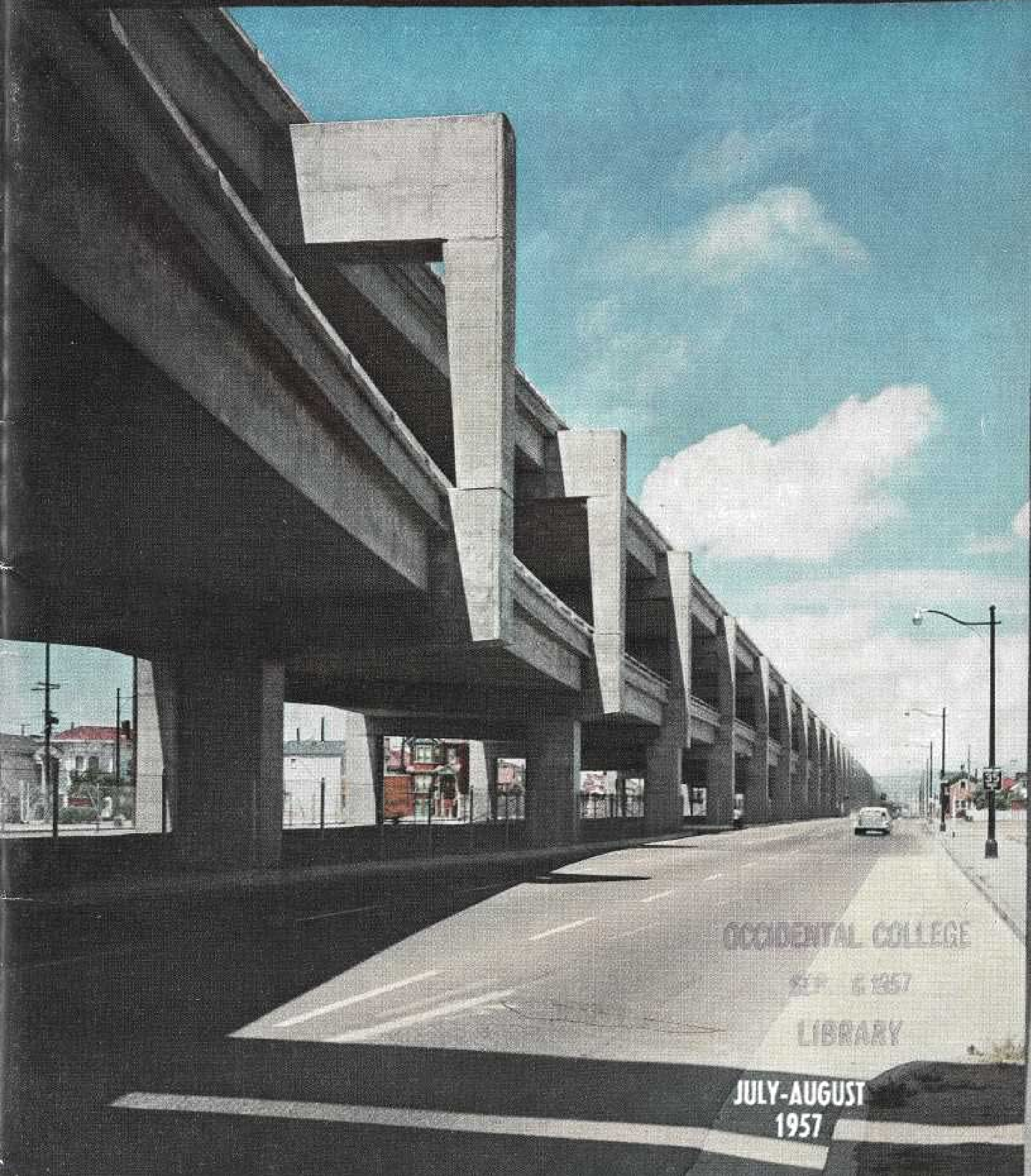
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



JULY-AUGUST
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California Highways and Public Works

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COVER

This $8,000,000 viaduct, first double-deck freeway in California, stretches for a mile and a half along Cypress Street in Oakland connecting the Bay Bridge Distribution Structure with the southerly extension of the Eastshore Freeway. Photo by Robert Munroe, Photographic Section, Department of Public Works, M. R. Nickerson, Chief.

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Information Worth While

By RICHARD H. WILSON
Assistant State Highway Engineer

Quantities and Values of Control Items Used on State Highway Construction Jobs

THERE HAS been a constantly growing demand in Headquarters Office for information concerning the volumes of construction materials, particularly mineral aggregates, cement and steel, that will be required for construction of highway projects included in various California Highway Commission budget programs. This information is usually in demand considerably in advance of when firm quantity estimates become available after adoption of the construction budgets by the commission.

Information of this nature is usually required by contractors and material suppliers and producers immediately following release of approved Highway Commission budget programs to the public. At these times, firms or their representatives attempt to determine the extent to which their facilities will possibly be involved in supplying materials during the construction program periods. Industries particularly concerned in this respect are those in the cement, asphalt, steel, equipment and machinery, and aggregate producing fields.

Factors Involved

Progress toward providing a means for forecasting the requirements of future programs has been made by the Bureau of Public Roads. This agency has prepared usage factor tables for steel and aggregates requirements from data reported by each of the state and territorial highway departments. We believe that the basic data, particularly with respect to the bureau aggregate factors, are in such detail that projection into future programs will be somewhat misleading. The bureau factors, being based upon projects financed partially with federal-aid funds, do not recognize numerous other projects financed wholly from state and local funds and therefore true averages are not reflected.

RICHARD H. WILSON

It was found in developing factor tables for state highway construction requirements in California that a definite relationship existed between the various factors and items used in the California Highway Construction Cost Index and the overall budgetary cost and estimates of material use. Considerable study of highway construction costs was made in developing our index and at the time, it was found that eight construction items were sufficiently recurring to establish definite patterns. Since inception of the index, specifications for construction of plant-mixed surfacing have changed to the extent that little difference now exists between its construction and the construction of asphalt concrete pavement. Recently the two items have been combined into a classification of asphaltic and bituminous mixes for purposes of the index which is now based on seven construction items.

Nine Contract Items

It was decided in preparing the factor tables that consideration should be mainly restricted to the seven items of construction used in index calculations but that in addition cement and asphalt as items upon which contractors furnish bids would be included since they are items for which regular reporting is made.

The value of the nine contract items for which factors have been determined represents slightly over 60 percent of the construction value of all contracts awarded.

From studies made in this office, factors have been determined for each of the years 1954, 1955 and 1956 based on actual quantities required for nine major bid items of construction contracts with relation to the total construction value of all contracts awarded during each calendar year. Composite factors were then determined for the nine items based on total requirements for the three years with relation to the total value. The composite factors agree favorably with the factors determined for each of the three years and it is believed that through their use it will be possible to forecast the requirements of our construction programs for these major items when the monetary value is known. Such forecasts should provide information reasonably accurate for the purposes intended.

Intelligent Guessing

Sufficient study has not been made to determine that the same degree of accuracy will prevail when the factors are applied to groups of projects or to projects within particular regions or areas. Since these factors are based upon statewide averages, it is recommended that they not be applied in instances other than where average conditions prevail. However, in the absence of data from which quantities can otherwise be determined, it is felt that the factors when applied in most instances, will afford a means for "intelligent guessing."

Tables have been prepared for the calendar years 1954, 1955 and 1956 and the three years have been consolidated to provide the information for a composite table. In each instance the total number of contracts awarded during the respective periods together with the total bid item values are shown. In addition, the tables include the total quantities embraced in the nine items together with the dollar value involved. From the foregoing figures, factors have been computed showing the quantity of material for each of the nine items required for each million dollars of contract item value; the dollar value for each of the items for each million dollars of contract item value; and a percentage representing the ratio that the dollar value of each item bears to the total contract item value for all contracts awarded during each period.

After bids are opened in the assembly room of the Department of Public Works, the proposals together with extension tabulations are handled by this group. The bid prices are extended, totaled and compared with bidder's proposal to assure that bid is correct. It is verified that the bidder's name and signature are consistent and in agreement with prequalification. The bidder's security is reviewed and, if inconsistencies are apparent in signature or security, the proposal is referred to attorneys for a ruling as to validity. LEFT TO RIGHT: Forren Lee, Margaret Harder, Joe Rieger, Raymond Edgell, Harry Sahagian, Floyd Reynolds, H. C. McCarty, Harry Slesinger, Walter Landers, Dick Roberts, and Carl Tomei.

Roadway Excavation

Roadway excavation is an item found in almost every contract awarded. Quantities and prices are affected to considerable degree by project location and prices are further affected by volume, by traffic interference and climatic conditions. Construction is so widely distributed over the State that reasonable averages prevail. Occasional exceptions are to be found during periods when a small number of large projects are put under way in locations where identical conditions exist, resulting in unbalancing average unit prices. Roadway excavation is let on an unclassified basis and therefore quantities and prices used in the factor determination include all earthy material handled except structure excavation, ditch excavation and other excavations of specified nature.

Types of Surfacing

The item of untreated rock base includes both base and surfacing aggregates in connection with which there is neither a cement or asphalt treatment applied as part of the item. Previous to 1953, crusher run base was used for the purposes for which untreated base is now being used.

Asphaltic and bituminous mixes include both plant-mixed surfacing and asphalt concrete pavement. Both of these surfacings are placed without side forms and the similarity of other specifications together with comparable bid prices generally received for the two items have eliminated the necessity of giving separate consideration in various cost analyses.

When asphalt concrete pavement is specified, the unit includes the weight of the asphalt content. In most instances plant-mixed surfacing requires separate items for asphalt and mineral aggregate. For factor purposes the weights and prices are combined to provide a price per ton for either surfacing in place. The average application of asphalt in these mixes is estimated at approximately 5 percent. To determine the approximate weight of aggregate, the total mix weight should be divided by 1.05 and the difference between the two weights will give the approximate weight of asphalt.

Concrete Pavement

Portland cement concrete pavement includes portland cement concrete used in all pavements of this type in which the cement content is specified at five sacks to the cubic yard. The volume for pavement includes the amount of cement used in the mix and the cement used for this purpose is not included in the item of cement. Should there be reason for breaking the item down into its components, the total quantity of pavement can be multiplied by 1.25 to provide the volume of cement stated in barrels. The volume of pavement when multiplied by 1.7 will furnish the approximate quantity of mineral aggregates expressed in tons.

Portland cement concrete structures includes all portland cement concrete used in structures of all kinds except the concrete used for footing blocks, railing, precast and prestressed members and other minor uses in connection therewith. Except in some minor instances, the cement content of the material for this purpose is six sacks per cubic yard. The cement volume in barrels can be determined by multiplying the total volume by 1.5 and the same volume multipled by 1.7 will provide the weight of the mineral aggregate in tons.

Reinforcing Steel

Bar reinforcing steel quantities include all reinforcing steel used in constructing bridges and other structures. Some instances occur when the item is bid on a lump sum basis and when this procedure is used, the quantity in pounds that is represented by the lump sum item is combined to provide the total reinforcing steel requirements expressed in pounds.

Structural steel includes the weight of rolled shapes and other steel required in the construction of steel structures. Special high-strength steels such as was specified in the construction of the Carquinez Bridge are exceptions and exclusion of these types of steel is for the reason that they are not generally found in normal designs and the price differential would throw unreasonable weight on price averages.

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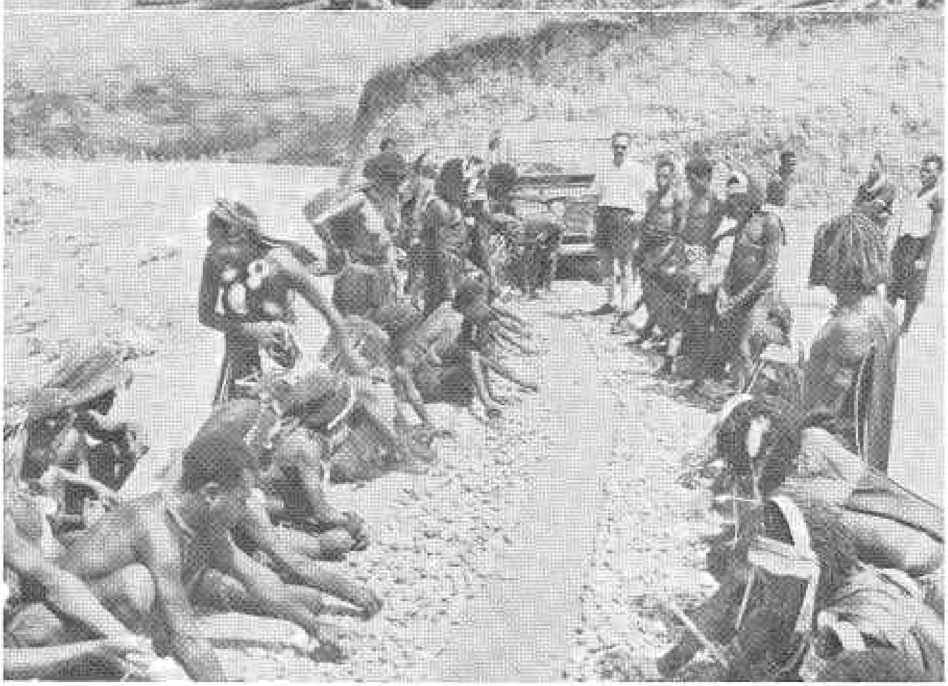
PRIMITIVE ROAD WORK IN NEW GUINEA



Photos from Australian News and Information Bureau.

The next time you see modern equipment at work building a freeway or expressway in California, compare it with these pictures of primitive methods of highway construction in the Australian trust territory of New Guinea. Upper picture shows workers laying a corduroy base over a sacsac swamp to give a firm foundation on the new Wewak-Dagua Road, a length of 30 miles. Lower photo shows villagers surfacing a road with stones from nearby streams. One day a week is allocated for roadwork and among the Eastern Highlanders enthusiasm for roadbuilding is so great that everybody turns out on road day to have a share in the work.

INFORMATION WORTH WHILE

Continued from page 3 . . .

While structural shapes are used for steel piling, the quantity of steel for this purpose is not included in the item of structural steel. It is the intention that the quantity of steel required for this item should be confined to superstructure construction or steel that requires fabrication.

When Cement Is Used

Cement is specified as an item when its purpose is intended for treating bases and subgrades. A barrel unit is specified when the material is used for these treatments. Total cement requirements for state highway construction programs can be obtained by combining the results of the factor for the cement item together with the cement requirements for pavement and structure concrete as determined above.

Asphalt when a separate item, covers its use for prime coat, penetration treatment, armor coat, seal coat, road-mix surfacing, bituminous surface treatment, etc. Asphalt used for plant-mixed surfacing is usually paid for as a separate item but for purposes of these factors and the cost index it is combined with the quantity of mineral aggregate to furnish the total weight of bituminous mixes. The average content of asphalt in plant-mixed surfacing is about 5 percent of the weight of aggregate used. The total asphalt requirements for the various construction programs is the resultant of the factor for this item combined with the weight of asphalt in the item of asphaltic and bituminous mixes determined according to the breakdown shown in that item above.

Various Materials Specified

There has been no attempt to include all materials required by the various construction programs that are common to the items for which factors have been computed. For in-

. . . Continued on page 34

SUMMARY OF QUANTITIES

California Division of Highways Contracts

January 1, 1954, to December 31, 1956

1831 contracts with total value of $520,951,100 (contract bid items only)
Weighted averages for three-year period

Contract items	Total quantities for 3 years	Dollar value totals for 3 years	Quantities per million dollars of contracts	Dollar value per million dollars of contracts	Percent of total contract value
Roadway excavation	114,008,151 cu. yds.	$48,189,820	218,900 cu. yds.	$93,000	9.3%
Untreated rock base	7,789,873 tons	15,939,758	15,000 tons	31,000	3.1
Plant-mixed surfacing	10,813,574 tons	55,874,241	20,800 tons	107,300	10.7
Asphalt-concrete pavement	92,675 tons	478,313	177 tons	920	0.09
Portland cement concrete pavement	2,107,120 cu. yds.	30,049,983	4,040 cu. yds.	57,700	5.8
Portland cement concrete structures	1,473,230 cu. yds.	76,175,612	2,830 cu. yds.	146,200	14.6
Bar reinforcing steel	272,509,722 lbs.	27,370,655	523,100 lbs.	53,000	5.3
Structural steel	108,589,871 lbs.	16,409,797	208,400 lbs.	32,000	3.2
Cement (contracts only)	7,127,955 bbls.	26,264,285	13,700 bbls.	50,000	5.4
Asphalt (contracts only)	761,490 tons	16,098,560	1,460 tons	30,900	3.1
State purchases cement	13,144 bbls.	54,779			
State purchases asphalt	139,407 tons	3,385,105			

California Division of Highways Contracts

January 1, 1956, to December 31, 1956

625 contracts with total value of $201,067,500 (contract bid items only)

Contract items	Total quantities for year	Dollar value totals for year	Quantities per million dollars of contracts	Dollar value per million dollars of contracts	Percent of total contract value
Roadway excavation	36,214,445 cu. yds.	$17,925,073	180,100 cu. yds.	$89,000	8.9%
Untreated rock base	3,093,426 tons	6,707,217	15,400 tons	33,000	3.3
Plant-mixed surfacing	3,423,296 tons	20,509,304	17,000 tons	102,000	10.2
Asphalt concrete pavement	1,950 tons	12,675	10 tons	65	0.006
Portland cement concrete pavement	795,631 cu. yds.	11,832,946	3,950 cu. yds.	58,800	5.9
Portland cement concrete structures	470,121 cu. yds.	26,825,952	2,340 cu. yds.	133,400	13.3
Bar reinforcing steel	89,313,253 lbs.	9,997,422	444,200 lbs.	50,000	5.0
Structural steel	34,200,821 lbs.	6,607,470	170,100 lbs.	33,000	3.3
Cement (contracts only)	2,540,616 bbls.	9,455,071	12,635 bbls.	47,000	4.7
Asphalt (contracts only)	291,578 tons	6,542,221	1,450 tons	32,500	3.3
State purchases cement	2,152 bbls.	11,592			
State purchases asphalt	47,798 tons	1,296,837			

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Pass of the Oaks

Paso Robles Project Is Progressing

By LOWELL D. KRAATZ, Resident Engineer

TRAFFIC CONGESTION in Paso Robles in San Luis Obispo County, originally named the City of El Paso de Robles, caused by an 82 percent increase in average daily traffic on the Coast Highway, US 101, in the past eight years, will be solved in the spring of 1958 by completion of a $3,340,000 freeway passing through the city on new alignment.

The City of El Paso de Robles, "the pass of the Oaks," is a moderately expanding residential and small commercial community with a population of approximately 7,000 located in a relatively narrow oak-studded constriction of the Salinas River valley, approximately 30 miles north of San Luis Obispo on US 101. Its history includes an era of worldwide fame in the early part of the century when tourists and the ailing flocked to the area to take warm sulphur baths supplied by still active sulfur wells which are located throughout the city. The area is served by the coast route of the Southern Pacific Railroad and State Sign Route 41 and US 101 which intersect at 13th and Spring Streets.

Four-lane Divided Highway

The project now under construction by the Madonna Construction Company consists of 5.1 miles of four-lane divided highway which will pass through the city between the Southern Pacific Railroad tracks on the west and the Salinas River on the east. It will connect existing four-lane divided expressways 1.3 miles south and one mile north of the city limits. Six bridge structures are included in the project. Also, under this contract, recently completed projects on State Sign Route 41 from Huero Huero Creek to the Estrella River will be connected to the freeway by construction of 2.2 miles of two-lane highway on new alignment.

Work started October 15, 1956, and at present grading has been completed and the concrete paving operation started. The contractor moved 1,200,000 cubic yards of roadway excavation at a rate of 10,000 to 15,000 cubic yards per day. This was accomplished using two- and three-axle pneumatic-tired scrapers in conjunction with tractors with dozers for loading and ripping. The major portions of excavation were contained in high benced cuts at each end of the project. Median crossover detours were constructed at each end of the project to carry two-way traffic through the construction area.

Roadway Excavation

Roadway excavation in these high benced cuts was completed without incident, even though it was necessary for the heavy grading equipment to work adjacent to and cross traffic. In general roadway excavation material consisted of clayey sand, soft clay shale and talus which were expansive in nature. Most of this material required 20 percent to 50 percent moisture in order to obtain the required compaction. Compaction equipment consisted of standard sheepsfoot rollers and segmented steel wheel rollers. An attempt to use a tractor-drawn 50-ton pneumatic roller failed due to the difficulty in maintaining traction in the wet clay.

The structural section for the freeway on US 101 consists of 0.67 foot of Class B portland cement concrete on 0.33 foot of cement-treated subgrade over 0.50 foot of selected material. The structural section for the portion of the project on State Sign Route 41 consists of 0.25 foot of Type B plant-mixed surfacing on 0.67 foot of Class B cement-treated base over 0.50 foot of selected material. The selected material was obtained from a cut on State Sign Route 41 and is a uniform sandy material of good quality. Most of this material was excavated and hauled in pneumatic-tired scrapers, but the long-haul material was loaded into 10-cubic-yard capacity dump trucks using a pneumatic-tired six-cubic-yard skip-loader.

Drainage Structures

All drainage structures under the main lanes consist of reinforced concrete pipe varying in size from 18 to 66 inches in diameter. Pipe installations were hampered by the presence of ground water and unstable basement soil. At these locations the pipe trenches were subexcavated and backfilled with Type C filter material to provide firm bedding for the large culverts. Where necessary, eight-inch perforated metal pipes were installed either below or adjacent to the pipe culverts to carry the profuse ground water flows. Four large-diameter culverts were extended adjacent to the freeway under city streets. Great care was taken during the installation of these pipes to avoid damage to water, sewer and gas lines. At two locations it was necessary to install 60- and 48-inch centrifugally cast extra-strength reinforced-concrete pipe under the Southern Pacific Railroad tracks by the jacking method in order to avoid a disruption of rail traffic. These reinforced-concrete pipes were jacked through the railroad embankments by means of four 125-ton hydraulic jacks operating in pairs.

Special Methods and Design

Special methods and design were necessary to solve the relatively minor drainage problem of warm sulfur

Present steel pratt truss bridge across Salinas River looking westerly toward Paso Robles

water artesian wells located under planned frontage roads. An attempt to cap one of these wells failed due to the poor condition of the steel well casing. The final solution to this problem was to attach vitrified clay pipe or asbestos bonded corrugated metal pipe to the existing casing with a concrete collar to drain the flow horizontally outside the embankment area. As insurance against possible subsurface casing leakage, a 10-foot-diameter filter material cone was constructed around the casing to a depth of three or four feet.

Planned grade requires a 20-foot cut to carry the freeway under the 13th Street Overcrossing. Due to the presence of ground water in this area, a network of eight-inch perforated metal pipe underdrains in conjunction with a 1.0-foot pervious blanket under the freeway lanes will be placed to carry off ground water.

Future Expansion

In order to provide for future expansion of this facility to a six-lane divided freeway, 550 lineal feet of metal bin-type retaining walls designed for future vertical extensions were installed at the toe of two embankments. These walls are constructed to a height varying from four to eight feet and may be extended to a maximum height of 13 feet. Construction of these retaining walls under this contract will eliminate the necessity of purchasing expansive right-of-way or making costly realignment of the highway in the future.

Some 73,500 tons of imported base material for use under shoulders and as cement-treated subgrade are being obtained from the Salinas River bottom adjacent to the project. This material is produced by pit-blending clean river run sand with silt binder and screening the mixture to remove oversize rock, deleterious roots, etc. Approximately 41,000 tons of mineral aggregate for Class B cement-treated base to be used under ramps, frontage roads and the traveled way of State Sign Route 41 are being produced by a portable crushing and screening plant from a terraced gravel deposit on the banks of the Salinas River. In an adjacent pit of similar material 36,600 tons of mineral aggregate for ¾-inch maximum Type B plant-mixed surfacing will be produced.

Using a bulk cement truck spreader and a self-propelled 54-inch mixer, Class B cement-treated base is road-mixed and placed at the rate of 4,000 square yards per day. The addition of the specified minimum of 2½ percent cement has produced a base with a compressive strength varying from 600 to 800 pounds per square inch.

Plant-mixed surfacing is being produced by a 5,000 pound capacity asphalt plant coupled with a portable crushing and screening plant. On the street a level course 1½ inches thick is laid with a motor patrol and pneumatic roller. Pavers have been used to lay a surface course of satisfactory quality.

High-grade Aggregate

Aggregate of exceptional quality for use in Class B portland cement concrete is produced by the contractor from a rock quarry located 20 miles south of the project on the Salinas

River. Aggregate is produced from granite rock by normal methods consisting of drilling, shooting, crushing, screening and washing. Sand grading is controlled by a hydraulic classifier, and river run sand is blended with the crusher sand to produce the fine aggregate. Some 22,000 cubic yards of concrete paving is being produced by a normal construction train consisting of a double-drum mixer, mechanical spreader, tamper finisher and float. Since the aggregate is 100 percent crushed, an air entrainment additive is introduced into the mix to improve workability. Concrete paving is being placed at the rate of 900 to 1,400 cubic yards per day and 130 to 140 cubic yards per hour. Due to the wide range in daily temperature change in this area, weakened-plane joints constructed by the sawed method on previous concrete paving projects have not entirely controlled random cracking.

Temperature Change

Daily temperature changes of 30 to 50 degrees are not uncommon. For this reason metal weakened-plane joints are installed at 60-foot intervals in the initial lane and at all working joints, not to exceed 60 feet, in the companion lane. The metal strips are 16-gauge sheet metal 1¾ inches wide and 12 feet long and are coated with a light oil. The joints are placed using a T-iron cutter prior to final finishing and maintained within ¼ inch of the finished concrete surface. The remaining joints at 15-foot intervals are sawed on the day following placing of the concrete pavement. This method of forming control joints and sawing the remaining joints appears to have stopped random cracking and has improved the quality of the sawed joints through a reduction in tearing and spalling.

Two Overheads

At each end of the city, US 101 will be carried over the Southern Pacific Railroad tracks by a pair of parallel welded steel girder bridges with reinforced concrete decks providing a 28-foot clear roadway. These South and North Paso Robles Overheads vary in length from 618 to 700 feet and consist of six and seven spans supported by single rectangular reinforced concrete piers with welded steel caps and concrete abutments, all founded on concrete piles. The three-foot by seven-foot-six-inch concrete piers vary in height from 15 to 38 feet and were poured monolithically. Pier forms were braced with eucalyptus piling. Concrete piles are circular step-tapered corrugated metal shells driven by mandrel and filled with concrete.

Local city traffic will be carried over the freeway on the 13th Street Overcrossing. This two-span bridge consists of a reinforced, prestressed concrete slab, about 118 feet long supported on reinforced concrete abutments and bent with spread footings. This bridge will provide a 55-foot clear roadway with 12-foot sidewalks. The deck slab is one foot six inches thick and will be prestressed with high-strength wire placed in conduits.

Diamond-type Intersection

At the diamond-type intersection of highways US 101 and Sign Route 41, the former will be carried over the latter on two parallel steel girder bridges with reinforced concrete decks, 133 feet long and providing 28-foot clear roadways. Each bridge of this Route 2/33 Separation consists of three spans supported on reinforced concrete bents and abutments, all on concrete piles. This structure has been designed for future lengthening with minimum traffic interference, when State Sign Route 41 is constructed to full four-lane divided freeway standards. On and off ramps will provide the necessary access to and from both highways.

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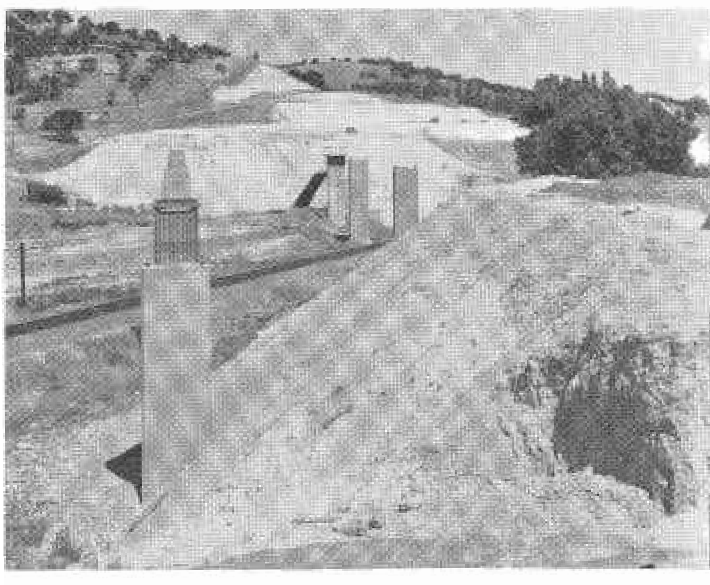
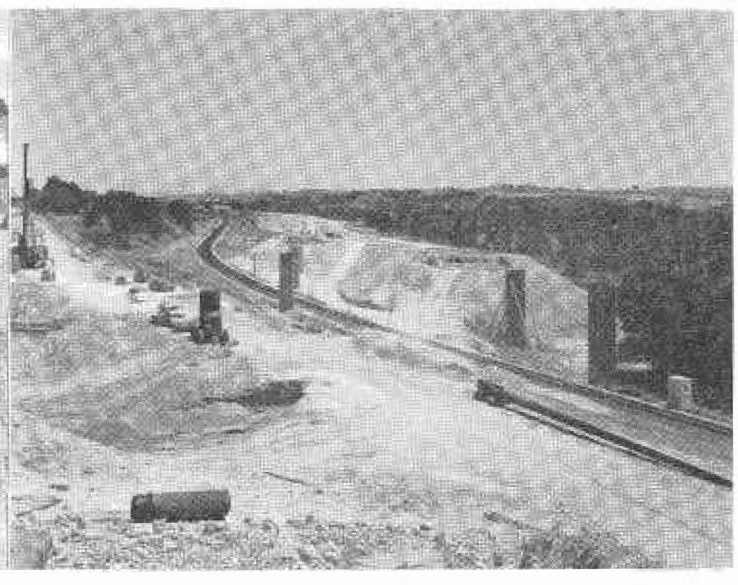
LEFT—View of North Paso Robles Overhead construction looking northerly. RIGHT—View looking northerly from site of South Paso Robles Overhead. Main coast line of Southern Pacific in foreground.





Famoso Project

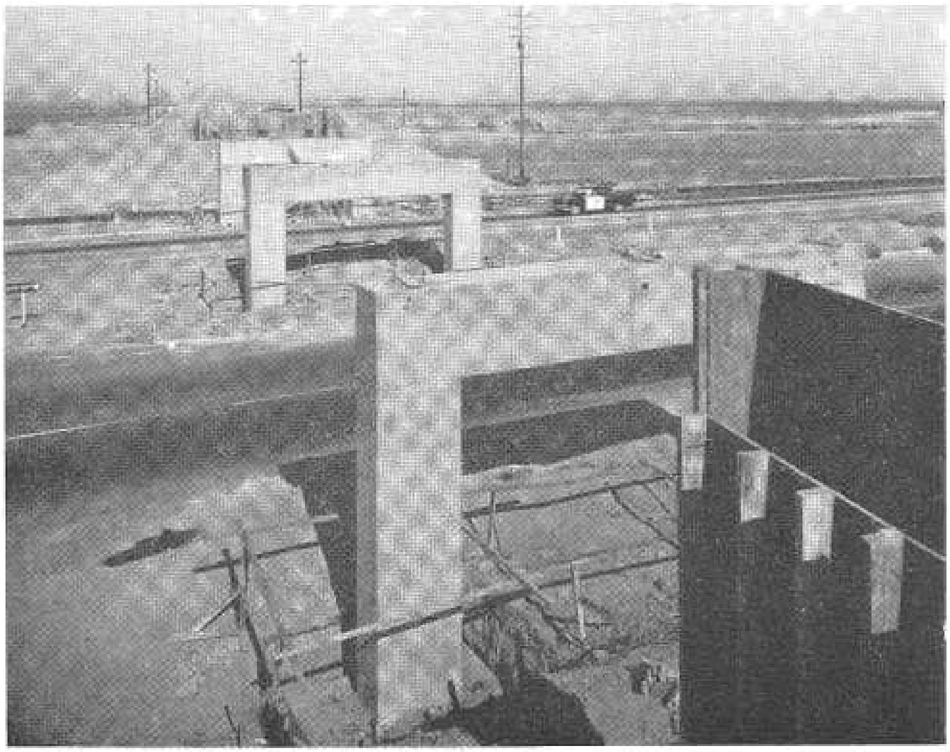
New Overhead Structure Will Supplement Underpass

By JOHN C. GARY, Acting Resident Engineer, and
RALPH E. HAVERCAMP, Bridge Department

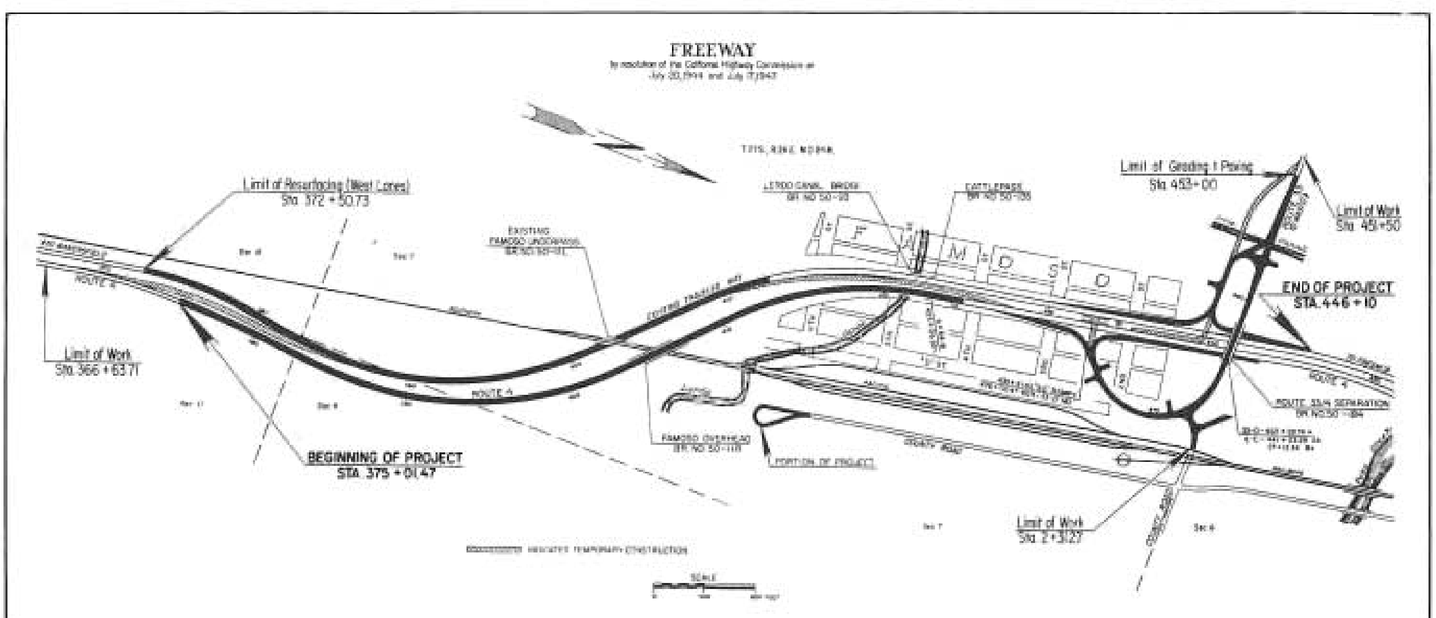
FAMOSO UNDERPASS, which is on US 99 about 21 miles north of Bakersfield and is near the junction with US 466 from the west, was first opened to traffic on January 28, 1937. The present road on either side of the existing underpass is of the four-lane divided highway type but the underpass is undivided. The work being done on this project will eliminate this bottleneck which has been the scene of numerous accidents in recent years.

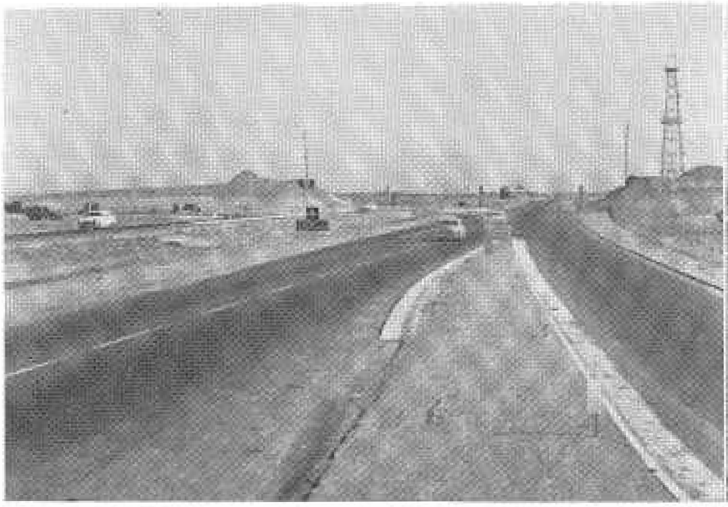
The improvement consists, in general, of constructing an overhead structure and approaches to carry northbound US 99 traffic over the Southern Pacific railroad tracks and of constructing a separation structure, approaches and channelization at the junction of US 99 and US 466 (State Highway Routes 4 and 33). The existing underpass will serve the southbound traffic.

This project is a part of a continuing program to develop US 99 into a



View westerly of the Route US 99 and US 466 separation





LEFT—View northerly showing existing divided US 99 with Route 99-466 separation in background. RIGHT—View northerly showing existing Famoso Overhead in the center background and its approach fills.

freeway status and was on an expressway basis prior to the commencement of this work.

Portland cement concrete pavement will be used for the US 99 section, and plant-mixed surfacing for US 466 and its connecting ramps.

The Lerdo Canal crosses US 99, and a lateral of Lerdo Canal crosses US 466. Extension of the triple 8 x 5-foot reinforced box on the former was required. Through agreement with the Kern County Land Company the existing double 48-inch corrugated metal pipe on US 466 was replaced with a double 5 x 5-foot reinforced concrete box, the land company paying the additional cost required to provide a flow of 200 cubic foot per second, whereas the original capacity was rated at 100 cubic foot per second.

The contractor was able to obtain a very favorable agreement from an adjoining property owner whereby he would land level the property for crop purposes. Since this area was immediately adjacent to the heaviest fill section of the project, the contractor benefited by the much shorter haul than from the state provided pit.

Famoso Overhead

To carry the US 99 northbound traffic across the Southern Pacific railroad tracks, an overhead structure was designed with a 37-foot roadway width, with provisions made for removing one curb should future widening be necessary. The 234-foot structure consists of three equal spans, each consisting of a reinforced concrete deck supported by five 42-inch welded plate girders. Skewed at an angle of 55 degrees with normal, the two concrete bents each consist of three columns supporting the concrete cap. Both the bents and the open-type abutments, situated high on the approach fill, are supported by concrete cast-in-drilled-hole piles. Construction was started early in March, 1956, and all of the substructure concrete had been placed by early June.

Separation

The US 466 traffic will be carried over US 99 on a new separation structure consisting of three 70-foot spans and one 35-foot span. Roadway width will be the standard 28 feet with concrete curb and railing on each side. Here also the design calls for 42-inch welded plate girders; however, the narrower width and shorter span

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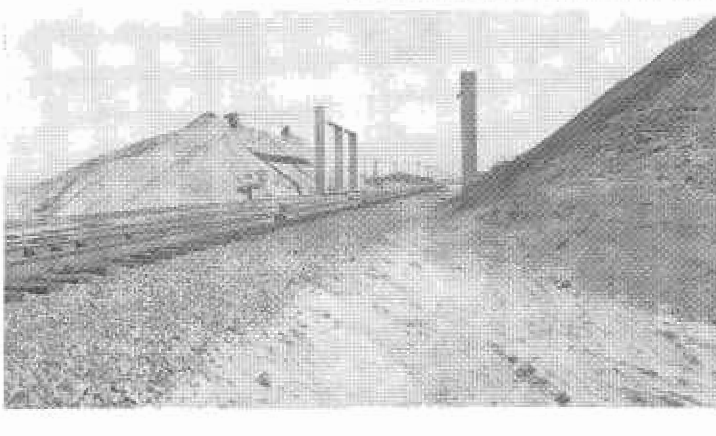
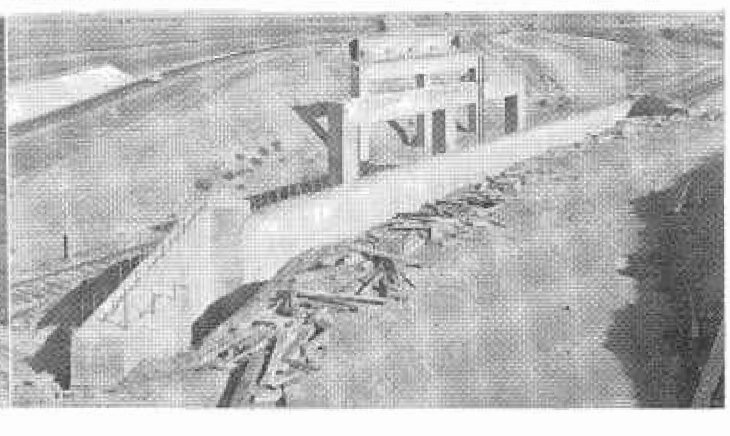
LEFT—View northwesterly of Famoso Overhead. This will be future northbound lane. RIGHT—View northerly at Famoso Overhead.





