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Cabrillo Freeway

San Diego Celebrates Opening Of New $3,500,000 Highway

By E. E. WALLACE, District Engineer

ON SATURDAY, February 28, 1948, San Diego's $3,500,000 Cabrillo Freeway was officially opened to public traffic. The opening was preceded by a luncheon given by the San Diego Chamber of Commerce in honor of the Highway Commissioners and others who had a part in the accomplishment of this major project. Following the luncheon the party proceeded to the southerly end of the freeway where the ribbon was cut by Arthur H. Marston, son of the late George W. Marston, who was one of the early promoters of the freeway, assisted by Highway Commissioners C. Arnholt Smith and Harrison R. Baker, and Vice Admiral C. A. Blakely, United States Navy, retired.

Following the cutting of the ribbon the entire assemblage proceeded in a parade of cars over a mile in length as they drove to the northerly end of the freeway, where a joint celebration was held with the Linda Vista Chamber of Commerce at the Linda Vista Civic Center.

On the following day it appeared that most of San Diego had turned out to tour the new project, and both lanes of the highway were practically filled for several hours on Sunday afternoon, handling traffic estimated in excess of 3,500 vehicles per hour.

Project Begun in 1938

Preliminary negotiations and planning for this project were begun as early as 1938. The route was adopted by the California Highway Commission on November 27, 1940, and on December 31, 1940, the commission passed a resolution establishing the route as a freeway.

On March 25, 1941, the people of San Diego voted eight to one to set aside a 200-foot width of right of way through Balboa Park for this parkway.

During the war years the project was considered as a highway which would provide proper access to military and naval establishments, and was at one time approved as a federal access project. However, due to changing conditions and other projects which were considered more urgent, this one was indefinitely delayed. During the war period the plans for the project were completed and prepared for advertising as a part of the State-Federal Postwar Program, and it was later approved as Postwar Project No. 116.

Long Range Planning

The freeway was finally accomplished through the efforts and close cooperation of the citizens of San Diego, city and county officials, federal and state authorities, and the various contractors.

Due to the long range planning, several other highway units and structures in the vicinity of this project which were constructed in advance of the Cabrillo Freeway were planned as an integral part of same. For example, the Robinson Street Bridge was designed to accommodate an ultimate six-lane divided highway underneath the structure: the two Washington Street bridges were designed to span the several ramps and an ultimate six-lane divided parkway. The new San Diego River Bridge was so located and

Freeway Facts

COST—$3,500,000 from funds authorized by state highway officials at Sacramento for building the four-lane divided highway.

LENGTH—From the south end of the freeway to its northern terminus where it connects with Highway 395 the distance is 7.1 miles.

RIGHT OF WAY WIDTHS — Four lanes of divided highway having a width of from 150 to 200 feet. Wherever possible the right of way is fenced.

TIME SPENT IN CONSTRUCTION—Almost two years. Ground-breaking took place February 6, 1946. Twelve separate contracts were let for the construction.

TERMINALS—In San Diego, Tenth Avenue from Ash Street to Market Street has been designed as a one-way street for southbound traffic, and Eleventh Avenue from Market Street to Ash Street is one-way northbound. The northern terminus is at Highway 395.

PERMISSIBLE SPEED LIMITS—Fifty-five miles an hour will be permitted except at one or two intersections, where "prudent speed" regulations under the State Motor Vehicle Code prevail.

Quince St. off Ramp | North Under Cabrillo Bridge | Northerly From Date St. Bridge | Date St. Overcrossing | North From Date St. Crossing

planned that it would become the southbound lane of the freeway.

Some of the items involved in the construction of this project include the acquisition of approximately 200 separate parcels of right of way, and the moving of several residences to new locations. Not a single eviction of residents was necessary.

Fifteen Structures

Including the auxiliary projects of Washington and Robinson Streets above mentioned, there were 12 different contractors involved, some of whom had several different structures underway simultaneously. There were 13 grade separation structures and two bridges involved.

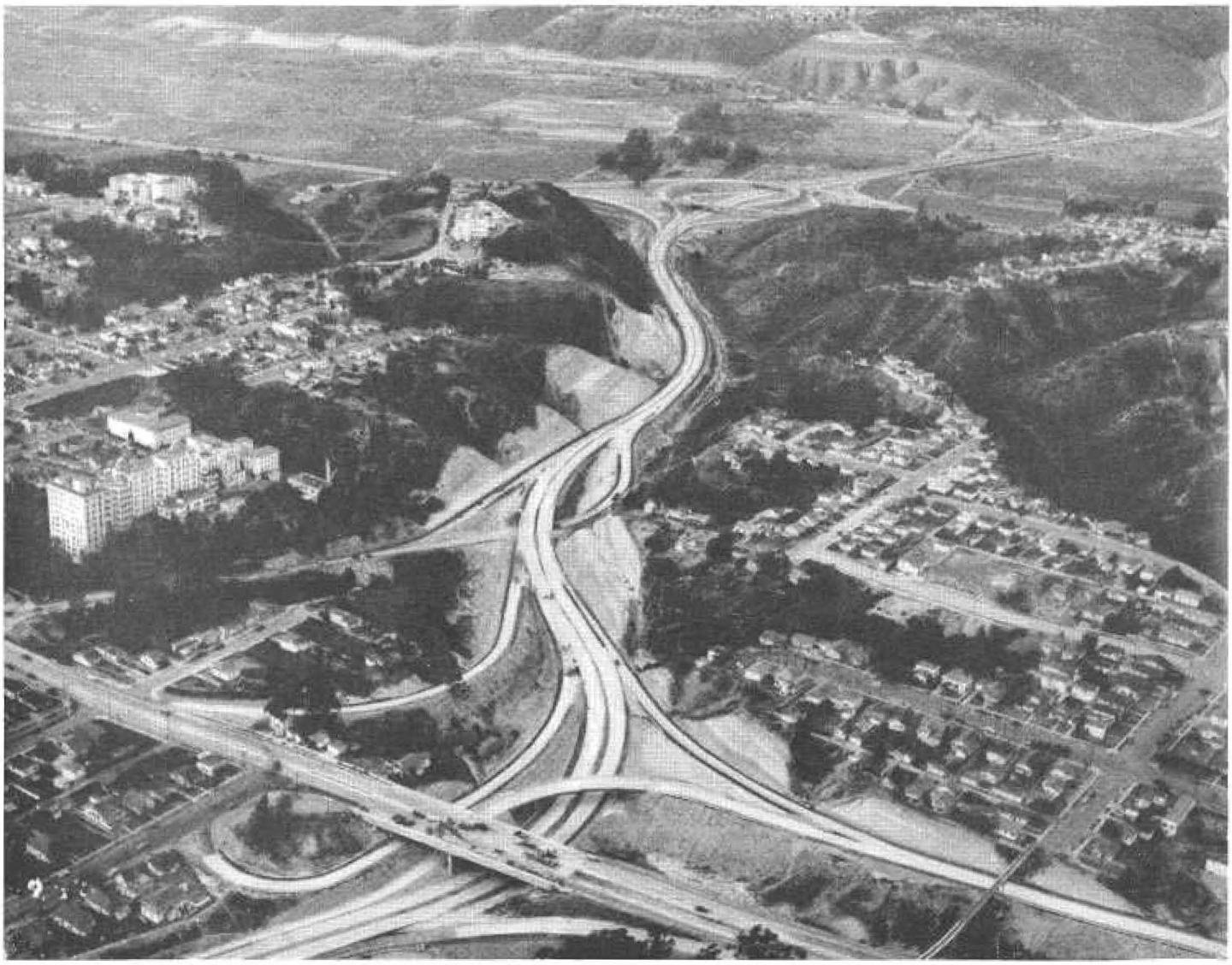
Two and one-half miles of city sewer and water mains had to be relocated and reconstructed, approximately six miles of culverts and storm drains were installed, and many trees and shrubs through Balboa Park were transplanted. Approximately 2,000,000 cubic yards of excavation were involved; over seven miles of four-lane concrete pavement was placed on cement treated subgrade, and over 10 miles of pipe line was installed for use in properly landscaping the project.

As a part of the grading operations all suitable top soil was salvaged on the project. This top soil was later placed on the excavation and embankment slopes to a depth of six or eight inches, after which the slopes were covered with straw and planted with grass to prevent erosion.

Landscaping

Subsequently all of the slopes south of Washington Street are being planted

Cabrillo Freeway traversing Hillcrest District, with separations in the foreground across Robinson, University, Washington, and Pascoe Streets



Looking north across interchange connecting with Mission Valley Road

with shrubs and ground cover which will ultimately result in a beautifully landscaped project. Approximately half a million plants, involving 28 varieties, are being placed, mostly on the southerly end of the project so that this parkway will harmonize with the landscaping of Balboa Park.

Approximately one and one-half million man hours of labor were involved in the entire project.

The result is a modern parkway with no intersections at grade between Ash Street and Kearney Mesa. The freeway will have seven times the traffic capacity of any of the downtown streets on which parking is permitted, and should reduce the accident rate per million vehicle miles by 40 percent.

Anticipating considerable traffic congestion at the south end of the project, the city council was requested to make 10th and 11th Streets one-way arterials southerly to a connection with Market Street. After a public hearing before the city council, a resolution was finally adopted by the city officials designating 10th Street as a one-way street to serve southbound traffic, and 11th Street as a one-way arterial for northbound traffic. Traffic actuated signals were installed at both Ash and "A" Streets, and synchronized signals have been installed on both 10th and 11th Streets.

Observation of the large volume of traffic on Sunday afternoon indicated that the various outlets connecting with the city streets were functioning satisfactorily, and no objectionable congestion occurred.

An especially interesting unit of the Cabrillo Freeway project is the traffic interchange connecting the freeway with the Mission Valley Highway. This unit provides for the free flow of traffic in any and all directions with a minimum of interference. This is the first traffic interchange of this particular type to be placed in service in California.

The Cabrillo Freeway is the southerly terminus of U. S. Highway 395, and is the first freeway construction in this part of the State. With the completion of other units in San Diego County, now underway or planned for

Upper—Looking south toward Pascoe Street and Washington Street. Lower—Section of new freeway through Balboa Park

Close up of interchange connecting with Mission Valley Road. This view is looking north as is aerial view of same structure

the future, this highway will attract a large volume of traffic originating in the Riverside-San Bernardino areas and the easterly Los Angeles metropolitan area, and will assist in relieving other highways in the vicinity which are rapidly becoming severely congested.

Before the dedication ceremonies a luncheon sponsored by the Chamber of Commerce was held in the Stag Room of the San Diego Club, Russell Stowell, Chairman of the Chamber of Commerce Highway Committee and President of the San Diego County Highway Development Association, was toastmaster.

Brief talks were given by De Graff Austin, Chairman of the County Board of Supervisors, Frank Forward, Vice Chairman of the Chamber Highway Committee, District Highway Engineer E. E. Wallace, Highway Commissioners Baker and Smith, Marston, Fred Ridout, Celebrations Committee Chairman of the Linda Vista Merchants Association; Walter V. Pittman, Chairman, Board of Supervisors, Riverside County; Fred Rhodes, San Diego City Manager, and Admiral Blakely.

Military representatives attending the luncheon and ribbon cutting ceremonies were Major General L. D. Hermle, U. S. M. C., Commanding General Marine Corps Base; Colonel Fred Waters, U. S. A., Commanding Ft. Rosecrans, and Captain H. S. Agnew, U. S. N.

Ribbon-cutting ceremony at dedications of Cabrillo Freeway. Left to right—Vice Admiral C. A. Blakely, USN retired, Arthur Marston, Major General L. D. Hermle, USMC, Highway Commissioners C. Arnholdt Smith, and Harrison R. Baker

Among the guests was Rowland Reed, who is credited by Marston with being one of the original planners of the freeway. Reed conceived his highway plan in 1932 and presented it to the City of San Diego. He consulted with Marston, who in turn interested his father, the State Highway Commission, and later the city council. Finally some of Reed's ideas were incorporated in the freeway.

Luncheon guests from Riverside County included Supervisors Ed Hill and Floyd Gilmore; Howard H. Hays, Williams C. Evans, H. P. Younglove, J. H. Prater, John Cote, and Harold Johnson representing the Riverside Chamber of Commerce, and L. A. Evans, City Planning Engineer.

Residents of Linda Vista celebrated the opening of the freeway with a program of music and speeches in the Linda Vista plaza following the ribbon cutting ceremonies.

Sand Drains

Foundation Consolidation and Accelerating Settlement of Embankments

By THOS. E. STANTON, Materials and Research Engineeer

This is the second of two papers, prepared by Mr. Thomas E. Stanton, Materials and Research Engineer of the State Division of Highways, to be read at the forthcoming Second International Conference on Soil Mechanics in The Hague, Netherlands

A PRELIMINARY discussion on this topic was contributed to the First International Conference by O. J. Porter.* The discussion included only one California field project involving 3,530 lineal feet of vertical drains constructed in 1934.

The 1936 report recited that in connection with the fill construction on the easterly roadway approach to the San Francisco-Oakland Bay Bridge, the late Daniel E. Moran, then consulting engineer for the bridge, suggested the use of sand piles for stabilizing the foundation by draining and laterally compacting the mud. Mr. Moran's suggestions were not carried out on that project, but they stimulated interest in this type of construction, and were the occasion for the studies of hydraulic pressures on the Bay Bridge approach, described in detail in the 1936 paper, and the subsequent stabilizations of weak foundations on many state highway projects by the vertical drainage method.

Since 1936, the foundations on 22 projects, aggregating 1,108,807 lineal feet of drains, have been stabilized by this method. The projects ranged in size from the first project constructed in 1934 (3,530 lineal feet of drains) to the largest project involving 221,000 lineal feet just completed on the Bayshore Freeway, south of San Francisco.

Therefore, experience with this type of construction now extends over a period of 13 years and the data relating thereto are much more comprehensive than the relatively limited experience reported in 1936.

Vertical Drain Method

Interest in the vertical drain method of relieving hydraulic pressures under highway embankments and thereby accelerating the rate of settlement and reducing the displacement and consequent embankment yardage followed observations of numerous projects constructed over marsh land where considerable displacement had occurred during construction and on which subsequent settlement had continued for many years thereafter; the length of time and extent of settlement depending on the depth, nature, consolidation, and saturation of the underlying mud.

This experience suggested the possibility of greatly reducing the normal settlement period of embankments over deep mud deposits by construction of 18-inch to 24-inch diameter sand filled vertical drains spaced approximately 10 feet on center, thus providing a short distance horizontal flow through saturated clay and similar type soils into the porous vertical drains. Even only a partial de-watering of the over-saturated low bearing value foundation material increases the shear resistance and reduces the pore pressure to such an extent that under a proper rate of application of the fill load the foundation acquires such stability that there is no serious displacement during construction. Furthermore, the period of major embankment settlement is materially reduced with resultant less inconvenience to traffic and lower maintenance costs. The consolidation rather than displacement of the saturated foundation means less fill quantities thereby at least partially offsetting the cost of the vertical drains.

Following is a description of the design and construction procedure and some of the problems encountered in connection with this type of construction.

Design of Foundation Treatment

Extensive preliminary investigation is essential for the proper application of the vertical sand drain method of treatment. Borings are made to determine depth to solid material. Undisturbed samples are obtained for such laboratory tests as moisture content, density, grain size, consolidation, cohesive strength, and angle of internal friction. From these data are determined the required spacing and depth of the vertical drains for the design height of fill and anticipated ultimate settlement.

Working Platform

As the ground surface is frequently too soft to support the required construction equipment the first order of work, under such conditions, is the placing of a blanket of suitable quality material of sufficient depth to provide adequate support for the equipment. This blanket is known as the "working platform."

Drain Construction

Various types of equipment have been utilized for the construction and backfilling of the vertical holes, with many modifications to meet the subsurface conditions on specific projects.

Following is a brief description of five methods which have been used on California projects, each possessing advantages and disadvantages.

1. Rotary Drill

This type of equipment *(Fig. 1)*, consisting of a rotary drillrig with a bucket having cutting blades on the bottom, efficiently cuts through layers of soft and moderately firm material; holes of varying depths can be bored providing the sidewalls remain in place prior to backfilling.

Disadvantages include the necessity of raising and emptying the bucket after each few feet of cutting, and the slowness of the operation when caving of the sidewalls requires casing of the hole. In many cases, the holes can be kept open during drilling operations by keeping them filled with water.

* Proceedings of the First International Conference on Soil Mechanics and Foundation Engineering, June 22-26, 1936, Vol. 1, page 299.

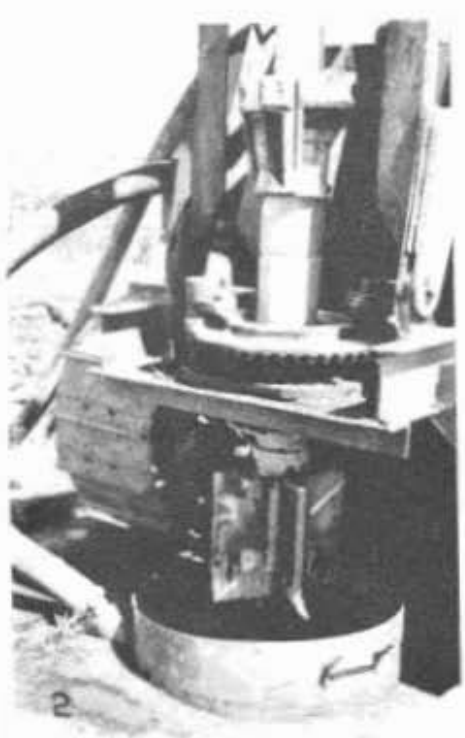
1

2. Rotary Jet

Equipment used in this method *(Fig. 2)* consists of cutting blades and jets of water to wash the cuttings to the surface.

The rotary jet is satisfactory in fibrous peats where sidewalls will hold. Depths up to 60 feet have been reached by this method.

Considerable quantities of water are required for the washing operation and in some formations of silt and clay, difficulty is encountered due to collapse of the sidewalls.



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3. Driven Mandrel

The driven mandrel *(Fig. 3)* has provided the best results of any of the types so far used in placing vertical drains to fairly uniform depth in soft mud or peat.

A hollow steel mandrel with a hinged bottom plate is driven to the desired depth; the sand backfill material is introduced at the top, and as the mandrel is withdrawn the hinged bottom plate allows the backfill sand to flow into the hole. Compressed air applied into the mandrel often facilitates the extrusion of the sand into the drain hole.

In this "dry" method, the driving is comparatively fast, a maximum of 2,000 lineal feet of completed drain having been installed per shift. The hole is kept open while backfilling and there is no water or washings involved.

3

Difficulties encountered with the driven mandrel include: (1) In some clays, pulling of the mandrel may be difficult; (2) Certain stratified formations, particularly sand lenses, cause hard driving, slow down operations and may cause excessive deterioration of the equipment, and (3) vibrations set up by the driving may endanger nearby structures.

4. Jetted Mandrel, Double Wall Type (Fig. 4)

5. Jetted Mandrel, Closed End Type (Fig. 5)

These two types of jetted mandrel have been used under conditions where those previously described have not been feasible or economical.

The double wall type of mandrel *(Fig. 4)* consists of a double-wall pipe made of a 16-inch diameter steel pipe fitted inside of a 19-inch diameter pipe, the annular space between the two being closed at the ends, with jets at the lower end. Compressed air and water supplied to the jets through the annular space between the two pipes washes the jetted material to the top through the inside pipe.

4

With the closed end type of jetting mandrel *(Fig. 5)* both ends of the inner pipe are closed, with jets in the bottom plate; this inner pipe and outer shell

5

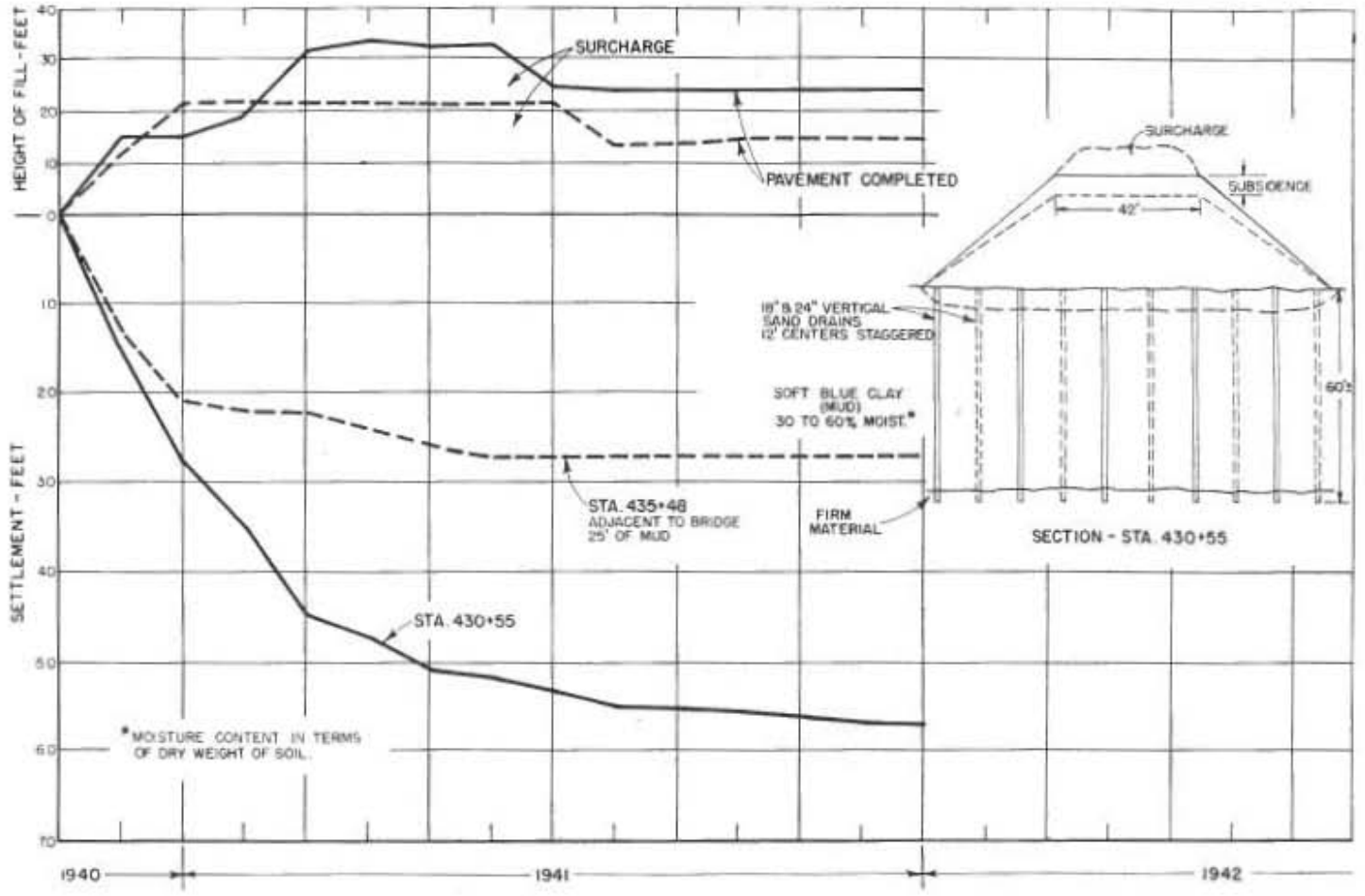

FIG. 6

EMBANKMENT & SETTLEMENT RECORD
SOUTH APPROACH TO SAN LUIS OBISPO CREEK BRIDGE
SAN LUIS OBISPO COUNTY

are jetted down as a unit, the jetted material rising to the surface through the space between the inner pipe and outer shell.

