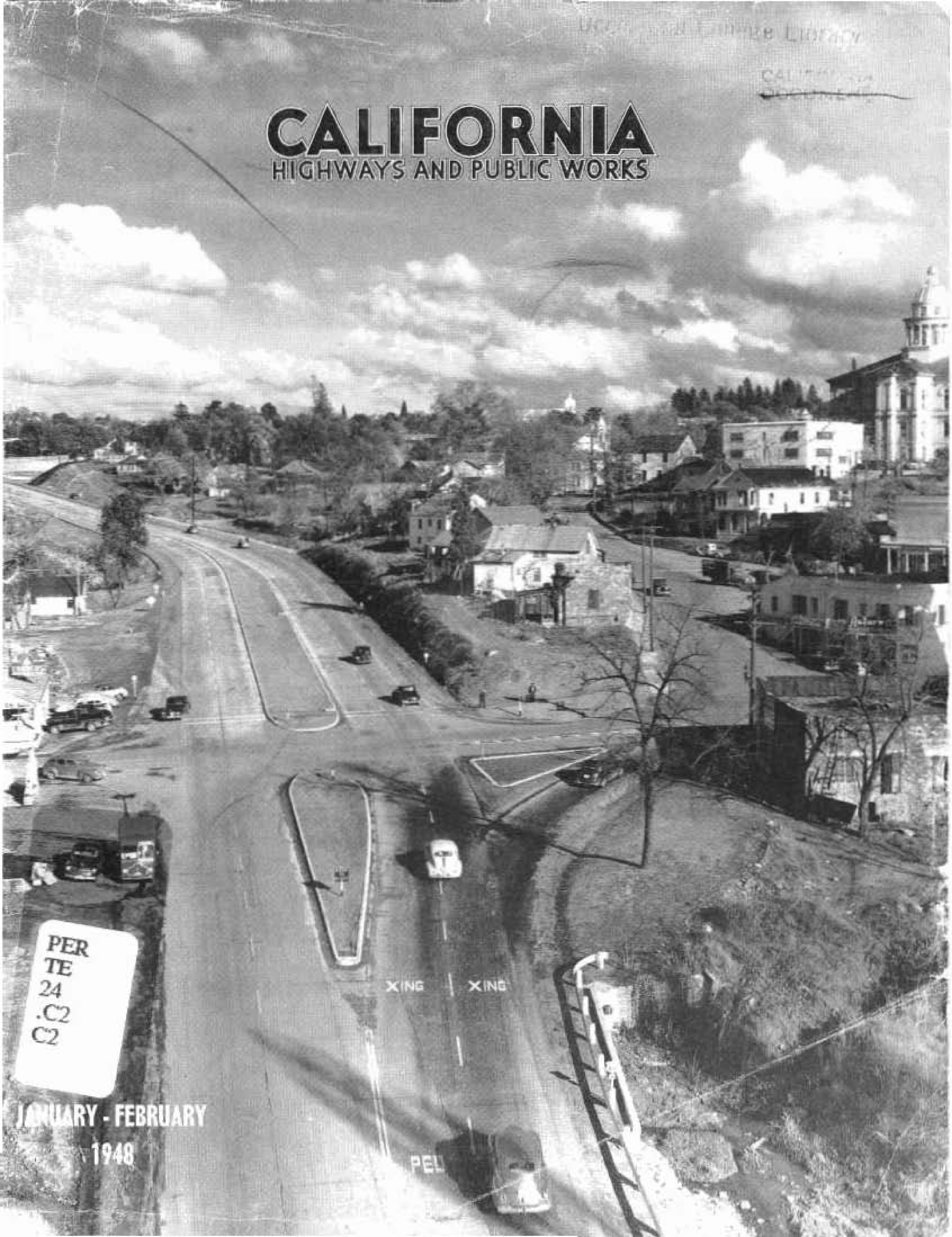
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



JANUARY - FEBRUARY
1948

California Highways and Public Works

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

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Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 27 JANUARY-FEBRUARY, 1948 Nos. 1, 2

Public Works Building Twelfth and N Streets Sacramento

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Rising Cost

More Money Is Required for Modern Highways Each Year

MAINTENANCE

By T. H. DENNIS, Maintenance Engineer

EACH of us in personal life has experienced the effect of the shrinkage of the dollar's value over the past six years. This downward trend is very evident in the field of highway construction, being reflected in higher costs and a resulting decrease of necessary work. To those of us engaged in maintenance, it is a constant threat to both the standard and the scope of our work. At the present time, we are attempting to meet the situation through a wider use of equipment and the concentration of our efforts on the more essential features of maintenance.

A comparison of today's costs of the major items of maintenance; namely, labor, materials, and equipment rentals, with those of 1941 reveals some startling figures. For instance, while the average monthly wage of all maintenance classifications was $123 in 1941, this same figure had increased to $223 in December of 1947—an increase of approximately 80 percent. As a result, the pay roll of the 2340 men engaged in maintaining our 14,000 miles of state highways today is more than that paid the 3495 men who were employed on this same work in July of 1941.

Materials likewise have risen above the 1941 index by approximately 50 percent. For example, the liquid asphalts, which cost an average of $6.50 per ton in 1941, are now

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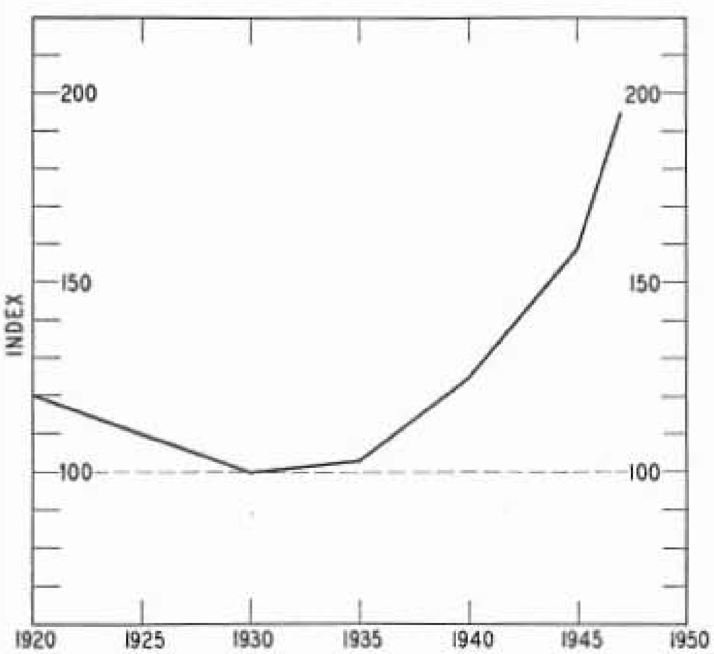
Trend of construction and building costs within the U. S. for the period 1920 through 1947, using 1930 as a comparative year with an index equal to 100.



CONSTRUCTION

By J. W. CORVIN, Assistant Traffic Engineer

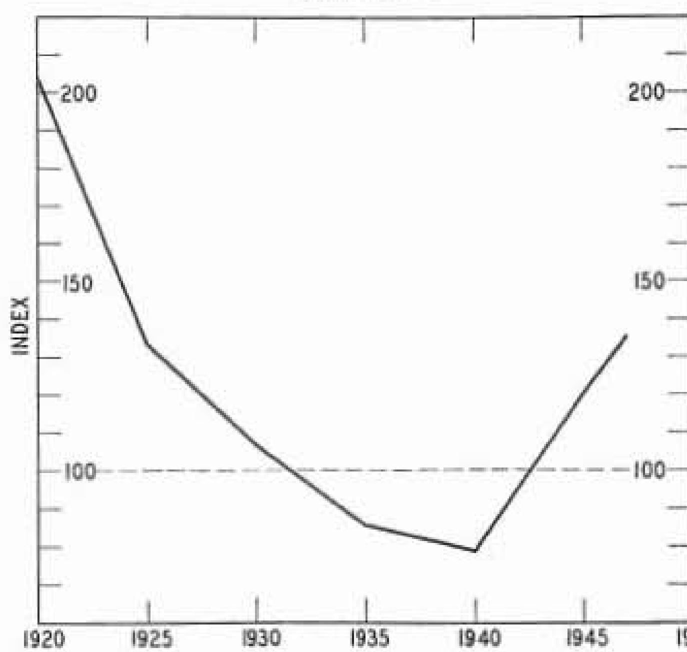
PRESENT-DAY vehicle speed, together with increased traffic densities, unite with the rising cost of labor and materials to make construction of highways—freeways in particular—a costly procedure.

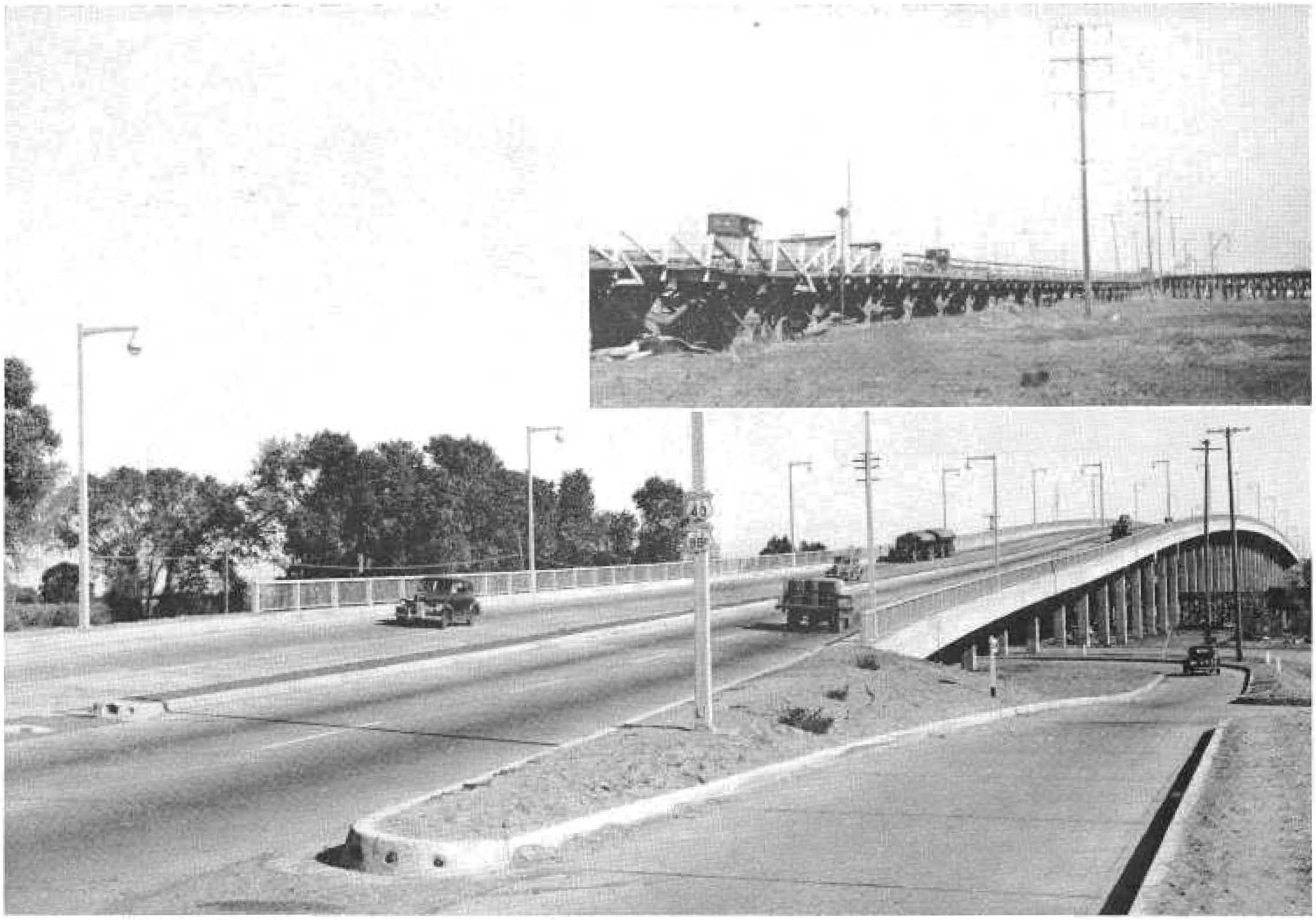
Back in the early twenties, the total motor vehicle registration in California amounted to less than a million. Roads and facilities were designed to accommodate the vehicles of the Ford Model T and Chevrolet 490 vintage.

Today the 1948 estimate for California vehicle registration is 3,600,000 of all types, and in the design of highway facilities consideration must be given to the characteristics of the 100 h.p. pleasure car and the heavy duty diesel truck and trailer. This design calls for heavy pavements, concrete structures, railroad grade separations—and on freeways, interchange structures.

Improvements and construction of this nature cost money. Back in the early twenties satisfactory roads could be built at costs ranging from $10,000 to $40,000 per mile. Today two lanes of Portland cement concrete pavement cost $35,000 per mile for pavement only without any other items of work. On a divided four-lane highway, if constructed of Portland cement concrete, the pavement item alone will amount to $70,000 per mile.

Trend of four major highway construction items compiled from actual costs on California highway construction projects for the period 1920 through 1947 and using the year 1930 as a base with an index of 100.





Back in the 1920's the wooden trestle shown in the insert sufficed to carry traffic across the overflow lands and the Western Pacific Railroad at the west end of what is now the North Sacramento Freeway. Modern traffic demands required the construction of the North Sacramento Viaduct, completed in 1942, and photographed from about the same position as the picture showing the old trestle.

Add to this figure the cost of rights of way, grading, drainage structures, and, if in urban areas, the cost of numerous grade separations, and the cost per mile increases by leaps and bounds.

A recent publication by the Federal Public Roads Administration containing a reprint from the American Society of Civil Engineers Proceedings covering an article and discussions on "Express Highway Planning in Metropolitan Areas," cites examples of estimated freeway costs in a city with a population of 300,000 at $2,500,000 per mile. Another example in this same publication indicates a cost of $1,000,000 per mile for construction, and rights of way costs ranging from $50,000 to $100,000 per mile.

Our natural tendency at first is to say that these costs are terrific and entirely out of line. However, in addition to the rise in prices, these present-day costs cover multiple-lane divided highways on which access rights have been acquired, and such facilities have been designed to provide the motorist, bus or truck operator with 1948 standards regarding sight distances, grades, turning movements, overall driving time and driving comforts.

The freeway is actually two roads; and in any comparison of unit costs per mile the total cost should first be divided in half; the dollar and cent value of improvements, such as controlled access, safety in turning movements, etc., should be considered; and the cost then compared on the basis of present-day cost indices.

The accompanying graphs show the cost trend on engineering construction, and on four major highway construction items from 1920 to 1947. The graph covering engineering construction is a composite curve constructed from the average of various governmental and private agencies, and plotted at five-year intervals. A smooth curve results, as the monthly and yearly variation due to depression, wage changes, and material shortages does not appear.

It will be noticed that since 1935 the curve indicates that costs have practically doubled. During the period covered by the chart, the rate per hour for common labor in California has increased from 30 and 40 cents to $1.35 and $1.50. This is no reflection on labor costs, as our standards and costs of living have increased accordingly.

The chart indicating the unit trend on four major highway construction

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Chief Engineer

Col. Ralph Tudor Heads New Division of Bay Toll Crossings

GRADUATE of West Point and with 24 years of outstanding engineering achievements in the Army and in public and private employment, Col. Ralph A. Tudor of San Francisco and Palo Alto will be Chief Engineer of the newly-created Division of San Francisco Bay Toll Crossings, Director of Public Works C. H. Purcell announced on January 12th.

The new division, which will be an agency of the Department of Public Works, will have charge of studies and surveys, preparation of plans, specifications and estimates for and the construction of any additional toll-highway crossings of San Francisco Bay. Col. Tudor will be responsible to Purcell, who built the San Francisco-Oakland Bay Bridge and under whom he worked from 1929 to 1941, during which period Purcell was State Highway Engineer of California.

Col. Tudor announced the selection of three assistants who will be with him in the San Francisco headquarters of the division.

Norman C. Raab, Supervising Bridge Engineer in the Bridge Department of the Division of Highways, Sacramento headquarters, was named Design Engineer for Bridges.

Edwin F. Levy, Associate Bridge Engineer, who was in headquarters of the San Francisco-Oakland Bay Bridge, will be Office Engineer, and Oliver R. Bosso, Associate Bridge Engineer of the San Francisco-Oakland Bay Bridge, will be in charge of surveys.

During 1929-1930, Col. Tudor was Assistant Bridge Engineer of the Division of Highways; from 1931 to 1936, he was Assistant and Senior Bridge Engineer, participating in the investigations, designs and construction of the San Francisco-Oakland Bay Bridge and from the opening of the span in November, 1936, through 1937, he was in charge of its operation and maintenance.

N. C. Raab

Col. Ralph A. Tudor

As Assistant Administrative Officer of the California Commission for the Golden Gate International Exposition during 1938, Col. Tudor had charge of planning and building exhibits and structures for the State on Treasure Island. In his capacity as Principal Bridge Engineer during 1939 and 1940, he had charge of operation and maintenance of state-owned toll bridges and assisted in the economic studies which led to the purchase by the State of Carquinez and Antioch Bridges and the refinancing of the San Francisco-Oakland Bay Bridge.

O. R. Bosso

Recalled to active service by the Army in 1941, Col. Tudor performed General Staff duty with the 40th Division (California National Guard) and as Engineering Officer, Portland, Oregon, Engineer District, U. S. Army Engineers.

As District Engineer in Portland, Col. Tudor was in charge of investigations, plans and construction of approximately $150,000,000 of military construction and the planning of over $300,000,000 of civil works, including completion of Bonneville Dam on the Columbia River, all basic investigations and designs of McNary Dam on the same river and Meridian Dam on the Willamette River. He planned and initiated a comprehensive study for the coordinated development of the Columbia River System and served as War Department representative on the Bonneville Power Administration Advisory Board.

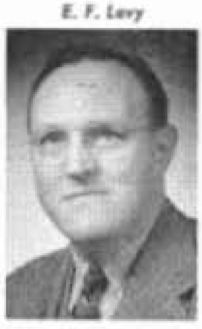
West Point Graduate

Following the cessation of hostilities, Col. Tudor became vice president of the Morrison Knudsen International Company and went to China where he conducted a survey of all Chinese railroads and parts south of the Great Wall and engaged in negotiations involving Chinese and American government agencies.

Col. Tudor has retired as a member of the firm of Seage and Tudor, Consulting Engineers, presently engaged in planning a toll bridge across the Columbia River at The Dalles, Oregon, and in economic and construction studies of the McNary Dam on the Columbia River.

Col. Tudor graduated from West Point with a BS degree in 1923 and from Cornell University with a CE degree in 1925. He is a member of the American Society of Civil Engineers and of the Society of American Military Engineers.

E. F. Levy



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F. A. S. Project

New Highway on Historic Site In Riverside County Completed

By WILLIS F. JONES, Assistant Highway Engineer

RIVERSIDE County recently completed the construction of a two-lane major county road on the Federal Aid Secondary System. The project began in West Riverside at the junction of "B" Street and U. S. Highway 60, known locally as Mission Boulevard, thence extended northerly along "B" Street and Crestmore Road for a distance of approximately three miles to the north boundary of Riverside County.

West Riverside is a fast-growing community with an expanding business section fronting on both sides of the four-lane, divided state highway on Mission Boulevard. It was on the present site of West Riverside that Louis Robidoux settled in 1844 and developed the first homestead in the Rubidoux Rancho.

The ranch house was an adobe structure on the north side of Mission Boulevard. Here, before the settlement of Riverside in 1870, was centered the social, commercial, and military activity of those early days in this section of Southern California. South of the homestead, across Mission Boulevard at the end of the street now called "Fort Drive," Robidoux erected what was probably the first grist mill in the southern section of the State. Its former site is now marked by a monument made of stones taken from the old mill. It was this grist mill that supplied the only source of flour for the American Army in this vicinity during the war with Mexico and the Civil War, as well as flour for the Mormon Battalion which assisted in the occupation of Southern California during the war with Mexico.

First Land Grant

On the south side of Mission Boulevard, the U. S. Government built a "fort" in 1852 which consisted of a walled enclosure where 200 soldiers

UPPER—At Fourth Street, looking northerly. Old road with 200-foot radius turning to left. CENTER—At junction in West Riverside looking northerly along the project. LOWER—At junction in West Riverside, looking west along U. S. 60 toward Riverside. Portion of Mt. Roubidoux in right background were stationed for several years to protect the settlers from the marauding bands of Indians. This "fort" at one time was in charge of Captain A. J. Smith, who later became one of Grant's Generals during the Civil War.