The New Look

Fresno Working on Pattern of Highways

By EARLE W. TAYLOR, District Traffic Engineer

The new pattern of state highways for the City of Fresno, now rapidly nearing completion, will utilize a simple yet peculiarly efficient means of connecting the six major entrances to the city and connecting them in the most difficult part of town—the central business district.

The ingenious plan consists of providing a tight inner cordon of highways or circumferential route in the form of an approximate square around the core of the downtown area. It makes use of a combination of freeway, one-way couplets and divided and conventional city streets to form this cordon and its approaches.

The Effect of a Railroad

As do so many San Joaquin Valley communities, Fresno shows the profound effect the building of the first railroad had on community development and street pattern. Fresno's state highway problem really started in 1873 when the original townsite was laid out with streets paralleling and at right angles to the railroad which runs in a northwesterly direction.

County Road Pattern

Before the budding city outgrew the original townsite, the pattern of county roads located on section lines was so firmly established that later subdivisions outside the original townsite generally followed this exterior pattern. Thus it occurs as a natural consequence that at the lines of demarcation between the two patterns, most streets make an angle of about 45 degrees.

The principal exception was the road now known as US 99. Since it was built to connect the numerous towns strung along the railroad, it naturally paralleled the railroad and passed through Fresno parallel with the first street pattern.

The Effect of Both

But not so the other two state routes. Sign Route 41, the north-south Yosemite-to-the-coast highway, and Sign Route 180 running east from Tracy to Kings Canyon National Park were adopted from former section line county roads, which were forced to jog to pass through the city. The nature of the recent path of these routes through the old part of the city is illustrated by the insert on the accompanying sketch.

Each route made two 45-degree angles and three 90-degree ones and suffered losses of distance of 0.6 and 0.7 mile over a straight line. Further, portions of both routes passed through the congested center of the business district on narrow undivided streets and used several blocks of Broadway in common with US 99, further congesting it. And to further complicate matters, the connections of the three routes occurred in the heart of the business district.

Even US 99 followed a somewhat devious path, crossing the railroad twice and making several jogs. Forced to follow Broadway, it found itself on the second most important shopping street, now carrying about 32,000 vehicles a day.

What to Do?

It was patently impossible to do much in the way of straightening and shortening Highways 41 and 180. To do so would have caused them to cut diagonally across and grossly disrupt the existing street pattern through the heart of the business district. The only solution for the problem was to make the most efficient use of the present awkward street pattern and to move the routes out of the most congested section.

But something good *could* be done about US 99! It could be replaced by a full freeway lying entirely west of the tracks, no longer than the present route and removed from the central business district, yet close enough to serve it well. This five-mile, 10 million dollar project is nearing completion.

The Plan: A Cordon

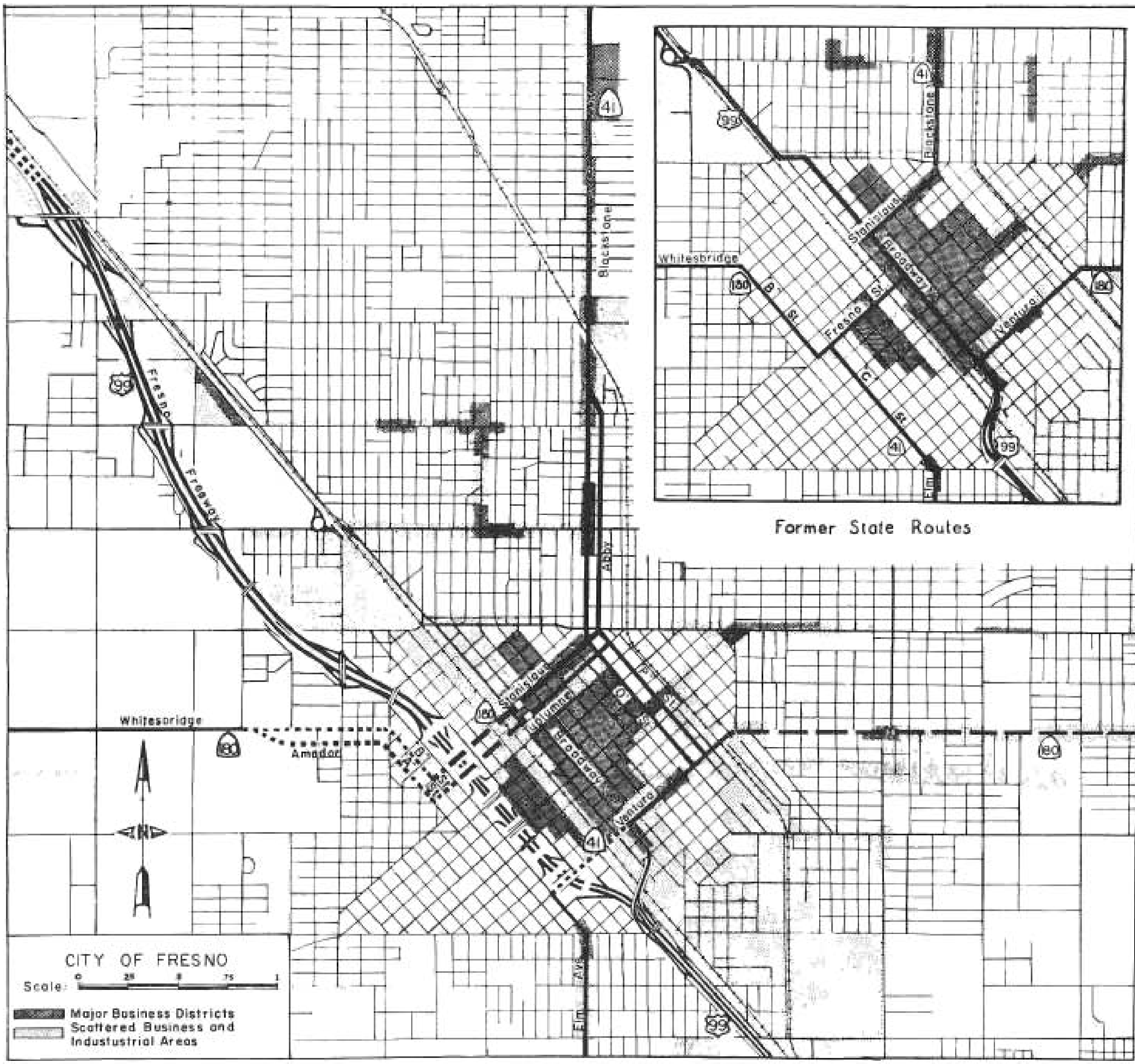
A cordon of new highway routes will surround the core of the downtown area. The US 99 Freeway will form one side of the square. Two other sides consist of one-way couplets and the fourth of a four-lane city street, part of which is divided. All six approaches join the cordon at or near its four corners.

The cordon, as shown on the accompanying sketch, will enclose an area of 0.8 square mile, or 110 city blocks. It contains the bulk of the downtown retail business district, the civic center and many industrial plants along the Southern Pacific tracks. It also encloses a large secondary shopping area west of the tracks. Situated within the first few blocks outside the cordon are additional retail outlets, industries, parks, schools, churches, and, along the A. T. & S. F. Railway, another well-developed industrial area.

How It Will Work

This cordon arrangement and the six state highway feeders to it will permit through traffic to traverse the heart of the city with much less delay by following a reasonably direct path yet skirting the most congested area. It will permit convenient interchange from any route to the others. And it will make it possible for most home-to-work and shopping drivers, the largest group of users, to stay on a major highway almost to their ultimate destination.

It will be possible to reach any point within the cordon from a state highway route without traveling more than five blocks on city streets. By considering also the area immediately outside the cordon, a trip over city streets of that length will permit drivers to reach every point in an area of three square miles containing over 430 city blocks.



Map showing the awkward street pattern in downtown Fresno and the new routing of state highways which form a cordon around the heart of the central district with connections at its four corners. INSERT—The former unsatisfactory routing through the downtown area.

A Freeway

Much of the program is already completed, and other sections are under construction. The Fresno Freeway is finished except for a one-mile section in West Fresno, which should be ready for traffic by mid-September.

The O and P Street one-way couplet has been in operation more than 18 months, as has the Stanislaus-Tuolumne pair between Broadway and P Street. The portion between the Freeway and Broadway is under construction and scheduled for completion by April, 1958. The particular feature of this project is a pair of one-way bridges which will span not only the 21 tracks of the Southern Pacific yards, but the street on each side of them as well. The accompanying picture shows the present stage of construction of one of these bridges.

The plan is to further extend this one-way couplet to the west another mile over A and B Streets and Whites Bridge Avenue and Amador Street to the edge of the city. It is expected this section will be constructed during 1959.

Ventura Avenue

Ventura Avenue from Broadway east to the bend needed no improvement, being a four-lane street with painted divider and left turn lanes. The section from the bend to a point 2½ miles easterly is under construction as a four-lane divided highway, to be completed during February,

Construction of the Tuolumne Street one-way bridge over the Southern Pacific, G Street and H Street which will carry eastbound (toward the camera) traffic on Highway 180. The bridge over the depressed US 99 freeway can be seen in the background. Companion bridges on Stanislaus Street for westbound traffic are one block to the right. View is westerly along Tuolumne Street. Near street in foreground is Broadway—next to the west is H Street. G Street is first west of tracks. Structure in center background on Tuolumne Street is the Tuolumne overcrossing of the West Fresno Freeway (Route 4, US 99).

1958. Between the Freeway and Broadway, the street will be repaved soon.

Blackstone Avenue and Abby Street, Highway 41, went into one-way operation nearly two years ago, following the widening and complete repaving of Abby. Farther north, Blackstone has been the scene of a continuous program of widening to six lanes divided since 1953. It is now completed to a point 3½ miles north of the end of the one-way couplet. The next three-mile section is under construction and by January, 1958, will complete this program through Pinedale and nearly to the Fresno-Madera County Line.

Succesful One-way Streets

The Blackstone-Abby pair well illustrate the success of one-way traffic operation in Fresno. They have fully met—even exceeded—the most optimistic advance expectations of their success. Traffic volume has increased by 53 percent and they now carry about 33,000 vehicles a day on their six 12-foot lanes. Average speed has been increased and peak-hour delay measurably reduced, as drivers are normally able to maintain the speed of 30 miles per hour for which the progressive signal system is timed. The accident rate was reduced 38 percent and the injury rate went down by the strikingly large amount of 72 percent.

A Look to the Future

The new plan for state highways into and through Fresno, even in its present incomplete status, is already paying large dividends in more expeditious driving and less hazard. By utilizing a rather unique and ingenious method of interconnecting the six entrances by a route close around but not within the congested central district, the plan, when completed, holds bright promise of solving for some time to come major traffic problems in this rapidly growing city.

Congestion will be relieved not only on the former state routes, but on several other shopping streets as well. The expected large decrease in accidents from the freeway and additional one-way streets should have a marked influence on the total citywide accident picture.

Even though it may develop that additional freeways are needed some time in the future, the present plan would still continue to well serve important needs of the community and would become a valuable adjunct to any future freeway network.

Contractors Take Public Into Their Confidence on Jobs

The idea of a personally delivered explanatory message to residents in the neighborhood of heavy freeway construction, as initiated by a contractor on the Glendale Freeway and described in the May-June issue of *California Highways and Public Works*, is apparently catching on.

A similar "greeting card" has been delivered to people living in another part of Los Angeles, the section where the Harbor Freeway is being extended southward from 88th Street to 124th Street.

In this instance the contractor is the Guy F. Atkinson Company. The project calls for excavation of more than 1,300,000 cubic yards of earth from the area between 110th Street and 124th Street, which must be transported to build embankments at the northerly end of the job.

In order to speed up the excavation phase of the project, the contractor applied to city authorities for permission to carry on work during the evening hours, up to 10.30 o'clock. When this permission was granted, the contractor had the explanatory pamphlet printed and delivered to nearby residents. In addition to a brief explanation and map of the project, the pamphlet contained a reprint of a newspaper article stating that the double-shift operation is intended to speed up completion of the whole freeway project by six months.

The explanation in the pamphlet is signed by R. W. Atkinson. Like the one distributed by the Thompson Construction Company on the Glendale Freeway project, the pamphlet is reported to have received favorable reaction from residents of the area.

In Memoriam

WAYNE J. DEADY

Wayne J. Deady, Associate Bridge Engineer for the Division of Highways, died suddenly at his home in Sacramento on July 19th, while convalescing from a major operation. His many friends throughout the division regret his passing.

Born July 5, 1902, at Carson City, Nevada, Wayne was the son of Nevada State Surveyor-General C. L. Deady, a Nevada pioneer. Deady graduated from Carson High School. He continued his education with university extension courses and was a registered civil engineer in California.

Wayne began working in the Design Office of the Bridge Department in Sacramento in 1926 following varied engineering experience as a draftsman and instrumentman with the U. S. Bureau of Public Roads, the Southern Pacific Company, San Mateo County Surveyor, Michigan-California Lumber Company at Camino, and as a draftsman in the Headquarters Office of the Nevada Highway Department.

After three years in the Bridge Department's Design Office, Deady was assigned to bridge construction projects as resident engineer and served in this capacity from 1929 to 1949. During this time he became one of the key men in the Bridge Department construction force, supervising construction of many important major projects.

Before the day of organized training programs, Wayne always made a special effort to give young engineers on his jobs as wide experience as possible and is well known for his interest in aiding them.

Deady had been in the Design Section of the Bridge Department in Sacramento since 1949 preparing contract specifications and special provisions for major structure projects on state highways.

Deady was a member of the American Society of Civil Engineers; Turlock Lodge No. 395, F&AM; and the James W. Marshall Chapter 49, Placerville, of E Clampus Vitus.

Deady is survived by his widow, Lola M. Deady, and his son, Willett C. Deady.

US 50

Improvements in Stockton Area Will Solve Bottleneck

By LOUIS G. KROECK, District Design Engineer, District X

During the past few years the importance of Highway US 50 (State Route 5) in the Stockton area has become quite evident. This route is the main link between the metropolitan San Francisco Bay area and the great food-producing areas of the San Joaquin Valley. US 50 is also one of the main routes between the Bay area and the vast recreational area of the Sierra Nevada.

Under contract at the present time and scheduled for completion in the spring of 1958 is a 6.8-mile length of highway between the San Joaquin River at Mossdale and Richards Avenue south of the French Camp area. Conversion of the old 20-foot pavement to a freeway will be accomplished in two stages.

New Southbound Lane

A 24-foot concrete pavement has been laid to the west of the existing 20-foot pavement and will become the southbound lanes. For the present, the existing pavement will carry the northbound traffic. This old pavement will be resurfaced and a new eight-foot-wide shoulder will be constructed for the entire length on the easterly side. The southbound lanes have been so placed to allow for the construction of the northbound lanes and yield a 22-foot median with three lanes of pavement in each direction.

Interchange Planned

At the southerly end of this project State Route 66 (Sign Route 120) connects with US 50. This intersection is located between the approach to the old Mossdale Underpass on the north and the San Joaquin River bridges on the south. In view of the very poor history of accidents at this location it was determined to construct this interchange to its ultimate design. The very close controls at this location greatly restricted the designers.

The highway from the west is four-lane divided and crosses the San Joaquin River on two bascule span bridges, approximately 550 feet in length and placed 125 feet center to center. East of the river the four lanes converge into two lanes and pass under the mainline Southern Pacific railroad tracks with substandard horizontal and vertical clearance. Only 1,150 feet exists between the bridges and underpass in which to fit the entire interchange including the speed change lanes. To make things worse, the pavement drops on a 2½ to 3 percent grade between the bridges and the railroad.

Crossing of Railroad Tracks

In this area the Southern Pacific railroad's double tracks are on a fill approximately 14 feet in height. To go over these tracks with the required clearance would require a highway fill of approximately 45 feet in height. To design an underpass to present-day standards also has its difficulties. There have been many times in past history when the high water in the San Joaquin River has been well above the height of the surrounding land. We are quite fortunate that during our ground water studies in December of 1955 and January of 1956, the San Joaquin River reached an elevation almost as high as it has any time in recent years. Test wells were drilled at 200-foot intervals for about 1,600 feet extending along a line approximately normal to the river. The ground water elevation in these wells was read at intervals between December 20, 1955, and February 6, 1956. The results were plotted showing the ground water profile along the test line at time intervals of only a few days.

Water Tables

From this study it appeared that there was a steady rise in the water table at the underpass site beginning three days after the river started to rise. The heavy soil dike encountered about 600 feet east of the river apparently had little effect on the rate of percolation to the structure site.

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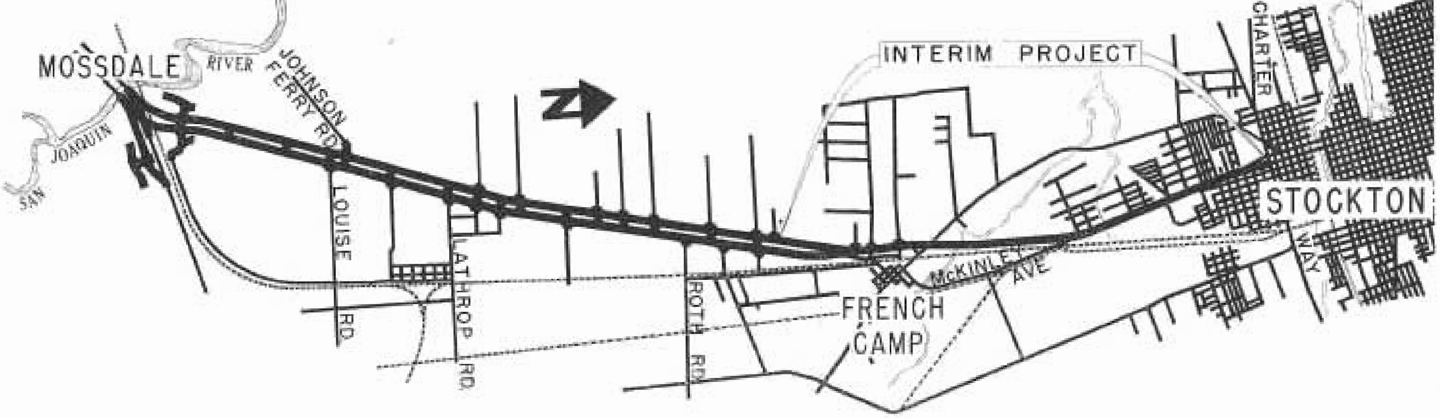


US 50

Boehmer Hill to Castro Valley Improvements

By HAIG AYANIAN, Assistant District Engineer

With the completion of the "Dublin Canyon Project" on US 50 in Alameda County, which will occur later this year, a continuous divided freeway will exist between the distribution structure at the eastern terminus of the San Francisco-Oakland Bay Bridge to Tracy, a distance of about 54 miles.

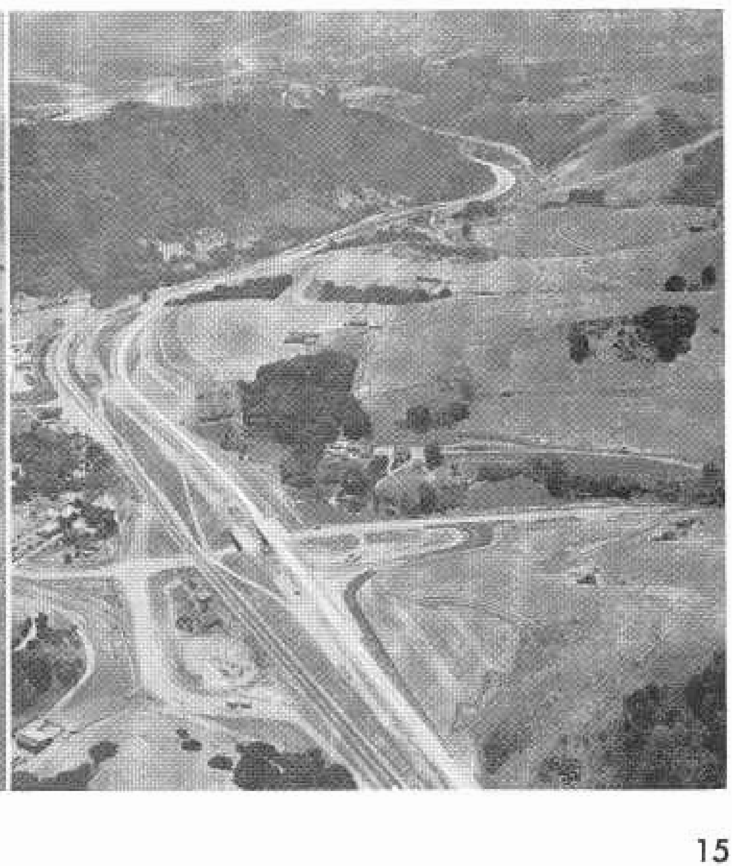
The part of this freeway known as US 50, a major arterial through Alameda County, and a part of the interstate system, provides a direct connection between the metropolitan areas of San Francisco and Oakland and the Livermore and San Joaquin Valleys. The "Dublin Canyon Project" will climax a five-stage construction program which was started in 1950. This route, in addition to the heavy passenger traffic, carries a heavy truck and bus traffic as it serves as a primary route for the San Joaquin Valley and points east. The importance of this route has been increased by the reactivation of Camp Parks as Parks Air Force Base, and the activity at the recently constructed atomic research laboratory farther to the east. The route is of prime importance as an aid to national defense and military needs of the future. The above installations have resulted in a large increase in population with a proportionate increase in traffic volumes. Present construction will alleviate this traffic congestion and promote future expanse and growth to the southern Alameda County valleys of Pleasanton and Livermore.

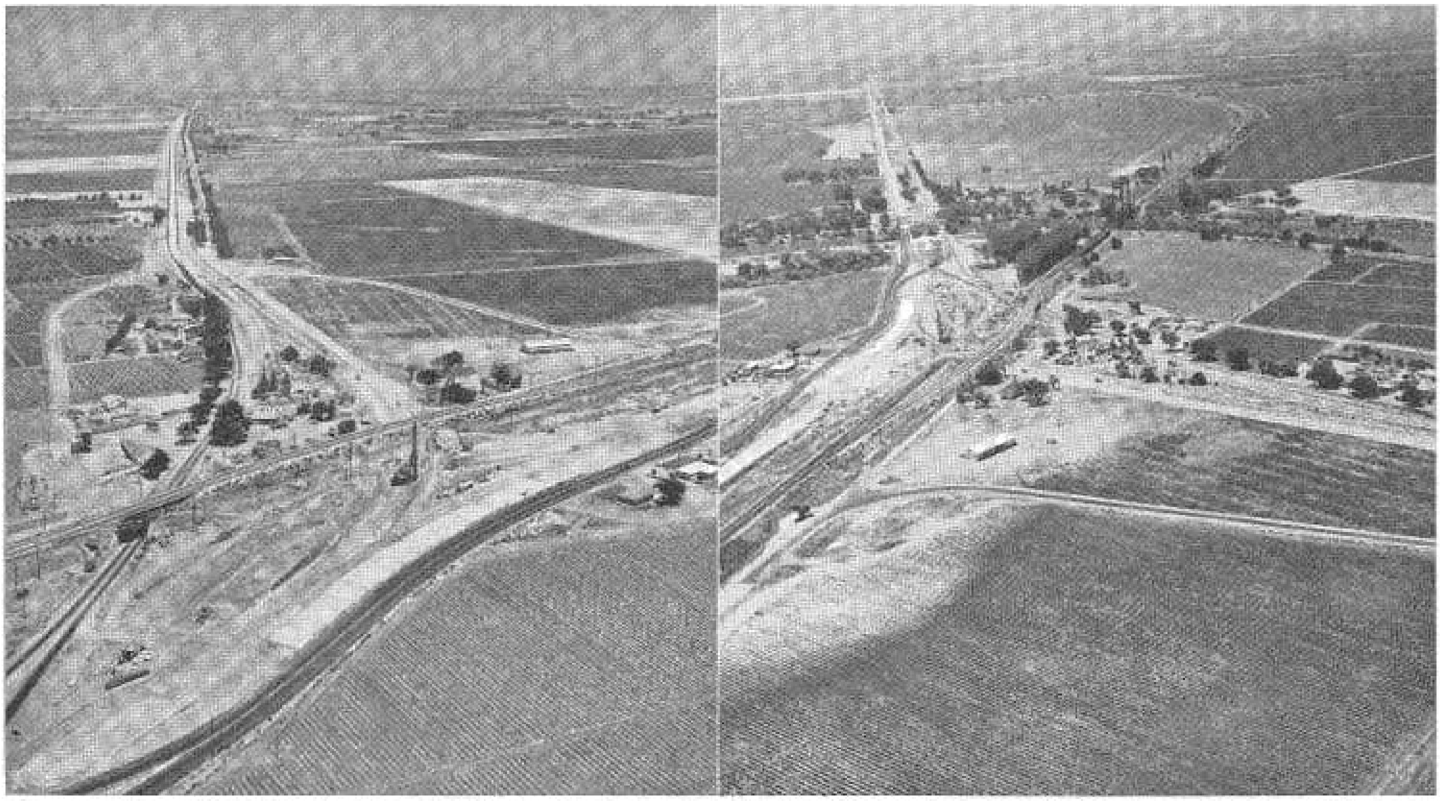
On New Alignment

The old highway from 2½ miles west of Dublin to Pergola Hill was originally constructed as a 30-foot-wide oil-macadam pavement. Subsequent improvements over the years resulted in widths of up to 40 feet of portland cement concrete pavement in some areas, along with bituminous surfacing in others. The new construction will provide a limited-access freeway between 2.3 miles west of Dublin and 0.3 mile west of Center Street in Castro Valley. The new alignment roughly parallels Palamares and San Lorenzo Creeks throughout its full length and traverses rather rugged terrain for a considerable portion of the distance.

... Continued on page 17

LEFT—Looking westerly from easterly end of project, showing newly constructed eastbound lanes and portion of existing traveled way to be resurfaced for ultimate use as westbound lanes. RIGHT—Looking westerly, showing Eden Canyon Interchange in foreground, newly constructed westbound lanes on right, old alignment left, with Castro Valley in background.





RIGHT—At Mossdale looking north showing new two lanes on the left, reworking of existing undercrossing of Southern Pacific railroad at left, preparing for new undercrossing of Southern Pacific at right, and Route 66 to Manteca in lower right. LEFT—At Mossdale looking south.

US 50—STOCKTON AREA

Continued from page 14 . . .

On February 6, 1956, the water level in the soil was practically at the river stage and was still slowly rising as the river water level was receding. Water started flowing into the existing underpass through construction joints on January 30, 1956, when the head was 18 inches. This was somewhat disturbing inasmuch as the profile of the proposed subway would be about five feet below the existing.

On February 6, 1956, at the site of the proposed underpass the ground water was less than one foot from the ground surface and it became quite evident that it would be necessary to seal off the excavated area to prevent the ground water from inundating the roadway. It was evident that it would be necessary to extend this seal up to the average surface elevation in this area.

Underpass and Interchange Design

With this information we then designed several interchange arrangements incorporating both the overhead on a 45-foot fill and the underpass requiring a seal slab. These studies proved that the underpass and interchange design as now being constructed are geometrically superior and more economical.

The concrete seal slab, of course, must be designed heavy enough so the buoyancy of the subsurface water will not lift the pavement. In this case it was necessary to construct a slab with a maximum thickness of 7 feet 8 inches and containing 9,700 cubic yards of Class B concrete. All expansion and construction joints are fitted with 6-inch rubber waterstops. A total of 7,250 linear feet of waterstops are required.

It is the intention to continue to use the existing railroad underpass, constructed in 1927, for southbound traffic. Although substandard with respect to our present-day standards it is felt that more years of good use can be obtained from the old structure by obtaining standard vertical clearance. This is being accomplished by relocation of the girders with respect to the floor beams plus a track raise of about six inches.

Drainage Facility

A pumping plant has been constructed with adequate capacity for both the old and the new underpass. This will provide a more positive drainage facility with greater capacity.

Approximately one mile north of the San Joaquin River the highway crosses a low area which has a long record of flooding. In this area the new lanes have been held well above the flood plane to prevent future interruptions to traffic and to reduce the maintenance costs that are usually incurred when a pavement lies low in a wet area.

It is planned to convert this new section of expressway into a freeway. Three interchanges will be constructed on the rights of way acquired under the first stage and frontage roads will be provided on both sides and for the entire length of the project.

. . . Continued on page 18

US 50—BOEHMER HILL

Continued from page 15 . . .

The project as constructed provides a limited-access freeway consisting of two new traffic lanes from the beginning of the project at the easterly terminus southerly of and approximately parallel to the existing roadway for about one-third of the length of the project. The balance of the project consists of four new traffic lanes on new alignment and to full freeway standards. The existing highway at the easterly third of the job was resurfaced with plant-mixed surfacing and will be utilized as one roadway of a divided facility. The pavement section consists of eight inches of portland cement concrete on four inches of cement-treated selected material. Provisions have been made for the adding of future lanes when the need arises.

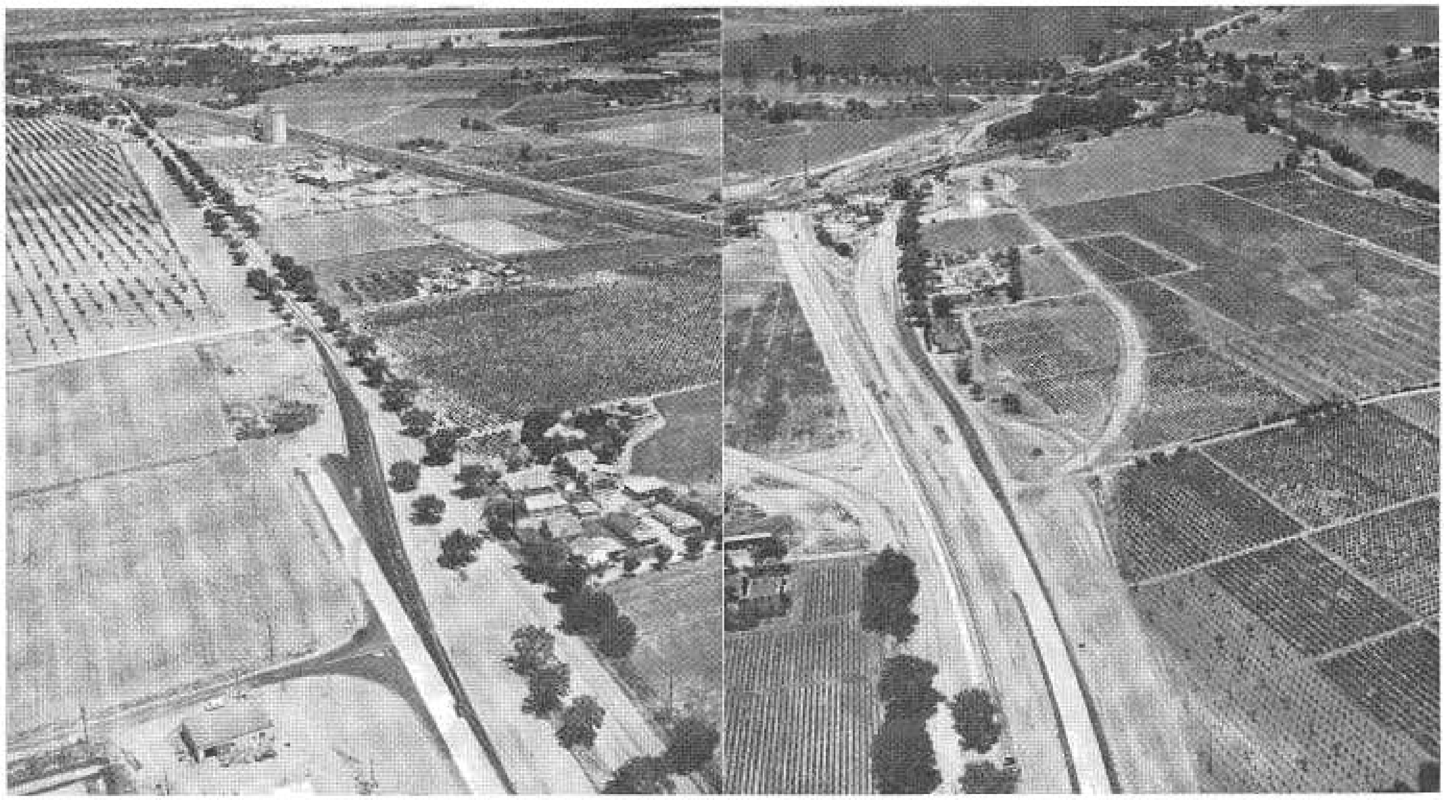
Drainage Aspects

The drainage aspects of this project are of particular interest due to the maze of underground installations necessary to dispose of the natural runoff of the area. As noted above, the line parallels Palamares and San Lorenzo Creeks, crossing and recrossing them a number of times, and in some instances runs on top of the drainage course. It was necessary to place 1,160 feet of 20-foot-diameter reinforced concrete arch culverts, and approximately 6,500 linear feet of 78-inch and 84-inch reinforced concrete pipe to carry the waters of the natural drainage courses. These facilities were laid approximately parallel to the roadway, and are in addition to the many cross drains. The difference in elevation of the inlet and outlet of this installation is approximately 75 feet and required the use of three dis-

. . . Continued on page 19

Looking easterly from Castro Valley. End of project showing both new and old alignment with ramps to Castro Valley Bypass shown in lower left.

Looking westerly from Pergola Hill showing new alignment on left, existing route on right, with Castro Valley in background



LEFT—South of French camp showing temporary transition of four-lane divided to two-lane road to Stockton. This is the beginning of proposed interim project to be under construction soon. RIGHT—North of Mossdale looking south showing undercrossing construction work at Southern Pacific railway, twin bridges across the San Joaquin River, and divided four lanes ahead toward Tracy.

US 50—STOCKTON AREA

Continued from page 16 . . .

The completion of this project will eliminate one of the last bottlenecks existing on US 50 between Stockton and the Bay area, and will correct one of the most dangerous intersections in District X.

F. M. Babcock is resident engineer in charge of construction work under contract to A. Teichert & Son, Sacramento.

Interim Project Extends Four Lanes

As an interim project plans are now complete for the construction of four lanes between Richards Avenue, just south of French Camp, and Charter Way in Stockton.

Beginning at Richards Avenue it is proposed to use the existing two-lane pavement as the two northbound lanes with construction of two additional lanes to the west to provide the two southbound lanes. This four-lane divided highway would continue up to French Camp, where the divided feature would be merged into a four-lane undivided section.

The four-lane undivided section from south of French Camp into Stockton will be constructed by resurfacing and widening the existing pavement within the existing right-of-way. Along with this improvement of the existing pavement there are four intersections that will be improved by providing median pocket lanes for left turns along with acceleration and deceleration lanes into the intersections. These intersections scheduled for improvement are at the entrance to the County Hospital, French Camp Turnpike Road, Clayton-McKinley Streets, and at California Street entrance to the City of Stockton.

In addition to the widening to four lanes, the bridge at French Camp Slough will be replaced with a concrete structure, whereas the remaining existing bridges at North Branch French Camp Slough, Walker Slough, and at Homestead Canal will be replaced with culverts.

This interim project, with the project east of Tracy also being planned, will provide the final links to a four-lane facility for the entire distance between Stockton and Tracy.

THEN THERE'S IDA

Then there's the mystery that cropped up in a midwestern city. Within the span of a couple of days, reports the National Automobile Club, about a dozen new cars were found badly battered and dented. Law officers scratched their heads and asked a lot of questions, and then a little old man came forward and explained it all.

Seems he had a junk wagon and the junk wagon was pulled by a horse named Ida. Now apparently Ida got to thinking about the horseless carriage and how it was replacing her dwindling breed. This made Ida so mad that whenever she saw a fancy new model she would give it a good kick and then run like blazes.

Officers didn't dare to argue with Ida. They just asked her owner to keep her back, well back, from the fancy new models.

US 50—BOEHMER HILL

Continued from page 17 . . .

sipators to avoid excessive erosion at the outlet.

The design of these dissipators is based on model studies and irrigation weir prototypes in Pakistan. These special dissipators are placed at the outlet ends of the 72-inch and 84-inch reinforced concrete pipes. This type of dissipator efficiently breaks up the jet flows of the large longitudinal culvers as they discharge into the natural channels. This type of dissipator combines the use of the principles of insufflation and baffles, and is more economical and practical than the usual stilling basins for these particular cases.

Extensive Seepage

The problem of drainage on this project was not confined to surface runoffs but was complicated by extensive seepage areas throughout the length of the project. It was necessary to place some 18,500 linear feet of six-inch porous concrete pipe underdrains and 4,500 linear feet of two-inch horizontal drainpipe.

Many of the cuts constructed for this project were of considerable magnitude and required benches 20 feet wide at intervals of 40 feet vertically. One such cut was in excess of 180 feet in depth. A total of 1,600,000 cubic yards was removed under roadway excavation by use of various types of earthmoving equipment including rubber-tired scrapers, a large power shovel and trucks in heavy rock areas.

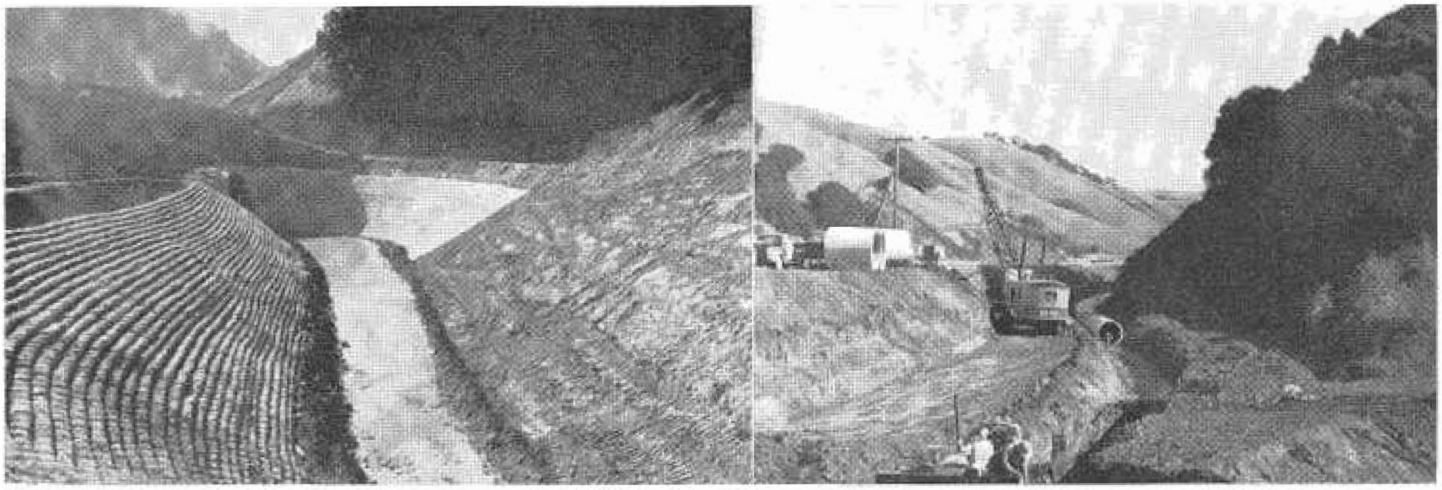
Included in the contract are seven bridges described as follows:

EDEN CANYON ROAD UNDERCROSSING—A T-beam type bridge of parallel structures about 118 feet long consisting of three spans over the realignment of Eden Canyon Road.

SUNNYSLOPE AVENUE UNDERCROSSING—Another T-beam type bridge, parallel structures about 158 feet in length over the realignment of existing state highway at Sunnyslope Avenue.

SAN LORENZO CREEK BRIDGE AND UNDERCROSSING NO. 1—A box girder type bridge consisting of parallel structures. The left bridge about 388 feet long and the right bridge about 438 feet

LEFT—Looking westerly toward 84-inch reinforced concrete pipe installation, showing depth of cut from existing traveled way. RIGHT—View of completed aero energy dissipators.



LEFT—Looking westerly down riprap section of channel approaching 20-foot arch culvert, one of three on project. RIGHT—Showing 84-inch reinforced concrete pipe installation's relative position to existing traveled way—new alignment.

in length, each with five spans over Old Dublin Road and San Lorenzo Creek.