After jetting the "double wall" type mandrel to the required depth the inside of the mandrel is washed clean, backfill material is introduced, and the hole filled as the mandrel is withdrawn. With the "closed end" type the inner mandrel is withdrawn before backfilling is started. The outer shell is then drawn as the sand backfill is placed.

Both jetting methods have proven to be fast and are capable of readily cutting through various formations, including cohesionless sand which causes difficulties with the other types of equipment; also, with the jetting methods, vibration is eliminated.

The principal objectionable features are the large supply of water required for jetting, and the difficulty of disposing of the water and jetted material.

Backfill Material

To assure that the backfill material is sufficiently pervious to provide rapid drainage of the saturated soil as the moisture is squeezed out by the embankment load and to insure that the material does not contain such large size voids as to permit a silting of the drain material by the surrounding soil, rigid backfill grading specifications are established for each project, the most economical available local materials being considered. Consistent with economy and availability of materials, the following are typical grading limits which were established on several recent projects:

Sieve size	*Percent passing*
½"	90-100
#8	25-100
#50	10- 30
#100	0- 3
#200	0- 2

In addition to the requirements for a clean permeable sand it is essential that all excessively muddy water be pumped from the hole before backfilling.

Settlement Measuring Platforms and Pressure Gages

Observations of the operation of the vertical sand drains, both during construction and subsequently, include the measurements of hydrodynamic pressure and subsidence.

Progressive settlement of the foundation material is determined by installing platforms on the original ground prior to any fill placement; changes in elevation of the platforms are measured in pipes attached to the platforms and extended as the embankment is built up.

Hydraulic level methods have likewise been used.

Hydrodynamic, or pore pressure, in the foundation soil is measured by well

points, placed at various depths and connected to pressure gages outside the fill area. Attached sketch "Pore Pressure Apparatus" *(Fig. 9)* illustrates the method and the required materials.

A sudden increase in the rate of settlement as the embankment is placed may indicate that the shear resistance of the soil has been exceeded and plastic flow of the foundation is occurring. Excessive pore pressures are a warning of the imminence of foundation movement or displacement. When high pressures are observed the rate of fill loading is slowed down or temporarily discontinued to permit consolidation of the foundation by the release of moisture through the vertical drains. When the pore pressure drops to a safe point the grading is resumed.

"Embankment and Settlement Records" of the results observed on two typical California highway projects are shown in *Figures 6 and 7*. On the Pacific Coast Highway project in Los Angeles County the subsidence of more than two feet occurred prior to the construction of the paving, with negligible settlement thereafter. On the south approach to San Luis Obispo Creek bridge in San Luis Obispo County, subsidence of up to 5½ feet was recorded during construction, with only very slight settlement after the pavement was constructed.

No serious slides or fill failures have occurred on any of the areas treated with vertical sand drains, and settlement records show that the consolidation has generally been greatly accelerated by the drains, demonstrating the effectiveness of this method of treatment where applicable.

Specifications

The job or contract specifications are drawn to permit complete control of the contractor's operations to insure that the drains are properly constructed and the rate of loading is so regulated as to avoid failure and produce the desired results.

Copy of that portion of the specifications relating to vertical sand drains on a recent project are included with this report *(Appendix A)*.

Table I is a list of all vertical sand drain projects constructed since 1934. The table includes statistics relating to depth, spacing and cost. The average cost of completed drain, including drilling or punching the hole and the sand backfill for five major projects constructed during 1946 and 1947 was slightly less than $1 per lineal foot. The unit cost, of course, has varied considerably, depending as it does on a number of factors such as number, spacing, and depth of drains, availability of backfill material, and the current cost of labor and materials.

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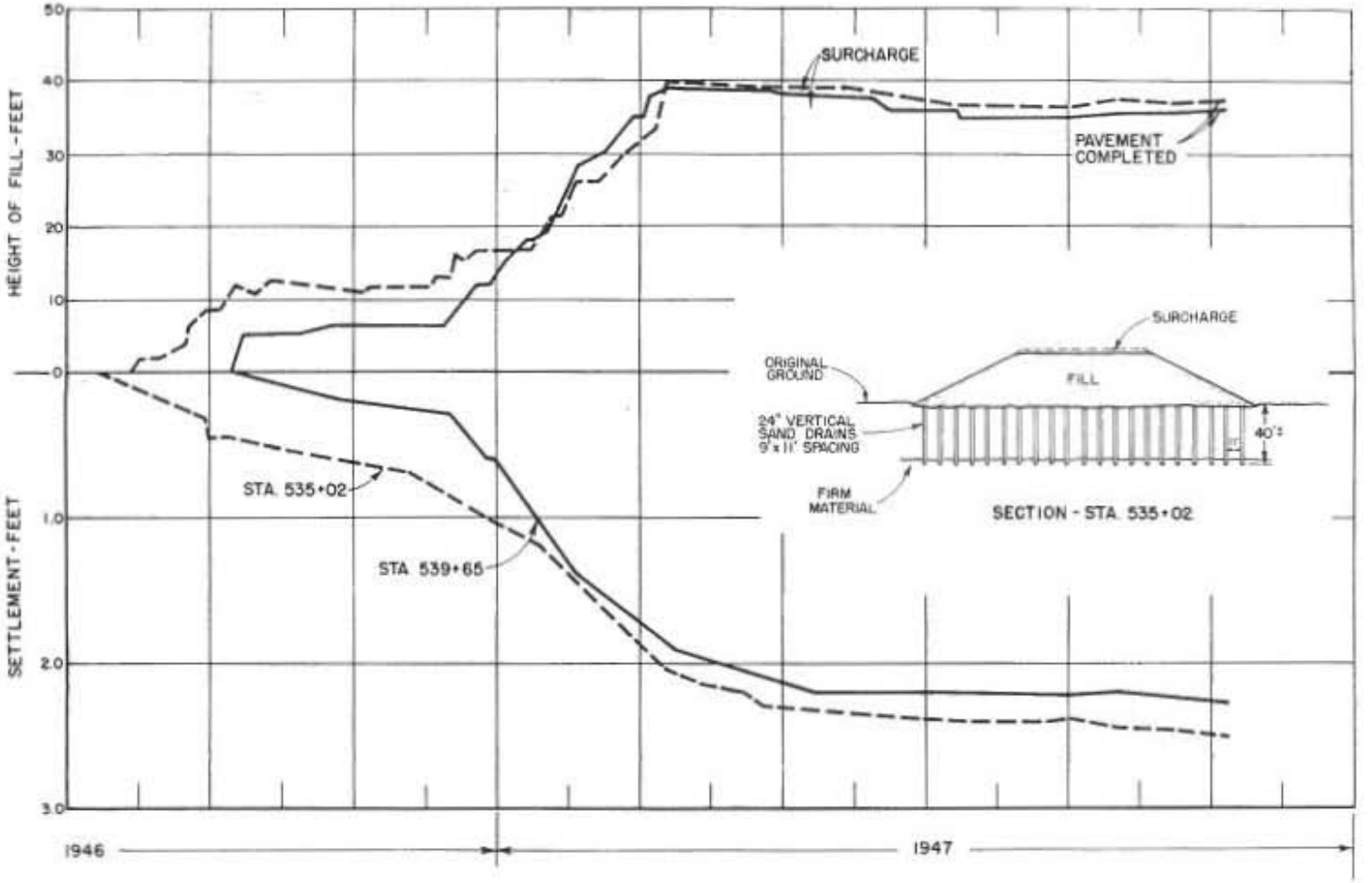


FIG. 7

EMBANKMENT & SETTLEMENT RECORD

PACIFIC COAST HIGHWAY
LOS ANGELES COUNTY

Unique Span

Alameda Creek Bridge in Niles Canyon Spectacular Improvement

By E. R. FOLEY, Associate Bridge Engineer, and G. D. GILBERT, Assistant Bridge Engineer

WITH THE completion of the $450,000 Alameda Creek Bridge and Overhead in January of this year, a structure of most modern design took its place in the California Highway System.

Alameda Creek winds through picturesque Niles Canyon, a narrow circuitous pass through the Livermore Hills. Inasmuch as Niles Canyon affords the only water level route between the Central Valleys and the Oakland-San Francisco Bay area, its narrow canyon walls are crowded by State Highway Route 107, the transcontinental line of the Western Pacific Railroad, the Niles Canyon branch of the Southern Pacific railroad and the Spring Valley Water Company aqueduct.

The new bridge, four miles east of Niles, presents an almost spectacular improvement in the alignment in this section, as it eliminates five sharp highway curves and a narrow wooden bridge posted for drastically restricted load limits. The new structure also crosses over Alameda Creek and the tracks of the Western Pacific Railroad.

Nearly 1,000 feet long, more than half of its length is on a 750-foot radius curve, necessitating an 11 percent superelevation of the deck. The entire structure is concrete box girder design with a portion of its length uniquely adapted to single pier construction. The portion of the structure over the railroad is about 500 feet long, made up of 60-foot spans of conventional box girder design on two column bents.

Owing to the high runoffs carrying considerable amounts of drift which occur in Alameda Creek, however, the high skew angle of the crossing would have resulted in a large number of columns falling in the creek bed. In order to cut down the interference with the creek flow, the single column design was adopted for the 682-foot spans in the creek crossing. This portion of the bridge was designed as a continuous structure, with single cell box girder and cantilever arms to support the 26-foot roadway.

The cylindrical pier shafts varying in height from 35 to 55 feet are battered 1:48, a fact which greatly increased the complexity of the concrete forms. The forms were carefully made of individually tapered sections which give the columns very pleasing form lines. A four-foot diameter hollow section was formed in the center of each column.

At its widest portion the box girder contains three cells, then after crossing

. . . Continued on page 40

This is the new $450,000 Alameda Creek Bridge and overhead four miles east of Niles in Alameda County

Ridge Road

Heavily Traveled Section of U. S. 99 Being Converted to Modern Highway

By C. P. MONTGOMERY, Senior Highway Engineer

RAPID progress is being made in converting the Ridge Road, U. S. 99, from Castaic to Frenchman's Flat, from a three-lane highway to a modern divided thoroughfare.

Hailed in the twenties as an "example" of bold engineering and highway construction, the original Ridge Road attracted such a volume of traffic that by the early thirties it had become entirely inadequate to carry the load.

At that time a more direct route on an improved gradient and alignment, was located, and constructed through the mountainous section between Castaic and Gorman Station, following roughly the course of Piru Creek.

The roadway was surfaced with a concrete pavement 30 feet wide and asphaltic shoulders of ample width to provide off-pavement parking.

The development in the Los Angeles area as well as a corresponding growth from Bakersfield north, has created a traffic load on this road which now makes the present road inadequate.

The problem confronting the Highway Department was not so much the improvement in grade and alignment, though some slight improvement has been made in both respects, but largely a matter of increasing the pavement width and providing a definite division of northbound and southbound traffic. This division of traffic is especially important where the lighter fast traffic is continually passing the slow moving trucks on long steep grades.

Eleven-mile Stretch

The work now in progress extends from the foot of the five-mile grade, just north of Castaic, 11 miles to Frenchman's Flat.

Aside from a few rather minor changes in alignment, the work consists of widening the existing roadbed to 78 feet providing two 12-foot paving lanes and a 9-foot paved shoulder on each side of a 6-foot dividing strip.

Due to lack of stability in the geologic formation of these mountains, precautions have been taken to protect high fill against a lateral movement by the construction of heavy buttress fills at their base.

Cut slopes are being built on a slope of 1½ horizontal to 1 vertical and at many critical points benches are excavated at the upper levels to relieve the weight.

Controlled traffic using Ridge Route while heavy grading is in progress

Two views of heavy excavation cut operations on new Ridge Route Highway

Channel changes, especially in the bed of Oso Creek between Whitaker Summit and Frenchman's Flat and others not so large constitute an important feature in the protection of fill slopes.

Existing drainage structures are being extended and where necessary, additional drainage provided.

As a protection against the absorption of moisture by the fill material from the original ground, due to capillary attraction, a blanket of river bed sand and gravel is being laid as base for the fills.

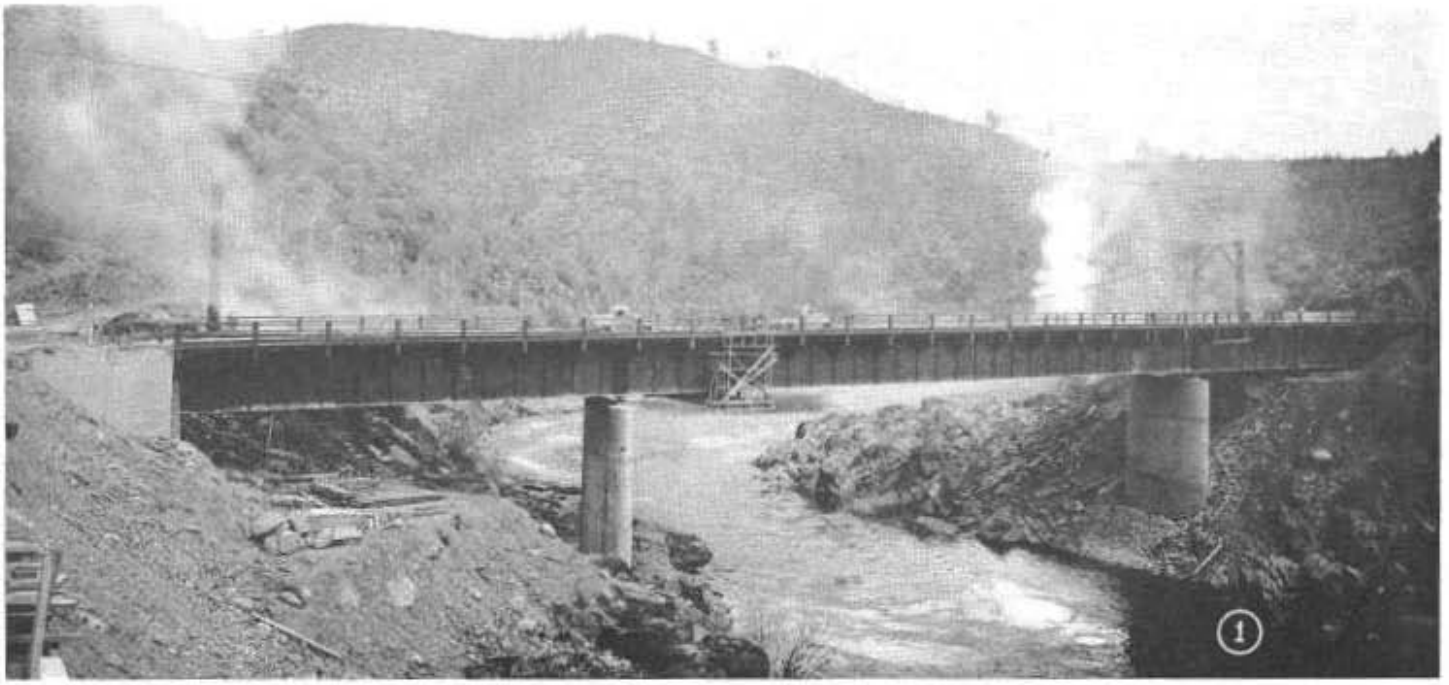
The contractors are employing modern excavation equipment consisting of power shovels and dump trucks for the longer hauls, turnopulls and carryalls for the shorter hauls. Embankments are compacted by spreading in uniform layers, watering

. . . Continued on page 21

New Bridge

Site of Pioneer Toll Span Now Occupied by Modern Structure

By H. D. STOVER, Senior Bridge Engineer



THE NEW bridge across the North Fork of the American River, *Photograph No. 1*, was opened to traffic February 14, 1948, at which time the old cable suspension bridge was barricaded.

This bridge will reflect general benefit to lumbering and mining interests in this vicinity that have heretofore been required to haul less than legal loads over the old cable bridge due to its light design and deteriorated condition.

The cable bridge of 322 foot span as shown in *Photograph No. 2* was constructed in 1930 by the State under contract with Smith Brothers at a total cost of $27,274.

Upon the completion of the cable bridge in 1930 the old wire cable bridge of 285 feet span shown in *Photograph No. 3* was dismantled. The latter bridge was known as the Lyons Bridge which was financed by private capital and operated as a toll bridge on the toll road from Auburn to Cave Valley. It was completed in July, 1866, forming an important outlet for the communities in northern El Dorado County to Auburn Station.

The rates of toll were as follows:

8 Animal team each way	$2.50
6 Animal team each way	1.75
4 Animal team each way	1.50
2 Animal team each way	1.25
1 Horse and cart each way	.75
Horseman each way	.50
Footman each way	.25
Loose stock per head each way	.10
Sheep and hogs each way	.05

. . . Continued on page 37

City Creek Road

Old Lumber Wagon Route Will Be Modern Highway

By WILLIS F. JONES, Assistant Highway Engineer

In San Bernardino County, as construction proceeds on the State's modern mountain highway into the San Bernardino Mountains, replacing the steep and winding City Creek Road, the contrast between the old and the new is being clearly shown. Out of the contrast in time, purpose and use comes the contrast in type, grade and alignment.

About 1892 the original City Creek Road was graded and used as a lumber wagon road by a logging and lumber company. This was before the establishment of the National Forest in the San Bernardino Mountains and there existed large private holdings of merchantable timber along the ridges and upper slopes of the mountains.

It was at Fredalba in this timbered belt, near the summit of the mountains, that a sawmill was erected to which the logs were hauled on a narrow gauge railroad with its small Shay-geared steam locomotives. Remains of the grade of this old railroad can still be seen.

Old Lumber Road

The lumber was hauled down on horse and mule drawn wagons to a box factory in the town of Highland, where it was milled into shooks or box parts. These shooks were bundled and distributed to the several citrus fruit packing houses throughout the well established Citrus Belt. It took a lumber wagon all day to make a round trip with four trips a week, allowing three days a week to rest the animals.

After the cessation of the logging and lumbering operations, the lumber road was taken over by the County of San Bernardino about 1917. The county reworked the entire road, reducing some of the hairpin turns; reducing the 18 or 20 percent grades to 10 or 12 percent; regrading to about a 22-foot roadbed; applying about 16 feet of oil surfacing and maintaining the road until 1937 when it was taken into the State's Secondary Highway System. A typical view of the present road is shown.

As far back as the days of the lumber wagon road, on which the public had to pay toll, the recreational features of the San Bernardino Mountains were being appreciated and enjoyed in spite of the long and arduous trip with horse and buggy. As the growth and population of Southern California increased, with the attendant increase in visitors and tourists so did the demands for increased facilities of access to a recreational area that is now one of the most

Typical view of grading operations on the Second Unit of the City Creek Road now under construction in San Bernardino County

On a precipitous rock slope above the bed of City Creek on the First Unit are these two bin-type retaining walls. The one on left is completed, the one on right under construction. Remains of old road appear above

patronized in the United States. In addition to the ever increasing population, now approximately 25,000 in towns, villages and camps, established over a distance of about 30 miles from the Crestline and Lake Arrowhead areas to the Big Bear Lake area, it is estimated by the Forest Service that 1,765,900 summer and winter visitors entered this area in 1947.

Modern Standards

The City Creek area offered the most feasible route into the mountains with which to alleviate the present traffic conditions now existing on the State's two-lane high gear highway via Waterman Canyon, on which the 1947 traffic count showed as high as 15,248 vehicles in a 24-hour period. This figure greatly exceeds the maximum capacity considered safe by nationally accepted standards.

The City Creek route is being constructed on the latest standards for a high gear mountain highway. When finished, it will extend from a connection with the State Highway on Highland Avenue at Boulder Avenue, near the town of Highland, to a connection with the State Highway at Running Springs located between Lake Arrowhead and Big Bear Lake. This new two-lane highway will have a 26-foot roadbed with three inches of plant-mixed surfacing, 22 feet of Class "C Fine" seal coat, plant-mixed surfaced gutters and shoulder dykes, all on a 6-inch selected material base; alignment with minimum radius curves of 300 feet and maximum grades of 7 percent. A special safety feature in the alignment design is the interspersing of tangents long enough to give a safe passing distance for the faster moving vehicles around the slower ones. Embankment slopes are being given protection against erosion and bin-type retaining walls are being installed.

Contracts Let in Units

Contracts for the work are being let in units. The first unit of 3.2 miles from Highland Avenue to the old City Creek Bridge is practically complete as shown in the accompanying pictures.

Construction on the second unit of 4.3 miles from the old City Creek Bridge to 0.7 mile east of Plunge Creek is well under way, as pictured herein under grading operations.

Bids on the contract for the third unit of 1.8 miles from the end of the second unit to "Long Point" have recently been received.

