coding room in the State Division of Highways Building in Los Angeles. Reviewing the work in the foreground (left to right) are A. L. Hutchison, Assistant General Manager; Jim Hardy, Senior Traffic Engineer; and Charles Koch, Traffic Engineering Associate, all of the Los Angeles City Traffic Department.

plan of integrated transportation facilities for the greater Los Angeles area.

The existing pattern of the movement of vehicles, people and goods will be derived from five Origin and Destination Surveys:

1. The postcard questionnaires which were mailed with the 1959 motor vehicle registration renewal forms. Data from these cards furnish most of the details related to patterns of movement.

2. Limited Home Interview Origin and Destination Survey. This survey was conducted in the summer of 1960 by the Division of Highways. It was designed to furnish household and travel characteristics such as: type of dwelling units, number of registered automobiles per dwelling unit, the mode of travel used by occupants of dwelling units, trip length distribution, proportion of trips by purpose, number of trips per car, etc.

3. Office Interview Origin and Destination Survey of "for hire" trucks. This survey will establish the pattern of "for hire" truck movements and the commodities carried. The field work for this survey was completed in the summer of 1960 by the Division of Highways.

4. Postcard Questionnaire Origin and Destination Survey of regular commercial vehicles. This survey was conducted during September and October, 1960, by the Division of Highways. Questions are the same as those asked in the "for hire" truck survey.

5. External Cordon Origin and Destination Survey. Roadside interviews of outbound traffic were conducted at 17 cordon stations on the perimeter of the LARTS Study Area. This survey, conducted in the summer of 1960 by the Division of Highways, will furnish data on travel in and out of the study area.

Although the field work is complete on these surveys, there still remains a tremendous task of coding, key punching, and analyzing these data so that they can be integrated with other phases of the study.

Preparation of Maps

Another sizable job in connection with the inventory of travel is the preparation of maps and tabulations showing the 1960 average daily travel on all freeways, major arterials, and collector streets which will be used in the network for traffic assignment. These traffic volumes will be obtained from various City, County and State traffic count records or from previous studies such as the SCR-62. These 1960 ADT's will be used to test the study methods by comparing them with 1960 traffic assignments made by the computers.

Public transit usage will be obtained from mass transit companies in the area, as the LARTS Study does not intend to duplicate work that has already been completed for this mode of travel.

Land use information will be of major importance for the completion of the LARTS Study. For analysis purposes, these data must be recorded in a uniform and systematic manner for the entire study area. The job of co-ordinating the collection of land use information is under the general direction of Milton Breivogel, Director of Los Angeles County Regional Planning and a member of the LARTS Advisory Committee.

The first steps to standardize procedures of data collection were taken by the temporary Land Use Criteria Committee headed by Joseph A. Mellen, Planning Director of the City of Glendale. This committee, in co-operation with the LARTS staff, determined what land use data were needed and developed an instruction manual and a set of forms on which this information could be recorded.

Land Use Form

A four-page land use summary form was developed and is being distributed to all the planners in the five counties and 117 cities in the LARTS area. The planners will be asked to complete these forms for each 1960 census tract in their jurisdiction. Since Ventura County is not tracted, some system of planning areas will be developed. The large census tracts in the other counties will also be split into suitable planning areas. The forms as transmitted will include:

(1) Present land use inventory for each of the 1960 census tracts using seven major categories such as residential, commercial, community service, industrial, transportation, military

Survey Interviewer I. B. Monahan (center) interviews truck driver William Kiner. Lending assistance (right) is Gene Thuesen, sales manager of Knudson Creamery.

A home interview for origin and destination information being conducted by Survey Interviewer John Crisp (left) in the home of Mr. and Mrs. Levring and their two daughters Judy and Janet.

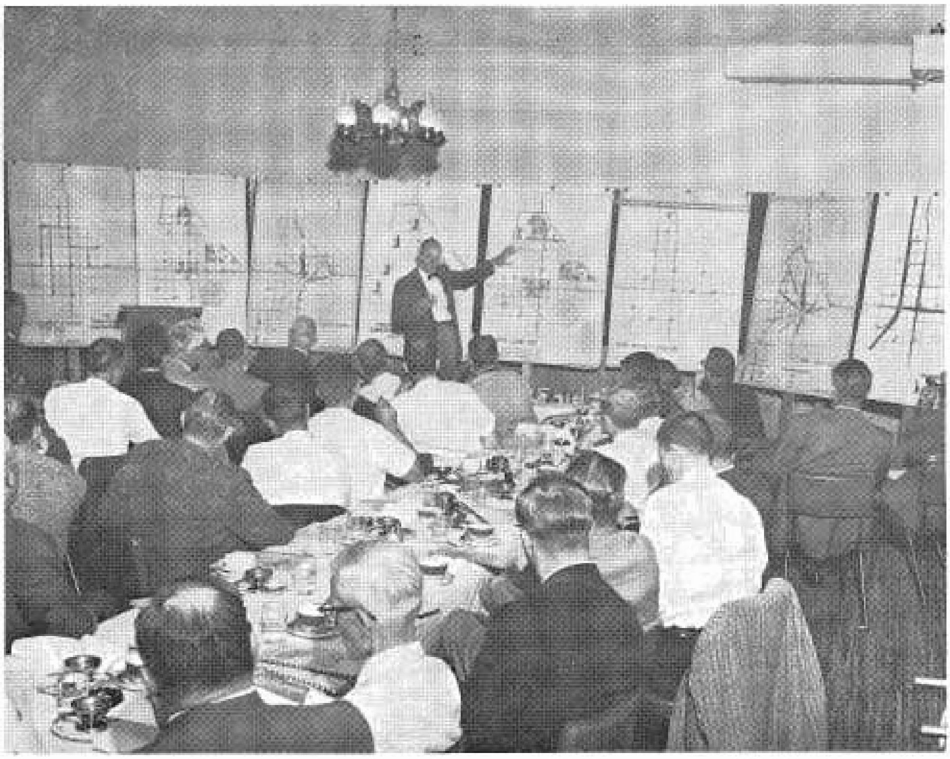
installation, open land. These categories and land use groupings are primarily oriented toward traffic generation and land use predictions. This will be used with other data to establish population and employment densities, traffic generation, and other factors necessary in the allocation of traffic over the entire study area.

(2) Special land use information such as the ultimate development of the 1960 open usable land and the historical data for 1950 open usable land indicating type of land use conversion taking place, and listing redevelopment projects and any special high-traffic generators.

(3) Residential land characteristics for two time periods, 1950 to 1955 and 1955 to 1960. The characteristics requested for these periods include water, sewer, highway, public transit service, and an indication of whether or not the vacant land was suitable for mass development. In addition, information is requested on the 1960 average vacant residential land cost per acre, and the average topographic conditions.

(4) The final page will require information in regard to industrial land characteristics existing between 1955 and 1960. The information requested includes highway, water, sewer, rail, transit service, and the average 1960 vacant industrial land cost and topography.

The LARTS staff has obtained from the State Department of Employment 1960 employment data by census tracts. Historical employment data for community labor market areas will come from the same source and others such as the US Census of Manufacturers, US Census of Business and Sales Management Surveys. Information is also being obtained on motor vehicle ownership distribution from special surveys made by the Times-Mirror Company and the Division of Highways. Current information will also be available by census tracts from the 1960 US Census.



The LARTS study being explained to local officials in Orange County by Gibson W. Fairman, District Planning Engineer, District VII.

Computer System Installed

The Highway Planning Survey Department in Sacramento has just acquired an IBM 704 magnetic tape data processing system, which will be used in processing the above land use and traffic data. By mid-1962 this computer system is expected to develop the following quantitative and qualitative results:

(1) A complete pattern of the movement of people and goods for the entire study area for the years 1960, 1965, 1970, 1975 and 1980. The pattern will show travel desires between census tracts (zones).

(2) A complete analysis of vehicular transportation needs by the same five-year intervals on a local and region-wide basis.

(3) The Average Daily Traffic volumes for the years mentioned above for the freeway system, and major arterial and collector streets.

(4) Objective evaluations for the same years in terms of transportation needs, of present land use and future land use plans proposed by the city and county planners. These evaluations by five-year intervals will be tools for planning on a priority basis.

(5) A data summary of population, employment, motor vehicle ownership, etc., and an inventory of land use for every local community by census tracts. These data will be punched on IBM cards by the Division of Highways and each local community may request a duplicate deck for its own planning purposes.

These are some of the qualitative results expected by mid-1962:

1. A greatly increased understanding on the part of planners and engineers of the interrelationships between land use and transportation planning.
2. A greater appreciation of the value of well-coordinated, systematic, uniform data collection.
3. A better understanding of the factors influencing residential, industrial and commercial land development.
4. A better insight into patterns of growth on a local and region-wide basis.
5. An increased awareness of the effect each community's planning has on surrounding communities and the region as a whole.

... Continued on page 68

Guthrie Reappointed, Erreca Named to C.H.C.

JAMES A. GUTHRIE

JOHN ERRECA

Governor Edmund G. Brown has reappointed James A. Guthrie of San Bernardino to a four-year term on the California Highway Commission and has appointed John Erreca of Los Banos to a four-year term, succeeding Chester H. Warlow of Fresno.

Both appointments were effective January 15, 1961.

Guthrie was first appointed to the Commission by Governor Earl Warren when it was established in its present form on September 14, 1943, and was reappointed by Governor Warren in 1945, 1949 and 1953, and by Governor Goodwin J. Knight in 1957.

He is a widely known newspaper publisher, and has been associated for many years with the San Bernardino *Daily Sun* and *Telegram*, of which he is the editor and president.

He has also carried on a broad range of civic improvement activities in his home community and – especially in the field of good roads – statewide. He is a member of the board of directors of the California State Chamber of Commerce and has served on its highway committee for a long time.

At the Commission's January meeting, Guthrie was elected to serve as vice-chairman for 1961. He has been vice-chairman in previous years.

Long-time City Official

Erreca, the new Commission member, has also achieved a distinguished reputation in civic service, especially in the Los Banos area, where he is a farmer and cattleman. He has been a member of the Los Banos City Council since 1938 and the mayor since 1944. Upon his appointment to the Highway Commission he resigned from the City Council.

In 1953 Erreca was elected to the board of directors of the League of California Cities, and served as president of the League in 1959. Last year he was chairman of the League's highway committee.

He is a past president of the Merced County Livestock Association and president of the board of directors of the Merced County Spring Fair.

Warlow's service on the Commission, which ended in January, extended over more than 17 years. Like Guthrie, he was a member of the original 1943 Commission.

SIGN ROUTE 68

The Salinas-Monterey Highway has been designated State Sign Route 68, it was recently announced by State Highway Engineer J. C. Womack.

This route, previously unposted, extends from Sign Route 1 in Monterey to U.S. 101 in Salinas. The new designation will be effective as signs are posted.

Womack Is Elected To A.A.S.H.O. Post

State Highway Engineer J. C. Womack is serving as first vice-president of the American Association of State Highway Officials for 1961. He was elected to the office at the Association's 46th annual meeting, held in Detroit in December, 1960.

Womack also continues as a member of the executive committee of AASHO, on which he began serving last year.

The Association elected Dwight H. Bray, chief engineer of the Kentucky Highway Department, as its president for 1961, succeeding David H. Stevens, chairman of the Maine State Highway Commission.

Advisory Committee Named by Governor

Governor Edmund G. Brown has appointed a three-man Advisory Committee on the planning of a Southern Crossing for San Francisco Bay. The committee plans to meet quarterly, starting in February.

Members of the committee are State Director of Public Works Robert B. Bradford; John J. Purchio of Hayward, a member of the California Highway Commission; and William Roth of San Francisco, a member of the California Toll Bridge Authority.

The Governor said the committee's functions will be to bring together the reports on progress in planning an additional crossing; to suggest additional studies or investigations; and to hold public hearings and meetings. It will also be very much interested in increasing public participation in planning for the additional crossing.

Studies for a Southern Crossing have been made by the Department of Public Works over a number of years, and will continue.

The State Division of San Francisco Bay Toll Crossings will advertise for bids shortly for strengthening the upper deck of the west bay portion of the San Francisco-Oakland Bay Bridge.

of nationwide effort in the field, Bureau specialists have been able to stimulate the program by facilitating a very desirable interchange of procedural and other data. The value of this kind of coordinating activity is quickly apparent. As a result of it, for example, the possibility of developing a national "bank" of empirical data by which appraisal theory may ultimately be tested and evaluated becomes highly encouraging, since uniform reporting and uniformity of data become easily possible.

Recently, Bureau specialists have begun the formidable task of organizing for machine tabulation and analytical programming, and significant progress leading to the development of a manual of procedure in this area is currently being made. Thus the logical step from relatively simple documentation at the appraisal level, to complex testing of hypotheses at the theoretical level, has already been taken.

California Program

From time to time since the Pasadena Freeway (then Arroyo Seco Parkway) was constructed in 1940, California right of way agents have been compiling and utilizing case studies of freeway adjacent parcels in their day to day right of way work.

Practically, these early case studies were of tremendous appraisal significance; they were the first items of empirical data available regarding freeway effects. As such, they were weighed and evaluated by both appraisers and landowners, and became the basis for countless subsequent investment and development decisions. Generally, the data showed *positive* freeway effects and benefits, and with relatively few exceptions, the validity of even the earliest decisions predicated on the freeway as a salutary factor were in fact borne out by subsequent events. Thus in the area of practical use, even the few cases available in early years proved to be accurate and realistic appraisal tools.

Theoretically, however, these initial data were limited by something of a "built-in" deficiency — they were almost by definition, limited in number, in scope, and in applicability. Thus, since it could not be shown that they did in fact truly represent *all* remainders over any specific time period, ready acceptance of them was impaired, and they were subject to the basic criticism that perhaps they might be the exception rather than the rule. Moreover, since they were limited, their actual usefulness was restricted as well, in the sense that in any particular appraisal problem, the chances of finding a really close fit to the problem at hand were proportionally small.

Taking first things first, then, it was quite early premised that California remainder parcel studies would clearly have to:

1. Include the analysis of each remainder along every freeway completed within at least the preceding three years.
2. Be on a continuing basis so that, at regular intervals, all remainders along any given freeway would be checked for sales and developments.

Only when these prime requisites had been met, it was premised, would it be possible to begin to utilize effectively the theory-making potential of remainder parcel data, as well as utilize its practical advantages and applications.

Remainder Parcel Concept

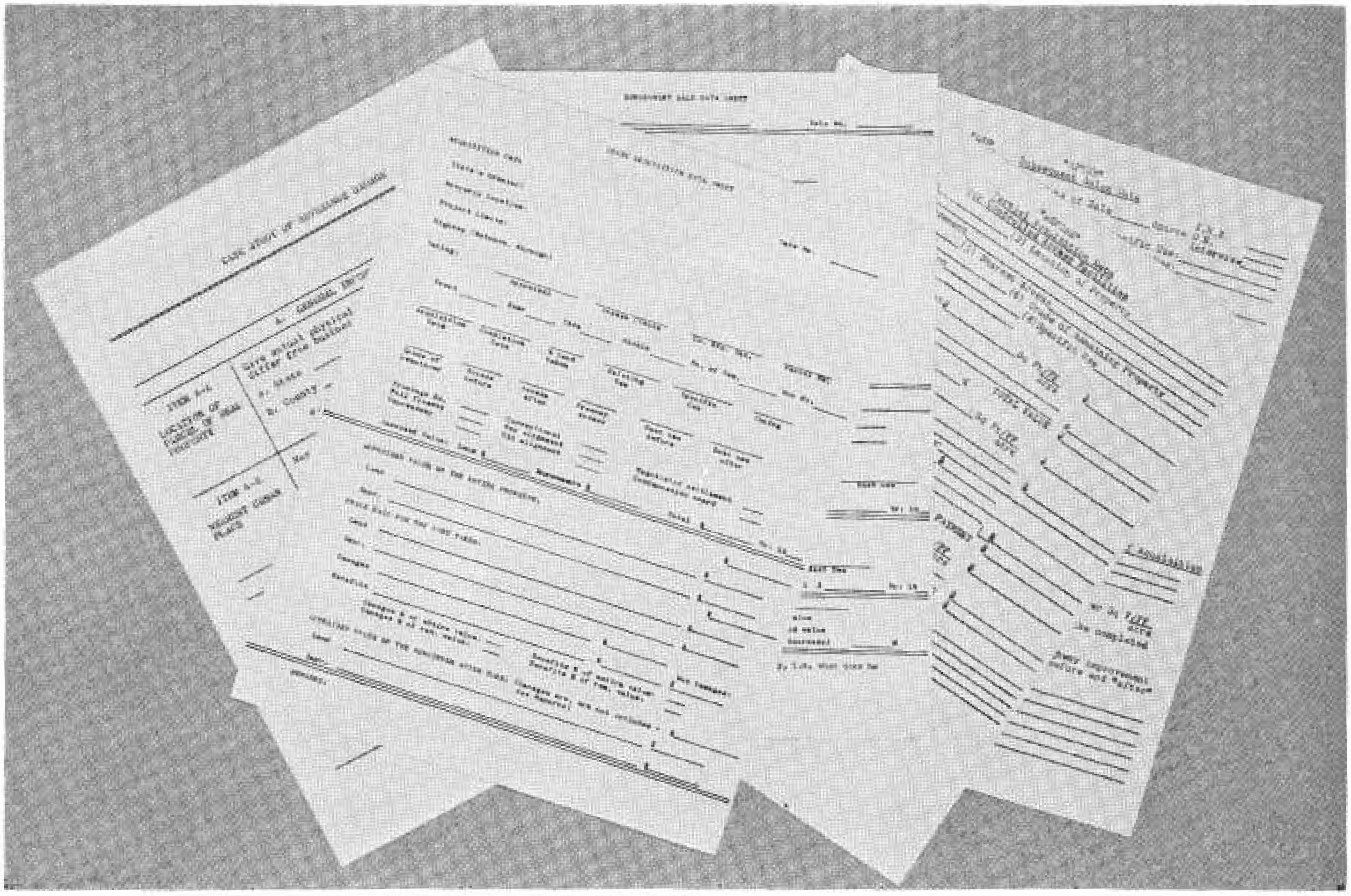
As would be expected, many of the early statements of the need for and purposes of remainder analysis came from California, and reflected California freeway experience. The subsequent emergence of right of way studies reflected the conditions already noted as being necessary to stimulate and thereafter permit such research, i.e., completed freeway mileage, an expanding freeway right of way program, an active and dynamic real estate and economic environment, etc., which conditions had existed in this state for a relatively long period. Even in California's earliest freeway days, the need for remainder parcel facts had already begun to make itself felt. Shortly there followed the concomitant stimulus to do something to satisfy the needs, and the earliest starts at this kind of analysis were made. As a result, the remainder parcel concept has been in existence for some time in the state and may be briefly outlined. Presently it constitutes the rationale for the current land economic study effort.

Remainder studies would clearly be useful in determining if a particular freeway imposed a damaging or beneficial effect upon a particular property. As has already been noted, the evaluation of the sale or development of a remainder in the light of activities similar but uninfluenced areas, should quite accurately reveal freeway effects, or more precisely, the effects of the construction of the freeway improvement itself. The nature and extent of activity on the remainder, after completion of the new highway, is broadly seen as reflecting not only the general interplay of economic forces, but the influence of the abutting freeway as well. When by means of control area comparison the general influencing factors are removed, the result may be reasonably attributed to the abutting freeway.

Reference to Original Unnecessary

In such an approach, reference to the original holding of which the remainder was formerly a part is unnecessary, and contributes little if anything to the analysis. In effect, the remainder is viewed as an "entire" parcel as it stands, and the question that sales analysis would want to answer, for example, would be: "Would this remainder (now simply a property adjacent to a freeway) sell for the same amount if it were *away* from the freeway and its influence?" The answer would thus help only to solve the problem of determining the effects of the *freeway construction itself;* and attempting to relate back at any point in the analysis to the original, pre-freeway holding would probably add little but confusion.

Largely, it can be seen, remainder parcel study in this sense is similar in concept—if not identical—to studies of *any* kinds of freeway-abutting parcels, e.g., "intact" properties from which no right of way was ever acquired, and which are perhaps adjacent to a new freeway now occupying what formerly was a neighbor's land. Thus the remainder parcel—to be singled out for special study—must be



Typical reporting and analytical forms for the compilation of remainder parcel data. Such forms include a complete "before and after" history of each property and its highway environment, and provide the basic data source from which freeway and right of way acquisition effects are inferred.

capable of making some other significant contribution over and above that of "freeway effect," and this is very clearly the case. *Actually, to conclude that remainder studies are a measure only of this one element—freeway effect—is to fail to grasp the full right of way appraisal context involved, and thus actually to fail to fully develop their appraisal and investment potential.*

Effects of Severance

Perhaps the significant element in the entire partial acquisition process is the determination by the appraiser of the effects, if any, of the *severance of the part sought to be acquired from the remaining property*. In addition to the effects of the construction of the freeway itself (freeway effects) this latter element must be considered as well in ascertaining the nature and extent of damages and benefits, if there in fact be any. It is immediately apparent that remainder parcels actually offer the *only* opportunity to study the effects of the *acquisition* itself, and it is primarily because of this that they are being studied. The entire context in which the original right of way appraisal was made thus becomes the unique reference for remainder analysis, and the original valuations and assumptions become both the bases for testing as well as the items to be tested.