SAN LORENZO CREEK BRIDGE AND UNDERCROSSING NO. 2—Another box girder type bridge about 330 feet in length consisting of parallel structures of three spans over a private road and San Lorenzo Creek.

CROW CANYON ROAD UNDERCROSSING—A composite steel girder type bridge about 482 feet in length of parallel structures consisting of five spans over the existing state highway at Crow Canyon Road.

CROW CREEK BRIDGE—A box girder type bridge of about 264 feet in length consisting of three spans over Crow Creek, providing a clear roadway width of 64 feet between curbs.

CASTRO VALLEY BOULEVARD OVERCROSSING—A box girder type bridge of about 254 feet in length consisting of four spans over the new freeway providing a clear roadway width of 54 feet between curbs.

The project included the following major items of work:

Roadway excavation	1,600,000 cubic yards
Structure excavation and backfill	122,000 cubic yards
Ditch and channel excavation	13,000 cubic yards
Class B concrete pavement	25,300 cubic yards
Class A concrete structures and bridges	17,200 cubic yards
Bar reinforcing steel	3,170,000 pounds
Structural steel	934,000 pounds
Drainage pipes	41,000 linear feet

The total cost of the project will be approximately $4,479,000, and it is anticipated that it will be completed in October, 1957, about two months ahead of the expiration of the 400 working days allotted for the work. The contractor is Peter Kiewit & Sons and the project is under the supervision of W. E. Roche, Jr. The State is represented by A. A. Andrade, Jr., as resident engineer and E. F. Van Zee as Bridge Department representative, under the supervision of Assistant State Highway Engineer, B. W. Booker.

MERIT AWARD BOARD WINNERS

Following is a list of the Division of Highways employees who received merit award recognition during the months of June and July, 1957:

Henry E. Davis, Stockton, $50 for suggestion in which he developed a soil dehydrator to replace and supplement present drying equipment. This oven incorporates the essential features of the best drying ovens on the market.

Mrs. Helen M. Rake, San Bernardino, $20 for suggestion recommending a new form for ordering topographical maps which eliminates costly delays in the filling of orders. The change in the form consists of a space to show the co-ordinates of the southeast corner of each quadrangle to enable an area to be identified even though the name is changed.

Glen A. Wallis, Sacramento, $150 for suggestion recommending a method of computing construction material quantities through the use of the electronic computors. Other uses are also being developed as a result of this proposal.

Michael Valentine, Sacramento, $20 for suggestion in which he developed a series of graphical solutions for the design of pile footings.

Herbert Shipley, San Luis Obispo, received a $50 check as an additional award for a combination of grade and grid sheets he developed. In March, 1956, the board had awarded him $50 and recommended a review at the end of one year. His method is based on an IBM procedure already installed in some of the districts.

Adel R. Leitch, San Francisco, recommended using one combination stamp in place of two stamps to record the date scheduled and the schedule number on receiving records, posting pages, and transfer records in District VII. Mrs. Leitch received a Certificate of Commendation.

Gloria M. Anthony, San Francsico, proposed a different use of pounce on vellum and ozalid paper for appraisal maps. Pounce is a powder used to prevent ink from spreading, used in drafting work wherever ink does not take to the surface properly. Mrs. Anthony's idea is to prepare the vellum and ozalid paper in advance with pounce, which makes clear, black imprints, shortens the time to dry the prints, and makes it unnecessary to erase and restamp faded stampings on vellum or a print. A $30 award was granted.

Mabel Graham, Los Angeles, received a $100 award for recommending an improved statement form and return envelope for the active rental accounts of the Division of Highways. Benefits will be a savings in material, in time required to prepare for mailing, and particularly in the time required to identify and process the payments received.

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Jubilation

Opening of Lafayette Bypass Is Cause for Celebration

Citizens of Lafayette in Contra Costa County staged a jubilant three-day celebration following opening of the Lafayette Bypass on June 27th.

This four-lane section of new freeway, costing $3,300,000, eliminates the most seriously congested portion of Sign Route 24 between Oakland and Walnut Creek, which has been daily traversed by commuters from the residential developments to East Bay business and industrial areas and the San Francisco-Oakland Bay Bridge. Provision has been made in the project for two additional lanes as the increase in traffic volume warrants.

In the business district of Lafayette, which has been the site of the serious congestion, local traffic is now able to move freely, and traffic hazards which have been experienced in the past, will be minimized.

The average daily traffic through this area is approximately 38,000. The accident rate has been approximately 3.52 accidents per million vehicle-miles. Congestion will be practically eliminated and the accident rates considerably reduced.

Work started on the project October 17, 1955, by contractor Gordon H. Ball. This project will provide an alternate traffic route through the town of Lafayette, and will leave the present highway as a high-standard, uncongested, local arterial servicing the rapidly growing community of Lafayette.

Other Projects

In December, 1956, a two-quadrant cloverleaf interchange at Pleasant Hill Road, at the easterly end of this project, was completed. This interchange serves as a connection between the freeway and Pleasant Hill Road, which is an important county expressway. In the future, it will also be a connection to the Route 233, Shepherd Canyon Freeway, which is another future freeway into Oakland via Moraga now in planning and design stages.

A contract for a project which will extend the freeway to the south and north of Walnut Creek was recently awarded to Chas. H. Harney, Inc. This project will be 4.2 miles long, and construction will cost approximately $8,800,000. There are approximately 17 major structures involved in this project, which will provide an initial four- and six-lane freeway with provisions for ultimate six and eight lanes. To the north, it connects with the project which was completed early this year extending from Walnut Creek to north of Monument, a distance of 2.8 miles, costing approximately $2,850,000 for construction.

Some 200 persons participated in opening ceremonies arranged by the Lafayette Chamber of Commerce.

Lafayette Bypass

Project length: 2.6 miles.

Description of project: between west of Sunnybrook Drive and west of Pleasant Hill Road.

Number of lanes: initial 4, ultimate 6 lanes.

Type of facility: full freeway.

Estimated construction cost: $3,300,000.

Major structures: the Lafayette Undercrossing, Dolores Drive Undercrossing, Happy Valley Road Undercrossing, Oak Hill Road Undercrossing, East Bay Municipal Utility District Aqueduct Overcrossing.

There is an interchange at each end of the project and grade separations at other major local streets.

Controlling quantities: 1,500,000 cubic yards roadway excavation, 13,700 cubic yards portland cement concrete pavement, 10,500 cubic yards concrete bridge work, 2,293,000 pounds of reinforcing steel, 82,000 tons of imported subbase material.

At ribbon cutting, left to right: Captain R. R. Magill, California Highway Patrol; L. A. Weymouth, District Engineer, San Francisco; Supervisor Ray Taylor, H. Boetz, Lafayette Chamber of Commerce; Assemblyman Donald Doyle, Highway Commissioner H. Stephen Chase; T. Fred Bagshaw, Assistant Director of Public Works; B. W. Booker, Assistant State Highway Engineer; Pat Whiehead, Attendant to Queen; Dolores Roescher, Fiesta Queen; Betty Clark, Attendant to Queen; C. A. Maghetti, Secretary, State Highway Commission; Earle Pierce, Lafayette Chamber of Commerce; Supervisor Mel Nielsen.

Helicopter instead of traditional shears used to cut barrier tapes

In lieu of the traditional ribbon cutting, a helicopter flown by Ed Haapala, executive pilot for Contractor Gordon Ball, swooped down and clipped barrier tapes at each end of the new freeway.

Luncheon Is Held

Automobiles carrying dignitaries and Fiesta Queen Dolores Roeschen and her two attendants, Pat Whitehead and Betty Clark, made the round trip over the new freeway back to El Nido, where a luncheon was held.

B. W. Booker, Assistant State Highway Engineer, told the group "several million dollars remain to be spent between here and Orinda. There is still a $100,000,000 highway deficiency in Contra Costa County. There are still some 'bugs' in the new expressway here, where the freeway rejoins Mount Diablo Boulevard at Upper Happy Valley Road. But it'll be at least two years before you get the next job. We'll do what we can to alleviate the situation in the meantime."

Praise Co-operation

Both T. Fred Bagshaw, Assistant Director of Public Works, and Assemblyman Donald Doyle praised cooperation of Contra Costa County with the State in solving highway problems.

Among others participating in the opening celebration were Deputy State Highway Engineer, J. W. Vickrey, Chelso Maghetti, Secretary of the State Highway Commission; Commissioner H. Stephen Chase from San Francisco; Earle Pierce, President of Lafayette Chamber of Commerce; L. A. Weymouth, District Highway Engineer; Highway Patrol Captain Russ Magill; and County Supervisors Ray Taylor, Mel Nielsen, Bud Buchanan and Joe Silva.

Some 20 civic groups participated in the community celebration.

MERIT AWARD WINNERS

Continued from page 20 . . .

Wallace R. Turpen, Sacramento, received a $50 award for recommending the use of snap-out carbons for certain form letters in the Bridge Department.

Oliver Dowd, Stockton, received a $42 award for suggesting the elimination of freehand lettering on culvert lists and construction note sheets. He proposes instead the use of a typing and photographic process in preparing contract plan tracings with tabular data.

William Wallace, Oakland, designed and built a roller chain pulling tool, used when two ends of a roller chain must be pulled together and properly aligned to insert the connecting link. The device speeds the job of chain coupling and minimizes the hazard of accidents to hands. A $45 award was made.

Lloyd Ray Brush, Sacramento, received a Certificate of Commendation for proposing that the bolts fastening the tire rack under Division of Highway light trucks be wrapped with friction tape to protect them from dirt and facilitate their removal.

James H. Hirotani, Sacramento, received a Certificate of Commendation for recommending that in the few cases where there are no construction changes on the plans of highway contracts, a letter be forwarded advising Headquarters Office in lieu of sending final plans.

Highway Engineer E. E. East Retires From Automobile Club

E. E. East, chief engineer of the Automobile Club of Southern California—the man who proposed a freeway system for Los Angeles more than 20 years ago—retired July 1st.

East, with the club since 1920, is also known for the two exploration trips he led to Mexico City and San Salvador in 1930 and 1931, which proved that construction of a West Coast Pan-American highway was possible.

This highway—from Nogales, Arizona, to Mexico City—was dedicated only last May, at which time Cayetano Blanco Vigil, Mexico's most ardent supporter of this project, lauded East for proving that such a road was possible almost 30 years ago.

One of the first engineers employed by the California Highway Commission—in 1912—East, throughout his long career, has adhered to one principle in particular: The way to approach highway problems is with a look to the future as well as the present.

A working example of this belief is revealed by the recommendation he made in the auto club's 1937 metropolitan Los Angeles traffic survey, when he stated:

"It is recommended that a network of motorways be constructed to serve the entire metropolitan area of Los Angeles. These motorways should be developed upon a right-of-way not less than 360 feet in width through residential territory and not less than 100 feet in width through established business districts."

He also recommended that these motorways be built to accommodate four to six lanes of traffic divided by a physical barrier.

Both of these ideas were rather "futuristic" in 1937.

East was also one of the early proponents of oil-bound gravel roads.

Southern Tour

Highway Commissioners View Major Projects

By C. A. MAGHETTI, Secretary, California Highway Commission

Superlatives are quite often used to describe high mountains, blue lakes, tall buildings, sleek ships, and many more "bigs" in California so it isn't entirely out of order to picture the fantastic amount of roadwork going on, particularly in the Counties of Orange and Los Angeles.

To see this tremendous effort firsthand, members of the California Highway Commission, together with representatives from the Division of Highways, took time out from a busy schedule during June to see where many gasoline tax dollars are now being expended to produce better traveling facilities for persons in that part of the State.

Over the years it has been the practice of the California Highway Commission to hold business meetings away from Sacramento, occasionally in Los Angeles and San Francisco. This procedure provides the opportunity for commissioners to view many construction operations over the State and to very often accept invitations from organizations to appear before them to give firsthand information of the State's highway program. Sacramento being the seat of State Government seems far, and is far, away to many persons south of the Tehachapi Mountains.

Members of Tour Party

Included on the tour through the South were Frank B. Durkee, State Director of Public Works and Chairman of the California Highway Commission, Commissioners Chester H. Warlow of Fresno, Robert E. McClure of Santa Monica, James A. Guthrie of San Bernardino, Fred W. Speers of Escondido, Robert L. Bishop of Santa Rosa, and the author. Unable to make the trip because he was in Washington was H. Stephen Chase of San Francisco.

From the Division of Highways were G. T. McCoy, State Highway Engineer; J. C. Womack, Assistant State Highway Engineer; and George N. Cook, Assistant Secretary of the Highway Commission.

Aside from its regular monthly business, the commission participated in a ceremony of "turning the first shovel of dirt" for the bridge to span the Los Angeles River on the new Santa Monica Freeway.

McClure Breaks Ground

Commissioner Robert E. McClure performed this function before a large group of officials and spectators. Los Angeles "River," which sometimes brings raised eyebrows from northerners, did have a trickle of water in the channel. Actually the "river," which is paved with reinforced concrete, is a tremendous effort to control flash floods which occur occasionally in that area, winter and summer.

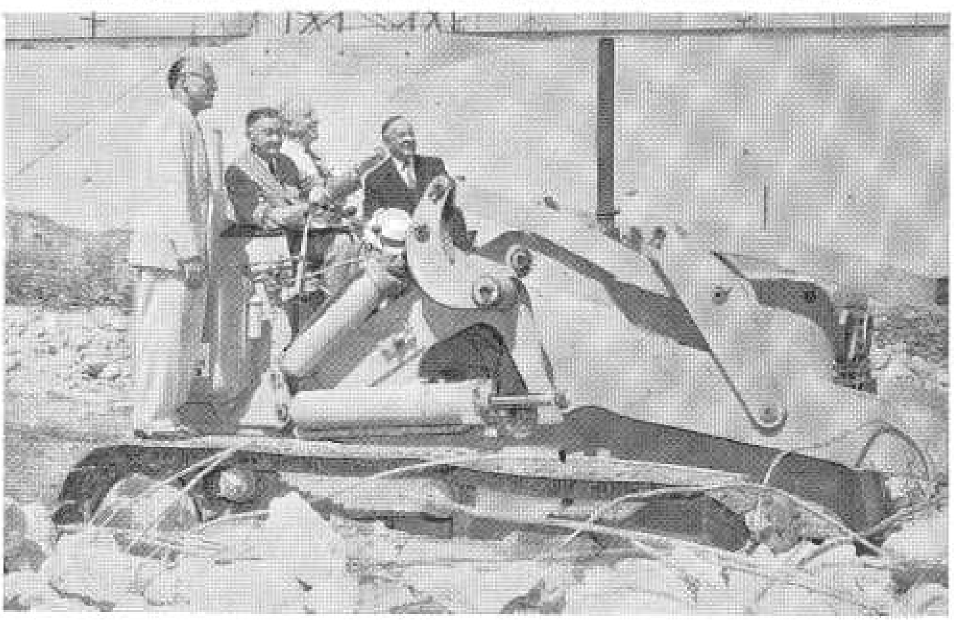
The viaduct and bridge is a project costing some $5,000,000. The "first shovel of dirt" started a bridge which will be completed about the middle of 1959.

The commissioners then journeyed over several freeways and stopped particulary to see the progress under way on the Ventura-San Diego Freeway. This huge project is near the $8,000,000 mark in cost. It is in two sections, the first beginning at Sepulveda to Encino and the second from Valley Vista to Burbank Boulevard, with a total of 8 lanes and 10 bridges.

Delays due to new construction were encountered on the Santa Ana Freeway to Newport Beach. While the slowdown was an annoyance, it did contribute further to the commission's knowledge of work being done in Southern California.

Because of a controversy under way at the time, the caravan made a stop on Friday, June 21st, to view the pro-

Groundbreaking on Santa Monica Freeway in paved channel of Los Angeles River June 17. On bulldozer, left to right: Los Angeles City Councilman Rasom Callicott, State Highway Commissioner Robert E. McClure, State Highway Commissioner Chester H. Warlow, Los Angeles City Councilman Harold Henry.



Looking southeasterly showing start of construction work excavating for center pier in the Los Angeles River channel for Santa Monica Freeway bridge. In background is Sears, Roebuck building.

posed freeway through Cardiff, Encinitas, and Leucadia. These communities are split between an inland route and one further east through Green Valley. By inspecting the two lines the commissioners now feel they can evaluate both proposals and arrive at a more intelligent conclusion.

The Los Angeles municipally owned International Airport is probably the third in activity in the Nation. Unlike the new airport in San Francisco, which was planned completely in advance, the Los Angeles project, like "Topsy," just grew; but the time has come for the directors of the port to do something about it, and plans are now on the boards for a new layout.

Because the proposal involves the closing of some of the state highways in the area the commissioners spent the greater part of one morning inspecting the airport area and, a few days following, prepared an agreement which was accepted by the City of Los Angeles.

Thursday evening, at the Lafayette Club, a short distance out of San Diego, the commission met at dinner with representatives of the chamber of commerce and city and county officials.

Friday, the final day of the tour, was spent inspecting highways of the county.

For the commissioners to see things firsthand is undoubtedly a desirable thing. However, it does take time, and each commission member, a businessman in his own right, often finds it difficult to give more time to travel over the State. Due to devotion to the job by this commission and those that preceded it, goes the pride of great accomplishment to the end that California, with its thousands of miles of highways, is now second to none in the Nation in this respect.

SPEED AT NIGHT

Don't overdrive your car's headlights at night. If you are going faster than 45 miles per hour you cannot stop within the distance illuminated by your headlights, according to the California State Automobile Association. Remember, 45 is the safe maximum speed at night.

A government worker sat at the table after breakfast one morning, engrossed in his newspaper for over an hour. Finally he asked for another cup of coffee. "Coffee!" echoed his wife. "But look at the time. Aren't you going to the office today?"

"Office?" explained the startled man. "Heavens! I thought I *was* at the office."

Bonneroo

Haddock Wins Topper For Best 1956 Contract

WITH FRANK B. DURKEE, Director of Public Works, State of California, making the presentation Friday evening, May 31st, the contracting firm of J. E. Haddock, Ltd., of Pasadena was the recipient of the "Topper" trophy for having completed the No. 1 state highway contract in District VII during 1956. The winning contract was a section of the Harbor Freeway between 42d Street and 23d Street in Los Angeles, which was completed on April 26, 1956.

A similar trophy was presented by Edward T. Telford, Assistant State Highway Engineer, to Maurice E. Camp, State Resident Engineer in charge of construction on the project. Milton Harris, State Construction Engineer, presented certificates of merit to George Wiggers, Art Anderson, and Jack Erwin, the superintendents for the Haddock organization on the job, and to the subcontractors and the state engineers who participated in the construction.

Bonneroo Banquet

Scene of the award presentation was the sixth annual "Bonneroo," a stag banquet sponsored by the District VII Construction Department of the California Division of Highways and staged at the Rodger Young Auditorium in Los Angeles. The annual affair, sixth of its kind, is primarily held for the purpose of honoring contractors and resident engineers who completed the 10 best state highway contracts in District VII, comprising Ventura, Los Angeles, and Orange Counties, during the preceding calendar year. The winners for 1956, announced at the Bonneroo, were:

No. 1—Harbor Freeway, Los Angeles County, 42d Street to 23d Street—J. E. Haddock, Ltd., Contractor; M. E. Camp, Resident Engineer

No. 2—Ojai Freeway, Ventura County, Highway 101 to Mills School near Ventura—Guy F. Atkinson, Contractor; J. F. Smith, Resident Engineer

No. 3—San Bernardino Freeway, Los Angeles County, Durfee Avenue to one-half mile east of Puente Avenue, near West Covina—Griffith Company, Contractor; B. N. Frykland, Resident Engineer

No. 4—Harbor Freeway, Los Angeles County, Battery Street to Pacific Coast Highway near Wilmington—Vinnell Co., Inc., and Vinnell Constructors, Contractor; F. E. Sturgeon, Resident Engineer

No. 5—Houston Freeway, Orange County, Cypress Avenue to Santa Ana Canyon Road near Anaheim—Ukropina, Polich, Kral, and Ukropina, Contractor; C. J. McCullough, Resident Engineer

No. 6—Santa Clara-Rico Road, Ventura County, near El Rio—Fredrickson & Watson, Contractor; J. F. Smith, Resident Engineer

No. 7—Artesia Street, Los Angeles County, Central Avenue to Alameda Street near Compton—Vido Kovacevich and O. B. Pierson, Contractor; C. C. French, Resident Engineer

No. 8—Verdugo Road, Los Angeles County, Glendale Avenue to Towne Street near Glendale—Griffith Co., Contractor; T. L. Patterson, Resident Engineer

No. 9—Katella Avenue, Orange County, Stanton Avenue to Santa Ana Freeway near Anaheim—Sully-Miller Company, Contractor; R. B. Vaile, Resident Engineer

No. 10—Santa Ana Freeway widening, Los Angeles County, Camulos Street to Olympic Boulevard—Webb and White, Contractor; Don Frischer, Resident Engineer

LEFT—John Haddock, President of J. E. Haddock, Ltd., left, receives the gold-plated roller, symbolic of the "Topper" award, from Frank B. Durkee, Director of Public Works for the State of California. RIGHT—Maurice E. Camp, who was project engineer on the winning contract, receives a similar roller from Edward Telford, Assistant State Highway Engineer, Los Angeles. Rollers are donated by Galion Iron Works.

Prestressed Bridge

New Structure Over Santa Clara River

By W. A. McINTYRE, Senior Bridge Engineer

Saticoy bridge out has been a familiar sign on the highway which crosses the Santa Clara River on Sign Route 118 leading in and out of the Town of Saticoy in Ventura County. Washout signs have frequently been required when floods caused the Santa Clara River to shift its channel and damage sections of this highway.

In 1911 the first bridge was constructed over the Santa Clara River on Del Norte Avenue, now known as Sign Route 118, by Mervey-Elwell Company for the County of Ventura. This bridge, consisting of 10 steel through truss spans, with roadway width of 18.5 feet between timber wheelguards, each span having a length of 130 feet, was designed by a firm known as Venturco Company. The bridge approaches were protected with slope paving, oiled slopes and boulder mats placed at the toe of the fill slopes.

Frequent Washouts

Since the original construction of the 10-truss spans by Ventura, large floods occurred in 1913 and again in 1914. During the later year, river discharge of 112,000 second-feet washed out the bridge approaches and a pier on the east approach, necessitating additional spans and lengthening the structure. On three other occasions since the earlier days, during the months of March, 1938, December, 1939, and February, 1944, heavy downpours within the 1,500-square-mile drainage basin again created maximum river discharge which resulted in washing out the bridge approaches or bridge detours during reconstruction or repair work.

Soon after the flood of 1938 a contract was let to extend the bridge southeasterly with 11 additional 70-foot reinforced concrete girder spans, with a wider roadway width of 26 feet between concrete curbs. This work was done under a PWA grant and the new section of girder bridge was constructed as an extension to the narrow steel truss span, requiring a roadway transition and a grade change. Because of the narrow width of the steel truss section, it was difficult for two heavily loaded trucks of maximum legal width to negotiate the narrow transition section of the bridge safely. As a result of the heavy trucking in the vicinity, considerable damage has continued to be a headache to the Division of Highways bridge maintenance department due to continual damage to timber curbs, railing and to truss members caused by collision.

During February, 1944, the river discharge was about 60,000 second-feet. The channel of the river again shifted, drifting the main stream flow against the westerly approach, and causing the bank protection and the roadway approach to again be washed out, requiring the approach fills to be replaced.

War emergency made it necessary to defer plans to rebuild the bridge and to substitute a program of repairs to extend the life of the existing structure. In 1945 the entire timber deck and surfacing of the truss spans were replaced.

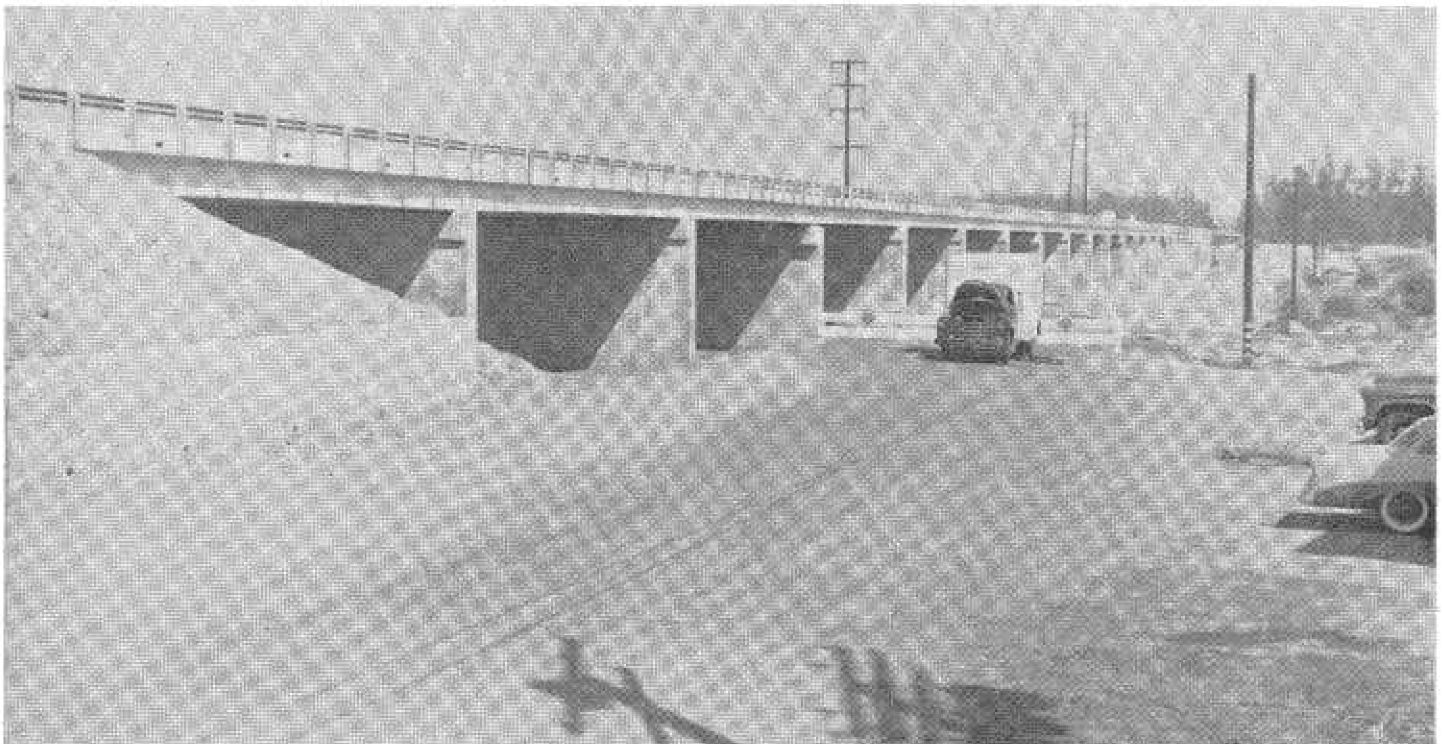
New Prestressed Span

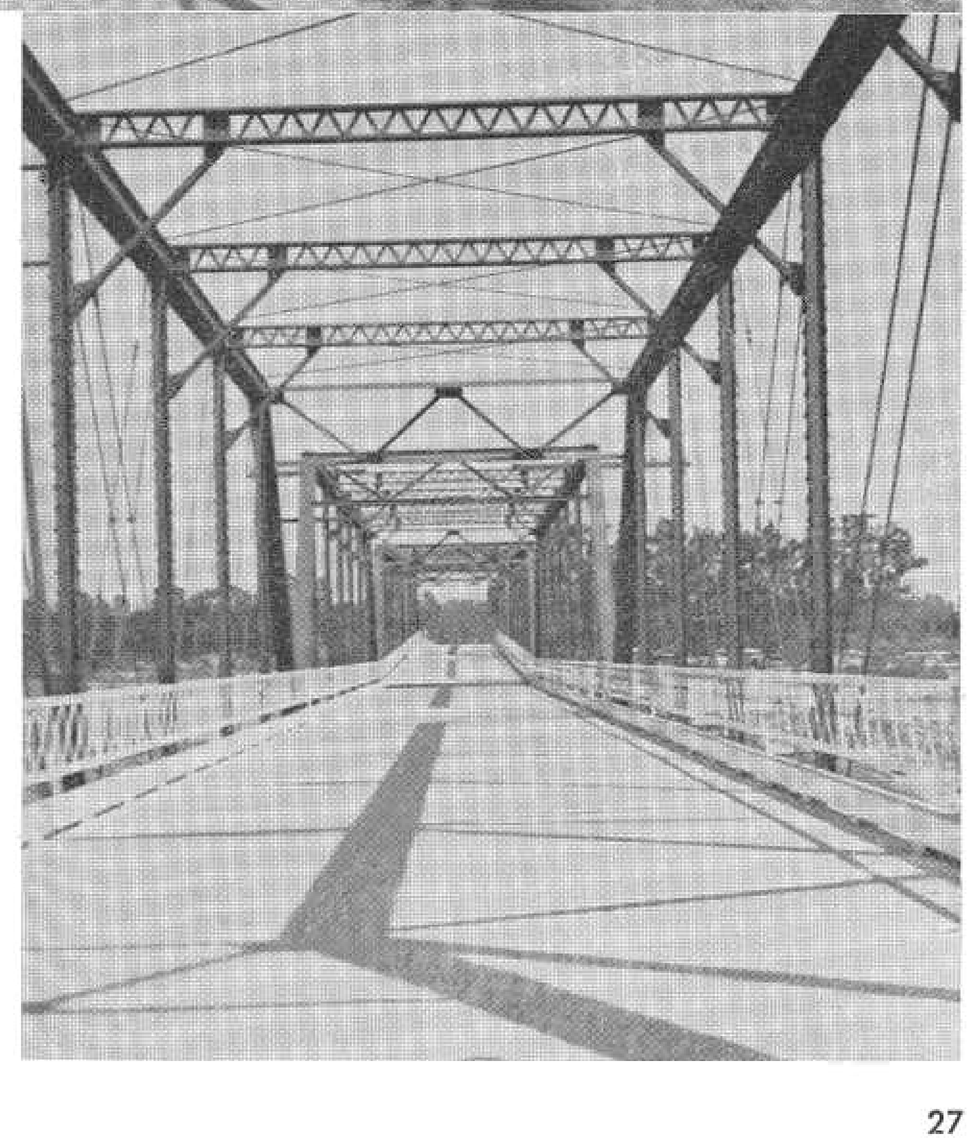
Bids were received in the District VII office in Los Angeles on April 12, 1956, for the construction of 23 precast, prestressed concrete girder spans 70 feet 4 inches in length, having a net overall length of 1,636 feet. This westerly section of the Santa Clara River Bridge crosses the river about one-half mile east of Saticoy and carries State Highway Routes 9 and 154. Route 118 is an east-west road, being part of a secondary road system. The portion of Route 118 on which the bridge exists is known locally as Del Norte Avenue. All prestressed spans are supported on reinforced concrete piers resting on 42-pound steel H-beam piles. In order to provide a clear 28-foot roadway through the entire length of bridge, it was necessary to remove and construct the curb and railing on 11 existing concrete girder spans of the bridge constructed in 1939. The construction work under this contract included a detour over the Santa Clara riverbed, roadway approaches on the westerly, or Saticoy end, plant-mix surfacing, and new metal beam guard rail for the entire length of bridge. The contractor submitting the low bid of $605,442 was W. F. Maxwell Co. of Fontana. The contract was awarded by State Director of Public Works Frank B. Durkee, April 18, 1956. The final cost of this project was $607,348, and the work on this contract was completed May 7, 1957.

New Design

The new section of bridge departs from the usual design practice of a simple supported precast girder bridge. One of the features of the design of the Saticoy structure is that of continuity, where multiples of three and four spans are tied together solidly over the piers. This condition was provided for in the construction of the T-girders where a section of the deck slab or flange was omitted in the precast operation.

After the girders were erected the closing sections of the deck and the pier extension were cast to provide the necessary "fixity" for the continuous spans. The designer provided conventional reinforcing steel to resist the negative bending movement of the support. Every fourth span, except the first where three span lengths were





UPPER—View of completed bridge. LOWER—Showing connection between the all through truss bridge and the new concrete bridge over the Santa Clara River.

used, was provided with bar plates where the ends of the prestressed girders rested on expansion bars cast into the pier stems. To increase maximum efficiency in resisting shearing stresses, the thickness of the girders varied from 16 inches at the end to nine inches at a distance of 15 feet from the ends of girders. The contractor set up 48 casting beds on the job site to cast 184 girders that were used in the new bridge extension. Each completed span is 71 feet in length and required eight girders. The concrete casting beds were used a maximum of five times, requiring a minimum of reinforcing steel for strength.

Some Innovations

Some innovations have been used by Contractor Maxwell in the casting of these beams. Forty-eight reinforced concrete casting pads were poured directly on the ground. These pads were constructed to the exact width and length of the girder. Cast into these pads were horizontal holes for anchor bolts to furnish positive anchorage at the base during the concrete pouring operations when forces are a maximum due to fluid pressure of the vibrated concrete.

Both ends of the casting bed contained wooden blocks which were placed flush to the surface. The reason for this arrangement was to take care of end rotation caused by the increasing camber of the girders as the tension is applied to the prestressing wires. The soft wooden blocks were used to eliminate crushing or breaking of the ends of girders.

The location and spacing of the casting beds near the bridge site was considered by Maxwell from the standpoint of (1) eliminating waste motion by pouring the concrete directly into the forms from the transit mixer, (2) keeping the distance between the casting and erection points as short as possible, and (3) the proximity of the local concrete supplier, the Saticoy Rock Company plant. This company furnished 2,860 cubic yards of Class A bridge concrete in addition to 1,750 cubic yards of concrete for the prestressed girders.

Precast Girders

Form work for the construction of the precast girders consisted of five-eighths-inch plywood treated with a hard surface glaze. Individual girders weigh approximately 21 tons each and have stems ranging from 16 inches thick near the piers to 9 inches in the center. The upper flange of the girder, which eventually forms the bridge slab section, is three feet wide by 5½ inches thick. The connecting one-foot section between the flange was poured later, during the casting of the pier and deck.

During the girder casting operation, construction of the bridge piers was underway. All reinforced concrete footings rest on steel H-piles. The number of piles varies from 12 to 16 per footing, depending on the location and type of pier, either fixed or expansion. These piles were driven in the Santa Clara riverbed to a point below the scour line. There were 22 piers constructed, each pier wall 18 inches thick and 33 feet wide with heights ranging from 25 to 35 feet

UPPER—Floodwaters washed out detour bridge and detour during reconstruction work on the Santa Clara River bridge in 1939. LOWER—Southwest approach to the Santa Clara River bridge washed out during flood of February, 1944.

above the footing elevation. In constructing the piers, the lower section of the wall and footing were formed and poured together. The wall sections varied in height from six to eight feet above the footing elevation.

Reinforcing Steel Cages

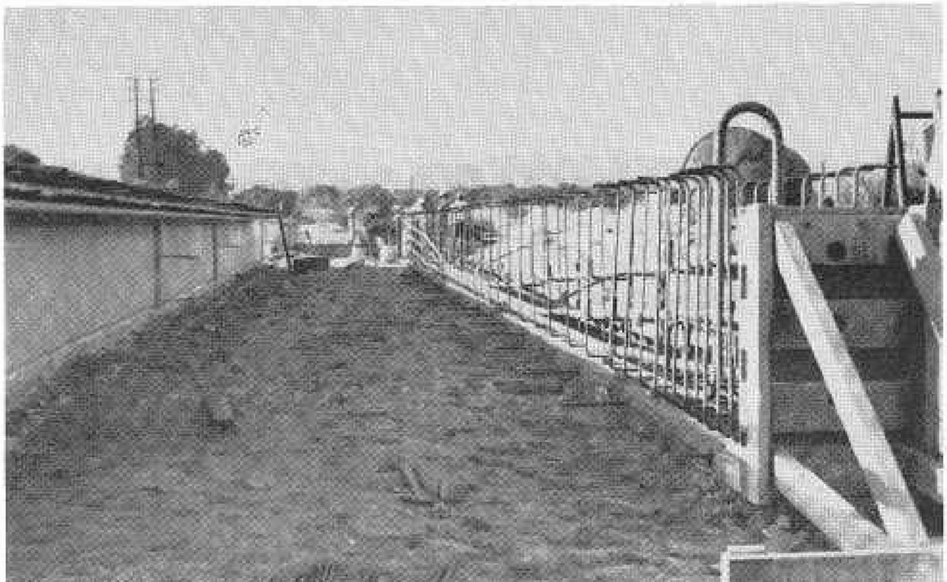
The next sequence of operations was to place the reinforcing steel cages, previously fabricated on the ground, for the upper section of the pier extension. The cages were lifted in position with the contractor's truck crane. A prefabricated pier form was then lowered over the steel reinforcing cage in one unit. Two or three days after the upper section of the pier concrete was placed, pier forms were removed in two halves and cleaned, rejoined and lowered over the next reinforcing steel pier cage. In this manner the contractor made maximum use of form panels, using four form panel sets to construct the 22 piers required for the contract. These forms were designed to withstand full hydrostatic head using double 4 x 8 walers on 3-foot centers and 3 x 4 studs at 12-inch centers.

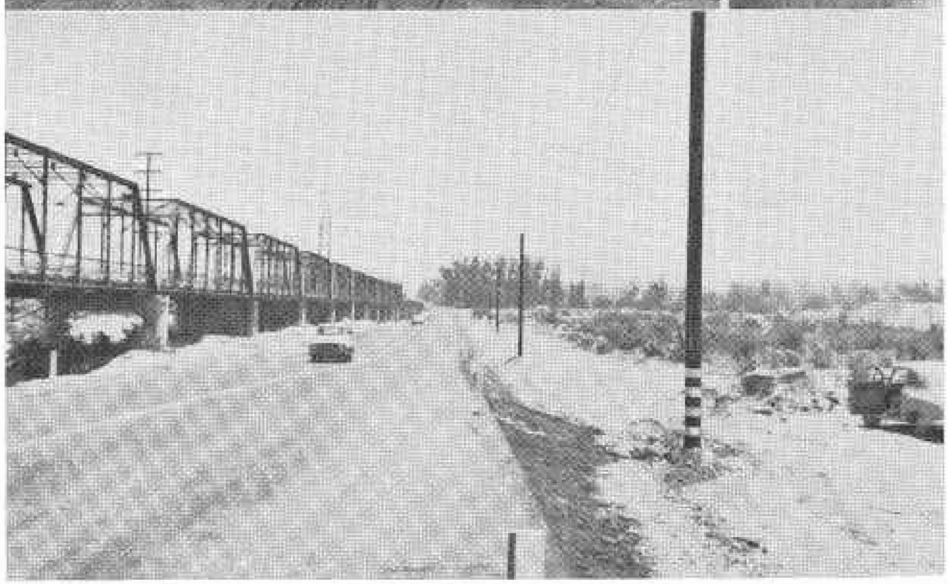
Concrete Control

All concrete for this project was supplied by the Saticoy Rock Company which is located about one-half mile downstream from the bridge site. Concrete was delivered to the job in the concrete supplier's 6½-cubic-yard transit trucks.

All concrete for the prestressed girders was made using 7½ sacks per cubic yard. Cement used was manufactured by California Portland Cement Co., Mojave Brand Type II low alkali. The aggregate used for prestressed girders was No. 3 gravel with the maximum size of one inch. Concrete requirements set up in the specification required that no reactive aggregates would be used in the manufacture of concrete. An approved admixture was used in the concrete at the rate of one-fourth pound per sack of cement. This admixture helped to secure greater workability, lower water-cement ratio, and higher strength, which was required prior to the prestressing operation. An average strength in excess of 5,000 pounds per square inch was obtained over a 14-day period with slumps ranging from two to three inches. The curing of the precast girders to be prestressed was a colorless, impervious membrane. Piers and other parts of the bridge were cured by wet burlap or water spray.

Factors that contributed to the uniformity in strength in concrete for the girders were (1) close control of the sand moisture content by a calibrated elctronic moisture indicator installed in the rock company's sand bin, and (2) comparative ease in transfer of the concrete to the girder forms direct from mixer truck. Primarily, due to the close control of water content of the concrete mix, it was rarely necssary to add additional water for the concrete at the job site.





UPPER—Prestressed girders at casting bed. LOWER—View along detour and existing bridge.

Prestressing Operation

The BBR system, registered under Swiss patents, was used in the post-tensioning operations for the 184 girders. This system required button-headed wires within the stressing washers and finally anchored in position with flat split shims to an integral steel distribution plate which had been cast into the girder.

Due to the continuous design nature built into the girders, flexible tubes positioned in the forms prior to pouring the girders followed a pattern along the center of gravity of prestressing force rather than the pattern of catenary, or parabolic curve, the latter of which is usually true for simple span.