Being a "Limited Freeway," controlled points of access are being worked out in agreement with abutting property owners. Since practically the entire route lies within the boundaries of the San Bernardino National Forest, close cooperation is being maintained with the Forest Service under the con-

. . . Continued on page 33

View of present City Creek Road on the Second Unit, looking down toward "Dutch John's Flat." Its steep grades, sharp curves, and narrow roadway are now being replaced by a modern mountain highway

On valley floor among the orange groves. Looking East at beginning of the nearly completed First Unit. Channelized connections to Highland Avenue in foreground, leading toward San Bernardino and to Boulder Avenue at right, leading toward Redlands. New highway curving to left in background entering City Creek Canyon.

Geology

Its Relation to Highway Construction in California

By E. D. DREW, Assistant Geologist, Materials and Research Department

" * * and some rin up hill and down dale, knapping the chucky stanes to pieces wi' hammers, like sae mony road-makers run daft—they say it is to see how the warld was made!"—Sir Walter Scott, "St. Ronan's Well."*

THE CALIFORNIA Division of Highways has long realized the use and utilized the application of geologic interpretation to many of its construction problems. To show how the application of geology with its related sciences of geo-physics, soil mechanics, and materials of construction have been of economic value in highway construction, the following geologic problems from different sections of the State are described from a nontechnical viewpoint.

Lookout Point Cut

Lookout Point, located on U. S. 101 about 40 miles north of Eureka, at the crest of steep grades coming from the north and south, is a popular stopping place for tourists and truckers.

It is proposed to realign this portion of the highway at a lower elevation around the face of the point to eliminate the present steep grades and tortuous curves. Question as to the stability of underlying formations called for a geologic investigation.

Geologically the "Point" is composed of old sediments of Pre-Cambrian Age which have been subject to such intense deformation that their original characteristics are entirely changed. This change or metamorphism has resulted in the production of a very unstable rock called graphite schist. Although at the present time the material at the point apparently stands on a slope of 1:1 and steeper, its stability if thousands of yards of material were removed in the course of construction was questionable. Careful geologic measurements along with power borings showed that the schist did not improve with depth and the existence of ground water further complicated the problem. However, it was found that there was an apparent dip to the northeast which was favorable for construction. A conservative design was recommended for the cut, with suitable drains to take care of subsurface water.

Camp Lowe to Bailey Hill

One of the most interesting areas from a geologic standpoint is in the Cottonwood Valley, Siskiyou County. Here are exposed in a comparatively undisturbed condition, Mesozoic sediments of Upper Cretaceous Age. The sediments occupy a belt approximately two miles in width and ten miles long. Deposition of the sediments in a relatively shallow arm or strait of the Cretaceous sea is implied from the thickness and present attitude of the beds. The sediments are composed mainly of shale with sandstones and conglomerates. That the old Klamath Mt. Island contributed and was a source for part of the Cretaceous beds there can be no doubt. The existence of a basal conglomerate composed of meta-andesite or greenstone pebbles which are easily traced in the deeper canyons to the west clearly mark the old Cretaceous shore line.

Structurally, the sediments are tilted to the east in a rather steep dipping monocline (20 degrees to 35 degrees). The strike is to the northwest varying from 25 degrees to 50 degrees and except for local variations the beds can be followed continuously from south to north. Abundant fossils are found along the proposed alignment and it is probable that in many of the cuts further evidence of marine life will be uncovered. At several places along the alignment the shales have been intruded by igneous sills which have forced their way up along the bedding planes. The shales for distances of 6 inches or more on either side of the sills show evidence of the heat which accompanied the intrusions.

A geologic survey was needed in this area to determine the proportional amounts of shale, sandstone and igneous rocks that would be encountered in the cuts and to ascertain the attitude of the sediments in relation to the direction of the roadway. After a thorough study of the structural conditions, it was found that with very little modification of design the cuts would pass through the sediments at a favorable angle to the apparent dip.

Cuesta Grade

Many motorists will remember the crooked and steep road known as the Cuesta Grade which wound up out of San Luis Obispo through School House Canyon and over the pass to Santa Margarita. This canyon, now traversed by a four-lane road with large radius curves and moderate grades is still called the Cuesta Grade.

The scope of the investigation and the interlocking of the methods used in studying this particular project illustrate how the integration of engineering, geology, geo-physics and soil mechanics was utilized.

Cuesta Grade traverses an area of very complex structure. The area is underlain by Miocene sediments which have been faulted and are in contact with ultra-basic rocks on the west and older sediments on the east.

The accurate interpretation of geologic structure by the usual surface methods was not possible, as the hills through which the alignment passed were covered with a deep mantle of alluvium and landslide debris.

Hand Power Borings

When outcrops are scarce and the area is covered with deep alluvial deposits, or landslide conditions are present, it is then desirable that geo-physical or subsurface explorations be made by means of bore holes and seismic methods.

. . . Continued on page 34

Preformed Material

Its Use in Weakened Plane Transverse Joint Approved

THE USE of preformed material remaining in place in the weakened plane transverse joint in Portland cement concrete pavement has met with considerable favor among contractors, as well as the Division of Highways. In order to promote uniformity in the placement of such material, a pictorial record was obtained of the method in use on Contract 10WC14, Solano-90-A, where a preformed mastic material was being used. This method will work equally as well for metal and wood joint fillers.

The contractor on this project was equipped with a two-axle flatbed that rides on the side forms, and he trails this behind the second finishing machine to carry the joint material and the installing tools. This can be handled just as well from a platform built on the back of the finisher.

The installing tool is a sheet metal backing plate with one side the full depth of the preformed strip and the other side extending down three-fourths of an inch along the opposite side of the strip. The upper one inch of the installing device is a stiffener plate to give rigidity. On each end is a bolt threaded through a bracket fastened to the end of the installing device. At the bottom of the bolt is a disc shoe that rides on the side form and gauges the depth to which the installing device can be submerged in the concrete. This disc is set so that the top of the preformed strip is one-fourth inch below the side forms.

The ordinary T-iron cutter that is generally used with the steel forming strips was being used to form the groove in the fresh concrete. It is essential that the depth of the cutter be at least the full depth of the preformed strip.

Immediately following the forming of the groove, the installing device is laid flat on the pavement with the open side up and with the edge of the preformed strip directly over the groove in the surface. The device is then revolved to a vertical position about the lower edge of the strip and lowered vertically into place until the disc at each end comes in contact with the side form. This method of handling prevents mortar from separating the preformed filler from steel backing plate and insures a vertical placement.

As soon as the device is in its proper position, the metal holder is removed by raising vertically. The man at each end of the installing device presses down on the end of the preformed filler as they lift the metal installing device. The resulting open groove is floated full of mortar prior to the first pass of the Johnson Drag Finisher by cutting from the ridge of concrete thrown up by the T-iron.

Immediately following the last pass of the Johnson Drag Finisher, the end of the joint strip adjacent to the next lane to be poured is opened up with a trowel to facilitate matching up the joint installation on the next lane. This opening up of the joint ends, edging both sides of the pavement, and floating the groove over the joint filler is all performed by one finisher. No other finishers are necessary.

On the day these operations were observed, 727 cubic yards of concrete were placed in an eight-hour day. The maximum air temperature was 98 degrees. The mix consisted of 37 percent of 2½-inch rock, 21 percent of 1½-inch rock, 4 percent of ¾-inch rock, and 38 percent of sand with 55.7 pounds of free moisture per sack of cement in a Class "B" mix of 5 sacks per cubic yard. In the combined aggregate 65 percent passes 1½-inch, 42 percent passes ¾-inch, 37 percent passes No. 4, 14 percent passes No. 30, and 2 percent passes No. 100.

It Was a Pleasure

STANFORD UNIVERSITY
SCHOOL OF ENGINEERING
Stanford, California

Mr. George Thompson
Resident Engineer, Bridge Department
California Division of Highways
Bayshore Highway and Grand Avenue
South San Francisco, California

Dear Mr. Thompson: Please accept my thanks for your kindness in taking my class in highways, 60 students in all, over the bridge projects now under construction on the Bayshore Freeway. The men learned a great deal about both design and construction by visiting your job.

Please extend my thanks also to Messrs. Moore, Colly, and Samovich, and others on your staff for their courtesy. The explanations which these men and you gave of the engineering and construction problems were very helpful in making the jobs actually come to life.

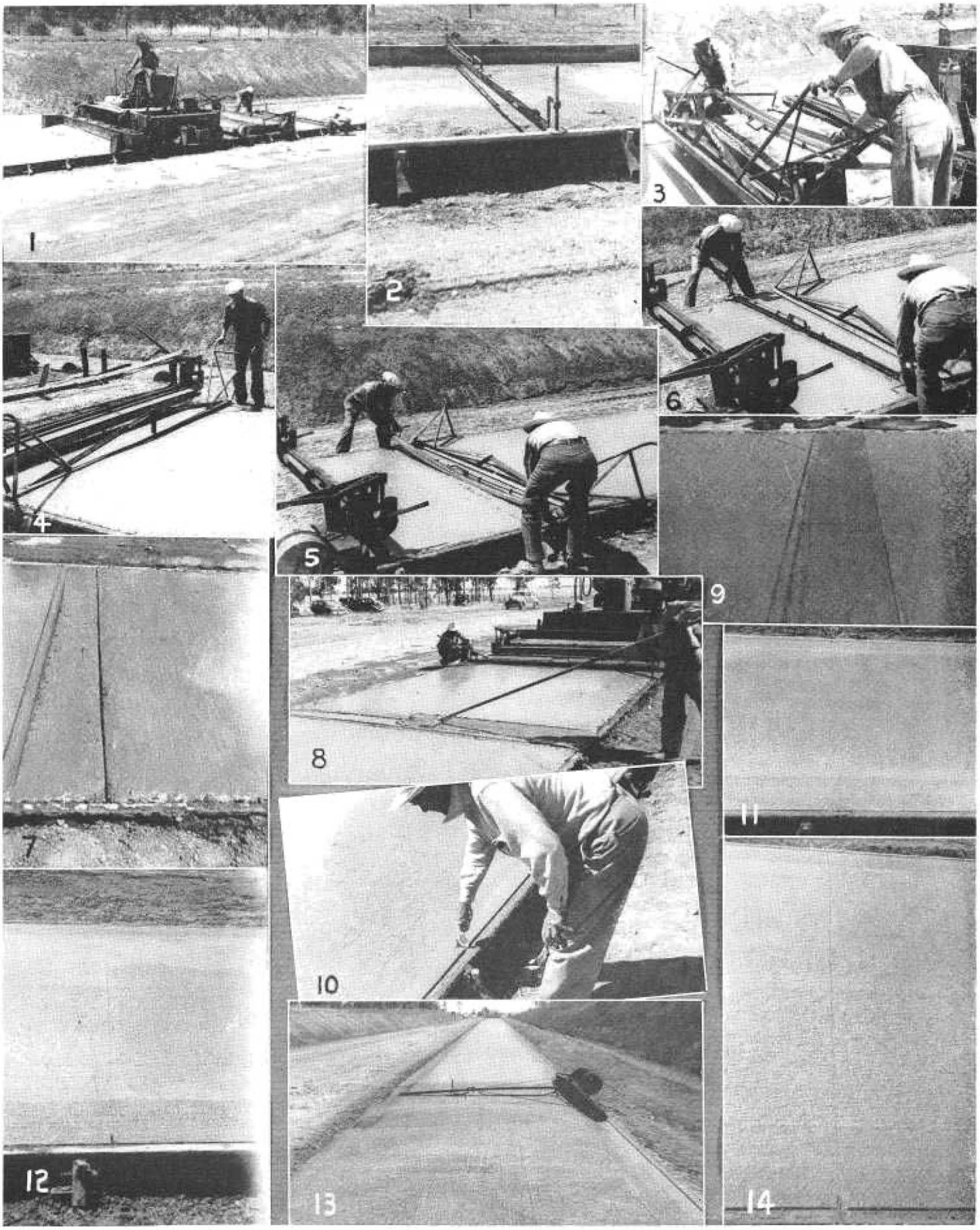
Very truly yours,
C. H. OGLESBY
Assistant Professor

Alaska Highway Now Is Open to Travel

All travel restrictions on the Alaska Highway have been abolished and motorists may now drive the 1,500-mile route from Dawson Creek, British Columbia, to Fairbanks, Alaska, without permits or other restrictions previously imposed by the Canadian Government.

An increase in accommodations, supply points and repair facilities along the highway caused the lifting of restrictions at this time.

1. Finisher trailing two-axle flatbed. 2. Installing tool. 3. Inserting preformed strip in installing device. 4. Forming groove with T iron cutter. 5. Placing the installing device flat on the pavement. 6. Lowering the installing device into place. 7. Appearance of joint after removal of installing device. 8. Finisher floating the open groove full of mortar. 9. Floated joint ready for first pass of Johnson Drag Finisher. 10. Opening up end of joint strip. 11. Start of joint crack two hours after pouring. 12. Full crack appearing in 2½ hours after pouring. 13. Cut float operation. 14. Completed joint after operation of cut-float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New Devices

For Surfacing Side Ditches and Back Slopes and Building Shoulder Dykes

VERY effective attachments were developed by N. M. Ball Sons, contractor, at the suggestion of A. L. Lamb, Resident Engineer, for the paving of shoulder dykes, side ditches and back slopes on a recent highway project on U. S. 101 in Santa Barbara County.

The attachments are of welded construction and are fabricated with sufficient taper to consolidate the plant-mixed surfacing as it is forced under them. Each attachment has a vertical and horizontal half-hinge permitting it to be rapidly fastened in place and to be adjusted to a level position where the slope of the shoulder changes due to superelevation. The other half-hinge is attached to a special plate that replaces the regular side plate on the finisher. The special plate leaves sufficient opening at the end of the worm

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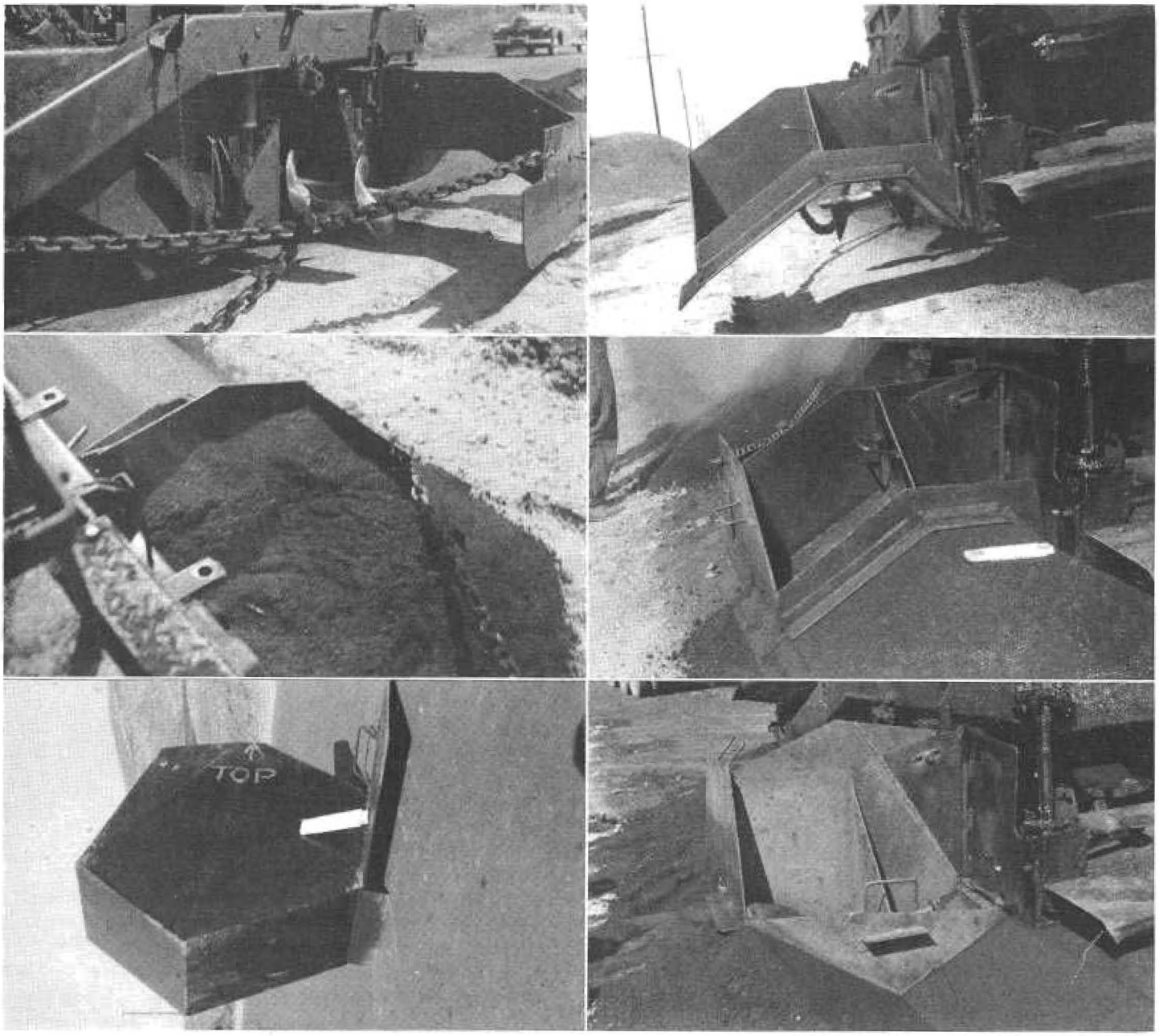
In sequence from upper left to lower right—Shoulder dyke shaper. Forward view unloaded; rear view unloaded; forward view operating; rear view operating. Side ditch and back slope shaper, dismantled; shaper in operation



Heavy grading on five-mile grade north of Castaic

Ridge Road

Continued from page 12 . . .

with tank trucks and rolling with sheeps foot tampers. All embankment is constructed to the required 90 percent relative compaction, as determined by tests of laboratory assistants, constantly on the work.

A outstanding feature of this work is the fact that no detours are available and traffic has to be maintained through the work at all times. This means that in the 11 miles now under construction, over 3,000,000 cubic yards of material has to be moved over, or across the roadway along with the normal heavy flow of traffic.

This is being accomplished only through the very careful planning of the contractors and the engineers in charge.

In many cases the contractor has to sacrifice efficiency and economy of operation to the convenience and protection of the traveling public.

Flagmen direct the movement of contractor's equipment and traffic, wherever any danger of conflict exists.

The present pavement to a width sufficient for two lanes of traffic is held open as long as possible. All freshly graded road bed is given, at least, a temporary surfacing before being used by traffic.

The full width of the embankment is covered with six inches of pervious material, to prevent the impounding of any water, by providing a drainage plane under the subgrade.

Over the pervious material is laid and compacted a course of imported borrow to a minimum depth of eight inches. This material is crushed rock and binder with a high stability.

The subgrade, six inches in depth, also extending the full width of the roadway is classified as untreated rock base. This material is the product of the rock crusher and provides a base of extremely high bearing value.

The paving consists of four inches of asphaltic surfacing extending from gutter line to gutter line with raised bars indicating the six-foot division strip, separating the north bound and south bound traffic.

Pervious material for the southern section is obtained from the bed of Castaic Creek near Castaic, and for the northerly contracts from Piru Creek at Frenchman's Flat.

Imported borrow and untreated rock base for the southerly contract was produced at a crushing and screening plant located approximately half a mile south of the southerly end of the contract. This type of material for the two northerly contracts is being crushed at plant located near Frenchman's Flat.

Aggregates for the asphaltic surfacing will all be produced at the rock plant at the southerly contract.

The southerly contract, two and six-tenths miles in length, was awarded to the Clyde Wood Construction Company of Los Angeles. Work started March 13, 1947, and completion is expected about June 1, 1948.

The northerly section from Whitaker Summit to Frenchman's Flat, length 3.8 miles, is under contract to Winston Bros., Los Angeles. Work started June 16, 1947, and completion is expected September 1, 1948.

Winston Bros. are also the contractors on the middle section from the five-mile grade to Whitaker Summit, length 4.4 miles. Grading operations have just started and completion date is set at May 23, 1949.

The two contracts from Castaic to Whitaker are under the supervision of Resident Engineer Ray M. Cooley and Fred A. Read is Resident Engineer on the contract from Whitaker Summit to Frenchman's Flat.

With the exception of a comparatively short section through the Piru Gorge this work now under way is through the most rugged section of the entire Ridge Route. Future improvement will require less heavy grading, fewer cuts, and consequently less interference with traffic.

Concrete Arch

Attractive New Bridge Near San Bernardino Is Completed

By JOHN H. HORN, Associate Bridge Engineer

A CONCRETE arch bridge, distinctive in its appearance and pleasing in its harmony with the surrounding landscape, has just been completed in the rugged hills east of San Bernardino. This arch will provide a link in the new City Creek Road, which connects with the Rim-of-the-World Drive about midway between the Lake Arrowhead and Big Bear Lakes vacation resorts. This new road will provide a tremendous improvement in a series of old, narrow winding roads which have existed in the City Creek Canyon since the first logging road was built there in 1891. From 1892 until the county purchased the road in 1914, it was operated as a toll road for travelers going from the San Bernardino Valley to the mountains.

The bridge itself is the third structure to span City Creek through this same location within the past 50 years. The earliest structure consisted of a short steel truss with timber trestle approach spans. This was followed by a high steel deck truss which, with its height of 95 feet above the streambed, was distinctive as being the highest bridge in San Bernardino County. The graceful, concrete arch springing from an abrupt bluff on one side to land on a narrow hogback between two forks of City Creek now replaces the steel bridge and exceeds its height, with a new elevation of 125 feet above the streambed.

The new structure is 430 feet long with a 160-foot central arch span. The roadway width is 26 feet between curbs. All of the main footings are founded on solid granite rock. The structure is slender and graceful and the setting in the rugged brushy canyon serves to emphasize its pleasing lines.

Owing to the steep rocky canyon walls and the great height of the bridge above the streambed, the engineering work of laying out and constructing the arch rib presented a major problem. In order to assure accurate location of the columns and the control points on the arch rib, all of the layout work was done by means of intersecting transit lines rather than by tape measurements. A base line was established along the side of the canyon parallel to the bridge centerline and all of the points for the bents and on the arch ribs were intersected from this line. By this method of intersecting lines it was possible to construct the arch rib and the spandrel columns with an exceptional degree of accuracy.