The Jurupa Rancho, of which the Rubidoux Rancho is a part, was the first land grant from the Mexican Government in San Bernardino County which then included what is now Riverside County. This larger Rancho extended along the rich bottom lands and the fertile bench lands of the Santa Ana River, from Colton to Rincon. In time, some of this large acreage was subdivided by private interests, roads were laid out, and irrigation lines installed.

In 1892, the County of Riverside took over one of these subdivision roads and built an improved road along the route just constructed along "B" Street and Crestmore Road. Subsequent improvements on this route were made until the present traffic, estimated by the county as 1,500 vehicles per day, with the increased weight of loads made the present improvement necessary.

Heavy Truck Traffic

The southerly section of the project traverses irrigated lands largely subdivided into 10-acre tracts. The trucking of farm and dairy products from these tracts contributed to this increased traffic. Adjacent to the northerly portion of the project are several commercial gravel plants and a large cement plant and the transport of the products of these plants in heavy industrial equipment, has required the construction of a heavier and wider type of pavement. This route also is an important north and south connection between U. S. Highways 60, 70-99, and 66.

The improvement was 2.9 miles in length. A 22-foot Portland cement concrete pavement, with two 8-foot plant-mixed shoulders, was constructed for 1.7 miles. Improvement of the remaining distance consisted of resurfacing an existing 20-foot concrete pavement with two inches of plant-mix surfacing and two 9-foot plant-mixed shoulders.

On Crestmore Road, looking northerly toward spur track crossing. Old reverse curves on left and behind tree on right

The satisfactory conclusion of this cooperative project was indicated in a letter from A. C. Keith, County Surveyor of Riverside County, to the Department in which he wrote, "We are proud of this improvement to one of our major county highways and wish to express our appreciation for the assistance and whole-hearted cooperation given this office by your department in carrying out our part in this improvement."

The contract was constructed by E. L. Yeager of Riverside at a cost of approximately $117,000 exclusive of engineering. The contractor commenced work on March 19, 1947 and all work was completed on August 25th.

The construction was under the supervision of Clyde V. Kane, District Construction Engineer, J. M. Cowgill was Resident Engineer, and Riverside County was represented on the contract by Deputy County Surveyor C. T. Wolsey. The design and plans were prepared under the supervision of A. C. Keith, County Surveyor.

Looking northerly toward grade crossing of Union Pacific Railroad's Crestmore branch. Old road on left

Hydrauger Method

Stabilizing Earth Slopes Through Installation of Horizontal Drains

By THOS. E. STANTON, Materials and Research Engineer

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

Construction and maintenance of highways in hilly and mountainous regions is frequently complicated by the activity of old landslides and by the development of new mass ground movements in unstable material during and following construction.

The presence of ground water is the most important factor influencing the development of slides and embankment slipouts. Subsurface water reduces the stability of cut slopes and foundations under embankments through saturation of the soil, thereby diminishing the shear resistance, and thus reducing the stability.

The weight of the ground mass constitutes a driving force tending to induce slide movements, particularly where hydrostatic pressures are induced in impounded ground water, thereby adding to the driving force. The earth masses often contain strata of plastic material with an unfavorable dip. Lubrication of this plastic material by subsurface water may result in sliding along such a zone. The stratum or zone along which the sliding occurs is described as a "slip-plane."

Corrective Treatment

When unstable areas cannot be avoided the structural design of the highway embodies the necessary corrective treatment. Embankment foundations may be stabilized by drainage trenches, vertical sand drains, or pervious blankets, and cut slopes may be stabilized by benching, slope flattening or unloading. However, where slipouts of previously constructed embankments or cut slopes occur sub-drainage of the slide mass is more difficult. Excavation of drainage trenches through slipouts is usually very costly and experience shows that deep cut-off trenches above the slipout are often not effective. Slides in roadway cuts are also frequently costly to correct by the usual method of unloading and slope flattening.

In recognition of the need for some more economical and effective method of stabilizing landslides through subdrainage the California Division of Highways in 1939 undertook to correct such conditions through the installation of perforated metal pipe drains in horizontal or slightly inclined holes. "Hydrauger" equipment was adopted for drilling the holes and is still being used, although numerous improvements have been developed in both the procedure and equipment. In general, the tentative locations, lengths, and required number of drains are determined by a preliminary investigation consisting of vertical test borings and a geological survey. The final locations and lengths of drains are determined by conditions encountered during the installation.

Many Drains Installed

Since the first horizontal drain treatment of unstable areas in 1939, a total of 53 slides and slipouts on the State Highway System have been treated in this manner. Approximately 1,150 horizontal drains have been installed with six state-owned hydrauger machines, the total length of drains aggregating over 130,000 lineal feet. The horizontal drain installations are functioning satisfactorily with very little maintenance and, in general have proven very effective in stabilizing the treated areas, although occasional cleaning of the first 15 to 20 feet of the drains has been required in some cases to remove matted root growth entering through the perforations. In future installations it is planned to substitute solid pipe for the perforated pipe in portions of the drains near the surface where root growth can be anticipated.

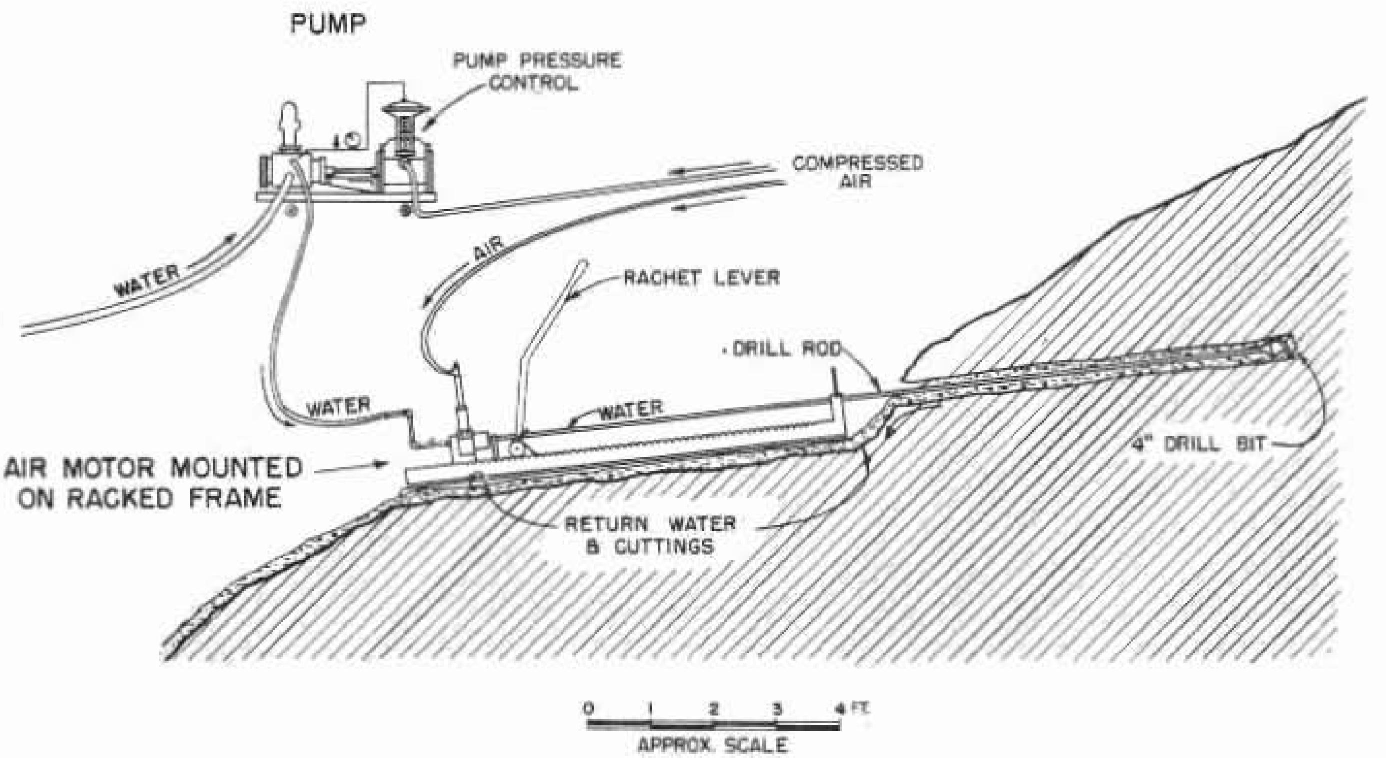
As a result of eight years' experience with this method of treating unstable areas, a general procedure has been developed. When a slide or slipout occurs, a preliminary investigation is made including foundation studies with vertical test borings and a geological survey to determine the structural composition of the mass and the cause, extent and direction of the movement. When the investigation indicates that improved surface drainage facilities alone will not eliminate the disruptive effects of subsurface water without large scale excavation of drainage trenches, unloading or slope flattening, the installation of horizontal drains is usually adopted as the most economical method of correction.

Tentative locations, lengths and number of drains required to drain the area effectively are estimated during the preliminary investigation of the probable ground water table, permeability of the material to be drained and location of water bearing strata supplying the reservoirs of impounded ground water. The final locations and lengths of drains are determined by conditions encountered as the job progresses.

Experience has shown that a modified procedure, utilizing vertical sand drains in conjunction with the horizontal drains, is very effective for draining highly stratified areas composed of flat lying sedimentary deposits interbedded with plastic clay. The vertical drains perforate the impermeable clay layers, releasing ground water from the upper portions of the mass to the horizontal drains.

Method of Installation

The horizontal drainage treatment of slides and slipouts by the hydrauger method is conducted by a traveling drill crew assisted by men from the local District Maintenance Stations. All of the equipment normally required for the work is carried by the traveling



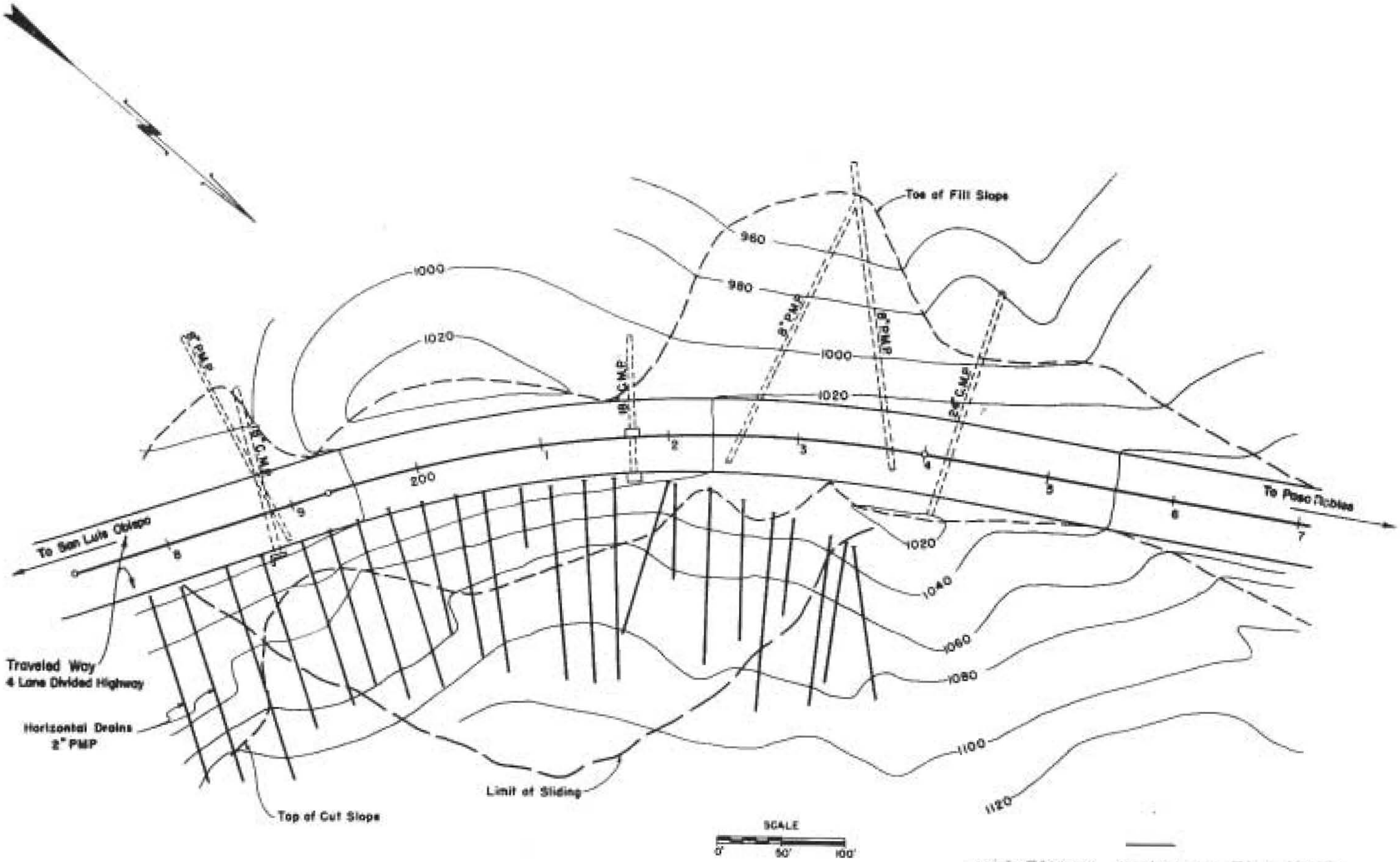
TYPICAL SET-UP FOR DRILLING HORIZONTAL DRAINS

crew, with the exception of the perforated metal pipe which is stockpiled at convenient locations throughout the State.

The first operation consists of clearing or benching to accommodate the drill equipment at the tentative locations proposed as outlets for the drains, and establishing water and compressed air supply to the hydrauger units which utilize air motors for power and water for washing the hole and cooling the bit. Whenever possible, local water from springs, small streams, etc., is utilized, but on some occasions it is necessary to haul water in tank trucks.

An air compressor and water tank are placed at convenient locations, and pipe lines of the proper size are laid to the job site with take-offs at the proposed drilling locations. The size of pipe which is dependent on the pressure and volume of air and water required by the units and the distance transmitted, normally varies between 1½ inches and 3 inches. The volume of water and air used per drilling unit varies with different types of material and

Hydrauger in drilling position at Grapevine slide



HORIZONTAL DRAIN INSTALLATION
CUESTA GRADE

formations which may be encountered, and air consumption is also affected by the elevation above sea level at which the units are operated. On the average job, a 120 c.f. compressor is used per unit and 4,000 gallons of water is consumed in 8 hours.

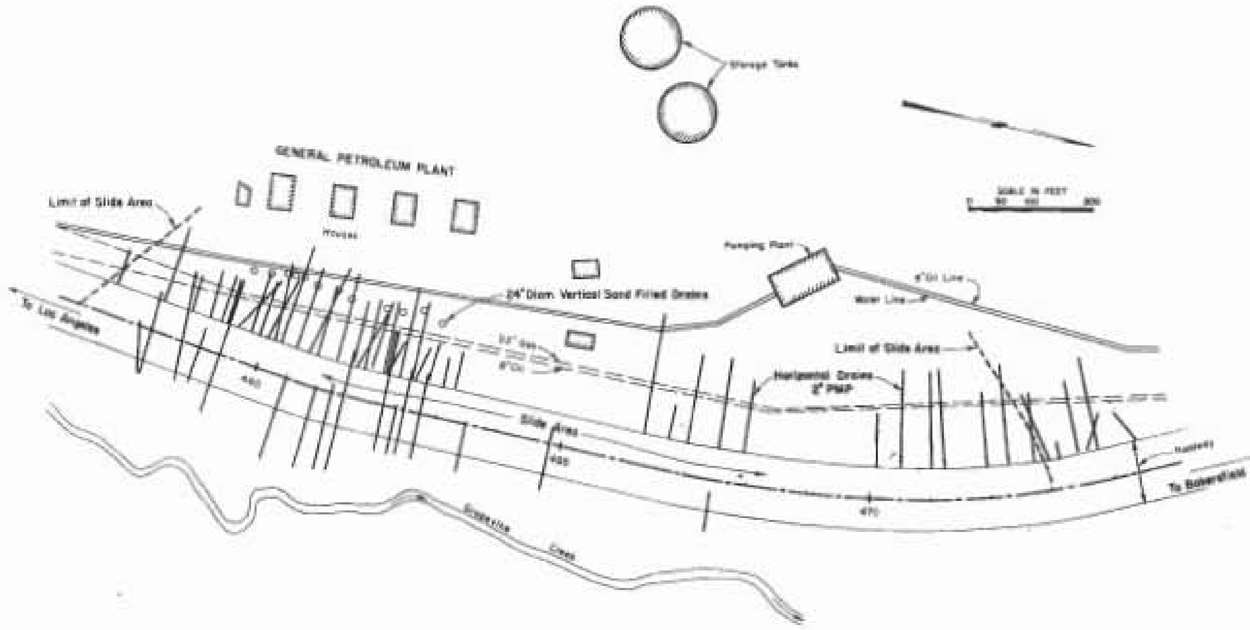
After the air and water supply lines have been constructed, the track is set up at the proposed location and adjusted for the proper slope and direction of the hole. The hydrauger is then placed on the track, connected to the water and air lines with flexible rubber hoses, and the drilling started.

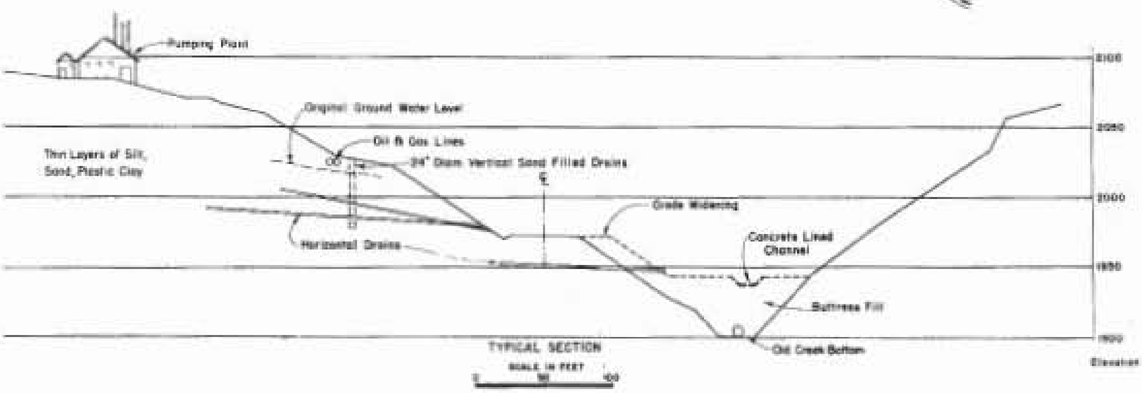
Drilling Process

A 4-inch auger type bit is started in the hole, and water is pumped through the hollow Diamond Drill "A" rod as the air motor revolves the drill in a clockwise direction. The bit is then advanced into the hole by a ratchet device mounted on the air motor frame. Additional drill rods, in 5-foot lengths, are added as the drilling proceeds.

When the desired depth of hole has been reached, the drill rod is backed out and the hole is ready for the installation of the perforated casing. The air motor is replaced by a ratchet type jack, and the casing is jacked into the

Two units drilling at Cuesta Grade





DRAINAGE OF SLIDE AREA
GRAPEVINE

Horizontal and Vertical Drains Used To Lower Ground Water Table

hole. The sections of 2-inch perforated metal pipe, used for casing the holes, are approximately 21 feet in length. They are butt-welded, as the casing operation proceeds, to form a continuous drain for the entire length of the hole. The casing, which is perforated on three-quarter points, is usually installed with the perforations placed up in order to carry seepage water past cracks and fissures in the slide area; however, through sandy strata it is often advantageous to place the perforations down to prevent silting and blocking of the drain.

Changes in Technique

When all of the drilling and casing operations have been completed, the individual drains are tied into a larger common drain, and led to culverts or other disposal areas out of the slide area.

Since the first horizontal drainage system was installed in 1939 numerous changes in the drilling technique have been made. New drilling tools have been evolved for work in different types of formations, and other changes

Drilling slide at Camp Cajon with hydrauger

are contemplated as the necessity arises. In the original outfit the hole was drilled with a 2½-inch pilot bit followed by a 4-inch reamer. Experience showed that the holes could be drilled with less difficulty by substituting a 4-inch auger bit for the pilot, and eliminating the cumbersome reamers, which often wedge in a hole constricted by movement of the unstable mass. A set of reamers is still carried as standard equipment, but are used only where a hole greater than 4 inches in diameter is desired.