An additional byproduct emerges. As has already been noted, every partial acquisition situation requires an appraisal of the presence and amount, if any, of damages and benefits attributable both to the freeway and the acquisition. Decisions on these factors *are* made in each such appraisal, and the amounts which remainder owners subsequently accept reflect the damage and benefit assumptions so developed. It thus becomes apparent that subsequent sales of and developments upon these "damaged or benefited" remainders become excellent indications of the validity of the original appraisal assumptions, over and above any light they may shed upon freeway effects as such.

District Effort

To carry out the California program, Senior Right of Way Agents in charge of the appraisal function—or sections—within each of the 11 highway districts have been given direct supervision over remainder parcel studies. These men have in turn assigned one Associate Right of Way Agent full time to the project, with the assistance in many districts of one or more Assistant and Junior Right of Way Agents as well.

These analysts are carrying out the following study sequence:

1. List completed freeway projects and all of the remainders adjacent thereto.

2. For every project, carry out a systematic parcel by parcel check of each remainder to determine:
   a. Chain of ownership since highway acquisition and development, including sales and sales data where changes in ownership have occurred.
   b. Extent and sequence of development of remainders, such as physical improvements, changes in use, etc.
3. Combine remainder parcel sales into groups of comparable units for the purpose of comparison with control data.
4. Locate control areas, which will:
   a. Contain properties being put to identical uses to those under study at the time of right of way acquisition.
   b. Be similar in all significant environing conditions to the area in which the remainders under analysis are located.
   c. Have followed a similar trend and exhibited similar developmental patterns and characteristics to those of the remainder areas, up to the time of right of way acquisition.
5. Determine by control area and study parcel comparison whether the remainders have done as well as, better, or worse than freeway-removed properties whose trends they would normally have shared had the freeway not been injected onto the scene.

With this information, parcel by parcel analysis is completed—at least for those remainders on which there has been some activity since freeway construction. Those which have not sold or have not been developed, are held for continuous future checks until they either become active and can be studied, or are inactive for so long that meaningful comparisons can no longer be made. Once on such a continuous basis, the program virtually assures the relatively early availability of the mass of remainder parcel data needed for realistic theory testing.

As valuable as these overall data evaluations will be, however, it is in the specific case-by-case comparison where this approach will develop its full, working potential. At this level, appraisers are seeking first of all not to find what *properties* are apt to do, but how well a *particular property* is likely to fare, and remainder parcel cases are uniquely suited to directly provide the answers. Thus the pinpointing of effects in a manner that will satisfy the property owner that his individual problem and parcel are receiving the full, factual measure of consideration, becomes the worthwhile promise this new era of analysis can continuously offer.

Survey Shows Cars Move At Faster Pace

Sacramento, December 30—Continuing a post-World War II trend, motor vehicles traveling state highways in California are moving at an appreciably faster pace in 1960 than they did in 1958, the Division of Highways reported today on the basis of a recent survey.

On the open road, average speeds of all vehicles increased 1.7 miles an hour from 52.8 in 1958 to 54.5 in 1960. Passenger cars on the average speeded up from 54.1 miles an hour to 55.7, two-axle trucks from 48.0 to 49.8 and three and more axle trucks and combinations from 47.0 to 48.6 miles an hour. Average speed of buses went up from 56.1 to 56.5 miles an hour.

Increase in the average speed of passenger cars on two-lane roads was 1.5 miles an hour (from 52.6 to 54.1) and on freeways 1.9 miles an hour (from 55.5 to 57.4).

The surveys were made in October of both years. In 1960, a total of 50,016 individual observations were made of the speed of traffic at 146 selected locations. The observations were made in hours of daylight during periods of clear and dry weather and free-flowing traffic conditions. The selected locations were on straight roads in areas away from the influences of speed zones, roadside developments and other physical controls which might affect the speed of traffic.

It was noted from previous years studies that except for 1958, speeds have risen at a fairly uniform rate during the post-war years. The average speed reported in November 1945 was 45 miles an hour.

BPR Revises Manual On Traffic Devices

New national standards for traffic signals, signs and markings have been approved by the Bureau of Public Roads, U.S. Department of Commerce.

The new standards are to be found in a revised manual drafted by the National Joint Committee on Uniform Traffic Control Devices. The committee is made up of representatives of the American Association of State Highway Officials, the Institute of Traffic Engineers, the National Committee on Uniform Traffic Laws and Ordinances, the American Municipal Association, and the National Association of County Officials.

G. M. Webb, Traffic Engineer of the California Division of Highways, is a member of the national joint committee. He has also served as chairman of its subcommittee on markings and as a member of its subcommittee on signs.

First written in 1936, the manual has been revised periodically since that time. The newest edition includes for the first time specific standards for expressway signing, a major section on signing and marking for construction and maintenance operations, and a brief treatment of civil defense signing.

"As a matter of policy the Bureau of Public Roads proposes to use its authority to approve, for the Federal-aid highway systems, only such traffic control devices as will conform to the new manual," a BPR announcement said. A reasonable time following the issuance of the revised standards will, of course, be allowed for the gradual replacement of any existing installations that may be made obsolete by the new manual.

Copies of the manual will be available from the Government Printing Office for general distribution in 1961. Publication details have not been announced.

Culvert Life

New Test Methods Estimate Life Expectancy of Pipe

By JOHN L. BEATON, Supervising Highway Engineer and
RICHARD F. STRATFULL, Associate Materials and Research Engineer

Many types of materials have been used for the small structures needed to carry water beneath highways and railroads. Such materials as wood, brick, stone, glazed and unglazed clay pipe, cast iron and steel pipe have been used for over a century. In recent years, however, the majority of the culverts under State Highways have been constructed from either concrete or corrugated metal pipe.

The use of metal for culverts has both advantages and disadvantages. The modern corrugated types are relatively light to handle and offer a degree of flexibility over yielding foundations. (Note right photo in Figure I.)

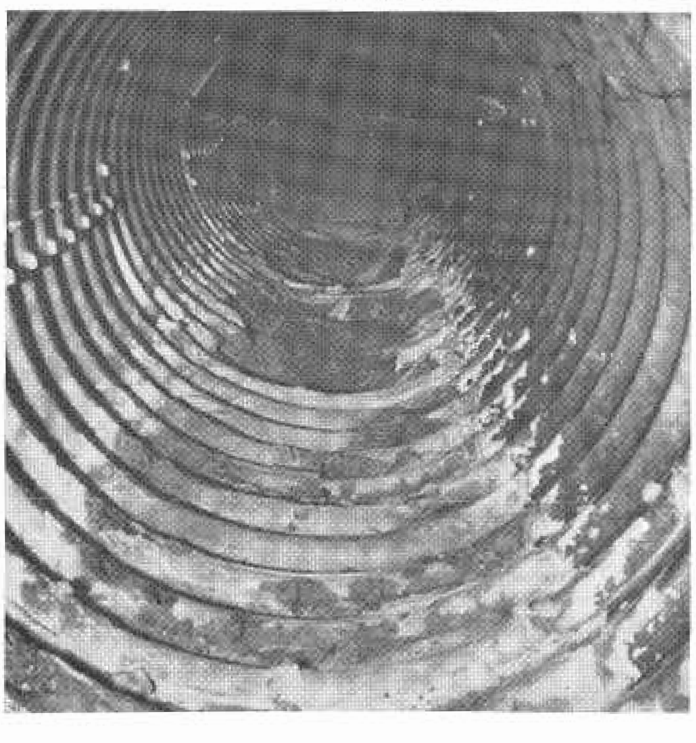
However, all steels and iron presently used in corrugated metal pipe production are subject to attack from ground water or atmospheric elements, and it has been obvious for many years that there is a considerable variation, as illustrated by Figure I, in the life of metal culverts. Studies show this variation to be caused primarily by environment. Up to recent times, however, no objective means has been available for evaluating a proposed culvert site insofar as the environment may affect the service life of a metal culvert.

Culvert Replacement

Since the replacement of a culvert can be expensive and also can seriously disrupt traffic service, it is important that the designer have as much pertinent preliminary information as can be obtained within limits of reasonable cost and time, so as to determine whether (1) plain galvanized steel pipe will have a service life commensurate with that of the alignment, (2) protective measures might be desirable, or (3) structures of other materials should be used. He has available fairly adequate hydraulic and foundation data; however, knowledge concerning the effect of environmental factors on the life of culvert material heretofore has been incomplete.

As a result of studies and investigations at various periods during the past 35 years, the Materials and Research Department has evaluated a total of more than 12,000 corrugated metal culverts in the State of California. In general, these various culvert research projects have led to the conclusion that the best criterion for estimating the life of a metal culvert in a particular location is the service life of an existing pipe. However, not all new highways are constructed in locations where metal pipes have been in place for a sufficient length of time to be used for this purpose. With the increasing rate of highway construction in new locations, it is obvious that there is a need for a comparative test method that will evaluate the relative aggressiveness of the environment sur-

FIGURE 1. Two corrugated metal pipe culverts, each 30 years old but in different locations. The pipe at the left was subject to corrosive flow which has removed the invert. The pipe at the right was installed in an area which is relatively non-corrosive.



rounding a culvert site prior to the placement of the pipe.

Any such method must, of course, take into account the environmental factors that cause or influence corrosion. A test method based on such factors is now in use by the Division of Highways.

Causes of Corrosion

In the most simple terms the cause of corrosion of metal culverts is moisture. However, the presence of moisture does not necessarily imply that the corrosion will be rapid, as the rate of corrosion depends upon the frequency with which moisture contacts the culvert. Corrosion is also influenced by the types and quantities of aggressive salts in the waters.

In a 1925 study by the Materials and Research Department it was found that when the average annual rainfall increased from 10 to 80 inches per year, the average life of metal culverts decreased by about 65%. One of the results of this study was an indication that the magnitude of the annual rainfall could be used to predict the corrosion rate. However, it was also observed that in areas of equal rainfall there were extreme differences in the rates of corrosion of individual culverts. It was apparent that factors other than relative amounts of rainfall were involved and needed to be investigated.

During a 1955 investigation in the northwestern section of the state, it was observed that when a certain type of soil bacteria was found at a culvert location the corrosion rate of the culvert was rapid. The presence of these bacteria was indicated by hydrogen sulfide gas in the soil. However, among other variables the propagation of these bacteria required that the soil be relatively flooded with moisture so as to restrict the ingress of air. It is therefore apparent that the presence of anaerobic bacteria is limited to areas of high rainfall or ponded water conditions and is of minor importance in many geographic areas of the State.

Influence of Salts

There are numerous kinds of salts in soils or water which can affect the corrosion rate of culverts. For instance, it is well known that the salts

Bituminous-coated corrugated metal pipe is inspected prior to shipment.

in sea water will result in rapid corrosion of steel. Also, the salts in "alkali" soils, effluents from mines, and numerous other sources are highly corrosive to common iron and steels.

With these corrosive salts present, and other conditions being equal, the corrosion of steel will generally vary as the concentration of the salts. Normally, the greater the concentration of "salts" the more rapid the corrosion rate. This rapid corrosion rate is the result of two factors: (1) the influence of the chemicals in causing the steel to "dissolve" or corrode and (2) the flow of electricity which accompanies the "dissolving action" or corrosion of the steel. Thus the corrosion rate is influenced by the rate of flow of electrical current as well as by the presence of salts or other chemical compounds conducive to corrosion. A large electrical current will result in a rapid corrosion rate. For instance, a flow of one ampere of direct current can cause about 20 pounds of steel to corrode each year. It is therefore apparent that the electrical resistance of the soil or water is a factor bearing on the probable rate of corrosion; a low resistance indicates rapid corrosion and a high resistance indicates a reduced rate of corrosion.

The electrical resistivity of a soil or water is also a rough indicator of the concentration of salts in a soil. The lower the electrical resistivity the higher the concentration of salts. For example, sea water has a resistivity of about 50 ohm centimeter, "alkali" soils range from about 10 to 200 ohm cm and a clean sand is about 10,000 ohm cm. An "alkali" soil is one which is generally alkaline, i.e., having a pH greater than 7.0, and contains considerable quantities of exchangeable sodium or potassium salts. An "alkali" soil is considered to be corrosive, but an alkaline soil may or may not be corrosive. (Alkaline merely indicates that the soil has a pH number that is greater than 7.0.)

Influence of pH

In this study it was observed that when the average annual rainfall increased, the hydrogen-ion concentration or pH of the soil decreased toward the acidic range. A pH of less than 7.0 is acid and a pH of more than 7.0 is considered alkaline.) It is generally considered that, with other conditions being equal, the corrosion of steel is more rapid in an acid than in an alkaline solution. Therefore, the general tendency is for the corrosion rate of metal culverts to increase with increasing rainfall. This apparent relationship between rainfall and corrosion was observed when 5000 metal culverts were evaluated by this department in 1925.

However, not all soils that are in areas of the same rainfall will have the same pH or soluble salt content because the drainage, vegetation and usage of all soils are variable. It is therefore readily apparent that the actual value required for estimating culvert life is that of soil pH and not necessarily rainfall. The measured soil pH is a value which is the result of the variables affecting the land in a particular location, while rainfall can only be indicative of an over-all average condition.

Corrosion of Culverts

From the preceding it is apparent that the factors which exert the greatest influence on the corrosion rate of metal culverts are pH and resistivity. With the same pH, the corrosion rate would increase as the electrical resistance decreased. Or, in a very general way, with a soil or water of the same acidity or alkalinity, the rate of corrosion would increase as the salt content increased. For the purpose of discussion we are assuming that resistivity is an indicator of salt content. A low resistance is inferred to represent a high salt concentration.

The relative influence of pH and resistivity on the corrosion rate of metal culverts is shown by Figure 2, which is drawn from field data accumulated throughout the State. On Figure 2 there are three variables: the time to perforation by corrosion of 16 gage C.M.P., the electrical resistivity, and the pH or hydrogen-ion concentration of the soils or waters.

On Figure 2 it will be noted that with a constant acid pH of 5.0 the time to perforation of a 16 gage metal culvert in 100 ohm cm soil would be less than 5 years. However, in an acid soil of pH 5.0 and a 5000 ohm cm resistivity, the time will be about 20 years. With an alkaline pH held constant at 7.5, the perforation time with a 100 ohm cm soil or water would be about 10 years, and at 5000 ohm cm the years to perforation would be about 55 years.

Sample Assumed Identical

With any such tests there will be differences between the culvert life as estimated from a soil or water sample and the actual life. One reason is that the sample that is obtained is assumed to be identical for the total time that the culvert has been in place, whereas it may or may not have been. Another reason is that a test method cannot include all of the many variables that can affect the corrosion rate. Some of these variables ignored in this proposed test are the dimensions of the pipe, frequency of flow, bacteria, vegetation, land use and the possible change in land usage. Even though these variable have not been included at this time, a statistical analysis indicates that the use of Figure 2 for estimating the years to perforation of 16 gage galvanized metal culverts should give indications within 12 years of the actual field life. Therefore, it is felt that this method is a useful tool for estimating service life at the present time.

The corrosion rate of metal culverts is described as the time to perforation for 16 gage galvanized culverts. The perforation time for a culvert with a metal thickness of a different gage is obtained by direct ratio. A metal with twice the thickness of 16 gage is assumed to last twice as long. It should be understood that the estimated years-to-perforation of a metal culvert does not necessarily mean that the culvert will then collapse or that its usefulness as a carrier of flow will cease. Instead, this period of years-to-perforation is considered as a common yardstick for all culverts. It is not considered that the arching action or erosion resistance of a fill is sufficiently substantial to warrant the disregarding of a perforation or the loss of a culvert invert, otherwise these factors should be considered in the mechanics of the original design.

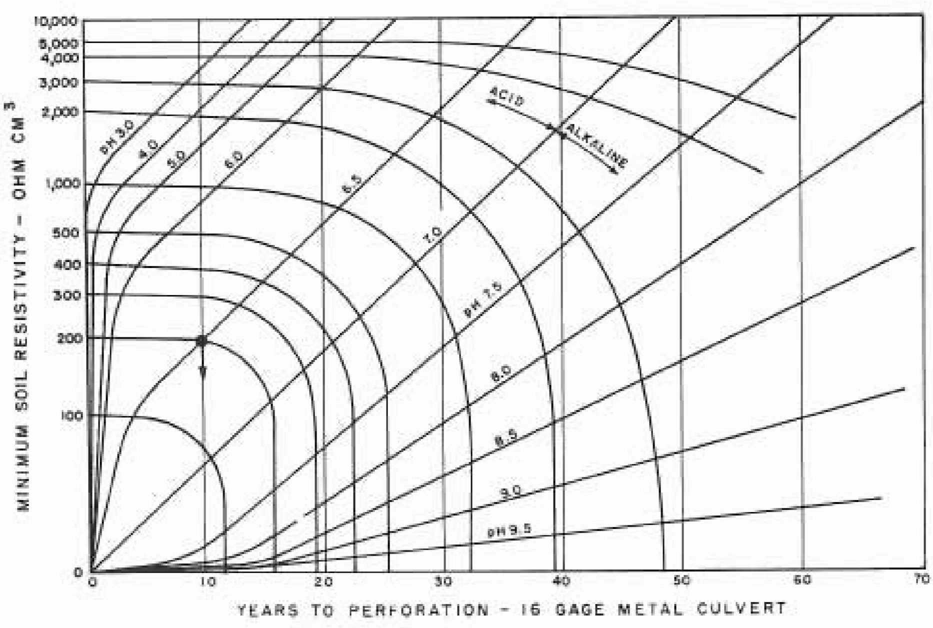
Generally, any laboratory test of this nature is a substitute for field data. Therefore, whenever possible, existing installations should be inspected and be given the greatest weight when considering the life of a metal culvert in a particular location.

Corrosion Test Method

The corrosion potential test method is relatively simple and rapid as the two factors to be obtained are the pH and the resistivity of the soils or waters. Naturally, whenever sampling is required there is a degree of judgment involved in the selection of representative samples.

The selection of the field samples is somewhat aided by the use of two portable instruments, the pH and resistivity meters. In general terms, the use of the pH meter, Figure 3, consists of gathering a small container full of water from a stream, inserting the electrode and pushing a button, or, if the pH of a soil is to be measured, about a tablespoonful of soil is mixed with about a tablespoonful of distilled water and placed in the small container. Then the pH electrode is inserted, and a button is pushed to read the meter. The entire operation of measuring the pH of a soil or water should not take more than 2 or 3 minutes.

As the time to perforation of a culvert depends upon the pH of the



EXAMPLE: Given, pH = 6.5 & Resistivity = 200 ohm cm^3
Then 16 gage CMP perforated in 10 years.
For a culvert metal gage of 12 multiply years by factor below. i.e. 1.8 x 10 = 18 years

Gage	14	12	10	8	6	2	0	000
Factor	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

FIGURE 2. *Chart for estimating metal culvert service life.*

FIGURE 3. *Measuring the pH of a stream which is used for estimating the perforation time of metal culverts.*

FIGURE 5. *Measuring the minimum electrical resistivity of soil at any moisture content. This resistivity value of soil is used for estimating perforation time or metal culverts.*

FIGURE 4. *Measuring the electrical resistivity of a soil in the field which is used for the selection of soils for further analysis.*

environment, sufficient pH measurements should be made to confirm that samples obtained for additional analysis will cover the range of any substantial variations in pH.

In an actual field survey the pH of all streams should be obtained at the site. For soils, either pH measurements or samples should be obtained in locations that differ in characteristics. For instance, samples should be taken or field pH measurements should be made when there are changes from no-vegetation to vegetation, changes in soil types or color changes of the soils, differences in land use, or distinct changes in the kinds of vegetation. These changes in the environment are most significant for the upstream side of a culvert site as it is the drainage water that can cause corrosion of the culvert. Also, samples should be obtained from the stream bed.

Soils May Alter

In many cases changes in the vegetation or color and types of soils may alter gradually over various distances. Therefore, in many instances visual observation of soils may cause a misleading feeling of confidence that a soil has not changed in characteristics. In addition, variations in amounts of corrosive salts in soils are impossible to detect unless they are crystallized on the surface of the ground. Therefore, the extensive use of instruments in the field is suggested.

As the electrical resistivity of soils can be considered as an indicator of the quantity of salts, changes in the salt concentration can be detected with a field instrument. The use of the field resistivity meter (Figure 4) involves thrusting a steel rod into the ground and pushing a button to read the meter. With liberal use of this resistivity meter (it is recommended that the resistivity of soils at each culvert site be measured) a considerable area can be explored to determine where soil samples should be obtained for laboratory analysis.