The stressing was done with two hydraulic pumps with 100-ton hydraulic jacks. These jacks were equipped with precalibrated hydraulic gauges and, in connection with the jacking equipment, were used simultaneously at both ends of the concrete girders. Close control of the jacking pressure and wire cable elongation were carried out by an intercommunication system between the equipment operators.

Total Initial Stress

The total initial stress in each of the intermediate girders is about 390,000 pounds. Three cables were used per girder and 16 one-fourth-inch wires were used in each of the cables. Girders adjacent to the expansion end were stressed to 420,000 pounds, and 17 wires were used in each of the three girder cables. All high-tension prestressing wire was stress-relieved to 80 percent of an ultimate stress of 240,000 pounds per square inch as required by the specification. In most cases the anchoring stress was in excess of 60 percent of the ultimate.

The pressure grouting which enclosed the wires in the flexible tubing consisted of a circulating grouting system which used neat cement and four and one-half gallons of water per sack of cement, which was mixed in a mechanical homogenizer. All pressure grouting of the cables in the girders was accomplished from one end of the girder, and the procedure works something like this: When the cable has been filled with grout the excess material is carried back into the grout pump hopper through the return

. . . Continued on page 72

New Freeway

Construction Begins on State Sign Route 12

By HOMER G. SASENBERY, Resident Engineer

In February, 1957, the California Highway Commission declared the first freeway for Sign Route 12 in Solano County between 2.5 miles east of Suisun and 0.5 mile east of Denverton. The route connects US 40 near Fairfield with US 99 near Lodi via Rio Vista.

Approximately five miles east of Fairfield, Sign Route 12 parallels the southern boundary of Travis Air Force Base. During the past few years the runways of Travis have been extended ominously close to the existing highway. The 1957 construction program of the U. S. Air Force provides for extending the present runway some 858 feet south plus an additional 1,000-foot clear zone plus a normal approach area. In so doing, the old highway will be crossed, and a new route has been located to the south to replace the existing highway.

New Alignment

At a point approximately 2½ miles east of Suisun, the new alignment swings southeast from existing Sign Route 12 to a point one mile south. At this point the new alignment extends due east until it crosses the existing route some 5.6 miles from the point of beginning. At a point approximately 1,000 feet east of the above crossing the new alignment swings southeast to connect with the existing route approximately one-half mile east of Denverton. Although right-of-way has been acquired for ultimate four-lane divided traveled way, the present contract provides for two-lane construction, with the remaining two lanes to be completed in the future when traffic warrants.

Old Route Substandard

The traveled way of the existing route consists of plant-mixed surfacing 19 feet wide with earth shoulders. The existing bridge across Denverton Creek is 21 feet wide, thus providing only one foot of horizontal clearance either side of the traveled way.

In the Denverton area sharp curves at the end of long tangents have resulted in many a lost load for truckers using this route. At one point near Denverton, it is a common occurrence to find a spilled load of lumber or some other product along the southern right-of-way line.

The new route being constructed will have a plant-mixed surfaced traveled way 24 feet wide with eight-foot paved shoulders on each side. The bridges to be constructed across Union Creek and Denverton Creek will be 40 feet wide, thus providing the same width as the paved section.

The new alignment has three curves with radii of 2,000 to 3,000 feet and delta angles ranging from 45 to 54 degrees. The old route had five curves with radii of 500 to 1,000 feet and delta angles of 12 to 63 degrees.

Financing

The extension of the runways at Travis Air Force Base has made necessary the reconstruction of this section of Route 53. The Federal Government is participating in the financing of this project to the extent of replacement costs of the existing highway, which will amount to approximately 83.4 percent of the cost of the new construction. The additional 16.6 percent required for construction will be provided by state funds. The cost of the first stage of construction will amount to approximately $1,000,000.

Right-of-Way

Right-of-way for the new alignment varies in width from 142 to 171 feet for ultimate four-lane construction, and in some cases sufficient width has been provided for future frontage road construction.

Sufficient right-of-way has been acquired in the area where the new route leaves the old route to provide for future interchange facilities to the Travis Air Force Base.

This project is one of the first projects in District X to utilize the earthwork and traverse calculations of the IBM tabulation section in headquarters.

IBM calculations are being used by field crews to determine quantities of roadway excavation, unsuitable material, and ditch and channel excavation.

Traffic

At the present time the old route serves approximately 2,100 cars per day. It is anticipated that the average daily traffic for the new section of highway will reach approximately 3,740 vehicles per day by 1971. Truck traffic comprises 15 percent of the total.

During construction traffic will have the use of the existing traveled way with a detour provided around the runway construction at Travis Air Force Base. The new alignment connects with the old route at three locations. Grading requirements at these locations are minor; thus a minimum of interference will be enjoyed by both the traveling public and the contractor.

Construction Highlights

Bids were received for the construction of the new route on May 8, 1957. Fredrickson Bros. of Emeryville were the low bidders with a bid of $1,008,181.50.

The project is 6.7 miles in length and consists of four-inch plant-mixed surfacing over six-inch untreated base over 12-inch imported subgrade material. Approximately 216,000 cubic yards of imported borrow will be required to construct the planned roadbed as the route traverses across low

LEFT—The new traveled way will be constructed through tidelands areas at the northerly end of Suisun Bay as pictured above. Unsuitable material is being removed by clamshell. RIGHT—Looking westerly from the easterly end of the project. This project will be constructed on new alignment due to extension of the runways of the Travis Air Force Base, which can be seen in the background.

ground for its entire length. A local borrow pit approximately two miles from the center of the project is available to the contractor.

The contractor is using two 2½-cubic-yard shovels and 13 14- to 16-cubic-yard dump trucks in the borrow operation at the pit. The material in the pit is rocky and is excellent for shovel loading. Taking advantage of the "off road" hauling conditions, the contractor's trucks average approximately 22½ tons per load. The hauling equipment is routed over the working area to supplement the grid and sheepsfoot rollers being used to obtain the necessary compaction. The equipment in use at this time with an average haul of three miles will place approximately 8,300 tons of import borrow per day. It is anticipated that a peak production of 10,000 tons per day will be reached when the contractor completes his plans to balance his hauling capacity with his potential loading capacity.

Crosses Swamp Areas

The new alignment crosses three swamp areas, one of which is 2,000 feet in length. Mud stripping varying in depths from two to six feet is being performed with shovels both of which are equipped with clamshell attachments. The contractor, in close cooperation with the Solano County Mosquito Abatement Control was able to drain the large swamp by manipulating the control gates in the levee across the lower end. The swamp area is at an elevation of two feet plus or minus and is subject to tidal action. At low tides the gates were opened to allow the swamp water to escape and when the tide started back in, the gates were closed to keep the tidewater out.

The success of this operation was evident by the fact that the contractor's equipment was able to walk along the bottom of the area where mud stripping had been performed with only a minimum of interference from seepage water.

State construction of the new freeway will provide for constructing the westbound lanes of an ultimate four-lane divided highway. Until the additional two lanes of the future four lanes are constructed a temporary intersection with the old route serving Travis Air Force Base will provide a left turn lane and storage facility adjacent to the eastbound lane as well as on and off turning movements to and from the westbound lane. Provisions are also made for a left turning movement from the old route to the eastbound lane of the new highway.

The contractor's operations are progressing satisfactorily towards a completion date in February, 1958. The paving operations should start around the middle of October and be finished during the first half of December.

Glen Fredrickson, partner in Fredrickson Bros., and Archie Edmonds, superintendent for Fredrickson Bros., are in charge of the work for the contractor.

The work is under the direction of J. G. Meyer, District Engineer, E. L. Tinney, Operations Engineer, K. N. Hatch, Construction Engineer, and the author.

FROM KYOTO UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

Kyoto University
Kyoto, Japan

MR. KENNETH C. ADAMS, *Editor*

DEAR SIR: I would like to express my gratitude for the kind and efficient advice and many kinds of useful information which your Division of Highways gave me on my visit to your office in the fall of 1953.

I thank you very much for your kindness in sending *California Highways and Public Works*. I do hope that your division will be kind enough to give us continuing aid hereafter, which, I believe, will be of great help to our institute and will provide us with valuable guidance for our study and research in highway engineering and traffic engineering. After reading the magazine, I get my colleague, Prof. Kometani, to read it and refer to it in his work.

Yours very truly,

TOJIRO ISHIHARA
Professor
Civil Eng. Department
Kyoto University

US 40

Project Between Heather Glen and Colfax Proceeding

By R. T. PHILLIPS, Resident Engineer

On Wednesday, November 7, 1956, bids were opened for the construction of a four-lane divided freeway on US 40 between Heather Glen and Colfax, a net length of about 6.1 miles. The contract was awarded to the contracting firm of McCammon and Wunderlich and Wunderlich, Inc., of Palo Alto with a low bid of $3,602,515.60. Work on the project started on November 11, 1956. On completion, this project will add another link to the four-laning of the interstate highway over Donner Pass between San Francisco and Reno.

The project consists, mainly, of grading and surfacing 6.1 miles of a four-lane divided freeway. To provide property access and leave usable the county road and Colfax street networks nearby, eight miles of frontage roads, ramps, connections and approach roads through mountainous terrain have to be constructed. The project includes placing 16,250 feet of corrugated metal pipe of various sizes up to 54 inches and a total of 1,600± feet of 60-inch reinforced concrete pipe to carry water in the Boardman Canal under the freeway at three separate locations; constructing seven bridge structures and 233 feet of 6 x 5-foot reinforced concrete box storm drain; and providing adequate lighting facilities at each of the three interchange systems.

On US 40 about one mile west of Colfax, looking easterly

Structural Design

The main-line structural design is composed of four-inch untreated base, eight-inch cement-treated base, three-inch Type A plant-mix surfacing, and one-half-inch open-graded plant-mix surfacing.

The earthwork involved features 1,800,000 cubic yards roadway excavation with cuts and fills up to 100 feet in height. The largest fill contains 198,000 cubic yards, and the largest cut 360,000 cubic yards. Although these quantities are not exceptionally large, the contractor's ability to clear over four miles of steep, wooded terrain and move over 1,500,000 cubic yards roadway excavation, approximately 80 percent of contract allotment, in eight months is quite commendable. On completion of preliminary engineering studies, it was considered that the cores of the cuts would contain hard rock formations of serpentine and slates; however, the basic material had been weathered to such depths that caterpillars with hydraulic mounted rippers were able to scarify everything with the exception of minor isolated rock formations encountered at several locations, requiring nominal drilling and shooting. During this same period, nearly 50 percent of the bridge structure work has been completed, and approximately 90 percent of the drainage and minor structure work completed.

Slides and Seepage

The two most prevalent threats to an otherwise normal operation have been slides and subsurface seepage. The basic rock formation north of Weimar consists of deeply fractured and weathered shale laminated with clay lenses on a north-south strike and dipping to the east on an approximate 1½:1 slope. The general alignment of the freeway through this area is about north-northeast with designed cut slopes of 1 to 1 or 45 degrees. The combination of the above conditions has created a dangerous slide threat on the west slope within cut sections. Several minor slides have occurred during construction: two partially remedied or stabilized by lowering the bench grades, another remedied by flattening the entire slope to 1½:1, requiring 17,000 cubic yards of extra roadway excavation. The corrective measures taken were considered the most economical solutions considering the quantities involved, depth of unstable material, and depth of cut below original ground.

The second threat mentioned has been the persistent troublemaker—"subsurface water" and surface seepage. In the contract allotments were included 1,270 linear feet of eight-inch perforated metal pipe and 225 cubic yards of filter material for draining the numerous wells and springs within the limits of the project and for control of ground water at various locations. To date, 5,414 linear feet of eight-inch perforated metal pipe and 1,650 cubic yards of filter material have been placed, representing increases of 330 percent and 630 percent respectively. It is estimated that at least another 1,000 linear feet of eight-inch perforated metal pipe with filter material will have to be placed, and the extent of control within some locations will still be in doubt.

Unsuitable Material Removed

Within a 1,300-foot section south of Colfax, over 17,000 cubic yards of unsuitable material was removed and disposed of and replaced with selected rocky material from cut sections back on line. Due to the saturated condition prevailing in this marshy area, the material had to be excavated with a dragline and loaded into scrapers until a section was cleaned and haul road for trucks constructed.

The inclement rainy weather encountered has not been mentioned as a "threat" because the winter and spring were unseasonably dry with intermittent rain permitting the contractor to accomplish far more than had ever been anticipated. The contractor should be commended for taking full advantage of this weather break by moving his equipment early and working whenever subgrade conditions permitted. If such mild conditions prevail this fall, it might be possible that this six miles of freeway can be opened to traffic by the end of this year, affording the contractor the distinction of completing the contract in one year and the State of the use of the freeway one whole construction season ahead of schedule. Of the 300 working days allotted for construction of this propect, only 91 have been used to date, and the work is approximately 47 percent complete.

Uninterrupted Traffic

Unlike the necessary traffic delays as encountered on other projects, uninterrupted traffic movement is provided by routing over constructed frontage roads and detours. At the Weimar Overhead the structure for eastbound traffic has to be completed and eastbound roadway surfaced to provide a facility for continued traffic flow, then the existing structure is to be removed and the future structure for westbound traffic constructed. Due to the time element involved, completion at this location is considered to be the key to an early completion of the entire project.

The major structures include three overcrossings and two double overheads, namely: Weimar overcrossing, Weimar crossroad overcrossing, the Route 25/37 grade separation, Weimar overhead over the Southern Pacific westbound track, and the New England Mills overhead, over the Southern Pacific eastbound track.

The decks of the two Weimar overhead structures are to be constructed as experimental sections to check slab cracking in relation to size and spacing of transverse main reinforcing bars. Other design features and construction methods are to remain identical for accurate comparison. Although the contractor has made every effort to expedite the bridge structure work, due to the steel beam construction of the two overhead structures and the Route 25/37 grade separation structure, the availability and delivery of structural steel will greatly affect the project's date of completion.

John New, project manager, and Pat Stewart, superintendent, represent the contractor. The work is under the general supervision of District Engineer Alan S. Hart. The author is resident engineer.

QUALIFY FOR PROMOTION

Four Division of Highways employees recently completed training courses at the Naval Reserve Officers School, Treasure Island, San Francisco. They are Louis J. Jennings, supervising bridge engineer, Bay Toll Crossings, Department of Public Works, San Francisco, a commander in the Naval Reserve, who was enrolled in international relations; James M. McDowell, civil engineer, San Francisco, a lieutenant, who studied naval leadership; Robert G. Rogers, Jr., engineering aide, Pinole, a lieutenant of the NROS Staff instructing Combat Information Center Course; and Paul J. Wild, right-of-way agent, San Francisco, a commander who specialized in military justice.

LEFT—On US 40 about two miles west of Colfax, looking easterly. Traffic on old highway near center of picture. RIGHT—On US 40 about three miles west of Colfax, looking westerly.

PASS OF THE OAKS

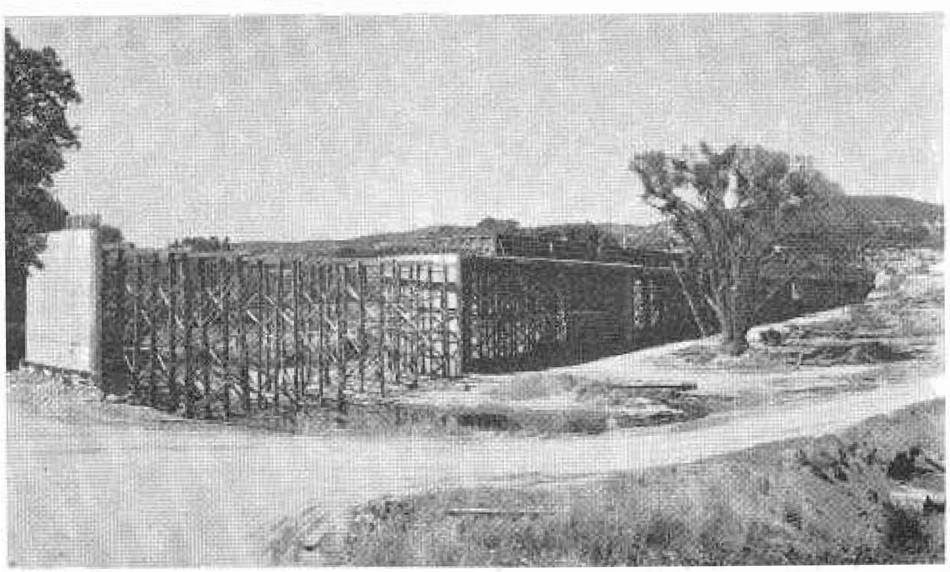
Continued from page 7 . . .

To replace a now substandard steel truss bridge which carries Sign Route 41 traffic over the Salinas River, a reinforced concrete box girder bridge is is being constructed over the Salinas River on the new alignment. This bridge consists of seven spans with a total length of 755 feet supported on concrete piers on steel piling and concrete abutments on spread footings. The bridge will provide a clear roadway width of 28 feet.

The Salinas River is locally known as the "Upside Down River" due to its flow from south to north and its peculiar habit of flowing underground most of the year. The underground flow made construction of pier footings extremely difficult due to the dewatering required. In most instances the footing excavation was kept dry by pumping, but at one pier it was necessary to drive sheet piling and pour a tremie concrete seal in order to dewater, after a well point system failed to keep up with the underground flow. Low rainfall this season allowed the contractor to complete work on piers in the river bottom and construction of the box girders is progressing rapidly.

Upon completion of this project, US 101 will be a four-lane facility from Santa Maria to Camp Roberts, a distance of 70 miles. Bridge work on this contract constitutes approximately one-half of the contract cost. The prime contractor is the Madonna Construction Company of San Luis Obispo represented by Superintendent R. W. Osborne. Major subcontractors are the Raymond Pile Company, for concrete and steel piling; Independent Iron Works, for structural steel; and the Valley Electric Company, for highway lighting. The work is under the direction of A. M. Nash, District Engineer, and the author is resident engineer. John Pettine is the Bridge Department representative.

Reinforced concrete box girder bridge over Salinas River. Reinforced concrete bents of welded steel girder bridges of Route 2-33 separation in background.



FAMOSO PROJECT

Continued from page 9 . . .

allows the use of only three girders per span instead of five as at the overhead. This bridge also features the open-type abutments but utilizes a two-column bent because of the flatter skew angle and narrower roadway width. Footings are supported by concrete cast-in-drilled-hole piles. Construction was started on this structure in March, shortly after work started at the overhead. In July the substructure concrete was all in place, waiting for structural steel.

Cattlepass Extension

In order for the connection to be made at the north end of the relocation of the northbound lanes, the present northbound lanes had to be detoured on to what was the dividing strip in the center of the roadway. The existing cattlepass was in two sections, one under each roadway. It was necessary to connect these two sections before the detour fill could be placed. The length of this extension is about 35 feet; span of the rigid frame concrete cattlepass is about 22 feet. Here was the controlling item of work for the north approach fill for the overhead, so here is where the contractor started work in January, 1957, completing it in February. The detours were then put in and work started on the approaches for the two structures and the structures themselves.

Resident engineer is M. F. Silva. R. E. Harvercamp is Bridge Department representative. Superintendent for Tumblin Company, the contractor, is C. Ray Tumblin.

INFORMATION WORTH WHILE

Continued from page 4 . . .

stance, mineral aggregates are used in constructing underdrainage installations, for pervious material backfilling and for other purposes requiring small quantities in relation to the entire program. Portland cement concrete is used for other than pavement and structures. Steel is used for other than structure purposes such as culvert pipe, guard railing, bridge and hand railing, fencing and various other uses. These are some of the uses of materials not included in the factor computations. Steel piling is an item of steel that has not been included in the factor determinations. Steel piling accounts for the largest quantity of material that has not been recognized in this study. During the 1955 calendar year, the quantity of steel piling was approximately 10 percent of structural steel quantities.

From the foregoing discussion of the bases for computing quantity and value factors and the purposes for which they are intended, it can be seen that they afford a "yardstick" for the reasonable forecasting of construction quantities and their representative values. Tables for the individual years 1954, 1955 and 1956 and a composite table for the three years are shown on pages 4 and 35.

SUMMARY OF QUANTITIES—Continued

California Division of Highways Contracts

January 1, 1955, to December 31, 1955

632 contracts with total value of $174,518,700 (contract bid items only)

Contract items	Total quantities for year	Dollar value totals for year	Quantities per million dollars of contracts	Dollar value per million dollars of contracts	Percent of total contract value
Roadway excavation	52,737,327 cu. yds.	$20,391,089	302,200 cu. yds.	$117,000	11.7%
Untreated rock base	2,373,916 tons	4,718,008	13,600 tons	27,000	2.7
Plant-mixed surfacing	3,337,178 tons	17,327,383	19,100 tons	99,000	9.9
Asphalt concrete pavement	32,550 tons	144,650	186 tons	830	0.08
Portland cement concrete pavement	695,833 cu. yds.	9,782,692	4,000 cu. yds.	56,000	5.6
Portland cement concrete structures	526,675 cu. yds.	25,155,795	3,020 cu. yds.	144,100	14.4
Bar reinforcing steel	104,694,441 lbs.	10,030,772	599,900 lbs.	57,000	5.7
Structural steel	33,494,580 lbs.	4,646,577	191,900 lbs.	27,000	2.7
Cement (contracts only)	2,315,662 bbls.	8,666,169	13,268 bbls.	50,000	5.0
Asphalt (conctracts only)	223,840 tons	4,456,772	1,282 tons	25,500	2.6
State purchases cement	2,420 bbls.	11,482			
State purchases asphalt	44,721 tons	1,050,042			

NOTE: Three contracts awarded for construction of the new parallel bridge across Carquinez Strait at Crockett have been excluded as the concentration of money and steel quantities in these contracts are not typical for the normal highway project.

January 1, 1954, to December 31, 1954

574 contracts with total value of $145,364,900 (contract bid items only)

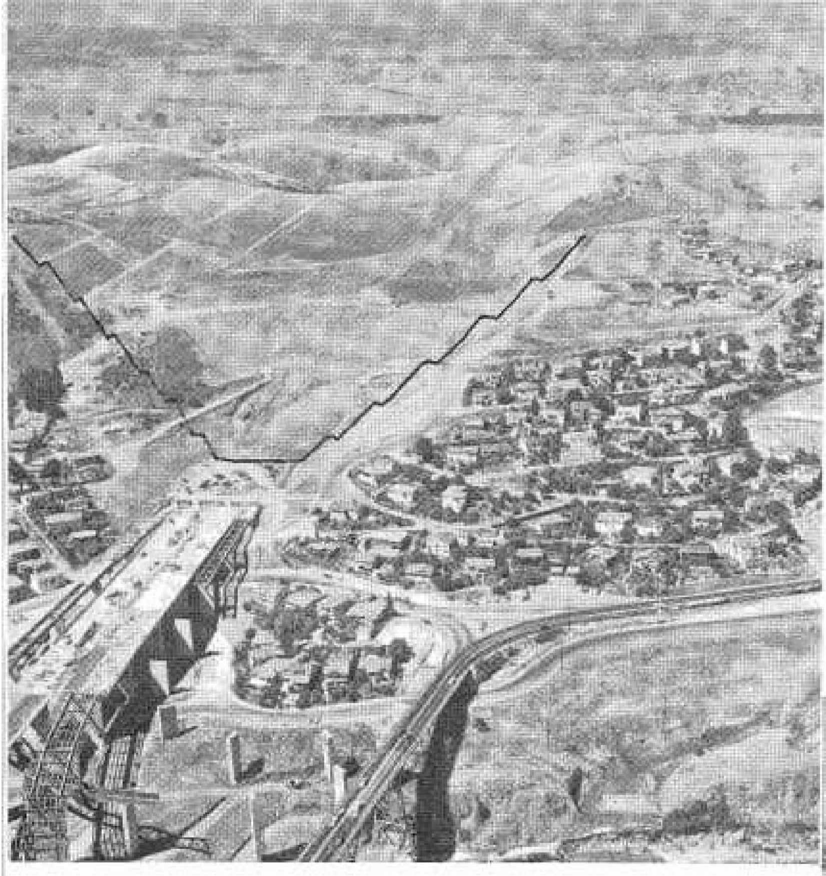
Contract items	Total quantities for year	Dollar value totals for year	Quantities per million dollars of contracts	Dollar value per million dollars of contracts	Percent of total contract value
Roadway excavation	25,056,379 cu. yds.	$9,873,658	172,400 cu. yds.	$68,000	6.8%
Untreated rock base	2,322,531 tons	4,514,533	16,000 tons	31,000	3.1
Plant-mixed surfacing	4,053,100 tons	18,037,554	27,900 tons	124,000	12.4
Asphalt concrete pavement	58,175 tons	320,988	400 tons	2,200	0.2
Portland cement concrete pavement	615,686 cu. yds.	8,434,345	4,230 cu. yds.	58,000	5.8
Portland cement concrete structures	476,434 cu. yds.	22,720,635	3,280 cu. yds.	156,300	15.6
Bar reinforcing steel	78,502,028 lbs.	7,342,461	540,000 lbs.	51,000	5.1
Structural steel	40,894,470 lbs.	5,155,750	281,300 lbs.	35,000	3.5
Cement (contracts only)	2,271,677 bbls.	8,143,045	15,627 bbls.	56,000	5.6
Asphalt (contracts only)	246,072 tons	5,099,567	1,693 tons	35,100	3.5
State purchases cement	8,572 bbls.	31,705			
State purchases asphalt	46,888 tons	1,038,326			

AGGREGATES PROCESSED THROUGH PLANTS

California Division of Highways Contracts

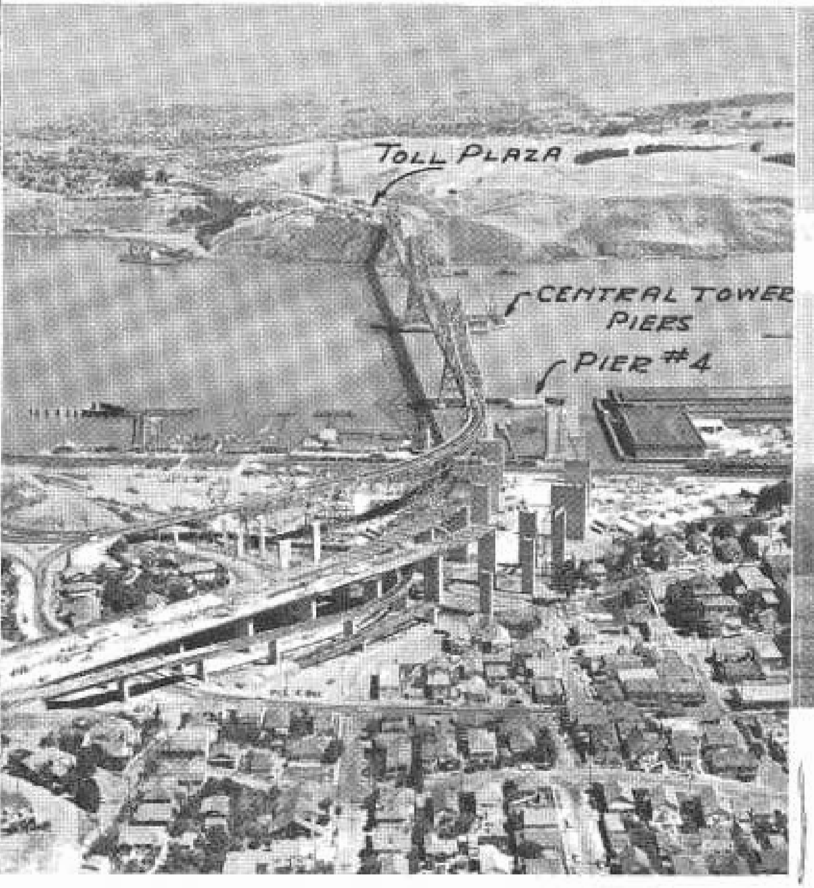
Items	1954 quantities per million dollars of contracts	1955 quantities per million dollars of contracts	1956 quantities per million dollars of contracts	Total 1954 to 1956, inclusive, quantities per million dollars of contracts
Untreated rock base	16,000 tons	13,600 tons	15,400 tons	15,000 tons
Plant-mixed surfacing	26,600 tons	18,200 tons	16,200 tons	19,800 tons
Asphalt concrete pavement	280 tons	177 tons	9 tons	170 tons
Portland cement concrete pavement	7,190 tons	6,800 tons	6,720 tons	6,870 tons
Portland cement concrete structures	5,580 tons	5,130 tons	3,980 tons	4,810 tons
Total processed aggregates	55,750 tons	43,907 tons	42,309 tons	46,650 tons
CEMENT REQUIREMENTS				
Cement (treated bases)	15,627 bbls.	13,268 bbls.	12,635 bbls.	13,700 bbls.
Cement (in PCC-pavement and structures)	10,210 bbls.	10,530 bbls.	8,448 bbls.	9,300 bbls.
Total cement requirements	25,837 bbls.	23,798 bbls.	21,083 bbls.	23,000 bbls.
ASPHALT REQUIREMENTS				
Asphalt (included in bituminous mixes)	1,320 tons	909 tons	801 tons	1,007 tons
Asphalt (as a contract item)	1,693 tons	1,282 tons	1,450 tons	1,460 tons
Total asphalt requirements	3,013 tons	2,191 tons	2,251 tons	2,467 tons
STATE PURCHASES (based on maintenance budget)				
Cement	373 bbls.	105 bbls.	86 bbls.	185 bbls.
Asphalt	2,039 tons	1,944 tons	1,912 tons	1,963 tons

NUMBER OF CONTRACTS AWARDED: **1954, 574; 1955, 632; 1956, 625; 1954 to 1956, inclusive, 1,831**

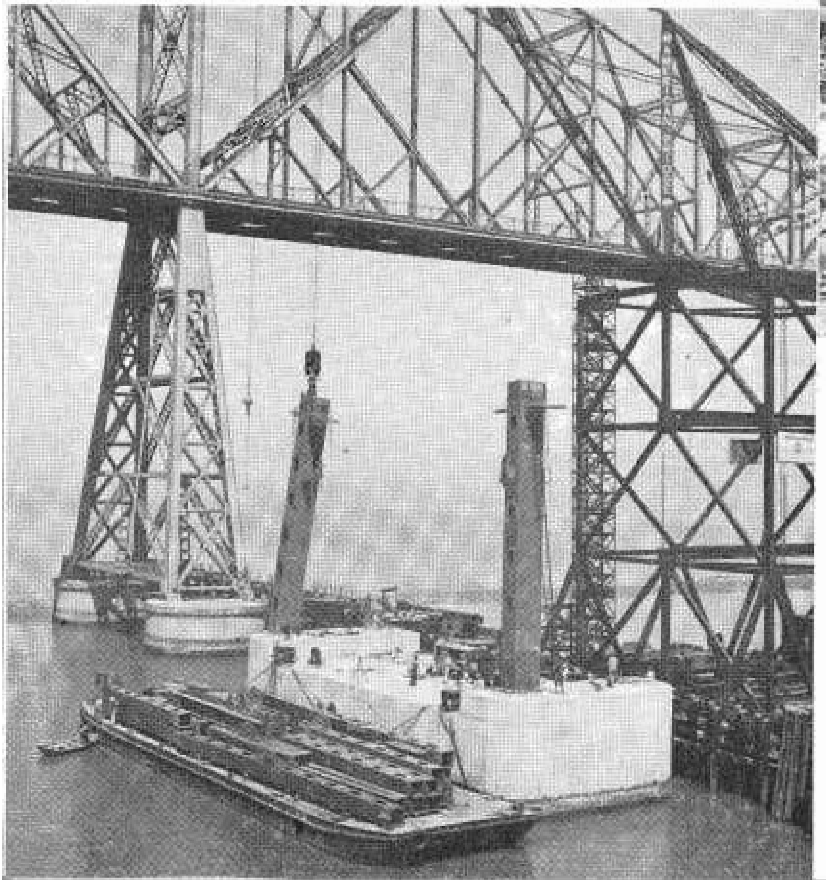


Carquinez Brid

LEFT—Work on the "big cut" to the south of the main bridge approach is in progress. This picture shows the approximate outline of the "big cut" as it will look when completed. This cut contains over 9,000,000 cubic yards of earth, and the contractor, Ferry & Crow, has now removed approximately 5,500,000 cubic yards at the rate of about 25,000 cubic yards per day. Work on the Crockett Interchange can also be seen in the foreground. Peter Kiewit Sons, Inc., the contractor, has a major por-



RIGHT—General view of the work at the Carquinez Bridge. Approach roadwork on the far side toward Vallejo is nearly completed. The administration building and 16 toll collection booths are well under way in the area of the toll plaza. This picture was taken shortly before steel erection started at Pier 4.



LEFT—The bottom section of two of the four legs to this steel tower on the Crockett side at Pier 4 are seen in place. This steel tower when completed will be similar to the tower of the existing bridge seen in the background, but, as can be seen, it will be much heavier in section.

dge Project

tion of the welded steel girders erected and is following closely with the placing of the reinforced concrete roadway slab.

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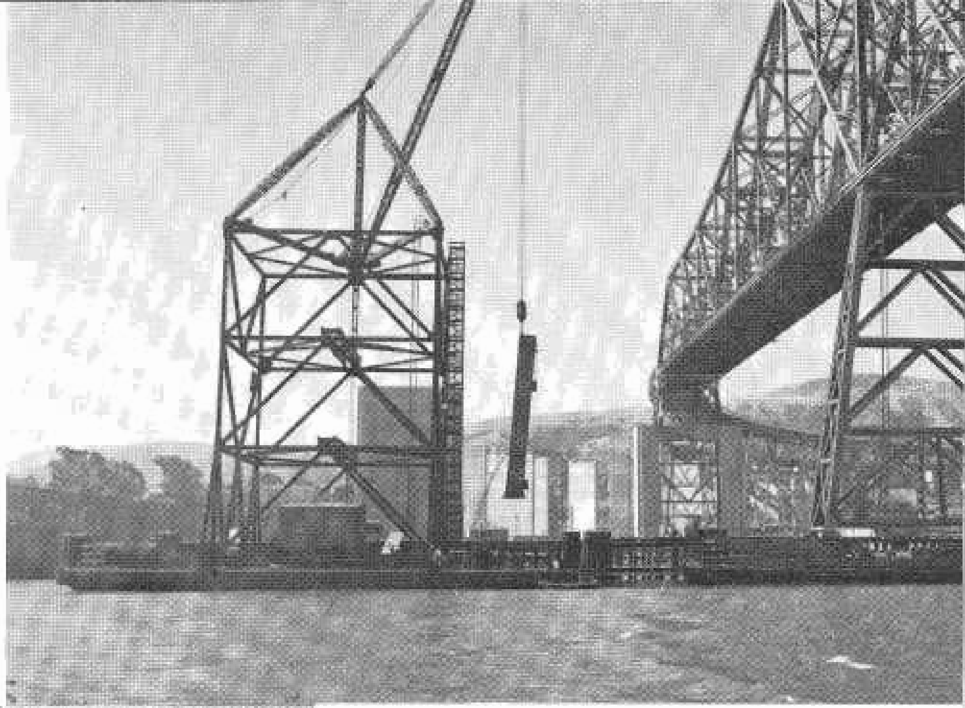
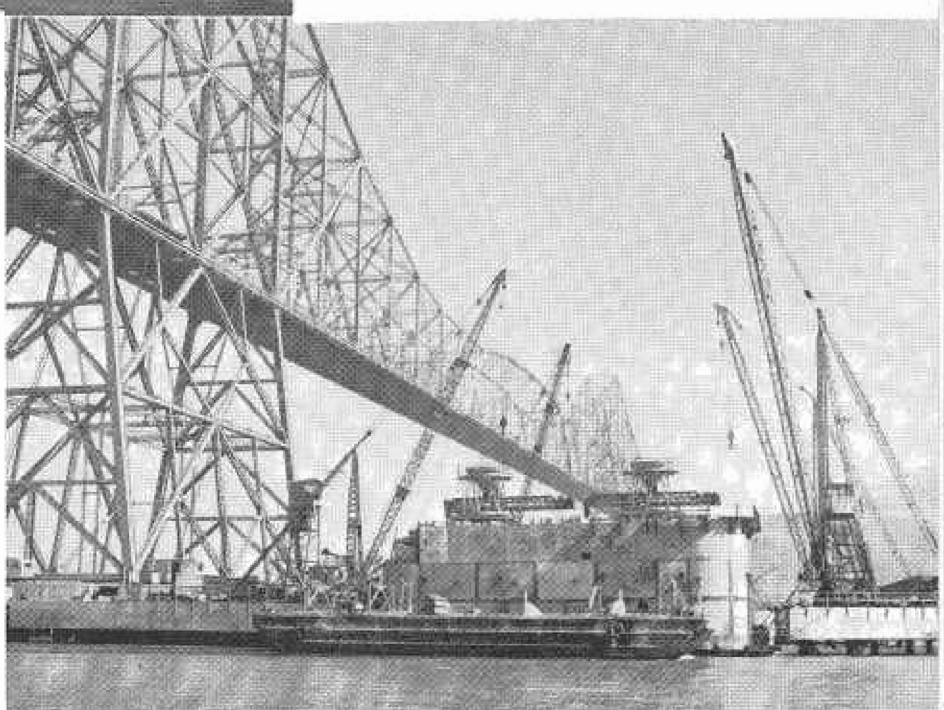


RIGHT—On June 27, 1957, steel erection on the main span was started by the American Bridge Division of the United States Steel Corporation at Pier 4. Their huge crane with a capacity of 100 tons is seen lifting the first piece of one of the main steel supporting towers into place. This single piece weighs 37 tons.

LEFT—Foundation work at the center tower is in progress by Contractors Mason & Hanger, Silas Mason and F. S. Rolandi, Jr. There are two large caissons at this point which will support the main center tower. One of these caissons has been founded on bedrock 132 feet below water, while the one seen in background has about 12 more feet to go before it comes to rest on the bottom. When these piers are sunk and the top cap with steel grillage for tower legs are placed, they will then be ready for the start of steel erection at the center tower.



RIGHT—This picture shows another view of the 53-foot by 102-foot, 6-inch reinforced concrete caisson at the center tower being lowered to bedrock 132 feet below water. The two hoppers on top the pier are used to receive and distribute concrete to the various walls and partitions of the caisson. As weight is added and mud from the bottom removed, the caisson sinks until it comes to rest on bedrock at the bottom. The surface of the bedrock is then thoroughly cleaned after which a solid footing of concrete 25 feet thick is placed under water forming the foundation for caisson and the main central tower for the bridge.

State Fair

Thousands Will Travel Over Superb Highways to Big Show

It's that time of the year again!

Thousands of Californians, and hundreds from outside the State, are planning to travel over superb state highways to attend the California State Fair and Exposition, scheduled August 28th-September 8th.

The word is out—the big show will be even better than in years past. And, if there were more room than the present 200-plus acres, it would be larger, too.

The problem of physical size will be solved in 1960 or 1961, when the fair will open its new 1,050-acre site north of the American River in Sacramento. The recent Legislature authorized expenditure of up to $25,000,000 in the next two years for construction on the gigantic new fairgrounds.

Meanwhile, this year, one precedent after another will be broken, as officials go all out in providing the greatest amount of fun and education possible.

Many Attractions

Events and programs designed for every age group are included in the galaxy of attractions already on tap or being negotiated. There will be star-studded night shows, fireworks, a full program of racing, horse shows, outdoor stage attractions, demonstrations in international cookery, a carnival, arts in action, and many other departments.

Livestock departments will be packed with thousands of blue blooded swine, sheep, cattle, goats, horses, rabbits, poultry, and pigeons.

The list of exhibits goes on, almost endlessly, through departments set aside for art, industry, wines, home shows, women, 4-H Clubs, Future Farmers of America, and others.

Entertainment? There will be scads of it, ranging from hourly puppet shows for the small fry to lavish stage presentations at night featuring some of the world's most popular stars.

Kiddies will be treated to a special circus headlined on opening day by the television star Mickey Braddock, who is "Corky" on the popular TV Show "Circus Boy," and Robert Lowery, the dashing Tim Champion of the same show.

Popular Horse Show

The West's oldest continuous horse show, witnessed by thousands annually, will be held each of the 12 nights, with some events spilling across the program into afternoon spots in the race track infield.

There is an outdoor bandstand, where music from Bach to "rock" will be presented daily free of charge by the State Fair orchestra, high school bands, accordion groups, and others. There are daily programs on the mall, such as flag-raising ceremonies, retreats, close order drills by military units, and other events.

The Outdoor Theater has for many years been noted for a wide variety of attractions. Duke Ellington and his orchestra have performed there, to cite one example of show "types," but so have children in dance studio revues, clowns, dog acts, etc.

New Race Track

Precedent was broken last year when the show was stretched from 11 to 12 days. As was the case in 1956, the big exposition will open on a Wednesday with a full slate of activities dedicated to kiddies. There will be clowns, special rates for carnival rides, free front gate admission for those under 12 (as always), scores of prizes, a parade, and many other highlights.