Auger Bit Improved

The standard 4-inch auger bit has been greatly improved by installing a carbaloy insert in the lead point, and by facing the sharp cutting edges with tube borium or other hard facing materials. Hard, dry, clayey shales and soft sandstones, which stopped the older type bit, are easily drilled with the improved bit.

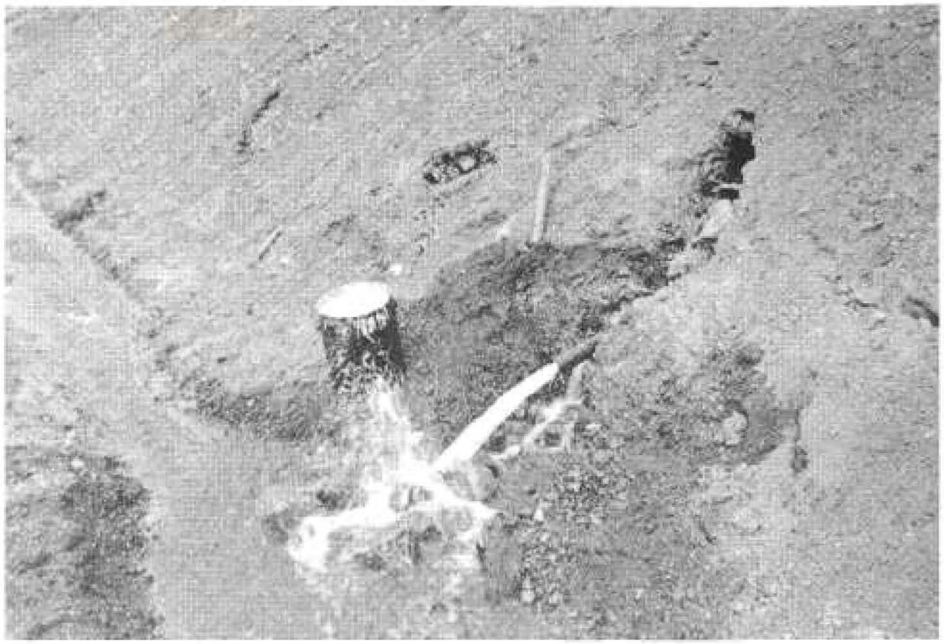
Special rock-type auger bits with seven carbaloy insets in the lead and cutting surfaces of the bit are being used for drilling in shale, sandstone and partially decomposed granite.

At Camp Tejon in Kern County, three holes were recently drilled in partially decomposed granite with this special rock bit, to an average depth of 122 feet. Several years earlier when this same slide area was drilled with the older type bit, the greatest depth attained was 80 feet.

Hard Rock Drilling

The presence of hard float rock and conglomerate in some slide areas has seriously handicapped drilling operations when using any of the auger type bits. Recently, this department acquired several standard diamond bits and core barrels for use in conjunction with the "Hydrauger" equipment for drilling through hard rock.

Experimental drilling with this equipment has shown very satisfactory results although the unit cost for core drilling is considerably higher than when auger bits are used, as the tools must be withdrawn each time a 10-foot core is taken. Therefore, the horizontal holes are usually started using the auger bit and when hard rock is encountered, the diamond bit and core barrel are substituted for the auger bit. After cutting through the rock and pulling the core, the drilling is resumed with the auger bit.



Flow from horizontal drain in Cloverdale slide at rate of six thousand gallons per hour

A modified fish-tail type bit has been used occasionally in sandstone and shale strata. Although this type of bit cuts fairly fast, directional control is difficult for any considerable length, and the use of this type bit for the entire length of the hole has not been satisfactory.

Active Slide Areas

As most of the locations where horizontal drains are installed are in active slide areas where the ground is in a saturated, unstable condition, some difficulty has been encountered in casing the holes after they have been drilled. By using a folding-type bit and a double track set-up, it is often possible to drill and case the holes in one operation. The drill rod is run through the 2-inch perforated casing with a 4-inch folding bit immediately ahead of the end of the casing. The drill and casing are moved ahead together to the required depth of hole. The drill rod is then backed out, collapsing or folding the bit and drawing it out through the casing.

In some localities, firm material is encountered at the start of the hole with saturated free-running sand or silt layers near the end of the hole. When this condition is met, the practice has been to jack the casing as far as possible and then to jet through the sand layer.

One of the greatest difficulties that we have had installing horizontal drains has been in holes where loose rock or broken shale strata have been intercepted. The loose rock falls into the hole, and due to the action of the bit, the rock is rolled around in the hole and not drilled. Under such conditions extreme care is necessary to keep the drilled hole straight, and in order to install the perforated casing the loose rock must be removed from the hole. Working in this type of material is difficult and often costly, but it is believed that much of the trouble could be eliminated by circulating a heavy mud under pressure through the hole instead of water, as is normally done.

Chief Engineer

Continued from page 3 . . .

Office Space Leased

Purcell requested and received approval of the Department of Finance to lease from the Secretary of the Army approximately 6,531 square feet of floor space on the fifth floor of the Call Building, 74 New Montgomery St., San Francisco, which was occupied by the newly created division January 12th.

Freeway Projects

Their Known Effect on the Value Of Adjacent Land in California

This is the second 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.

Subdividers in Los Angeles city and county, perhaps because of the very outstanding and advanced views of the City Planning Commission and the County Regional Planning Commission, have gone further with their plans of subdividing acreage without permitting access from properties abutting upon the main arterial to the through lanes of traffic than any other section of the west. In Los Angeles city and county you will find a very large amount of mileage on main arterials where the abutting property has no right of access to the through lanes of traffic.

Typical examples are Sepulveda Boulevard. *(See photographs 7 and 8 showing the front view of the same properties.)* (Sepulveda Boulevard will soon be converted into a freeway.)

Other typical examples of the subdivider himself barring access from the abutting property to the through lanes of traffic are along Ventura Boulevard in the San Fernando Valley section of the City of Los Angeles. *(See photograph No. 9 showing a very high type of residential development along the outer highway immediately adjacent to the through lanes of traffic.)* My investigation discloses that the front foot value of lots fronting on this outer highway is a little over double the value of lots on the next paralleling cross street.

A further example is Long Beach Boulevard where the subdividers in cooperation with the planning commission, are developing all residential properties for many miles on an outer highway. The main arterial will shortly be converted into a multiple-lane divided highway and because of the foresight of the subdividers, this development automatically becomes a limited freeway, with the abutting owners having access to the through lanes of traffic only at intersecting cross streets. Here again an investigation discloses that on these very modern type residential developments the lots fronting on the outer, highway have a very much higher front foot value than do the lots on the next paralleling street. *(See photographs 10 and 11.)*

Along Crenshaw Boulevard in the City of Los Angeles *(See photograph 12)* we again find a long section of highway where the subdivider on his own initiative created a limited freeway, and in this case multiple residence front foot values on the outer highway are three and four times the front foot values of lots zoned for multiple residential development on the next paralleling street.

Foothill Boulevard

Along our State Highway Route 9 identified as Foothill Boulevard between the cities of Pasadena and Arca-

Subdivision along Sepulveda Boulevard in Los Angeles County

This is front view of subdivision section shown in photograph No. 7

dia, there are two major subdivision projects, one the Haskell Estate, containing several hundred acres, with approximately a mile and a half of frontage, with only two entrances to the through lanes of traffic, these at existing intersecting crossroads. The other, one of the finest suburban subdivisions in all of Southern California, known as Santa Anita Oaks, consisting of several thousand lots with approximately 2½ miles of frontage on the state highway.

In this case the subdivider provided an outer highway along a portion of the distance and on the remaining portion

Ventura Boulevard, U. S. 101, in vicinity of Valley Vista Boulevard

of the subdivision the corner lots front on the state highway and the intersecting cross street, with the purchaser of such a corner lot having no right of access to the through lanes of traffic. Where the lots front on the outer highway the lot owner travels along such outer highway to the next intersecting cross street at the point where it intersects the state highway for ingress and egress to the through lanes of traffic.

The access rights were granted to the public by the subdivider at the time the Board of Supervisors of Los Angeles County accepted the tract subdivision, along with the dedication of subdivision streets as public roads.

Frankly, I know of no case along several hundred miles of State Highway in California where market value has depreciated because the subdivider has constructed his own outer highway and therefore restricted access from the abutting property to the through lanes of traffic, or because the subdivider has backed the first tier of lots up to the main arterial and dedicated the access rights, thus prohibiting access from the abutting lots to the through lanes of traffic. On the other hand, I have given you numerous cases where the subdivider because of construction of the outer highway has, as a result of the enhanced market value of the lots fronting on such outer highway, realized a very substantial profit on his investment in the outer highway. The same is true of residential subdivisions where the first tier of lots back up to the main highway.

Limited Freeway

We now come to the limited freeway, and I wish to first briefly touch on the limited freeway along entirely new alignment. In this case our attorneys have ruled that under the California Freeway Law and with a resolution having been first passed by the California Highway Commission declaring such new traffic facility to be a freeway, the abutting property owner has no right of access to the through lanes of traffic. It will be obvious that in most cases the property owner has all of the facilities for ingress and egress from the existing system of streets and roads that he enjoyed previous to the acquisition of right of way for the new limited freeway facility.

There are, however, some isolated cases where the severed portion of the property may perhaps be landlocked because of the taking of access, and in the case of a landlocked parcel we must determine whether we will allow an opening from the through lanes of traffic for ingress and egress or whether we will acquire the entire severed parcel and sell it to one of the adjoining owners.

In California we have followed this latter procedure in a number of instances and any financial loss to the taxpayer because of our success in eliminating an opening into the through lanes of traffic has been too negligible to mention. Of course, in those cases where we allow an opening from the through lanes of traffic to the landlocked parcel, this parcel would then for the purpose of our discussion be in the same category as any parcel along an existing conventional type of highway that is being converted into a limited freeway, insofar as the damage because of taking of access is concerned.

Looking west along Manchester Avenue at Truxton Avenue, in southwest Los Angeles

It must also be kept in mind that in discussing our subject as it pertains to limited freeways along new alignment, it is obvious that the affected property owner is entitled to the fair market value of the land taken and the fair market value of severance, if any, to the remaining property; and that the taking of access rights would be considered as an element of severance damage.

We should, however, be careful in considering the elements that go to make up the severance damage to which the property owner is entitled, that we do not find ourselves allowing a certain compensation for the severance damage that is created because of the construction of the improvement in the manner proposed, and then again allowing the same damage because of the fact we are taking the access rights. Also we must be careful that we do not in our own minds become confused and allow additional damages for the taking of the access rights when in reality the taking of such rights has only created an inconvenience because of circuity

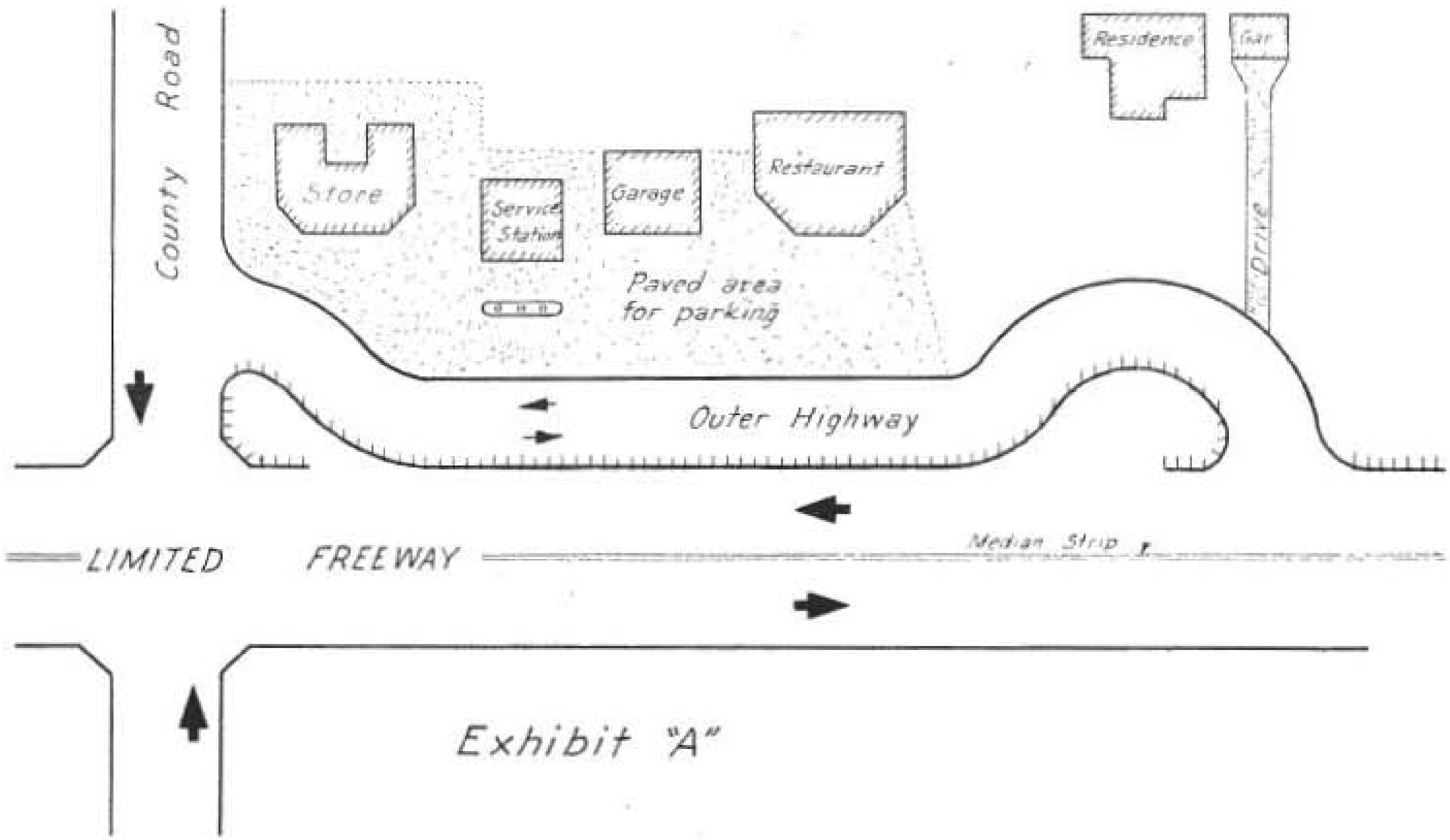


Exhibit "A"

of travel to get from the one portion of the property to the severed portion.

A number of actual sales that have taken place along limited freeways on new alignment where limited freeways have been constructed in California, have convinced me that the taking of access rights on this type of an improvement represents practically no additional element of damage over and above the normal severance damage that the property owner would suffer.

Enhanced Market Value

On the other hand, in practically every case a very definite benefit accrues to the property, although I again concede it may be a general benefit. Nevertheless, the property owner with whom we are concerned enjoys a definite enhanced market value to his property because of the location of this new limited freeway facility, and we are supplying this property owner not only with a new highway facility but a super-safe facility supplying a rapid means of transportation from his particular piece of property in both directions to market centers.

Before we can clearly understand the effect of freeway development on adjacent land values in California, or in any other state, we should study each affected property to determine its highest and best use. Obviously if the highest and best use is for agricultural purposes, the taking of access rights will have no effect whatsoever upon the productivity of the farm and I contend that the inconvenience in operation results from severance damage which would exist if we did not take the access rights.

It follows that the taking of the access rights from farm property represents only an inconvenience in operation which is far offset by the improved traffic facility we are supplying; permitting the owner to travel to his source of supply and outlet for his products, with a maximum safety and speed.

In case the highest and best use of the property is for industrial purposes whether already developed or potential industrial development property, the modern trend in the operation of manufacturing plants should be studied carefully as you will find that the developer wants to limit insofar as possible the number of access facilities from the system of streets and roads to the manufacturing plant.

We are merely legally enforcing a limitation that the modern industrial plant places upon its property because the owner has discovered the advantages of limitation of access in added safety, security, and reduction of outside influences thereby greatly reducing the plant policing problem.

As a matter of fact, I can cite to you many modern industrial subdivisions where the subdivision streets are purposely laid out as cul-de-sacs leading out from a secondary street with access to the adjacent arterial limited to perhaps only two points, although there

Looking north along outer highway adjacent to Long Beach Boulevard at 44th St. in North Long Beach

may be 20 or more industrial plants in the subdivision, with several thousand employees.

If the highest and best use of the property with which we are concerned is residential subdivision or roadside business development, we should determine the most practical manner in which it can be developed without access to the through lanes of traffic, or with tight limitations on the means of access to the through lanes of traffic; and with this thought in mind, I am submitting several rough sketches showing ways of development with tight access control which in my opinion supply adequate ingress and egress facilities without depreciating the market value of the property. An excellent example of this type of development is the Ford Foundation Housing Project at Dearborn.

Upon reference to *Exhibit A* you see an outer highway with proper bulb design taking off from the county road at a point 50 to 100 feet from the intersection of the county road and freeway right of way line and extending for a reasonable distance to a termini on the

. . . Continued on page 39

Looking north on Crenshaw Boulevard, Leimert Park, Los Angeles

Innovations

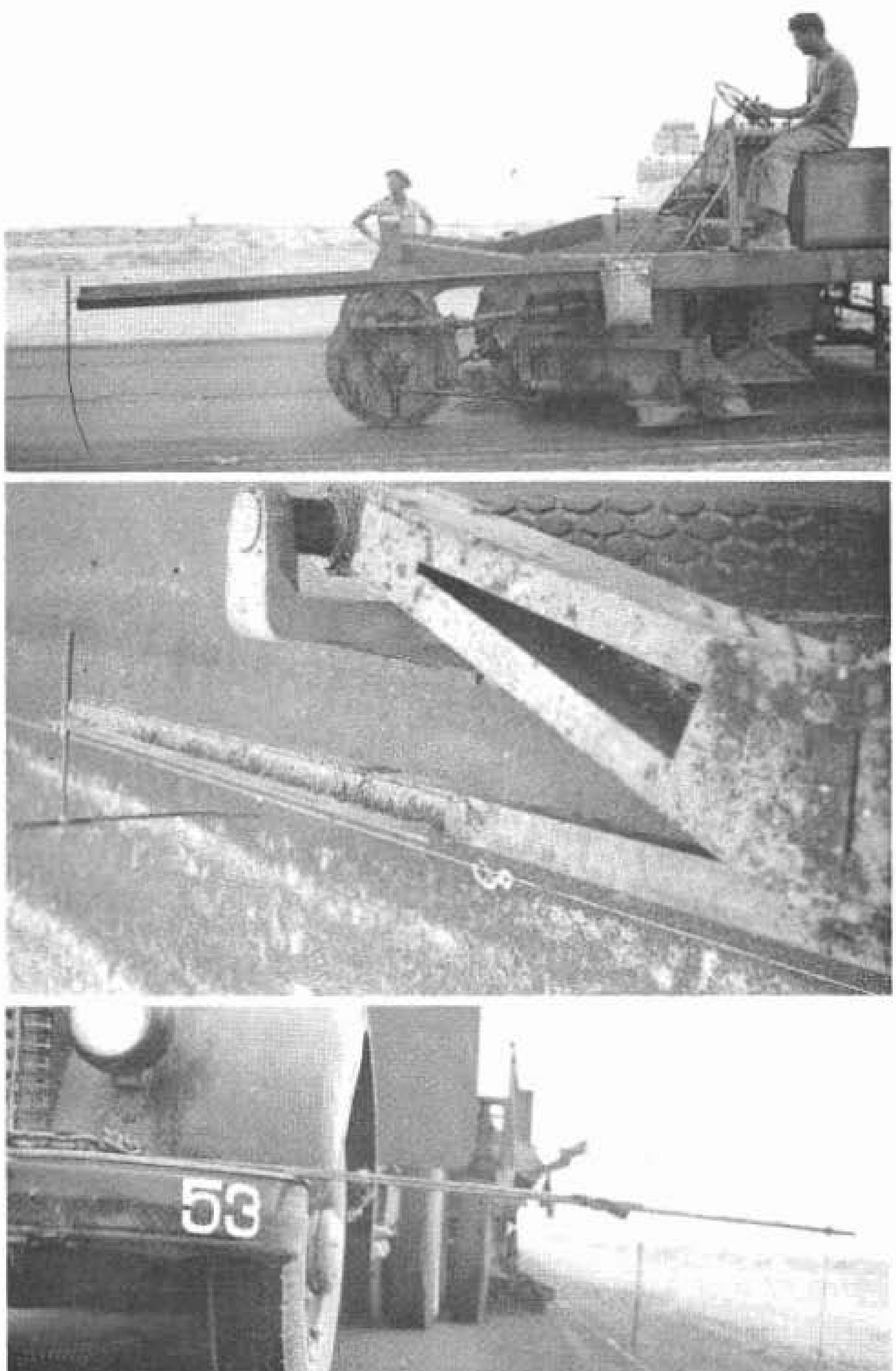
New Devices on Paver Conceived By California Highway Engineers