Samples for laboratory analysis should be those that are significantly different in pH or resistivity. A "significant" difference is dependent upon (1) the average values for the sites in question, and (2) the magnitude of differences from this average that will significantly alter the culvert perforation time as shown on Figue 2.

Essentially, the laboratory analysis of soils (Figure 5) consists of adding water to soils to obtain the minimum resistivity at any moisture content. In addition, the pH of the soils is checked. For metal culverts the pH and resistivity measurements of waters obtained in the field are sufficient for design purposes and laboratory analysis is not necessary and applies only to waters and not to soils.

Pipe Coatings

As the corrosion of metal culverts is the result of aggressive soils or waters coming in direct contact with the steel, a membrane or protective coating that prevents moisture contact will increase the life of the culvert.

Retarding the corrosion of steel by a coating depends not only upon its quality and thickness but also on many variables such as abrasion, soil movement on the backfilled side of the pipe, moisture absorption, chemical stability and weathering. In estimating the additional life of culverts obtained by applying the commonly used asphalt coating on pipes, individual variables are of necessity expressed as an approximate average. This results in a degree of inaccuracy that depends upon the geographic area.

As an extreme illustration, in certain locations the asphalt in the invert of a plain asphalt coated pipe could be abraded by rocks and debris in one winter. Conversely, in low rainfall areas, the plain bituminous coating could remain and protect the culvert invert from corrosion for better than 15 years. Therefore, an estimate of coating life must be tempered by the environmental conditions at the proposed culvert site.

Statewide, the average result of inspecting coated metal culverts indicates that, in areas of frequent flow, a plain bituminous coating may protect the culvert invert from a corrosive flow for about 6 years. In areas where the corrosion is due to the soil backfill, a bituminous coating could add about 25 years to the life of a metal pipe. When a pipe is asphalt dipped and the invert is paved in locations of nearly or fully continuous flow, then it is estimated that this type of coating may add 20 years to the life of the pipe.

The asphalt coating on the majority of the existing pipes inspected during this study was an uncontrolled type of common commercial dip and undoubtedly resulted in erratic service life. The presently specified bituminous dip and lining material is superior in quality to that used formerly and should result in a greater increase in life than is indicated by this study.

Test Method Compared

As an indirect means of verifying this empirical method for comparing the aggressiveness of different soils toward steel, the data on the corrosion rate of steels embedded in soils throughout the United States published by the National Bureau of Standards in Circular 579, titled "Underground Corrosion," were correlated with the results obtained by using Figure 1.

This comparison of results from the test method developed in this study and the data published by the National Bureau of Standards, showed that the relative corrosivity of soils throughout the United States could be determined with a relatively high degree of accuracy.

For instance, if the depth of a corrosion pit in a piece of steel exposed for a number of years in an alkaline soil was used to estimated the weight loss of the same piece of steel, then the data obtained from a correlated Figure 2 would be half as accurate as estimating the weight loss by means of the pit depth. In acid soils the use of a correlated Figure 2 would result in the same approximate accuracy as using pit depth to estimate the weight loss of the same piece of steel.

Whether the measurement of the depth of pitting or the weight loss of steel buried in soils is a true measure of soil corrosivity is a matter of debate. However, the results from using the test method outlined in this study appear to be sufficiently accurate to predict the relative corrosivity of the soils in the United States as reported by the N.B.S. Test Method No. Calif. 643-A has recently been issued to the Districts and covers all test procedures involved in estimating the life of metal culverts. In the future design engineers can select the type of culvert with greater assurance that the economic life will be adequate.

AASHO Test Ends, Data Being Compiled

The initial phase of the biggest highway research project in world history ended November 30, 1960, when trucks rolled to a halt on the AASHO Test Road in Illinois.

The 25-month test was sponsored by the American Association of State Highway Officials to determine relationships between pavement performance and design under various test loads. Operations began in November, 1958.

Research engineers will spend the next several months analyzing some 200 million pieces of collected data and compiling final reports.

Cost of the test, about $27,000,000, was shared by all the states, the federal government, and industry. Field direction was handled by the Highway Research Board.

The eight-mile test road consisted of 836 concrete and asphalt pavement test sections and 18 short span bridges. Army personnel manned the fleet of 126 trucks which traveled some 17,000,000 miles on the test road loops. The trucks were operated 19 hours a day.

The test facility will be rehabilitated and incorporated in U.S. Interstate 80.

Staff Changes

Frank Balfour Retires; Hess, MacBride Promoted

FRANK C. BALFOUR, chief right of way agent for the California Division of Highways, retired February 1 after 30 years of state service.

Rudolf Hess, Assistant Chief Right of Way Agent (Northern California) since September, 1956, has been promoted to succeed Balfour.

The Division also announced the promotion of Dexter D. MacBride, Supervising Right of Way Agent and Balfour's administrative assistant since 1956, to Assistant Chief Right of Way Agent, replacing Hess.

Since 1943, Balfour has headed the Division's right of way department, one of the largest right of way aquisition agencies in the world.

He is recognized nationally as an authority on highway right of way matters and land economics. In the past 18 years he has been responsible for the acquisition of California real estate valued at about one billion dollars.

In 1943 the Division's annual expenditure for rights of way was about $5,000,000. Today, the annual right of way budget is approximately $150,000,000. The right of way department also acquires property for the State Public Works Board and the Department of Water Resources.

RUDOLF HESS

FRANK C. BALFOUR

Under Balfour's direction, California's highway right of way organization has come to be recognized as one of the outstanding of its kind in the country.

It was the first to publish a comprehensive manual setting forth acquisition procedures and the first to initiate an extensive program of in-service training.

As chief right of way agent, Balfour was instrumental in the establishment of the Division of Highways policy which assures the payment of fair market value for property required for highway purposes.

This policy eliminated "horse-trading" from right of way negotiations and insured payments equitable to both the individual property owner and the taxpaying public.

Balfour has constantly emphasized recruitment and development through civil service of trained and experienced right of way personnel

The success of these measures is demonstrated by figures on land acquisition for the 1959-60 fiscal year. Of the 7,052 transactions involving purchase of land parcels, about 98 per cent were negotiated settlements with property owners. Only two per cent were concluded through court proceedings.

Another widely endorsed feature of California's right of way acquisition program, established while Balfour headed the department, is the revolving fund for the advance purchase of rights of way.

The 1952 Legislature authorized this fund for the early purchase of property on which costly improvements are planned. Money paid out of the fund is later returned at the time when right of acquisition would normally be undertaken.

In the eight years since the fund was established, savings of more than $200,000,000 have resulted.

Pioneered under Balfour's direction were studies on the economic effect of freeways on communities. These studies have been used as guides in California and throughout the country.

Balfour is the founder and presently executive vice chairman of the American Right of Way Association. After

. . . Continued on page 79

DEXTER D. MacBRIDE

C.T.B.*

Improved Spreading Devices, Control Methods Speed Work

By L. D. WANEE, Assistant Construction Engineer

THE USE of cement treated bases (CTB) in the construction of highways in California became an accepted practice for certain traffic and economic conditions in 1938. Initially, plant mixing was specified to assure accurate control of the ingredient proportions and some of the results were excellent. One of these early highway projects utilizing aggregate similar to that used in concrete remained in excellent condition for more than 15 years, carrying traffic loads far beyond those originally estimated.

Classes of Bases

California currently uses four classes of cement treated bases. These are listed, with their principal characteristics, in the accompanying tabulation:

Note: See "Review of Cement Treated Bases in California" by Carl Alzueta, published in the May-June 1955 issue of *California Highways and Public Works.*

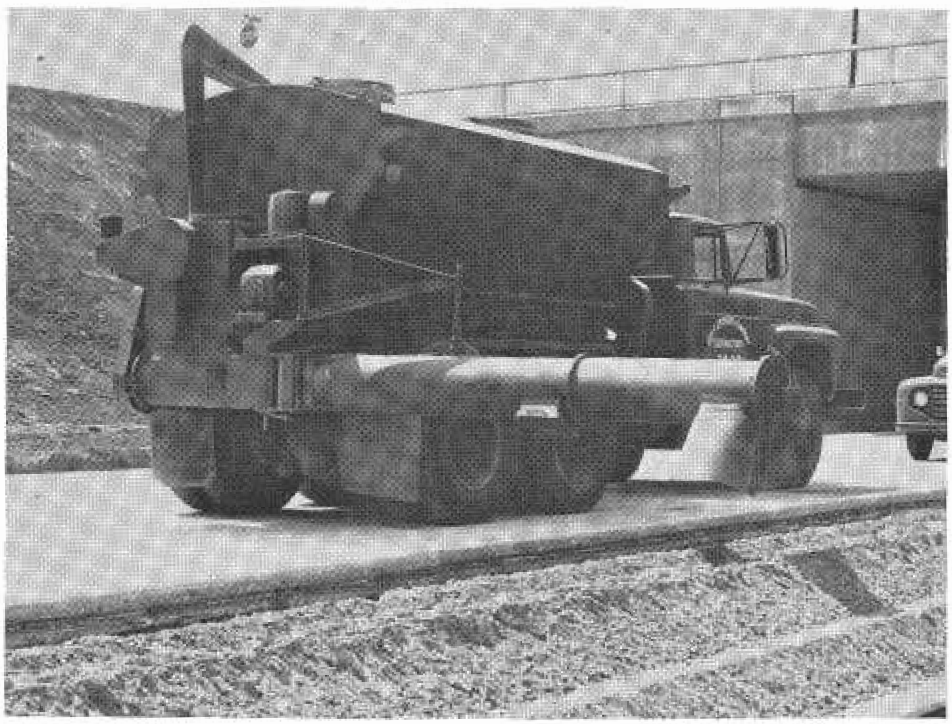
Mixing Methods

Over the years the development of efficient road-mixing methods which materially reduced costs led to specifications which permitted the contractor to use either plant-mix or road-mix methods. For economic reasons, almost all cement treated bases have since been road mixed, and results were, until recently, considered satisfactory except in a few cases.

With such wide application of road-mixing methods, various kinds of road mixers in use for road-mixed bituminous surfacing were adapted and developed for cement treatment, some of which mixed the cement and water with the aggregate which had been spread to grade and cross section on the roadbed. However, this latter type of mixer was not always op-

* Cement-Treated Base.

Sizing windrow of mineral aggregate for road-mixed cement-treated base operation. California requires that the quantity of material in windrows shall not vary more than 5 percent from that specified.



A cement spreader truck. This type of equipment can easily deposit cement within the tolerance allowed by California's 1960 Standard Specifications. (Above photos by Pettibone Wood Mfg. Co.)

QUALITY OF AGGREGATE

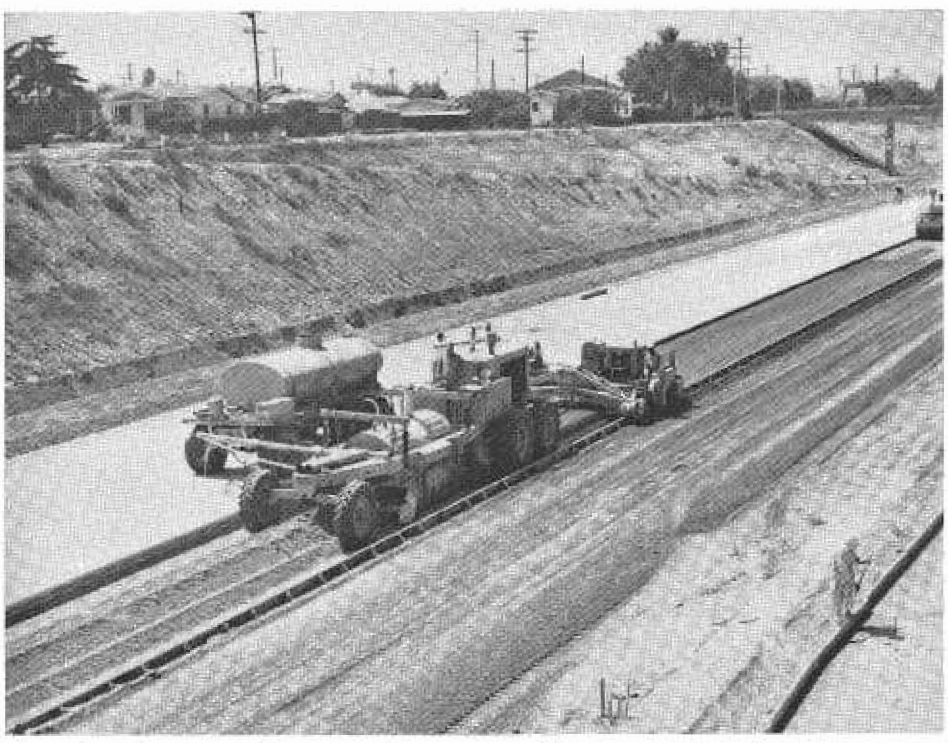
CTB[*] class	Amount of cement	Size	Sand equivalent	When mixed with specified amount of cement, compressive strength required: Cement	7-day compressive strength	Resistance value
A	3.5 to 6%	¾" max. or as specified	25 min.	5% max.	750 psi	not specified
B	2.5 to 4.5%	¾" max. or as specified	not specified	4% max.	400 psi	not specified
C	2 to 3%	¾" max. or as specified	not specified	2.5% max.	not specified	80 min.*
D	specified for each project	Aggregate for Class D consists of material already in place on the roadbed.				

* Aggregate for Class C CTB must have an R-value of not less than 65 before mixing with cement.

* Cement treated base.

erated properly to obtain the full thickness specified, nor did it always disperse and mix the cement uniformly throughout the treated base both to the full depth specified and laterally. This deficiency was indicated by a wide variation in the strength of compressive test samples taken from various locations on the roadbed and pointed out the need for a quick way to field test cement distribution immediately after mixing.

Recognizing this need, the Materials and Research Department investigated and developed an "Acid-Base Titration Method" for determining the cement content in a sample. (See "Cement Test" in the November-December, 1959, issue of *California Highways and Public Works.*) This test has proved satisfactory and has emphasized the need for better control of cement distribution in road-mix methods, and more thorough mixing in some cases which involved certain mixing machines.



The road-mixed cement-treated base operation uses a pugmill-type mixer and operates between sideforms set for concrete pavement 12 feet wide. (Photo by Pettibone Wood Mfg. Co.)

As a further result of tests and measurements of thicknesses of constructed bases, it was evident that the better control possibilities offered by plant-mix methods warranted the specifying of plant mix for certain main-line highways designed with cement treated base. Today about 10 percent of our bases are constructed using plant-mix methods.

Specification Changes

The 1954 Standard Specifications were not specific as to tolerances relating to variation in cement content, uniformity of the mixture and thickness of the completed base. The 1960 Standard Specifications require that the cement content in the completed mixture shall not vary more than 0.4 of a percentage point from that specified by the engineer in the case of plant-mixed bases. This tolerance is increased to 0.6 of a percentage point for road-mixed bases. These tolerances were selected as being the acceptable limits after studying that which could economically be obtained using the best of the present mixing methods. At the same time, the need for better control in spreading or introducing the cement into road-mixed CTB was recognized as a major factor in control and some progress has been made in improving spreading devices.

The 1960 Specifications for plant-mixed cement treated base are more complete than the 1954 Specifications, particularly for continuous-mix plants. The requirements are now the same for continuous-mix asphalt concrete plants and cement treated base plants except for a few details. Provision for checking rate of aggregate and cement feed without interruption of plant operation, except momentarily, is now required.

Aggregate Supply

As California's highway program expands, economical sources of good mineral aggregates for highway construction continue to diminish. Since cement treatment can be used to make many otherwise unacceptable aggregates satisfactory for bases, it seems certain that cement treatment will become even more important as times goes on. Expanded use of fine aggregates for treated bases may also result. Although some difficulty, due to low shear strength, has been encountered in the use of aggregates such as sand or silty sand used for Class C cement treated bases, the problem appears to be largely related to the surface texture of the base. Finishing such a base by the usual methods results in a smooth surface texture which, in some cases, allows the bituminous surfacing to slip under traffic loads, particularly where motor vehicles must slow down or stop. Preferred practice is to add the maximum amount of cement specified for Class C and roughen the surface when finishing the base.

Equipment in Use

The most popular type of mixer used in road-mixing cement treated base is a continuous-mix pugmill, partly enclosed in a cylindrical shell, which takes the material from a windrow, elevates it only over the bottom pan of the mixing chamber, introduces the water and mixes the ingredients as the machine advances. The material is deposited in a windrow then flattened with a spreader at the rear of the machine.

Another type of road mixer commonly used is a continuous-mix pugmill mixer which lifts the windrowed material completely off the subgrade to an elevated mixing box, adds water and cement, mixes the materials and deposits the mixture in a windrow behind the machine.

Three types of mixers used in the past, which mixed the cement with aggregate which had been spread on the roadbed to the required grade and thickness, although of large capacity, appear to require major modification before they can be made to produce a cement treated base which will meet the requirements of the 1960 Specifications.

Cement spreaders, used widely in past years for depositing cement on the windrows preparatory to road-mixing, have generally been unable to spread uniformly due to operation under a variable head of cement as the vehicle is emptied. This difficulty has been largely overcome by improved equipment which spreads the cement from a feed hopper through which cement is constantly recirculated so as to maintain a constant head above the spreading augers. Cement spreaders using this principle are capable of easily spreading within the 5 percent tolerance allowed by the 1960 Specifications.

Spreading requirements for bases after mixing are much more specific than formerly, with methods in general specified and tolerances given. All classes of cement treated bases must be placed and completed within two hours after mixing.

Plant-mixed bases must be spread with self-propelled spreading devices that spread a lane width to the desired thickness ready for compaction. The use of motor graders, except for final trimming, is not permitted. The finished base must be within 0.05 feet of the required thickness.

Road-mixed bases may be spread with any device which will place the material to the required width and thickness. A variation of not more than 0.05 foot from the specified thickness is also required for road-mixed bases.

CTB Under Concrete Pavement

California uses cement treated base 0.33 foot thick under all portland cement concrete pavements, primarily to prevent pumping and development of "rocking" slabs. This base was formerly termed "cement treated subgrade."

Apparatus used for obtaining cores of completed pavement and bases to measure thickness and test the quality of materials.

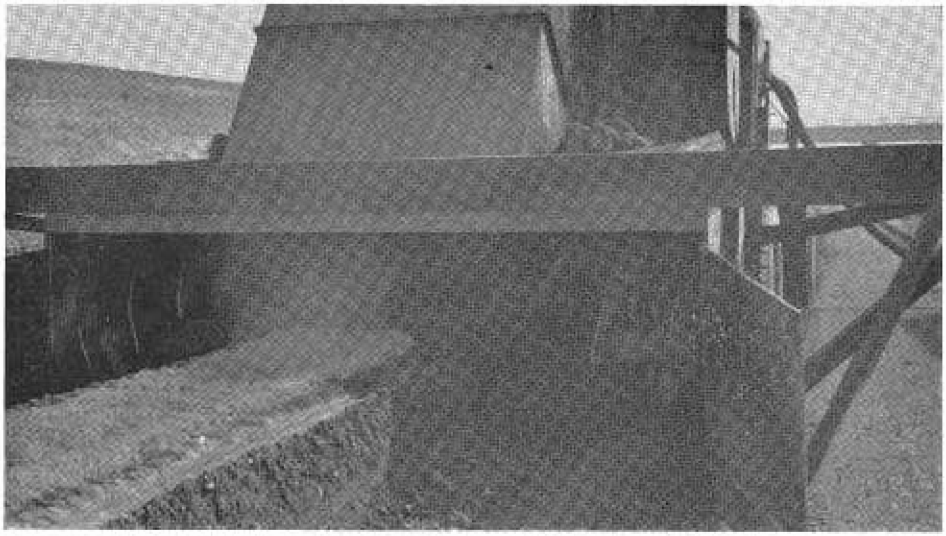
Recent developments in concrete paving methods, such as paving 24 feet wide in one operation in lieu of 12 feet, and the use of the slip-form method which eliminates the necessity for setting side forms, have caused further changes in the underlying cement treated base operations.

One contractor, in changing over to 24-foot width formed paving, constructed a composite side form 20 feet long and 12 inches in depth by bolting two 10-foot metal side forms on top of a 4" x 12" x 20' plank. His purposes were to assure more rigid side forms and to speed up form-setting operations. Then, instead of road-mixing, the CTB was plant-mixed in a continuous-mix central plant and spread with an asphalt paving machine. The cut to final grade was made by a subgrader riding on the side forms.

In the case of slip-form paving, the need for finishing the road-mixed CTB to the close tolerances required to assure that the completed pavement is satisfactory as to grade and cross section has created a problem. In this method of paving there are no side forms from which a machine can be operated to accurately cut the CTB to final grade and from which the subgrade can be tested for accuracy. Motor graders equipped with automatic blade control, a road grader using a variation of the land plane principle, and a self-propelled subgrading machine which is controlled at each side from taut piano wire guides, are being used with moderate success. The adaption of the long wheel-base subgrader which can operate off a taut piano wire set to grade appears also to be a possible solution.