Racing will return, better than ever, with precedent shattered right and left. Purses have been boosted by $600 to $195,000, with increases for both quarter horses and harness events.

A straightaway track extension will put an end to the time-honored "Sacramento Course," a distance 220 feet short of six furlongs. The additional 220 feet will give a standard distance, offering better comparisons with other tracks for times, records, and other statistical information.

The $20,000 added Governor's Handicap, traditionally run on the second Thursday of the fair, has been shifted to the second Saturday.

Metal Inside Rail

Gallopers will thunder around a new metal inside rail, calculated to produce more speed through less fear of accidents. A wooden rail, in use for many years, is being removed and the metal type substituted.

Also important: There will be daily doubles for the first time in the fair's history. In this popular variation of parimutuels, bettors must select the winners of the first two running races to cash a ticket. The improbability of selecting two front runners in a row, making for high odds and producing more than a small share of excitement.

Arrangement of Departments

Precedent will also be established in arrangement of departments.

The Woman's Building, used for home economics for many years, is being converted into the Telephone Building and will boast displays showing the inner workings of that medium of public communications.

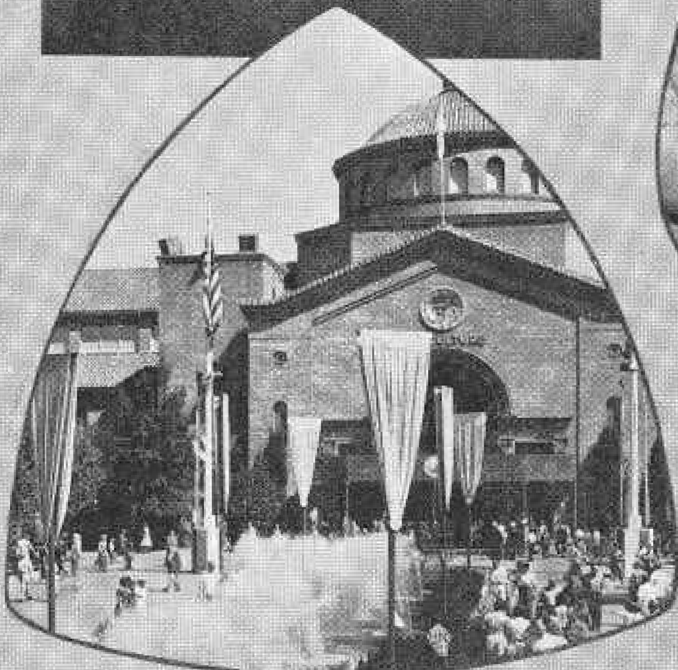
Home economics will be transferred to what formerly was the Home Show Building, now the Woman's Building, where arts of the home and family living will be shown in many ways. A highlight will be the sensational new electronic miracle kitchen.

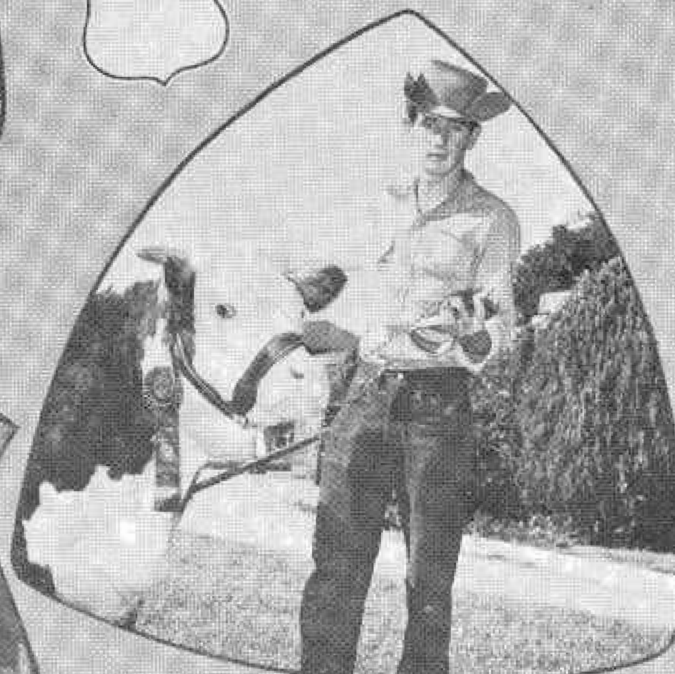
All of the international exhibits formerly displayed in the Counties Building will be transferred to the Woman's Building, and there will be international cookery demonstrations as an important adjunct.

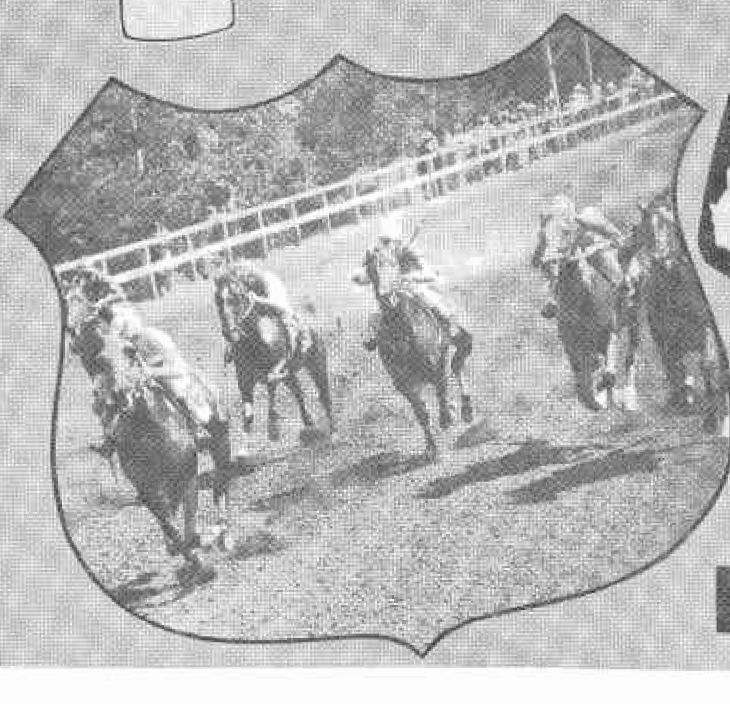
Also located there will be Consumer Reaction and Consumer Survey Councils. In the first, fairgoers will sample

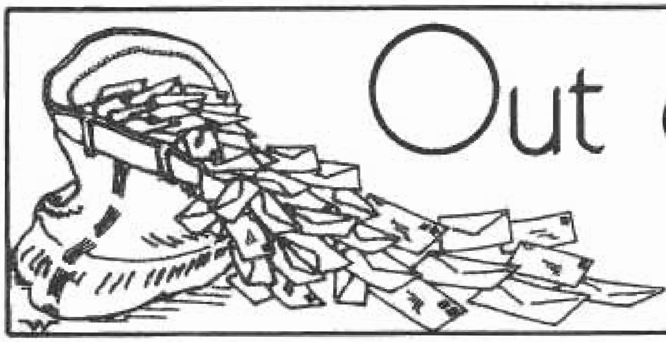
. . . continued on Page 72

ALL HIGHWAYS LEAD TO THE STATE FAIR









Out of the Mail Bag

LETTER OF APPRECIATION

VETERANS ADMINISTRATION CENTER
Wilshire and Sawtelle Boulevards
Los Angeles 25, California

MR. GEORGE T. MCCOY
State Highway Engineer

DEAR MR. MCCOY: Reference is made to the recent completion of that portion of the San Diego Freeway and appurtenant construction within the boundaries of the U. S. Veterans Administration Center at Los Angeles.

The foregoing construction work was difficult and the problem of interference with Veterans Administration Center Hospital and Home activities was ever present, and some apprehension was felt prior to the beginning of construction concerning the welfare of our approximately 7,000 patients and home members.

Mr. George E. Dickey was the State Division of Highways Resident Engineer, and it is felt it was largely through his management the project was completed with dispatch and efficiency. At no time during the period of construction were our operations severely hampered or interrupted.

We also desire to express our appreciation to Mr. E. T. Telford, Mr. Ralph Chase, Mr. E. F. King, Mr. Jack Hudson and the entire staff of District VII with whom we came in contact; their co-operation and solicitous concern with our problems resulted in completing the project with a minimum of interruption to the functioning of the Los Angeles Veterans Administration Center.

Very truly yours,

R. A. BRINGHAM, Manager

YOU ARE WELCOME

THE AUTOMOBILE ASSOCIATION
OF SOUTH AFRICA
A.A. House, De Villiers Street, Johannesburg

MRS. HELEN HALSTED, *Assistant Editor.*

DEAR MRS. HALSTED: Thank you for your letter of 20th May and the two copies of *California Highways and Public Works* included therein. This publication will be very useful to us and we look forward to receiving future copies.

Having seen in these magazines something of what the State of California is doing in the field of road construction it is not surprising that its achievements are spoken of across the world, and that the Americans are described as the greatest road-builders since the Romans!

We are grateful to you for your interest in our problems and for your practical assistance in our endeavours to implement Johannesburg's expressway scheme.

Yours sincerely,

L. B. GERBER,
Public Relations Officer.

VALUABLE PUBLIC RELATIONS

PETER KIEWIT SONS' CO.
CONTRACTORS
Arcadia, California

MR. G. T. MCCOY, *State Highway Engineer.*

DEAR MR. MCCOY: Too often most people, including myself, have an opportunity to see something that impresses them with being a good idea and simply pass it up as something nicely done. Not too often, however, are those responsible for some of these good ideas complimented for their thought and effort that go into them. For these reasons, I personally feel that you, and whoever else in your organization is responsible, should be highly complimented for the little pamphlet printed by your department which so ably describes the prevailing situation in regard to delays to the traveling public on US 40.

As a contractor, we place a great value upon our relationship with the traveling public, and even though we have no responsibility in the reconstruction of Highway 40 we firmly believe that giving pamphlets of this kind to the motorists that are being delayed can result in nothing but respect for both the Highway Department and the contractor involved.

Sincerely yours,

PETER KIEWIT SONS' CO.
THOS. H. PAUL

SOURCE OF INFORMATION

RICHFIELD OIL CORPORATION
Richfield Building, Los Angeles 17

Editor, *California Highways and Public Works*

DEAR SIR: I have received my first copy of your excellent publication and have enjoyed it very much. The information contained therein is factual, informative and interesting. I am looking forward to subsequent issues and wish to take this occasion to thank you for your courtesy in forwarding this magazine to us.

Very truly yours,

RICHFIELD OIL CORP.
By H. A. MUNN
H. A. Munn, Manager
Motor Truck Sales

Economical

New Device for Motor Grader Saves Engineering Time

By BERNDT NELSON, Assistant Construction Engineer

In one respect roadbuilding can be compared to a golf game. Down the fairways of the golf course, and before finish grade is reached on the road, the accent is on power and yardage. As the golfer approaches the green and the roadbuilder gets closer to finish grade the accent must change or include a degree of exactness not required on the fairway or the placement of materials far removed from finish grade.

As the golf player must be able to "putt out" in a minimum number of strokes for a good score, so must the roadbuilder be able to efficiently "finish off" the layers of roadbuilding material to proper grade and cross section.

One type of equipment used to perform the "finish" operation on graded surfaces of earth, untreated and cement-treated base layers and bituminous-treated base and surface layers is the motor grader

Skilled Operators Needed

Truly skilled operators of this type of equipment are in great demand, for upon them is the responsibility of quickly and correctly finishing off the materials which are being supplied to them in ever increasing quantities. Reworking in case of error is not always the answer for often the materials being placed are such that the time element is a large factor, as in the case of most bituminous mixes that can only be placed at controlled temperatures and certain cement-treated bases that must be placed, compacted and a curing seal applied within a prescribed elapsed time.

A device called the Preco automatic blade control has been developed and is now being commercially produced for attachment to a motor grader to aid in its operation in quickly and accurately grading a surface to its required slope.

The following is quoted from a report made by Paul Kirst, Resident Engineer of a project on which the device was first used:

"The need for a device enabling an equipment operator to accurately and economically produce a graded surface of specified cross slope has long been recognized by both contractor and engineer engaged in street, highway, airport, subdivision work, etc."

A motor patrol equipped with the device is shown in *Figures I and II.*

The added equipment is inconspicuous, so arrows are placed to indicate members making up the device. Members 1 and 2 house units of the linkage system which transmits the attitude of the blade to member 3, which the manufacturer calls the "brain," in which data is translated into electrical signals to the control box, member 4, from which the automatic operations of the motor grader blade lift levers are actuated.

FIGURE I

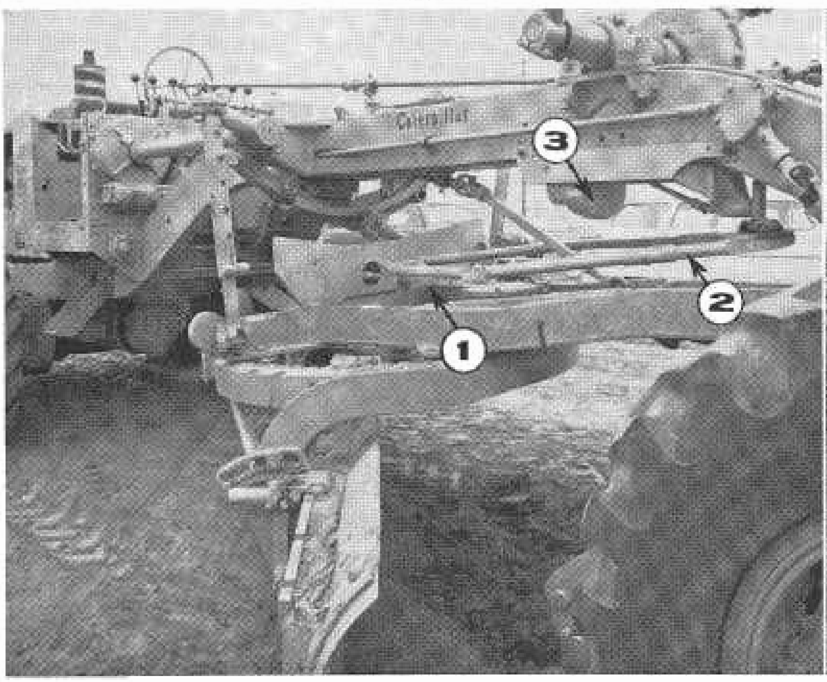


FIGURE II

Job of Staking

Ordinarily in the finishing of any particular layer of roadbed, stakes are set, generally one row on each side of the roadbed and on a selected offset line or grade line or both to provide the equipment operators a guide from which to work. Standard practice is that breaks or changes in grade are staked and a straight line grade is assumed between staked points.

Where the breaks in the coss section vary from the job typical cross section or are in transition areas from one to another typical section, reference to those points are made on the witness or guard stakes set adjacent to the grade stakes.

Up to this point staking as described is generally performed by state forces, the staking for the intermediate points across the roadbed is left to the contractor.

Improved Methods Needed

The amount of work involved here in setting and resetting stakes, performing work over and over again, "wearing the material" out as is often expressed, and lost time of equipment framed the need for improved methods.

The contractor's method of obtaining the specified cross slopes has generally been that of setting additional stakes across the roadbed to work to. Under this system the area between the stakes is graded to the plane indicated by the stakes and the accuracy of the completed product varies with the skill of the individual operator, the accuracy of the stake setting, and the inconsistencies that are bound to occur because of grade stakes being rolled down, covered up, knocked out, or otherwise displaced. One large disadvantage of stakes in the immediate area to be worked on is that equipment movement is hampered and in addition, although stakes are set to guide the operator, the area between stakes is still left to guesswork.

Guesswork Eliminated

With the automatic blade control device the "guesswork" in cross slope can largely be eliminated and without the aid of stakes within the working area.

In short, the device is a control system for automatically adjusting the elevation of one end of a mold board or blade of a motor grader to maintain a desired and dialed cross slope. The opposite end is under the manual control of the operator in the usual manner, being raised or lowered to conform to longitudinal slope or grade required. Automatic adjustments occur whether change becomes necessary by uneven terrain being traveled over, change in the position of that end of the blade controlled by the operator, or by a change in the dial setting.

Substantial Saving

On the first projects on which the device was used, it became apparent that not only was the need of setting intermediate stakes across the section eliminated, other savings were possible. The following is another quote from the report on the project where the device was first used:

"A substantial saving in staking costs, to both contractor and contracting agency, may be realized by use of the automatic blade. The device is capable of carrying required cross slope from one side of the roadbed to the other, including various intermediate slope changes, such as shoulder "breaks" and center crown. This allows one row of stakes, set to proper line and grade, to adequately serve for both the construction of the section and subsequent checking by the contracting agency."

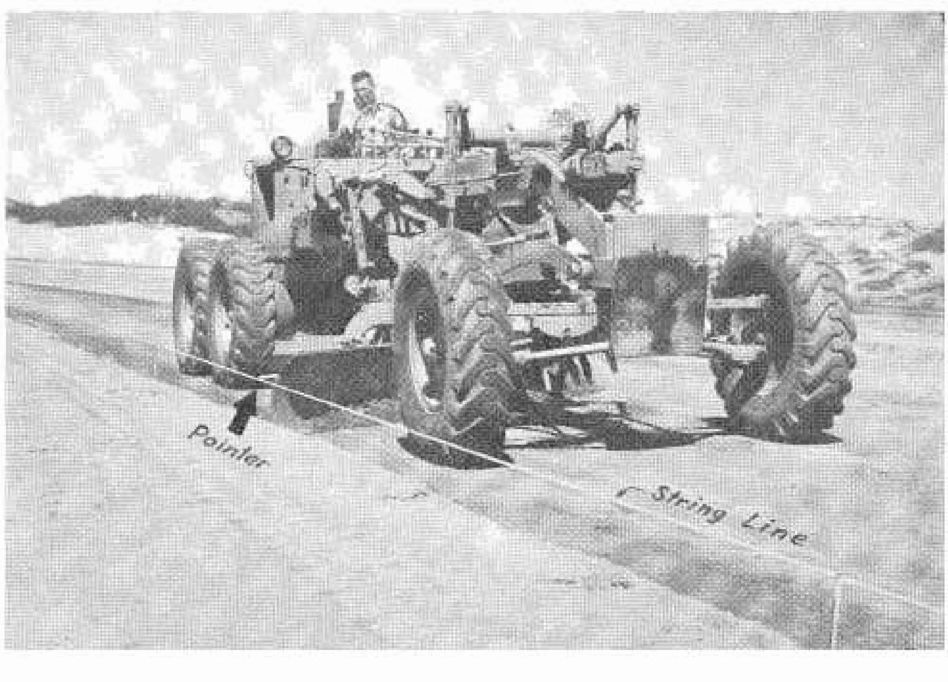
Although designed for automatic control of cross slope—a tremendous step—a natural followup question was: "In what way can the work be done so that there is more control of longitudinal slope or grade, as that end of the blade, under the control of the operator is still subject to individual operator skill?"

Comments by Resident Engineer

On a subsequent project where a motor patrol equipped with the device was used this was taken into consideration and a staking procedure used which provided the operator a continuous visible grade line to follow. The following are excerpts from a report made by M. E. Darrough, Resident Engineer on the project:

"In the attempt to realize the advantages in the use of this machine, certain heretofore common construction practices had to be altered. The first alteration was that of changing the subgrade staking procedure. Under normal conditions, two rows of offset subgrade stakes would have been set by the State. These would

FIGURE III



have been supplemented by two or three rows of blue tops set by the contractor at each subgrade elevation. In lieu of this, however, only a single line of offset grade stakes was set. These stakes were placed at the subgrade elevation for, and at 0.5 foot offset from, the edge of the two-foot median border. A two-foot metal stake was then placed adjacent to the grade stake and driven to a top elevation of one foot above the grade stake. A string line was then stretched between and at the top of these metal stakes, forming a continuous longitudinal grade line to be followed by a pointer affixed to the toe of the grader blade. At this point, it should be noted that the grade stake or the string line could have been set at any elevation and the pointer adjusted so that the blade's cutting edge would operate on any desired plane. * * *

"With the string line in place and the aforementioned pointer adjusted so that the blade's cutting edge operated on the desired plane, the subgrade finishing operation was commenced."

Figure III shows how the latter procedure appears in operation.

The following is quoted from the previously mentioned reports regarding savings in engineering manpower.

"Obvious savings do occur, as previously noted, in staking costs. The contractor's primary saving in these costs is obtained by reduction of 'grade checker' and 'guinea chaser' time, as well as reduced equipment and operator time necessary to produce required results.

"The contractor on this project has estimated that this unit eliminated approximately 80 percent of his finish staking, reduced the finishing time by 30 percent.

"The State saved 50 percent of the normal cost of setting subgrade stakes.

"The State can expect to realize quality benefits not so dependent upon operator skill; and further montary savings passed on through the bidding as reflected by reduced contractor costs."

A First

Initial Double-deck Freeway In Oakland Is Opened

California's first continuous double-deck freeway structure, the Cypress Street Viaduct in Oakland, was officially opened to traffic on June 11th with appropriate ceremonies sponsored by the Alameda County Highway Advisory Committee.

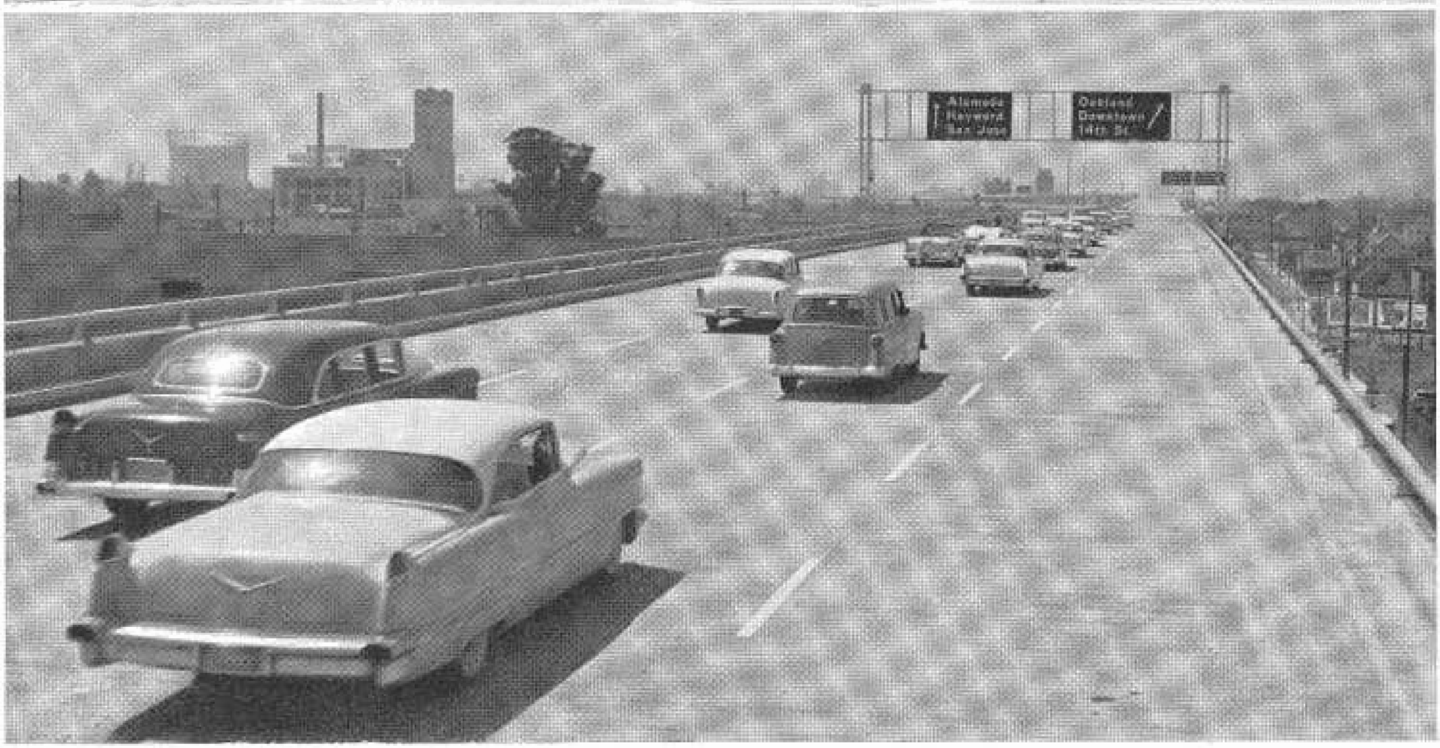
The project provides four lanes in each direction along Cypress Street in the industrial area above city street traffic.

This unit of the Eastshore Freeway extends south from the distribution structure for a distance of 1.3 miles with ramp connections to city streets. The upper deck carries southbound traffic, and the lower deck northbound traffic, both on 52-foot roadways divided into four lanes. It was constructed in two contracts at an approximate cost of $8,500,000, performed by Grove, Sheperd, Wilson & Kruge of California, Inc. It will relieve the local city streets of through traffic and enable traffic to proceed from the Bay Bridge through the industrial area without interference. It also provides for the considerable local traffic service along this route. During the construction all traffic used the parallel surface roadways which were constructed on either side to clear the viaduct area. These roadways will remain a part of the surface street network in this area.

Last Link Under Construction

A short distance southerly there is now under construction the last link of the Eastshore Freeway in Oakland between 0.25 mile east of Fallon Street to 0.22 mile west of Market Street, a length of 1.55 miles of freeway for which the Highway Commission has allocated $6,750,000. Johnson, Drake & Piper, Inc., of Oakland are the contractors on the project, and it is expected that this will be

Sharron Gleason, Miss Oakland, center, is surrounded by admirers as she poses for ribbon cutting. Left to right: C. A. Maghetti, Secretary Highway Commission; State Highway Engineer George T. McCoy; F. W. Panhorst, Assistant State Highway Engineer; Robert L. Bishop, Highway Commissioner; Director of Public Works Frank B. Durkee; Mayor Clifford Rishell of Oakland; B. W. Booker, Assistant State Highway Engineer, and William Travis, District Construction Engineer.



UPPER—Crowd at Cypress Street Viaduct dedication and caravan of officials and guests using new facility

completed by early summer of 1959. When completed, there will be a freeway in operation the entire distance from Ford Road, south of San Jose, through Oakland to Sacramento, with the exception of a short portion between El Cerrito Overhead in Albany to Richmond. (Carquinez Bridge and approaches are slated for completion the latter part of 1958.)

Dedicatory ceremonies were held on the upper deck of the freeway where a crowd of 200 citizens, mayors, city managers and civic group representatives of Alameda County together with state officials cheered Mayor Clifford Rishell of Oakland and Alameda County Supervisor Chester E. Stanley as they cut twin ribbons while pretty Sharron Gleason, Miss Oakland, and her maid, Sally Galbreath, beamed approval.

Following the ribbon cutting an auto caravan carried guests to the Athens Athletic Club in Oakland for a luncheon. Among those present, in addition to Mayor Rishell and Stanley, were: Frank B. Durkee, State Director of Public Works; State Highway Commissioner R. L. Bishop of Santa Rosa; George T. McCoy, State Highway Engineer; F. W. Panhorst, Assistant State Highway Engineer; Boyd E. Sylvester, bridge engineer, Bureau of Public Roads; B. W.

. . . Continued on page 51

San Diego Freeways

Four Contracts Are Completed in Year

By R. B. LUCKENBACH, Assistant District Engineer, and
C. SMITH and AL ESTEP, Resident Engineers

On March 18, 1957, a six-lane full freeway between Wabash Boulevard and 56th in San Diego was opened to traffic. This was the fourth contract completed within a year, opening 9.6 miles of full freeway between Wabash Boulevard in San Diego and US 80 east of La Mesa, State Sign Routes 94 and 67.

These contracts were as follows:

Description	Contract cost	Right-of-way	Contractor	Resident engineer
Wabash Blvd., 2.4 miles	$2,168,000		Guy F. Atkinson	Al Estep
56th St., 2.8 miles	$1,668,000	$4,600,000	Guy F. Atkinson	C. E. Walcott
College, 2.6 miles	$2,998,000		Guy F. Atkinson	Don Smith
Campo Rd., 1.9 miles	$1,492,000		E. C. Young, Service Const. Co., & Young & Arrieta	W. T. Rhodes

Bridge Department resident engineers were R. L. Hathaway, Wayne Cryderman and Jack Burns.

The City of La Mesa at the easterly end is contiguous to San Diego and together with Mount Helix is one of San Diego County's finest residential areas. The city was a trading post known as La Mesa Springs in 1870. It was incorporated in 1912 with a population of 700. Mount Helix is the location of San Diego's largest outdoor amphitheater, where Easter services have been held each year since 1918. Many famous musicians called La Mesa or Mount Helix their home, including Madame Schumann-Heink, Carrie Jacobs Bond and Charles Wakefield Cadman.

Full Freeway

The 1957-58 highway budget includes $4,065,000 for construction of 1.8 miles on the westerly end between Wabash Boulevard and 18th Street where it will connect to the future US 101. There is currently under construction a 2.0-mile section of US 80 on the easterly end which will complete a full freeway between the future US 101 at 18th Street in San Diego and Chase Avenue in El Cajon.

The section between College Avenue and Campo Road was officially dedicated with a luncheon and ribbon-cutting ceremony on February 14, 1957, by the Lemon Grove Chamber of Commerce. The section of Route 67 between Campo Road and US 80 was dedicated on March 12, 1957, with a program sponsored by the La Mesa Chamber of Commerce.

The section of Route 94 from Wabash to Campo Road is graded for eight lanes with initial construction of six lanes. The structures are built to clear two more lanes in the median. The section of Route 67 between Campo Road and US 80 is constructed of four lanes with grading for ultimate six lanes. This is actually a cross connection between US 80 and Sign Route 94. Therefore six-lane design will handle estimated future traffic.

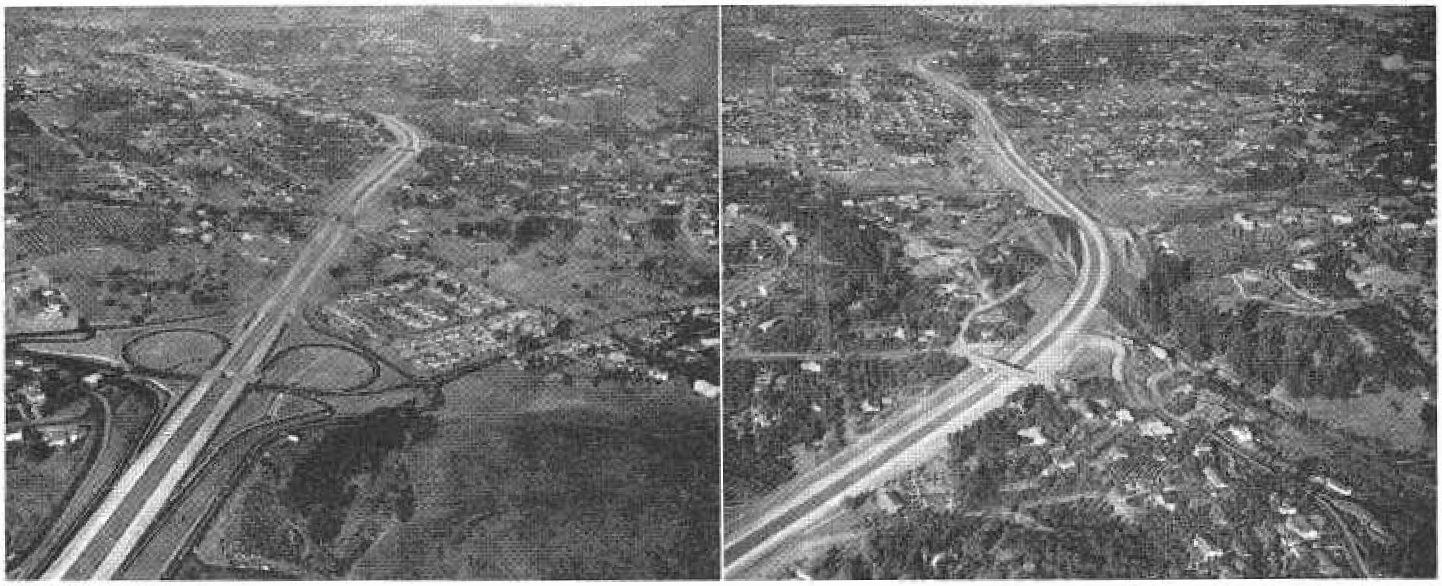
All main line paving is eight-inch portland cement concrete over four-inch cement-treated subgrade and sub-base treatment as individual location required. The ramps are of asphaltic plant-mix. The entire route is of full freeway design with crossings only at structures.

Modified Epoxy Resins

Two construction items of special interest are the use of modified epoxy resins to repair breakouts adjacent to weakened-plane joints resulting from random cracking, and the use of metal strips for weakened-plane joints. These are described in articles by the resident engineers.

The improvement of Route 94 (A) has been under study for many years. Project reports were prepared July 8, 1949, June 15, 1951, and November 8, 1951, all providing for a four-lane conventional road or at best some access control.

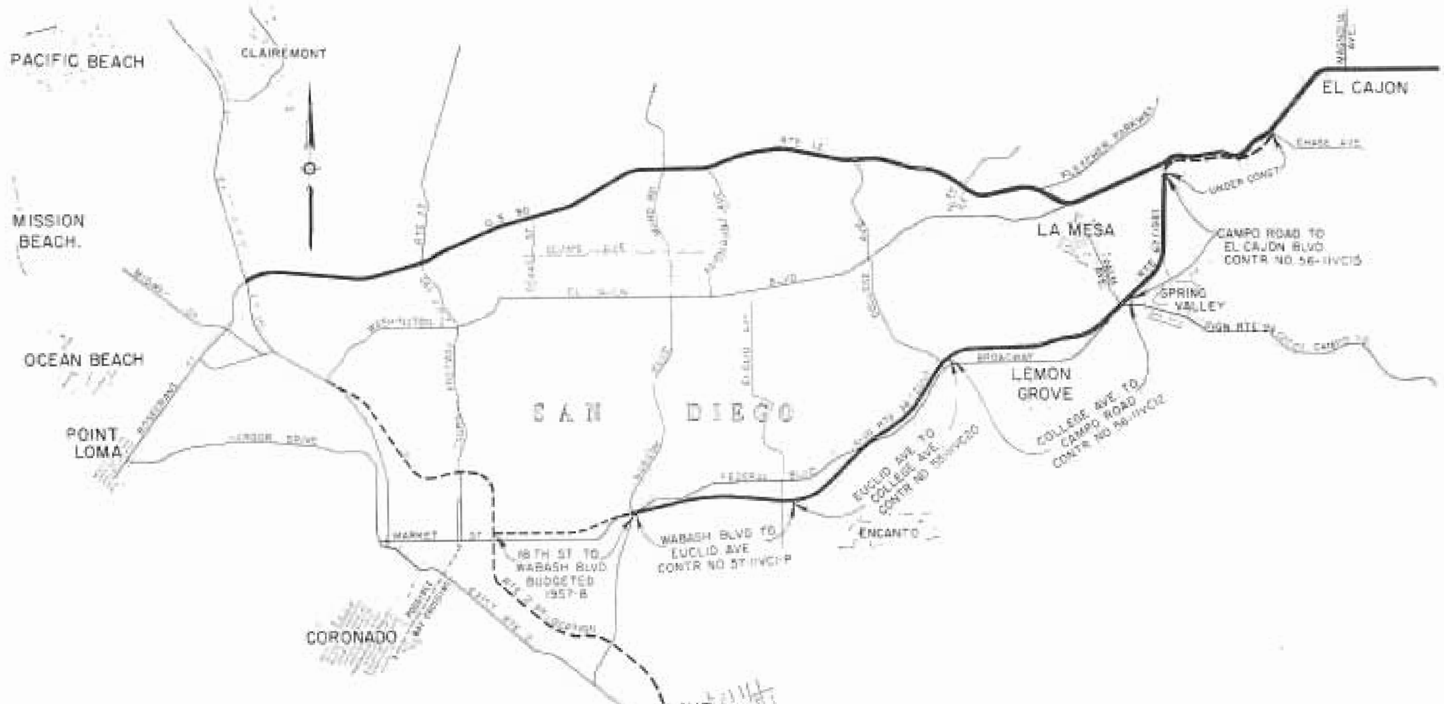
A detailed traffic analysis including post card and origin and destination survey in 1952 showed a full freeway of eight lanes was needed. A traffic report was completed in March, 1953, recommending the route as now constructed. The progress on this route is nearly a record. The report was reviewed and recommendation was made to the California Highway Commission enabling it on May 20, 1953, to advise the county board of supervisors and the city councils of La Mesa and San Diego of its intention to adopt the route. The Highway Commission adopted the portion through Lemon Grove on June 17, 1953, with the complete cooperation of the local people and the county board of supervisors. Bids on the first project were advertised in December, 1954, or 18 months after the route adoption. During this time, freeway agreements were signed, rights-of-way purchased and cleared, plans completed and funds budgeted. In May of 1957, after less than four years' elapsed time, the entire 9.6 miles is open for traffic. The completed projects include the most modern of signing and safety lighting now characteristic of California's freeways.



LEFT—View northeasterly at junction of Sign Routes 94 and 67. Structure in center is the Route 67-94 separation. Sign Route 94 continues to right of picture. Panorama Drive Undercrossing shows in center, with the Mariposa Street Overcrossing following. RIGHT—View northeasterly of Sign Route 67. Structure in foreground is the Mariposa Street Overcrossing. Lemon Avenue Undercrossing and Grossmont Boulevard Undercrossing follow, with future connection to US 80 at Grossmont Summit visible in far background.

By AL ESTEP, *Resident Engineer*

An experimental installation of metal strip weakened-plane joints was made on the contract between Wabash Boulevard and 56th Street. This contract included 10,000 linear feet of six-lane and 1,100 linear feet of eight-lane portland cement concrete pavement. Some 1,072 metal strips were installed for weakened-plane joints. They were placed an average of 43 feet apart at the average rate of 77 per day. The strips were two inches deep and initially 11 feet 11 inches long, later reduced to 11 feet 10 inches to clear flanges of the finishing machine. Fourteen-, 16- and 18-gauge hot-rolled black iron was used. The finished product does not indicate any difference between gauges used; how-

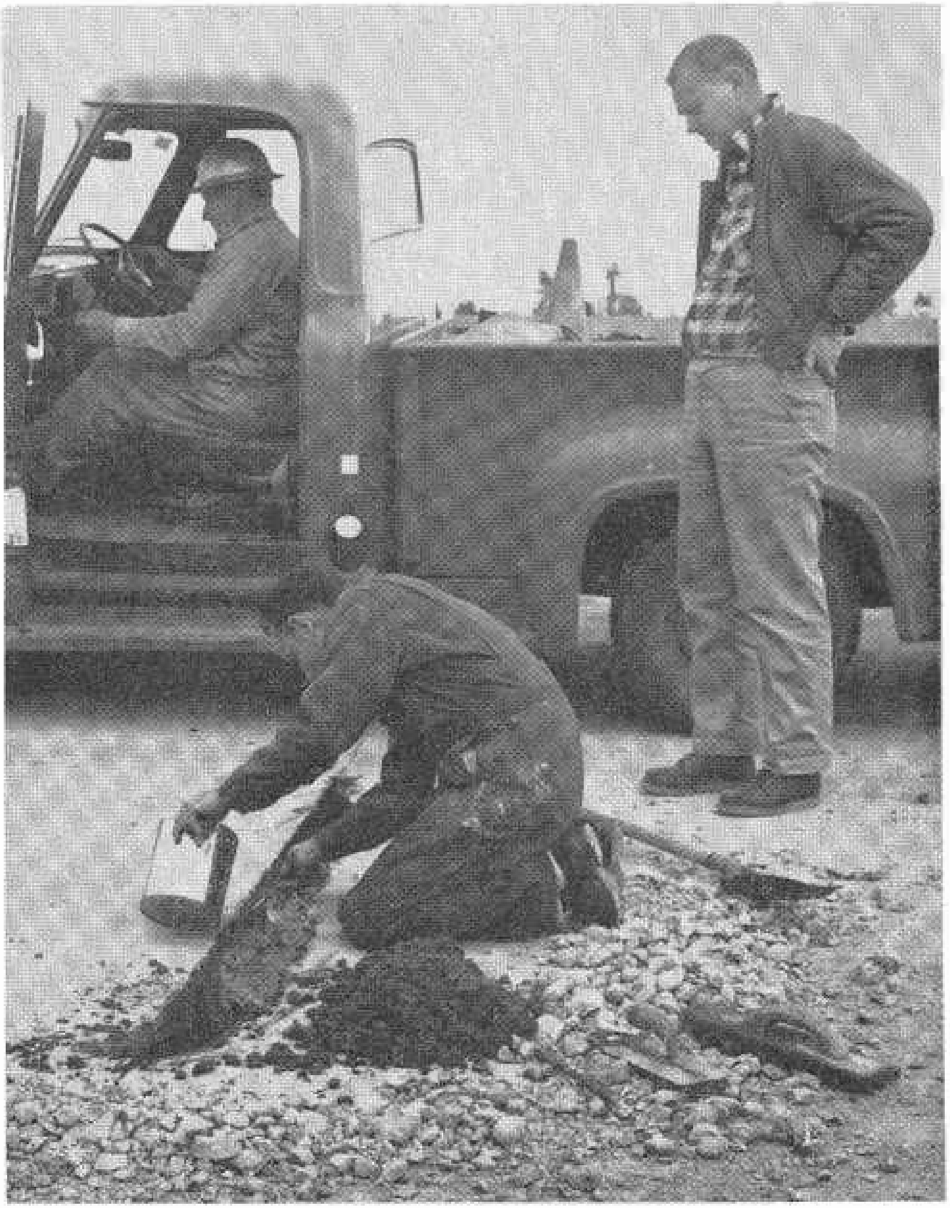


ever, the 16-gauge seemed satisfactory for this project. The 14-gauge appeared unnecessarily heavy and the 18-gauge too flexible in that it was easily deformed and difficult to adjust to grade.