By EARL WITHYCOMBE, Construction Engineer

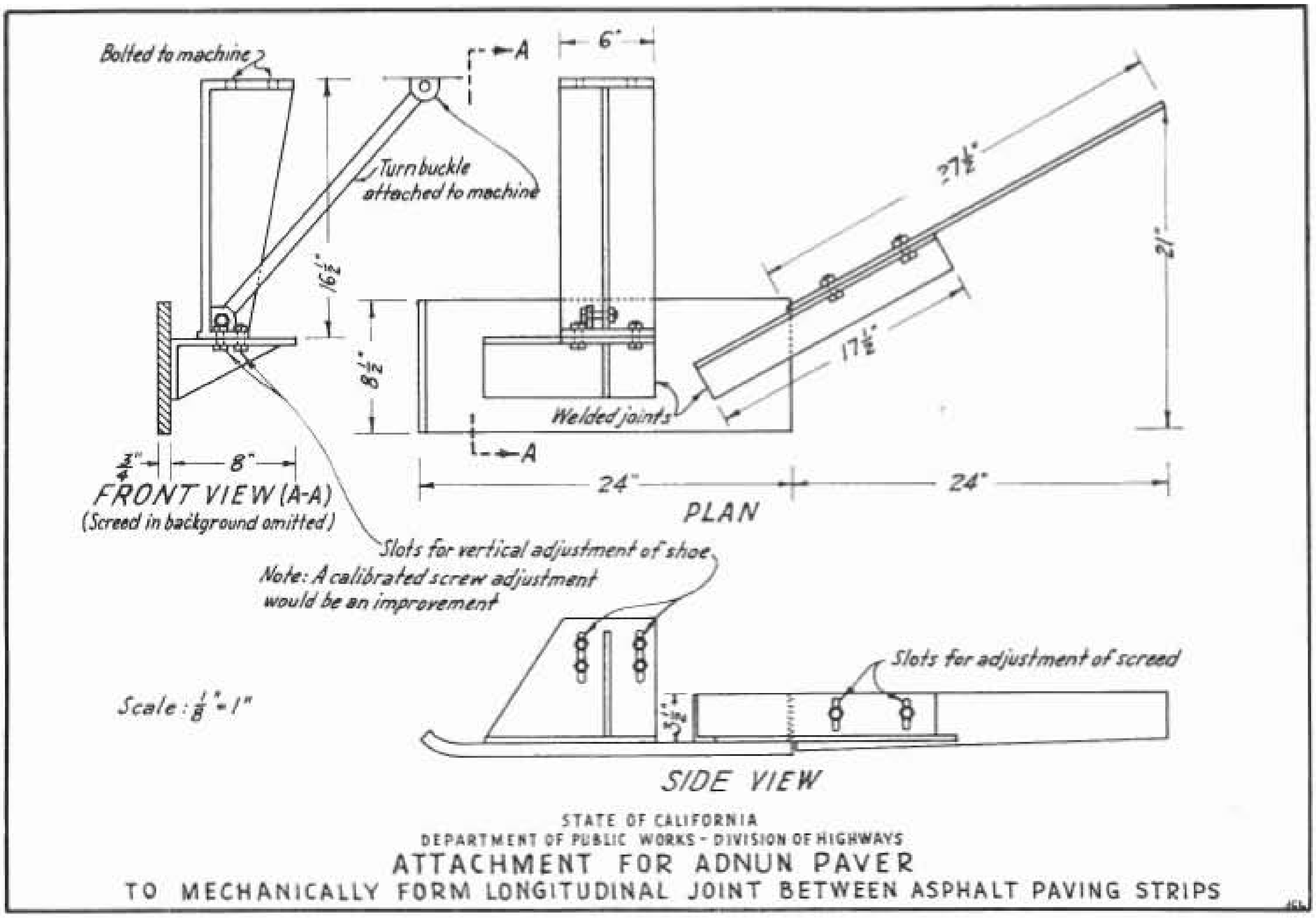
SOME DIFFICULTY is usually experienced in maintaining a true line to the spread on nearly every surfacing job where the Adnun Paver is used for the first time. On the project on U. S. 466 between 12 miles east of Mojave and Muroc, Kern County, the Adnun was giving excellent results except that the operator could not control the spread to any uniformity of alignment with the machine as it was equipped. Resident Engineer C. G. Gates, in cooperation with the contractor, Basich Brothers, worked out means of overcoming this difficulty that will be of value to anyone else using the same type of equipment.

The usual chalk line stretched along the shoulder was insufficient in itself as a guide to the operator, and a 3-inch x 3-inch x 12-foot length of ¼-inch angle iron was welded to the frame of the paver on the operator's side, so that it projected about 6 feet beyond the front wheels. To this was welded another section of angle, back to back, to give rigidity. An adjustable rod with set screw was fitted through a pipe guide at the forward end of the channel projecting out over the shoulder and a vertical pointer suspended from the end from which to measure position from the previously stretched chalk line.

Difficulty was experienced in properly spotting variable width trucks. Some were so wide that there was little clearance between the rear tires of the truck and the steering wheels of the Adnun. To remedy this a stick with a weighted string was fastened to the front bumper of the truck from a previously placed mark each time it backed into the paver. With some ex-



UPPER—Looking down on steering guide from operator's seat. CENTER—Side view of paver, showing steering guide. LOWER—Steering guide for trucks.



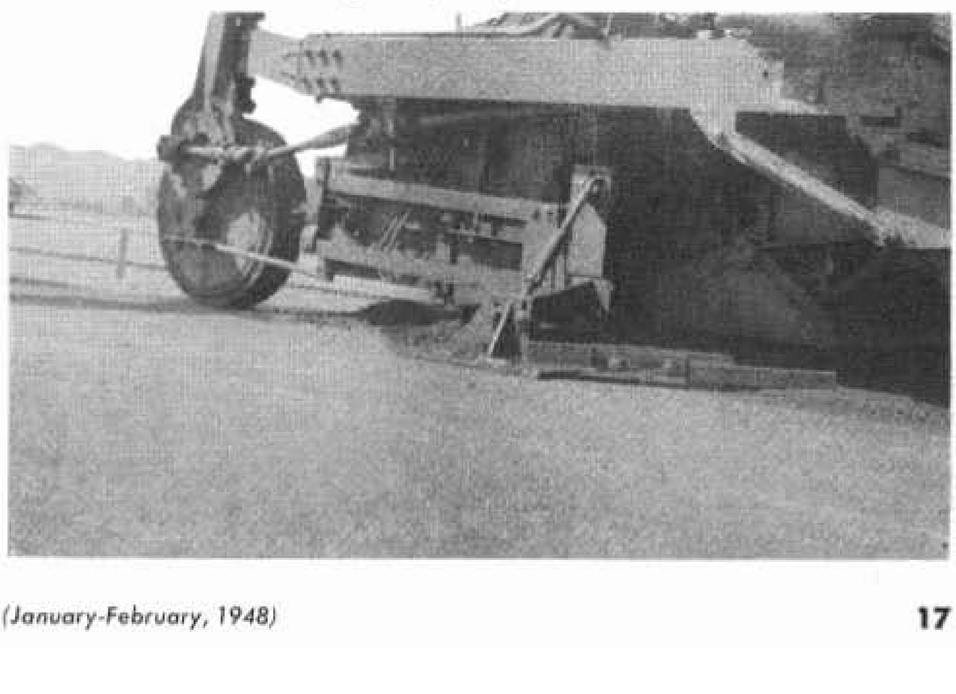
perience on the part of the truck driver this could later be discontinued without experiencing any difficulty.

On this project, as with nearly every other paving job where self-propelled spreading and finishing equipment is used, it was found desirable to chain each truck to the paver with a single chain hooked to the front bumper of the truck.

A mechanical means of forming the longitudinal joint between adjoining strips of asphalt concrete paving has also been developed on a contract on the Bayshore Freeway from Colma Creek in South San Francisco to Broadway in Burlingame by the combined efforts of the contractor, Macco Corp. & Morrison-Knudsen Co., and the Resident Engineer, H. A. Simard.

The device eliminates the necessity of hand raking. It is attractive to the contractor from the cost standpoint and to the engineer because of uniformity in results. The attached sketch and pictures of the device are sufficient guide to construct and install it on any job. The device was developed for the Adnun Paver, but it is believed it can be adapted to any type of self propelled finishing machine.

Longitudinal joint shaper attachment



Pavement Design

Effect on It of Inherent Volume Change Characteristics of P. C. C.

By N. C. McCORKLE, Assistant Engineer, Surveys and Plans

PHYSICISTS tell us practically all matter changes volume with variations in temperature and Portland cement concrete is no exception to the rule. Furthermore it has been ascertained that concrete also changes volume in response to variations in moisture content. Thus a concrete pavement is not completely inert, as one might suppose, but is instead constantly changing volume and shape in response to differences in temperature and moisture content, roughly following variations in atmospheric conditions. It is the purpose of this paper to discuss the influence of the foregoing described behavior on the design of Portland cement concrete pavements.

Goldbeck [1*] found that concrete shrinks as much as .05 percent upon loss of moisture but being unable to detect a shortening of pavement slabs concluded that the damp subgrade supplied enough to make up for surface evaporation. Hatt's [2] studies verify Goldbeck's findings relative to total shrinkage but he was also able to measure a shrinkage of .02 percent in pavement slabs subjected to controlled conditions. Measurements by the California Division of Highways [3] of weakened plane joint openings in a mile long section not provided with space for expansion disclosed an average shortening after correcting for temperature of .0039 percent in concrete paving slabs two years of age. Some indeterminate portion of this shortening may have been due to plastic flow since the concrete doubtless experienced relatively high compressive stress during periods of hot weather.

Subgrade Moisture

Inasmuch as Hatt completely dried the subgrade by artificial means it seems probable that the shrinkage he found is considerably in excess of that to be expected in normal conditions. Our studies [4] indicate damp subgrade to be the rule even at the end of the dry season.

On the other hand Teller [5] reports a gradual increase in the length of a 40-foot test section totaling one part in ten thousand over a period of four years. The growth reported is apparently from slab length *after* solidification, and since there is some evidence that concrete experiences a slight decrease in volume during the transition from a plastic to a solid state the possibility of an overall net decrease in dimension in even this instance is not ruled out. The preponderance of evidence seems to indicate that in the absence of reactive aggregate, paving slabs tend to decrease slightly from their cast dimensions.

Seasonal Variations

Teller,[5] the California Division of Highways,[3] et al, have found that seasonal variations in the average temperature of pavement slabs frequently reach 70 degrees and that daily fluctuations may exceed 30 degrees F. *(See Fig. 1 for typical example.)* It is not customary and probably not feasible to schedule paving operations to insure solidification at minimum temperature and at least a tendency toward periodic contraction from the cast dimensions of pavement slabs could be anticipated even if shrinkage from loss of moisture were preventable.

It can be easily demonstrated that a temperature drop of only 16 degrees or so below that prevailing at the time of solidification would break a monolithic slab into units of a length depending principally on the amount of frictional resistance offered by the subgrade even if no other destructive forces were acting. This was such an obvious explanation for the troublesome transverse cracking that was developing in long paving slabs, that early engineers called the weakened plane joints introduced for crack control "Contraction Joints." Unfortunately, the name persists even though it has long since been demonstrated that axial stresses are normally a minor factor in transverse cracking.[4]

Moisture Variations

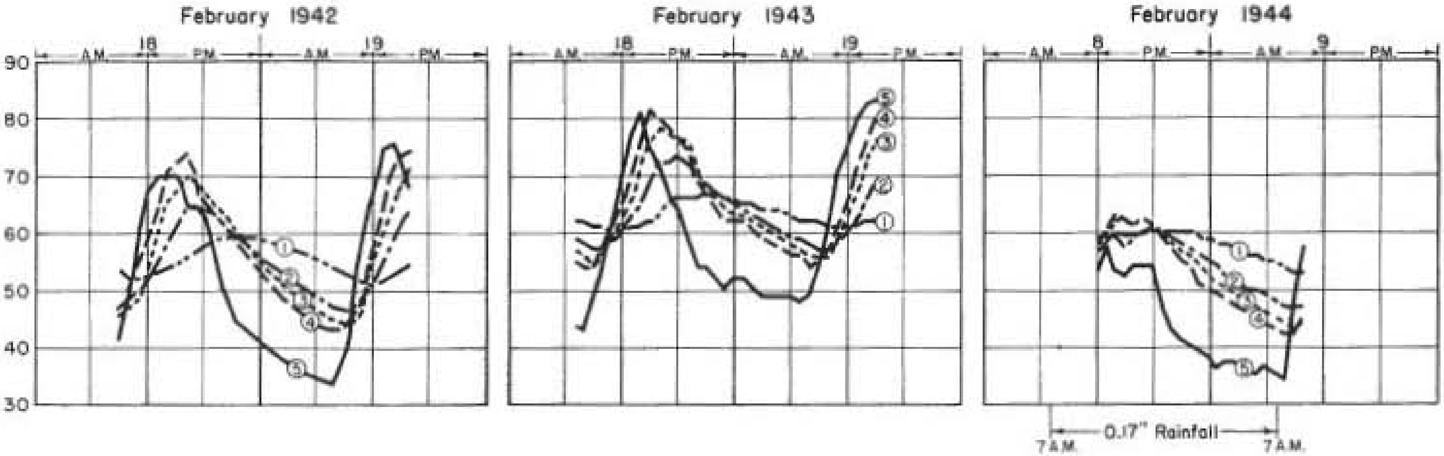
Several investigators have shown that variations in moisture and temperature conditions are almost invariably present through the vertical dimension of the slab and that the shape of the slab is correspondingly affected. Hatt [2] reported an upward curling of slab corners of .20 inch due to differential moisture. This behavior was confirmed by Teller [1] and further substantiated by profilometer measurements obtained by Galloway.[6]

Profilograph records of a considerable mileage of concrete pavements scattered throughout California show that the majority of slabs present a slightly concave upward profile. *(See Figure 2.)* Incidentally, the amount of curling in some slabs exceeds the theoretical maximum attributable to the combined temperature and moisture differential by a wide margin and it appears that some exterior influence, presumably differential volume change and/or displacement of the subgrade, is also a contributing factor in this behavior.

Fluctuation in Temperature

The daily fluctuation in temperature in response to atmospheric conditions is usually accompanied by a reversal in gradient though the slab and moisture curling is accordingly alternately augmented and opposed by temperature curling. Westergaard [7] concluded that stresses from temperature curling often reach magnitudes sufficient to develop transverse cracks at intervals of from 15 to 25 feet in unreinforced pavement slabs. The tendency for a majority of pavements laid with planned joints at 30 feet or over to subsequently suffer transverse cracking at intervals approximating this order seems ample verification of this theory even though the behavior is not invariable.

* References to figures in superscript are to be found on page 39.



Daily Temperature Records

VII-Ven-79-C Station 484 + 57
9"-7"-9" Slab Thickness
North Lane

Legend

- ① - Subgrade 6" below concrete slab
- ② - Bottom 1" of concrete slab
- ③ - Center of concrete slab
- ④ - Top 1" of concrete slab
- ⑤ - Air

All time shown is Pacific War Time

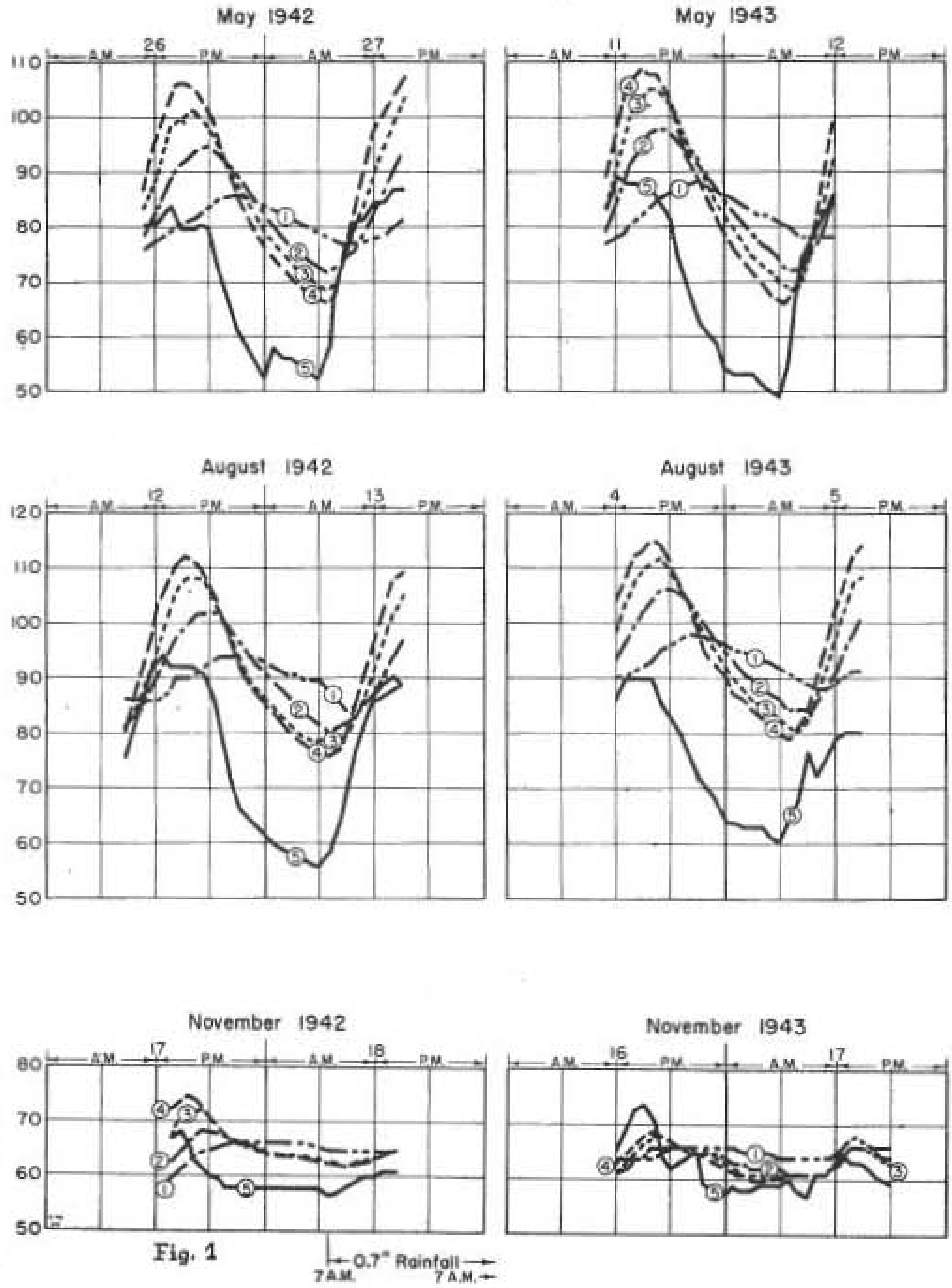


Fig. 1

The conclusion seems inescapable that an *unreinforced* pavement composed of Portland cement concrete as commonly manufactured and of a thickness determined by customary load carrying requirements will have joints whether contemplated in the design or not. If planned joints are not provided at relatively frequent intervals then sufficient unplanned fractures will automatically occur to relieve the stresses that normally accumulate subsequent to solidification. It appears that these initial fractures are not the result of compressive stress but are chiefly due to flexural stresses set up by moisture and temperature curling; less often as the consequence of direct tension induced by frictional resistance of volume change.

Joint Faulting

It is self evident that the presence of joints destroys the continuity of structure and it follows that the effect of a given load varies with the point of application, i.e., the maximum deflection of a slab under edge loading either dynamically or statically applied is normally much greater than that resulting from a similar load imposed in the interior area.[5] Furthermore, unless some adequate provision is made for the transfer of shearing stresses between adjoining slabs, rolling loads seem to deflect the leading edge of the approaching slab a greater amount than the contiguous edge probably due to the greater velocity at which the deflection takes place. Experience has shown that on any but a strong, rigid, erosion resistant base this can be depended upon to ultimately develop the now familiar and much discussed joint faulting or "stepoff."