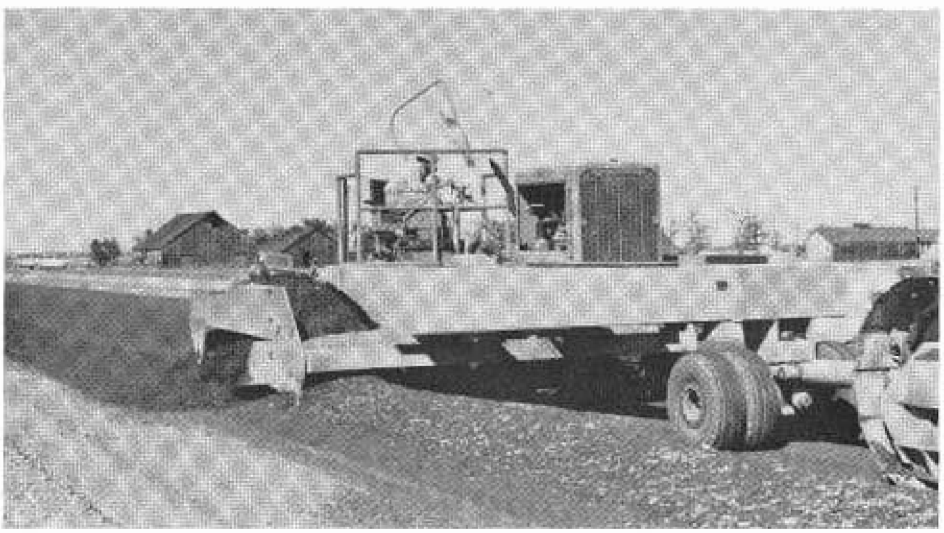
Field Control

To assure uniform quantity, untreated aggregate for Classes A, B and C road-mixed cement treated base must be deposited upon the roadbed through a spreader box which will deposit the material within 5 percent of the rate required to provide the specified width and thickness. Windrows are spot-checked as necessary to assure that the tolerance is complied with. It is not adequate to check the material



Front view of the custom-built, cement-treated base road mixer. This machine picks up a windrow of material containing approximately 12 cubic feet per foot (loose) and mixes it in a continuous-type pugmill mixer.

A rear view of the custom-built, cement-treated base mixer shown above.



A land-plane type grader finishes the cement-treated base in advance of slip-form concrete paving operations.

per 100 feet of windrow. Much smaller increments must be used.

Cement must be spread in such a manner that the rate will not vary more than 10 percent from that designated. As with checking the quantity of aggregate in the windrow, the cement spread must be checked in small increments at various locations to assure that the spread is uniform as well as correct in amount.

If the aggregate and cement are deposited on the roadbed within the tolerances specified, and road-mixing is complete and uniform, it is not difficult to conform to the 0.6 percentage point requirement when the completed mixture is tested for cement content. For example, if 3.0 percent cement is specified, the acid-base titration test (Test Method No. Calif. 338) must show variations in the cement content within a range of 2.4 percent to 3.6 percent to be acceptable. This is a 20 percent variation, which may seem large, but prior to the use of the 1960 Specifications, variations of more than this were found in some cases. Subsequent study determined that the 0.6 point tolerance is practical and will assure acceptable bases.

In the past, variations in thicknesses of bases beyond that contemplated in design were found on some projects. This led to the tolerance of 0.05 foot now allowed by the 1960 Specifications. Frequent measurements of the compacted material through holes dug to the bottom of the base are necessary to assure compliance.

All cement treated bases must be completed through final compaction after trimming within two hours after the water has been added to the aggregate and cement in the mixing operations.

In the case of plant-mixed cement treated base, control of the correct proportioning of the aggregate, cement and water, is, of course, maintained at the plant. The variation in cement content is 0.4 of a percentage point instead of the 0.6 allowed in road-mix because a better product is desired and such accuracy is practicable to attain through proper plant operations.

The thickness of the uncompacted base, as well as the thickness of the compacted base, is frequently checked by direct measurement in holes dug through the base. Since the base must be spread with a self-propelled spreading device, in most materials, once the ratio of compacted to uncompacted thickness has been determined, the compacted thickness may be predicated fairly accurately from measurement of the loose thickness.

Cement treated bases after 22 years of extensive use continue to serve well and no economical substitute has been found to replace this type of construction under the conditions used in California. The nearest substitute is the new Class 1 Aggregate Base described in the 1960 Standard Specifications. This is a well-graded, high-quality aggregate containing 80 percent to 90 percent crushed material. So far there has been only limited use made of Class 1, but in certain localities it may be used economically and may become a limited substitute for Class A cement treated base.

Placing plant-mixed cement-treated base using paving machines. With this method the thickness tolerance of .05 feet can easily be met and it reduces to a minimum the amount of finishing equipment required.

A table showing unit bids on representative projects is presented to illustrate present price ranges on typical projects.

REPRESENTATIVE UNIT BIDS ON RECENT PROJECTS

Approximate location nearest city or town	Cement Treated Base							Pavement type and thickness (feet)	Class of CTB
	County	Thickness (feet)	Mix method	Quantity sq. yds.	Unit price	Cement bbls.	Unit price		
1954 SPECIFICATION PROJECTS									
1. Dunsmuir	Siskiyou	0.33	Road	85,000	$0.22	2,930	$6.00	0.67 PCC	CTS
2. Castella	Siskiyou	0.67	Plant	96,000	0.26	6,500	5.00	0.33 PMS	B
3. Davis	Yolo	0.33	Road	128,000	0.25	7,700	4.00	0.67 PCC	CTS
4. Vallejo	Solano	0.67	Plant	114,250	0.40	8,470	4.50	0.33 PMS & 0.06 OG-PMS	B
5. Monterey	Monterey	0.50	Plant	33,000	0.40	1,855	4.30	0.25 PMS & 0.06 OG-PMS	B
1960 SPECIFICATION PROJECTS									
6. McKittrick	Kern	0.50	Road	36,300	0.11	2,400	5.40	0.25 AC	D
				Aggregate tons					
7. Los Angeles	Los Angeles	0.33	Road	47,400	2.40	2,100	3.90	0.67 PCC	B
8. Sunnyvale	Santa Clara	0.67	Road	12,000	2.85	3,350	4.00	0.25 AC	A & B
9. Lodi	San Joaquin	0.83	Plant	11,000	4.00	5,900	4.70	0.33 AC & 0.06 OG-AC	A
10. Van Nuys	Los Angeles	0.67	Plant	43,700	3.50			0.33 AC	B
		0.33	Road	31,900	3.15	115,300	4.00	0.75 PCC	A
		0.33	Road	31,700	3.15			0.67 PCC	B
11. Beaumont	Riverside	0.33	Road	32,800	2.20	92,000	3.40	0.75 PCC	A
		0.33	Road	37,100	1.80			0.67 PCC	B
12. Creston	San Luis Obispo	0.50	Road	16,900	1.25	1,800	5.00	0.25 AC	C
13. Fortuna	Humboldt	0.67	Plant	62,500	3.00	14,000	5.00	0.30 AC & 0.05 OG-AC	A & B

Abbreviations:
PCC—Portland cement concrete.
PMS—Plant-mixed surfacing (now termed asphalt concrete).
CTB—Cement treated base.
CTS—Cement treated subbase.
OG-PMS—Open graded PMS.
AC—Asphalt concrete.
OG-AC—Open graded AC.

Two F.A.S. Jobs

San Bernardino County Adds 4 Important Miles

By MARTIN A. NICHOLAS, County Engineer

WHILE general public attention has been focused upon the State's freeway construction program in the San Bernardino-Riverside area, the counties have been busily engaged in planning and constructing major arterials which complement the freeway system.

San Bernardino County has recently completed two major Federal-aid Secondary projects providing additional important traffic service in the San Bernardino valley. One of these projects consisted of widening 2¼ miles of Riverside Avenue (FAS 707) south of the City of Rialto and the other was the widening of Barton Road and Washington Street (FAS 714) for a total length of 1¾ miles between the Riverside Freeway and Waterman Avenue.

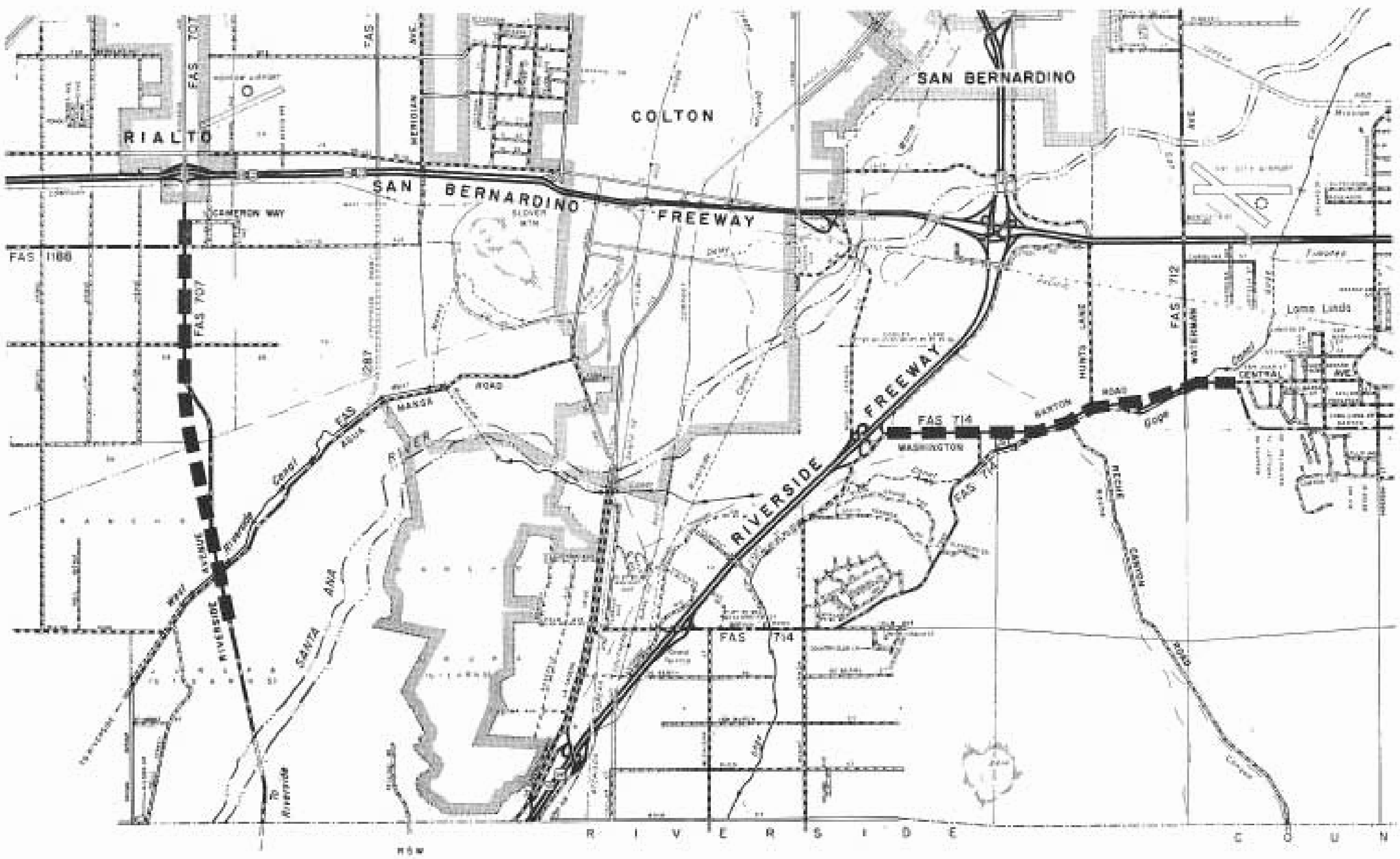
The following discussion of the planning and construction highlights on these projects illustrates the comprehensive planning and engineering work performed by the County in carrying on the Federal-aid Secondary Program.

Riverside Avenue

Studies of Riverside Avenue were begun in 1957 because of the low sufficiency rating reflecting approaching inadequate traffic capacity, the construction of an interchange with the San Bernardino Freeway, and general interest developing in the establishment of heavy service industries south of the City of Rialto.

The opening of the Riverside Avenue interchange involved the closing of the Meridian Avenue intersection at grade with the San Bernardino Freeway. Since Meridian had served as the principal access to the freeway for the California Portland Cement Company rigs, the closing was certain to create additional traffic on Riverside Avenue.

In estimating future traffic volumes, it was found that trend traffic (the normal growth on a particular route) and development traffic (the increase which would be generated by vicinity development) would create a demand of 21,000 vehicles per day by 1979, with an unusually high percentage of these vehicles being trucks. As esti-



The two projects discussed in this article are shown in the above map by the heavy dash lines.

mated in 1957, Riverside Avenue (then carrying 4,000 vehicles per day) would become critically deficient within the next five years.

Riverside Avenue functions as a prime local through arterial between the Cities of Riverside and Rialto, which areas are expanding rapidly. It is the principal north-south street in the City of Rialto extending northerly to connect to the Devore Cutoff and serves as an important link southerly to the central business district of the City of Riverside. It also has advantageous connections to the three east-west State highways on the north, the San Bernardino Freeway, Foothill Boulevard and Highland Avenue.

Phase Construction Planned

Study of such factors as traffic, costs, financing, and Riverside City and County advance planning problems led to the decision that the route improvement should be planned as phase construction. It was evident that reconstruction from Cameron Way south to Agua Mansa Road would logically be the first phase. Here, the greatest immediate need was indicated by higher traffic densities and expanding industry.

The second phase, from Agua Mansa Road south to the Riverside County Line, will require bridging the Santa Ana River, for which the precise alignment of the channel has not been fixed. It was apparent that second-phase improvement would not be necessary or possible until sometime in the future.

Cost consideration was the factor which influenced the decision to design and construct a four-lane highway with only a four-foot painted median. Acquisition of additional right of way for a fully divided facility would have increased the cost beyond the funds available.

Reversing curves north of Agua Mansa Road were eliminated and replaced by a 6,000-foot radius curve on new alignment.

The entrance to the Service Rock Company, which angled into the intersection of Riverside Avenue and Agua Mansa Road on the northwest quadrant forming a five-way intersection, was relocated westerly to connect directly to Agua Mansa.

The Riverside Avenue F.A.S. project looking from above the San Bernardino Freeway south toward Riverside.

The Washington Street-Barton Road project constructed by San Bernardino County under the F.A.S. Highway Program. The view is northeastward with the Riverside Freeway interchange in the foreground.

The West Riverside Canal Crossing under Riverside Avenue, paralleling Agua Mansa Road on the north side, was bridged with reinforced concrete slabs supported by concrete walls.

Barton Road—Washington Street

Simultaneously with the studies of Riverside Avenue the county planners were considering Barton Road and its Washington Street connection to the new Riverside Freeway.

Barton Road, although improved in 1949 under an F.A.S. project to a high standard two-lane highway, was carrying 9,000 vehicles per day in 1957, maximum capacity for such a facility. The route is expected to be carrying approximately 12,000 vehicles in 1961 and 21,000 vehicles in 1981. The 1981 volumes can be compared to the existing traffic on US 99 between the Riverside Freeway and the City of Redlands.

The Washington Street-Barton Road Highway lies in a strategic location immediately south of the City of San Bernardino and east of Colton, an area having an almost assurred potential for a transition from agriculture to residential, commercial and industrial development. Functionally, it is a multipurpose arterial highway carrying traffic between the cities and communities of Riverside, Highgrove, Grand Terrace, Colton, San Bernardino, Loma Linda, Bryn Mawr and Redland. It provides convenient connections to the Riverside Freeway and the San Bernardino Freeway, and access to the important north-south principal streets which lead to the business and commercial districts of Colton and San Bernardino as well as a major employment center, Norton Air Force Base.

High Right-of-way Cost

Although the 20-year traffic projection indicated that it would be desirable to construct a four-lane physically divided highway the entire length of the project, an analysis of the expense involved in acquiring additional right of way and moving the many homes along Washington Street revealed that the cost would be prohibitive. Consequently, a four-lane curbed highway with a four-foot painted median was selected as a compromise for Washington Street. For Barton Road between Washington Street and Waterman Avenue where right of way was reasonable in cost and could be easily acquired, a fully divided four-lane highway was designed and constructed. It is of importance that this portion of the project can be widened to six lanes by reducing the 46-foot median to 22 feet when the additional capacity is required in the future.

The eastern end of the Barton Road F.A.S. project in San Bernardino County. Waterman Avenue intersection is in the center.

In the treatment of the final portion of the route from Waterman Avenue to Central Avenue, there is a difference in elevation of the eastbound and westbound roadways designed to preserve access to abutting properties.

To provide a smooth flowing free right turn from westbound on Barton Road to northbound on Waterman Avenue, it was necessary to acquire considerable right of way, including a residence and outbuildings and to bridge a portion of the Gage Canal Company main waterway for a distance of approximately 300 feet.

Crosses a Canal

The canal crossing diagonally under Barton Road at Waterman Avenue presented a problem. A reinforced concrete cover was designed for the canal, supported by piling. An unusual construction feature of this installation was the use of concrete piling cast in place. Since the canal was concrete-lined and covered with only a lightly reinforced concrete arch, this type of piling was chosen because it could be placed without the damaging vibration which usually accompanies driven piling. It was incumbent on the County to perform the work without rupturing the canal lining or interrupting service.

High standard channelized intersections were built on Barton Road at Washington Street, Reche Canyon, Hunts Lane and Waterman Avenue to minimize the hazard of high-volume conflicting movements. The islands were curbed and paved inside to provide better visibility and less maintenance.

Traffic signals and safety lighting were installed at the major intersection of Barton Road and Waterman Avenue. Three-phase traffic-actuated signals were specified to handle the unbalanced movements assuring minimum delay and maximum efficiency. Safety luminaires of the 20,000 lumen class furnish adequate night-time visibility of all vehicles within the intersection proper. San Bernardino County accomplished the widening of these four miles of important county roads at a total construction cost of approximately $500,000. This included $301,583 of Federal-aid Secondary funds and $67,188 of State Highway Matching Funds.

ADEQUATE DESIGN STRESSED

Proper design of acceleration and deceleration lanes can practically eliminate accidents at freeway interchanges, according to a report presented at the 40th Annual Meeting of the Highway Research Board in Washington, D.C., by R. L. Fisher of the New Jersey Highway Department.

Arroyo Seco

Pasadena Freeway, First In West, Has 20th Birthday

By A. D. GRIFFIN, Supervising Highway Engineer (Retired)

THE PASADENA Freeway from the four-level structure at the intersection with the Hollywood Freeway near the Los Angeles Civic Center area northerly to Glenarm Street in the City of Pasadena is 8.2 miles in length, with total cost to date for right-of-way and construction shown by the record to be $12,218,000. This important freeway logically divides into two units at Avenue 22.

The construction for six miles northerly from Avenue 22 to Glenarm Street in Pasadena is old design and was completed at a cost of $6,000,000 prior to December 30, 1940. This section was known as the "Arroyo Seco Parkway," costing $1,000,000 per mile. The southerly portion, being 2.2 miles in length from Avenue 22 to the four-level structure, is, in every sense of the word, a modern design freeway for which construction was carried out after December 30, 1940. Its cost per mile was $3,000,000. The record shows that the last unit of the southerly section to connect the Pasadena Freeway with the four-level structure was not completed and opened to public traffic until December 22, 1953. P. O. Harding, who was Assistant State Highway Engineer in charge of District VII from 1949 to 1956, always referred to this key construction project as "pulling the plug."

Old Section Described

Thus, we have on the Pasadena Freeway two sections—northerly the old $1,000,000 per mile freeway and southerly the new $3,000,000 per mile freeway. The subject of the present story is the six-mile older northerly section now 20 years of age, and for clarity this writeup throughout refers to it by the original name "Arroyo Seco Parkway."

On December 30, 1940, when the six-mile length of the Arroyo Seco Parkway was dedicated and opened to public traffic, it was acclaimed by civic leaders and motorists as "the West's first freeway." It extended from Avenue 22 in the City of Los Angeles through Arroyo Seco park lands and private property into the City of South Pasadena adjoining Grevelia Street, entering the City of Pasadena at Garfield Street and ending where Glenarm Street intersected Broadway.

A. D. Griffin retired as Assistant District Engineer and Executive Assistant to Assistant State Highway Engineer Edward T. Telford in District VII on August 1, 1960. He had completed 41½ years of service with the Division of Highways. He had been a resident engineer on early roadbuilding projects, design engineer in charge of the district's plan preparation program for highway and freeway construction, 1927-1947, and Assistant District Engineer-Administration, 1947-1960. As design engineer, he had direct charge of plans for the development of the Arroyo Seco Parkway-Pasadena Freeway. He is therefore the logical authority to write this commemorative report on the 20th anniversary of the construction of the Pasadena Freeway.