Weather permitted sawing of control joints in the initial lanes 30 hours after pouring. Only nine random cracks are evident in the initial lanes, seven of these being in one day's pour. Trouble was encountered in a companion lane when a morning pour of 650 linear feet was not ready to cut by the following morning. Random cracking had developed opposite 15 of the 20 working joints in the initial lane. Therefore the experimental metal strips were used in subsequent pours in companion lanes.

Construction Details

Each morning working joints on the adjacent pavement within the limits of the proposed pour were marked. This was done because later in the day the random cracks or working formed joints would become invisible. Paint marks were placed at the center and edge of the adjacent slab. The metal strips were placed at the marked locations and installed as soon as the tamper made its last pass. A special tool designed by Resident Engineer Don Smith was used. Finishing operations immediately followed the installations which were made by two men using a wooden bridge and the special tool. The strips were inserted in the tool and forced into place one-fourth inch below grade. Two pieces of one-



Preparing spalled area for repairs

View northeasterly of State Sign Route 94 during construction. Bridge in foreground is the College Avenue Undercrossing. Following is the Massachusetts Avenue Undercrossing. Old State Sign Route 94 through Lemon Grove parallels new construction on right.

eighth-inch strap iron were used to hold the ends of the strip while the tool was withdrawn. The finishing machine occasionally hit the strips at this depth, so they were set to three-fourths inch, then adjusted to grade after three or four passes by the float. It required two men to adjust the strips to proper position in respect to finished surface if a center sag was to be avoided. Pliers were used to work them.

Temperatures were from 49 degrees Fahrenheit at night to 76 degrees Fahrenheit daytime average. Pouring was completed by 4 p.m., finishing 10 to 11 p.m. Remaining joints including those where strips were removed by the finisher were sawed 48 to 72 hours after pouring. The finished product indicates the strips should be one-fourth inch or less below grade for best results.

By D. C. SMITH, *Resident Engineer*

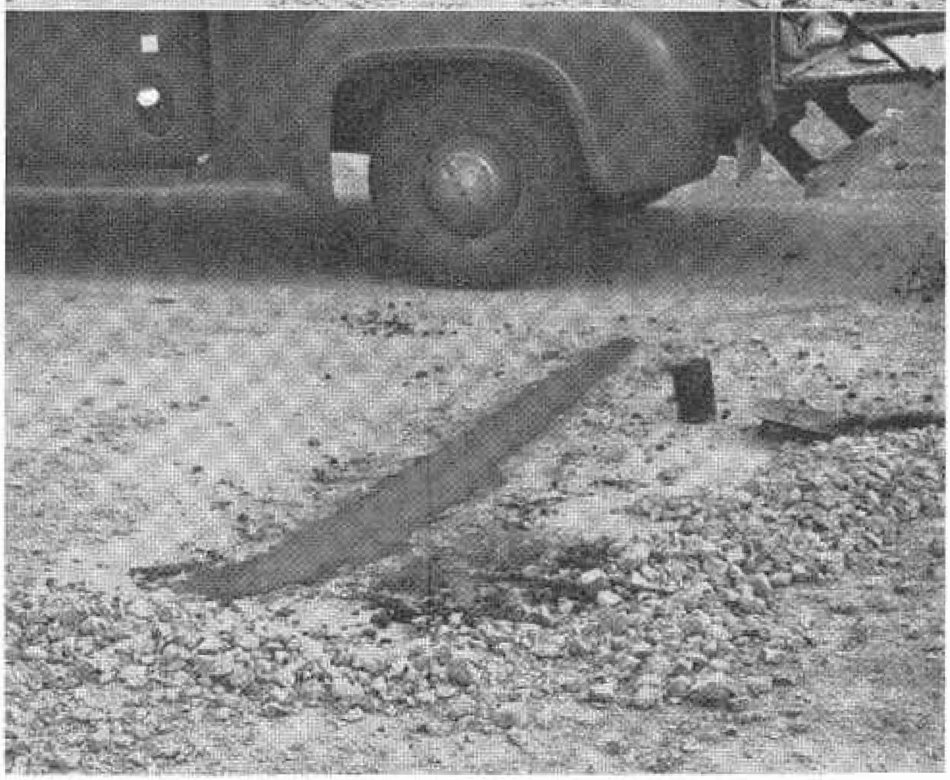
ON THE contract between College Avenue and Campo Road random cracks developed in companion lane before the weakened-plane joints could be sawed. This resulted in pavement spalling between the cracks and the cut joints.

Experimental repairs were made using a modified epoxy resin adhesive. Herbert A. Rooney and E. D. Botts from the Sacramento Materials and Research Laboratory supervised the mixing and placing of the adhesives. In excess of 100 separate repairs were made and to date no failures are evident.

Where small spalls were repaired, the material was removed and the space refilled with a grout of an epoxy adhesive and dry sand. The working joint was retained by application of oil to one face.

At larger breaks, the concrete was removed to sound material (usually four to five inches). The entire surface was coated with adhesive and immediately filled with regular concrete. The working joint was reformed by stress.

Where random cracks were three feet or less from the cut and no spalling evident, two methods were used.



UPPER—Placing epoxy adhesive mixture to repair break. LOWER—Repair completed.

(1) The original saw cut was filled with an epoxy adhesive to eliminate the joint.

(2) A parallel cut was made one inch from the original, the material removed and replaced with a grout of dry sand and an epoxy resin adhesive. Chipping was expensive and the parallel cut method was the more economical.

... Continued on page 56

Cost Index

Below First Quarter of 1957 But Shows Increase Over First Quarter Alternate Computation During Second Quarter of 1957

By RICHARD H. WILSON, Assistant State Highway Engineer,
H. C. McCARTY, Office Engineer, and
LLOYD B. REYNOLDS, Assistant Office Engineer

THE CALIFORNIA Highway Construction Cost Index for the second quarter of 1957 shows a moderate decline from the first quarter of 1957. The index now stands at 266.9 (1940=100), which is 10.8 index points, or 3.9 percent, below the first quarter. However, in the first quarter of 1957 two unusual projects exerted an unbalancing weight upon the index in its upward course causing the index to take a large unnatural jump from 252.1 in the fourth quarter of 1956 to 277.7 for the first quarter of 1957, an increase of 10.1 percent. While this large jump reflected the actual figures when the two unusual projects were included, it was felt that the index was overly influenced and was out of line with the cost trend and should show a decrease in the second quarter. Our predictions proved true as the second quarter index shows a decrease to 266.9, or 3.9 percent below the first quarter figures.

The present standing, however, is 5.8 percent over the fourth quarter of 1956 and 6.9 percent over the alternate index for the first quarter of 1957. Disregarding the sharp rise in the second quarter of 1956 in anticipation of uncertainties of the outcome of the labor strike in the steel industry and the first quarter of 1957 which included two unusual projects, the California Cost Index has shown a steady rise during the last 2½ years.

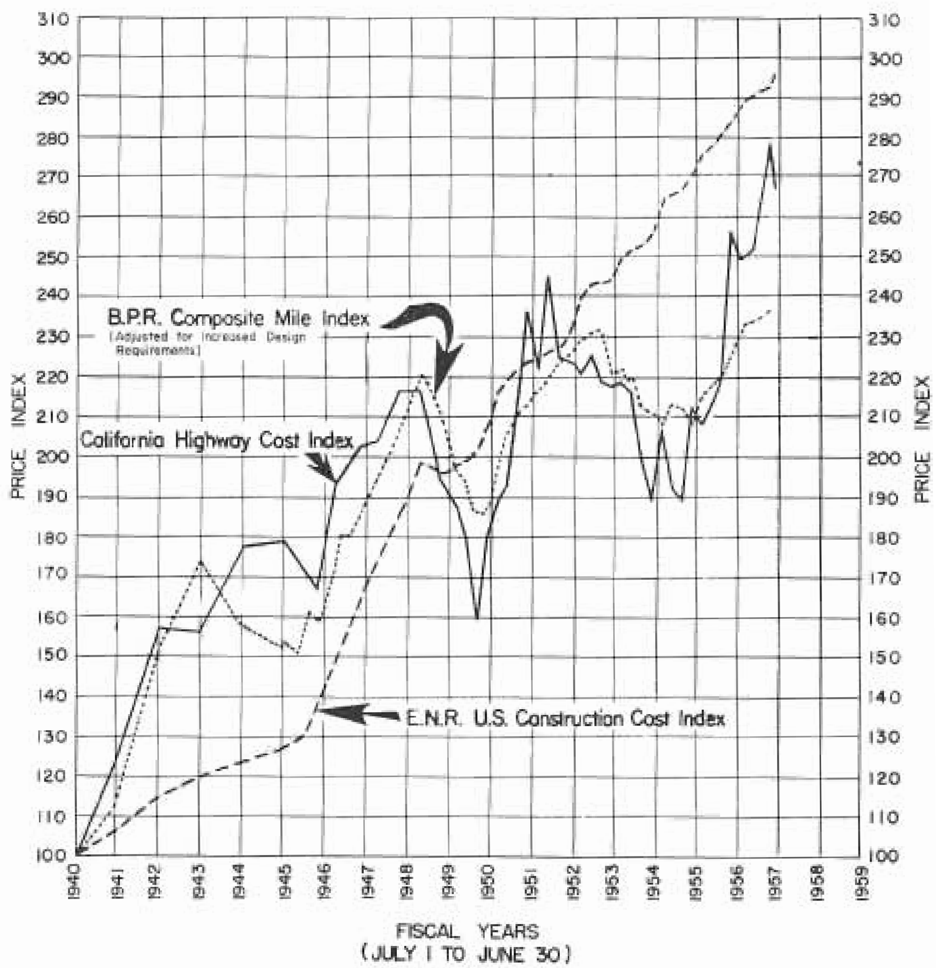
Projects placed under contract during this quarter are situated in all parts of the State. These projects being so widely distributed and similar in most respects, the cost data obtained is well averaged. Adverse conditions prevailing in one area have been correspondingly offset by favorable conditions in another.

Increases in highway construction costs were to be expected during the second quarter. Wage adjustments were made in the construction field in this period as required by the long term labor agreement made last year. Increases in bid prices for steel items during the first and second quarters over the second half of 1956 were no doubt based upon the prospective rise in steel costs at midyear to result from the annual wage adjustment provision included in the contract at the termination of the strike in the steel

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PRICE INDEX
CONSTRUCTION COSTS

1940 = 100



industry a year ago. It had been anticipated in many quarters that steel prices would possibly be adjusted upward between $8 and $12 per ton. The announced $6 per ton increase being in a lesser amount will no doubt result in some lowering of future bid prices on steel items involved on highway construction.

The highway construction industry in California appears to be in an extremely healthy condition since it has been able to absorb the continually expanding programs of the Division of Highways. The Legislature in 1953, through increases in motor vehicle and fuel, taxes, made available considerably more revenue for highway construction. On July 1, 1953, the Division of Highways had 307 contracts in progress valued at $166,963,200, and on July 1, 1957, the number of contracts under way increased to 363 while the contract value rose to $409,464,700. It will be noted that, while the number of contracts has not materially increased in this four-year period, the value has appreciably risen. This is accounted for not only by increases in cost per project but, with the availability of larger fedral fund allotments, by the sizes of a good many jobs having been considerably increased.

With but few exceptions the average number of bidders per contract has remained high, which shows that competition and capacity for more work prevail in the highway contracting field. The average number of bidders per project during the second quarter of 1957 was 5.5, which is 1.5 below the previous quarter, but still in the realm of good competition.

Tabulations are included in this release which show the average number of bidders per project according to value brackets. One tabulation cóvers the Fiscal Year July 1, 1956, to June 30, 1957, and the other for the six-month period, January 1, 1957, to June 30, 1957.

From the remarkable progress being made on many state highway contracts, it is evident that newly developed techniques and labor saving equipment are being utilized toward greater production on state highway construction projects. These features

NUMBER AND SIZE OF PROJECTS, TOTAL BID VALUES AND AVERAGE NUMBER OF BIDDERS

(January 1, 1957, to June 30, 1957)

Project volume	Up to $50,000	$50,000 to $100,000	$100,000 to $250,000	$250,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000	All projects
Road Projects							
No. of projects	130	27	53	18	14	6	248
Total value*	$2,062,463	$1,829,293	$8,755,546	$6,578,523	$9,836,335	$9,214,503	$38,276,663
Avg. No. bidders	5.4	4.9	6.5	8.6	7.6	6.0	5.9
Structure Projects							
No. of projects	26	2	9	5	3	5	50
Total value*	$333,585	$144,383	$1,596,392	$2,094,234	$2,374,204	$18,881,372	$25,424,170
Avg. No. bidders	5.5	6.0	10.1	8.0	7.0	8.4	6.8
Combination Projects							
No. of projects	---	---	---	---	3	25	28
Total value*	---	---	---	---	$2,759,730	$82,861,871	$85,621,601
Avg. No. bidders	---	---	---	---	4.3	6.9	6.6
Summary							
No. of projects	156	29	62	23	20	36	326
Total value*	$2,396,048	$1,973,676	$10,351,938	$8,672,757	$14,970,269	$110,957,746	$149,322,434
Avg. No. bidders	5.4	5.0	7.0	8.5	7.0	6.7	6.1

* Bid items only.

Total Average Bidders by Months

	Jan.	Feb.	Mar.	Apr.	May	June	Avg. for six months
1957	7.1	7.3	6.7	5.5	5.5	5.9	6.1
1956	5.9	5.1	5.1	4.1	4.7	3.3	4.3

NUMBER AND SIZE OF PROJECTS, TOTAL BID VALUES AND AVERAGE NUMBER OF BIDDERS

(July 1, 1956, to June 30, 1957)

Project volume	Up to $50,000	$50,000 to $100,000	$100,000 to $250,000	$250,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000	All projects
Road Projects							
No. of projects	337	63	87	37	26	11	566
Total value*	$5,244,367	$4,737,975	$14,276,164	$13,140,728	$18,670,146	$18,739,124	$74,808,504
Avg. No. bidders	4.3	4.3	6.3	6.7	6.5	6.8	5.9
Structure Projects							
No. of projects	48	4	23	7	4	9	95
Total value*	$781,842	$285,283	$3,985,362	$2,861,157	$2,877,091	$30,034,287	$40,825,022
Avg. No. bidders	5.0	4.3	7.3	6.4	6.5	5.8	5.8
Combination Projects							
No. of projects	---	---	---	---	5	49	54
Total value*	---	---	---	---	$4,100,964	$159,639,740	$163,740,704
Avg. No. bidders	---	---	---	---	3.8	6.2	6.0
Summary							
No. of projects	385	72	110	44	35	69	715
Total value*	$6,026,209	$5,023,258	$18,261,526	$16,001,885	$25,648,201	$208,413,151	$279,374,230
Avg. No. bidders	4.4	4.3	6.5	6.7	6.1	6.3	5.1

* Bid items only.

Total Average Bidders by Months

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Avg. year
1956-57	3.8	3.7	3.7	4.2	5.3	6.1	7.1	7.3	6.7	5.5	5.5	5.9	5.1
1955-56	4.9	4.2	4.4	5.4	6.2	5.4	5.9	5.1	5.1	4.1	4.7	3.3	4.7

THE CALIFORNIA HIGHWAY CONSTRUCTION COST INDEX

1940 = 100

Year	Cost Index
1940	100.0
1941	125.0
1942	157.5
1943	156.4
1944	177.8
1945	179.5
1946	179.7
1947	203.3
1948	216.6
1949	190.7
1950	181.2
(1st quarter 1950—160.6)	
1951	225.0
(4th quarter 1951—245.4)	
1952	225.9
1953	215.2
1954	193.5
(2d quarter 1954—189.0)	
1955 (1st quarter)	189.3
1955 (2d quarter)	212.4
1955 (3d quarter)	208.6
1955 (4th quarter)	212.6
1956 (1st quarter)	219.5
1956 (2d quarter)	255.9
1956 (3d quarter)	249.1
1956 (4th quarter)	252.1
1957 (1st quarter)	277.7
1957 (2d quarter)	266.9

are no doubt being employed by contractors to partially offset increasing labor and materials costs.

The tabulation on the following page shows the average unit prices forming the basis for computing the cost index since 1940.

Of the seven construction items upon which this index is based, four were lower than in the previous quarter, two were identical and one showed an increase. Roadway excavation and untreated rock base were the same in both quarters, standing at $0.63 and $2.10 respectively. Asphaltic and bituminous mixes increased from $5.94 to $6.18. The four items showing a decrease are portland cement concrete pavement, which dropped from $17.28 to $15.59; Class "A" concrete structures, from $61.14 to $58.61; bar reinforcing steel, from $0.129 to $0.119; and structural steel, from $0.235 to $0.204—no doubt reflecting the inclusion of the two large unusual projects previously referred to.

Construction costs for this period compared with the adjusted computations for the previous quarter in which two projects were not included. Roadway excavation was higher, advancing from $0.43 to $0.63, and asphaltic and bituminous mixes moved upward from $5.89 to $6.18. The remaining five items are lower than the previous quarter: untreated rock base, from $2.21 to $2.10; portland cement concrete pavement, from $15.79 to $15.59; Class "A" concrete structures, from $59.96 to $58.61; bar reinforcing steel, from $0.127 to $0.119; and structural steel, from $0.208 to $0.204.

The California Construction Cost Index, the Engineering News-Record Construction Cost Index and the United States Bureau of Public Roads Composite Mile Index, all reduced to the base 1940 = 100, are shown on the accompanying graph. The latter two indexes are based on nationwide construction costs.

The Engineering News-Record Cost Index again shows a rise at a slightly higher rate of increase than in the first quarter of 1957. It is up 3.2 index points, or 0.85 percent, from the previous quarter.

The Bureau of Public Roads Composite Mile Index for the first quarter of 1957, which is the latest available, was up 3.2 index points, or 1.4 percent, over the fourth quarter of 1956. The marked increase in this quarter over the previous period is parallel with the California Index for the first quarter.

CALIFORNIA DIVISION OF HIGHWAYS AVERAGE CONTRACT PRICES

	Roadway excavation, per cu. yd.	Untreated rock base, per ton	Plant-mixed surfacing, per ton	Asphalt concrete pavement, per ton	Asphaltic and bituminous mixes, per ton	PCC pavement, per cu. yd.	PCC structures, per cu. yd.	Bar reinforcing steel, per lb.	Structural steel, per lb.
1940	$0.22	$1.54	$2.19	$2.97	--	$7.68	$18.33	$0.040	$0.083
1941	0.26	2.31	2.84	3.18	--	7.54	23.31	0.053	0.107
1942	0.35	2.81	4.02	4.16	--	9.62	29.48	0.073	0.103
1943	0.42	2.26	3.71	4.76	--	11.48	31.76	0.059	0.080
1944	0.50	2.45	4.10	4.50	--	10.46	31.99	0.054	0.132
1945	0.51	2.42	4.20	4.88	--	10.90	37.20	0.059	0.102
1946	0.41	2.45	4.00	4.68	--	9.48	37.38	0.060	0.099
1947	0.46	2.42	4.32	5.38	--	12.38	48.44	0.080	0.138
1948	0.55	2.43	4.30	5.38	--	13.04	49.86	0.092	0.126
1949	0.49	2.67	4.67	4.64	--	12.28	48.67	0.096	0.117
1950	0.40	2.25	4.26	3.75	--	11.11	43.45	0.079	0.094
1951	0.49	2.62	4.34	5.00	--	12.21	47.22	0.102	0.159
1952	0.56	2.99	5.00	4.38	--	13.42	48.08	0.098	0.150
1953	0.51	[1]2.14	5.31	4.58	--	12.74	50.59	0.093	0.133
1954	0.45	2.13	4.50	4.86	--	14.41	48.42	0.094	0.124
1955	0.39	2.22	4.93	--	--	13.35	45.72	0.095	0.142
1st quarter 1956	0.40	2.08	5.40	6.50	--	14.05	52.51	0.105	0.166
2d quarter 1956	0.51	2.06	6.27	--	--	14.64	57.13	0.113	0.219
3d quarter 1956	0.52	2.27	6.12	--	--	15.57	56.32	0.121	0.178
4th quarter 1956	0.52	2.21	[2]	[2]	[2]$5.93	14.95	59.63	0.112	0.197
1st quarter 1957	0.63	2.10	--	--	5.94	17.28	61.14	0.129	0.235
2d quarter 1957	0.63	2.10	--	--	6.18	15.59	58.61	0.119	0.204

[1] The item of crusher run base was used before 1953.
[2] Asphaltic concrete pavement combined with plant-mix surfacing in fourth quarter, 1956, and will be identified as asphaltic and bituminous mixes in the future.

A FIRST

Continued from page 44 . . .

Booker, Assistant Highway Engineer, District 4, California Highway Commission; Hampton H. Roberts, Vice President, and K. P. Morris, Project Manager, of the contractors, Grove, Shepherd, Wilson and Kruge of California, Inc.; Chairman Leland W. Sweeney and Supervisors Francis Dunn, Emanuel P. Razeto and Kent O. Pursel; City Councilmen Peter M. Tripp, Frank J. Youell, Howard E. Rilea, Ernest A. Rossi, Fred Maggiora, Glenn E. Hoover and Lester M. Grant; Dudley W. Frost, Chairman of the Oakland Chamber's Highway and Freeway Committee; Nat Levy, President, Oakland Board of Port Commissioners; Norris Nash, President, and William A. Sparling, General Manager, Oakland Chamber of Commerce; Joseph R. Knowland, Publisher of the Oakland Tribune; Wayne E. Thompson, City Manager of Oakland; John A. Morin, City Engineer; and the following mayors: William M. McCall, Alameda; George Haruff, Emeryville; John J. Purchio, Hayward; R. S. Milligan, Piedmont, and Thomas O. Knick, San Leandro.

Roadside Merchandising

By JAMES R. SMITH, Headquarters Right-of-Way Agent

If the word "sprawling" is descriptive of today's metropolitan development, it is certainly not characteristic of the ribbon commercial development packed along the major arterial roadways entering and leaving our Nation's metropolitan areas. Here all too often "concentration" is the theme, and case examples of the sluggish traffic disorder that eventually goes hand in hand with this mass type of highway merchandising are many. Here is the arena in which the through traveler, the local shopper, and the marketing transient slug it out 24 hours a day, emerging only half satisfied and generally the worse for wear and tear.

The Division of Highways did not have to reach far from its headquarters in Sacramento to find an excellent example of just such an arterial battleground, now all the more enlightening as a case study because on June 15, 1954, a completed freeway bypass came into the scene to work its economic effects.

The front-door example was West Sacramento, and it developed in an atmosphere that promoted the concentration of roadside merchandising with enthusiasm. It had a major highway, US Highway 40 and 99, down its middle, and it lay within the shadow of a major destination point, the capital city of the State of California. It literally developed a string of roadside merchandisers a mile long and they were strung on both sides of the old highway like beads on a thread. In this case, however, the beads were motels, service stations, cafes, bars, and a multitude of other related and unrelated businesses. If they had anything in common it was perhaps the traffic, together with an almost universal belief on the part of the merchandisers that without this traffic, they were nothing. With the completion of the freeway bypass, 14,150 cars a day from this traffic stream were diverted from the existing highway.

Timely Case Study

The study of the effect of traffic diversion on this merchandising string was undertaken by the Land Economics Study Section of the Division of Highways for a very significant reason. These roadside merchants were typical of an economic group that can be found in varying degrees of size and quality almost anywhere along our Country's highways, and their problems are not peculiar but are universal. And, with increasing frequency, this group is going to be faced with the same traffic diversion; for, with the vastly expanded federal aid highway program just now unfolding across the Nation, the freeway bypass will be the predominate answer to the traffic battle already described. When this happens, as it did in our study area of West Sacramento, many weighty decisions must be made. Unfortunately, a goodly percentage of these decisions will be based upon beliefs and assumptions which are totally inaccurate. It is only through publication of the results of studies such as this that merchants will be able to factually assess their own traffic sensitivity when the controlled access facility comes to their area. It is only with such a factual background that the prudent merchant should proceed in planning and constructing the roadside developments of today and tomorrow.

West Sacramento

Unincorporated West Sacramento is located entirely in Yolo County and lies westerly across the Sacramento River from California's capital city. The county line threads this river, and our study area is actually only minutes away from the heart of Sacramento and its metropolitan environs—an ideal stopping place and headquarters for the commercial traveler and the visiting tourist. Bounded generally by the river on the east and north, and the Yolo floodwater bypass on the west, the area can be likened to an island through which major US Highway 40 and 99W runs in an east-west direction.

Prefreeway West Sacramento had all its economic big guns along West Capitol Avenue (old Highway 40 and 99W), and they were heavily loaded for service to the traveling public. Here was the "West Capitol Mile" and its multimillion-dollar motel strip—here were the other traffic-catering merchants, the cafes, service stations, bars and garages, dominating the economic scene in size, number, and dollar investment. These were the roadside merchandisers our study examined, starting with the beginning of freeway construction in late 1951.

Freeway Project

The West Sacramento bypass is a full, four-lane divided freeway approximately four miles long. Its location with respect to the community and the old highway is clearly shown on the accompanying map sketch. Its interchanges and entering and leaving points are also clearly shown. After it opened to traffic on June 15, 1954, an average of 14,150 cars a day used it during the remainder of the year.

The Problem

What, then, happened to the millions of dollars invested in the old highway's commercial plant when this 14,150-car traffic jam pulled out? Did the superseded highway decline in desirability as a sound investment location? Did West Capitol Avenue merchants suffer an irreparable loss in business? And did new investment rush to the freeway fence and the freeway's on and off ramps? These were the timely questions this study sought to explore through the use of factual gross business data, land values, and related economic yardsticks.

Investment

The accompanying before and after aerial photographs offer striking evidence of the degree to which development has taken place along the superseded highway. That business investors have continued to look at West Capitol Avenue with optimism clearly appears from a visual appraisal. That this visual appraisal can be factually established is evident from abundant data.

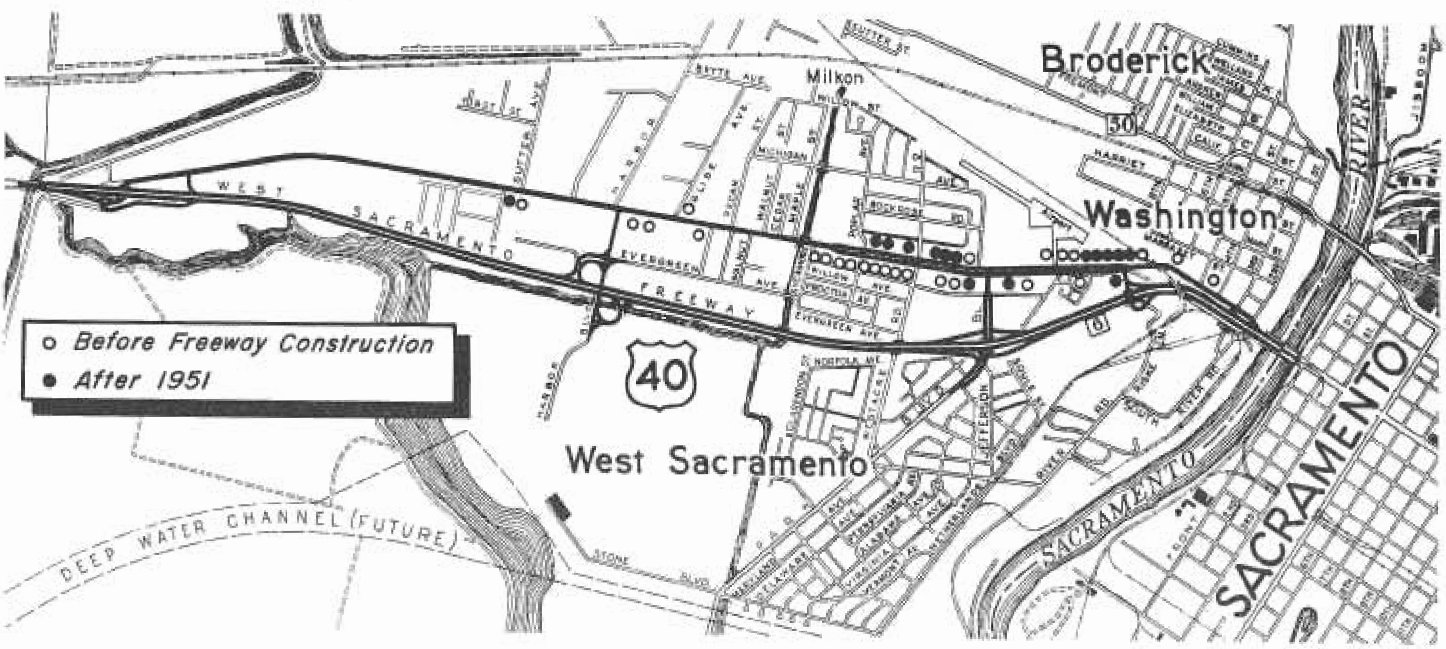
In late 1951, when freeway construction was well enough along to give an unmistakable clue to the major traffic diversion soon to occur, there were 25 motels located along the old highway; today there are 40. To an existing motel strip already well into the multimillion-dollar class, these new additions created an additional investment in the vicinity of $3,000,000. In terms of facilities offered to the traveling public, this expansion in motel units placed half again as many rooms into the market as existed previously. Today over 1,100 guests can spend a night or a lifetime in West Sacramento's motel row. It is noteworthy this expansion was unfolding within a group generally held to be extremely traffic sensitive, and was taking place when there could be no doubt as to the pending traffic shift. *Indeed, even if our comparison is restricted to the period after completion and formal opening of the freeway, we find 11 new motels, increasing the available rental units by 35 percent, being constructed along the superseded highway.* That this dominant and traffic-sensitive merchandising group has clearly answered the first of our problem-questions through its own tremendous expansion, is unmistakably evident.

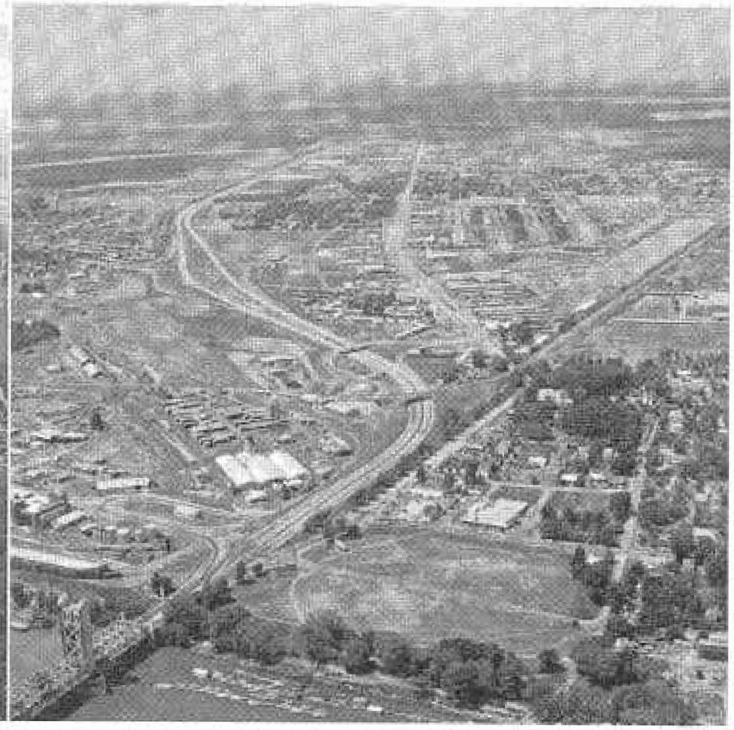
There is further evidence, however, of continued investment in the roadside merchandising facilities along the old highway which should be noted as well. While perhaps not as striking as that within the motel group, it is, nonetheless, significant. *Two major-brand service stations have joined the West Capitol Avenue group since the opening of the bypass. Construction has commenced on an additional site for immediate development of one more major station to be located along the old highway.* While it may logically be said that these new outlets will be merchandising in large part to a growing local market developing within the area, it is likewise as logical they will be seeking a share of the business generated by the surrounding motels.

The cafe and bar group has also added new outlets to its existing merchandisers, and eight such establishments have made a postfreeway debut along West Capitol Avenue. While, as with service stations, an expanding local trade makes the reasons for growth in this group less clear cut, it is nevertheless significant by reason of the fact that cafes and bars also are considered by highway merchandisers to be highly vulnerable to traffic diversion.

What, then, is the investment picture along the former highway? It may be ably summed up as follows: The roadside merchandising expansion described above, together with the growth of other almost purely local business, has utilized almost all of the available bare land along "downtown" West Capitol Avenue, the old highway; vacant lots are becoming a rarity.

Diagram shows new freeway and superseded highway through West Sacramento. The circles indicate motels along the old highway, with shaded circles indicating motels erected after 1951 when freeway construction was unmistakably apparent on the ground.



LEFT—Aerial photograph taken before completion of the freeway facility. The superseded highway, West Capitol Avenue, lies northerly and to the right, of the freeway. Water shown near the top of the photograph at the westerly terminus of the freeway is the temporary diversion of high water from the Sacramento River over the Yolo Bypass. RIGHT—Aerial photograph of the West Sacramento area after completion of freeway construction showing new commercial development along the superseded highway which is right of and roughly parallel to the freeway facility. At the time of year this photograph was taken, no floodwaters were being diverted onto the Yolo Bypass.

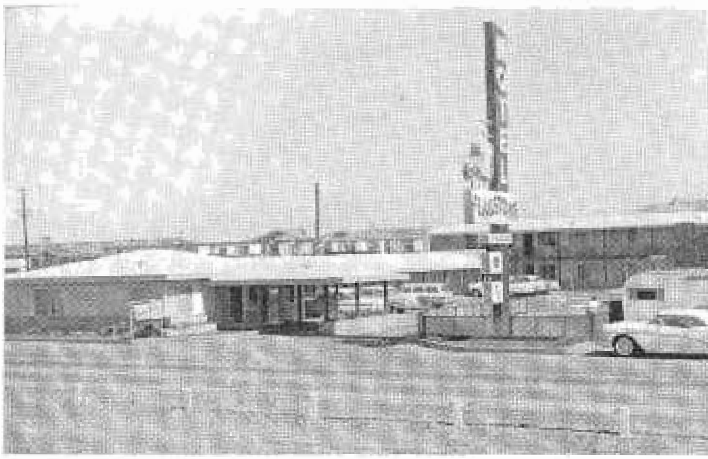
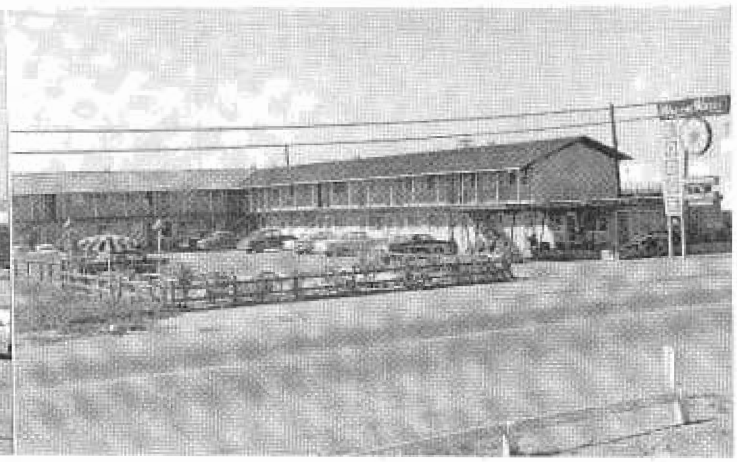
Land Values

Property sales along the superseded highway were examined and analyzed to determine if traffic diversion had introduced any variations into the overall land value trend over the prefreeway and postfreeway years. Since only vacant parcels were used for comparison to avoid arbitrary improvement breakdowns, the available data were limited, largely because of the expansion in the motel and other business groups. Resales of the same vacant parcels were almost nonexistent since, once bought, the properties were subsequently improved almost without exception. There were a sufficient number of sales of similar adjoining properties, however, to establish a uniform upward trend continuing with little, if any, fluctuation throughout the entire period. While the limited number of sales is not as conclusive as desired, it is still significant that no downward, or even fluctuating, trend in land values existed.

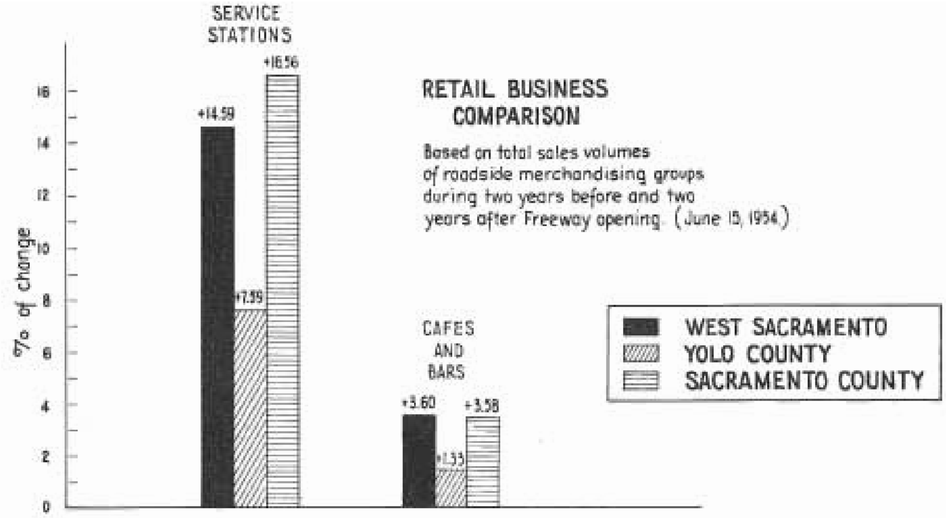
Retail Business

How well are West Sacramento's businessmen doing along the former highway? This question was answered by an analysis of the total business volume transacted by West Capitol

Photographs showing two motels constructed since completion of the freeway bypass. They are considered representative of the type and quality of new motel investment along the old highway in the postfreeway period.

Avenue's roadside merchants in the two-year "before" and two-year "after" freeway periods. Since primary emphasis was being placed upon traffic sensitive merchandisers rather than upon the local or community businesses, our analysis was broken down into two segments: the service station group and the cafe and bar group. These are the retail outlets which have largely held to the theory that "traffic removal is generally the kiss of death." In our study area, traffic had been diverted and the effect this diversion had upon these two retail groups was measured by gross sales figures as reported to the State Board of Equalization for sales tax purposes. (It should be pointed out that the motel group do not so report and thus are not included in any of the following comparisons. Motels having cafe, dining room, and cocktail lounge operations—there are two in our study area—are included, however, to the extent of such business only.)

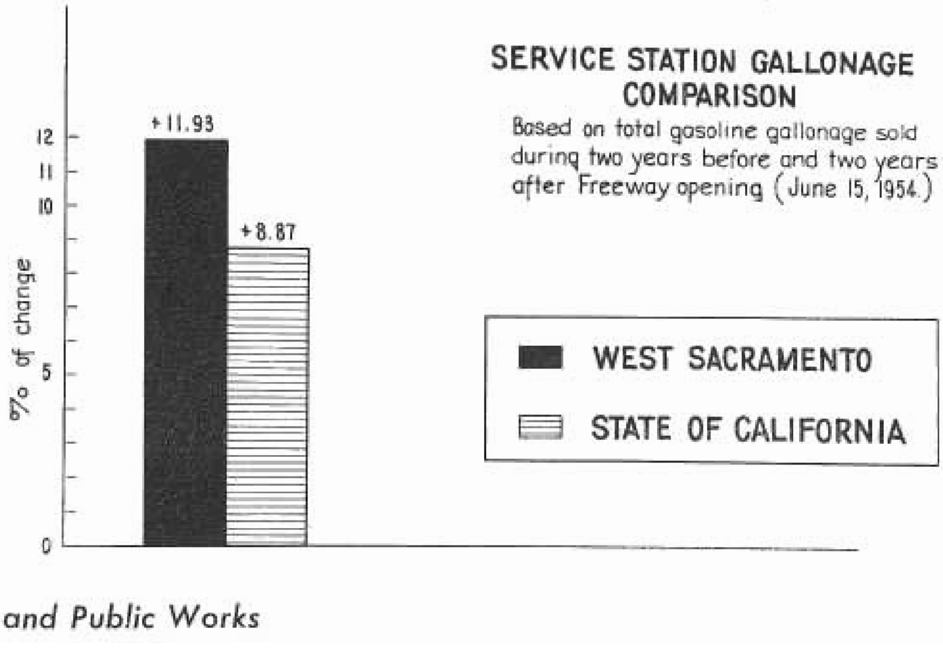


Graph showing percentage increase in retail sales volume of traffic-sensitive business groups in West Sacramento as compared with same groups in Yolo and Sacramento Counties during a similar period of time.