Recently completed arch bridge, which will provide a link in the new City Creek Road near San Bernardino

Another interesting point in the construction was the laying out of the full scale template on which the forms for the ribs were built. In addition to laying out the curvature of the side forms of the arch ribs, the exact locations of the falsework stringers caps and the curved soffit segment were laid out on this template. All the timbers were then cut to fit very closely. The concrete for the structure was mixed on the bank and was wheeled out over the falsework in buggies. The falsework for the deck structure was supported on steel beams inserted through openings which were left in the top of the spandrel columns. These openings in the columns were filled upon completion of the work. As a result of good workmanship and materials, an excellent appearance was obtained on all portions of the structure.

As this arch is placed in service, it joins the ranks of one of the better looking bridges in the State Highway System. The bridge was designed by the Bridge Department in cooperation with District VIII and the Division of Highways. Denni Investment Corporation of Wilmington were the contractors, and Wayne H. Crawford was the resident engineer on the project. The author was the Bridge Department representative.

Freeway Projects

Their Known Effect on the Value Of Adjacent Land in California

This is the third installment of a paper read by Frank C. Balfour, Chief Right of Way Agent, California Division of Highways, before the Right of Way Committee of the American Association of State Highway Officials at the thirty-third annual meeting of the Association in New York City.

Referring to Exhibit B, in the acquisition of right of way for limited freeways, we often find a combination of service station, restaurant and garage, sometimes also a motel, at a location where it would not be economically sound to attempt to wipe out the business for the purpose of eliminating the access openings, for we must give some consideration to the service and convenience of the traveling public. Here again the conversion of the present highway into a limited freeway will undoubtedly necessitate the acquisition of additional right of way and the relocation of buildings.

We have accordingly recommended to several companies in California which operate chain service stations, that they work out a new design under which there will be a circular drive into the property from one 30-foot opening with the pump islands installed on the opposite side of the service station building from the limited freeway. The glass-lined walls of the service station building will permit full view of the pumps and other service facilities—the garage and the restaurant to be located on the outside of the circular drive on the opposite side of the service station building from the highway. This type of development may at first seem fantastic to you, but we actually have several of this style of service station being planned in California at the present time and frankly, I believe that this is the answer to roadside business development along limited freeways. This design also represents the maximum in safety and convenience to the driver.

Roadside Service Stations

Also shown on this sketch is our opinion of another convenient and safe location for roadside service stations and other types of drive-in business establishments along limited freeways. In this plan the roadside business fronts on the intersecting county road with the nearest access opening located a minimum distance of 50 feet beyond the intersection of the right of way line of the county road and the limited freeway, with access rights being acquired along the county road from the freeway right of way line to the point where the opening for vehicular access is permitted.

A typical example of roadside business development on a county road immediately adjacent to a limited freeway, is shown in *photograph 13*.

On Exhibit C we show a basic method of subdivision development along a limited freeway without the necessity of any access openings to the through lanes of traffic except at intersecting cross roads. In one case the subdivider fronts his first tier of lots on the outer highway identified as First Street. This tier of lots can be developed for either residential or business use. On the west side of the limited freeway, we show the first tier of lots backing up to the limited freeway and fronting on A Street. The comparison of the two types of subdivision introduces an ap-

Fruit and vegetable Drive-in west of Fairfield, Solano County, on U. S. 40

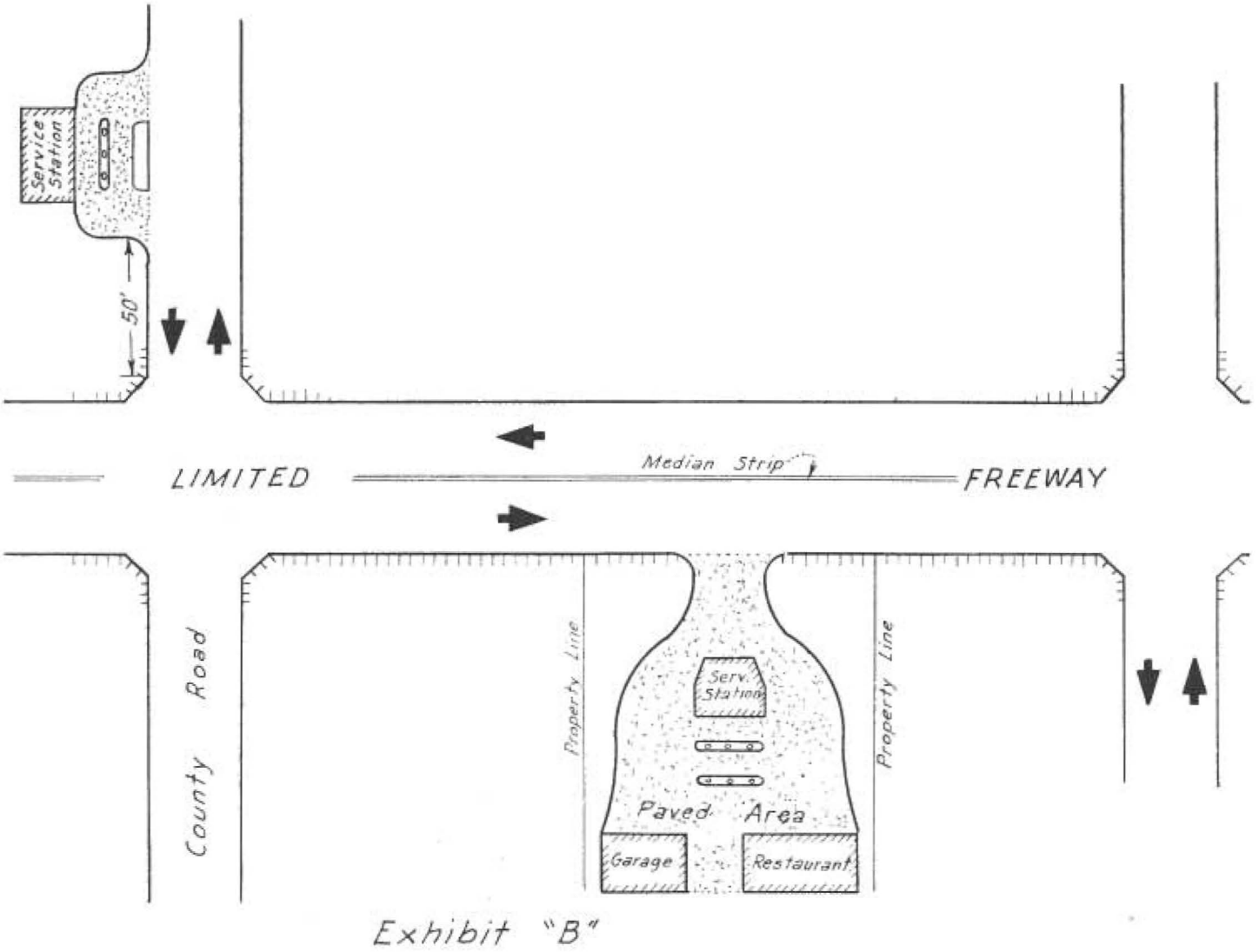


Exhibit "B"

praisal factor that should receive the careful consideration of appraisers when considering value of access rights; namely, if the subdivider constructs an outer highway and develops the first tier of lots for business, he will probably secure a considerably higher price for Lots 1, 2, and 3 for business use, than would be the case on the opposite side of the limited freeway for Lots 101, 102, and 103 for residential use.

Market Values

However, the business use of Lots 1-3 will materially reduce the desirability of Lots 21-23 for residential use because of the fact that these residential lots back up to business property and the usual mess found in the rear yard of any rural store, and there will be some reflection in a lower market value of Lots 41-43 because of this fact; while on the opposite side of the limited freeway the undesirability of the second and third tier of lots will not exist. It is therefore obvious that there exists some disadvantage and definite depreciation that will accrue to the second and third tier of lots in the one subdivision.

The following factual information is given to support my opinion that in most cases the taking of access rights for a limited freeway represents only a nominal damage to the property that suffers the taking.

About 26 miles east of Los Angeles on U. S. Route 99 the State has acquired all the access rights from a subdivision located in Rolling Hills lying between Covina and Pomona; and although there are over a hundred rural estate type lots in this subdivision, there is only one opening into the through lanes of traffic on each side of the highway and when the subdivision development is completed and freeway construction finished, these openings will be closed and access from the freeway to the subdivision roads will be at another location where grade separations and entrance and exit facilities are provided as a part of the freeway construction program.

Record of Twenty Sales

The record of some twenty sales already consummated in this subdivision, a number of which lots abut upon the highway, indicates that the restriction of access has had no effect whatsoever on market value. It is also interesting to note that the subdivision salesmen are using the freeway and the access restrictions as a strong selling point when contacting prospective purchasers. The salesman points to the fact that the separation of the through traffic lanes from

the normal means of access to subdivision streets, will eliminate the major portion of the ordinary annoyance and danger created by sightseeing traffic and the usual type of travelers seeking short cuts from one point to another and that elimination of this type of unnecessary traffic almost entirely from the tract streets, represents the maximum of safety for their children.

About two miles west of this property in the City of West Covina on the same freeway project our Legal Department tried a very bitterly contested condemnation case where an orange grove with some 2,000 feet of frontage presently fronts on the existing state highway. The property owner's contention was that he was losing the value of his potential roadside business frontage because we were taking 90 feet of his property and putting him on an outer highway. However, the verdict of the jury allowed him a nominal severance damage to the remainder of his property because of the taking, no severance damage because of the taking of access rights, and very substantial benefits to his property for ultimate subdivision purposes because of the manner of the proposed improvement.

Extensive Study

About four miles west and also on U. S. Route 99 (the Ramona Freeway) and in an already created subdivision, the first tier of lots abutting upon the existing state highway had been laid out with a depth of 200 feet, anticipating our taking of 90 feet. Here the property owner in the trial of the case contended that we were ruining the value of his business frontage because his business lots were being put on an outer highway. However, the verdict of the jury was identical to that in the preceding case.

We have had an opportunity to review and study some two hundred sales that have taken place along limited freeways, in 14 different counties in California extending from Imperial Valley in the vicinity of El Centro to points in the northerly part of the State.

Typical examples are: With 2,000 feet of frontage an owner will perhaps be allowed two 30-foot openings, or the owner with 600 feet of frontage who would otherwise be landlocked is allowed one 30-foot opening; or perhaps an owner with 3,600 feet of frontage devoted to orchard operations would be allowed one or perhaps two

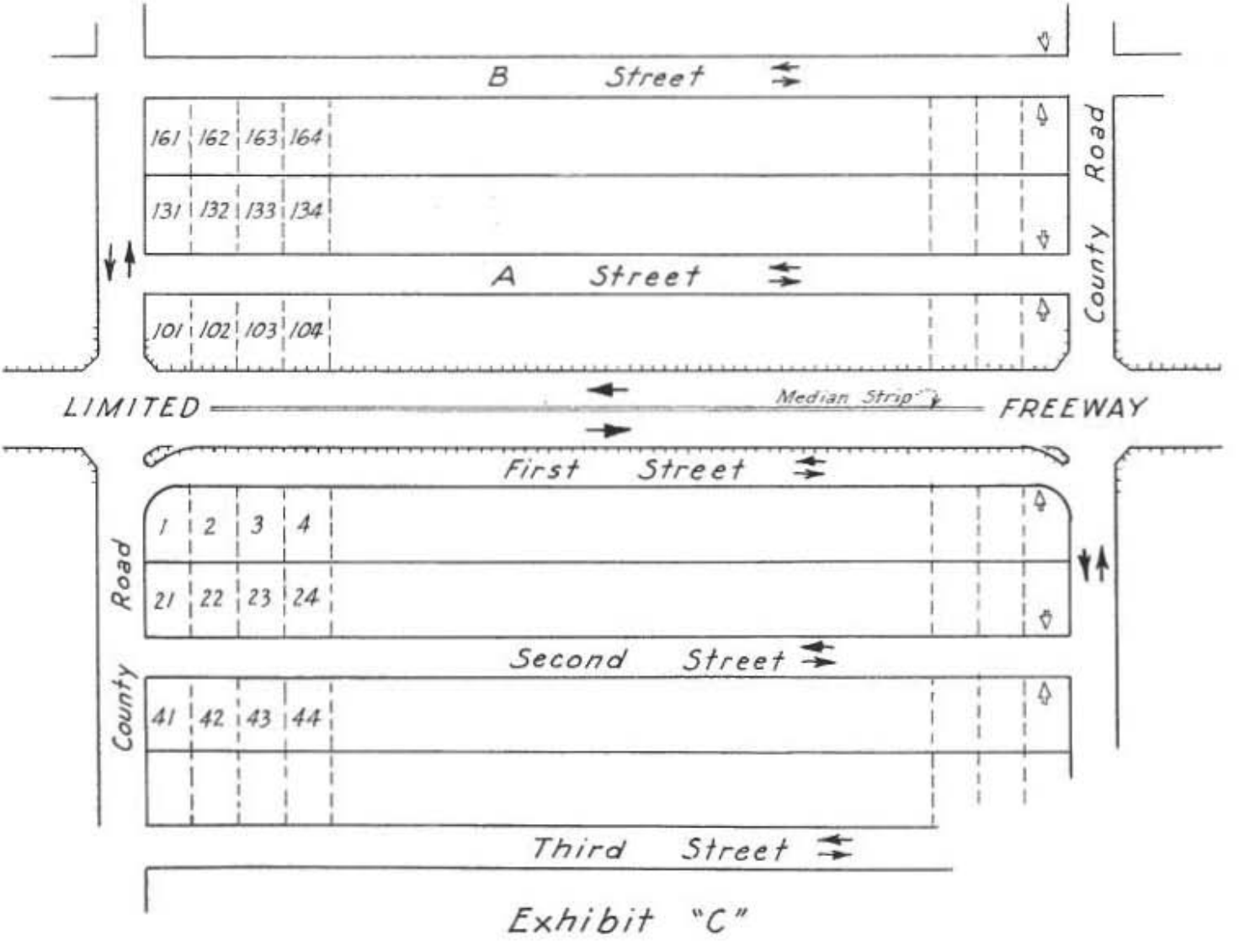


Exhibit "C"

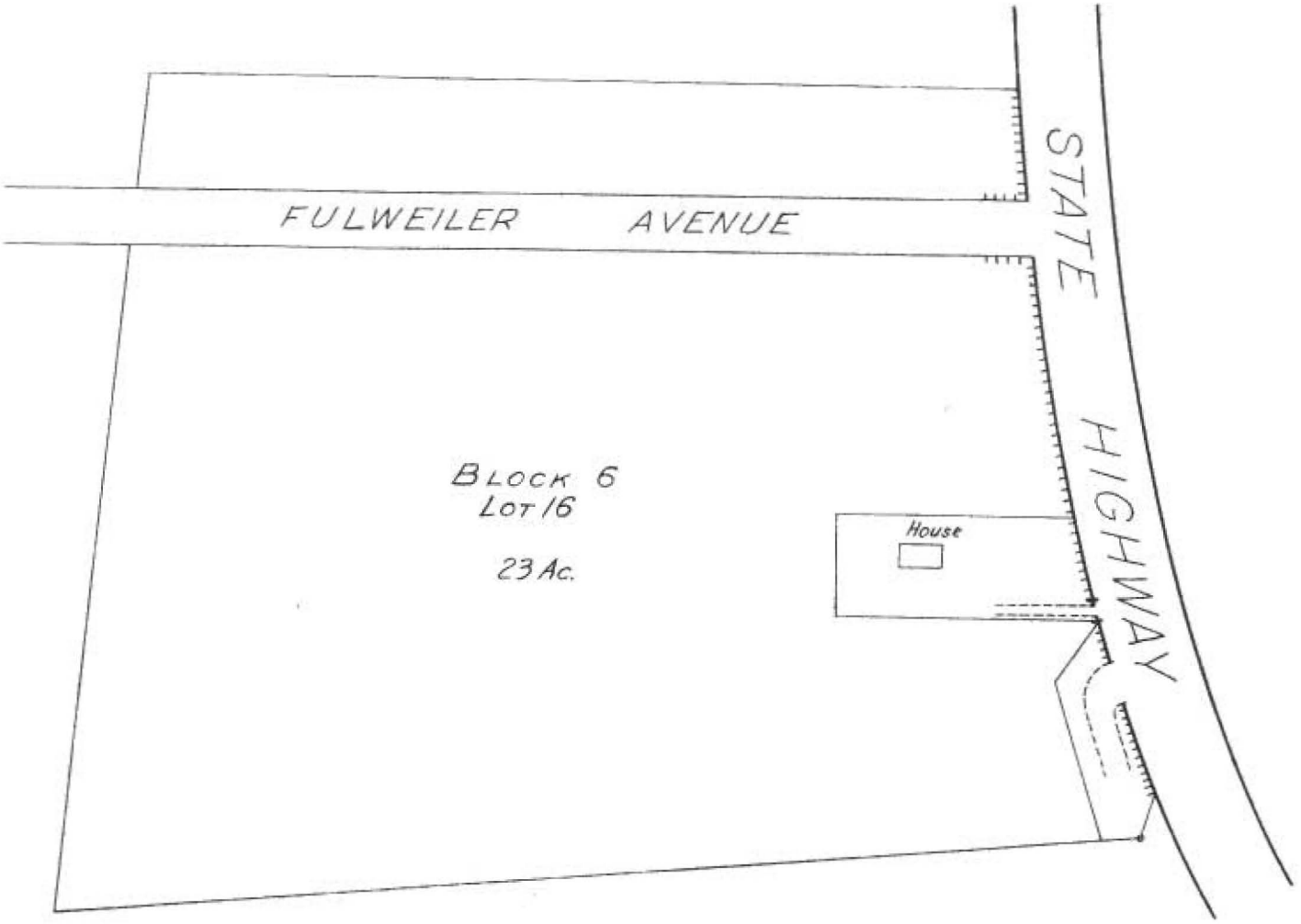


EXHIBIT "D"

III-Pla-37-Aub
U.S. 40 in Auburn

30-foot openings into the orchard and one 20-foot opening to accommodate the driveway into his residence and farm buildings.

In nearly every case we have studied to date, when all or a portion of the property has been sold, we find that the sales indicate a market value comparable in every way to the sale of comparable highway frontage sold where the access has not been taken.

Typical Cases

A typical example is on Route 99 just north of the City of El Centro where we condemned a widening strip and the access rights, permitting the owner to retain, because of the topography of the land, three 30-foot openings along the 2,640 feet of frontage. Our appraisal of the fair market value of the land at the time of acquisition was $500 per acre. We made a nominal offer of $50 for access rights which the owner refused. We ended up in a condemnation trial. However, at the time of trial our attorney placed the owner on the stand and made him admit that he had sold five acres with one 30-foot opening, for $1,500 per acre. Obviously, the case blew up and the defendant received a nominal award from the court.

A few other typical cases in Imperial County are the sale of 4.1 acres with 600 feet of frontage and one 30-foot opening. We settled our transaction after agreeing that the value of the property was $1,200 per acre; however, shortly thereafter the property was sold for $1,830 per acre and we settled on the basis of $400 per acre on a parcel with 160 feet of frontage and one 20-foot opening. The property was again sold within three months for $1,500 an acre on 240 acres with 2,640 feet of frontage and three 30-foot openings allowed, we settled on the basis of $175 per acre and the entire parcel less the portion we had taken for the widening, was sold six months later for $300 per acre.

Direct Effect on Values

So that we may all better understand the effect of the taking of access for limited freeways, I submit for your consideration and study a number of typical examples in the northern part of the State of California.

Please refer to the sketch, Exhibit D, where we have a parcel with 1,540 feet of frontage along the state highway, containing 23 acres, with the portion of the property fronting on the highway blocked out for a home place. Along

the upper right-hand corner of the property, because of the topography the adjoining owners to the right of the subject property had a private easement for ingress and egress. All access was taken along the state highway, including the taking of access for a distance of 100 feet back along both sides of Fulweiler Avenue. A 20-foot opening was left for ingress and egress to the driveway at the home, and a 30-foot opening was left for the private easement for the adjoining owners. The access rights including a 60-foot widening strip, were acquired January 16, 1945, at which time an appraised value of $10,350 was placed on the entire parcel. In checking back we found that the entire parcel sold on October 8, 1946, for $22,500. It would, therefore, be obvious that the value of the new limited freeway improvement far offsets any damage because of the taking of access rights, even though we concede that there was perhaps an over-all increase in the value of this and comparable properties in the vicinity of Auburn on U. S. Route 40, of 20 to 25 percent between the time we acquired the right of way and the time the sale took place.

Unusual Situation

Upon reference to Exhibit E, on U. S. Highway 101 north of Salinas, we find a rather unusual situation where the owner is subdividing his 141.75 acre parcel along his private roadway extending at right angles from the state highway right of way line. The State acquired the access rights and a 60-foot widening strip, leaving the owner a 30-foot opening for ingress and egress. The improvement, as is the case on all limited freeways, is a four-lane divided highway. At the time of acquisition of the right of way and access rights on August 20, 1945, the appraised value of Parcel A as a part of the whole was $200. On May 4, 1946, Parcel A sold for $500. Parcel B as a part of the whole at the time of our acquisition also had an appraised value of $200, but on September 14, 1945, this parcel sold for $500. At the time of acquisition, on Parcel C the appraised value was $450. However, on January 20, 1947, Parcel C sold for $1,500.