Joint Openings

Where the spacing of joints is at intervals of from 15 to 20 feet the opening from shrinkage or contraction alone seems to be of a small enough order to permit reliance upon aggregate interlock for load transfer if further opening can be prevented. The factor of safety is slight however as it has been definitely shown that the load transfer capabilities of aggregate interlock decrease sharply with a small opening of the joint.[9] Obviously the elimination of space for expansion will keep cracks or weakened plane joint openings to a minimum and thus insure more reliable performance of their load transfer functions.

Between about 1915 and 1930 many hundreds of miles of concrete pavements were constructed in the U. S. A. without expansion joints. While some of these have shown no evidence of distress attributable to this omission, others have buckled or "blown up" manifestly as a result of excessive compressive stresses.

Expansion Theories

While the literature contains only meager references to this phenomenon it appears that early engineers quite generally accepted the obvious but superficial conclusion that the expansion forces generated by high temperature alone were responsible and searched no further for an explanation. Of recent years enough additional information has been obtained concerning the volume change characteristics of concrete and the temperature ranges likely to be experienced in a pavement to show that other important factors must be involved. Unfortunately, the identity of the additional factors is largely conjectural. Certainly reactive aggregate is a major element in some instances.

Sheets [10] offers the plausible explanation that the infiltration of extraneous incompressible material into cracks and weakened plane joints during periods when the pavement is in a contracted state reduces the space available for subsequent expansion and submits the experiences of five states in support of this view.

The many miles of pavement in the U. S. A. constructed without provision for expansion that have served a long period of time without evidencing signs of distress from expansive forces

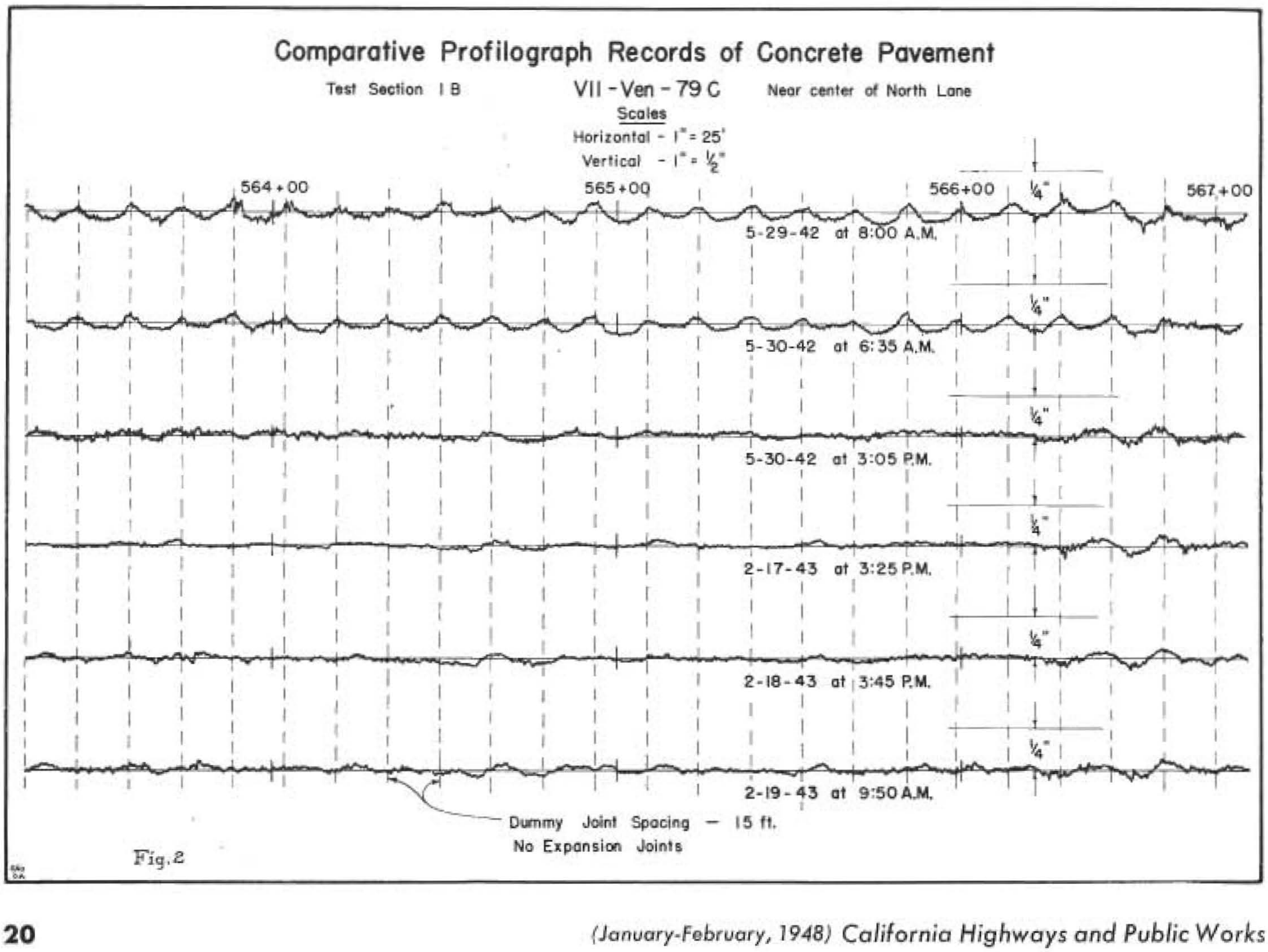


Fig. 2

are proof that space for expansion is unnecessary *if certain yet to be determined precautions are observed.* In view of the meager knowledge of the factors contributing to the occurrence of "Blowups," it therefore appears prudent to approach any decision to eliminate expansion joints with caution, especially if construction is likely to be carried on in cold weather. This is particularly true in areas that experience wide temperature ranges.

Pavement Pouring

Other things being equal, a pavement poured monolithically could be expected to develop fewer breaks in longitudinal continuity than one provided with properly designed weakened plane joints sufficiently numerous to insure against intermediate cracking. This is because concrete is of variable strength and crack control must be based upon the capabilities of the portions with the least resistance to cracking. Since joints are undesirable for a number of obvious reasons any acceptable means to reduce their numbers represents improvement and it might appear that monolithic construction comes in this category.

Experience has disclosed a serious objection to this design in the tendency for unplanned transverse cracks to "crowfoot," that is, for the initial crack to run out at a skew leaving a weak corner to be subsequently detached by the passage of heavy loads.

Another objection more concerned with aesthetics than with structural adequacy is the unsightliness of random cracking. This would be somewhat less of an objection if sealing could be omitted or accomplished with materials offering less contrast in color than those commonly in use.

This photograph shows one of several similar cracks that developed between 80 and 300 feet from an unrestrained end of a long unreinforced concrete pavement. No expansion joints were provided

Spalling Problems

Furthermore, under certain conditions the natural crack interval may be so great that the opening due to shrinkage and contraction will be of sufficient magnitude that aggregate interlock cannot be depended upon for load transfer. Serious spalling may also develop as a consequence of the relatively large slab end movements common to long joint spacing. Cracks occurring near the ends of long slabs unrelieved by expansion joints are particularly vulnerable and in such cases the spalling may actually become destructive. *(See accompanying photograph.)*

Thus we arrive at a dilemma: If we supply the space for expansion essential to provide an adequate factor of safety against potential blowups we reduce the efficiency of aggregate interlock for load transfer at weakened plane joints. Furthermore, a practical and dependable load transfer device has not yet been developed for use at expansion joints. On the other hand, if we eliminate space for expansion we achieve maximum protection from joint faulting but at the expense of a greater liability to blowups.

California's current design practice represents a compromise in that space for expansion may or may not be provided as the climatic condition to be

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A Warning

Don't Hastily Buy or Sell Land Abutting on State Freeways

By RAYMOND S. J. PIANEZZI
Assistant Chief Right of Way Agent—Administration

THE STATE highway systems of our Nation are going through a rapid expansion period, with California, because of the enactment of the Collier-Burns Highway Act by the 1947 Legislature, leading the way.

Many miles of freeway are being constructed in and through our metropolitan areas, with several hundred miles of our main cross-state highways in rural districts being converted into limited freeways.

Because the public generally is not as yet fully informed concerning legalities involved in freeway construction the Division of Highways feels impelled to reiterate this warning:

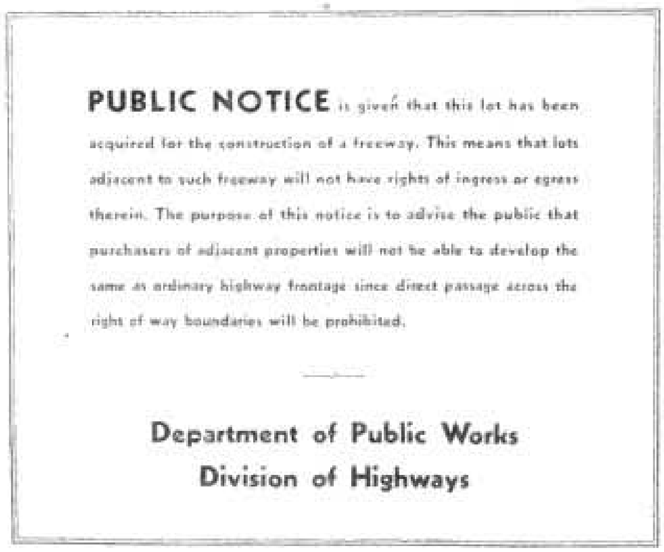
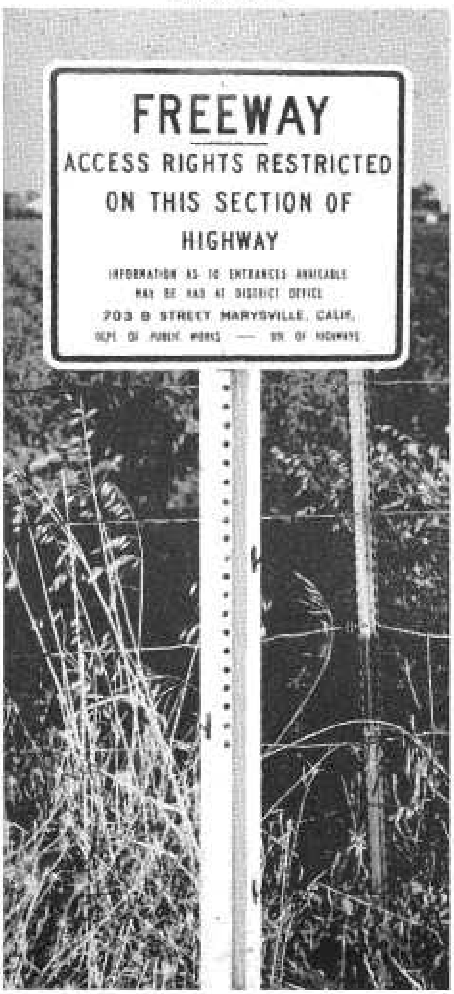


Photo No. 1

Photo No. 2



When listing, buying, selling or appraising real estate along the State Highway System, proceed cautiously. Look, read, and ask questions.

The Legislature in 1939 enacted the Freeway Law, which, as set forth in Section 23.5 of the Streets and Highways Code, defines a freeway as "a highway in respect to which the owners of abutting lands have no rights or easement of access to of from their abutting lands or in respect to which such owners have only limited or restricted right or easement of access."

The act authorized the California Highway Commission and the Department of Public Works, Division of Highways, to designate certain routes as freeways, to acquire the necessary rights of way and rights of access from private property, and to construct and maintain such freeways.

The abutting owner under no circumstances is permitted access from his property to the through lanes of traffic along freeways in the metropolitan areas and all intersecting cross streets cross the freeway on grade separations.

Frequently one or more tiers of lots fronting on one side of an existing street or highway are acquired for freeway development with the existing streets being utilized for the outer highway.

Experience has proven that often the owners of the next tier of lots as well as community real estate brokers become optimistic over the possibility of these lots becoming very valuable because of highway frontage. This optimism is unwarranted for the reason that the next tier of lots will continue to have the same means of ingress and egress to the existing system of local streets and highways and will be permitted access to the through lanes of traffic of the freeway only at points designated by the California Highway Commission.

If you are the owner of such property or the prospective buyer of it and

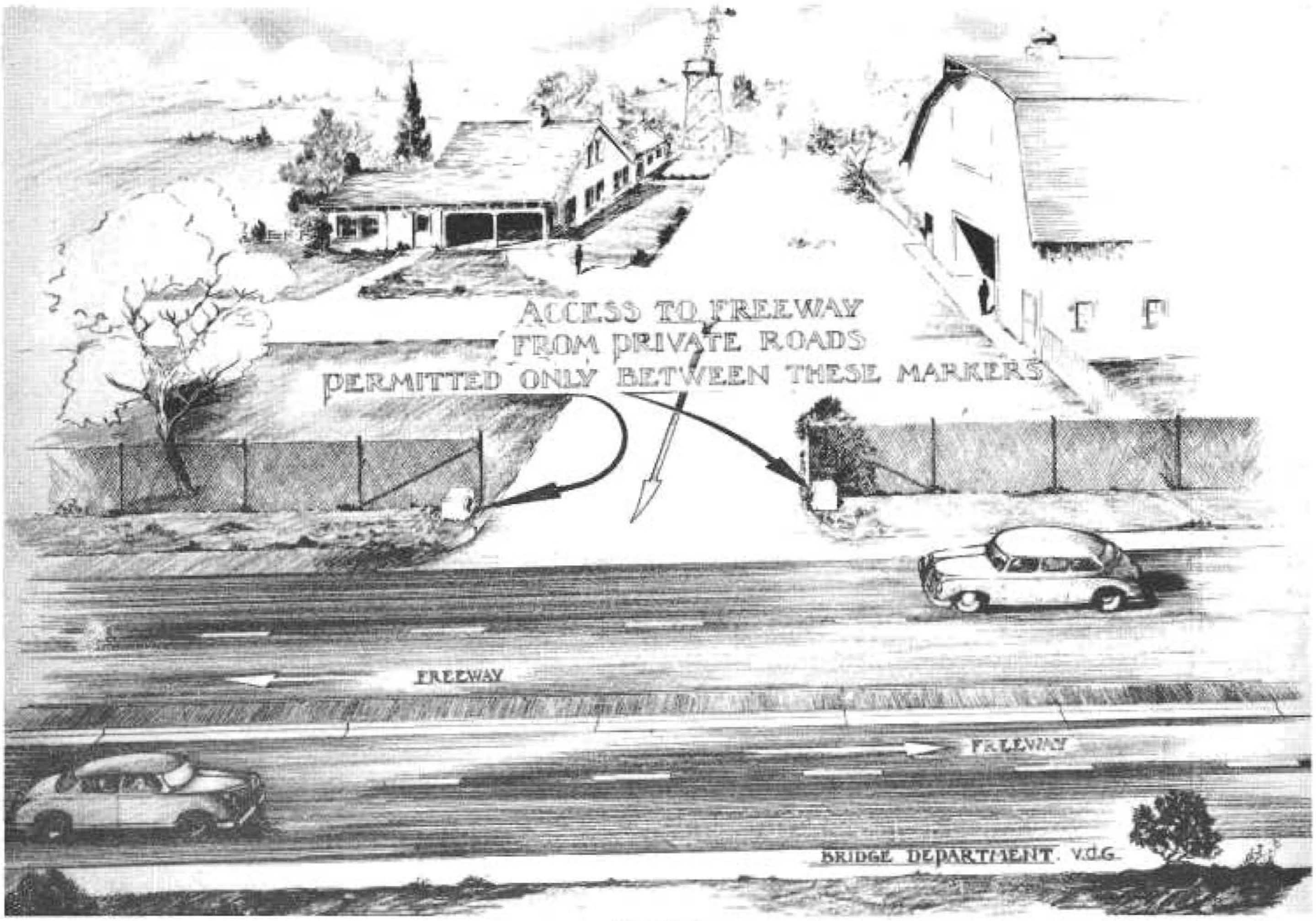


Photo No. 3

there is any question in your mind of its future value, look along the lot line or adjacent vantage points and you probably will find the sign shown in *Photograph 1* nailed onto a building or set up on a stake. If you wish to make certain whether the lot or lots in which you are interested will have access to the freeway, contact the local District Office of the Division of Highways and make sure. Don't gamble.

Many miles of the most important rural state highways already have been converted into limited freeways and additional miles are being added almost daily.

When you see the sign, shown in *Photograph 2*, installed along the right of way line, it should be a warning to exercise caution. This sign means that the abutting owner has restricted access to the through lanes of traffic of the freeway or may possibly have no right of access.

If he has been permitted limited access you will find along the right of way line at the point where such limited access has been authorized, two 8-inch square concrete monuments projecting from 8 to 10 inches above the ground and set from 10 to 30 feet apart. On the inside of these monuments where they face each other will be found a cross (+) mark. *See Photograph 3.*

Keep in mind that no access from the abutting property to the through lanes of traffic of the limited freeway is permitted except between these two markers.

If there is any further question in your mind, carefully check the title report or contact the Right of Way Department at the nearest local office of the Division of Highways.

This cautious and common sense procedure on your part will lessen any possibility of misunderstanding between buyer and seller, between lessee and lessor or between borrower and lendor and, most important of all, will be a protection to you.

Under the present program of the California Highway Commission, the following major cross-state arterials will be converted into limited freeways in rural areas and to freeways in metropolitan areas as rapidly as financing can be effected:

1. U. S. 99 from the Mexican border near Calexico to the Oregon border, via El Centro, Redlands, Colton, Los Angeles, Bakersfield, Fresno, Sacramento, Woodland, Red Bluff, Redding and Dunsmuir.
2. U. S. 101 from the Mexican border to Santa Rosa, via San Diego, Santa Ana, Los Angeles, Santa Barbara, Salinas, San Jose, San Francisco and San Rafael.
3. U. S. 40 from San Francisco to the Nevada border, via Vallejo, Fairfield, Sacramento and Auburn.

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Human Interest

Right of Way Agents Find It As They Go About Their Work

By EARLE R. BUNKER, District Right of Way Agent

ONE OF the sights to stare at in America is that of houses moving from place to place . . . . They make no difficulty of moving dwellings from one part of the town to another. Those I saw traveling were all of them frame houses, that is, built wholly of wood, except the chimneys; but it is said that brick buildings are sometimes treated in the same manner. The largest dwelling that I saw in motion was one containing two stories of four rooms each; 40 oxen were yoked to it . . . . This locomotive power was extremely convenient at Cincinnati, as the constant improvements going on there made it often desirable to change a wooden dwelling for one of brick; and whenever this happened, we were sure to see the ex No. 100 of Main Street or the ex No. 55 of Second Street creeping quietly out of town to take possession of an humble suburban station on the common above it."

A hundred and twenty years ago Mrs. Trollope, an Englishwoman, was visiting the frontier town of Cincinnati and wrote this comment. Americans are still moving houses—in quantities—witness any growing city or public improvement. In 1947 in the City of Fresno, the familiar house-moving scene was reenacted for a State Highway Overpass.

The Project

State Route 4, better known as U. S. 99, is one of the Nation's heaviest traveled roads. It enters Fresno from the south and crosses the Southern Pacific main line tracks at grade. A couple blocks farther there is a second crossing of a branch line. This is the only grade crossing of main line tracks on this route between Los Angeles and Sacramento.

The City of Fresno and the Division of Highways have been studying this grade crossing for many years. The excessive costs of an extended separation structure through this industrial area and complicated right of way problems, postponed the grade separation project. In the latter part of 1946, however, certain federal aid funds became available, dependent on their commitment by June 30th of 1947. This condition was the element that crystallized studies and plans into realization.

Surveys had to be made, location and design chosen, plans drawn, contracts prepared, advertised and let. Rush, yes, but overshadowing the feasibility of the project was the spectre of right of way clearance. Time can be allotted to a survey or a plan, but how can time be allotted for a tenant to find a new home for his family when housing is practically extinct?

Right of Way Problem

A quick count revealed that there were 72 families living in 67 houses on the project. In all, over 230 persons. There were few vacant lots. Six concerns had storage yards. There was a fire station with its elaborate signal set-up. The International Institute, an eleemosynary enterprise for forwarding citizenship in varied racial units, was taken. There was a gasoline station, grocery store, beer wholesaler, shoe shop and a combined restaurant and bar. Last and most important was the church.

The church was built by German people who had emigrated to Fresno from Russia. Their ancestors had left Germany to colonize on the Volga River at the invitation of Catherine the Great. Throughout their long sojourn in Russia their language and customs were never altered. Quiet, industrious and German, they form a considerable colony in Fresno with the larger part of their activities centered in the church they built in 1914.