In examining all the groups, two yardsticks were necessarily used to determine if West Sacramento had fared as well as other areas which had undergone the same highway change. Sacramento County business volumes during the comparison period were employed as well as those of Yolo County in which West Sacramento is located. This was done to avoid any bias in our comparisons which might be injected because of dissimilarity in the economic structures and patterns of our test community and its parent county. The importance of agriculture to the remainder of Yolo County's economy is considerably greater than to West Sacramento and this one factor alone could significantly affect our comparison. On the other hand, the similarities between our study area and the City of Sacramento, which sets the tone for Sacramento County business, are many. The percentage summaries, using both yardsticks, look like this:

Within these segments which would be most likely to be significantly affected by a highway relocation, the cafe and bar group registered an overall increase of 3.60 percent compared to a slight increase of 1.33 percent for this type of business for Yolo County as a whole and a 3.58 percent rise for Sacramento County's cafe and bar operators. In other words, West Sacramento cafe and bar owners, after traffic had been diverted, had almost three times the business gain their counterparts throughout Yolo County enjoyed in the same period. They also did slightly better than the same businesses in Sacramento County, a striking measure in itself, since Sacramento County, because of its greater population and diversity, could be considered a truly conservative yardstick.

Graph showing percentage increase in gallons of gasoline sold by service stations along the old highway in West Sacramento compared with statewide gallonage increases over a similar period of time.



In our other traffic-sensitive group, West Sacramento's service stations did 14.59 percent more business in the two years after freeway construction than they did in the same period before. Yolo County service stations were doing only 7.59 percent better over the same periods while Sacramento County stations showed an "after" business increase of 16.56 percent. Here again, our study area merchants were doing better after traffic removal than before and compare more than favorably with the two unaffected yardsticks employed. Actually, this group was doing even better than the retail comparisons indicate, and a further examination of gallonage sales, which are not included in sales tax totals, reveals the following:

In the two years after the freeway through West Sacramento opened, the total number of gallons of gasoline sold by stations along the old highway increased 11.93 percent over the gallonage sold during the previous two years before traffic diversion. Over this same period the state trend in gasoline gallonage was showing only an 8.87 percent increase. Also during this same "after" period, three new outlets were constructed between the old and new highways. These new outlets, all in very successful operation, are not included in our comparison of strictly highway merchandisers. It is evident they are claiming a substantial share of total available business. The increase in retail and gallonage sales of the highway service station group studied, despite this increased competition, becomes, then, even more significant.

Growth Pattern

The last questions posed—has expansion taken place only at the freeway fence?—have new competitors moved into locations adjacent to the freeway and its on-and-off ramps to the detriment of the old highway's merchants? —were answerable almost as a mere matter of observation. That answer was definitely no. All new motel construction has not only been along the old highway but it has been more of a continuation and concentration of the existing motel row, on land considered good motel ground before the freeway facility as well as after. Of the five new service stations constructed since opening of the freeway, two are on the old highway and two more, while closer to the freeway, are more accurately located in and adjacent to a newly developed local shopping area. The last, a modern truck station and garage, is the only true "interchange type." The new station already mentioned as soon to be in operation, will utilize a location on the old highway. No new cafes and bars have sought out freeway locations.

Conclusion

A final analysis of the effect that diversion of traffic from a conventional arterial to a modern controlled access highway facility has had upon the substantial concentration of roadside merchandising establishments found in West Sacramento leads to these conclusions:

1. Those retail outlets whose gross business generally is held to be wholly geared to the flow of traffic past their door—the cafes, and bars, and service stations—have registered considerable gains in business volume since traffic diversion to the new freeway facility. These gains have exceeded those of similar, unaffected groups within their own county, and compare more than satisfactorily with those of more intensively developed Sacramento County.

2. New development within the highway merchandising group has been substantially confined to the old highway. Rather than a decline in property values and a drop in new expansion, "superseded" West Capitol Ave. has achieved almost 100 percent development, and land values have been uniformly upward.

3. There is no evidence that roadside investment desirability has shifted to the new freeway and its on and off ramps, and no ruinously competitive developments have arisen in these locations in the three years since traffic "left" West Capitol Ave. Indeed, it has been demonstrated emphatically in the motel group that the choice of location for new facilities has been wholly in favor of the superseded highway.

This study conclusively shows that the highway merchant need not expect business decline and capital depreciation as a universal aftermath of traffic diversion. His traffic sensitivity, as all the other economic forces which regulate the profits from his roadside business, can be factually assessed and evaluated. West Sacramento's highway entrepeneurs have made their evaluation and as a group are showing a progressive face to the postfreeway world.

TRAVEL

There are more than 61 million registered motor vehicles in the Nation today, traveling about 590 billion miles a year.

There are 130,000 school busses in use in the United States, carrying nearly 8,000,000 pupils along 1,000,000 miles of school bus routes.

In Memoriam

SAMUEL B. SAUNDERS

Samuel B. Saunders, Accounting Officer with the Division of Highways, died on June 14th in his home of a heart ailment.

He had recently been appointed to the position vacated by Henry Mahoney, who retired in March as chief of the Headquarters Accounting Office.

Saunders' state service began in 1935 when he went to work for the Compensation Insurance Fund in San Francisco. He later transferred to the Board of Equalization and in 1936 joined the Division of Highways where he was continuously employed except for two years when he served as the first accounting officer for the newly organized Division of San Francisco Bay Toll Crossings in 1948 and 1949.

In 1956 Saunders spent six weeks in Central America as a consultant on accounting and financial procedures to the Government of Honduras in the organization of a highway construction department.

A native Californian, Saunders was born in Solano County. He attended grade and high schools in Sacramento, graduating from Sacramento Junior College in 1933.

He was active in the Boy Scouts.

Saunders is survived by his widow, Martha, a daughter, Linda, and a son, Robert.

SAN DIEGO FREEWAY

Continued from page 48 . . .

A test to determine the strength of epoxy resin was made on a concrete beam. The broken faces of the beam were separated one-half inch, the space then filled with epoxy resin. No pressure was used to force the faces together. After eight days the beam broke at 600 pounds per square inch but at a new break indicating the resin was much stronger than the original concrete beam.

CROSS-COUNTRY

The first transcontinental automobile trip in the United States was made in 1903, reports the California State Automobile Association.

Bold Venture

Open-water Highway Project Is Dedicated to Traffic

By WILLIAM TRAVIS, District Construction Engineer

ONE OF the boldest highway engineering designs ever undertaken became a reality on Thursday, July 11, 1957, when the northbound lanes of the "open-water" project between Candlestick Point in San Francisco and Sierra Point in San Mateo County were opened to traffic. This four-mile section of freeway is located across an arm of San Francisco Bay and provides a direct straight-line connection between San Francisco and San Mateo Counties, superseding the existing heavily congested undivided highway through industrial areas of Brisbane and Visitacion Valley. The new section connects with completed portions of the Bayshore Freeway at either end, thus providing a continuous full freeway between San Carlos in the heart of the Peninsula and San Francisco's financial district.

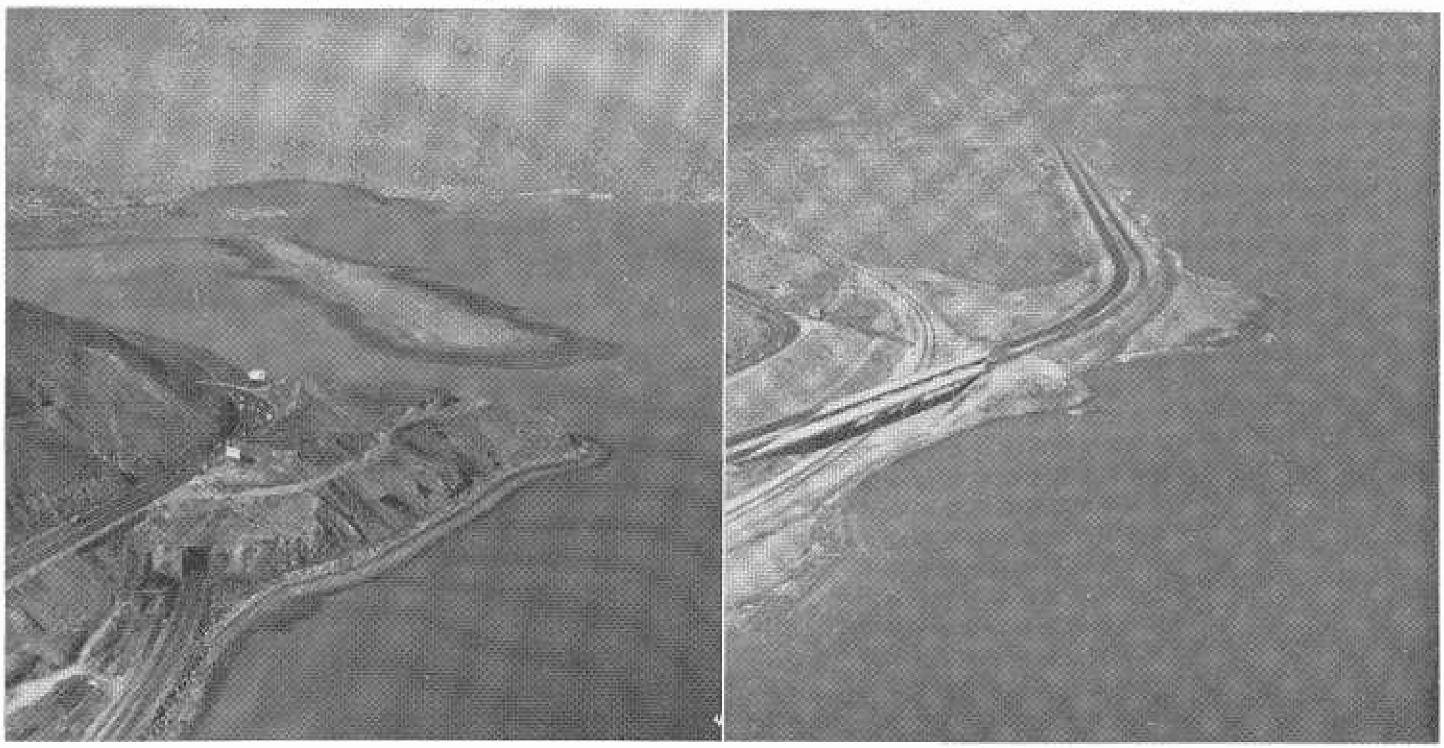
The occasion was marked by ribbon-cutting ceremonies at the site and a luncheon-reception jointly sponsored by the San Francisco Chamber of Commerce and the San Mateo County Development Association. Speakers included Director of Public Works Frank B. Durkee, State Highway Engineer G. T. McCoy, Mayor George Christopher of San Francisco, Edward P. McDonald, Chairman, San Mateo County Board of Supervisors, and B. W. Booker, Assistant State Highway Engineer.

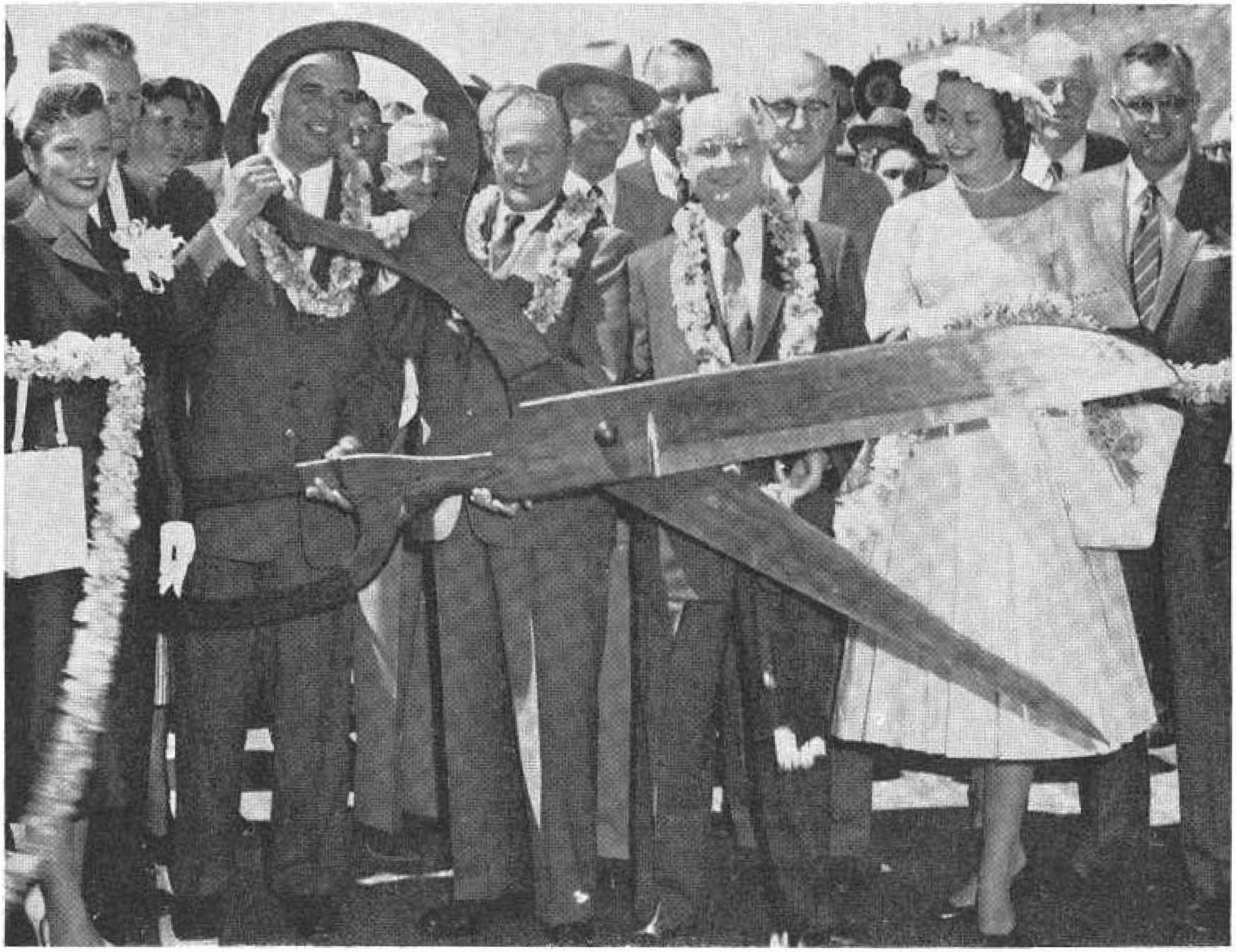
Provision for Eight Lanes

The new facility consists of a six-lane divided freeway with provision for ultimate development to eight lanes. Construction of the project has been continuous since January, 1952, under seven separate highway contracts. Five and a half million cubic yards of embankment were placed in a two-mile fill section over the "open water." The total cost of the contract construction work was $8,000,000.

Engineers were faced with a problem of staggering proportions in planning the new freeway facility. The San Francisco Peninsula, only a few miles in width, is dominated by the San Bruno Mountains and heavy residential and industrial development already covered all but the most mountainous areas. Substandard alignment, steep grades and constricted right-of-way precluded further development along the existing highway. The proper freeway location was obvious—the direct route across a portion of San Francisco Bay. This routing was adopted and declared a freeway by the Highway Commission in July of 1941.

LEFT—This view, taken in 1955, shows the existing highway and the railroad tunnel at Sierra Point prior to freeway construction. RIGHT—A recent picture at Sierra Point. The point itself has disappeared. The railroad tunnel has been eliminated, and the freeway is nearing completion.





A ribbon woven of 5,000 orchids flown from Hawaii by Pan American World Airways was severed by Mayor George Christopher of San Francisco and Chairman Edward P. McDonald of the San Mateo County Board of Supervisors to signalize opening of the overwater section of the Bayshore Freeway. Left to right: Roberta Ward, Miss South San Francisco; State Senator Robert J. McCarthy; Mayor George Christopher (holding scissors); Edward McDonald, B. W. Booker, Assistant State Highway Engineer; Frank B. Durkee, State Director of Public Works; Highway Commissioner H. Stephen Chase; George T. McCoy, State Highway Engineer; and Christine Falkenberg, Miss San Francisco.

Problems of Construction

The adopted route across the water was underlaid with 90 feet of soft bay mud. Many engineers felt that it would not be possible to construct a highway in this location. The engineering resources of the various departments of the Division of Highways were then combined in making studies to determine a feasible and economical method of highway construction under these conditions. The Bridge Department investigated the costs and problems involved in causeway construction. The theoretical factors affecting the stability of embankments constructed over poor foundations were studied by the Materials and Research Department. District IV carefully reviewed its experience gained through embankment construction over the tidal marshes of San Francisco Bay during the past 30 years.

These studies definitely established that the only economically feasible construction would be to "float" a fill on the mud by end dump methods, utilizing material available from heavy cuts at either end of the project and importing additional material from nearby borrow sites.

Considerable doubt remained in the minds of the engineers, however, as to whether an embankment of sufficient stability could be produced by this method. The first construction contract was therefore experimental in nature to determine the behavior of the embankment and the general supporting power of the underlying bay mud. Started in January of 1952, this contract consisted of 400,000 cubic yards of embankment material which was placed in the northerly 1,400 feet of the proposed fill. Information developed from this experiment was then

. . . Continued on page 72

OPERATIONS AND ACTIVITIES OF MATERIALS AND RESEARCH DEPARTMENT

PART II—PAVEMENT SECTION

By ERNEST ZUBE
Supervising Materials and Research Engineer

In the preceding issue of *California Highways and Public Works*, F. N. Hveem, Materials and Research Engineer, presented a general review of the scope of laboratory activities, setting forth some of the problems and responsibilities delegated to materials engineers, and also the progression of growth and development of the laboratory from its early day inception to the large and nationally recognized organization which now comprises the Materials and Research Department of the California Division of Highways.

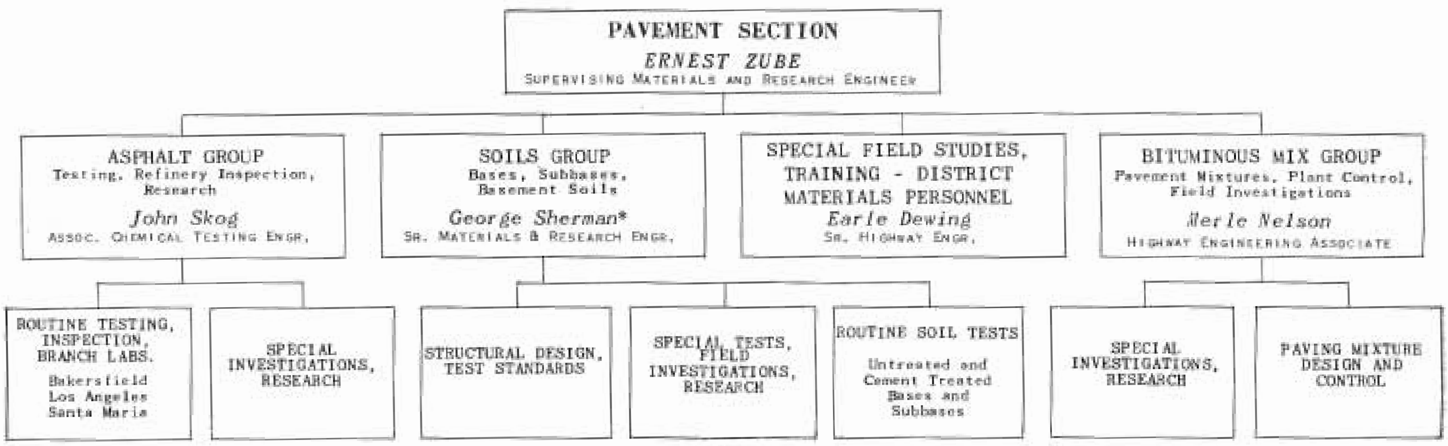
This article will be devoted to the activities and operation of the Pavement Section which constitutes one of the five major subdivisions of the Materials and Research Department.

Pavement Section

The Pavement Section is concerned with all materials used in the pavement structure with the exception of portland cement concrete. While most of the testing of the soils, subbase, base and bituminous pavements is now carried on in the district laboratories, the responsibilities of uniform test methods and maintaining accuracy of testing equipment are under the control of the Pavement Section.

Those of us who have been around for some years can observe rather a startling contrast between the old "Oil Mix" Department of the early 1930's which dealt only with one type of light road surfacing and the present day Pavement Section which deals with all components of the pavement structure including the soils which support the pavement.

The functions of the Pavement Section, see *Figure 1*, are divided into four primary groups or subsections; namely, Bituminous Mixes, Asphalts, Soils Group and Special Field Studies. As all of the subsections are concerned with the various phases of the pavement structure, either in the form of testing or research, their functions are not sharply defined and some overlapping inevitably exists. A fifth group consists of the clerical personnel. This latter group, although comparatively small, performs very necessary and exacting functions, such as the typing of test reports, maintaining records, assembling reports, which are sometimes



The Pavement Section tests all materials used in the top three feet of the roadbed. This work includes the testing of all paving materials except concrete, and all base, subbase and basement soil materials.

It gives advice and makes recommendations to the Design, Construction, Maintenance and Bridge Departments and other outside agencies.

This Section reviews and approves specifications for materials used in the structural design of the highway.

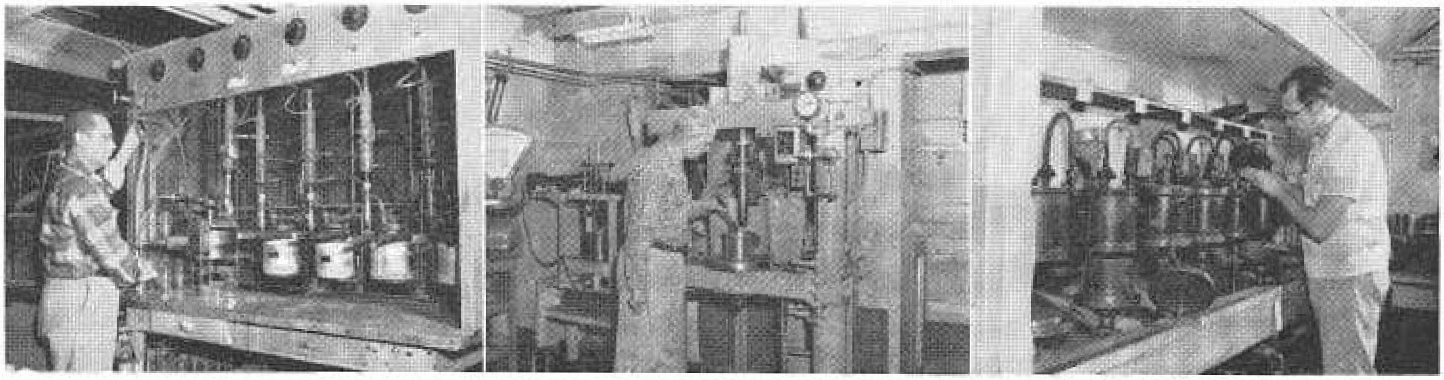
It calibrates testing equipment and coordinates and maintains uniform test standards between the District and Headquarters' Laboratories. It reviews field construction testing practice.

It plans and supervises full scale experimental field projects covering the use of new products.

It conducts special research projects.

* Principal Assistant

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
MATERIALS & RESEARCH DEPARTMENT
PAVEMENT SECTION
ORGANIZATION CHART
July 1, 1957



LEFT—Apparatus for moisture determination of bituminous mixtures. CENTER—Mechanical kneading compactor designed in the Materials and Research Department for compacting test specimens of surface and base to densities comparable to those obtained during construction. RIGHT—Extraction apparatus to determine whether bituminous paving mixtures have the correct amount of asphalt.

rather comprehensive, on the various field investigations or experimental installations. The reports are primarily distributed to our own Division of Highways, but, in some cases, to technical organizations throughout the Nation.

Routine Tests

For many years, the Pavement Section performed practically all of the routine tests on asphalts and bituminous mixtures for the entire Division of Highways, however, as the work increased it became impracticable to give prompt and adequate service to the remote districts. A few years ago a decision was reached to establish laboratories in each of the 11 highway districts for the purpose of performing as many of the routine physical tests as possible thereby relieving Headquarters of a major portion of this work and at the same time placing the testing facilities in closer proximity to the construction activities.

The district laboratories were supplied with testing equipment and machines, most of which had been devised and perfected in the Pavement Section. District personnel were brought into Headquarters Laboratory for a course of training and instructions in performing the tests and operating the testing machines. In addition to the training course, detailed descriptions covering all of the tests were compiled in a Laboratory Manual which has been distributed to all districts.

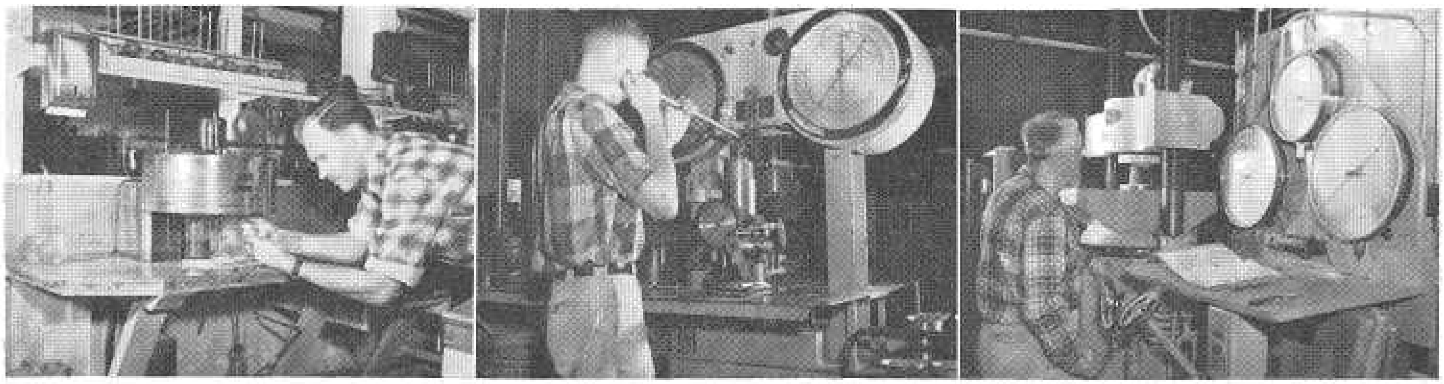
Reference Laboratory

In a continuous effort to maintain standard procedures and uniform practice we now act as the reference laboratory and periodically the districts submit a certain number of samples for check tests. In addition to periodical interchange of samples for check testing, experienced and trained personnel from Headquarters Laboratory make schedule trips to each district and with special equipment check and calibrate the testing equipment and also discuss details of test methods and interpretation of test results with district personnel.

The shifting of a major portion of the routine testing load to the districts has made it possible for Headquarters Laboratory to devote more time to needed research and special investigations. The development or improvement of any test procedure or any investigational technique often entails the performance of many routine tests. Therefore, equipment and personnel for routine testing must always be available as a part of research and investigation activities.

The Pavement Section works in close co-operation with the counties and cities whenever requested to do so. Some of the counties now maintain well-equipped testing laboratories whereas others are in the process of establishing such facilities. When

LEFT—Making centrifuge kerosene equivalent determinations in order to ascertain how much asphalt should be added to a paving mixture. CENTER—Mechanical mixer for mixing bituminous test specimens. RIGHT—Performing tests on bituminous products, penetration test for paving asphalts and shock test for pipecoating asphalts.



LEFT—Viscosimeter for determining grade of liquid asphalt. CENTER—Inserting test specimens in stabilometer prior to testing. RIGHT—Compression test for determining strength of cement-treated base test specimens.

called upon, we supply information regarding testing equipment and help with the training of their personnel so they may become proficient and self-sufficient in handling the testing apparatus and analyzing test results. We also on occasion check their testing equipment and testing procedures. Work is also done for other state agencies and the Federal Government when requested.

The following is a detailed outline of the work and activities of the subgroups forming the Pavement Section.

Bituminous Mix Group

The Bituminous Mix Group or subsection is under the direction of Merle Nelson, Highway Engineering Associate. This group is engaged in numerous activities under the following categories: design of bituminous paving mixtures, physical testing of potential sources of materials proposed for use in bituminous pavements and control testing for compliance with specifications on materials actually entering into the work. They are also engaged in research work involving both laboratory and field studies, special investigations relative to actual behavior of bituminous pavements and conducting co-operative check test series with the 11 district laboratories and with certain national organizations.

As an insight into the routine physical testing of bituminous paving mixtures, whether performed at Headquarters Laboratory or in the district laboratories, the following will present a general view of some of the things which must be taken into account in this phase of highway construction.

Prior to awarding a contract for constructing a section of highway the State makes sure that suitable materials are available. The investigation of materials sources is referred to as

Small pressure tests to determine how much weight of base and pavement will be required to prevent soil from expanding

preliminary testing and involves the application of all of the basic routine physical tests such as sieve analysis, centrifuge kerosene equivalent, stabilometer test, swell test, film stripping test, moisture vapor susceptibility, cohesiometer, etc., and oftentimes may involve some special tests in order to definitely determine the suitability of the proposed material for use in a bituminous pavement. When special tests are required they are performed in Headquarters Laboratory.

The properties which must be determined from tests prior to approval of materials for use in bituminous pavements are several in number. First, the aggregates must be of proper gradation which means that a certain specified amount of each particle size must be present in the total mixture. The gradation is determined by sieve analysis and consists of shaking the aggregates through a set of sieves having various specified size openings ranging from say one inch down through successively smaller openings to the minimum size which is normally a No. 200 sieve with 40,000 openings to the square inch.

After the aggregates have been processed and proportioned to conform to specification requirements, the next step is to determine the proper amount of asphalt to be added in order to cement the particles together. This determination is made by one of the basic tests called the "centrifuge kerosene equivalent test."

Damage to Pavement

If insufficient asphalt is used, a pavement will deteriorate quite rapidly from several causes such as water action, the abrasive action of fast-moving vehicles and more rapid oxidation of the asphalt film. As a result of these actions the pavement in a relatively short time will exhibit a rough textured, cracked and pot-holed surface requiring expensive maintenance or reconstruction.

On the other hand, if an excessive amount of asphalt is added, the pavement will become unstable and tend to shove, groove or ripple under the action of heavy vehicle loads and the excess asphalt will oftentimes flush to the surface of the pavement presenting a skid hazard. Here again, expensive maintenance or reconstruction operations are the only recourse. There is no dependable way to determine the precise amount of asphalt required except by proper laboratory methods.

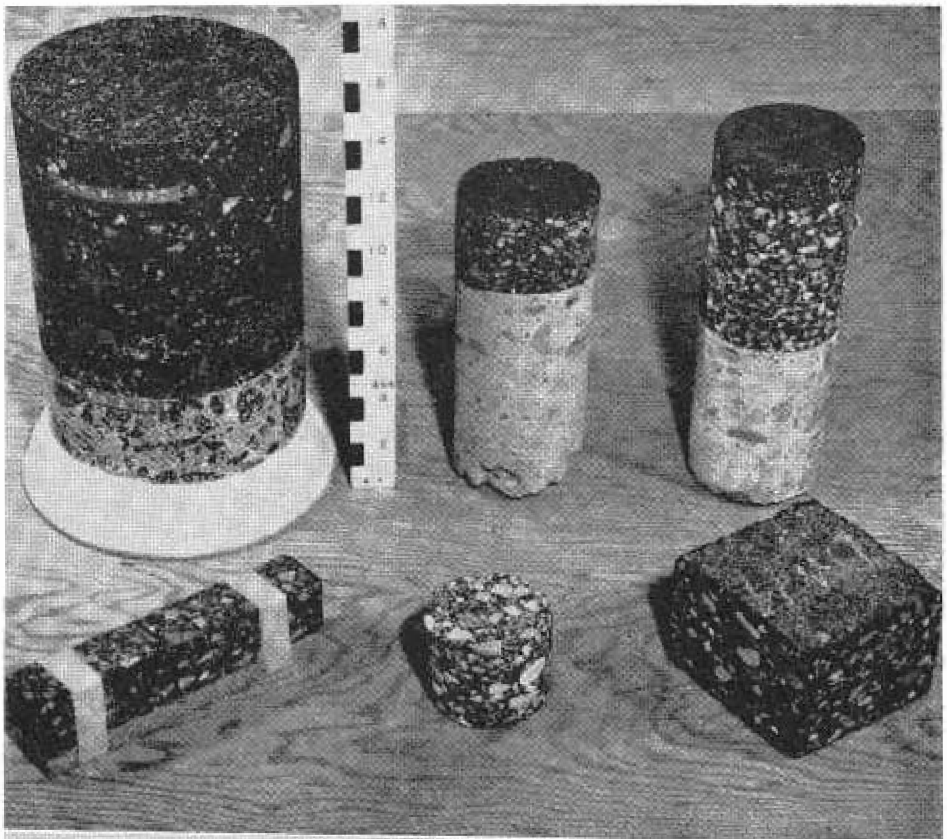
After the grading of the aggregates and asphalt content of the mixture are established, additional tests are performed. Test specimens are prepared by compacting the mixture of asphalt and aggregate using a special kneading compactor, designed in this section, which will duplicate the compaction obtained on the finished pavement under the construction equipment and anticipated traffic. The compacted mixture is then tested for its ability to resist deformation when subjected to heavy traffic loads. This test, originally designed in the Pavement Section, is made in the Hveem Stabilometer which has been adopted by many other states and foreign countries.

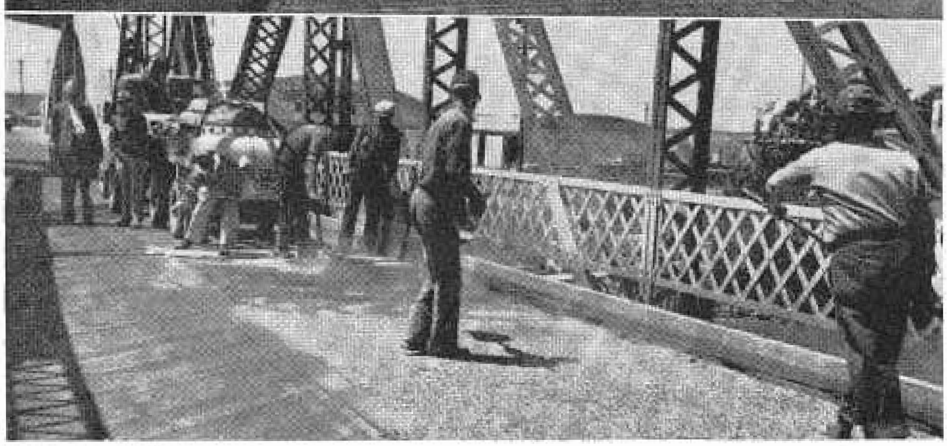
Records of Test Results

Some additional tests are performed which evaluate the ability of the mixture to resist the deteriorating effects of water and finally a test report is prepared which records all of the test results, the laboratory analysis and recommendations.

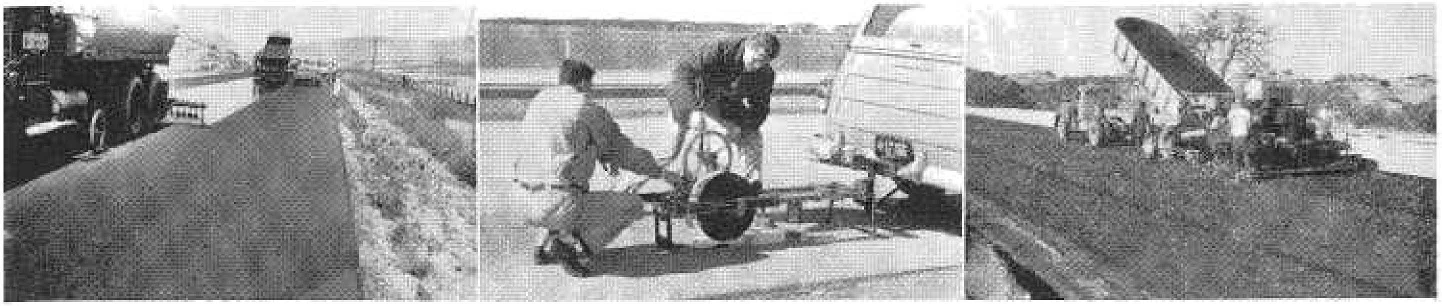
The next category, control testing, is pretty much what the name implies. During the actual construction of the pavement, daily samples are obtained by the engineer in charge and submitted to the district or Headquarters Laboratory where certain basic routine tests are performed. This maintains a constant check on the work of the contractor, the quality of the materials and the proportions of the ingredients. These results are then reported to the engineer in charge of the job.

Bituminous pavements provide by far the greatest mileage of surfacing on California highways and investigations pertaining to methods of improving them constitute a never-ending program of observing and checking actual service behavior.





UPPER—Test specimens cut from pavements by coring or sawing. CENTER—Experimental installation of wire mesh to determine whether it will be effective in preventing cracks in asphaltic resurfacing. BOTTOM—Experimental installation of asphalt-latex seal coat to protect wooden bridge deck.



LEFT—Experimenting with bituminous binder containing rubber latex for seal coat work. CENTER—Measuring skid resistance of pavement surface. RIGHT—Placing of Zaca to Wigmore experimental asphalt test sections to determine quality of asphalt necessary for durability.

Studies and investigations are made of certain pavements not performing up to expectations as well as those giving excellent performance and every effort is made to establish proper correlation between test results and pavement performance.

Asphalt Group

The Asphalt Group is concerned with the inspection, testing and research on the various asphaltic binders including paving asphalts, liquid asphalts and asphaltic emulsions. This group is under the supervision of John Skog, Associate Chemical Testing Engineer.

Paving asphalts are used in the so-called "hot mix" process or asphaltic concrete and are mixed with sand and coarse aggregates that have been heated to about 300 degrees F., whereas liquid asphalts and asphalt emulsion are used primarily in surface applications where the aggregates are not heated and can be handled at ordinary atmospheric temperture. These various types of materials are further divided into grades to meet the different conditions encountered in construction. For that purpose our Standard Specifications cover some 25 grades of bituminous products.

One of the primary jobs of the Asphalt Group is to perform the necessary inspection and testing required to determine compliance with specifications of approximately 300,000 tons of asphaltic products per year which enter into the construction and maintenance work of the Division of Highways. The production of these materials is centered in four areas in the State, and involves some 20 different refineries.

Testing Field Samples

In order to expedite the inspection and testing of asphaltic products, the Materials and Research Department maintains a resident representative at each of the asphalt production centers which are located in Berkeley, Bakersfield, Santa Maria and Los Angeles. In three of these locations, branch laboratory facilities are maintained for performing all necessary routine testing of field samples. Headquarters Laboratory performs the necessary routine testing of asphaltic products used in Northern California and supplied from the Berkeley-Oakland area of production.

One of the important duties of the branch representative is to check the grade of each product being shipped to each job. Before shipping any asphalt ordered by a contractor, the refinery contacts the state representative who checks the special provisions governing the contract and if the grade is called for in the specifications he then grants permission to start shipment of the particular grade. A batch or control number is assigned to this material and these inspection records are available for any future investigations of pavements. In many cases, four or five projects in two or more districts may obtain their asphaltic material from the same series of refinery batches. If trouble is encountered on one of these jobs, the investigation may be extended to the other projects to see if the asphalt involved is a possible cause of the trouble.

Samples Tested

Samples obtained at the job site representing the various shipments are submitted to the laboratories for testing. If tests show the material does not conform to specifications, corrective measures are applied. This may involve special checking at the production source, trucking facilities or visits to the job site for checks on plant storage and sampling techniques.

Although some 20 routine tests are performed on the various types of bituminous binders, the most common tests are penetration, flash, loss on heating, ductility, spot test, viscosity, distillation, float, demulsibility and residue test.

As a matter of illustration, the penetration test, as the name implies, consists of penetrating the sample of asphalt at specified conditions with a needle similar to a sewing machine needle. The depth of needle penetration determines the hardness or specific grade of the asphalt.