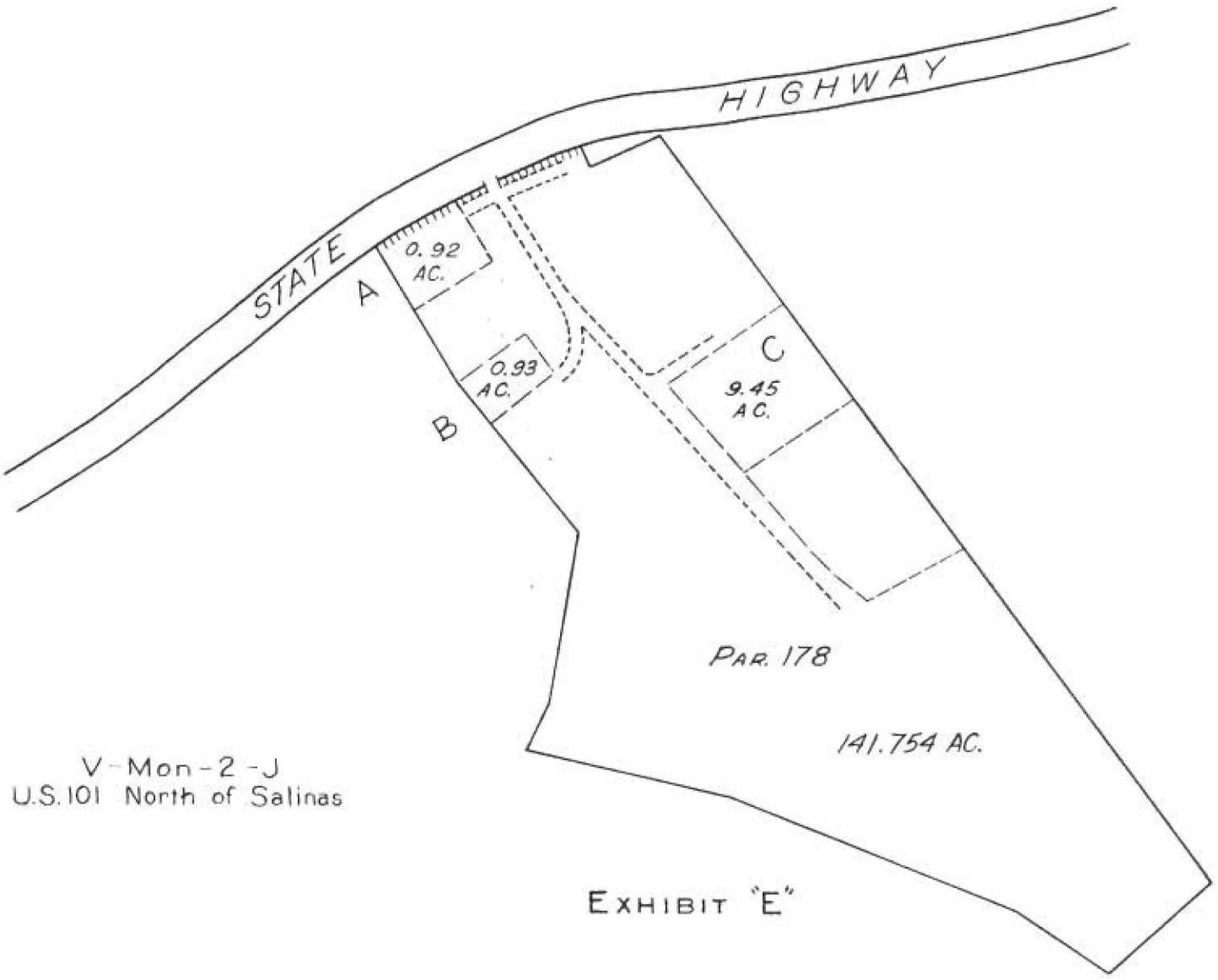


EXHIBIT "E"

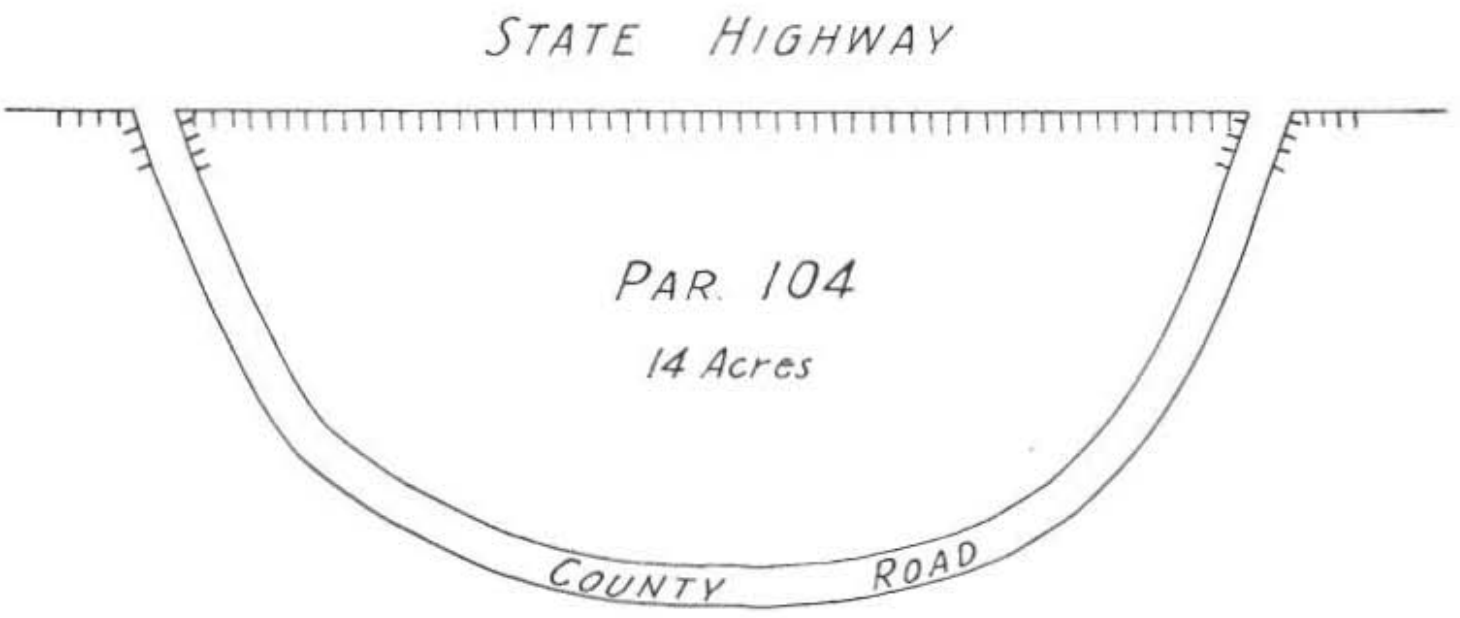


EXHIBIT "F"

V-Mon-2-J
U.S.101 North of Salinas

Values Increase

Upon reference to Exhibit E, in which case all access along the state highway was taken from Parcel 104 containing 14 acres, including the access rights along the county road for 100 feet back from the state highway right of way line. This parcel contains 2,250 feet of frontage and it is obvious that we acquire 2,250 feet of access rights at the time of our acquisition including the land for widening. On October 17, 1944, we placed an appraised value on the parcel, of $1,400. On November 8, 1945, the parcel sold for $3,000. It is our opinion that in the interval between our acquisition and the sale, comparable properties had increased from 30 to 35 percent in this section.

Upon reference to Exhibit G, you find Parcel 145 containing five acres. The State acquired a 60-foot widening strip and all access rights along the 810 feet of frontage, plus the access rights 100 feet back along the county road from the state highway right of way line. At the time of our right of way acquisition on September 25, 1945, the fair market value of the entire parcel was $3,000. However, on August 21, 1946, the entire parcel sold for $5,000. During this interval the market value of comparable properties in the same community in our opinion increased 30 to 35 percent. It is therefore rather difficult to say that the taking of the access rights depreciated the value of this parcel in any way.

Big Jump in Price

Please refer to Exhibit H where we have a parcel fronting on the state highway and extending in both directions from the intersecting county road, on which we acquired the access rights along the entire 2,026 feet of frontage including the taking of the access rights back a distance of 100 feet along the county road from the state highway right of way. At the time we completed negotiations for the acquisition of the widening strip and the taking of access rights on April 17, 1946, the entire parcel containing 140 acres in our opinion had a fair market value of $14,000. However, on August 9, 1946, the owner sold Parcel A containing 88.51 acres for $18,500. Conceding that this and comparable properties in the same community had increased 20 to 25 percent during this period, we still can certainly find no indication that the taking of the access rights affected the fair market value of this agricultural property.

Upon reference to Exhibit I, please note Parcels A, B, C and G. In the case of these four parcels, we acquired all of the access rights including 100 feet along the county road, except a 30-foot opening for ingress and egress at the extreme right-hand corner of parcel G. You will note that the owner has used this opening to construct a private road to give ingress and egress to Parcels A and C. At the time of our acquisition of access rights and a widening strip, on November 27, 1944, the appraisal of the fair market value of Parcels A, B, C and G was $3,500. However, Parcel A sold on April 9, 1946, for $1,500; Parcel B on April 9, 1946, for $1,000; Parcel C on April 18, 1946, for $1,000, and Parcel G on September 6, 1945, for $5,000—a total of $8,500. Referring to Parcels D, E, F and H, all access was acquired with the exception of two 30-foot openings along the frontage of Parcel H. You will note

from the sketch how the owner has laid out the private roadway for ingress and egress to Parcels D, E and F. At the time we acquired the access rights for limited freeway including a widening strip, on March 28, 1945, our opinion of the fair market value of the property as disclosed in our appraisal prepared at that time, was $4,000. However, on August 22, 1946, Parcel D sold for $1,500; on September 13, 1946, Parcel E sold for $1,000; Parcel F for $1,000 on December 11, 1946, and Parcel H for $4,000 on October 14, 1945—a total of $7,500.

Market Values

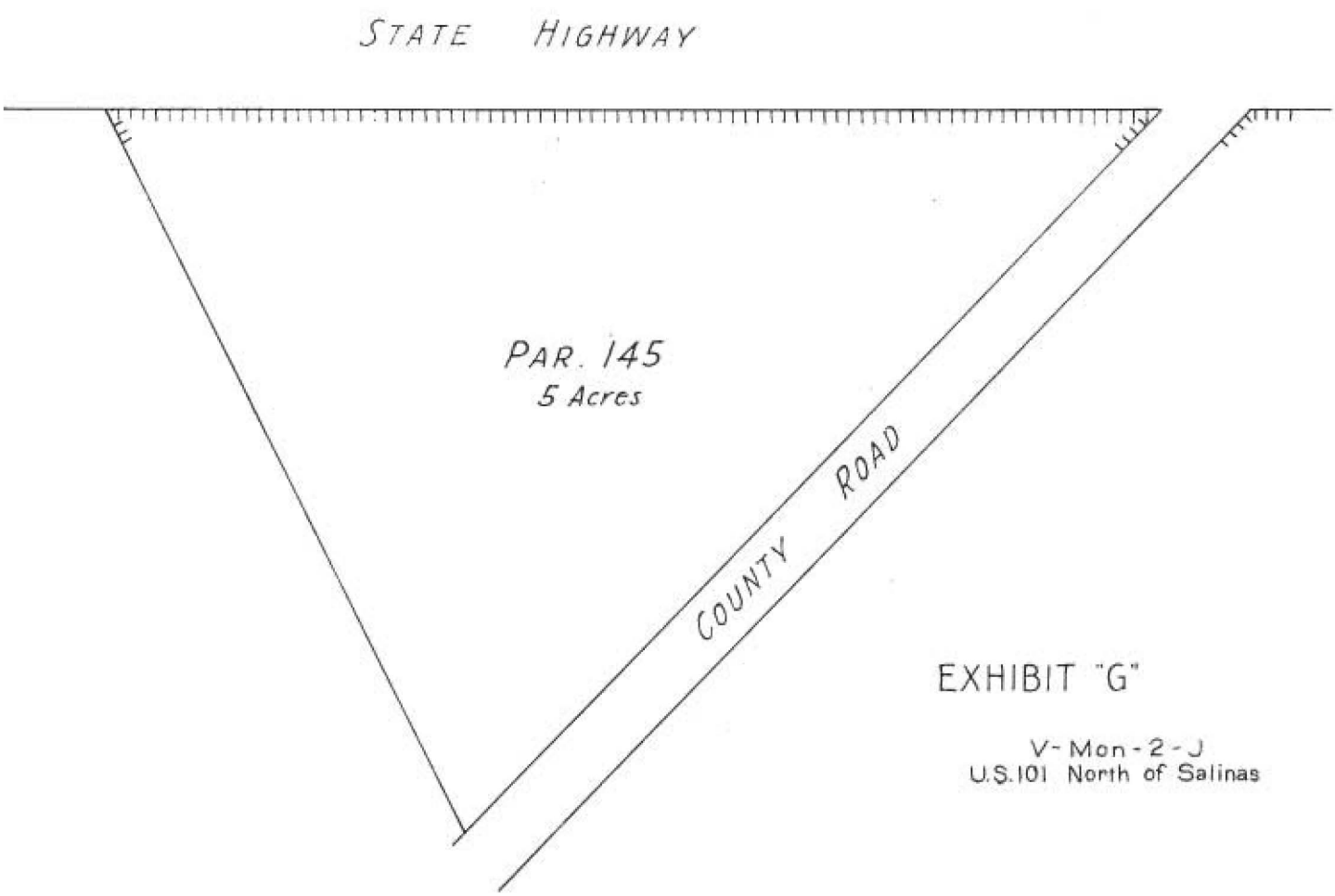
Please now refer to Exhibit J in which case all access rights along the state highway and back along the county road for a distance of 100 feet, were acquired from the parcel including a strip of land for widening purposes. Because of the way the property line intersects the state highway, the taking of all of the access from Parcel A actually meant that we acquired only 50 feet of access rights plus a very small area for widening. At the time of our acquisition on February 11, 1946, the appraised value of Parcel A was $4,500, and on April 22, 1946, this Parcel sold for $6,500. Upon reference to Parcel B of Exhibit J, we acquired 600 feet of access rights and a widening strip. At the time of our acquisition on February 11, 1946, the appraised value of this one acre parcel was $200. However, on May 10, 1946, Parcel B sold for $1,000.

I feel quite certain that if you will carefully study the properties shown on Exhibits D to J, inclusive, and review the history of real estate transactions on these parcels since the time of our acquisition, you will agree with me that in all cases the taking of the access rights insofar as market value is concerned, represents nothing more than a nominal or nuisance value; and, in this connection, it will be of interest to you to know that all of these transactions were closed out on the basis of the market value; the access rights ranging from $10 to $40 depending upon the size of the parcel.

New Field for Appraiser

We have made a study on U. S. Route 40 in the Vacaville area lying between San Francisco and the State Capital (Sacramento) and along this route we have available the information on some thirty sales, and without a single exception there is no indication that the taking of access rights affected the market value in any way.

We also have similar information on U. S. 99 between San Bernardino and Los Angeles, and U. S. 70 between Riverside and Ontario (Ontario being some 34 miles east of Los Angeles). I have the record of all these sales in my possession and if you wish, will be glad to supply them upon request. There are, however, so many sales to bear out our contentions, that the taking of access rights in general represents a nominal damage, that they are too voluminous to report at this time.



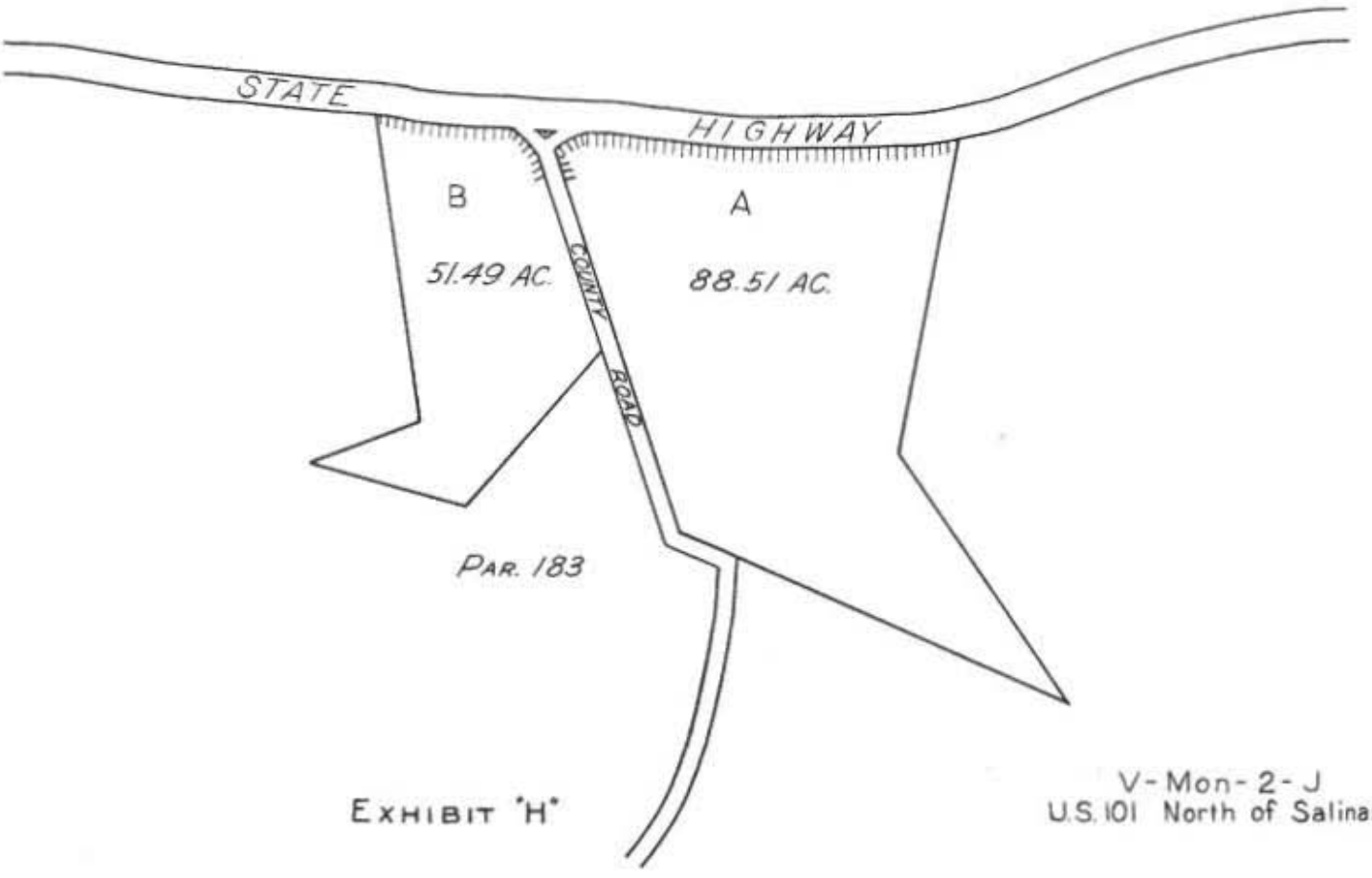


EXHIBIT "H"

V-Mon-2-J
U.S. 101 North of Salinas

We must keep in mind that the appraisal of the taking of access rights as such, is a comparatively new field for the appraiser. We must proceed cautiously and not be swayed by fantastic ideas of value presented by the property owner or his attorney, but at the same time we must be fair and just and in cases where the property owner suffers substantial damage because of the taking of access rights he should rightfully be compensated. It will also be apparent that the taking of access rights from one piece of property may reflect no damage while the taking of

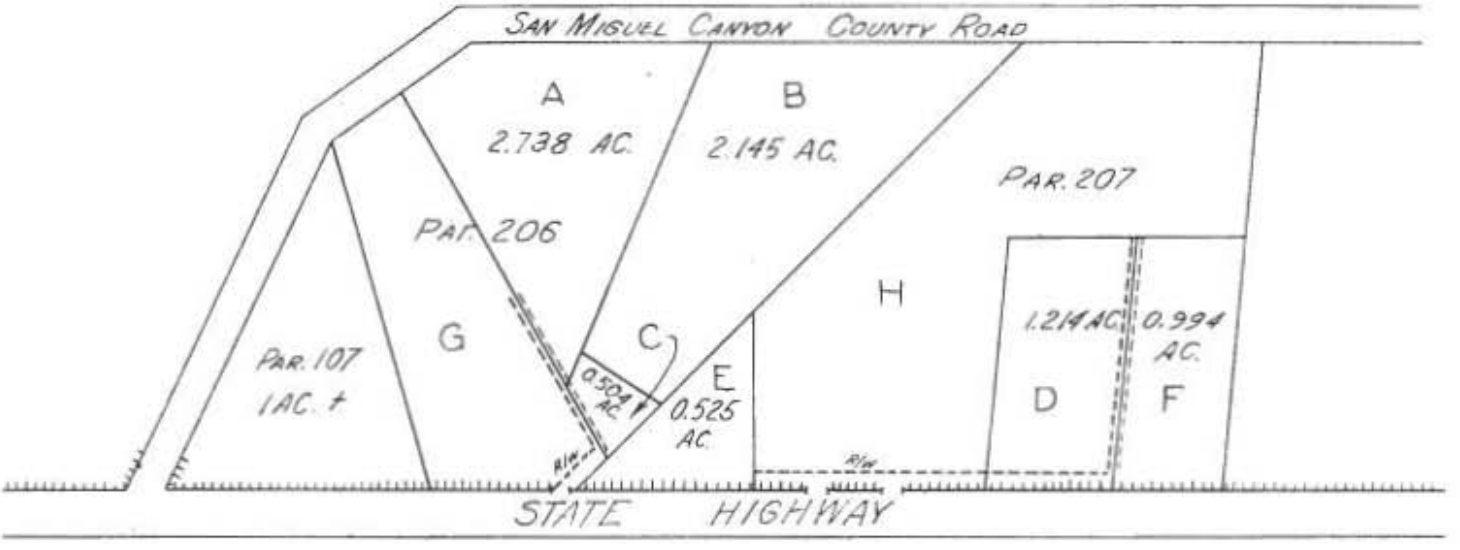
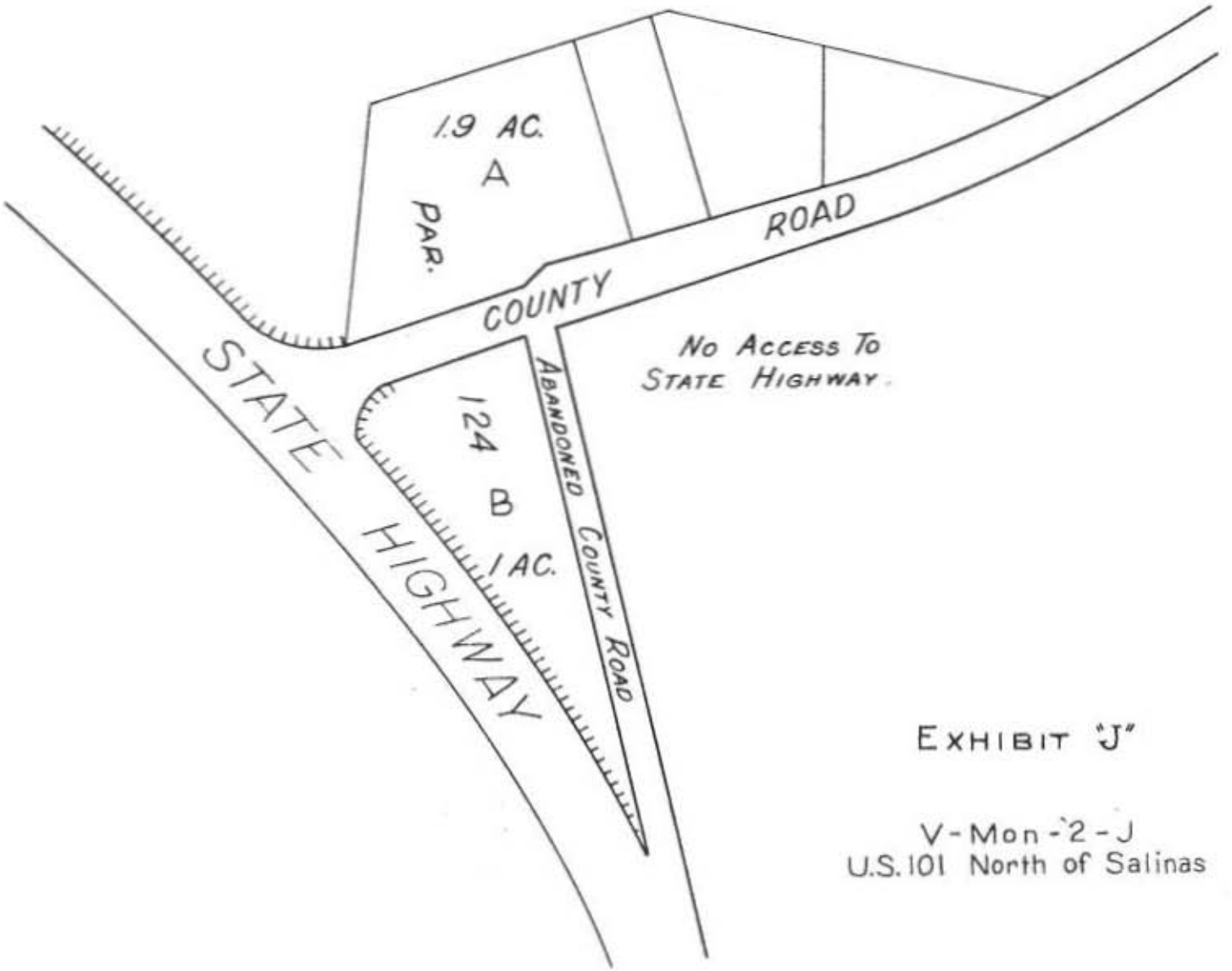


EXHIBIT "I"

V-Mon-2-J
U.S. 101 North of Salinas



such rights from other property may be tantamount to a damage perhaps equal to the value of the entire property.