The Freie Evangelical Lutheran Kruez Kirche has a membership of about 2,200. Two services a month are in English, the others are German. During the week it is the center of many activities. The structure is 62 feet wide, 130 feet long, has 35-foot walls, and the cross-surmounted steeple rises 88 feet from the sidewalk. The building is brick, without reinforcing of any kind, pierced with stained glass windows. The main chapel, altar and roof are frame. The full basement contained Sunday school rooms, kitchen and lavatories.

The church, surrounded by the homes of its members, lay in the path of the overpass.

The right of way project required 83 parcels, six of them without improvements. Nearly all were entire takings. The contractor would be expected to start construction about August 1, 1947. With but few exceptions, all improvements had to be removed before that time.

The Solution

Associate agents John Steinman and T. A. Wright were assigned the task, assisted by junior agents R. A. Bergman, Jr., and M. A. Anderson. Mr. Steinman was given the church, the institute, and the business properties east of the railroad, together with a few miscellaneous houses and lots. Mr. Wright took all the other properties. All hands went to work on the appraisal.

It was decided that normal construction procedure would call first for the building of the overpass structure, followed later by grading and paving operations. This meant that we should clear that area at once, with priority on residences. It was realized, too, that the clearance must be by sections as the local house movers would be hopelessly swamped if all moving were to be done at one time. A time-schedule was set. The structure area was to be cleared by June 15. All other areas were to be cleared by August 1, except the beer wholesaler, fire station, bar and the

UPPER—View southerly from the church tower during the move. The old foundation with part of the cribbing used in the move is in the foreground with the cleared right of way extending beyond. Once filled with buildings, there remained only the fire station on the left with the beer wholesaler just beyond and the bar being moved when the picture was taken. LOWER—View northerly from the church tower. In the foreground workmen are laying tracks for another move. Note the retaining walls for the Monterey Street overpass that curves to the right

The German Lutheran Cross Church starts on its way to new site

church. The latter was set for clearance November 1 with the others September 1.

On February 21 the appraisal of the first unit of 20 parcels was submitted. Agents Bergman and Anderson continued the appraisal work, submitting units 2, 3, and 4 at monthly intervals. As soon as the first unit was submitted, Agents Wright and Steinman, each fortified with a sizeable box of aspirin, commenced acquisition.

The Acquisition

For the owners and residents on the project, the overpass was added to the two inevitables—death and taxes. Every interview drove home the necessity for the immediate consummation of the sale to the State and the vacation of the property at the earliest moment. The owner was made two offers, one, that the State purchase the entire property and it be immediately vacated; or two, that the owner keep the improvements and move them or sell them to be moved.

The first property that Mr. Wright started with was improved with a one-story, five-room house, but the basement was partitioned into two parts, each housing a family. Nineteen persons! His very next property had a brick store plus three small frame houses. The woman in one house counted 16 people, almost forgetting "Ol' Joe, who sleeps in the attic." Those two small properties housed nearly 50 people!

Public housing projects and welfare authorities were consulted but absolutely no housing aid could be enlisted. We had to work out the solution ourselves.

Housing Problem

The natural demand of the occupants was that the State provide housing. It was explained that that was impossible. There was no way other than that they solve their own housing problem—and speedily. They did! Our investigation for the appraisal had, of course, disclosed all properties in the vicinity that were listed for sale as well as completed sales. With this information, Mr. Wright and Mr. Steinman on several occasions were able to locate new homes for displaced families. Some doubled up with relatives, others moved their improvements to vacant property, a few moved into auto and trailer courts. Every resident on the project moved without one public protest being registered. This 100 percent cooperation, although grudgingly given at times, was as welcome as it was unexpected.

On March 3d the first deal was signed followed by 16 more that month, 20 in April and so on. The exodus began at *once. Every day saw timbers being placed, interfering trees felled and dragged to one side, houses being raised, houses rolling down the streets. By July it seemed as if a tornado had passed by, leaving stark foundations, felled trees, broken shrubbery, debris! Only a few houses and other buildings seemed to have miraculously escaped. They, too, were soon to go.*

The church was contacted immediately as it was realized that considerable time would be required for its purchase and the building of a new one. A reputable contracting firm was hired to study the structure and make a firm offer for its replacement. The reaction was immediate.

The membership retained an able attorney who took prompt steps to protest the improvement before the State Highway Commission, the City Council, the Public Utilities Commission, or any other body in authority. The objection of the church was due to the realization that the time consumed in building a new edifice would result in a serious and probably permanent loss in membership coupled with a heavy indebtedness arising from the loss by depreciation in the value of the original structure. Although there were salvable materials in the church, there were many construction items that were still scarce or unobtainable. Mr. Steinman was also faced with the proposition that many of the properties we needed were owned and occupied by church members. Any disagreement with the church would naturally be reflected in difficult and delayed acquisition.

Contract Finally Signed

At this point the Star House Movers of Los Angeles were invited to inspect the church and advise if it could be moved. They not only said that moving was practical, but gave an estimated cost that made the project feasible. Due to the street system in the vicinity, only one site was possible.

The contract with the church was signed and the property necessary for its relocation was placed under condemnation for exchange. After several weeks of unrelenting effort, the required properties were purchased at a cost considered reasonable in the circumstances. The supply of aspirin was running low.

All this time the acquisition was proceeding without interruption or any serious problems. The Headquarters Office of the Division of Highways, by close and effective cooperation with the District Highway Office and the Department of Finance, expedited the approval of contracts and payments assuring the success of the acquisition. With the appraisals completed, Agents Anderson and Bergman took over some of the remaining acquisition. The church problem being settled, the members owning property within the project concluded their transactions with the State. Of the some 63 residential properties, all but seven owners kept the improvements and moved them to new locations or sold them for moving. The seven sets of improvements owned by the State were vacated and sold. Three were wrecked as not worth moving.

In no case, with the understandable exception of the property required for the church relocation, was a bonus given, although nearby vacant lots doubled, then tripled, then quadrupled

The church move from the air. Note the church on rails. The old foundation with part of the cribbing in left foreground; the new foundation being readied on the next street above as indicated by arrow

"Sidewalk superintendents" on the job. From left to right: George Christian, Peter Weber, Jacob Deibert, Martin Scheideman (now deceased), John Messenger, Jacob Alles, Fred Rebensdorf, John Klemm, and Phillip Reider

in price. The appraisals were based on sound, current market value and only in two or three rare cases did the price paid exceed the appraisal. These exceptions were properly allowed for values not contemplated by the appraisers and unearthed during negotiations.

Condemnations

To meet advertising requirements and the requirements of law, a condemnation resolution was passed by the Highway Commission covering all parcels on the project.

Three actions were filed. One was against the City of Fresno for the firehouse and a vacant lot owned by the city. This was necessary as the city charter prevented a direct sale to the State. The action was friendly in that the city approved the States offer. A trial was held and judgment vested title in the State.

An action versus the church was filed as required by law in a condemnation for exchange. One of the two parcels involved was taken as a test case but as before noted, never reached court for trial.

The third action, *People* versus *Patrick*, covered all other properties unacquired at the date of its preparation. Transactions were being closed so fast that there were very few unacquired properties when the construction contract was awarded on June 30th.

Of the 83 parcels it appears that three are going to trial. Two of them are vacant lots and are entire takings. We have not been able to justify the speculative values demanded. The third parcel is a part taking of one of the very poorest properties in the vicinity. The owner indicated that, for the part of his lot and front porch that lay in the right of way, he would only be willing to settle for an amount which the State considered excessive. We have been unable to share his opinion regarding the value of his property.

As contracts were signed, dismissals of the suits were filed.

Successful Conclusion

During the first week in May the first buildings began to move out. On July 1st one vacant, state-owned house was in the overpass structure area. On August 1st the only buildings on the project were: The church, the firehouse, beer wholesaler, the lunchroom and bar and one house. The last was on timbers ready to move.

The contractor started operations September 2d, taking over the fire station for an office and warehouse. He gave an extension of time to the beer wholesaler until the land was needed for actual construction. The agreement for the lunchroom and bar was being made with additional time to move given as the building was not holding up the contractor. The Star House Movers started moving the church September 16th. It reached its place over its new foundation on December 4th. There remained the final resetting of the church and the completion of its basement.

It was more than two years ago that Mr. Schmall saw two men standing in front of his beloved church. They were agents for the Division of Highways, making budgetary estimates for highway relocation studies for vague future plans. The church was just something of general interest. He told them how in 1914 the 1,500 members had each contributed $10 to buy materials and how they had worked laying brick, carpentering, plumbing and painting to raise their church, and the dinners and lunches their women had served the workers. Then Mr. Kissler, the pastor, joined the group to tell Mr. Schmall that he had just heard through the Red Cross that Freddie Schmall was not lost but had been wounded in the South Pacific. Mr. Schmall lost all immediate interest in his church as he rushed home across the street to tell mama the good news.

Today Mr. Schmall sits on his front porch but all is changing. The neighbors across the street are gone. So are their houses. Even the church is gone. In their place concrete retaining walls are rising. Bulldozers are rooting out foundations, making cuts and building fills for an overpass that will pour thousands of autos into the heart of Fresno. And the church? As Mrs. Trollope remarked, "brick buildings are sometimes treated in the same manner" so Mr. Schmall, (and Freddie, too, we hope) will go two blocks to church instead of just across the street.

Church Is Moved

Engineer Describes Technical Problems Which Were Solved

By L. S. VAN VOORHIS, Associate Highway Engineer

IN CONNECTION with the new freeway now under construction at the southern entrance to Fresno, the contract contains an item of work which is unique so far as highway work is concerned: Moving the German Lutheran Cross Church from the highway right of way.

Ordinarily this type of work is done prior to starting the road work. However, in this case the urgency of getting the project under way was so great it was decided to include it in the road contract.

The church is 62 feet 10 inches x 130 feet exclusive of the front porch, and consists of a main floor with a balcony, and a full basement. The outside walls, except for the bell tower, are brick and lime mortar with no reinforcement. The building was constructed in 1914 and is estimated to weight approximately 1,800 tons. The side walls are 35 feet high and the top of the cross on the bell tower is 88 feet, both measurements being from the ground.

Moved Two Blocks

The new church site is one block northwest and one block southwest, a distance of about 900 feet from the old location. The direction of the move was changed twice, once at the end of the first block, and once at the end of the second block, where the church was moved from the city street onto the new site.

Work was started on September 17, 1947, and consisted of removing basement windows and basement partitions. As soon as this work was completed, the stacking of timber cribs in the basement was begun. Timber blocks 6 inches x 8 inches x 4 feet were used. The cribs were 7 feet high, the top of which were 4 feet below the basement ceiling to provide adequate room for the equipment used to support the building. Fourteen rows of cribs were made laterally across the basement and two low rows across the front outside the basement. A total of 7,000 timber blocks was used in the cribbing.

Upon completion of the cribbing, the following operations were performed in the order named: (1) six 18 inch x 18 inch timbers were placed longitudinally as shown on the sketch indicating the method of supporting and towing the church; (2) Twelve 10 inch steel "H" beams and four 18 inch x 18 inch timbers were placed laterally and directly above the timbers listed in (1) above; (3) Sixty-pound railroad rails were laid on the cribbing; and (4) Shoes consisting of two 6 inch x 8 inch x 4 feet timbers with a steel plate on the bottom, and steel rollers 1¾ inches in diameter were placed between the railroad rails and the longitudinal timbers.

Placement of Beams

The locations of the above facilities and their relation to the work may be understood more easily by veiwing the accompanying photograph showing a close-up view near one corner of the building.

The 18 inch x 18 inch longitudinal timbers were held in place temporarily by means of jacks while the railroad rails, rollers and shoes were being placed.

The top of the basement windows, about four feet above ground, was chosen as the proper location to cut off the building from the foundation, and the tops of the 10 inch steel "H" beams were placed at the cut-off. Needle beams were placed through the outside walls between the steel "H" beams at approximately 30 inch centers.

Technical Problems

The contract called for placing the church on the new site at an elevation which would make the relation between the building and the street curb the same as that at the old site. The curb at the new site is 13 inches below that at the old location. The church people, however, decided that they would prefer to have the building higher with respect to the curb, in order that the bottom of the basement windows would be above ground. This revision allowed the building to be held at the same elevation and permitted the contractor to lay the railroad rails on a level grade, which greatly simplified the move. Otherwise it would have been necessary to lay the rails on a descending grade, because the contractor stated that lowering a building of this type with jacks is not feasible.

A high degree of accuracy was used in laying the rails. A deviation of one-sixteeenth inch from the level grade was adopted as the maximum tolerance. Approximately 5,200 lineal feet of rails were procured, which provided only enough railing in front of the church to allow a maximum move of about 90 feet in any single move.

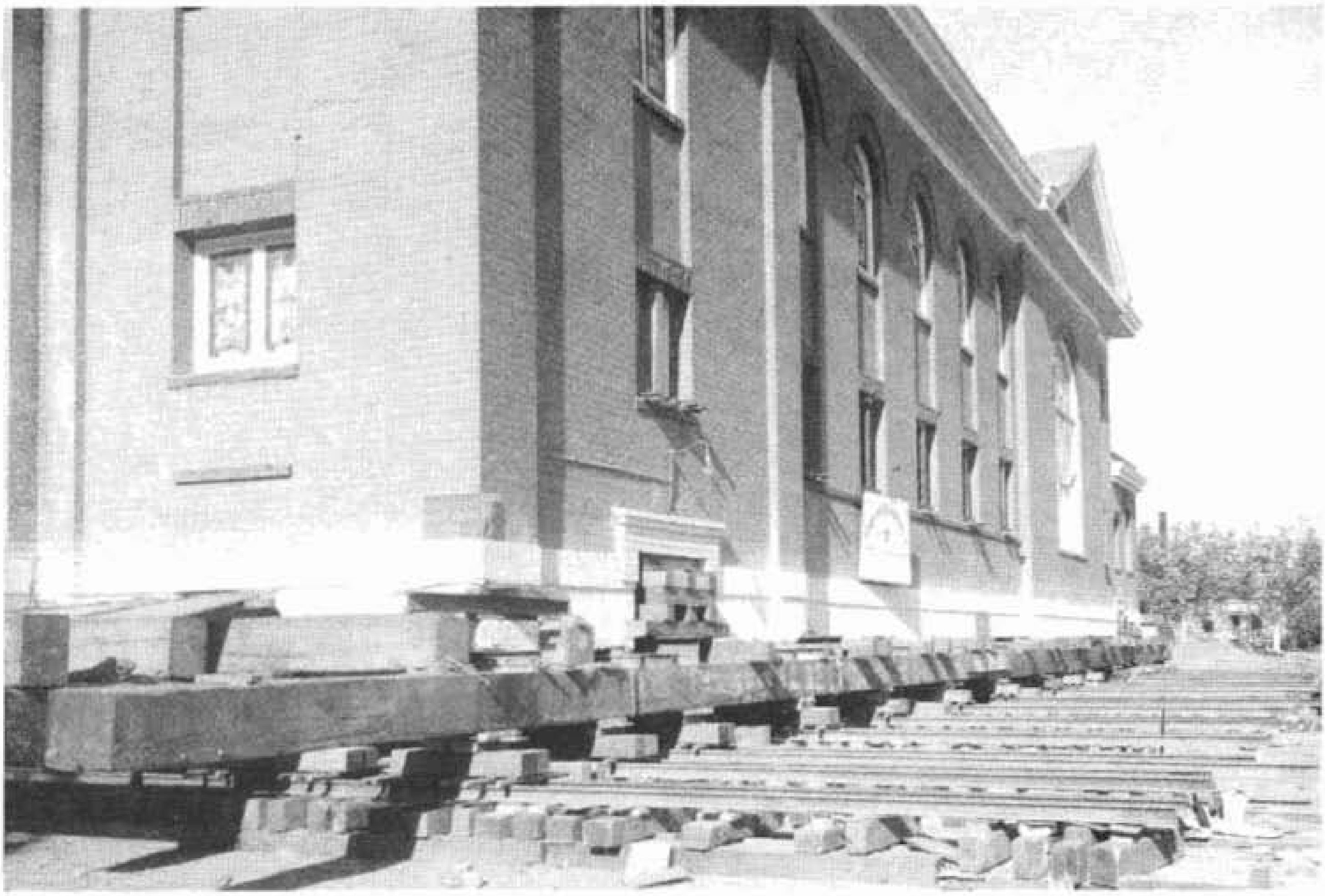
8,500 Blocks Used

Timber blocks similar to those employed in the cribbing were used for ties under the rails. A total of 1,500 blocks was available for this purpose during the time the other blocks were in use as cribbing in either the old or new basement. The 8,500 blocks on the job contain 136,000 board feet of lumber.

The church was moved off the foundation on November 3, 1947, making the preparation period a total of 37 working days.

The method of towing the building is illustrated in the sketch titled "Method of Supporting and Towing the Church."

The cable between the winches on the towing trucks was continuous in order to insure equal pull on each cable. Equal pull was necessary to prevent the building from drifting laterally to the direction of towing, and to avoid any unnecessary strain on the building. Drifting could be corrected, however, by placing the rollers on a small skew angle with the centerline of the rails. Considerable time was consumed in



Looking at south corner of the front of church, showing the arrangement of the supporting timbers, shoes, rollers, and rails. Note the cornerstone inscribed in German and dated 1914

changing the rollers first to correct the drift and then normal to the rails, and every effort was made to keep the building moving in the desired direction.

Building Moved Easily

The building moved quite easily, as evidenced by the fact that the towing trucks were always working under an idling throttle. The rate of movement was approximately one foot per minute, which allowed the force of 22 men stationed around and under the church to properly handle the rollers. Only enough rollers were available to allow one or two ahead of each shoe and it was necessary to move each one as soon as it was released by the shoe. From five to eight rollers, depending on the concentration of weight, were under each shoe.

Moving the church in a northwesterly direction to the first intersecting street, a distance of 415 feet, required five moves. One and sometimes two days were required between moves to remove the rails over which the building had passed and relay them for another run.

Angle of Rails

Prior to altering the direction of towing 90 degrees and along the intersecting street mentioned above, it was necessary to place the entire weight of the structures on jacks and turn the rails parallel to the street. This operation required one week to complete. Six pairs of rails were used during this part of the move, one pair under each of the 18 inch x 18 inch longitudinal timbers. The same numbers of shoes and rollers, however, were used as when 16 pairs of rails were employed. The shoes were merely turned 90 degrees and remained in the same position with relation to the building. Only two moves were required along the city street, a distance of 394 feet, as more rails were available for each of the six pairs used.

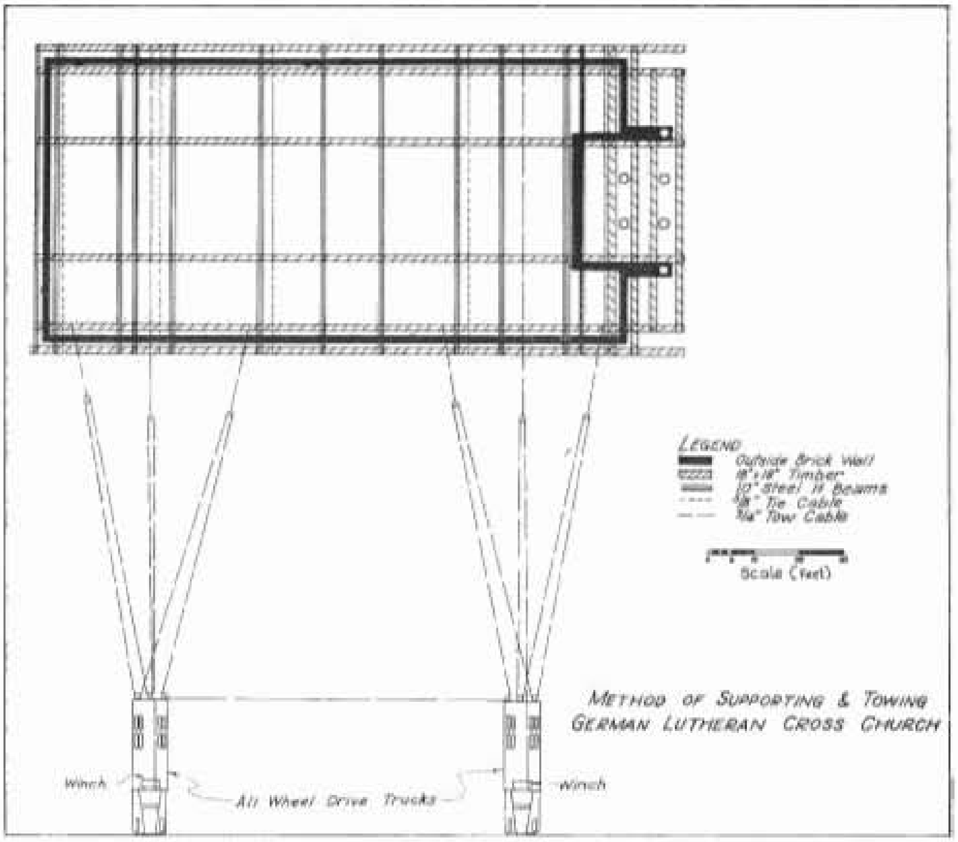
To move the building onto the newly constructed foundation, required the rails to be turned 90 degrees for the second time. This operation was performed in the same manner, except that there was insufficient room between the new foundation and the house on the adjoining property to allow the towing trucks to be stationed parallel to the direction of towing. The difficulty was overcome by creating two deadmen near the property line, and three pulleys were attached to each. One additional pulley was placed on the bed of each truck near the back to guide the cable onto the winches. The trucks were not anchored against being pulled sideways, providing further evidence of the small amount of power required to move the structure.