The occasion for this story is the 20th anniversary of its opening. There should be such a story because during the 20 years that have elapsed since this freeway was opened to public traffic, while there have been occasional stories in the press and in technical magazines, almost nothing has appeared relative to the Arroyo Seco Parkway in *California Highways and Public Works.* Such references that have been made to it have been in connection with stories about other freeways. Everybody has been so engrossed in the newer freeway projects that there was no time for going back into the old.

1941 Writeup

Perhaps another reason for the dearth of writeups was that it was so well covered in the January 1941 issue of this magazine and also in the special pamphlet prepared for distribution at the dedication ceremonies on December 30, 1940.

Still another reason could be that there has been very little new construction or reconstruction carried out on this freeway during the 20-year interval. The expenditure of construction funds during the 20 years has been comparatively small, being largely for additional safety lighting and signing, reconstruction of landscaping, installation of chain link fence in the central median and for refuge areas.

During the years 1949 and 1950, at a cost of about $1,000 apiece, 50 "refuge areas" or "safety bays" were installed on the Arroyo Seco Parkway. As traffic volumes increased, these were found to be necessary because there were no shoulders for emergency parking on this freeway.

The original design of the Arroyo Seco Parkway called for a four-lane freeway with shoulders on both sides. Recognition of traffic considerably in excess of that originally expected caused a last minue change in the design, wiping out the earth shoulders and substituting in their place another lane of pavement, thus providing a six-lane freeway. Because of constricted right-of-way, where for long lengths the freeway was located between the Arroyo Seco channel on the one side and Union Pacific Railroad on the other, it was impractical to obtain shoulders in addition to the six-lane freeway. When vehicles broke down or motorists needed to change a tire, this had to be done out on the pavement lanes. Thus, the installation of the refuge areas, at strategic locations where the topographic conditions would permit, fulfilled a vital need.

The first survey for a highway in the Arroyo Seco was made in 1895 by T. D. Allen of Pasadena. Then early in the 1900's a bicycle speedway, sponsored by a Horace Dobbins, was partly constructed but never fully completed. As the Arroyo Seco began to be developed as a city park, a few more or less disconnected unimproved park roads were built. In the early 1930's, as traffic on existing city streets between Los Angeles and Pasadena began to approach congestion, the need for a new traffic artery in the Arroyo Seco area began to gain public recognition. In 1934 a committee, consisting of Edward S. Graham, chairman, and J. C. W. Hinshaw, Harrison Baker, Harold B. Bryon, J. K. Dotten, Robert Swink and William Wilson, was appointed by the Pasadena Realty Board to look into the possibility of road development in the Arroyo Seco.

Association Is Formed

Later the Arroyo Seco Parkway Association was formed to work in conjunction with the Pasadena Chamber of Commerce. Its officers included Graham, chairman, Hinshaw, Baker, William Dunkerley, Major Charles T. Leeds, F. G. Martin, R. W. Caspers and Jackson Kendall. This association was very active in publicizing the need for a new traffic artery in the Arroyo Seco and obtaining the co-operation and support of city officials of Pasadena, South Pasadena and Los Angeles and the various civic organizations interested in highway development.

Shift of Scene

"The scene now shifts to Sacramento for the final and most important step—the securing of an act of the Legislature making the Arroyo Seco Parkway a state highway. The Arroyo Seco Parkway Association assigned a special committee, and for their yeomen's work, J. C. W. Hinshaw, now congressman, Edward S. Graham, Harrison R. Baker and William Dunkerley gained the title, 'The Four Horsemen of the Arroyo Seco.' With the approval and co-operation of the administration and through the splendid services of Miss Eleanor Miller, representing the 47th Assembly District, who introduced the bill and saw it through final passage, the vision neared reality.

"The snowball had been started and the individuals retired from the front line trenches leaving the project in the care of the California Highway Commission and such able men as State Highway Engineer Charles H. Purcell, District Engineer Spencer V. Cortelyou and Frank C. Balfour, supervising right-of-way agent of the State Division of Highways."

"Arroyo Seco" is Spanish for "dry wash" and it is that for more than 99 percent of the time. However, during times of winter storm, heavy rainfalls can cause serious flooding conditions when storm waters in the Arroyo Seco natural channel, as it existed years ago, overflowed its banks. No serious thought could be given to the establishment and engineering design of a highway arterial in the Arroyo Seco until the flood control problem had been solved. In commenting upon this situation in the August 1940 issue of *California Highways and Public Works*, Cortelyou stated as follows:

"Special mention should be made of the very effective efforts of City Engineer Lloyd Aldrich of Los Angeles in securing for the people of Los Angeles City, after numerous trips to Washington, D.C., the allotment of large amounts of federal relief funds for important engineering projects in Los Angeles City.

Channel Financed

"One of the most important of these was the financing of the paved channel for the Arroyo Seco flood waters from South Pasadena to the Los Angeles River. Without this control of the flood waters, it would not have been possible to build and maintain the Arroyo Seco Parkway in its present location.

"The total cost of the Arroyo Seco channel work, carried out as a Federal Relief Labor project, was about $7,000,000."

When the Arroyo Seco Parkway was under engineering design as a freeway, there was little in the way of established precedent that could be followed. It is true that there were two such highways that had been built in the east but these had not been in operation long enough to determine the practicability of certain features of their design. Thus, to a very considerable extent, the design features of the Arroyo Seco Parkway had to be worked out independently. Original sketches contemplated the kind of a curving low standard highway that would be suitable for slow-speed sight-seeing traffic through a city park.

In the early days officials of the Cities of Los Angeles, Pasadena and South Pasadena were unanimous in the view that, since the Arroyo Seco Parkway was for the most part through city park lands, heavy trucking should be prohibited. In designing the on- and off-ramp connections for this freeway, the engineers of the Cities and of the State took this into account and made considerable money saving by establishing curvature suitable for passenger vehicle operation but not for big trucks. All three of these cities have passed ordinances prohibiting trucks weighing more than 6,000 lbs. from using the Arroyo Seco Parkway. It is interesting to note that this prohibition of heavy trucks was by city action in accordance with established laws, establishing alternate routes on existing city streets and was not action on the part of the State Division of Highways.

Improved Design

The design finally approved and constructed was vastly improved over the original. Much credit is due to City Engineer Aldrich and his Deputies, Merrill Butler, L. E. Arnold, C. J. Shults, L. W. Armstrong and R. W. Stewart, in preparation of plans for the Arroyo Seco Parkway with its large number of bridge structures. The same may be said for City Engineer Harvey W. Hincks of Pasadena and his assistants for the plans they made of the portion of the parkway in Pasadena and South Pasadena. The final design work by the city engineering staffs was carried out in close co-operation with the engineers of the State Division of Highways to the end that specifications could be written complying with state standards and that state construction contracts could be advertised and let.

Among the contractors that were engaged in major construction operations on the Arroyo Seco Parkway prior to December 30, 1940 are the following: The Contracting Engineering Company, J. E. Haddock, Ltd., Columbia Steel Company, Claude Fisher Co., Ltd., V. C. K. Construction Company, Oscar Oberg, J. S. Metzger & Son, Carlo Bongiovanni. The money to finance construction came from sources as follows:

State 1½ cent gas tax fund	$2,614,547.72
¼ cent state highway gas tax for Pasadena	335,981.98
¼ cent state highway gas tax for South Pasadena	64,778.36
¼ cent streets of major importance gas tax for South Pasadena	12,271.04
¼ cent state highway gas tax for Los Angeles	40,000.00
South Pasadena city funds	644.16
Los Angeles city funds	113,584.14
P.W.A. funds	472,315.63
W.P.A. funds	1,394,364.73
Total	$5,048,487.46

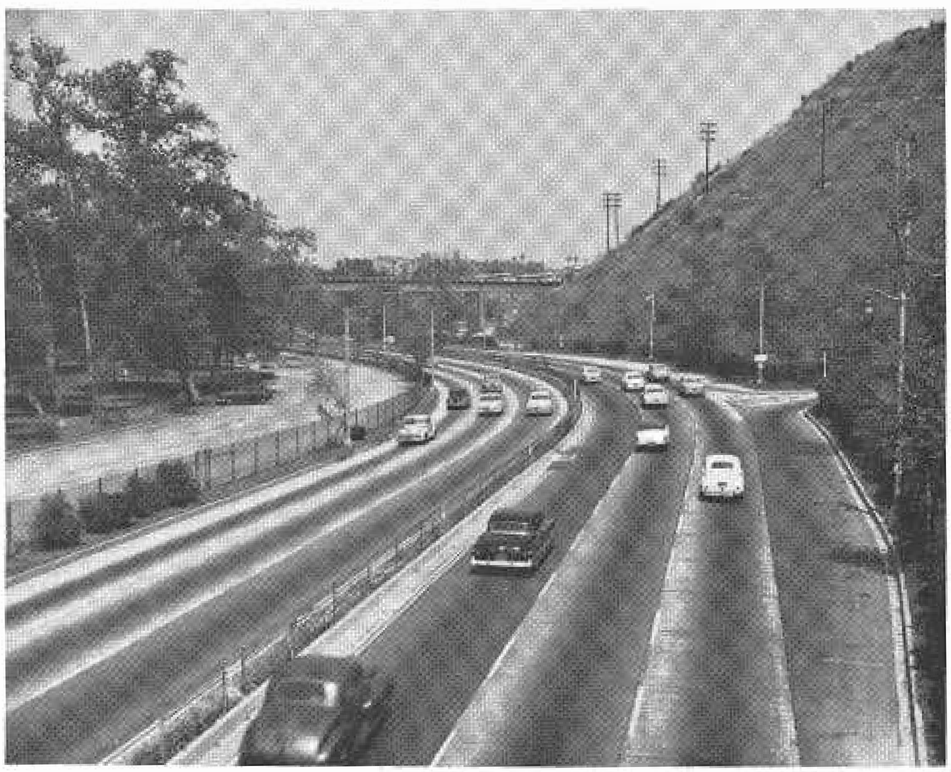
On December 28, 1940, just two days before the official ribbon-cutting ceremony for the Arroyo Seco Parkway, a symbolical and highly colorful ceremony was staged in the Arroyo Seco. Chief Tahachwee of the Kawie Indians, whose ancestors lived in the Arroyo wilderness for hundreds of years before the coming of Father Junipero Serra and his Franciscan mission builders, smoked the pipe of peace with Director of Public Works Frank W. Clark. To the beating of tribal drums, Chief Tahachwee relinquished the rights of his people in the Arroyo Seco and formally transferred their ancient property interests to the State.

Governor Officiates

At the ribbon-cutting ceremony on December 30, 1940, Governor Culbert L. Olson officiated, and with the assistance of Miss Sally Stanton, Queen of the 1941 Pasadena Rose Festival, and other high dignitaries of federal, state, county and city governments and civic leaders, cut the ribbon of roses which stretched across the freeway near the Fair Oaks Avenue Bridge. On this occasion Governor Olson said:

"Forty-five years between the first survey and today's splendid comple-

BEFORE. In January, 1940, the Arroyo Seco looking north from Avenue 60 looked like this. The Santa Fe Railroad viaduct is in the background.



AFTER. Fifteen years later the above section of the Arroyo Seco looked like this.

tion. This is a long time. But perhaps it is just as well that the dream was a long time in its dreaming. Perhaps it is just as well that many obstacles stood in the path to its final realization. Perhaps it is just as well that the dream had to wait, and wait—wait until, under the pressure of sheer necessity it finally burst out of the confining walls of public indifference, official inertia, selfish opposition, and narrow vision. It is just as well because, while confined, the dream grew and matured. So, when that dream was translated into legislation, that legislation was well conceived and broad visioned. And when the engineers were finally told to go to work, their working plans were *bold* and comprehensive, and they have given us something worth while.

"I say *bold* because they were just that. They dealt boldly and realistically and *effectively* with a traffic problem that had become almost terrifying in its urgency of solution. Now that we have it, and it all looks so rather simple, so obviously necessary, so wholly practical, some there will be who will ask, 'What is there so wonderful, or so bold about it?' Oh, yes—but it takes courage to do a thing the *first* time, no matter how simple and obvious it may appear *after* it is done. And this, fellow citizens, is the *First Freeway in the West.*"

With the cutting of the ribbon, a cavalcade consisting of an estimated 400 automobiles made the round trip over the completed Arroyo Seco Parkway.

Economic Benefits Stressed

Officials and members of the Automobile Club of Southern California, particularly E. E. East, Chief Engineer, and Hal Holley, his assistant, in the old days were enthusiastic advocates of the Arroyo Seco. East contributed a story about the economic benefits to be expected from the Arroyo Seco Parkway in the pamphlet that was distributed at the dedication ceremonies on December 30, 1940. This pamphlet of 14 pages was prepared by Kenneth C. Adams longtime editor of *California Highways and Public Works*, who retired from state service in 1957. The pamphlet was printed by the Automobile Club of Southern California as a part of their participation in the dedication ceremonies. It contains much interesting information about the Arroyo Seco Parkway which is of historical value, and so few copies are in existence that a copy now has become a collector's item for those interested in Californiana.

In 1951 the Arroyo Seco Parkway scored another first in connection with the building of the first bridge in California using the prestressed-precast principle for building a concrete bridge. The occasion for this construction was an agreement made some 15 years previously between the Los Angeles City Park Department and the State Division of Highways to the effect that a pedestrian bridge would be built if and when development of park facilities required access to a certain area in the Arroyo Seco Park near the South Pasadena city limits where access to adjoining park lands was cut off by reason of freeway construction on one side and storm drain channel construction on the other. The agreement stated that when the City Park Department needed access to this area that the State would at that time construct a pedestrian bridge across the Arroyo Seco storm drain channel. Until that time only two bridges had been constructed elsewhere in the United States using the prestressed-precast principle.

Bridge Attracts Attention

During construction the bridge attracted considerable attention in the engineering field, and stories concerning it appeared in *Engineering News Record, Civil Engineering, American Concrete Institute Journal, Western Construction, California Highways and Public Works* and others. The story in this last-mentioned publication appeared in the March-April, 1951, issue under the title "Prestressed Bridge," authored by Robert M. Barton, associate bridge engineer.

The bridge consists essentially of two simply supported girders, each 113 feet long, with a clear span of 110 feet. These girders support the eight feet wide pedestrian walkway and also serve as handrails. The girders were constructed in an area alongside the channel and were lifted into place by three giant truck cranes after prestressing operations had been completed. The work was done under a state contract with Contractor Walter Kaucher of Los Angeles. The total cost including engineering was $31,877. Jack Sylvester was resident engineer on the project for the bridge department.

In commenting upon the project, Dale F. Downing, who is now southern representative for the bridge department with offices in Los Angeles, states: "The value of this initial project in adapting prestressed concrete to bridge construction is best illustrated by the fact that prestressed concrete structures have been used to some extent on every freeway in the Los Angeles metropolitan area. The experience and lessons first learned here during design and construction has undoubtedly led to greater economy and more efficient bridge construction throughout the State."

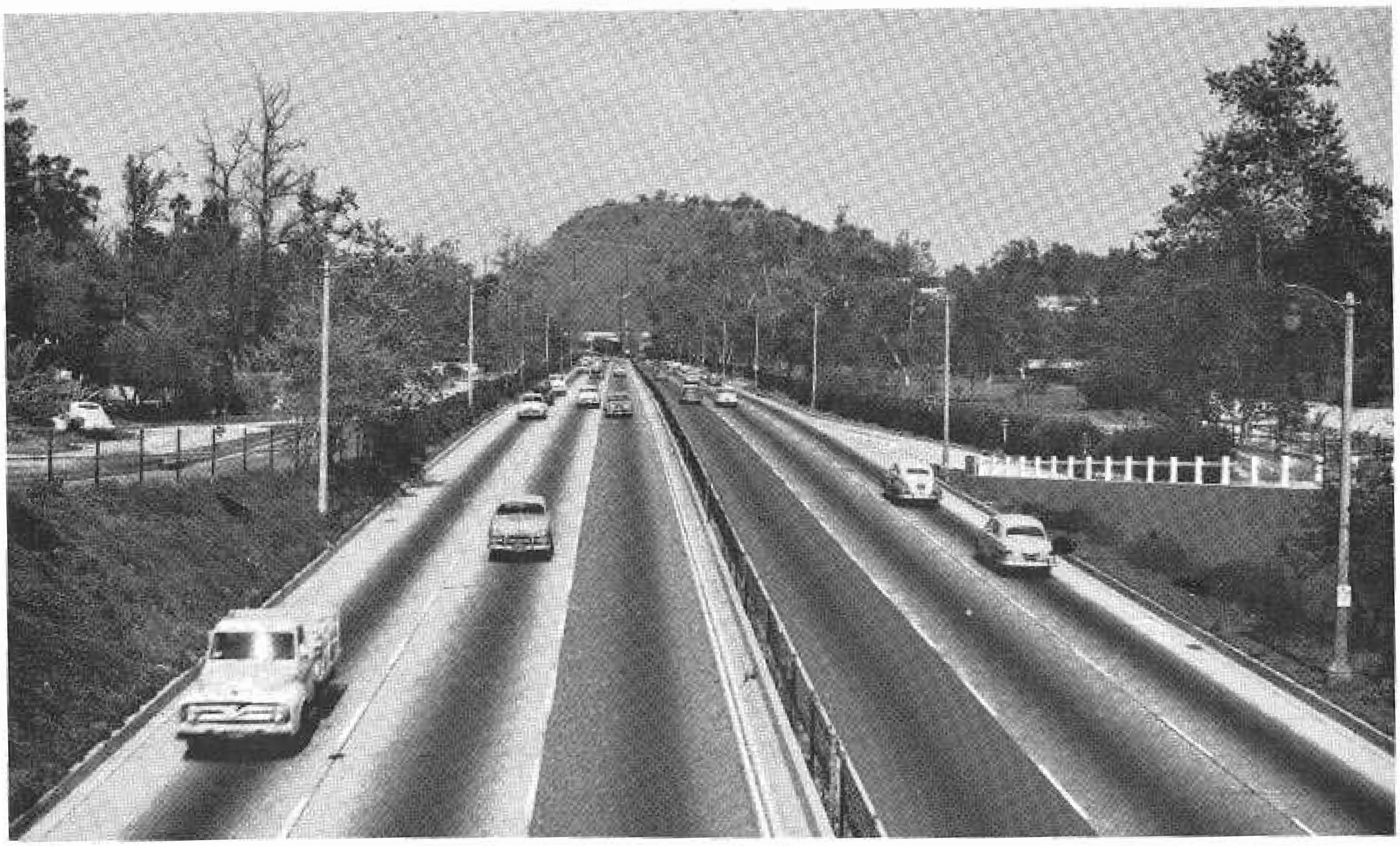
Design Called "Bold"

When the Arroyo Seco Parkway was dedicated by Governor Olson on December 30, 1940, he stated that it was a "bold" design. In many respects it did seem so at the time, but because the many so-called "bold" features have since proved inadequate for present day high speed traffic, much has been learned by study of various features of design on the Arroyo Seco Freeway. In a sense, the Arroyo Seco Freeway has been an experimental laboratory although it was not built as such. Invariably when we have officials from other states or visitors from foreign lands who wish to inspect the Los Angeles Freeway System, they always ask to see the Arroyo Seco Parkway because they wish to compare the old with the new and see what lesson can be learned.

A. L. Himelhoch, District Engineer-Operations, summarizes the lessons to be learned from the old design standards as incorporated 20 years ago in the Arroyo Seco Parkway, as follows:

1. A four-foot median is too narrow to provide space for safety features or planting of shrubbery. Chain

BEFORE. This view of the Arroyo Seco, looking north from Hermon Avenue, was taken in 1933.



AFTER. The same portion of the Arroyo Seco (shown above) as it appeared in a recent photograph.

link fence that had been installed in this median has had to be removed due to repeated damage by vehicle collision. The planting of shrubbery in the median strip to screen out headlight glare has proved a complete failure in the four-foot-wide median strip because plantings could not survive the whipping action of passing vehicles. The action is similar to subjecting plant life to a continuous 60-mile-an-hour gale. In the six-foot-wide median strip where the freeway goes through South Pasadena and Pasadena, however, pyracantha shrubs have survived.

2. On the Arroyo Seco Parkway, acceleration and deceleration lanes are conspicuous by their absence. Vehicles entering the freeway are required to come to a stop at the approach to the freeway roadway. This is not in accordance with modern freeway design which from the standpoint of efficiency and safety provides sufficient acceleration and deceleration lanes so that traffic entering and leaving the freeway will not impede or be impeded by the freeway traffic.

3. On the Arroyo Seco Freeway the superelevation or banking of curves was done to only one-half of the present day standard. It is largely for this reason that this freeway has been signed for a speed of 55 miles per hour instead of the state speed limit of 65 miles per hour. The present day standard of superelevation is necessary for freeway operation at maximum efficiency.