I have previously stated that the taking of access rights for limited freeway purposes from the parcel of land on which the highest and best use is for agricultural purposes, probably represents no damage. In another case, however, involving a roadside business property, the taking of all access rights could perhaps create a damage practically equaling the full value of the property.

In my opinion, the measure of damages of the taking of access to any given piece of property now devoted to its highest and best use, can be simply and correctly defined as a sum of money representing the difference between the fair market value of such property *before* the taking of access rights and the value of such property *after* the taking of such rights.

Conceding that the "*before and after*" rule correctly indicates and evaluates the total damage to which the owner is entitled, it is readily apparent that the difficulty in applying this rule lies in properly analyzing and evaluating all of the elements that must be taken into consideration in arriving at the after-value.

Another factor that I have previously referred to, and which must be considered in evaluating the taking of access rights, *is that of benefits created by virtue of the proposed improvement*. With the theory of appraisal procedure and evaluation of the effect of freeway development on adjacent land values in mind, I have attempted in the short time allotted to me for presentation of the subject, to give you several thoughts which I hope may be of interest to you.

May I impress upon you the importance of the several states carrying on a continuing program of research and exchange of information so that we may to the best of our ability develop as much factual data as possible, looking toward the accurate and scientific determination of the effect of freeway development on the market value of adjacent lands.

It is our solemn duty to our employers—the state highway departments—and to the affected property owners, that we establish a definite program of procedure looking toward the accomplishment of this program.

Bids and Awards

Contracts Awarded for February and March, 1948

February

IMPERIAL COUNTY—Across Apache Wash and Sandy Ditch, between Coyote Wells and El Centro, two bridges to be redecked with Portland cement concrete. District XI, Route 12, Section B. H. C. Johnson, Long Beach, $23,054; Walter H. Barber, La Mesa, $24,056; G. W. Peterson, Los Angeles, $27,676; Covina Construction Co., Covina, $29,822. Contract awarded to E. G. Perham, Los Angeles, $21,431.

INYO COUNTY—Between Independence and Kearsarge, about 4.5 miles to be graded, a penetration treatment to be applied and an existing bridge to be widened. District IX, Route 1068. Bepsher Brothers, Bakersfield, $56,754; Westbrook & Pope, Highland, $56,810; Basich Bros. Construction Co. & Basich Bros., Alhambra, $57,531. Contract awarded to Browne & Krull, Palo Alto, $45,339.

LOS ANGELES COUNTY—On Olympic Blvd., between Lincoln Blvd. and Bundy Drive, about 2.3 miles to be graded and paved with Portland cement concrete and asphalt concrete. District VII, Route 173, Sec. SMca, LA. Griffith Co., Los Angeles, $892,129; Mike Radich & Co., V. S. Price, Glenn Graham, Burbank, $997,697; Morrison-Knudsen Co. Inc., San Francisco, $1,063,227; United Concrete Pipe Corp. & Ralph A. Bell, Baldwin Park, $1,087,984; N. M. Ball Sons & Madonna Construction Co., Berkeley, $1,127,482; Peter Kiewit Sons Co., Arcadia, $1,158,000. Contract awarded to J. E. Haddock Ltd., Pasadena, $884,691.90.

LOS ANGELES COUNTY—Between Violin Saddle and Whitaker Summit, about 44 miles to be graded and surfaced with plant-mixed surfacing on untreated rock base. District VII, Route 4, Sections G,H. Griffith Co., Los Angeles, $1,680,090; Clyde W. Wood, Inc., North Hollywood, $1,698,503; Guy F. Atkinson Co., Long Beach, $1,709,439; Morrison-Knudsen Co. Inc., Los Angeles, $2,128,555. Contract awarded to Winston Bros. Co., Azusa, $1,373,504.

LOS ANGELES COUNTY—In the City of Hawthorne on Hawthorne Ave. from Redondo Beach Blvd. to Century Blvd., furnish and install full traffic actuated signal systems at one intersection, semi-traffic actuated signal systems at three intersections, fixed time traffic signal systems at eight intersections, modify existing fixed time traffic signal system at one intersection, modify existing highway lighting at four of the above intersections. District VII, Route 164, Section A,Haw. Econolite Corp., Los Angeles, $76,998. C. D. Draucker Inc., Los Angeles, $75,690.

LOS ANGELES COUNTY—On Atlantic Blvd. at Jardine St. and Everington St., furnish and install semi-traffic actuated signal systems, and modify existing full traffic actuated dispatcher and conduit runs at Atlantic Blvd. and Washington Blvd. District VII, Route 167, Section A. C. D. Draucker, Inc., Los Angeles, $14,990. Contract awarded to Econolite Corp., Los Angeles, $12,501.

LOS ANGELES COUNTY—Across Big Rock Wash, about 9 miles east of Little Rock, two reinforced concrete slab bridges to be constructed and approaches to be graded and bituminous surface treatment applied. District VII, Route 59, Section H. Bent Construction Co., Los Angeles, $39,805; Thomas Construction Co., Santa Barbara, $39,902; L. V. Mulherron, Glendale, $39,907; Oberg Bros., Inglewood, $41,667; H. R. Breeden, Compton, $42,907; F. Fredenburg, Temple City, $44,571; Clifford C. Bong & Co., Arcadia, $45,586; Byerts & Dunn, Los Angeles, $46,751; A. A. Edmondson, Glendale, $47,209; E. G. Perham, Los Angeles, $50,655; C.J.B. Construction Co., Oxnard, $52,833; Norman I. Fadel, North Hollywood, $56,480. Contract awarded to Troy Construction, Inc., Los Angeles, $36,968.

LOS ANGELES COUNTY—On Hollywood Parkway, at Figueroa Street, four reinforced concrete undercrossings and two reinforced concrete separation structures to be constructed. District VII, Route 2. Haddock Co., Pasadena, $1,077,761; Peter Kiewit Sons Co., Arcadia, $1,081,558; W. J. Distelli & R. J. Daum Construction Co., Los Angeles, $1,094,735; Guy F. Atkinson Co., Long Beach, $1,164,000; Griffith Co., Los Angeles, $1,185,375; James I. Barnes Construction Co., Santa Monica, $1,313,407. Contract awarded to Carlo Bongiovanni, Los Angeles, $999,999.99.

LOS ANGELES COUNTY—In the City of Los Angeles between Macy Street and Indiana Street, about 1.8 miles to be landscaped. District VII, Route 26. Henry C. Soto & Co., Los Angeles, $38,294. Contract awarded to Jannoch Nurseries, Altadena, $37,755.70.

LOS ANGELES COUNTY—On Santa Ana Parkway between Soto Street and Eastman Avenue, about 2.0 miles to be graded and paved with Portland cement concrete and asphalt concrete, and a pedestrian underpass to be constructed. District VII, Route 2. Peter Kiewit Sons Co., Arcadia, $1,063,715; J. E. Haddock, Ltd., Pasadena, $1,121,341; Mike Radich & Co., Price & Graham, Burbank, $1,154,434; United Concrete Pipe Corp. & Raph A. Bell, Baldwin Park, $1,174,190. Contract awarded to Griffith Co., Los Angeles, $1,037,126.

LOS ANGELES COUNTY—On Olympic Blvd. from Indiana Street to Anaheim-Telegraph Road, furnish and install fixed time traffic signal systems at six intersections and modify existing fixed time traffic signal systems at two intersections. District VII, Route 173, Section A. Tri-Cities Electric Service, Inc., Oceanside, $24,866; C. D. Draucker, Inc., Los Angeles, $27,960; Econolite Corp., Los Angeles, $29,857. Contract awarded to Electric & Machinery Service, Inc., South Gate, $22,427.

MENDOCINO COUNTY—At Rock Creek about 25 miles south of Garberville, about 0.6 mile, a structural steel bridge to be constructed and roadway approaches to be graded and surfaced. District 1. Route 1, Section J. Mercer Fraser Co., Eureka, $168,431; R. G. Clifford & A. R. McEwen, South San Francisco, $168,573; Baldwin-Straub Corp., San Rafael, $169,891; Grant L. Miner, Palo Alto, $179,978; Northrup Construction Co., Long Beach, $191,009; Chittenden & Chittenden, Auburn, $199,742. Contract awarded to H. W. Ruby, Sacramento, $167,100.

MERCED COUNTY—In the City of Merced on 16th Street, at intersections with "O" Street and "R" Street, traffic signals to be furnished and installed. District X, Route 4. Ed Pierce Electric Co., Vallejo, $6,720; Severin Electric Co., San Francisco, $7,491; L. H. Leonardi Electric Construction Co., San Rafael, $7,571. Contract awarded to R. Goold & Son, Stockton, $6,123.

SAN BERNARDINO COUNTY—Between south "E" Street and State Street in Redlands, about 7.2 miles to be widened and surfaced with plant-mixed surfacing on cement treated base and existing pavement and an existing bridge to be widened. District VIII, Route 26, Sections E,A,Rld. Matich Bros., Colton, $812,668; Griffith Co., Los Angeles, $879,168; J. E. Haddock, Ltd., Pasadena, $911,359; Morrison-Knudsen Co., Los Angeles, $929,042; Peter Kiewit Sons Co., Arcadia, $983,146. Contract awarded to Geo. Herz & Co., San Bernardino, $774,189.

SAN BERNARDINO COUNTY—Between Larch Avenue and Spruce Avenue, near Bloomington, trees to be removed or topped. District VIII, Route 26, Section D. Mead House Wrecking Co., Pasadena, $4,087; George F. Casey, Maywood, $4,766. Contract awarded to California Tree Service, Los Angeles, $2,336.

FRESNO AND TULARE COUNTIES—Between 0.1 mile west of Tulare-Fresno county line and one mile east of Kings River, about 1.9 miles to be graded and bituminous surface treatment applied. District VI, FAS 1142. Geo. E. France, Inc., Visalia, $66,105; Gordon L. Capps, Stockton, $67,749; Claude C. Wood Co., Lodi, $70,857; Munn & Perkins, Modesto, $72,480; Anderson Company, Visalia, $73,230; Oilfields Trucking Co, Bakersfield, $72,800; Huntington Bros., San Anselmo, $73,493; N. M. Ball Sons, Berkeley, $74,644; C. M. Syar, Vallejo, $74,675; Louis Biasotti & Son, Stockton, $75,615; Dix-Syl Construction Company, Inc., Bakersfield, $76,423; W. C. Railing, Redwood City, $79,452; A. A. Edmondson, Glendale, $85,170; R. M. Price Co. and Rex B. Sawyer, Huntington Park, $85,520; Volpa Brothers, Fresno, $86,239; Valley Paving and Construction Co., Inc., Fresno, $90,935. Contract awarded to P. J. Moore & Son & Haerns Bros., Sacramento, $57,796.

TULARE AND FRESNO COUNTIES—Between Mendocino Avenue and ¼ mile north of Kingsburg, furnishing and installing a traffic signal system and highway lighting systems at six intersections. District VI, Route 4, Sections E,D,Kngb,A. L. H. Leonardi Electric Construction Co., San Rafael, $25,039; Severin Electric Co., San Francisco, $26,405. Contract awarded to Tri-Cities Electrical Service, Oceanside, $24,356.

SACRAMENTO COUNTY—At Three Mile Folsom Boulevard, a warehouse site to be constructed. District III. A. Teichert & Son, Inc., Sacramento, $35,309; McGillivray Construction Co., Sacramento, $36,041. Contract awarded to Brighton Sand and Gravel Co., Sacramento, $34,901.85.

SACRAMENTO COUNTY—At Three Mile Slough about 4.3 miles south of Rio Vista, about 1.2 miles to be graded, surfaced with imported borrow and bituminous surface treatment and seal coat applied. Sacramento County, Route 11, Section C. Munn & Perkins, Modesto, $64,195; Louis Biasotti & Son, Stockton, $67,089; Parish Bros., Benicia, $65,866; Asta Construction Co., Rio Vista, $68,112; W. C. Railing, Redwood City, $71,799; Jensen & Pitts, San Rafael, $73,074; Fredericksen & Kasler, Sacramento, $74,399; Claude C. Wood Co., Lodi, $76,241; A. Teichert & Son, Inc., Sacramento, $76,297; Johnston Rock Co. & Gordon L. Capps, Stockton, $77,635. Brighton Sand & Gravel Co., Sacramento, $78,452; J. R. Armstrong, El Cerrito, $79,166; A. A. Edmondson, Glendale, $84,994. Contract awarded to Sheldon Oil Co., Suisun, $63,763.55.

SACRAMENTO COUNTY—Between North Sacramento Viaduct and one-half mile east of Ben Ali, about 4.2 miles to be landscaped, a well to be drilled, and pumping equipment to be furnished and installed. District III, Route 3, Section B. Henry C. Soto & Co., Los Angeles, $83,286; Jannock Nurseries, Altadena, $83,887; Huettig & Schramm, Palo Alto, $85,862; Tyson & Watters Co., Sacramento, $87,218; Leonard Coates Nurseries, Inc., San Jose, $89,950; Stolte, Inc., Oakland, $97,498; Capital Nursery Co., Sacramento, $102,466. Contract awarded to Master Plumbing & Heating Co., Inc., Berkeley, $72,677.39.

SAN DIEGO COUNTY—In Oceanside at the intersections of Wisconsin Avenue, Third Street, and Sixth Street with Hill Street, furnish and install traffic actuated signal systems. District XI, Route 2. Tri-Cities Electric Service, Oceanside, $27,538; Econolite Corp., Los Angeles, $32,145. Contract awarded to California Electric Works, San Diego, $23,456.

SAN DIEGO COUNTY—In the City of San Diego, at intersections of Washington and Normal Streets, and at intersections of Park Boulevard, Texas Street and Rolando Boulevard with El Cajon Boulevard, furnishing and installing traffic actuated signal systems at four intersections and installing highway lighting systems at two intersections. District XI. California Electric Works, San Diego, $53,391. Contract awarded to Tri-Cities Electric Service, Oceanside, $40,716.

SAN DIEGO COUNTY—At San Felipe Creek, about 15 miles east of Julian, a reinforced concrete girder bridge to be constructed and about 0.3 mile to be graded and bituminous surface treatment applied. District XI, Route 198, Section F. Clifford C. Bong & Co., Arcadia, $92,390; E. G. Perham, Los Angeles, $103,218. Contract awarded to Walter H. Barber, La Mesa, $89,552.

SAN MATEO COUNTY—Between Broadway in Burlingame and Peninsular Avenue in San Mateo, about two miles to be planted. District IV, Route 68. Henry C. Soto & Co., Los Angeles, $9,481; Watkin & Sibbald, Richmond, $11,347.81; Leonard Coates Nurseries, Inc., San Jose, $12,282; Stephen L. Vistica, San Mateo, $16,195; Jannoch Nurseries, Altadena, $16,641. Contract awarded to Huettig & Schromm, Palo Alto, $8,886.15.

SOLANO COUNTY—Between Vallejo Wye and ½ mile north of Route 208, about 5.6 miles to be graded and paved with Portland cement concrete on untreated rock base and with plant-mixed surfacing on Portland cement concrete base and on existing pavement and a reinforced concrete grade separation structure to be constructed. District X, Routes 7 & 74, Sections FG,D. Fredrickson & Watson Construction Co., Oakland, $1,254,033; N. M. Ball Sons & A. Madonna Construction Co., Berkeley, $1,536,383; Guy F. Atkinson Co., South San Francisco, $1,591,517; Chas. L. Harney, Inc., San Francisco, $1,670,073. Contract awarded to Parish Bros., Benicia, $1,210,080.

YUBA AND SUTTER COUNTIES—Between "D" Street Bridge in Marysville and Live Oak Road in Yuba City, about 2 miles to be landscaped, a well to be drilled and pumping equipment to be furnished and installed. District III, Route 3. Luppen & Hawley, Inc., Sacramento, $42,746; Henry C. Soto & Co., Los Angeles, $45,820; J. W. Beem Co., Berkeley, $47,420; Capital Nursery Co, Sacramento, $49,308; M. & K. Corp., San Francisco, $50,096. Contract awarded to Huettig & Schromm, Palo Alto, $41,842.35.

VENTURA COUNTY—At the junction of Routes 2 and 60, near El Rio, about 1.3 miles, a four-lane divided highway with channelized intersection to be provided, new roadway to be graded and surfaced with plant-mixed surfacing on Portland cement concrete base, existing pavement to be surfaced with plant-mixed surfacing and outer highways to be graded and surfaced. District VII, Routes 2,60, Section C,B. Frank T. Hickey, Inc., Los Angeles, $181,489; Baker & Pollock, Ventura, $189,384; Dimmitt & Taylor & T. M. Page, Monrovia, $197,472; Hensler Construction Corp., Glendale, $198,611; N. M. Ball Sons, Berkeley, $217,545; J. E. Haddock, Ltd., Pasadena, $217,800. Contract awarded to Smith-Edmondson Co., Glendale, $179,056.40.

MARCH 1948

DEL NORTE COUNTY—Across South Fork of Smith River, about 12 miles northeast of Crescent City, a structural steel arch bridge and 0.17 mile of approaches to be constructed. District I. Baldwin Straub Corp., San Rafael, $78,313; Grant L. Miner, Palo Alto, $78,944; Dan Caputo, San Jose, $82,698; Mercer, Fraser Co., Eureka, $84,451; W. C. Railing, Redwood City, $85,301; Guy F. Atkinson Co., South San Francisco, $108,213; Charles MacClosky Co., San Francisco, $108,506; Dragline Rentals Co., Long Beach, $128,512. Contract awarded to Underground Construction Co., Oakland, $75,950.90.

KERN COUNTY—Between two miles south of Isabella and Isabella, about 2.0 miles to be graded, bituminous surface treatment applied thereto, and a steel beam span bridge to be constructed. District VI, Route 57, Section I. Oilfields Trucking Co., Bakersfield, $157,970; Westbrook & Pope, Highland, $158,490; A. F. Heinse, Alhambra, $165,881; George E. France, Inc., Visalia, $172,670; Claude C. Wood Co., Lodi, $174,980; Clyde W. Wood, Inc., North Hollywood, $188,118. Contract awarded to Munn & Perkins & Matthew & Jorgenson, Modesto, $147,949.

LAKE COUNTY—At Coyote Creek about six miles north of Middletown about 0.5 mile to be graded, imported base material to be placed, a seal coat to be applied, and a reinforced concrete bridge to be constructed. District I, Route 49, Section B. Jensen & Pitts, San Rafael, $68,991; C. M. Syar, Vallejo, $72,733; Baldwin, Straub Corp., San Rafael, $75,847; Louis Biasotti & Son, Stockton, $78,667; O'Connor Bros., Red Bluff, $78,846; Chittenden & Chittenden, Auburn, $82,971; J. Henry Harris, Berkeley, $108,389. Contract awarded to Harold Smith, St. Helena, $66,935.

LOS ANGELES COUNTY—On Lincoln Boulevard at Jefferson Boulevard and on Sepulveda Boulevard at Centinela Avenue, Slauson Avenue and Jefferson Boulevard, furnish and install traffic actuated signal systems and highway lighting. District VII, Routes 60, 158, Sections C, B. C. D. Draucker, Inc., Los Angeles, $52,547. Contract awarded to Econolite Corp., Los Angeles, $48,269.