Placed on New Site

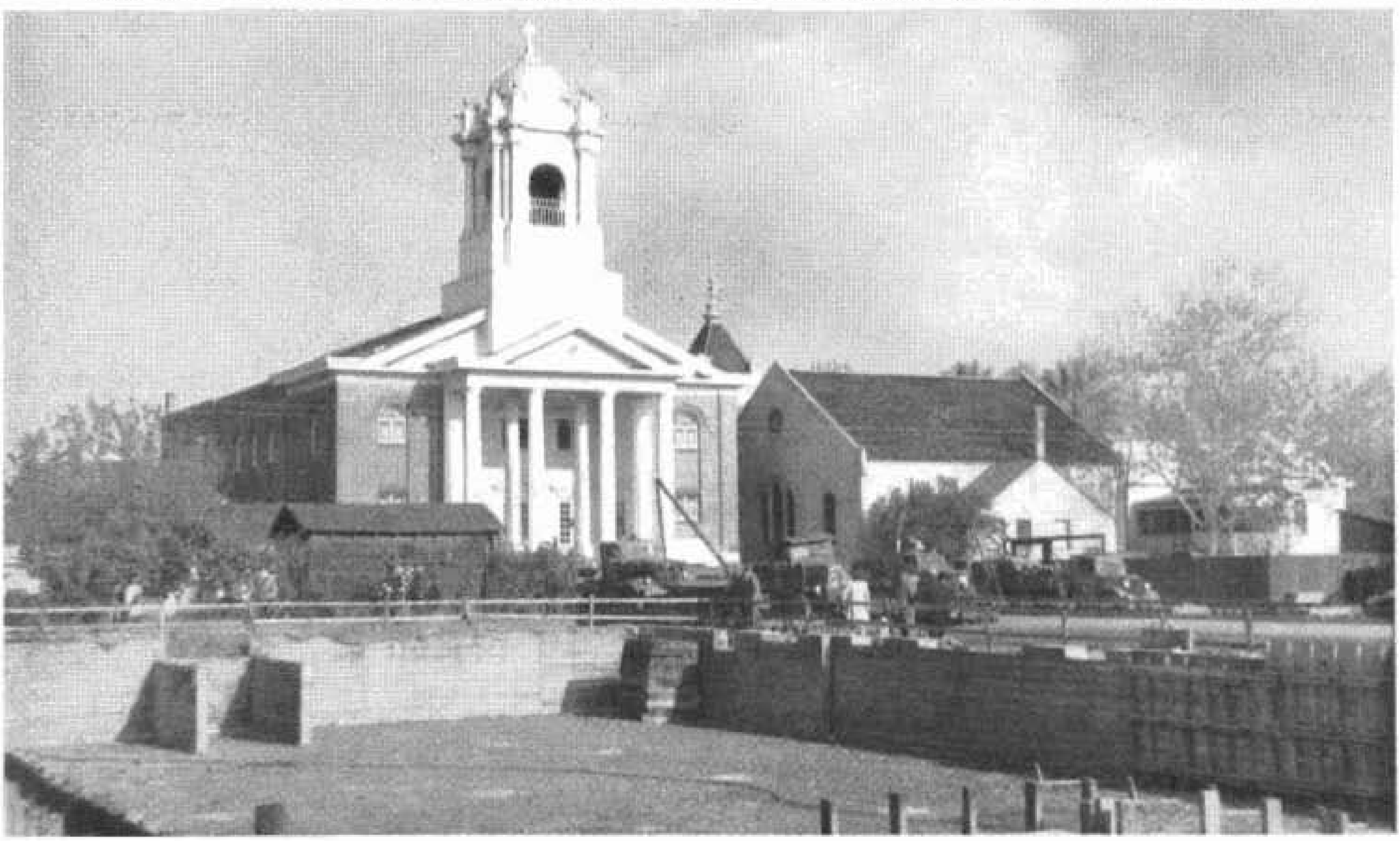
The last 15 feet of the move was performed very slowly, because some shifting was necessary to place the building directly over the new concrete foundation, the top of which was four feet below the existing walls. All shifting perpendicular to the direction of towing was done by manipulating the rollers as explained earlier in this report. In order to bring the side of the structure parallel to the foundation, all the pulling was done with one truck until the proper position was attained. Very little of the latter was necessary because the first check disclosed a discrepancy of only one-half inch. When the final signal was given to stop the winches, the corners of the building were checked and found to be in the proper location without further adjustment. Check levels revealed that the building was three-eighths inch higher than it was at the old site.

The only work remaining at this point consisted of placing the weight of

. . . Continued on page 40



View of church being towed longitudinally along city streets with the newly constructed basement and concrete foundation in the foreground



Bids and Awards

Contracts Awarded December, 1947, And January, 1948

November, 1947—Continued

SAN LUIS OBISPO COUNTY—Between Miles Station and Marsh Street, about 6.6 miles in length to be graded and surfaced with plant-mixed surfacing on crusher run base. District V, Route 2, Sec. E.SLO. N. M. Ball & Sons & Macdonna Const. Co., Berkeley, $1,363,591.50; Bressi & Bevanda Constructors Inc., Los Angeles, $1,374,526.65; Morrison-Knudsen Co., Inc., San Francisco, $1,408,791.75; Peter Kiewit Sons Co., Arcadia, $1,411,457.95; Wintson Bros. Co., Azusa, $1,468,650.50; Guy F. Atkinson Co., South San Francisco, $1,491,628.75; A. Teichert & Sons, Inc., Sacramento, $1,495,795; Frederickson & Watson Const. Co., Oakland, $1,572,714.60; Macco Corporation, Clearwater, $1,644,677.05; J. E. Haddock, Ltd., Pasadena, $1,681,227.30. Contract awarded to Frederickson & Kasler, Sacramento, $1,338,523.65.

YOLO COUNTY—Across Knights Landing Ridge Cut Canal, about three miles south of Knights Landing, a timber trestle bridge with reinforced concrete deck to be constructed. District III, Route 1158. Macco Corporation, Clearwater, $55,498.50; Lew Jones Const. Co., San Jose, $56,138; A. L. Miller, Sacramento, $59,292; W. Lenkeit Construction Co., San Francisco, $59,856; Lord and Bishop, Sacramento, $59,957.50; Grant L. Miner, Palo Alto, $61,577; E. G. Perham, Los Angeles, $62,879; George Pollock Co., Sacramento, $63,959; Dragline Rentals Co., Long Beach, $69,274; Piombo Construction Co., San Francisco, $69,680; Butte Construction Company, San Francisco, $72,744. Contract awarded to Chittenden & Chittenden, Auburn, $51,148.50.

YUBA and SUTTER COUNTIES—Between D Street bridge in Marysville and Route 15 in Yuba City, furnishing and installing traffic signals at seven locations and highway lighting systems at five locations. District III, Route 3, Sec. Mvl,YC. L. H. Leonardi Electric Construction Co., San Rafael, $84,705; Severin Electric Co., San Francisco, $84,954; Abbett Electric Co., San Francisco, $89,922; Scott-Buttner Electric Co. Inc., Oakland, $92,835. Contract awarded to Tri Cities Electrical Service, Oceanside, $79,119.

December, 1947

INYO COUNTY—Between Alabama Gates and Manzanar, about 4.3 miles to be graded, and surfaced with plant-mixed surfacing on crusher run base and a bridge to be constructed. District IX, Route 23, Sections L, M. Clements & Co. & Browne & Krull, Hayward, $235,528; Dimmitt & Taylor, Los Angeles, $236,787; Griffith Company, Los Angeles, $238,650; A. Teichert & Son, Inc., Sacramento, $264,571; Cox Bros. Construction Co., Stanton, $267,985; Westbrook & Pope, Highland, $268,315; Clyde W. Wood, Inc., North Hollywood, $270,445; Guy F. Atkinson Co., South San Francisco, $319,704; Contract awarded to Basich Bros. Construction Co. & Basich Bros. & O. B. Pierson, Alhambra, $205,321.71.

KERN COUNTY—Across Main Drainage Canal, about 25 miles west of Bakersfield, a reinforced concrete slab bridge to be constructed. District VI, Route 58, Section K. F. Fredenburg, Temple City, $23,952; C. C. Gildersleeve, Plymouth, $24,437; H. R. Breeden, Compton, $25,308; C. J. B. Construction Co., Oxnard, $26,577; Dan Caputo, San Jose, $28,132; Wheeler Construction Co., Oakland, $35,766. Contract awarded to E. G. Perham, Los Angeles, $23,197.

LAKE COUNTY—Between 1.0 mile east and 2.1 miles east of State Highway Route 89, about 1.1 miles to be graded and a Class "B" double seal coat applied. District I, Route 1039. Morrison-Knudsen Co., Inc., San Francisco, $32,550; Tyson & Watters Co., Sacramento, $38,611; C. M. Syar, Vallejo, $41,048; J. Henry Harris, Berkeley, $58,949. Contract awarded to George Stout, Merced, $29,627.

LOS ANGELES AND ORANGE COUNTIES—On Lakewood Blvd. at Flower Street; at Stanton Avenue and Lincoln Avenue; at Spadra Road and Orangethorp Avenue; and at Tustin Avenue and Chapman Avenue, furnishing and installing full traffic actuated signal systems and highway lighting. District VII, Routes 168, 2, 175, 43, 182, 171, 178; Sections A, F, A, B, Ora, B, A. C. D. Draucker Co., Los Angeles, $32,050; Econolite Corp., Los Angeles, $34,687; Prescott Electric and Manufacturing Co., $42,000. Contract awarded to Tri-Cities Electrical Service, Oceanside, $28,873.78.

NEVADA COUNTY—Between Kingvale and ½ mile west of Fox Farm, between Donner Summit and one mile east and at Flycaster's Curve, about 4.5 miles east of Truckee, about 3.7 miles to be graded and surfaced with plant-mixed surfacing on imported borrow and crusher run base. District III, Routes 37, 38; Sections BC, A. Harms Bros., Sacramento, $182,086. Contract awarded to H. Earl Parker, Inc., Marysville, $177,635.48.

ORANGE COUNTY—In the City of Newport Beach and vicinity on Coast Highway, from Poppy Avenue to Broadway, furnishing and installing full traffic actuated signal systems at 6 intersections, fixed time traffic signal systems at 4 intersections, and highway lighting at 9 of the intersections. District VII, Route 60, Section Npt B, B, A. Tri-Cities Electrical Service, Oceanside, $75,847; Econolite Corp., Los Angeles, $82,649. Contract awarded to C. D. Draucker Co., Los Angeles, $73,970.

RIVERSIDE COUNTY — Between Whitewater Point and one-half mile north of Palm Springs, about 4.1 miles to be graded and surfaced with plant-mixed surfacing. District VIII, Route 187, Section D. Morrison-Knudsen Co., Inc., Los Angeles, $399,498; Griffith Co., Los Angeles, $401,395; MacDonald & Kruse, & Hensler Construction Corp., Glendale, $417,758; N. M. Ball Sons & Madonna Construction Co., Berkeley, $424,818; Clyde W. Wood, Inc., North Hollywood, $427,003; Dimmitt & Taylor & K. B. Nicholas, Los Angles, $437,374; Nathan A. Moore, San Gabriel, $437,853; Norman I. Fadel, North Hollywood, $446,065; J. E. Haddock, Ltd., Pasadena, $453,643; Geo. Herz & Co., San Bernardino, $459,502; Matich Bros. & E. L. Yeager, Riverside, $467,306; Arthur A. Johnson, Laguna Beach, $486,019; R. P. Shea Construction Co., Indio, $494,355; Basich Bros. Construction Co. & Basich Bros. & O. B. Pierson, Alhambra, $506,288. Contract awarded to Peter Kiewit Sons Co., Arcadia, $339,458.50.

SACRAMENTO COUNTY—At the intersection of Stockton Blvd. and 14th Avenue, traffic signals and highway lighting to be furnished and installed and existing pavement to be widened with plant-mixed surfacing on crusher run base. District III, Route 4, Sections B, Sac. J. R. Reeves, Sacramento, $28,274. Contract awarded to A. Teichert & Son, Inc., Sacramento, $23,856.

SAN DIEGO COUNTY—In the City of San Diego, between Tecolote Creek and Balboa Avenue, about 2.5 miles, shoulders to be graded and surfaced with plant-mixed surfacing on imported borrow and portions of existing pavement to be resurfaced with plant-mixed surfacing. District XI, Route 2. Griffith Co., Los Angeles, $47,395; V. R. Dennis Construction Co., San Diego, $48,974. Contract awarded to R. E. Hazard Contracting Co, San Diego, $44,759.25.

SAN DIEGO COUNTY—Across Agua Caliente Creek and across Buena Vista Creek, one mile west and four miles south of Warner Springs, respectively, two reinforced concrete bridges to be constructed and about 0.5 mile of approaches to be graded and bituminous surface treatment applied. District XI, Route 78, Section D. Bent Construction Co., Los Angeles, $82,340; Clifford C. Bong & Co., Arcadia, $84,059; Haddock Engineers, Ltd., Oceanside, $91,527; Cox Bros. Construction Co., Stanton, $106,571. Contract awarded to E. S. & N. S. Johnson, Fullerton, $81,948.40.

SAN DIEGO COUNTY—At Wright Street Creek, in the City of El Cajon, a reinforced concrete culvert to be constructed. District XI, Route 198. Walter H. Barber, La Mesa, $16,640. Contract awarded to Johnson Western Co., Coronado, $15,260.

SAN JOAQUIN COUNTY—Between Mariposa Road south of Stockton and Calaveras River north of Stockton, and between D Street and new Route 4 in Stockton, about 6.3 miles to be graded; side roads to be graded and paved; and bridges and highway and railroad grade separation structures to be constructed. District X, Routes 4, 5; Sections E, Stkn, C, Stkn. United Concrete Pipe Corp. & Ralph A. Bell, Baldwin Park, $1,438,881; George Pollock Co., Sacramento, $1,457,343; Guy F. Atkinson Co., South San Francisco, $1,518,034; N. M. Ball Sons and H. W. Ruby, Berkeley, $1,532,869; M. & K. Corp. & Frederickson & Watson Construction Co., San Francisco, $1,538,351; Bates & Rogers Construction Corp. & Louis Biasotti & Son, San Francisco, $1,598,978; Bressi & Bevanda Constructors, Inc., Los Angeles, $1,624,665; Morrison-Knudsen Co., Inc., San Francisco, $1,673,532; A. Teichert & Son, Inc., Sacramento, $1,699,099; J. E. Haddock, Ltd., Pasadena, $1,715,657; Parish Bros., Benicia, $1,737,552. Contract awarded to Lord & Bishop & M. J. B. Construction Co., Sacramento, $1,394,373.75.

SHASTA COUNTY—Construct a foot bridge across Sacramento River in Castle Crags State Park. District II. Contract awarded to C. C. Gildersleeve, Plymouth, $4,469.

SHASTA COUNTY—Between Tower House and Schilling, about 5.3 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District II, Route 20, Section A. Morrison-Knudsen Company, Inc., San Francisco, $628,271; A. Teichert & Son, Inc., Sacramento, $629,304; Frederickson & Watson Construction Co., Oakland, $668,739; N. M. Ball Sons, Berkeley, $680,383; Bressi & Bevanda Constructors, Inc., Los Angeles, $683,127; Harms Bros., Sacramento, $687,689. Contract awarded to Frederickson Bros., Emeryville, $588,829.

SONOMA COUNTY—Across Tolay Creek about 14 miles west of Vallejo, the truss span of a bridge to be redecked. District IV, Route 208, Section A. C. M. Allen, Fairfield, $7,362; Bos Construction Co., Oakland, $7,630; C. C. Gildersleeve, Plymouth, $7,843; Wm. B. Willett Co., San Francisco, $10,013; James H. McFarland, San Francisco, $10,789. Contract awarded to Evans Construction Co., Berkeley, $6,895.

TULARE COUNTY—Between 6.5 miles and 4 miles west of Porterville, about 2.5 miles to be widened and surfaced with plant-mixed surfacing on imported borrow base and bituminous surface treatment to be applied to the shoulders. District VI, Route 1128. Contract awarded to F. Gunner Gramatky, Fresno, $53,000.

TULARE COUNTY—At various locations between 3 and 15 miles south of Visalia, four reinforced concrete slab bridges to be constructed. District VI, Routes 1126 and 1137. E. G. Perham, Los Angeles, $55,536; Dan Caputo, San Jose, $72,698; Charles MacClosky Company, San Francisco, $72,740; Northup Construction Co., Long Beach, $77,352; Wheeler Construction Co., Oakland, $106,892. Contract awarded to Trewhitt, Shields & Fisher, Fresno, $52,293.20.

TUOLUMNE COUNTY—Across Tuolumne River at Stevens Bar, a bridge to be constructed and approaches about 0.2 mile in length to be graded and surfaced with road-mixed surfacing on imported borrow. District X, Route 40, Sections A, B. H. W. Ruby, Sacramento, $185,834; Dan Caputo, San Jose, $198,626; Bent Construction Co., Los Angeles, $199,760; George Pollock Co., Sacramento, $214,342; Erickson, Phillips & Weisberg, Oakland, $221,365; Grant L. Miner, Palo Alto, $224,646; Johnston Rock Company, Stockton, $233,232; Chittenden & Chittenden, Auburn, $233,685; Northup Construction Co., Long Beach, $238,563; Guy F. Atkinson Co., South San Francisco, $238,694. Contract awarded to Elmer J. Warner, Stockton, $181,548.

January, 1948

FRESNO COUNTY—In Fowler at the intersection of Merced Street with Route 4, furnishing and installing full traffic actuated signal system with train and pedestrian actuation and highway lighting. District VI. Oilfield Electric Co., Inc., Bakersfield, $15,640; L. H. Leonardi Electric Construction Co., San Rafael, $15,840; Contract awarded to Severin Electric Co., San Francisco, $10,980.

IMPERIAL COUNTY—In El Centro at 4th Street and Main Street and at Eighth Street and Adams Avenue, furnish and install traffic actuated signal systems. District XI, Route 26. California Electric Works, San Diego, $19,620; Electric & Machinery Service, Inc., South Gate, $20,059; Tri-Cities Electric Service, Oceanside, $20,697. Contract awarded to C. E. Seymour, Long Beach, $17,200.

INYO COUNTY—Between 10.7 miles south and 2.0 miles south of Olancha, about 0.4 mile to be graded and bituminous surface treatment applied thereto; and culverts to be installed at various locations. District IX, Route 23, Sections H,I. Browne & Krull, Palo Alto, $13,371; Basich Bros. Construction Co. & Basich Bros., Alhambra, $14,242; Ken H. Jones, Van Nuys, $14,632; Oilfields Trucking Co., Bakersfield, $16,169; Jesse S. Smith & Arthur A. Edmondson, Glendale, $16,519; Dix-Syl Construction Co., Inc., Bakersfield, $19,888. Contract awarded to Bishop Engineering and Construction Co., Bishop, $12,617.

INYO COUNTY—Between 11 miles north of Trona and Water Canyon about 4.9 miles to be graded and a penetration treatment applied. District IX, Route 1065. C. G. Willis & Sons, Los Angeles, $143,301; Westbrook & Pope, Highland, $168,350; Clyde W. Wood, Inc., North Hollywood, $176,628; Louis Biasotti & Son, Stockton, $182,697; Rexroth & Rexroth, Bakersfield, $243,335. Contract awarded to Swedlow Engineering Co., Inc., Santa Monica, $132,350.