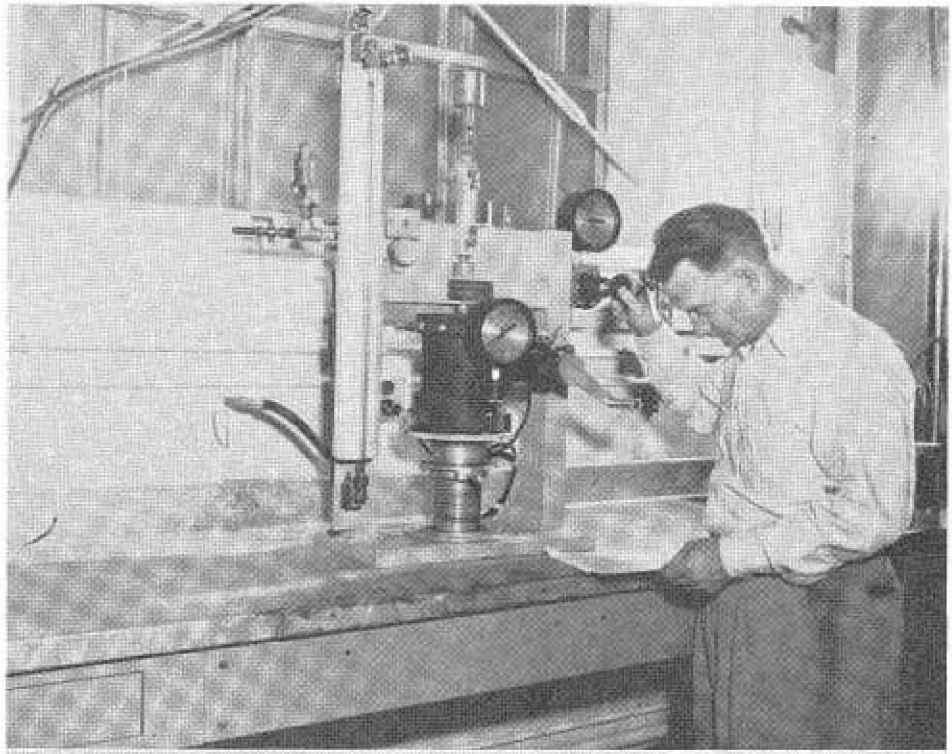
In the viscosity test the fluidity of the material is determined by allowing 60 ml. of the product to flow through a tube of standard dimensions. The time required in seconds is an indication of the viscosity or stiffness of the material.

Research studies by the Asphalt Group are principally centered upon the continuing development of improved and new test methods and specifications for asphaltic materials. The objective of these studies is to provide asphaltic materials of uniform engineering properties, without regard to method of production or crude oil source. Further, such tests should insure the production of material of satisfactory durability.

Soils Group

The Soils Group is under the supervision of George Sherman, Senior Materials and Research Engineer. Its activities are concerned primarily with untreated and treated bases, subbases and the lower or basement soils of the structural section. Its functions might be logically divided into three phases: routine operation of established tests, special investigations and research work. The routine operations consist of the Resistance Value (commonly called *R*-value) and tests on cement-treated base materials. The *R*-value test is performed on untreated base, subbase and basement soils. It is from these tests that the thicknesses of the various layers of pavement and bases are determined. The *R*-value test employs the stabilometer and the expansion pressure apparatus for determining the thickness of layer required to prevent lateral displacement. Cement-treated base tests, on the other hand, employ compressive strength as an index of the quality of aggregate-cement mixtures. In either event, these tests lead to quality specifications for materials furnished by the contractor.

The Soils Group is also responsible for the functioning of the structural design formula and in order to carry on these studies a considerable amount of field testing and investigation is necessary to correlate test data with actual performance. In this respect the *R*-value group investigates highway failures particularly where such failures occur before the pavement has gone through its expected life cycle. This requires a field crew for sampling, coring equipment and equipment for measuring the deflection of pavements under load. The latter is accomplished by two methods, the electronic gage method or the Benkelman Beam. Extensive laboratory tests are usually required in most investigations and it is sometimes necessary to modify existing test methods or procedures in order that the necessary data can be analyzed and combined into a report explaining a particular type of road failure.



UPPER—Resiliometer with stabilometer in place used to measure springiness of soils supporting pavements. LOWER—Making Benkelman beam deflection tests to find out how much a pavement is being bent or stressed under heavy wheel loads.

Special Field Study Group

A comparatively recent addition to the Pavement Section is the Special Field Study Group headed by Earle Dewing, Senior Highway Engineer.

This unit is engaged in a study of present field testing methods and the possibility of their improvement as well as the training of district personnel in the performance and interpretation of field control tests. The expanding construction program has developed a tremendous acceleration in material placement. Larger equipment, new techniques and changes in production procedures have quadrupled the average daily production in the last 10 years. This results in each sample of material representing larger quantities than in past years. Therefore, extreme care in field sampling and testing is required to insure true and adequate representation.

Typical Research and Special Investigations

The foregoing has given a general outline of the main functions of the various subsections. Now, let's take a look at some of the research and special investigational work carried on by the Pavement Section. It might be said that this is the most interesting type of work and quite often all groups are involved in the solution or analysis of certain problems.

Research, of course, is the life blood of the Pavement Section, as it is in any comparable organization; otherwise, our methods and procedures would soon become obsolete and unable to cope with the ever-changing concepts of design and the constant need for better quality in highway construction materials.

Some of the research and investigational projects being carried on at the present time are:

Studies involving *commercial admixtures for asphalt.* It is often claimed by manufacturers that certain additives greatly improve the adhesiveness of asphalts in the presence of water. Our studies include periodic inspection of a test section on US 40 in which several commercial admixtures were incorporated into the asphalt in the hope of preventing or retarding the destructive effects of water on the bituminous pavement.

Extensive studies are made involving the use of *aggregates having absorptive characteristics* in an effort to predetermine the amount and rate of absorption. Any appreciable amount of absorption over a period of time will cause a dry brittle condition and greatly affects the durability of bituminous pavements. In connection with the absorptive study, a re-evaluation and modification of our present C. K. E. method of predetermining the proper amount of asphalt to be used in bituminous pavements is currently active.

A rather extensive investigational program is presently under way to obtain further correlating data on the effects of *moisture vapor* which apparently originates in the underlying wet soils or base material and may be influenced by the heat absorbed by the overlying bituminous paving mixture which during summer season often reaches temperatures in the neighborhood of 140 to 150 degrees F.

Another project is concerned with the introduction of some type of *rubber in asphalt mixes.* Three experimental sections have been placed and are under observation by this department to determine if the benefits obtained warrant the additional cost of the rubber.

Quite frequently there appear on the market certain *commercial products* with the claim by the manufacturer that they are the answer to many of our pavement problems. When a study of literature or reports indicates that one of these products may offer some possible benefit the product or procedure is investigated first by laboratory tests and if it shows promise, later in a full-scale field test section.

After many years of service life, old concrete and asphalt pavements sooner or later become cracked and require a new wearing surface. In many cases this new surface course will shortly reflect the pattern of existing cracks in the old pavement and present a continuing maintenance problem. One of the proposed methods for preventing this reflection cracking in the new surface is to lay *some form of wire fabric* on the existing pavement prior to placing the new surface. Three experimental field test sections have been installed and periodical observations are being made. The major installation, about two miles long, involves eight types of wire reinforcement and has been placed on a heavily traveled section of US 40 near the town of Vallejo.

The use of *asphalt-latex emulsions* for sealing joints in portland cement concrete pavement was developed by the Pavement Section. More recently its use has been extended experimentally in the form of a seal coat providing a thin, lightweight wearing and skid resistant surface on steel deck bridges. Due to its excellent adhesiveness it has also been used in the form of a seal coat on the wooden deck of a draw bridge.

The *skid resistance* of various pavement surfaces is essential to the safety of the traveling public. A research project currently underway has resulted in the design and construction of a small skid tester, usable in both field and laboratory studies. Actual calibration experiments involving various types of surfaces have been performed in the field using a specially equipped truck and trailer provided by the Institute of Transportation and Traffic Engineering of the University of California. One of the laboratory studies involving this skid tester has for its objective the determination of the change in skid resistance of seal coat aggregates following simulated tire polishing. This project has required the construction of special equipment for preparing test specimens and also the construction of a machine to simulate polishing and wearing of the pavement surface. These studies are in a preliminary stage and will require further field correlation work.

For the past few years special field investigations have been underway to measure *uniformity in placing seal coats.* Equipment has been developed for checking the uniformity in spread of the asphaltic binder both transversely and longitudinally. Further improvement and simplification, however, is necessary to make its use more practicable for widespread use by field personnel.

The problem of devising tests for predicting the future *durability of asphaltic materials* has been under investigation for a number of years. This study has required the design and construction of weathering ovens and the development of methods to measure the changes in the characteristics of the bituminous binder under accelerated aging. In order to obtain essential information for correlation of the weathering unit with field aging, a number of experimental projects are sampled at intervals and the asphalt is recovered from the mixture for test by special methods. One rather elaborate project involved in this study is located on Route US 101 between Santa Barbara and Santa Maria and is known as the Zaca to Wigmore Job. Ten different asphalts from various production sources were used in 2,500-foot test sections. Such a test section provides extremely valuable information for checking test methods under development. After development of research techniques for predicting the durability characteristics, the next step is to devise rapid and simplified tests for routine control work. A number of such tests are now being studied in an attempt to accomplish this objective.

Curing Rate

Another problem concerned with the various liquid asphalts is the "*curing*" or "*setting*" *rate*. The present distillation test does not provide complete information on this subject, and differences in curing rates of the same grade from different production sources have been encountered in the field. An instrument called the Cohesiograph has been designed and constructed by the laboratory for studying this problem. Samples of Ottawa sand mixed with 2 perecnt of the liquid asphalt are cured in weathering ovens under simulated field conditions and the changes in the bituminous binder are evaluated by this device. This instrument has also proven very useful in measuring the setting rate of certain paving asphalts in hot mixes during and immediately after construction.

One of the most important research problems currently underway is the study of methods for measuring the *resilience or springiness of the pavement structure*. Under a moving load, a pavement is first depressed and then rebounds to its original position. This results in a bending action in the pavement surface which, if excessive, can lead to cracking and ultimate failure. Therefore, it is essential that this property of resilience be predetermined and that only the least resilient soils enter the upper portion of the roadbed.

New Apparatus

In order to measure the ablity of soils and aggregates to rebound under repeated loads, an apparatus has been devised known as the *resiliometer* which is, at the present time, being tried out to determine if test results can be made to correlate with field performance.

Another research project also connected with the problem of springiness is the gathering of data with the ultimate goal of developing pavements highly *resistant to fatigue*. In this study small test beams of the paving mixture are tested at various temperatures in a specially designed fatigue machine which measures the ability of various types of asphaltic pavement slabs to withstand repeated bending without breaking. This is a property which varies with aggregate gradation as well as with the quality and quantity of asphalt.

The Pavement Section has been engaged in the analysis and interpretation of results of the *nationally known test tracks* MD-1 in Maryland and WASHO Test Road in Idaho. We are also very actively involved in the design and testing of materials for the current multimillion dollar AASHO Test Road in Illinois.

During the past 25 years much of the testing equipment and test procedures for testing both asphalt and bituminous mixes as well as soils have been developed in the Pavement Section. Some of the methods have been adopted by other states and national organizations. In fact, methods and equipment such as the Sand Equivalent, Centrifuge Kerosene Equivalent, Kneading Compactor and the Hveem Stabiliometer are in use in laboratories in many countries of the world.

Outmoded Highways

The public has only to look about to realize that many of the highways constructed as recently as 10 years ago are now inadequate to serve the present day volume of traffic. The answer to this tremendous increase in traffic on our state highways is, of course, our modern freeway system which is the result of long-range planning and research.

While increase in volume of traffic is apparent to all it may not be so obvious that there are also marked increases in weight and size of vehicles, particularly trucks. These increases must be anticipated and advance preparations made to meet the conditions as they materialize. To meet these conditions, it may be necessary to develop new tests and testing equipment to measure and evaluate the necessary qualities required of the materials. Experimental field test sections must be constructed in order to correlate laboratory and actual field conditions. Many new products in the field of highway construction are evaluated in this manner to insure that we are getting the required quality. If we are to continue the progress which has resulted in providing the traveling public with better highways, we must keep well out in front with a research program in order that we can be always ready to test, evaluate and control the quality of our highway materials to insure that we are getting the most for the money we are spending.

New Personnel Officer Named

S. Alan White, who has been in personnel work in state service for the past seven years, has accepted an appointment by Director of Public Works Frank B. Durkee as departmental personnel officer of the Department of Public Works, effective September 1.

White is a graduate of the University of San Francisco, class of 1939, and has a year and a half of graduate work in history and education at the University of California. From August, 1941, to October, 1945, he was in service in the U. S. Navy and is presently a commander in the U. S. Naval Reserve.

On leaving the service, White was engaged in private industry, which he left to accept employment with the State Personnel Board. He is presently on the staff of the Department of Social Welfare.

He will be on the staff of the Department of Public Works to coordinate and advise on personnel management in the department.

Huge Contract

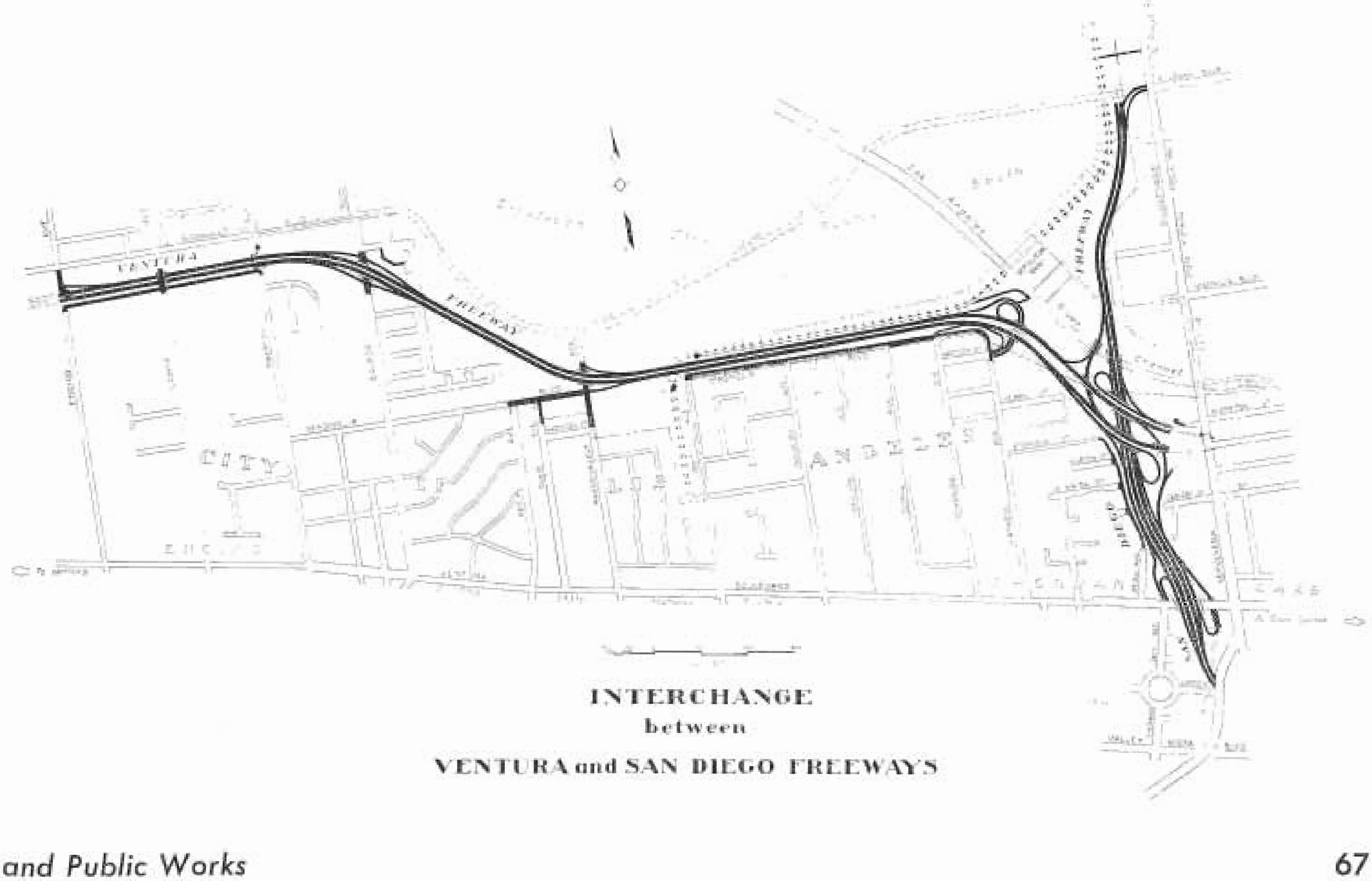
Engineers Discuss Job in San Fernando Valley

By F. E. STURGEON, Resident Engineer, and
P. T. TAYRIEN, Assistant Resident Engineer

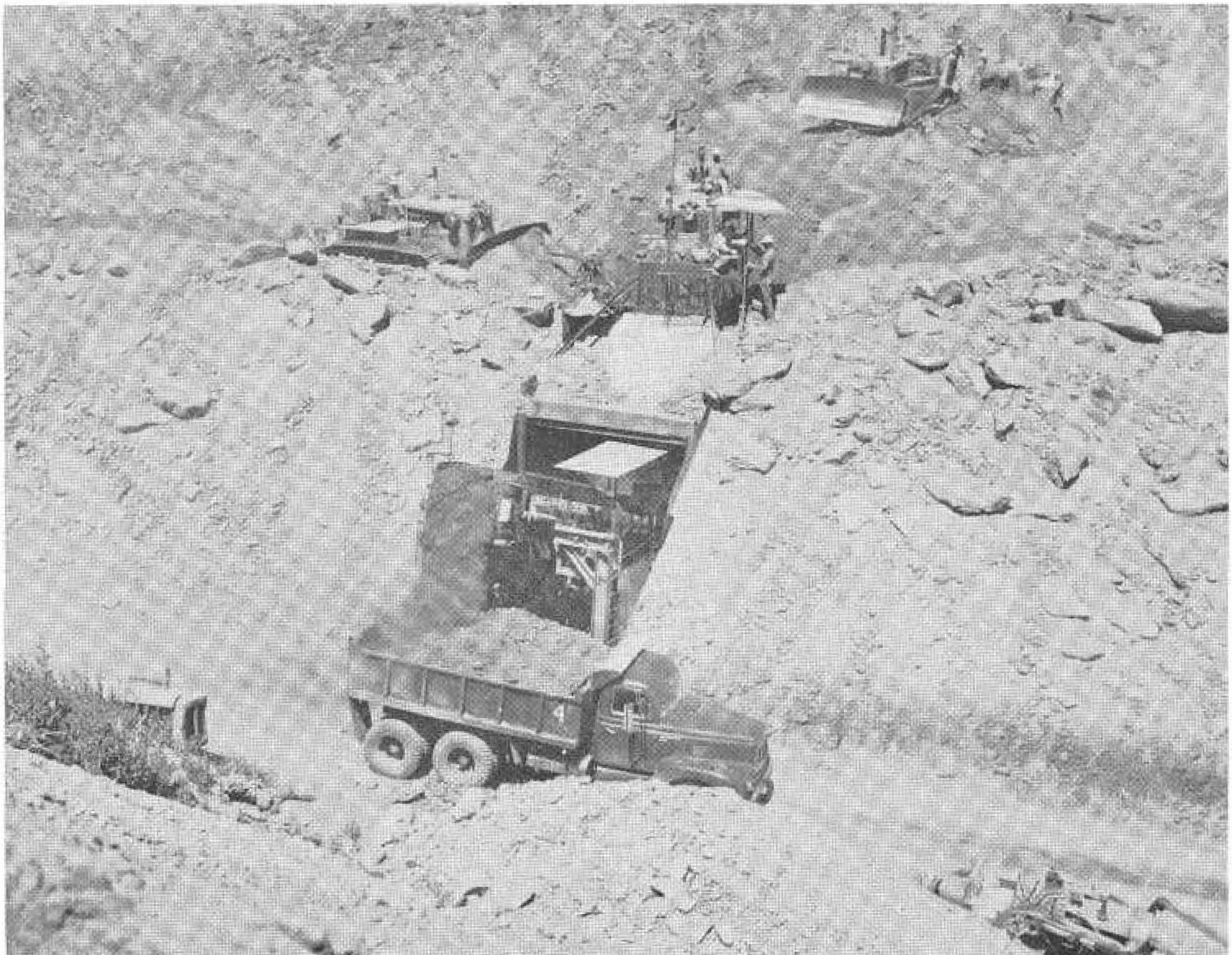
THE LARGEST District VII major construction contract awarded to date, a contract for the construction of 4.5 miles of six- and eight-lane freeway in the San Fernando Valley section of the City of Los Angeles was let to Oberg Construction Corporation and Oberg Brothers Construction Company, a joint venture, on December 28, 1956, by State Director of Public Works Frank B. Durkee. The $7,201,496 contract calls for grading and paving with portland cement concrete on completely new alignment a 1.5-mile portion of the San Diego Freeway between Valley Vista Boulevard and Burbank Boulevard, and a 3.1-mile portion of the Ventura Freeway between Sepulveda Boulevard and Encino Avenue. A full traffic interchange facility is being provided between these two important freeways. Included in the contract are construction of 10 bridges, an equestrian undercrossing, pedestrian overcrossings and undercrossings, 10 retaining walls, storm drain systems, sanitary sewers, highway lighting, illuminated signs, traffic signals and the usual miscellaneous items such as guard railing and fencing.

Sources for Embankment Material

Approximately four miles of the freeway roadbed is on embankment for which fill material must be hauled in. The only exception to this is the through cut between Encino Avenue and Amestoy Avenue on the Ventura Freeway. Material to make the roadbed fills require 1,095,000 cubic yards of roadway excavation to be obtained from the through cut on the job and from stock piles within right-of-way near Haskell Avenue, resulting from prior grading operations, and from local borrow from within the Sepulveda Flood Control Basin. The balance, estimated to be 1,100,000 cubic yards, is imported borrow from a site described as the "Mulholland Borrow Pit," located within the roadway prism of the proposed San Diego Freeway, two miles southerly of this project. On this contract earth will be removed to an elevation 160 feet below existing Mulholland Drive. Future



INTERCHANGE
between
VENTURA and SAN DIEGO FREEWAYS



UPPER—Closeup of belt loader. Note dozers feeding belt. LOWER—On San Diego Freeway looking northerly across interchange roadways. Picture taken from Camarillo Avenue.

construction contracts will also secure imported borrow from this location until the ultimate cut of 350 feet below top of ridge elevation for the San Diego Freeway over the Santa Monica Mountains has been reached.

Close Schedule Maintained

Start of this large earthmoving operation, as well as production rate, was governed by construction of necessary frontage roads, relocation of underground and overhead utilities, installation of storm drain and sanitary sewer systems, construction of certain key structures, surcharge of bridge sites, and start of pile-driving operations. To co-ordinate and expedite this maze of work, the contractor set up a precise schedule of operations based on performing the controlling items of construction with his own forces. These items included storm drain pipes and storm drain structures, portland cement concrete, curbs and gutters, earthwork, and bridges. That this close schedule has paid off is indicated by an average monthly progress pay estimate of $500,000 for the first six months. At this writing, the contract has progressed to a completion of 42 percent versus only 21 percent of time elapsed.

The earthwork, as indicated by figures above, is divided almost equally between roadway excavation and imported borrow. For the roadway excavation operation the contractor moved in with scrapers. This spread of equipment is moving earth at a rate of 10,000 cubic yards per day on a relatively short haul. For the imported borrow the contractor moved in 16 bottom-dump semitrailers and 16 10-wheel end-dump trucks. This latter equipment spread, more fully described below, is moving earth at a rate of about 8,000 cubic yards per day with an average three-mile haul. These two spreads operating nine hours per day have a daily combined output of between 17,500 and 19,000 cubic yards.

Advantageous Haul Road

To move imported borrow from pit to fill, the contractor could elect to haul legal loads over public thoroughfares, including the heavily congested Sepulveda Boulevard, or the contractor could construct a haul road within state-owned right-of-way for the proposed San Diego Freeway, thus eliminating conflict with public traffic and avoiding the necessity of keeping loads within legal limits. Loads are limited only by the safe load that can be carried over the existing Ventura Boulevard undercrossing constructed under another contract. This bridge structure fortunately was designed to carry safely overloads 20 percent above legal limits. The decision of the contractor to construct his own haul road has undoubtedly had considerable bearing on the favorable rate of progress. The haul road was constructed to a width of 40 feet on easy alignment, and required moving of approximately 160,000 cubic yards of excavation. The roadway splits at an advantageous point that allows a maximum 12 percent upgrade (empty) and a maximum 17 percent downgrade (loaded). As a safety feature, three escape roads were constructed to forestall disasterous results in event hauling equipment got out of control.

Route of Haul Road

The distance from the pit to the beginning of the project is two miles, and there is a fall of approximately 600 feet. The haul road is carried across Sepulveda Boulevard on a 130-foot bridge (using state-loaned steel girders), spans Valley Vista Boulevard on a 70-foot bridge, and traverses an exclusive residential area as well as a business district. Dust control was impractical by means of water, due to steep grades and consequent danger to trucks. Further, local high winds and hot weather combined to cause a high rate of evaporation. After some experiments by the contractor, a practical method was found to be an application of asphaltic emulsion, mixing type, 60-70 penetration, applied by means of a water wagon at a rate of 30 gallons per 1,000 gallons of water. Frequent applications at this light rate built up a satisfactory surfacing free of dangerous slick areas. Stabilization of haul road surface has now reached a point that disking and blading is needed only at five-week intervals.

The Mulholland borrow pit for the most part is a formation of soft sandstone and shale interspersed with occasional large rocks, and it breaks up easily under the action of a rooter. However, layers of hard sandstone, shale, and rock have been encountered that require special treatment to break up. The contractor breaks up these hard ledges with a headache ball and to date has not resorted to blasting. To cope with the variable conditions and to maintain an even production, the contractor operates two equipment spreads in the pit. The spread to handle hard material consists of 1½- and 2½-yard shovels which load 10-wheel end-dump trucks. In addition to the headache ball when necessary, a dozer with ripper is used to break up and push materials to the shovels.

Mulholland borrow pit. Chartered bus in background carrying highway commissioners on field trip.

Fleet of 16 Trucks

A fleet averaging 16 trucks is used on this operation. The spread to handle soft sandstone and shale consists of two dozers with rippers (one being used on both spreads, and three dozers feeding a 54-inch continuous belt loader mounted on skids for easy moving. A fleet of 16 bottom-dump semis supplemented by some of the end-dump trucks is used to haul from the belt. Some difficulty and delay were caused by large rocks getting into the hopper of the belt loader. This condition was remedied by stationing a watchman at the hopper to spot the rocks so they could be dozed aside and loaded into trucks by a standby skip loader. Also, a heavy-duty grizzly was built up and placed in front of the hopper to protect the belt. The belt loader operating under good conditions has loaded out heaped bottom-dumps (24 yards) in an average of 30 seconds.

Special Equipment

The belt loader used in the pit was put together in the contractor's yard. It is skid-mounted and is built around a 54-inch loader belt. Dirt falls through a 4x4-foot hole into the hopper, is funneled down to a 2½x4-foot gate, and onto the belt. Power is supplied by a diesel engine.

Ten of the 16-truck fleet of bottom-dumps are company-owned and were built to the contractor's specifications. They consist of a 20-cubic-yard (water level capacity) bottom-dump semitrailer and drawn by a tractor, powered by a turbocharged 250-horsepower diesel engine and dual-drive rear axles. The trailer is 36 feet long, and trailer plus tractor is 55 feet out to out. Maximum width is eight feet. These dimensions are within the California state highway legal limits. The load is carried on eight pairs of truck tires and the machines are designed for both offroad and legal highway hauling. The tractor and trailer, along with such special additions as Hydrotarders, and protector plow on front axle, weighs 31,000 pounds. The unit therefore can carry a 20-ton payload without special permit under the state highway legal load formula for dual-axled semis. The trailers have full airbrakes with hand and foot controls in the cab. The Hydrotarder is a special supplemental type of water brake which makes the unit safe for use on the relatively steep grades of the haul road. (Other rented trucks of equivalent capacities have been tried on the road, and only those equipped with water-cooled brake drums have been able to negotiate the grade safely.) Another safety feature installed by the contractor is special cutoff valves on each axle which prevent loss of air. Should any cylinder be broken or a diaphragm blown out, the air to that wheel is automatically shut off. Although the rigs were operated at much higher speeds originally, in the interest of safety the contractor ordered a maximum speed of 35 miles per hour downgrade. On the upgrade climb, the trucks maintain a minimum speed of 25 miles per hour.

Post-tensioned Girders

Five different types of construction are to be found in the 10 major bridges on the project. These are box girder, flat slab, T-beam, structural steel, and prestressed post-tensioned. When the pedestrian overcrossing is included, a sixth type is added—poured-in-place post-tensioned slab.

Of great interest to visitors on the project has been the Balboa Boulevard Undercrossing. This structure is a reinforced concrete precast prestressed post-tensioned girder bridge consisting of one span about 119 feet in length, which makes it the longest span of this type to be constructed to date on a state highway in California. There are 18 girders, and post-tensioned operation are now underway. Girders measure 5½ feet high by 119 feet long, with two-foot bottom flange and three-foot top flange, eight-inch-thick web and weigh approximately 62 tons.

Girders each contain 150 high-tensile-strength wires, 16 in each of nine two-inch-diameter flex tubes hung at a catenary, and six in a tenth tube near the girder top. In tensioning, a working stress of 130,000 pounds per square inch is exerted by hydraulic jacks. The PI system of post-tensioning is used.

Due to the heavy traffic on Balboa Boulevard during daylight hours, placing operations will be limited to the hours of midnight to 6 a.m. It is planned to use two heavy-duty truck cranes to set each mammoth girder in position. These girders will be placed on approximate seven-foot centers, and a six-inch slab will later be poured.

The Amestoy Pedestrian Overcrossing is also a post-tensioned structure, but differs from the Balboa structure in that it is a post-tensioned slab and will be poured in place. Post-tensioning is carried out before the removal of the falsework. The wires receive the same loading as in the girders. Strength requirements for the ders, and 4,500 pounds per square inch prior to tensioning on the girders, and 4,500 pounds per square inch for the slab.

Highway Commission inspects the Oberg Bros. contract in the San Fernando Valley for construction of portions of the Ventura Freeway and the San Diego Freeway in Sherman Oaks. From left to right are State Highway Engineer George T. McCoy; Commissioners Chester H. Warlow and James A. Guthrie; Edward T. Telford, Assistant State Highway Engineer; Frank B. Durkee, Director of Public Works; Commissioners Robert E. McClure, Fred W. Speers, and Robert L. Bishop.

UPPER—Stockpile removal and other operations in Haskell Avenue area. Haskell Avenue bridge structure on extreme left. LOWER—Looking southerly across interchange roadway. Ventura Boulevard bridge in background.

The 480-day contract calls for completion in January, 1959. However, the contractor hopes to finish as much as six months ahead of schedule, and, if his present rate of progress is maintained, this is not impossible.

Personnel on Job

Niles Oberg is project manager for the Oberg organization, assisted by Dick Woolard, excavation superintendent; Andy Dunlap is in charge of the pit; Bill Thomas is general carpenter superintendent, and Leonard Swanson is office manager.

In immediate charge of administering this contraet for the State Division of Highways is the resident engineer and his staff of assistants. H. E. Belford is construction supervisor. General supervision for State under Assistant State Highway Engineer E. T. Telford is carried out by District Engineer L. R. Gillis and Assistant District Engineer F. B. Cressy. On the job representing the State Bridge Department is Carl J. Verner working under general supervision of J. E. McMahon and George L. Laird of Southern Section of the Bridge Department.

STATE FAIR

Continued from page 38 . . .

unidentified food products, jotting down reactions on special forms. In the second, spectators will act as judges of home appliances which will be demonstrated continuously.

The former Foods and Hobbies Building has been redesignated as the "Merchandise Mart."

"Have Fun" Is Slogan

"Have Fun" will be this year's fair slogan, but there will be plenty of opportunity for education while enjoying oneself.

The sprawling Counties Building is an example, where each year more than 90 percent of all the fair visitors tour a fairyland of light, color, and motion, with the myriad products of the State on display.

Gold exhibits from the fabulous Mother Lode country, worth hundreds of thousands of dollars, will "educate" viewers, giving them an insight into the State's mining industries. So, too, will many other minerals shown each year, not to mention lumber, agriculture, horticulture, fisheries, natural resources, viticulture and vintage production, and the other diversified industries which are reflected in the name "The Golden State."

Of special interest are winetasting and splendid vintage displays, all boasting of the fact California produces 85 percent of all the domestic wines in the United States.

Perhaps the greatest delight of all is the Hall of Flowers, with its breathtaking vista of waterfalls, conifers, potted plants, simulated redwood trees, blooms, outdoor gardens, limpid pools, and many arrangements. More than 1,000,000 plants and blooms are on display each year.

And over all this will reign the Maid of California, chosen each year from a bevy of beauties representing the various counties of the State.

The fairground is located virtually in the heart of Sacramento, on 207 acres reached from any part of the city within a few minutes by municipal bus or taxi. Busses operate on a special express schedule. Once inside the grounds, visitors may ride from one location to another aboard "elephant trains."

BOLD VENTURE

Continued from page 58 . . .

utilized in the construction of a second experimental section started in September of 1953 which placed 1,000,000 cubic yards of embankment over the deepest portion of underlying mud.

Mud Displacement

The cross section finally developed for the project consists of a fill 200 feet in width and 45 feet in depth which penetrates approximately 25 feet into the underlying bay mud. By carefully controlling the shape of the advancing fill, the method and rate of fill placement, and by the use of explosive charges set off deep in the mud immediately in advance of the embankment, reasonably uniform mud displacement was achieved.

The total two-mile section across the open water was completed by four additional contracts, after which a seventh contract for base and surfacing was awarded. The completed embankment is still "floating" on the part of the mud not displaced by the fill.

Railroad Relocated

A further problem in the planning of this section of highway was a conflict at Sierra Point between the main line of the Southern Pacific Railroad and the proposed freeway location. The railroad was located in a tunnel through Sierra Point which was expensive to maintain and could not feasibly be widened to accommodate proposed additional tracks. The new freeway location crossed the railroad on a long skew which would have required a long, expensive overpass. The highway division's designers arrived at an ingenious solution to this problem. First, Sierra Point was excavated to the grade of the railroad and the material used to construct a portion of the open-water embankment. The railroad was then relocated in the resultant cut eliminating entirely the former tunnel and crossing the freeway at a far better angle, permitting a much less extensive overpass structure with proper provision for additional trackage. This procedure greatly improved the railroad's facilities at this location and resulted in savings of at least $1,000,000 in the cost of the highway improvement.

Three additional contracts are in progress on the San Francisco Peninsula. These contracts, scheduled for completion in the summer of 1958, cover an additional eight miles of freeway construction and will extend the completed portion of the Bayshore Freeway through Palo Alto.

PRESTRESSED BRIDGE

Continued from page 29 . . .

hose. Constant motion of the cement solution is accomplished by a system of bypasses to prevent it from becoming stiff, while connections are being made for the next girder.

Normal operations by the contractor's forces at the girder casting beds required a working period of the usual 40-hour week, for an average production of 12 to 14 girders per week.

When the posttensioning of the girders was completed two truck cranes were brought in and used for the erection work. These cranes moved the girders from the casting beds to the final position on the bridge piers. The average distance of this move was about 1,000 feet.

The final concrete pours to complete the prestressed bridge consisted of placing Class A concrete for pier stem connections, diaphragms and deck sections connecting the girders together, and the bridge curbs.

Due to a uniform camber of the girders of about 1½ inches, a plant-mix surfacing course was specified to provide a smooth roadway surface. Additional work under this contract consisted of metal beam bridge rail and approach, surfacing and guard rail.

This contract was under general administration of the Bridge Department of the State Division of Highways, headed by F. W. Panhorst, Assistant State Highway Engineer. Truman Hart was general superintendent for W. F. Maxwell Co. H. L. Harger was resident engineer for the Bridge Department and Thomas L. Patterson, construction representative for District VII.

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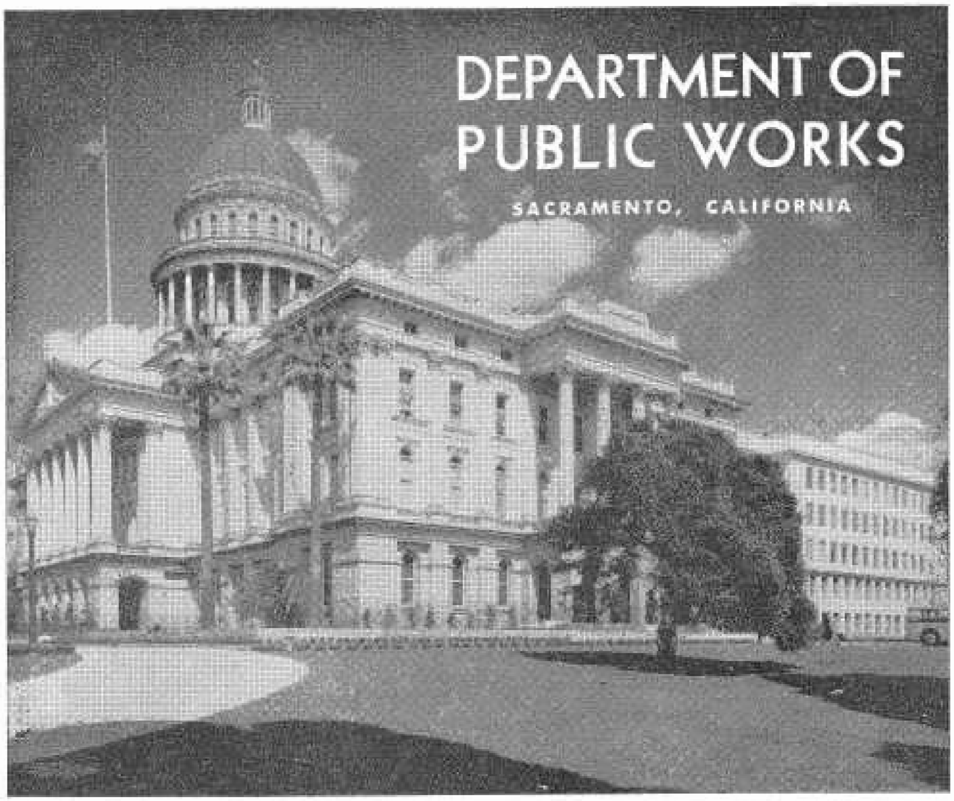

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Action, adventure, and romance fill the pages of California's last century of history. Human initiative and ingenuity repeats itself again and again through the colorful years of rapid development, but without the great natural wealth of water, soil, forests, mines, and petroleum, the interesting history could never have been written. Plenty abounded everywhere a century ago, timber for homes and farms, gold in staggering quantities to focus worldwide attention on a then remote frontier, rich soils for productive farms and pastureland, and subsequently, oil to supply energy for mechanized development, and finally, during the most recent 40 years harnessed water and waterpower to supply cheap electrical energy and to transform vast areas of semidesert to veritable garden lands of plenty. To this wealth there was added a temperate climate, recreational opportunities, and scenic beauties of such diverse nature as to have few equals. A haven for homelovers, a mecca for tourists and for sportsmen—a green and golden California. This great natural wealth and unique land of pleasure and opportunity was recognized early. The migration west was steady from the early days of the forty-niners. Human and natural resources joined and California flourished. From a few more than 6½ million people in the late thirties, the State's population has grown to 14 million in a little more than 15 years, a phenomenal growth in a short period; a phenomenal growth in 100 years of history.

Forty-five million acres of the land area of California is the vast natural catchment basin for lifegiving rain and snow water. Forty-five million acres from which is also produced 6 billion board feet of lumber each year, that provides summer feed for more than one million head of cattle and sheep, and offers mountain recreational and sports pleasure to millions of people each year. Forty-five million acres of highly inflammable vegetation that from May to October will burn like tinder. To protect this tremendous area of watershed, timber, and grazing land, the people of the State spend millions each year for fire protection facilities. Yet, people are the cause of nine out of 10 fires that threaten these lands, their products, and the State's very existence.

There is no state in the Union more dependent on her resources than is California. Every drop of water, stick of timber, and blade of grass is needed if we are to meet the challenge of our expanding population and economy. We cannot meet this challenge if we continue to allow the number of fires to start on our wildlands that we have experienced since the end of the war. It is false economy to spend millions on one hand to build mighty structures for water storage, transportation, and flood control and continue on the other to peril their existence and sacrifice resources to careless man-caused fires.

By F. H. RAYMOND, *State Forester*