LOS ANGELES COUNTY—On Valley Boulevard from San Gabriel Boulevard to Hoyt Avenue, furnish and install fixed time traffic signal systems at nine intersections and furnish and install modifications to existing fixed time traffic signal systems at two intersections. District VII, Route 77. C. D. Draucker, Inc., Los Angeles, $35,660; Paul Gardner, Ontario, $37,957; Econolite Corp., Los Angeles, $41,592. Contract awarded to Electric & Machinery Service, Inc., South Gate, $31,723.

LOS ANGELES COUNTY—In the City of Alhambra at the intersection of Ramona Boulevard and Garvey Avenue, full traffic actuated signal system and highway lighting to be furnished and installed. District VII, Route 26. C. D. Draucker, Inc., Los Angeles, $13,990. Contract awarded to Econolite Corp., Los Angeles, $12,764.

SANTA BARBARA COUNTY—Between Black Road and Point Sal Road, about 5.5 miles to be graded, imported borrow to be placed, bituminous surface treatment applied, and a structural steel beam span overhead crossing to be constructed. District V, Route 56, Section E. Dimmitt & Taylor, & T. M. Page, Monrovia, $241,727; N. M. Ball Sons, Berkeley, $249,727; Spicer Company, Los Angeles, $249,908; George E. France, Inc., Visalia, $262,125; J. E. Haddock, Ltd., Pasadena, $267,991; Ralph A. Bell, Monrovia, $276,412; Clyde W. Wood, Inc., North Hollywood, $280,825; Vinnell Co., Inc., Alhambra, $285,350; Wm. Radkovich Co., Inc., Los Angeles, $310,544. Contract awarded to Madonna Construction Co., San Luis Obispo, $237,252.

SAN DIEGO COUNTY—In the City of San Diego, Pacific Highway at Balboa Avenue, about 0.12 mile of existing pavement to be widened with imported base material, and existing pavement and newly constructed base material surfaced with asphalt concrete. District XI, Route 2. V. R. Dennis Construction Co., San Diego, $19,477; Daley Corp., San Diego, $19,865; Griffith Co., Los Angeles, $20,366. Contract awarded to R. E. Hazard Contracting Co., San Diego, $18,630.

SAN DIEGO COUNTY—Install traffic signals in San Diego at intersection of Fifth and Harbor Drive. District XI, Route 2. California Electrical Works, San Diego, $8,765; Ets-Hokin & Galvan, San Diego, $8,893. Contract awarded to Tri-Cities Electrical Service, Oceanside, $8,580.

SAN DIEGO COUNTY—Install traffic signals in San Diego at Euclid Avenue and Federal Boulevard. District XI, Route 200. Ets-Hokin & Galvan, San Diego, $10,259; Tri-Cities Electrical Service, Oceanside, $11,545. Contract awarded to California Electrical Works, San Diego, $9,860.

SAN DIEGO COUNTY—In the City of San Diego at College Avenue and El Cajon Boulevard and at 30th Street and Market Street, furnish and install full traffic actuated signal systems. District XI, Routes 12 and 200. Tri-Cities Electrical Service, Oceanside, $17,078; California Electric Works, San Diego, $17,250. Contract awarded to Ets-Hokin & Galvan, San Diego, $16,638.

SAN DIEGO COUNTY—Furnish and install traffic signals at National and Palm Avenues, Palm City. District XI, Route 199, Section A. California Electric Works, San Diego, $4,938; Tri-Cities Electrical Service, Oceanside, $5,373. Contract awarded to Ets-Hokin & Galvan, San Diego, $4,290.

SAN LUIS OBISPO COUNTY—Between State Route 56 and ½ mile west of Los Osos Creek, about 3.1 miles to be graded and imported borrow placed thereon. District V, Route 67E. Henry C. Dalessi, San Luis Obispo, $64,123; F. E. Young, Berkeley, $66,354; Dix-Syl Construction Co., Inc., Bakersfield, $79,238; Claude C. Wood Co., Lodi, $83,445; A. G. Raisch Co. and Starling and Galbraith, San Francisco, $83,857; Louis Biasotti & Son, Stockton, $96,280; Brown-Doko, Pismo Beach, $100,263; A. A. Edmondson, Glendale, $121,643; Cox Bros. Construction Co., Stanton, $123,746. Contract awarded to Madonna Construction Co., San Luis Obispo, $58,868.66.

City Creek Road

Continued from page 15 . . .

ditions of a special use permit. This cooperation, in addition to the usual forest regulations and requirements covering fire prevention and suppression, involves the providing of access to present and future forest roads; forest approval of construction roads; protection against erosion; leaving streams undisturbed and minimum interference with scenic values. In order to preserve as much as possible the benefits of a limited freeway, the Forest Service agrees to issue no new special use permits within a strip of 200 feet from the center line of highway without first consulting the appropriate state highway authorities and securing their advice and recommendations. It is also agreed that no signs other than directional or informative will be permitted on the State's Right of Way.

Traffic is being routed over the existing road, over detours as the existing road becomes eliminated, and through construction. It is not advisable for other than necessary traffic to use this route while it is under construction.

The first unit is under contract to Denni Investment Corporation of Wilmington, California, at a price of $652,000 including the new bridge over the West Fork of City Creek, a picture of which is shown on page 22.

The second unit is under contract to Westbrook and Pope of Sacramento, California, at a price of $744,000.

Contract bids for the third unit have been received.

W. H. Crawford is the State's Resident Engineer on the first and second units with Warren Ford acting as the Principal Assistant on the second unit, while J. H. Horn is Bridge Department Representative.

Previous articles on this project have appeared in this magazine's issues of July-August, 1946, and January-February, 1947.

Geology

Continued from page 17 . . .

Over a hundred hand and power borings were made along the alignment in conjunction with many resistivity and seismic tests. The correlation of the samples obtained in the borings, with the geologic information available, which in turn were combined with the geo-physical data resulted in a comprehensive picture of the materials to be encountered along the alignment. From this data it was possible to recommend treatment necessary to stabilize the cuts and fills. That this extensive preliminary investigation saved many thousands of dollars is attested by the fact that Cuesta Grade, although traversing an area of very unstable formations has caused very little trouble in the many years since its construction.

Los Gatos to Santa Cruz

In 1937 extensive foundation studies were made on a proposed alignment of the Los Gatos-Santa Cruz Road in Santa Clara and Santa Cruz Counties. The road as projected called for large cuts and fills through an area of unstable material paralleling the San Andreas Rift for a distance of three miles.

The San Andreas Rift or fault has been the subject of much discussion and many misconceptions since the day startled Californians were made acutely aware of its existence on April 18, 1906. To describe the many hypotheses about the fault is not the purpose of this article, however, it is a major part of California's structural features and as such, due consideration should be given to all types of engineering works which may come within the scope of future movements.

Structurally the area along the alignment is that of a highly inclined monocline dipping to the southwest, where the sediments composing the structure are in contact with the metamorphic Franciscan Series along the San Andreas Rift.

Unstable Materials

Paucity of outcrops and rugged terrain covered with a heavy growth of brush and timber necessitated the use of geo-physical and boring equipment to supplement the geologic information.

Over 200 borings having a total footage of 4,508 feet were made at various locations along the alignment. The information obtained showed the existence of unstable materials, at depths of 50 feet in many of the proposed cuts and beneath the fills.

Modification of cut and fill design were recommended and the installation of many feet of rock drain for fill foundation treatment have resulted in a comparatively stable section of roadway.

An interesting sidelight on this project and of geologic interest was the area around Moody Gulch.

Moody Gulch is the site of one of the earliest oil fields in the State. The date of discovery goes back to 1880 when the first well was brought in. Records show the total production up to 1921 was 85,000 barrels of high gravity oil. During recent years only a few barrels per month are being pumped from the old wells.

Preliminary plans called for a concrete arch bridge over Moody Gulch. Because of the proximity to the San Andreas Rift and the existence of a fault at Moody Gulch, this structure was not built.

Materials of Construction

The California Division of Highways keeps a rigid control over the quality of materials used in construction.

The problem of locating suitable materials for the many phases of highway construction, i.e., concrete aggregate, crusher run base, imported borrow, and earthwork has become rather critical in some areas of the State.

California as a whole has been generously supplied with materials of construction. The large streams cutting through rugged mountain ranges for many thousands of years have, where they debouch out into the valleys, deposited vast quantities of sand and gravel at many localities throughout the State. The production of sand and gravel alone according to the figures available for 1945 have a value of $10,371,647; to be added to this are macadum, ballast, rubble and riprap which make a total of 29,449,484 tons, and having a value of over $20,000,000, placing the production of miscellaneous stone fourth in rank of the minerals produced in California.

It must be remembered, however, that the above figures and quantities are for known commercial sources. Engineers and contractors on highway construction must, in most cases, rely on developing local sources within economic haul of proposed work.

Geology Important

Geology is becoming increasingly important in determining sources of material and is keeping pace with the highway construction program by use of preliminary geologic investigations in areas where conditions have not been favorable for accumulation of suitable road material.

A typical example in which geology was an important factor occurred recently in a district which is less favored in its supply of road materials, especially on the west boundary.

Several proposed borrow sites were thoroughly investigated, but proved unsatisfactory. Existing pits had developed material which failed to meet standards. A brief geologic study of these pits disclosed that zones of deformation or faulting had altered the rock to such an extent that it was very improbable that suitable material could be developed by further excavation. The problem of locating an area outside the zone of deformation was comparatively simple.

Laboratory Analyses

The Materials and Research Department has a completely equipped mineralogical and geological laboratory where detail petrographic analyses are made of aggregates and rocks from every section of the State.

It has been shown by past experience that certain aggregates containing cherty, and opaline minerals cause excessive expansion with subsequent deterioration of concrete when used in conjunction with high alkali cements. Particular attention is paid to aggregate from areas where deleterious or reactive rock particles are known to occur and detail petrographic analysis is frequently used to corroborate the presence of these reactive minerals.

. . . Continued on page 36

Bay Crossings

Engineer Cites Problems Which Must Be Studied

PROBLEMS involved in the preparation of plans for the construction of two proposed new San Francisco Bay toll highway crossings were listed categorically in a report submitted to Director of Public Works C. H. Purcell by Ralph A. Tudor, Chief Engineer of the recently created Division of San Francisco Bay Toll Crossings.

Studies are being made by Tudor for the California Toll Bridge Authority on two additional bay crossings; one the southern crossing between San Francisco and Alameda County, which would consist of a combined over-water structure and under-water tubes and the other a structure paralleling the present San Francisco-Oakland Bay Bridge.

In the event both crossings cannot be built simultaneously, factors which will determine which crossing shall be constructed first are costs, approaches, traffic counts, and service to the public, Tudor said.

Bids for test borings for foundation explorations for the southern crossing and parallel bridge will be opened on April 14. The work to be done consists of making sediment borings and core borings and taking samples for foundation studies at some seventy-three locations in San Francisco Bay between the City of San Francisco and the cities of Oakland and Alameda. Meanwhile the work of designing both structures will be carried on.

A comprehensive study of bay area traffic by the Division of Highways, which is nearing completion, will be thoroughly analyzed by experts in order to determine estimated traffic and revenue on the existing and proposed bay crossings, on which the marketing of required revenue bonds may be justified.

This review should be available to the Toll Bridge Authority when it undertakes to determine the amount of bonds that can be authorized.

Tudor's staff will consult with the city engineers of all the interested San Francisco Bay area communities on the location and cost of approaches to the new crossings on both sides of San Francisco Bay, Purcell said.

All plans for approaches to the crossings will be made in full cooperation with the Division of Highways, which will prepare all geometric layouts for actual connections with freeways and streets.

Engineers Needed

DESIGN engineers for bridges and subaqueous tunnels are urgently needed by the new Division of San Francisco Bay Toll Crossings, according to Ralph A. Tudor, Chief Engineer. The division must determine suitable sites and foundations for the two proposed new toll highway crossings of the bay between San Francisco and Alameda Counties, as well as design the structures and approaches.

Tudor is desirous of completing his engineering staff as soon as possible in order that there will be no delay in the designing of the structures required for the southern crossing, which will be a combination over water and under water structure, and for a new span paralleling the existing San Francisco-Oakland Bay Bridge.

Engineers qualified to fill the positions created by the formation of the Division of San Francisco Bay Toll Crossings, particularly design engineers for bridges and subaqueous tunnels, are urged by Tudor to write for full information regarding openings or to apply in person to division headquarters, Room 500, 74 New Montgomery Street, San Francisco.

Successful applicants will be afforded an opportunity to acquire state civil service status. Starting salaries range from $268 to $458 a month on a 40-hour work week basis.

Southern Crossing

Under "Design and Cost Estimate of Southern Crossing," the report says:

"This study will be based upon the location and type of crossing recommended by the Army-Navy Board.

"The principal problems that must be studied in connection with this crossing are:

"1. Will the proposed artificial islands restrict tidal flow in the bay excessively?

"2. How adequately and fast can the islands be consolidated and stabilized?

"3. Develop tunnel transition section through the islands into the bay bottom that will not suffer damage from settlement.

"4. Will the tubes be shield driven under air or pre-cast sections sunk in place?

"5. Is there dredging equipment available to reach depths of 120 feet?

"6. What slopes will the bay bottom material stand on?

"7. Will a dredged trench silt up before pre-cast sections can be placed?

"8. Will supporting and aligning foundations be necessary for tubes?

"9. What foundations will be necessary for ventilating buildings?

"10. What ventilating will be required for tubes?

"11. What lighting will be required for tubes?

"12. What foundations will be necessary for causeways and what types and lengths of spans will be best?

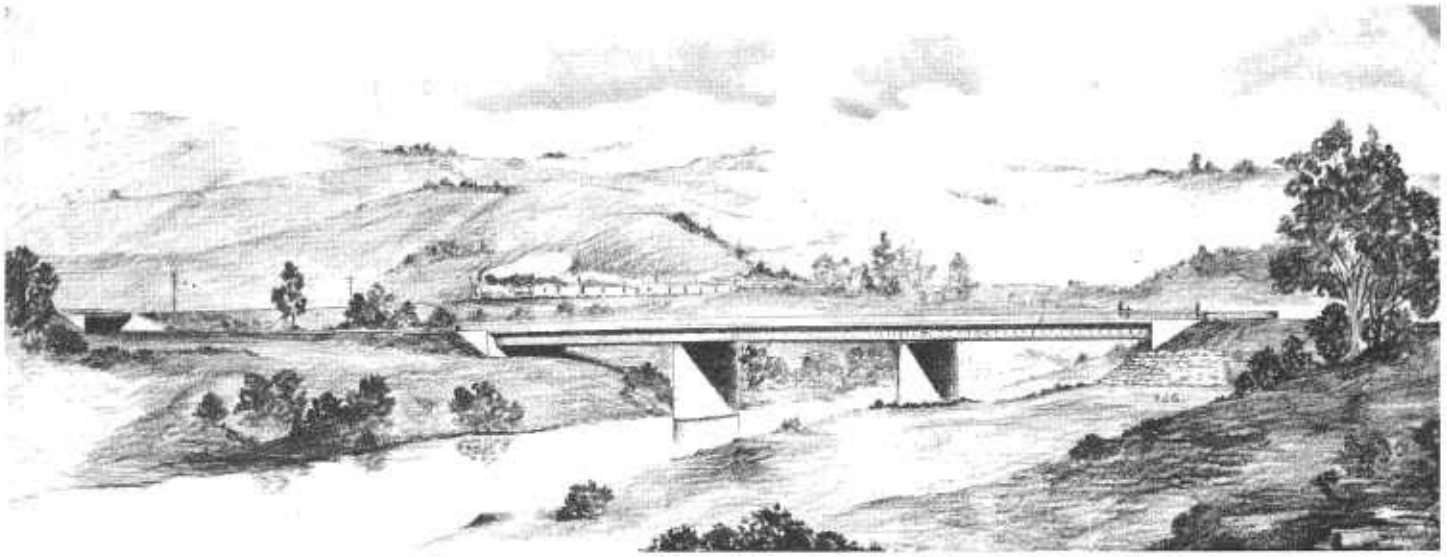
"13. Are there any underwater utilities that must be relocated?

"14. Estimate the time for construction.

"15. Consider the availability of materials and skilled labor.

. . . Continued on page 36

New Pajaro Bridge Contract Award Due Soon



THIS structure is to be located 10.6 miles east of Watsonville and will replace the present narrow and light steel truss bridge built by San Benito County in 1916, one span of which collapsed upon being struck by passing loads in 1941. This portion was immediately replaced by a temporary timber trestle.

It is expected the contract for the new bridge will be awarded shortly.

The new bridge is being built at a higher grade upon improved alignment eliminating the reverse curvature of the old highway. It is of simple design. Concrete abutments and piers, plate girder stringers and concrete deck. The railing steel, of standard design.

This sketch is by Van der Goes of the Bridge Department of the State Division of Highways.

Bay Crossings

Continued from page 35 . . .

"An analysis of these and other problems will permit a rational design and estimate to be made of the southern crossing including the tubes under the estuary between Oakland and Alameda."

Under the section, "Design and Cost Estimate of Parallel Crossing," the report states:

"This study will not be so difficult as that for the southern crossing for most of the unknowns have already been explored in connection with the existing bridge. Nonetheless, there remain numerous formidable questions to be answered. The principal ones are:

"1. To what depth must the foundations be taken?

"2. Can the piers be placed without disturbing or damaging in any way the piers of the existing bridge?

"3. What under-water utilities must be moved?

"4. Will there be any difficulty driving a new island tunnel without damage to the existing one?

"5. What can be accomplished by eliminating the interurban facilities on the bridge? It is believed that an appreciable amount of steel in the lower deck floor system and trusses can be saved.

"6. Studies for new structures where present bridge will not fit new location (Yerba Buena Island, etc.).

"7. What is the best way to distribute traffic between the two adjacent bridges?

"8. What is the best arrangement of traffic for upper and lower decks?

"9. Estimate the time for construction.

"10. Consider the availability of materials and skilled labor.

"An analysis of these and other problems will permit a rational estimate of cost to be made of the parallel crossing."

Based upon the work outlined in the Purcell report, a cost estimate for each crossing will be made. This will include the cost of construction of the crossing itself, approaches, right-of-way, engineering, legal, administration, interest, insurance, operation and maintenance, and contingencies.

Geology

Continued from page 34 . . .

Much has been said about the geologist not understanding the engineer and vice versa, but each recognizes his limitations, and it is through this medium that a spirit of cooperation is present in all problems which have a mutual end in view, namely better and safer construction.

So as Sir Walter Scott said, some will still continue to "rin up hill and down dale to see how the world is made."

H. D. Jerrett Retires After 21 Years of Service With State

H. D. Jerrett, District III Right of Way Agent, was guest of honor at a dinner in the Marysville Hotel, when more than fifty friends gathered to express their best wishes upon the occasion of his retirement from state service. Short talks were made by representatives of Headquarters, District I, District II, and District III. A fountain pen desk set and several sets of law books were then presented by various groups of co-workers.

After an early career in hydraulic engineering in El Dorado County and other parts of Northern California, "The Judge," as he was known in District III, began to read law and in 1914 was admitted to the bar. After 10 years of private practice as an attorney, he entered the right of way department of the Great Western Power Company and then in 1926 went to work for the California Highway Commission as Right of Way Agent.

During his 21 years of state service, all but a few months of which were spent in District III of the Division of Highways, Jerrett became widely known as a man of unquestioned integrity and clear thinking. His loyal devotion to duty and his friendly advice will be missed by those with whom he had worked so long. The best wishes of all of them go with "The Judge" in any activities he may choose to follow.

New Devices

Continued from page 20 . . .

to feed the mixture to the attachment. Although these attachments were mounted on a Barber-Greene finisher, it is believed they can be made adaptable to other makes.

The accompanying photographs show the operation of these devices.

These attachments maintain a fixed relation between pavement grade and adjacent drainage facility. The results were so uniform and pleasing in appearance that the use of these or similar devices is recommended for all such work by the Division of Highways.

When this photograph of the old wire cable bridge across the North Fork of the American River was taken on March 25, 1928, flood waters were only eight feet below the bottom of the span deck

New Bridge

Continued from page 13 . . .

The Mother Lode Highway offers facilities for transportation and travel to many of the early day mining communities, many of which are now thriving cities. Proceeding north from Mariposa it passes through Coulterville, Chinese Camp, Jim Town, Sonora, Columbia, Tuttle Town, Melones, Carson Hill, Angels Camp, San Andreas, Mokelumne Hill, Jackson, Sutter Creek, Amador, Plymouth, Eldorado, Placerville, Coloma, Lotus, Pilot Hill to Auburn.

From the Jackson and Placerville Folios of the Geologic Atlas prepared by H. W. Turner in 1894 we note the following description of the Mother Lode: "A series of quartz veins — highly auriferous," extending southeasterly from Plymouth in Amador County to four miles south of Angels Camp is called the Mother Lode. The Mother Lode which must not be considered as a continuous vein but rather as a belt of parallel, though sometimes interrupted, quartz fissures that can be traced continuously as far north as the St. Lawrence Mine on the Georgetown divide in El Dorado County.

The contract for the new bridge was awarded to H. W. Ruby, September 16, 1946 in the amount of $246,626.20, which includes the approach road connections. This project represents the largest single contract completed to date on State Route 65 extending from Auburn in Placer County, to Mariposa. This unit was taken into the State Highway System by legislative act of 1921, and is commonly known as the "Mother Lode" Highway.

The steel plate girders of 10 feet depth with reinforced concrete deck providing 26 feet clear width roadway between curbs designed for H-20 loading represent one of the most permanent types of bridges that can be built. The pedestrian walks 12 inches above the deck surface are made of steel floor plates which are rolled to 8 inch diameter semicircular at the roadway edge thus forming the curb and providing a continuous 4-inch drain. The railings consist of two 7-inch x 4-inch channels spaced 1 foot, 6 inches and 3 feet above the sidewalk floor, supported by 6-inch x 3½-inch channel posts at 12-foot centers.

The anchor girders at each end of the bridge have an over-all length of 112.5 feet extending from the abutments 25.5 feet beyond the piers and support the suspended span of 123 feet, giving a total bridge length of 348 feet. The clear span between concrete piers is 174 feet. An aggregate of 780,000 pounds of structural steel, 113,000 pounds of reinforcing steel, and 1,215 cubic yards of concrete were used in this construction.

Sand Drains

Continued from page 9 . . .