Shoulder Width Important

4. This freeway, lacking shoulder width, demonstrates the need for shoulders on all freeways of adequate width to take care of vehicles that become disabled. On the Arroyo Seco Parkway, this has been partly remedied by the construction of refuge bays, but only partly so because vehicles can break down between the safety areas off the pavement as now provided.

5. The Arroyo Seco Parkway has a number of curves of 1,000-foot radius and one compound curve where the minimum radius is 555 feet. This latter sharp curvature occurs where the freeway alignment follows parallel to a sharp curve in the Arroyo Seco Channel as it passes under the Santa Fe Railroad viaduct. To have eliminated this sharp curve would have required an expenditure of a million dollars or more, and that additional money was just not available at the time this freeway was constructed. A speed zone around this sharp curve has been established at 40 miles per hour and at this reduced speed, traffic can negotiate it with safety. It is clearly demonstrated here that the minimum radius of curvature for modern freeways should be 2,000 feet.

6. The two roadways of the Arroyo Seco Parkway are 35 feet in width consisting of three 11-foot lanes with one-foot gutter widths adjacent to curbs. While this item is perhaps a not too glaring deficiency on this freeway which does not have to handle heavy trucks, it does clearly demonstrate the value of having 12-foot width of traffic lanes for modern freeways.

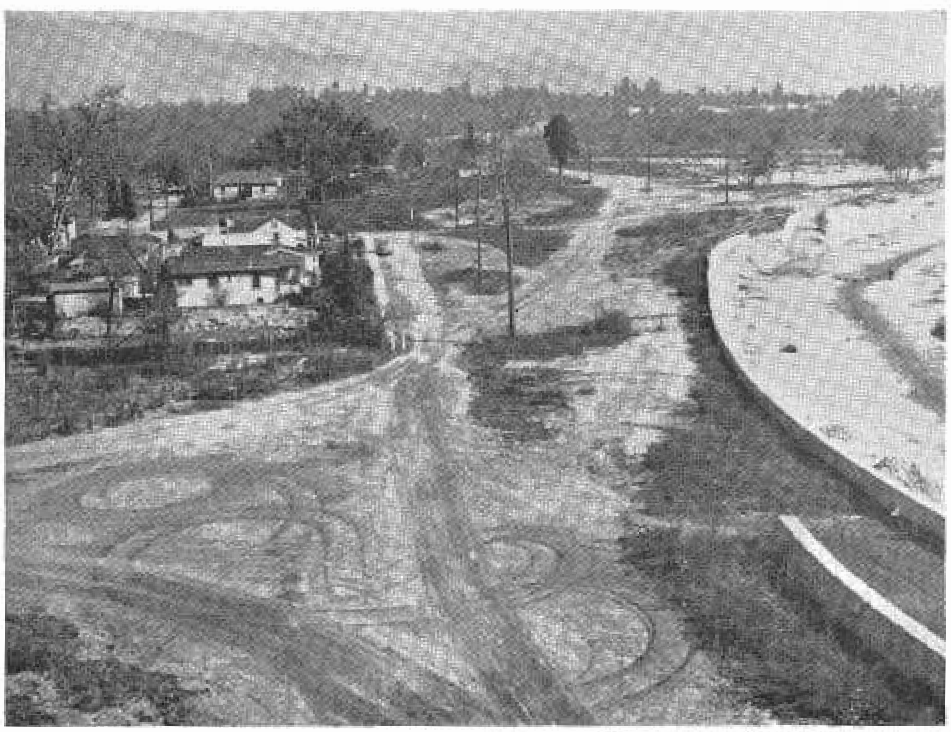
7. On this freeway both rounded and straight-sided barrier type roadway curbs were installed. Generally speaking, where curb delineation is required the evidence is that rounded curbs which traffic can easily negotiate for emergency parking are preferable for modern freeways.

Future Improvements

In describing future improvements that are planned for the Arroyo Seco Parkway section of the Pasadena Freeway, R. E. Deffebach, assistant District Engineer in charge of Design Section "A" in District VII, reports that the 1960-61 budget contains a $363,000 allocation for median barrier construction for the entire length of the Pasadena Freeway between the four-level structure in Los Angeles and Glenarm Street in Pasadena. This median barrier will provide a positive protection against vehicles crossing the median strip and becoming involved in head-on collisions with traffic moving in the opposite direction.

The type of barrier for the sections of median six feet or more in width will be the new standard double blocked-out type of barrier. Where the median is only four feet in width, as is the situation for the major length of the Arroyo Seco Parkway, then the "blocked-out" feature will have to be eliminated.

At the southerly end of the Arroyo Seco Parkway at the intersection with the new Golden State Freeway, an extensive traffic interchange facility is under construction under a con-



BEFORE. This pre-1940 view shows the Arroyo Seco looking north from South Pasadena City boundary.

tract with Vinnell Corporation, Vinnell Constructors and A. S. Vinnell Company, for which the total contract allotment applied between Pasadena Avenue and Arnold Street is $9,693,200. This construction is scheduled for completion, February, 1962.

For additional information concerning the Golden State Freeway, reference should be made to the "Freeway Loop" story by L. R. Gillis, *California Highways and Public Works*, September-October 1959 issue.

Studies Being Made

Deffebach also reports an item of great local interest applying near the south end of the Arroyo Seco Parkway. His design section has under preliminary study that section of the Pasadena Freeway in the vicinity of Elysian Park where the Los Angeles Dodgers baseball park is now under construction and where the proposed City of Los Angeles World Zoo and other recreational facilities will materially change the traffic pattern in this area. It is necessary that these studies be carried out now in co-operation with the city engineering staff of the City of Los Angeles, in order to determine the revisions that will be necessary in the existing freeway on- and off-ramps and in existing city street layouts.

16-HOUR TRAFFIC VOLUMES FROM ANNUAL COUNT BOOKS 1941-60 AT CYPRESS AVENUE PEDESTRIAN BRIDGE

Year	*Sunday*	*Monday*
1941	24,364	27,234
1942	19,494	22,561
1943	17,151	20,663
1944	17,750	21,488
1945	20,383	25,323
1946	31,427	43,805
1947	28,931	40,906
1948	28,451	41,659
1949	30,932	45,047
1950	30,967	49,225
1951	33,862	50,708
1952	34,799	51,101
1953	35,110	52,137
1954	40,343	59,551
1955	41,820	62,582
1956	47,467	64,749
1957	45,363	64,645
1958	45,206	66,499
1959	42,221	64,797
1960	44,688	68,766

Assistant District Engineer J. E. Eckhardt, in charge of the District VII Traffic Department, has prepared the accompanying tabulation showing 16-hour traffic volume counts on Sundays and Mondays during mid-July of each year between 1940 and 1960, and the chart shows a steady and consistent increase, except for the World War II years.

Apparently from 1955 through 1959, the actual counts would indicate that this freeway is working at full capacity under the existing conditions. During 1960, it is Eckhardt's opinion, due to steps which have been taken by large organizations to stagger office hours the peak hours for traffic on all freeways have been considerably lengthened. In some cases it would appear that the morning and night peak hours are no longer of one hour duration but are of two hours or even more. With the definite tendency for the traffic peaks to be of longer duration, it is possible for a greater number of vehicles to utilize the freeways than heretofore. Apparently the Arroyo Seco Parkway portion of the Pasadena Freeway is showing increased usage by motorists due to this fact.

No Special Studies Needed

Eckhardt further states that even though in many respects this freeway is substandard design by present day evaluation that the Arroyo Seco Parkway is, generally speaking, as safe as any of the other freeways. There are no points on the Arroyo Seco where accident concentrations would indicate the need for special studies and corrective measures. Thus, it appears that notwithstanding the fact that the Arroyo Seco Parkway is substandard, it still is giving the motorists of Southern California yeoman service.

The increase in traffic using the Arroyo Seco Parkway can well be understood when one considers the explosive population growth that has occurred in this area during the past 20 years, as indicated by the attached summary.

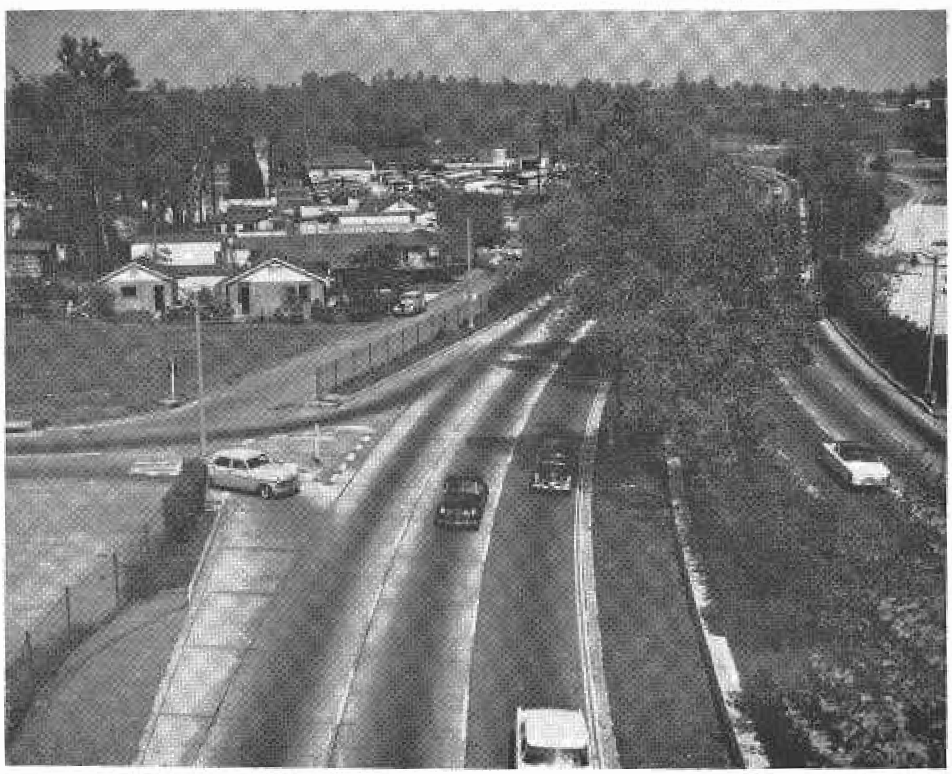
POPULATION

	City of Pasadena	*City of Los Angeles*	*County of Los Angeles*
1940	81,864	1,504,277	2,785,643
1950	104,577	1,970,358	4,151,687
1960	123,984	2,488,750	6,059,161

Future Outlook

It is the opinion of E. T. Telford, assistant state highway engineer now

. . . Continued on page 72



AFTER. The same area in the photograph on the previous page taken 15 years later.

Utility Problem

Cable Relocation Offers Challenge on Bridge Job

By L. E. MULLIN, Assistant Highway Engineer

An existing bridge over San Lorenzo Creek at the intersection of Mattox Road and East 14th Street near Hayward is being reconstructed and enlarged as a part of a 3.9 million dollar flood control project to increase the capacity of the San Lorenzo Creek Channel.

A Cooperative Agreement was entered into between the US Army Corps of Engineers, the Alameda County Flood Control and Water Conservation District, the County of Alameda and the State to jointly finance the reconstruction of this bridge with the main portion of the required funds contributed by the Alameda County Flood Control and Water Conservation District.

The highway traffic is approximately 30,000 cars per day and only half of the structure could be demolished and reconstructed at a time.

Telephone Ducts Described

Investigation revealed that the Pacific Telephone and Telegraph Company maintain a 12-way duct structure on one side and an 11-way duct structure on the other side of East 14th Street. These ducts contain nine full cables ranging in size between 455 and 909 pairs, and a coaxial cable which links Los Angeles and Oakland.

The completed bridge showing East 14th Street in background. Note the three telephone cables still suspended on the shoofly. The telephone company will require nine weeks to place and splice cables within the new bridge prior to removing the aerial cables.

A view of the pile driver in operation between the suspended telephone cables and the west half of the new bridge.

This coaxial cable contains eight coaxial tubes which can carry a maximum of 1,820 telephone conversations or two television programs and 620 telephone conversations simultaneously over each pair of tubes.

The existing bridge was constructed on a skew, and the alignment of the bridge and the position of the ducts governed the line where the first half of the bridge could be demolished.

The Telephone Company made studies and a plan was developed wherein the facilities on one side of the bridge could be placed on a shoofly. The Company had to construct two manholes and intercept the underground conduit and place three cables and the coaxial cable aerially on a shoofly to clear the contractor's pile driving operations.

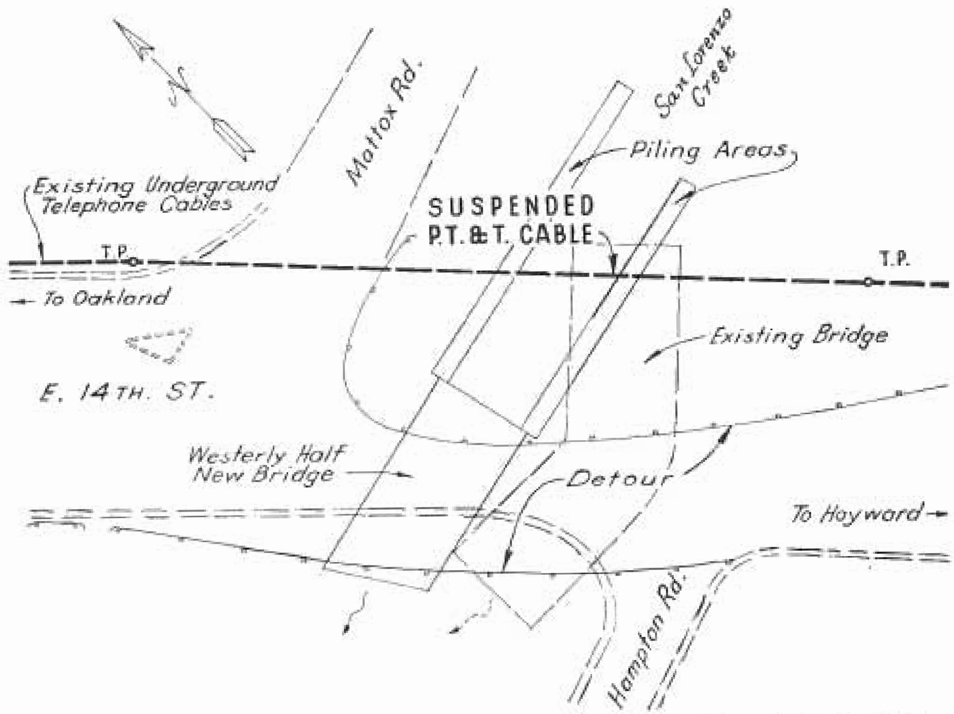
Cables Could Be Lifted

On the other side, the six telephone cables were close enough to the outer edge of the bridge so that the Company could place the cables in a sheet metal casing, lift them vertically and suspend them on a catenary as shown in the picture, while the contractor rebuilt the bridge. These cables still had to be shifted during construction a few feet laterally to clear the driving of individual piles.

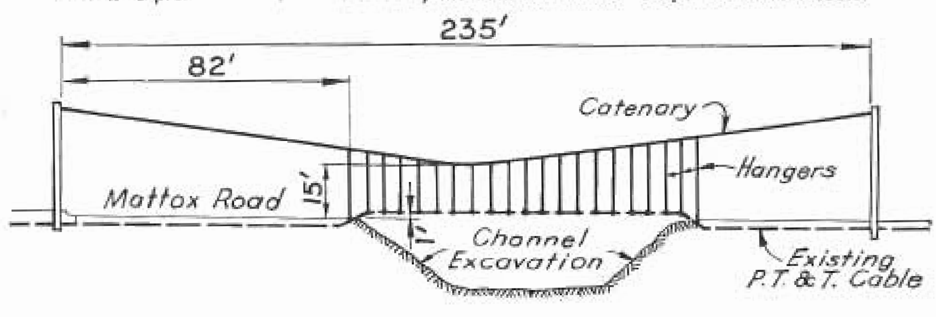
The bridge has approximately a 100-foot span and the cost of relocating the utilities to accommodate the new bridge will be approximately \$60,000.00.

Dan Caputo Company submitted a low bid of \$303,399.00 and the contract was awarded to them on August 26, 1959.

The manner in which these telephone facilities were rearranged has provided minimum interference to the contractor's operations and resulted in a minimum of cost to the Utility Company, the Contractor and the State, for what is probably one of the shortest highway construction projects involving major utility facilities.



After the west half of the bridge was constructed, it was used as part of the detour and the six telephone cables on the east side of East 14th Street were raised and suspended by catenary construction prior to the driving of piles for the remaining section of the bridge. UPPER—a map of the construction area. LOWER—a profile of the area indicated by the dash line marked "Suspended P.T.&T. Cable."



Harding Way

Traffic Flow in Stockton Aided by New Underpass

By R. J. GREENBERG, Assistant City and County Projects Engineer

WHEN the Harding Way Underpass was dedicated and placed in full operation on August 25, 1960, approximately 15,000 vehicles per day began passing safely, and without interruption, under the Southern Pacific Company and Western Pacific Railroad Company mainline tracks. The completion of this modern four-lane underpass eliminated one of the most serious bottlenecks to the movement of vehicular traffic within and through the City of Stockton.

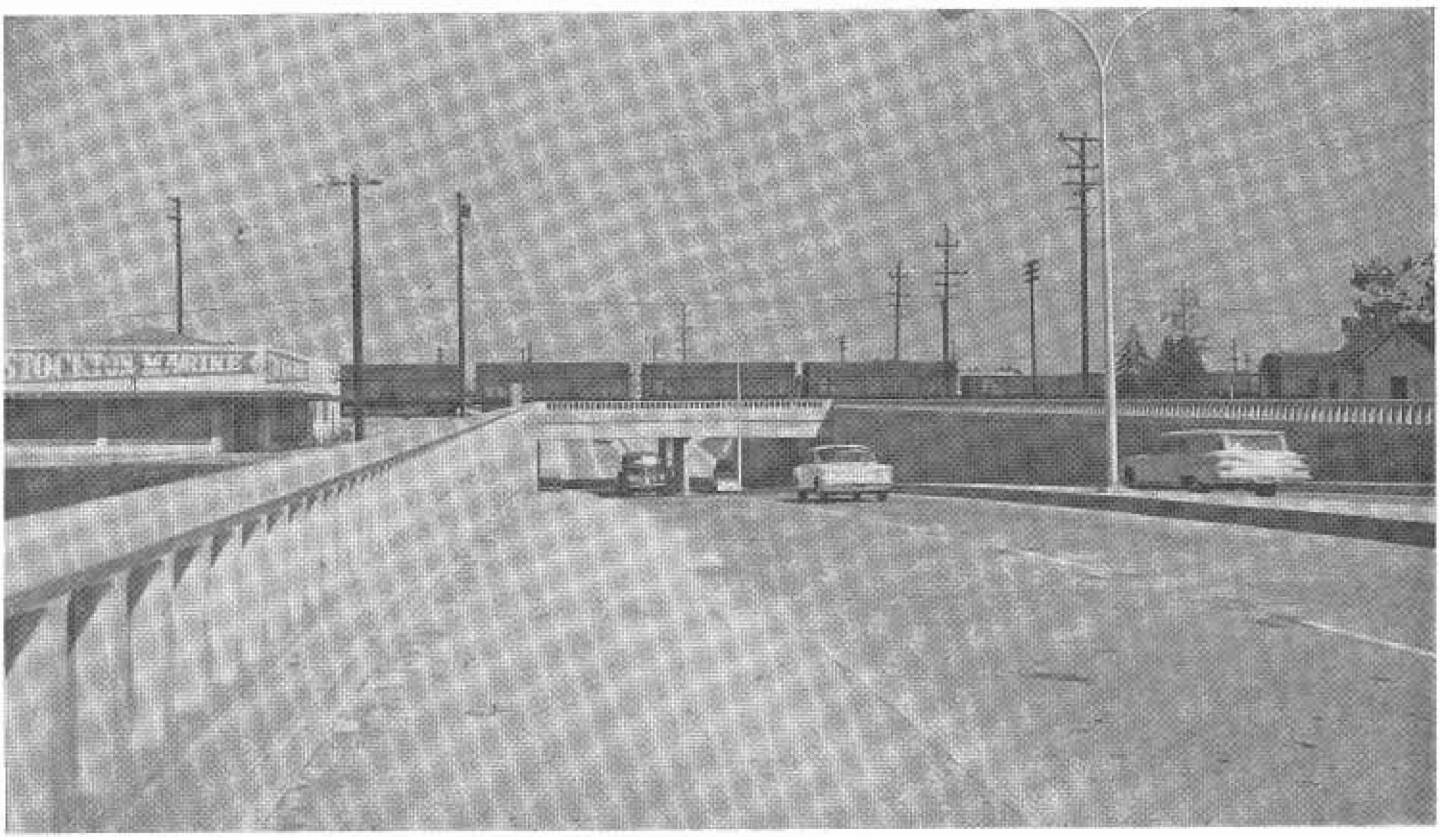
This $1,080,000 structure, which was designed by H. C. Holman of Stockton and constructed by Stolte, Inc., and Lee Stephens, was jointly financed by the City of Stockton, the State Division of Highways and the two railroad companies.

Crossing Elimination Considered

For several years, the City considered the elimination of these mainline railroad grade crossings on Harding Way of utmost importance, not only from a safety standpoint, but also as a savings in both time and operational costs to the vehicle owner and operator. However, not until the citizens of Stockton approved a Public Improvement Bond Issue, and until State funds became available through new legislation, could the structure become a reality.

The State Legislature, effective September 11, 1957, established an annual $5,000,000 Grade Separation Fund. The law providing this fund, as amended, provides that not more than $5,000,000 of the Highway Users Tax Fund be set aside annually to assist local governmental agencies, both City and County, in eliminating railroad grade crossings, and for improving existing railroad separation structures on city streets and county roads. Rail crossings on State highways continue to be a State responsibility.

Under this law, the State Public Utilities Commission is required to establish yearly and furnish to the State Department of Public Works a "priority list" of railroad grade crossings which, in the Commission's judgment, justifies elimination by construction of separation structures, or justifies alteration or reconstruction in the case



The new Harding Way Underpass in the City of Stockton, looking eastward.

Workmen place reinforcing steel in the south retaining wall of the Harding Way Underpass.

An aerial of the completed Harding Way Underpass (right center). At the center of the photo is the Stockton State Hospital.

of existing structures. This law further provides that the railroad or railroads contribute no less than 10% of the cost, and that the balance be shared equally between the local governmental agency and the State.

Determination Priorities

In determining the priority of projects, consideration is given to (1) the accident potential; (2) the traffic potential, both vehicular and rail; (3) the economic benefit to be derived; (4) the cost, and (5) the ability of the local governmental agency to finance its share of the cost.

The first list established included the elimination of the grade crossings on Harding Way. Harding Way is a main east-west arterial through the northern part of Stockton. Traffic at the crossing amounted to 15,000 vehicles and 49 train movements in a 24-hour period. This number of vehicular and rail movements presented a somewhat high accident potential.

Accident Rate Improves

The construction of the underpass has of course eliminated the train-vehicle type of accident and, in addition, will save many thousand dollars annually for the vehicle operator who no longer will be required to wait for trains to clear the crossings.

Since this underpass was completed and placed in full operation, vehicular traffic on Harding Way in the vicinity of these two grade crossings has shown a marked increase. This increase in traffic is due, for the most part, to vehicles using this route rather than existing grade crossings on each side of Harding Way.

Origin and destination trip analysis indicates 88,000 northeast-northwest quadrant transfers in 1975. The newly completed Harding Way Underpass and an inadequate underpass on Miner Avenue approximately 0.8 mile to the south will carry the bulk of this future traffic.

LARGE CONTRACT AWARDED

The State Department of Public Works has awarded a $12,625,800 contract for freeway construction on the Gold State and San Diego Freeways in the vicinity of San Fernando, north of Los Angeles.

Continued from page 36 . . .

6. The land use models developed in this study will provide powerful tools to the local communities for testing and evaluating alternatives of existing and future land use and transportation plans. In addition, they furnish the kind of information needed by local authorities for orderly planning of vital community services such as sewer, water and street improvements.

Since this is a continuing study, additional information will be developed as needs arise regarding evaluation of alternate land use and transportation plans, alternate concepts of mass transit and freeway systems; together with any refinements in the methods of analysis, appraisals of the socio-economic factors affecting travel and understanding of land development.

Orderly Development Stressed

Legislators, planners, administrators, engineers and others are charged with the responsibility of ensuring the orderly development of the greater Los Angeles Area on a local and regional level. The problems of adequately meeting this responsibility grow more numerous and complex as this area rapidly coalesces into one super metropolitan region. It becomes increasingly clear that the knowledge and skills of social and scientific disciplines should be coordinated in a common effort to understand the interplay of forces shaping the development of this super-region. A key to this understanding lies in the proper evaluation of the interrelationships of land use and transportation.

The Los Angeles Regional Transportation Study offers the means for deriving and using these relationships through integrated land use and transportation planning. It offers a study procedure for investigating the whole region without submerging the unique characteristics of the individual local communities. It offers the tools and the understanding required for more effective community and regional planning—all within the framework of existing governments—through voluntary cooperation.

Legislators Attend Highway Budget Briefing

One veteran and five first-term State Senators met in the California Highway Commission conference room in the Public Works Building in Sacramento in mid-January for a briefing session on state highway planning and budgeting procedures. After Senator Randolph Collier, long-time chairman of the Senate Committee on Transportation, had set the stage, the legislators heard from State Highway Engineer J. C. Womack and members of his staff, then asked questions for the rest of a 90-minute session. In the group, left to right, are Senators Vernon L. Sturgeon, San Luis Obispo County; Aaron W. Quick, Imperial County; John C. Begovich, Amador and El Dorado Counties; Collier, Siskiyou and Del Norte Counties; Samuel R. Geddes, Napa and Yolo Counties (former Assemblyman); and Robert D. Williams, Kings County.

L.A. Bridge Engineer C. W. Jones Retires

Charles W. Jones, Supervising Bridge Engineer for the Bridge Department in Los Angeles, retired January 31, after more than 41 years of service.

CHARLES W. JONES

Jones began his career with the State in 1919 in Sacramento as a draftsman with the Division of Highways. Shortly after, he was assigned to the newly organized "small group" handling bridge work. He is practically a Charter Member of the Bridge Department and has served in virtually every section of the organization.

During his activities as Resident Engineer on bridge construction in Los Angeles he was given the additional job of opening the first Southern Office of the Bridge Department in 1926. He later served as Bridge Maintenance Engineer, Construction Engineer, Planning Engineer, and in 1957 he was appointed Special Studies Engineer for the Southern Office of the Bridge Department.

Jones was born in San Francisco and attended school in that city. He graduated from the University of California at Berkeley with a degree in Civil Engineering, and shortly afterward joined the Army and served during the first World War as a Lieutenant in the Coast Artillery.

Jones is a Fellow of the American Society of Civil Engineers and is presently Chairman of the Task Force on Hydraulics of Culverts.

Design Course

Bridge Department Conducts Own Correspondence Lessons

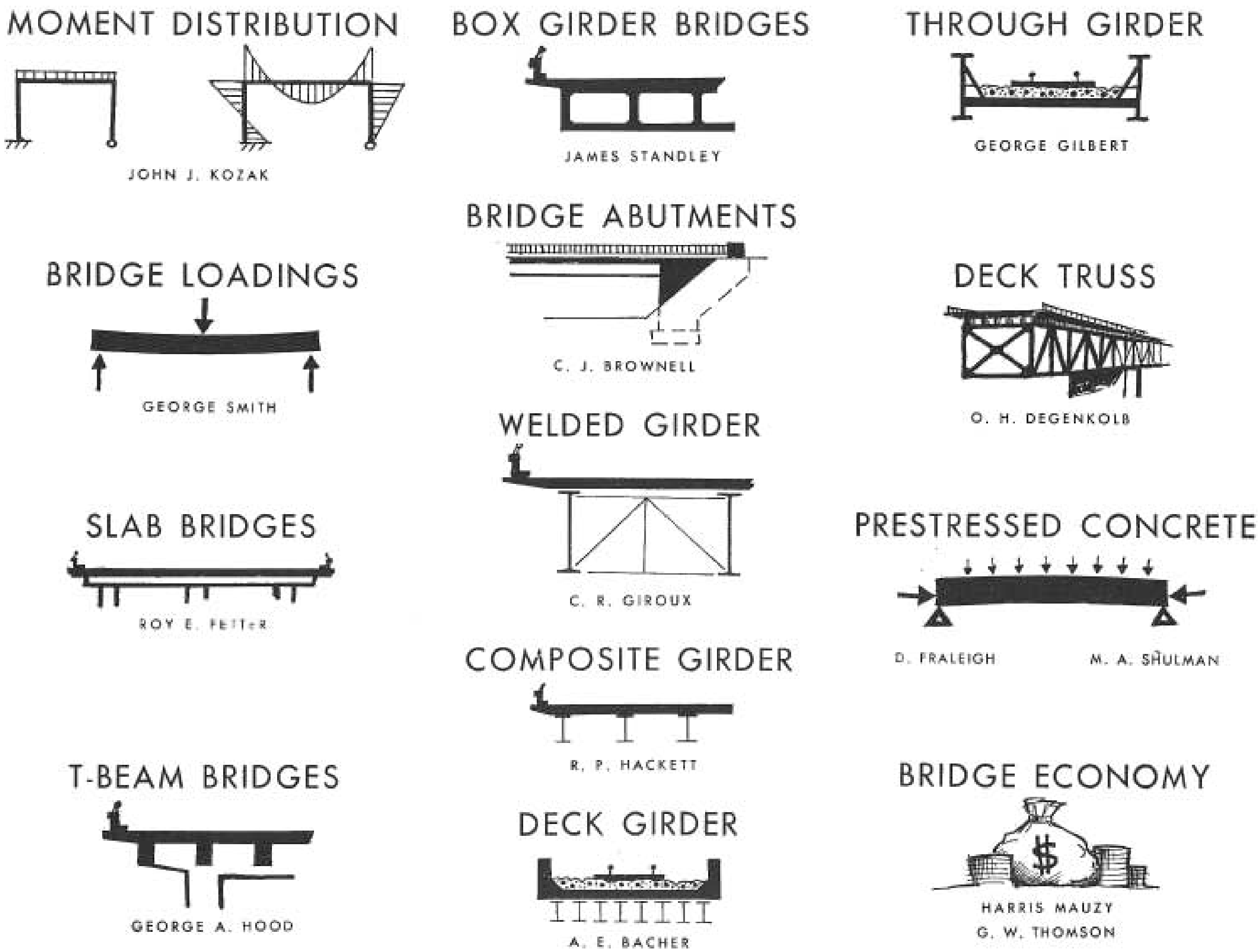
By WALTER W. WHITE, Associate Bridge Engineer

The month of June, 1960 saw the completion of the first correspondence course in Bridge Design Practice, and the issuance of 112 certificates of Completion to Bridge Department Engineers. A second offering of the course, now in progress, has an enrollment of approximately forty Engineers and is near completion. The course was authorized in the Bridge Department in response to a large number of requests by bridge men, about ⅔ of them in the construction phase of bridge engineering, and ⅓ in design.

The course is based largely on the "Manual of Bridge Design Practice," recently published and available for purchase. This manual is itself an outgrowth of a course given 7 years ago by a number of engineers organized by W. F. Pond, Supervising Bridge Engineer. However, the present course differs from the original one largely in that it is being given by correspondence, to accommodate the large number of field men showing interest. In addition to the Manual, supplementary material is also provided from time to time, as required.

Coordinated Effort

That the course represents a coordinated group effort is well illustrated by the fact that the manual was originally produced by 25 differ-



The 13 lessons comprising the new "Bridge Design Practice" correspondence course are listed in the diagram above with the names of the instructors, all engineers in the Bridge Department.

ent engineers and that an equal number are now originating the individual lessons and checking the papers. Mailing, reproducing, overall coordination and supervision are being done by still other personnel. The interest shown and full cooperation by those participating has been very gratifying.

The main objective in providing this course has been, as the title of the manual suggests, to give the engineer practice in the designing of bridges. The course affords a transition between college and the everyday work of design. It is purposed to give the engineer ample practice in the application of engineering theory to actual specific bridge design, in this way converting his theoretical knowledge into working knowledge, helping him to be a more competent Bridge Engineer, whether in design or construction.

Moreover, it is purposed to acquaint the engineer further with bridge design specifications and the engineering phenomena which are peculiar to the design of bridges. It is a specialized type of course and has been made relatively complete in the belief that value derived is proportional to the time spent, provided it is spent on important subject matter. Emphasis is placed first on course value as a means of stimulating student interest, rather than brevity to fit the interest the enrollee may have.

Repetitive Problems Avoided

In order to accomplish these objectives with the least amount of labor on the part of those preparing and grading the course and also with the least effort on the part of the enrollee, repetitive parts of problems are avoided entirely, or pre-calculated values are given with the problem as required. This approach has further served to facilitate integration of the course with the normal work program.

A goal has been set at approximately 15 hours of homework per lesson (average). To this end a complete digest of the manual material was prepared, and the subject matter was divided as equally as possible among the 13 lessons to be given. Subject matter was selected which would emphasize the important differences in bridge types. It is estimated that the equivalent effort of 100 classroom hours, roughly equal to two, 3-unit college courses, was put forth by each engineer completing the 13 lessons.

Lessons by Mail

Lessons are mailed in, graded by designated bridge designers, and returned to the enrollee with appropriate written comments. Any unsatisfactory papers must be corrected and re-submitted for credit, and all 13 lessons must be completed.

The complete course, including both the problems and their solutions, is now being reproduced, to be distributed to holders of the Manual of Bridge Design Practice.

In addition to those completing the entire course, there are about 100 engineers who have successfully completed the first half of the course, which deals with the more basic concepts and most important bridge types. These men can continue this training later, through home study and by experience or by resuming the course at a future date.

It is believed that the 150 engineers who have completed, and who will shortly complete the course have received a solid background in the application of engineering principles to the design of bridges. With proper supervision they are now able to undertake the design of almost any type of bridge currently being used in the huge construction program of the Division of Highways.

Eureka Chief Clerk I. F. Cramer Retires

I. F. "Ferd" Cramer, Highway Chief Clerk of the California Division of Highways, District I, in Eureka, will retire on December 30, 1960, ending a 40-year career in State service.


I. F. CRAMER

Cramer was born in Ogden, Utah and attended schools in Chicago, Illinois. His first job was with a department store in Chicago. Later he worked for the American Steel Foundry. Cramer was a member of the National Naval Volunteers and during World War I served at various naval aviation stations in the United States.

In 1919 he moved to California and settled in Willits, where he owned and operated a theater.

In 1920, he went to work for the State Division of Highways at Willits, where the District I Office was located at that time. His first assignment was as a draftsman. He transferred to the accounting section a few months later. He was promoted to Chief Clerk in 1927 and advanced through increasingly higher classifications of this title to head of all accounting functions for District I.

His wife is the former Dorothy Upp of Willits. They have 12 children; 4 girls and 8 boys, and 14 grandchildren.

Highway User Taxes To Exceed $600 Million

California highway-user taxes for 1960 should be more than $610,000,000 according to an estimate, prepared by the Bureau of Public Roads, U.S. Department of Commerce, based on reports from state agencies and other sources.

Nationwide state highway-user tax figures are expected to reach approximately $5,300,000,000, thereby exceeding 1959 totals by five percent. Amounts paid by highway users in the various states will range from the high of $610,499,000 for California to a low of $4,487,000 for the new state of Alaska. New York will be the state next highest to California with an estimated total of $377,204,000.

California's total will include (approximately): $344,227,000 for motor fuel gallonage tax; $235,502,000 for motor vehicle registration fees; $6,616,000 for other motor vehicle fees; $16,880,000 for motor carrier fees; and $7,274,000 for miscellaneous fees.

"B" Section Chief Retires in L.A.

Emil Hanson, Assistant District Engineer in charge of District VII's Design "B" section, retired from the Division of Highways, on February 2. He had been with the State since 1929.

Hanson was born in North Dakota and came west with his family in the early 1900's, settling in Pomona. He attended Pomona city schools, Los Angeles Polytechnic High School and the New Mexico School of Mines. During World War I he was a Gunner's Mate aboard the cruiser USS Cleveland assigned to convoy duty in the Atlantic Theatre.


EMIL HANSON

His first professional job was on dam construction work in Esperanza, Sonora, Mexico. From 1924 to 1929 he worked for the City of Los Angeles in field and design engineering. His State service began in San Luis Obispo in District V. He then transferred to District VI in Fresno and was promoted to Assistant and Associate Highway Engineer. In 1937, he was assigned to the Headquarters office in Sacramento, where he advanced to Senior and then Supervising Highway Engineer. His last 11 years were spent in the District VII office in Los Angeles as head of Design "B", which encompasses all of Orange County and southeast Los Angeles County. He has been responsible for the design of such freeways as the Santa Ana, San Diego, Long Beach, Riverside, Newport, Artesia and Garden Grove.

Hanson's interest in Western Americana and pre- and post-Columbian Mexican History is taking him to San Miguel de Allende outside of Mexico City, where he and his wife will study Mexican culture.

If a vehicle begins to skid, the driver should reduce the power and turn the steering wheel in the direction of the skid until recovery begins.

IN MEMORIAM

District I

John L. W. Zumwalt, Highway Field Office Assistant.

District II

Floyd M. Sunde, Janitor

District IV

Albert F. Alcorn, Highway Equipment Operator-Laborer

District VII

Charles L. Gildersleeve, Senior Highway Engineer

Thomas F. Jesko, Highway Equipment Operator-Laborer.

Charles H. Snider, Highway Equipment Operator-Laborer.

District VIII

George C. Bradley, Highway Equipment Operator-Laborer.

George H. Radmore, Janitor.

District IX

Leece L. Pauly, Laborer.

District X

Newell R. Gill, Highway Field Office Assistant.

Carl M. Heynen, Associate Highway Engineer.

District XI

Jay F. Hanley, Laborer.

Charles H. Peck, Highway Foreman.

State-owned Toll Bridges

Tom F. Allison, Structural Steel Painter.

James I. Totten, Repairman, Reinforced Concrete Bridges.

Headquarters Office

St. Elmo C. Robinett, Assistant Research Technician.

Shop 3

Eugene R. Clifton, Highway Equipment Superintendent I.

Over 50 percent of the vehicular fires on the Ohio Turnpike are a result of overheated tires caused from under-inflation or improperly functioning wheel bearings.

Bridge Designer A. Eremin Retires

Anatol A. Eremin, Associate Bridge Engineer, retired on December 31, after more than 32 years with the State Division of Highways.

Eremin began his career with the Bridge Department in 1928. Among the structures he has designed are the Peninsular Avenue Overcrossing on the Bayshore Freeway in San Mateo, the first single-column bent bridge in California; the Waldo Tunnel on U.S. 101 north of San Francisco, one of the largest vehicular bores in the United States; the University Avenue Overcrossing on U.S. 101 in San Diego, the first concrete box girder bridge constructed in California; and the Gaviota Creek Bridge on U.S. 101 in Santa Barbara County, which has the largest skew of any arch bridge in the state.


ANATOL EREMIN

In 1954, he served as consultant on the design and construction of the Nuani Pali tunnels in Hawaii and received high commendation for his work from the Territorial Government.

Born in Samara, Russia, Eremin received his B.S. degree in civil engineering from the Petrograd Institute of Ways and Communications in 1917. After two years in the construction of railroad bridges he moved to Shanghai, China, where he worked as a structural engineer. He came to the United States in 1922 and received an M.S. degree from the University of California at Berkeley in 1924.

Eremin is a member of the American Society of Civil Engineers. He is the author of three engineering books and numerous engineering treatises.

Eremin is an artist-member of the Northern California Art Association. Eremin and his wife, Claudia, plan to reside in Berkeley. They have three married daughters and four grandchildren.

25-YEAR AWARDS ANNOUNCED FOR 25 EMPLOYEES

Headquarters Office
Mervyn R. Blacow
Wilfred R. Penfold

District I
Ivan G. Lawson
Ralph C. Russell

District II
William J. Watt

District III
Roderick J. McLeod
Raymond L. Rusk

District IV
Edward W. Gustafson
Roy E. Hansen

District VI
Veydon G. Cramer

District VII
Byron V. Hauger
Louis E. Steele

District IX
Henry R. Scott

District X
Edgar D. Latour

District XI
Robert R. Goodell
Carson McNamee
Earl L. Petersen

Materials and Research Department
John L. Beaton

Bridge Department
James O. Darr
Theodore W. Rodgers

State-owned Toll Bridges
Austin W. Talbot
Arthur Fross

Headquarters Shop
Ray N. Henderson

Shop 8
John Everett Ford
George C. Ulrich

W. J. Lambert, Jr.

William J. Lambert, Jr., Associate Right of Way Agent with the District III Office of the Division of Highways in Marysville, died December 20 after a long illness.

Lambert started in with Highways in February, 1956, as a Junior Right of Way Agent. He was promoted to Associate Right of Way Agent in September, 1959. He was in charge of the District's Land Economics Studies Section at the time of his death. A native of Sacramento, Lambert attended local schools and was a 1955 graduate of the University of California where he was a Political Science major.

Lambert was active in community and church affairs and, at the time of his passing, was President of Peach Bowl Chapter 40, C.S.E.A. He was a member of the American Right of Way Association.

He is survived by his wife, Patricia, of Yuba City.