TABLE 1

List of Projects in Which Vertical Sand Drains Were Constructed in California Between 1934 and 1947

Location	County	Year completed	Height of fill (feet)	Depth of drains (feet)	Diameter of drains (inches)	Spacing of drains (feet)	Method of installation	Total lineal feet of drain	Cost of drain and backfill per lineal foot
Beatrice Flat	Humboldt	1934	3	40-50	28	10 x 10	Rotary drill	3,530	
El Cerrito	Alameda	1936	12	4-30	24-30	10 x 10	Rotary drill	4,871	0.72
School House Canyon	San Luis Obispo	1937	60	12-76	20-24	15 x 15	Rotary drill	1,204	
School House Canyon	San Luis Obispo	1937	60	48	13-15	10 x 10	Driven mandrel	11,256	1.06
Little Potato Slough	San Joaquin	1940	27	15-30	24	10 x 10	Rotary drill	10,644	0.62
Eureka Slough	Humboldt	1940	20	15-45	28	9 x 11	Rotary drill	15,045	1.18
San Luis Obispo Creek	San Luis Obispo	1940	10-25	7-66	18-26	10 x 10	Rotary drill	22,700	0.74
Ontario Gulch	San Luis Obispo	1941	63-70	8-56	18	12 x 12	Rotary drill	19,902	0.69
Harkins Slough	Santa Cruz	1941	34	6-21	20	11 x 13	Rotary drill	6,799	0.47
Watsonville Slough	Santa Cruz	1941	12	4-45	20	11 x 13	Rotary drill	8,246	0.47
Mokelumne River	Sacramento	1941	34	25-64	18	9 x 11	Rotary jet	45,865	0.66
Quay Wall-Mare Island	Napa	1942	25	79	14	8 x 10	Driven mandrel	28,000	
Casmalia	Santa Barbara	1943	45	38-75	20-24	11 x 13	Rotary drill	14,126	1.54
Port Chicago-NAD	Contra Costa	1944	17	11-60	14	10 x 10	Rotary jet	17,470	1.00
Port Chicago-NAD	Contra Costa	1944	15	15-26	14	12 x 12	Driven mandrel	49,061	1.00
Port Chicago-NAD	Contra Costa	1945	17	25-60	14	10 x 10	Driven mandrel	185,263	1.00
Port Chicago-NAD	Contra Costa	1945	7	30-40	14	9 x 9	Driven mandrel	167,648	0.60
Bayshore Freeway	San Mateo	1946	9-14	15-56	18	10 x 10	Driven mandrel	40,764	1.33
Bayshore Freeway	San Mateo	1947	8-14	15-56	18	10 x 10	Driven mandrel	221,374	0.84
Nicholson Approach	Los Angeles	1946	12-31	40	18-22	7 x 14	Jetted mandrel	13,240	1.29
Terminal Island Freeway	Los Angeles	1946	6-30	35-50	18-22	10 x 10	Jetted mandrel	119,123	1.09
Pacific Coast Highway	Los Angeles		12-42	32-48	18-22	9 x 11	Jetted mandrel	102,676	1.02

APPENDIX A

California Division of Highways

Typical Specifications for the Construction of Vertical Sand Drains and Sand Blanket

Sand Drains

Where shown on the plans or directed by the engineer, vertical sand drains shall be constructed as herein specified and as directed by the engineer.

The depth of the vertical sand drains will vary from 15 feet to 60 feet, the exact depth to be determined by the engineer.

Vertical holes, 18 inches to 22 inches in diameter, shall be excavated to underlying firm strata or to such depth as the engineer orders, and the holes backfilled with sand. The holes may be excavated by cutting or augering out the material, by jetting a casing down to the required depth, by driving with a pile driver and plugged mandrel, or by other approved methods. Any method of excavating or constructing the holes, which, in the opinion of the engineer is appreciably disturbing adjacent existing ground shall be discontinued. Holes that are out of place and holes that are damaged in excavating or during placing of sand backfill shall be backfilled and abandoned, if so ordered by the engineer, and no compensation will be allowed for furnishing materials or doing work on such holes.

If the contractor elects to excavate the holes by jetting a suitable casing to the required depth, the jetting shall be continued for a sufficient length of time after the casing has reached the required depth to remove all solid materials within the casing. After the hole has been backfilled with sand, the casing shall be removed.

Holes that contain muddy water shall be pumped out until the water does not contain more than two percent (2%) by volume of silt or clay.

Each hole shall be inspected and approved by the engineer before any sand filling material is placed therein.

Material excavated from the holes shall be disposed of as provided under "earthwork" of these special provisions.

Material for use in backfilling the holes shall consist of clean sand conforming to the following grading requirements:

Sieve size	Percentage passing sieve
½-inch	90 to 100
No. 8	25 to 100
No. 30	5 to 50
No. 50	0 to 20
No. 100	0 to 3

In determining the lineal feet of vertical holes (sand drains) to be paid for, the depth of each hole will be measured from the top of the working table to the bottom of the hole. The quantity of sand backfill (sand drains) to be paid for will be determined by weighing as provided in Section 9, article (a), of the Standard Specifications.

The price paid per lineal foot for vertical holes (sand drains) and the price paid per ton for sand backfill (sand drains) shall include full compensation for furnishing all labor, materials, tools and equipment and for doing all work involved in preparing the holes, furnishing and placing sand backfill and disposing of material removed from the holes, as specified above.

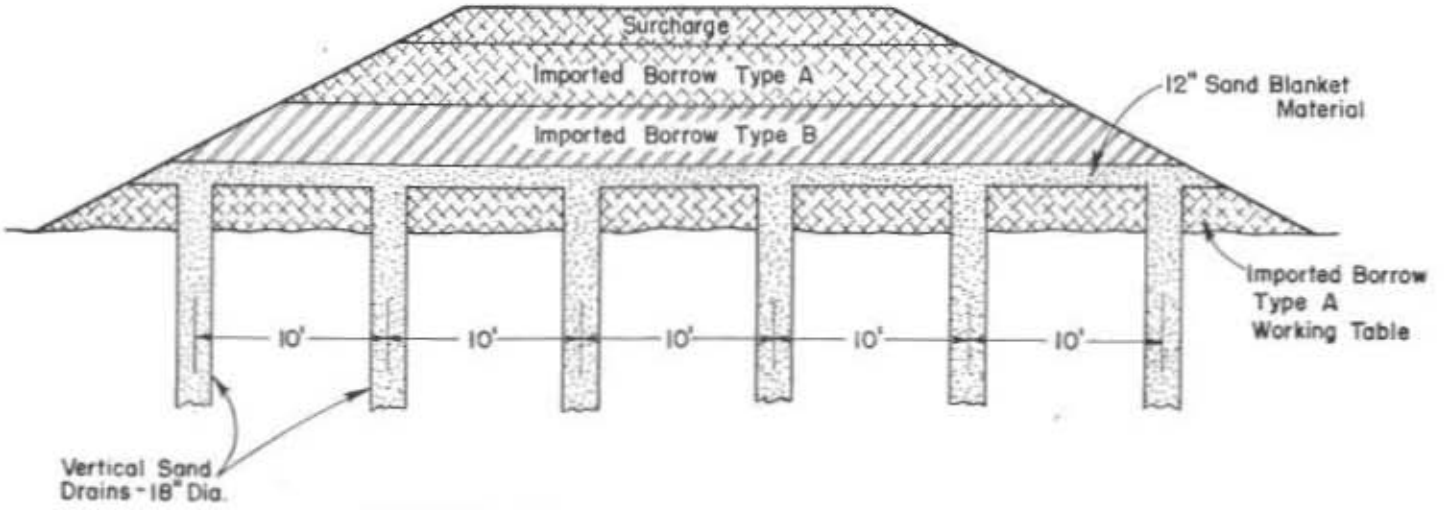
Sand Fill Material

A layer of imported sand fill material shall be placed over the top of the vertical sand drains. This layer shall cover the entire area where sand drains have been placed, shall extend to the outer initial slopes of the embankment and shall have a depth of one foot.

Sand fill material shall consist of clean, coarse sand or gravel conforming to the following grading requirements:

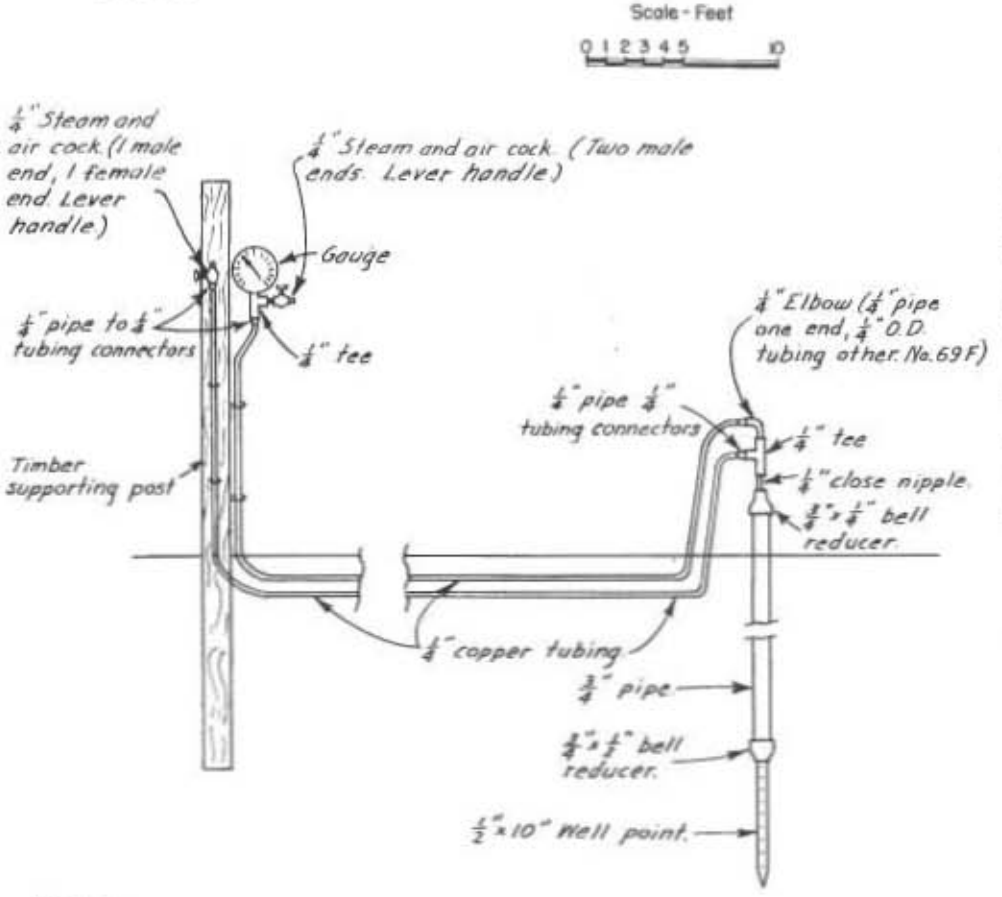
Sieve size	Percentage passing sieve
½-inch	80 to 100
No. 8	5 to 50
No. 30	0 to 20
No. 50	0 to 5

Prior to placing the sand fill material, the working table shall be bladed to a smooth plane and shall expose clean sand backfill material in the top of each sand drain to insure free shrinkage connections between the sand drains and the sand fill material. If the top of any of the sand drains is clogged or if the backfill material has become mixed with unsuitable material, the top of such sand drain shall be cleaned out before placing sand fill material. Sand fill material shall be placed in one layer by end dumping and spreading in a manner which will not disturb the vertical sand drains. The next layer of embankment material spread over the sand fill material shall be approximately eight inches thick before compaction and shall be placed by end dumping and spreading before rolling in such a manner that it will not become mixed with or displace the underlying layer



TYPICAL SECTION - SAND DRAIN AREAS

FIG. 8



PARTS LIST

1 - Well point
1 - ¾" × ½" Bell reducer
1 - ¾" × ¼" Bell reducer
___ ft. ¾" Pipe
1 - ¾" Coupling
1 - ¼" Close nipple
2 - ¼" Tees
1 - ¼" Elbow (¼" pipe one end, ¼" O.D. tubing other end. No 69 F).
3 - ¼" Connectors (¼" pipe one end, ¼" O.D. tubing other end. No. 68 F)
___ ¼" Copper tube unions (No. 62).
1 - Compound gauge 30# × 15" or 30"
___ ft. Copper tubing (¼")
2 - Caps ¼" (Brass)
1 - ¼" Steam and air cock. (Two male ends. Lever handle) Lukenheimer No. 381 or equal.
1 - ¼" Steam and air cock. (One male end, One female end. Lever handle.)

NOTE:

All compression type fittings to be Imperial or equal.

¼" Plastic tubing may be substituted for copper. If plastic is used, all fittings must be of the flared type

¼" Caps to be used on valve outlets

State of California Division of Highways Materials & Research Dept.	
PORE PRESSURE APPARATUS	
Approved: T. E. Stanton Materials & Research Engr.	Date 8-2-46

FIG. 9

of sand fill material. The remainder of the embankment shall then be constructed in accordance with the Standard Specifications and these special provisions.

Sand fill material (sand drain blanket) will be measured and paid for by the ton, as provided in the Standard Specifications, which price shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in placing the blanket of sand fill material as above provided.

Prior to constructing vertical sand drains, a layer of material shall be placed over the entire area where sand drains are to be constructed to form a working table capable of supporting light construction equipment and to provide access to the areas for construction of sand drains. The material shall be placed in a manner that will cause a minimum of displacement of the underlying mud. If the equipment used in construction of sand drains cannot be supported on the working table without displacement of the underlying mud, the equipment shall be supported on mats.

If the embankments are to be constructed of hydraulic fill material only one layer of such material, not exceeding three feet in thickness, shall be placed by hydraulic methods to form the working table specified above.

If the embankments are to be constructed of imported borrow, a layer of imported borrow shall be placed to form the working table specified above.

Material excavated from sand drain holes shall not be placed in roadway embankments within the limits for initial construction as shown on the plans but may be disposed of within the right of way but outside the limits for initial construction as directed by the engineer. Should the contractor elect to use jetting methods in excavating the vertical sand drains, the mud therefrom shall be disposed of to the satisfaction of the engineer.

Attention is directed to the unstable nature of the foundation materials in areas upon which embankments are to be placed and the necessity for placing embankment materials in layers of uniform thickness throughout the unstable area so as to consolidate the foundation properly and prevent excessive lateral displacement.

Embankment construction shall be so conducted as to safeguard the stability of the embankment at all times. If, in the opinion of the engineer, the rate at which material is being placed does not allow sufficient time for proper consolidation and stabilization of the foundation material, the State reserves the right to further restrict the rate of placing material or to suspend operations at any location as directed by the engineer. The total time during which operations may be suspended as above provided on any portion of the project shall not exceed twenty consecutive days, Sundays and legal holidays excluded.

The contractor shall furnish workmen to assist the engineer in installing embankment control equipment and the cost thereof will be paid for as extra work, as provided in the Standard Specifications. The contractor shall so conduct his operations as to assist in the placing of embankment control equipment and the protection of such equipment from damage during construction operations.

Full compensation for any delay or inconvenience to the contractor's operations by reason of the suspension of operations and the installation and protection of embankment control equipment shall be considered as included in the prices paid for the various items of work.

A layer of imported sand fill shall be placed over the top of the vertical sand drains as hereinbefore provided.

In order to accelerate subsidence, additional embankment material shall be placed as a surcharge at the locations and to the depths shown on the plans or as directed by the engineer.

After the rate of subsidence, determined by means of embankment control equipment to be placed as hereinafter provided, has reduced to an amount satisfactory to the engineer or after the resting period specified under "Order of Work" of these special provisions, surcharge material remaining above the required subgrade elevation, as shown on the plans shall be removed and used to flatten embankment slopes as directed by the engineer. Unless specifically directed by the engineer, no surcharge material shall be used to flatten embankment slopes within the areas where sand drains have been constructed. Removal and disposal of surcharge material will be measured and paid for as roadway excavation and overhaul.

Unique Span

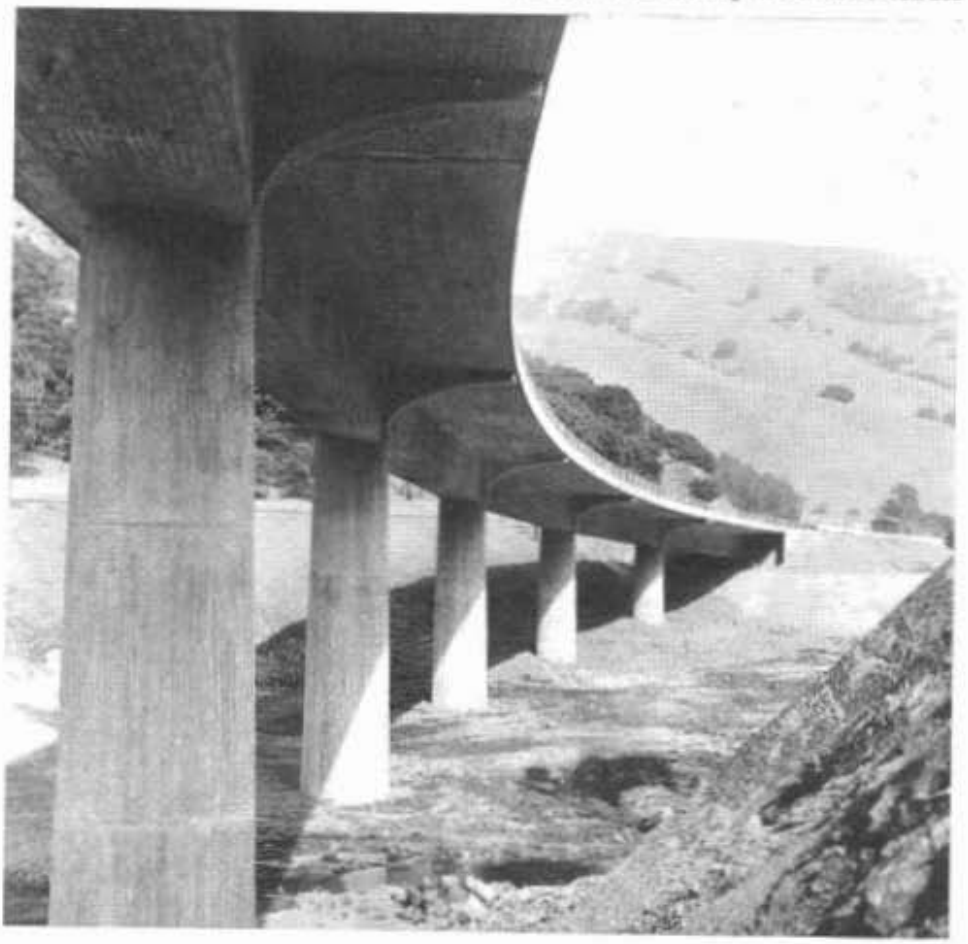
Continued from page 10 . . .

the railroad the width was gradually decreased and the number of boxes dropped from three to two, and finally to one for the last six spans.

The resulting structure with its thin section of reinforced concrete, single column bents, and long sweeping curves gives a streamlined appearance that is very pleasing. The circular piers supporting the deep narrow girders and the long overhang of the deck give the bridge a most unique appearance at the stream crossing.

The project was designed and constructed under the supervision of Mr. F. W. Panhorst, Assistant State Highway Engineer—Bridges. The contractors, R. G. Clifford and Louis Biasotti and Son, bid the job as a joint venture, with the Clifford organization constructing the bridge and Biasotti's firm doing the grading and paving. Mr. E. R. Foley was Resident Engineer for the Bridge Department.

New Alameda Creek Bridge as seen from stream bed



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Governor of California

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CHARLES H. PURCELL
Director of Public Works

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Deputy Director

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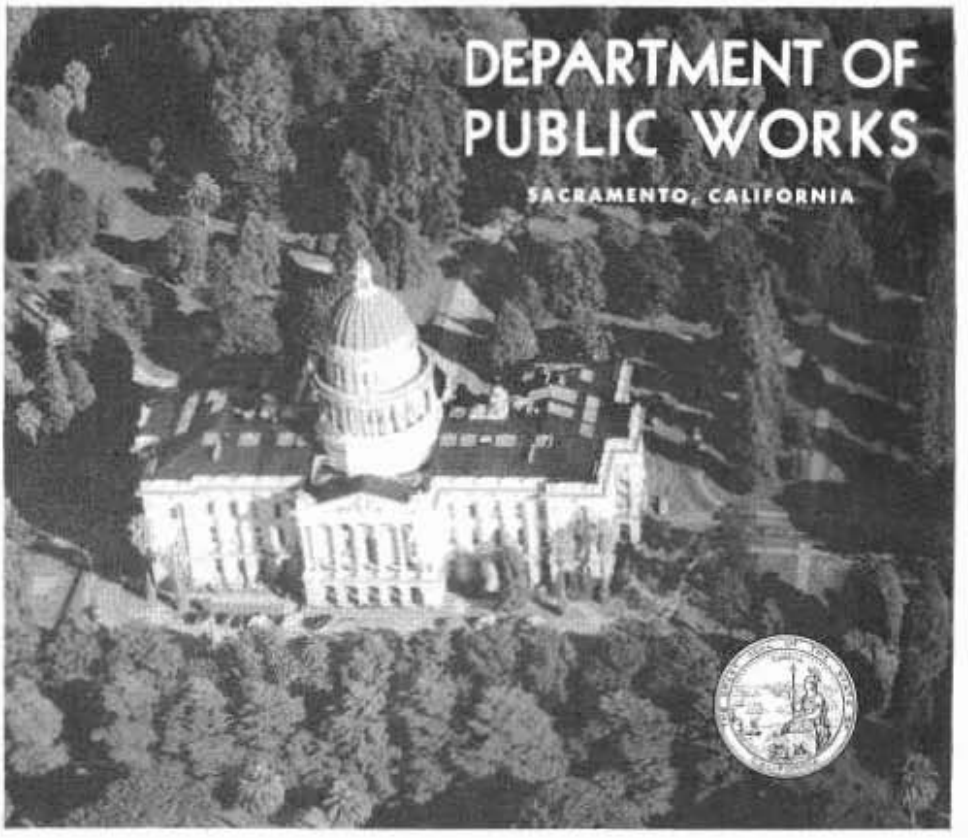

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