ARROYO SECO

Continued from page 63 . . .

in charge of District VII, that it is very unlikely in the foreseeable future that there will be any major reconstruction on the Arroyo Seco Parkway because there are too many vitally needed new freeways to be built before funds will be available to carry out major reconstruction to improve existing freeways. It is Telford's view that completion within the next few years of the Glendale Freeway to the west and the extension of Long Beach Freeway to the east will, to a very considerable extent, tend to keep the Arroyo Seco Parkway from becoming further overloaded.

The Arroyo Seco Parkway has given excellent traffic service for 20 years past and can be expected to do so for many years in the future. As the situation now stands, it can easily be proved that this 20-year-old freeway has paid for itself many times over. It is as Telford has said: "We do not need to apologize to anyone about the Arroyo Seco Parkway."

Former Commissioner Dies in San Gabriel

Newell Dyke Darlington, 86, former member of the original State Highway Commission, died at his home at 562 N. Darlington Avenue, San Gabriel on November 27, 1960.

Appointed in 1911 by Governor Hiram Johnson as a member of the first California Highway Commission, he served in that capacity until January 8, 1923, when he retired from State service.

The first meeting of the highway commission was held in Sacramento on August 9, 1911. At that time Darlington, with Charles D. Blaney of Saratoga and Burton A. Towne of Lodi, the other members of the three-man commission, and Austin B. Fletcher, State Highway Engineer, assumed the responsibility for making the surveys, plans and construction for the foundation of the vast California State Highway System.

Born in January 1874, he was raised in Pennsylvania and came to California soon after graduation with a degree in civil engineering from Lafayette College in Easton, Pennsylvania in 1895.

In 1909 he was appointed a member of the City Public Utilities Commission of the City of Los Angeles, and later was commissioner of the City Board of Public Works, from which position he resigned June 30, 1911, to become one of California's first three State highway commissioners.

LARGEST PRODUCTION YEAR

Project allocations to construction for which plans were developed by Division of Architecture personnel exclusively totaled $92.6 million for 1960, the largest production year of record in Division history. Of this amount, $33½ million was completed during the last quarter of the year, second only to a 13-week period ending August 18, 1958, when $35½ million completed established the all-time record.

Use recommended tire pressures for best tire performance on ice.

Principal Engineer R. R. Rowe Retires

R. Robinson Rowe, Principal Bridge Engineer in charge of special studies for the California Division of Highways retired on November 30 after an engineering career covering 40 years, 26 years of it in State service.

R. ROBINSON ROWE

Rowe began his state career as a construction engineer on the San Francisco-Oakland Bay Bridge in 1933. From 1937 to 1938 he worked as a hydroelectric engineer with the U. S. Forest Service in Juneau, Alaska, after which he rejoined the California Division of Highways. He was put in charge of special studies for the Bridge Department in 1955 and was promoted to Principal Engineer in 1956.

A specialist in hydraulics, Rowe has written many articles which have appeared in national engineering magazines. He is co-author of a widely known book, "California Culvert Practice" and was co-ordinator of a recent study of slides in the Pacific Palisades area in Los Angeles. His most recent research project involved the compilation of a treatise on stream bank protection based on cooperative studies. He is probably best known, however, as the author of the "N. G. Neare's Column" a mathematical puzzle feature which began in "Civil Engineering" magazine in 1940.

Rowe is listed in "Who's Who in America" for 1958-9, "Who's Who in Engineering" for 1942 and "American Men of Science" for 1948.

Rowe was born in Spencer, Massachusetts and received his preliminary schooling in Paris Township and Grand Rapids, Michigan. He graduated from Harvard University cum laude in 1916 and, two years later, was awarded concurrently a degree in engineering from Massachusetts Institute of Technology and one in civil architecture from Harvard. He served with the U. S. Army from 1918 to 1919 and was a member of the Army Reserve from 1920 to 1940.

Rowe was in private engineering and business until he joined the state in 1933.

He is past president of the San Diego and Sacramento sections of the American Society of Civil Engineers and was a national director of the organization from 1955 to 1958. He is also past chairman of the Engineering Council of the Sacramento Valley.

He is a member of the National Society of Professional Engineers, American Geophysical Union, American Association for the Advancement of Science, Structural Engineers Association of Central California, International Society of Soil Mechanics and Foundation Engineering, International Association for Hydraulic Research and Highway Research Board. Rowe is also a Mason and a member of Chi Epsilon and Lambda Chi Alpha fraternities.

Rowe and his wife, Edythe, have a daughter and two sons. After retirement, he intends to devote most of his time to professional writing and will continue his current column in "Civil Engineering" called "Examgems" which he authors under the name of "Reggie Strashn."

RECENT RETIREMENTS FROM DEPARTMENT ARE LISTED

District I

Felix O. Barney, Laborer, 22 years; Hugh Edgmon, Light Power Shovel Operator, 35 years; Andrew C. Moore, Highway Equipment Operator-Laborer, 32 years; Wesley H. Stowe, Highway Equipment Operator-Laborer, 38 years.

District IV

Fred Merango, Laborer, 27 years; James O. Orr, Associate Highway Engineer, 13 years; * Fernand A. Abert, Highway Leadingman, 28 years; Harold F. Greene, Highway Foreman, 21 years.

District V

Roy H. Burger, Assistant Highway Engineer, 31 years; Claude C. Cushwa, Assistant Highway Engineer, 7 years.

* Disability

District VII

Raymon E. Harden, Highway Engineering Technician, 5 years; Harold W. Leonard, Principal Right of Way Agent, 31 years; Oscar E. Poplin, Highway Equipment Operator-Laborer, 27 years; * Gale G. Sphon, Highway Traffic Signal Technician, 12 years; Elton F. Wagner, Deputy Chief Right of Way Agent, 32 years; * Bengt I. Ericksson, Engineering Aid II, 3 years; Feramorz H. Young, Highway Chief Clerk II, 24 years.

District VIII

Theria D. Lambert, Highway Equipment Operator-Laborer, 31 years; Wilfred L. Savage, Highway Superintendent, 33 years; Ted C. Yeager, Highway Foreman, 23 years; Lawrence N. Backus, Highway Leadingman, 29 years; Edward R. Little, Highway Field Office Assistant, 7 years; William R. Peacock, Highway Foreman, 34 years.

District IX

Martha E. McFarland, Accounting Technician II, 32 years.

District X

William L. Hurd, Senior Highway Engineer, 32 years; Clifford J. Temby, Supervising Highway Engineer, 46 years; Joseph E. Halloran, Assistant Highway Engineer, 18 years.

District XI

Carl O. Reinius, Assistant Highway Engineer, 30 years; John C. Webb, Supervising Right of Way Agent, 20 years.

Bridge Department

Anatol A. Eremin, Associate Bridge Engineer, 32 years; * Francis M. Morrill, Associate Bridge Engineer, 26 years; * Ralph W. Riley, Foundation Driller, 2 years; R. Robinson Rowe, Principal Bridge Engineer, 26 years.

State-owned Toll Bridges

* Walter T. Berg, Toll Collector, 9 years.

* Disability

. . . Continued on page 74

Senior Engineer Paul Hine Retires

Paul Hine, Senior Highway Engineer with District VII Maintenance Department, has retired after 24 years of service.

He was born in Junction, Illinois, in 1906 and attended primary and secondary schools in Junction and Dallas, Texas.

PAUL M. HINE

He began his engineering career as chainman for private surveyors in Los Angeles in 1927, having come to California in 1924. Until 1936, when he joined the State Division of Highways, he was employed by the County Surveyor's office, Riverside (1927-29); the Southern Sierra Power Company (California Electric Power Company) as transitman and map draftsman (1929-32); and the City of Riverside as engineering draftsman (1932-36). His State service began in District I, Eureka. In 1941 he transferred to District VII, where he worked in Maintenance, Hydraulics, Design and Construction, becoming a senior highway engineer in October, 1956.

Paul Hine pioneered hydraulic model work in District VII and made important contributions in the design of drainage drop structures.

Hine has a son, Lt. (j.g.) Paul M. Hine Jr., and a daughter, Mrs. Albert C. Ordway, of Monterey Park. He plans to move to Apple Valley.

RECENT RETIREMENTS

Continued from page 73 . . .

Shop 6

Leonard C. Fisher, Heavy Equipment Mechanic, 10 years; Lloyd A. Peet, Laborer, 8 years.

Shop 7

Clyde B. Barnes, Automobile Mechanic, 42 years.

Shop 11

Lillian E. Munnings, Accounting Technician II, 21 years.

Median Barrier Tests Win National Honors

A State Division of Highways research project won national honors at the annual January meeting of the Highway Research Board of the National Academy of Sciences in Washington D. C.

The study, entitled "Dynamic Full Scale Tests of Median Barriers," was made under the direction and supervision of J. L. Beaton, supervising highway engineer, and R. N. Field, materials and research engineering associate, both of the Division's Materials and Research Department in Sacramento.

It was selected for the honorable mention award as one of the three best papers presented at the Highway Research Board's 1960 meeting. Several hundred research papers are presented to the board each year.

The Beaton-Field research project involved the testing and evaluation of 15 different types of freeway median (center strip) barriers. Included was a spectacular series of crash tests using radio-controlled vehicles and an electronic dummy.

Purpose of the study was to find barrier designs which prevent vehicles from crossing the center strip and also minimize the severity of collisions with the barrier and reduce the threat of ricochet into the traffic stream.

Two types of barriers new to California highways were developed—the fence-cable barrier and the blocked out metal beam barrier. Both types have since been installed on sections of several heavily traveled freeways.

A summary of the study report appeared in the July-August, 1959, issue of *California Highways and Public Works*.

The last Division of Highways paper honored by the board was in 1957. The top winner then was a study entitled "California Freeway Capacity Study, 1956," by George M. Webb, Traffic engineer, and Karl Moskowitz, assistant traffic engineer.

In 1949, Francis N. Hveem, materials and research engineer, and Robert M. Carmany, assistant engineer of design, received the award for "The Factors Underlying the Rational Design of Pavements."

Rex H. Fulton

Rex H. Fulton, Senior Highway Engineer in charge of aerial surveys (Photogrammetry) for the State Division of Highways, died on January 11, following an illness of several months. He had retired from State service on December 31.

He went to work for the Division in the District V Office, San Luis Obispo, as acting resident engineer and Maintenance Superintendent in 1930 and transferred to Headquarters Office in Sacramento in 1933. He was appointed Associate Highway Engineer in charge of priorities and war surplus purchases in 1942. When the Service and Supply Department was organized in June 1947, he became Administrative Assistant of the department. In 1952, he was put in charge of the Photogrammetry Section which prepares plans and specifications, awards contracts, establishes standards of accuracy, consults contractors and other government agencies on aerial survey problems. He received commendation from the American Congress on Surveying and Mapping for his work in photogrammetry.

Fulton was born in Centralia, Washington, and attended school there. He studied Civil Engineering at University of Washington. His first job was as a logging engineer and topographical engineer in Portland. In 1929, he went to work for the City of Chico as a property appraiser.

He was a member of the American Society of Civil Engineers and the American Society of Photogrammetry.

Fulton is survived by his wife, Ersel; sisters, Mrs. Marvel Robinson of Spokane, Washington; Mrs. Garnet Bohannan of Seattle, Washington; and brothers, Mr. Fred Fulton, Santa Barbara; Harry Fulton, Olympia, Washington; and John Fulton of Toledo, Washington.

Rex Whitton Is New Federal Roads Chief

Rex Whitton, 62, former chief engineer of the Missouri State Highway Commission, is the new Federal Highway Administrator.

Whitton was appointed to the federal post by President John F. Kennedy. He succeeded Bertram D. Tallamy, who had headed the federal road-building program since 1957.

REX WHITTON

Whitton had been associated with the Missouri Highway Department since 1920. He became chief engineer in 1951. He is former president of AASHO and a former chairman of the Highway Research Board.

Whitton recently won the Thomas H. MacDonald Award for "outstanding service in highway engineering" which is presented annually by the American Association of State Highway Officials.

Whitton was the fourth person to be given this honor. The 1958 recipient of the award is G. T. McCoy, retired State Highway Engineer in California.

William A. Bugge Is New HRB Chairman

William A. Bugge, Director of Washington Highways, was elected chairman of the Highway Research Board for 1961, succeeding Pyke Johnson.

Bugge has served as Director of Highways in Washington State since 1949, and is a past president of the American Association of State Highway Officials.

The Highway Research Board was organized in 1920 to encourage research in highway matters as well as to provide a national clearing-house and correlation service for research activities and information on highway administration and technology. The Board operates under the auspices of the National Research Council and consists of 45 technical and commercial associations as well as 1300 nonvoting associates.

Robert Van Stan Retires in L.A.

Robert W. Van Stan, Senior Highway Engineer in the District VII Traffic Department, has retired after 37 years of State service.

He was born in Seattle on November 20, 1898, and attended public schools in Alameda, California. After a stint in the Army in 1918, he enrolled in the University of California at Berkeley. He was graduated in electrical engineering in 1923, at which time he entered State service with the Division of Highways in District II, Redding (Dunsmuir), in survey and construction work.

R. W. VAN STAN

Succeeding years found him in construction and the Bridge Department as assistant and resident engineer, including 1933-36 on the San Francisco-Oakland Bay Bridge.

In 1936 Van Stan returned to the Southern Area Bridge Department where he remained as resident engineer on various projects until 1942, when he was called to active duty in the Navy Civil Engineer Corps. As Lt. Commander and Commander (1943), he was in charge of construction of airfields, buildings, etc., in sections of the South Pacific. In 1945, he rejoined the Southern Area Bridge Department at Los Angeles, transferring in 1946 to the District VII Traffic Department. He has remained with this department until his recent retirement. He was appointed Senior Highway Engineer in 1948.

Van Stan holds California Civil and Electrical Engineering licenses and is a member of the Illuminating Engineering Society. He and his wife reside at 791 St. Katherine Drive, Flintridge, California.

G. T. McCoy Receives Golden Beaver Award

George T. McCoy, former State Highway Engineer, was the recipient of the Sixth Annual Golden Beaver Award for Engineering.

The presentation was made to McCoy in Los Angeles on January 19 by Paul Grafe, President of the Beavers, a national fraternity of leaders in the construction field.

Other Golden Beaver awards went to T. E. Connolly, head of T. E. Connolly Inc. and the Connolly Pacific Company, in the field of management; David E. Root, retired vice-president of the Guy F. Atkinson Company in the field of supervision; and John L. Savage, consulting engineer and former chief designer for the U.S. Bureau of Reclamation, a special award.

In making the award, Grafe said:

"When George T. McCoy retired from his long tenure as Chief of the California Division of Highways in the autumn of 1959, he left a record of engineering accomplishment few can equal. During his 16-year administration he directed the activities that revolutionized highway travel in California by creating 2300 miles of multilane, divided highways, a project whose size can be better imagined by the fact that it involved expenditures of two and a half billion dollars. The speed and efficiency with which the vast expansion was brought has established California as the home of modern freeways and the example for the other parts of the nation."

McCoy joined the State Division of Highways in 1927. A graduate of Whitman College in Walla Walla, Washington, McCoy also holds a degree in civil engineering from Columbia University awarded him in 1915. Much of his early career was spent with the Washington State Highway Department where he held the position of Assistant State Highway Engineer prior to coming to California.

On winter roads, pump brakes to reduce skidding, maintain steering control and shorten stopping distance.

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STAFF CHANGES

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leaving state service, he will be in charge of the association's new national office in Los Angeles.

Balfour has also taken part in the activities of the American Association of State Highway Officials. For 12 years he headed the AASHO standing committee on right of way.

He was born in Pomona in 1894 and received his early education there. He attended St. Vincent's College in Los Angeles and received a bachelor of science degree in electrical engineering from the University of Santa Clara in 1914.

He was employed by the Southern California Edison Company and the J. G. Braun Company and later became a real estate broker in the Los Angeles metropolitan area.

Balfour joined the Division of Highways in 1931 as an assistant right of way agent. He was appointed chief right of way agent in 1943.

He is a member of the Sacramento Rotary Club and has been prominent in local civic and welfare activities.

Balfour and his wife, Clare, plan to make their home in Los Angeles following his retirement.

Hess is a native of Valley Ford, Sonoma County, and was educated in San Francisco, studying engineering at Healds College there. He went to work for the Division of Highways in 1929 as a junior engineering aid in the Fresno district. The following year he transferred to the San Francisco district, working in right of way engineering and in construction inspection.

He shifted from engineering to right of way work in 1944 and moved to Division Headquarters in Sacramento in 1947 as an associate right of way agent.

His accomplishments include the development of the Division's Land Economics Section, whose studies of the economic effects of freeways have received nationwide recognition; editing the first right of way manual in the nation; and inaugurating an intensive program of in-service training for right of way agents.

For the past four years Hess has been in general charge of right of way acquisition and related matters in Central and Northern California.

He is a member of the American Right of Way Association and national chairman of its land economics study committee; a member of the Society of Residential Appraisers; and the Commonwealth Club of San Francisco.

Hess and his wife, Louise, reside in Sacramento. A daughter, Mrs. Toni DeFriese, lives in San Francisco.

MacBride, the new Assistant Chief Right of Way Agent, came to California in 1945 from Norfolk, Virginia, where he was raised. He attended the College of William and Mary, received a Bachelor of Laws degree from Cumberland University, and also attended the Medill School of Journalism at Northwestern University.

He practiced law and gave speech instruction in Virginia until he moved to Los Angeles as a right of way agent for the city. In 1946 he became an assistant right of way agent for the Los Angeles District of the Division of Highways. He transferred to Division Headquarters in Sacramento in 1956 as a Supervising Right of Way Agent.

MacBride is national secretary of the American Right of Way Association and a member of its executive committee. He is vice president of the Public Relations Round Table of Sacramento and a member of the Audubon Society. He and his wife, Margaret, live in Sacramento.

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C. J. "Cliff" Temby Retires in Stockton

Clifford J. Temby, Assistant District Engineer of District X, Stockton, retired December 1, 1960 after 46 years with the State Division of Highways. He entered State service at Sacramento in 1914 in the Department of Engineering, California Highway Commission. He has held numerous assignments in the Headquarters office in Sacramento; District III, Marysville; District V, San Luis Obispo; District IX, Bishop; and District X, Sacramento, until 1933 when district headquarters was moved to Stockton.

C. J. TEMBY

During Temby's professional life, he has seen California's highways advance from the horse and buggy era to a modern freeway system serving millions of Californians and tourists. For some thirty years as Office Engineer and Assistant District Engineer he supervised the planning and location of many projects throughout the State whose total value is in the neighborhood of half a billion dollars.

His long service record in District X has earned him the title of "Mr. Highway" among civic and service groups in the nine counties of the district.

He plans to continue his residence in Stockton after his retirement and spend some time traveling in the U. S. and abroad.

BURNED BRIDGE CLOSES ROAD

A major road closure occurred on US Highway 60-70 in eastern Riverside County as the result of the destruction by fire of Segal Wash Bridge about 17 miles east of Desert Center. The highway was closed from 4 p.m. December 23 to 3:45 p.m. December 25 while an adequate local detour was being constructed. During the period of closure it was necessary to detour traffic via the Los Angeles Aqueduct Road.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

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R. S. J. PIANEZZI . . . . Assistant Chief
JACQUES T. ZEEMAM . . . . . . Assistant Chief

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J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

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HOWARD C. WOOD . . . . Bridge Engineer
State-owned Toll Bridges

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I. I. LEVINE . . . . Accounting Officer
JAMES T. RANSDALL . . . Contract Administrator
W. F. PARKS . . . . Supervisor of Office Services
JUSTIN DuCRAY . . . Division Management Analyst
FRANK B. DURKEE, JR. . . . . Information Officer

Los Angeles Office

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LEONARD CHERNOFF . Supervising Electrical Engineer
ROBERT J. PALEN . . . . . . Supervising Estimator
R. J. CHEESMAN . . . Chief Architectural Draftsman
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J. WILLIAM COOK . . . . . Area II, Sacramento
CLARENCE T. TROOP . . . . Area III, Los Angeles

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THEN

The road paving job above was mainly muscle power—both horse and man muscles. This was about 1914, when mechanization was in its infancy. Horses pulled wagons carrying gravel from the borrow pit, a horse pulled the Fresno scraper seen in the background working on the grade, horses even had to pull the mixer to a new position when it was necessary to move it. The only evidence of mechanization is the mixer with its gasoline engine to turn the drum, and the steam roller in the background.

Each mix was about eight or ten wheelbarrow loads (one and a half cubic feet per wheelbarrow), wheeled to the skip by laborers. The big plank with the plow handles on it was used for finishing. The lower edge was cut slightly concave on the under edge to give the road a crown, and a man at either end slid it along.

The modern dual drum mixer shown below moves along and outside the forms, delivers a yard and a half batch about every half minute. Multibatch trucks unload one batch at a time directly into the skip, moving with the mixer. The entire train moves steadily along the job, with the mixer towing its own water tank.

The old type method above would do well to pave 150 feet a day—modern machines do 2,000 feet or more, 24 feet wide, with a better and smoother job.

NOW