LOS ANGELES COUNTY—On Hollywood Parkway, at Virgil Avenue, Hoover Street and Rosemont Avenue, respectively, in the City of Los Angeles, two undercrossings and one overcrossing to be constructed. District VII, Route 2. Haddock Co., Pasadena, $597,774; Carlo Bongiovanni, Hollywood, $604,444; Winston Bros. Co., Azusa, $625,574; Byerts & Dunn, Los Angeles, $625,846; Oberg Bros., Inglewood, $656,057; W. J. Disteli & R. J. Daum Construction Co., Los Angeles, $658,020; Guy F. Atkinson Co., Long Beach, $658,875; Peter Kiewit Sons Co., Arcadia, $676,830; Griffith Co., Los Angeles, $693,039; Mittry Bros. Construction Co., Los Angeles, $722,542. Contract awarded to Spencer Webb Co., Inglewood, $594,498.

LOS ANGELES COUNTY—On Foothill Blvd., Huntington Drive, Falling Leaf Avenue and Alosta Avenue between Fifth Avenue and Glendora Avenue, furnish and install fixed time traffic signal systems at two intersections, a full traffic actuated signal system at one intersection and full traffic actuated signal systems and highway lighting at six intersections. District VII, Route 9, Sections Mnro, G. H. Gdr. C. D. Draucker Co., Los Angeles, $80,870. Contract awarded to Econolite Corp, Los Angeles, $78,798.

LOS ANGELES COUNTY—At the intersections of Atlantic Avenue with Carlin Avenue, Broadway, and Morton Road, fixed time traffic signal systems to be furnished and installed. District VII, Route 167, Sections A, Lyn. Econolite Corp., Los Angeles, $12,228. Contract awarded to C. D. Draucker Co., Los Angeles, $11,970.

MADERA COUNTY—Between San Joaquin River and Arcola School, about 7.1 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and on untreated rock base. District VI, Route 4, Section A. Fredrickson & Watson Construction Co., Oakland, $928,775; Morrison-Knudsen Company, Inc., San Francisco, $933,045; Griffith Company, Los Angeles, $942,106; R. M. Price Co. & Rex B. Sawyer, Huntington Park, $965,014; Guy F. Atkinson Company, South San Francisco, $976,430; N. M. Ball Sons, Berkeley, $998,345; Granite Construction Co., Watsonville, $1,012,338; Clyde W. Wood, Inc., North Hollywood, $1,070,699; A. Teichert & Son, Inc., Sacramento, $1,081,548. Contract awarded to Harms Bros., Sacramento, $921,103.

MENDOCINO COUNTY—Erection and completion of a truck shelter, gasoline and oil house, and erection of chain link fence at Fort Bragg Maintenance Station. District I, Route 56. T. Feibusch Construction Co., Ukiah, $13,192; Mercer Fraser Co., Eureka, $21,046. Contract awarded to Reed & Tuttle, Redwood Valley, $9,032.

ORANGE COUNTY—In the City of Anaheim on Los Angeles Street and on Center Street, furnishing and installing fixed time traffic signal systems at 11 intersections and modifying existing highway lighting at nine of these intersections, and modifyng an existing fixed time traffic signal system at one intersection. District VII, Routes 2, 178. Electric & Machinery Service, Inc., South Gate, $46,241; C. D. Draucker Co., Los Angeles, $51,270; Tri-Cities Electrical Service, Oceanside, $52,013; Econolite Corp., Los Angeles, $53,795. Contract awarded to Prescott Electric & Manufacturing Co., Los Angeles, $42,000.

RIVERSIDE COUNTY—Four timber trestle bridges on Route 26 between 34 and 42 miles northwest of Indio, and one timber trestle bridge on Route 64 about 6 miles west of Indio, to be redecked with reinforced concrete slabs. Districts VIII & XI, Routes 26, 64, Sections C, Q. John Strona, Pomona, $33,094; F. Fredenburg, Temple City, $34,016; E. G. Perham, Los Angeles, $35,490; The Hogan Co., Riverside, $36,149; Norman I. Fadel, North Hollywood, $40,154. Contract awarded to E. S. & N. S. Johnson, Fullerton, $32,534.

RIVERSIDE COUNTY—Between four miles west of Blythe and Colorado River, about 1.8 miles to be graded, imported base material to be placed and bituminous surface treatment applied thereto and structures to be constructed. District XI, Route 64, Section E, Bly, F. Foster & McHarg, Riverside, $220,511; MacDonald & Kruse & Hensler Construction Corp., Glendale, $237,950; R. P. Shea Construction Co., Indio, $245,154; Vinnell Co., Inc., Alhambra, $249,397; Dimmitt & Taylor & K. B. Nicholas, Los Angeles, $280,123; Clifford C. Bong & Co., Arcadia, $288,077; Cox Bros. Construction Co., Stanton, $289,663; Norman I. Fadel, North Hollywood, $309,117. Contract awarded to Arthur A. Johnson, Laguna Beach, $196,266.

SAN DIEGO COUNTY—Between 3.1 miles and 3.5 miles north of San Luis Rey River and between Colby Ranch and Rincon Store, about 1.1 miles, to be graded and bituminous surface treatment to be applied. District XI, Routes 78, 195, Sections E, C. Einer Bros., Inc., Escondido, $39,483; Swedlow Engineering Co., Inc., Santa Monica, $42,875; A. A. Edmondson, Glendale, $45,683; Clifford C. Bond & Co., Arcadia, $48,615; Cox Bros. Construction Co., Stanton, $62,620. Contract awarded to Arthur A. Johnson, Laguna Beach, $38,969.

George W. Savage Named New Secretary Of the California Highway Commission

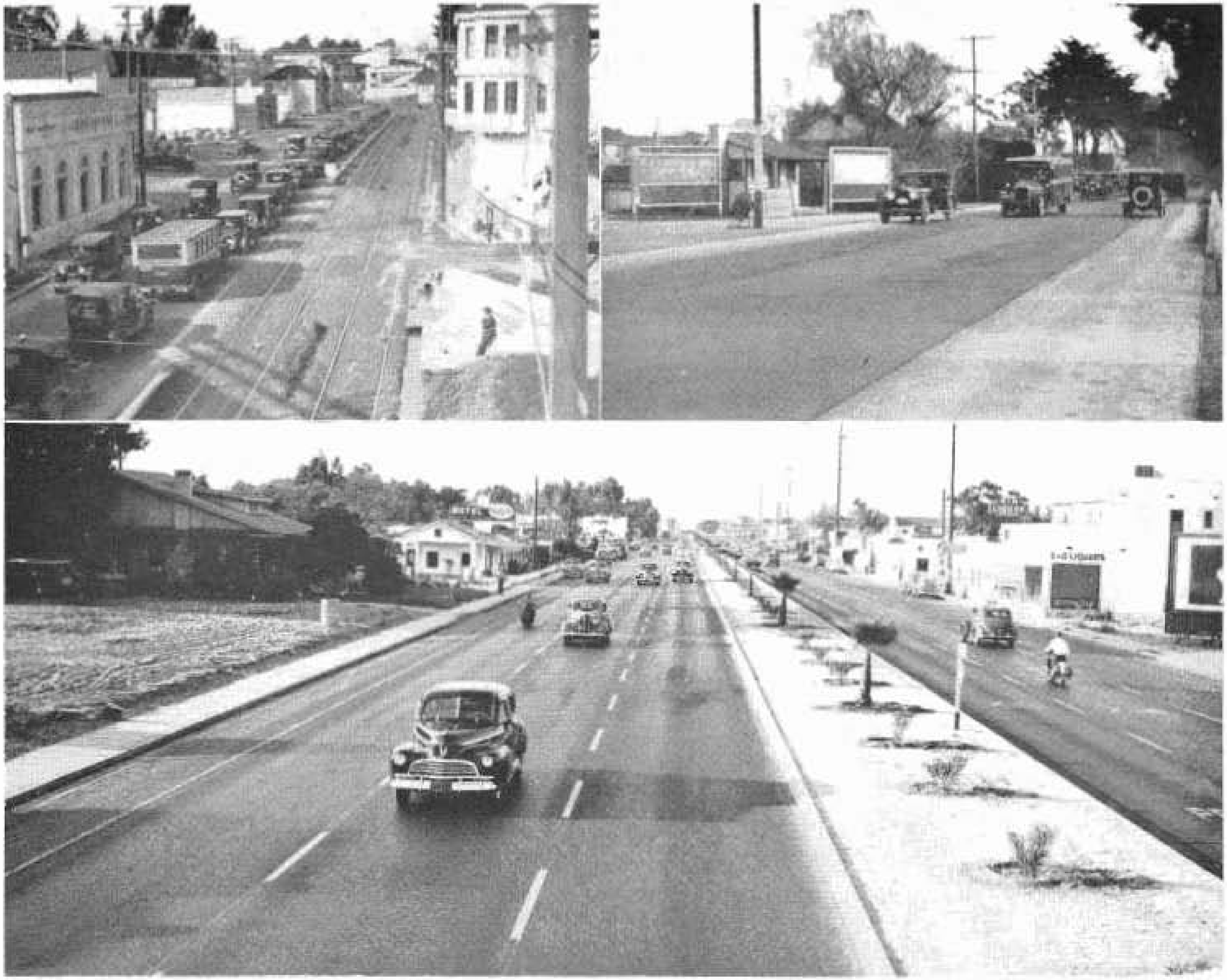
APPOINTMENT of George W. Savage of South Pasadena, widely known California newspaper editor an publisher and veteran of the two world wars, as secretary of the California Highway Commission has been announced by Director of Public Works C. H. Purcell, chairman of the Commission.

Savage, who assumed his new duties on January 9th, succeeds Ford A. Chatters, Tulare County publisher, who resigned to accept an appointment on the State Personnel Board from Governor Warren.

Born in Iowa, Savage has been a resident of California since 1916. From May, 1933, to January, 1946, he was co-publisher and owner of the *Inyo Independent* at Independence, *Progress-Citizen*, Lone Pine, and *Inyo Register* at Bishop. Following his return from 19 months overseas duty as a Lieutenant Commander, United States Naval Reserve, in World War II, he became the publisher and owner of the South Pasadena Review in February, 1946. He disposed of his interests in this publication on January 1st of this year.

Savage is a former vice president of the California Newspaper Publishers Association and presently is a member of the advisory board of that association; president of the California Newspaper Advertising Managers Association; secretary-treasurer of the California Newspaper Advertising Service and a member of the Public Relations Committee, American Legion, Department of California. He is a member of Sigma Delta Chi journalism fraternity, Masonic Lodge, Kiwanis, American Legion, Oneonta Club of South Pasadena, Eastern Star and Press Club of San Francisco.

George W. Savage



Upper left—Heavy traffic on highway near Colma in San Mateo County on February 14, 1926. Upper right—Completed 40-foot highway in San Bruno, San Mateo County, in 1926. Below—This is the type of multiple-lane highway which has replaced the outmoded types of roadway shown in the photographs above.

Construction

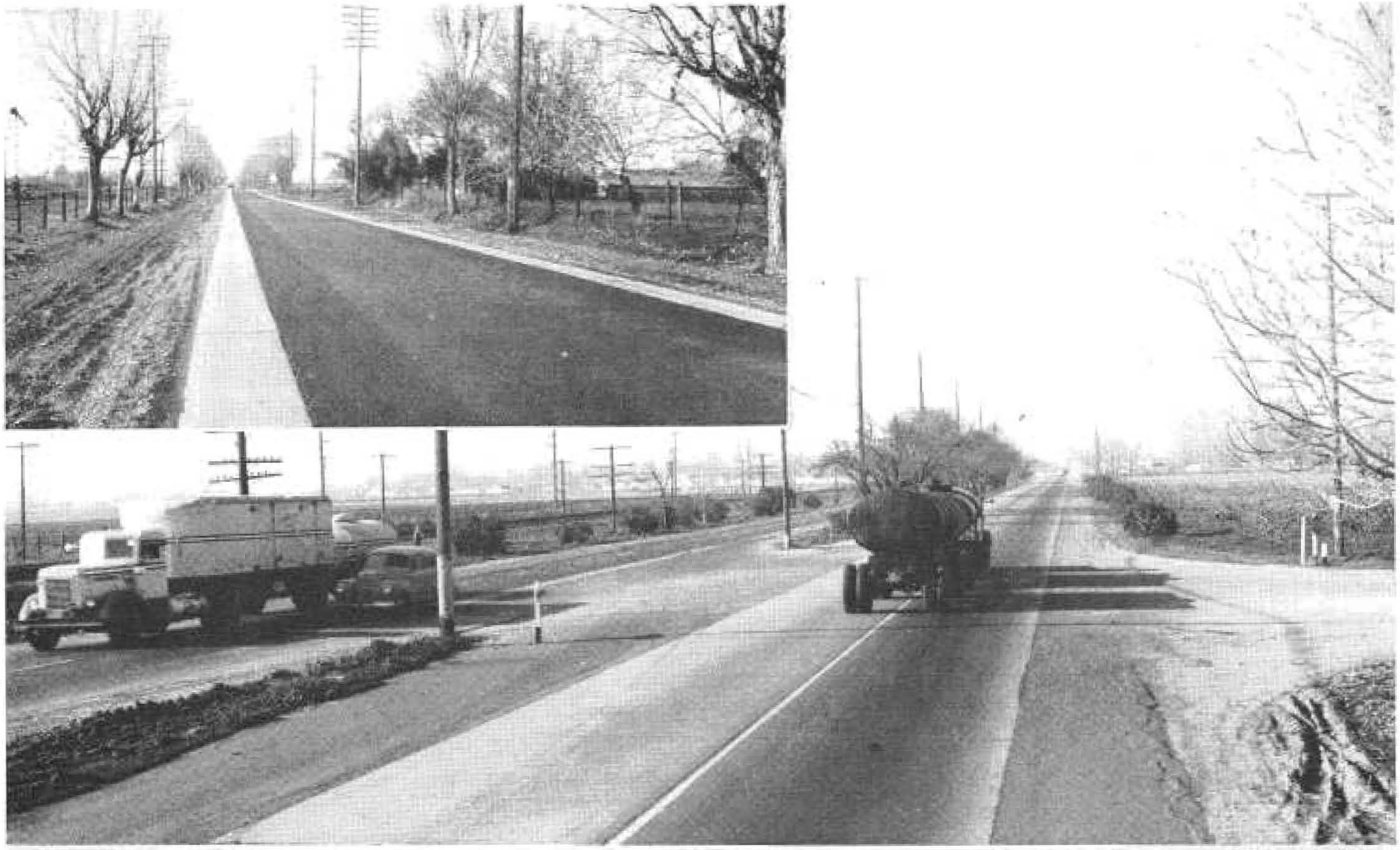
Continued from page 2 . . .

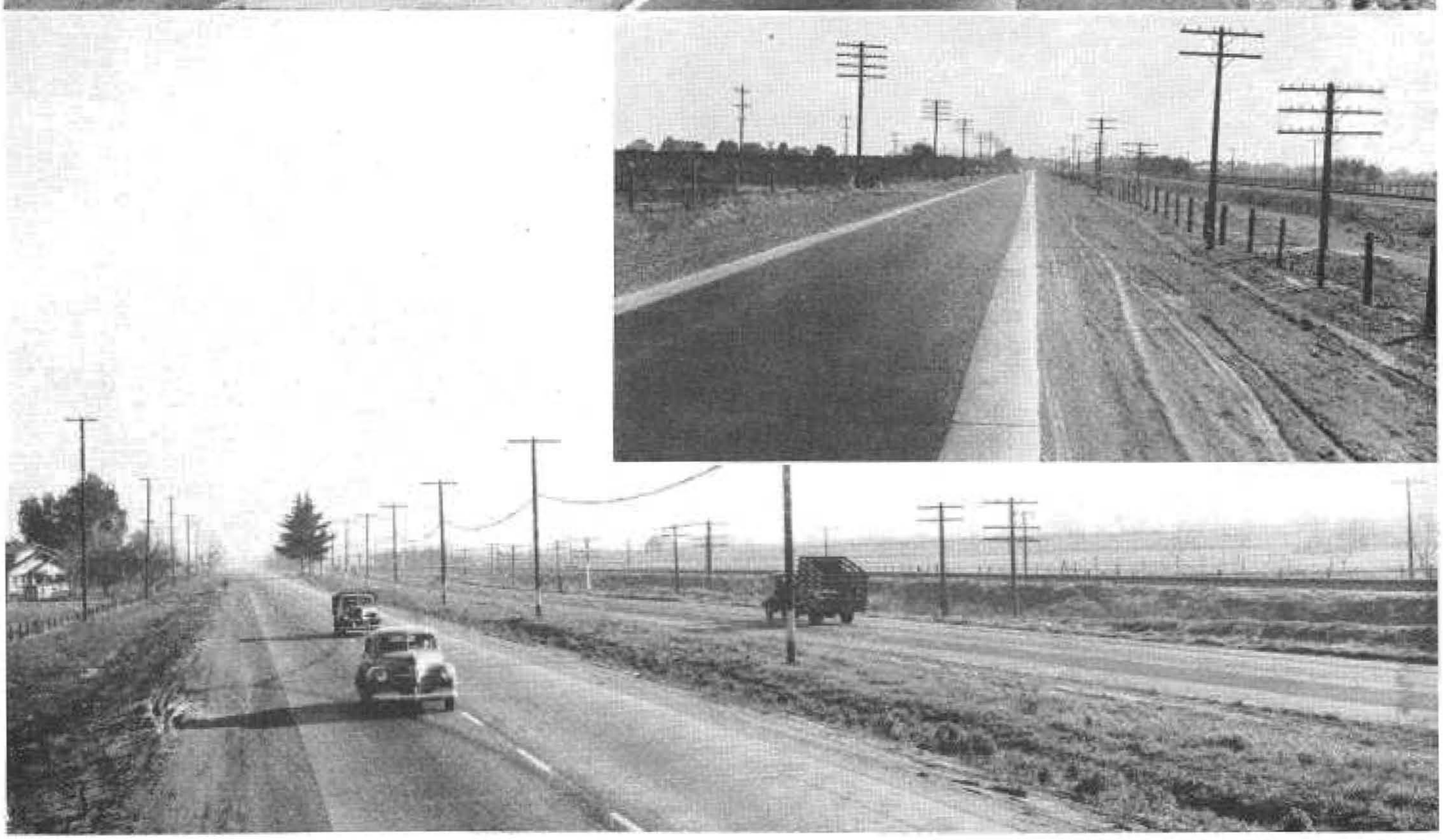
items shows a steady drop in unit prices from 1920 to the start of the last war. This drop was brought about by the development of modern and efficient construction equipment and the ingenuity of the highway engineer and constructor. Both charts indicate an upward trend in costs which will continue until present conditions become settled.

From time to time we hear or see statements to the effect that a mile of road costs a certain figure. The California Division of Highways has not established any such figure for the obvious reason that no one can say that each highway mile in the State can and will be treated the same. In one locality the native soil is bad and satisfactory material must be imported to construct a satisfactory roadbed. In another, local materials are satisfactory but expensive structures are required. Also, the type and volume of traffic and climatic conditions enter the picture, and the type of surfacing or pavement has to be varied accordingly.

From a review of highway projects recently completed and one just starting, the cost per mile of a multiple-lane divided highway in Sonoma and Marin Counties, with grading, structures of Portland cement concrete pavement, was $139,000 per mile; a six-lane divided highway in San Mateo County with grading, structure and asphaltic concrete pavement cost $567,000 per mile; a multiple-lane divided highway in Los Angeles County with grading and Portland cement concrete pavement cost $900,000 per mile; and a recently started two-lane project in Shasta County, consisting of grading and plant-mix surfacing pavement will cost $119,000 per mile.

The above listed costs are exclusive of rights of way cost, preliminary and construction engineering charges.





These photographs graphically show the modern standard of divided highways which are replacing the old roads which were deemed adequate up to a comparatively few years ago. The inset picture in the upper photograph shows a newly completed section of U. S. 99 north of Salida, San Joaquin County, as compared with the four-lane divided highway which recently replaced it. The lower photograph and inset show another section of U. S. 99 north of Salida, with the old and new highways.

Hydraulic Dredger *Fill on Eastshore Freeway In Oakland Nearing Completion*

By F. W. MONTELL, Senior Highway Engineer

THE INITIAL stage of a two-stage construction project of a portion of the Eastshore Freeway between the south city limits and High Street in Oakland is rapidly nearing completion. The Eastshore Freeway has been projected as an artery of rapid transit through the East Bay cities with ultimate direct connection to the San Francisco-Oakland Bay Bridge.

This project is approximately one and one-half miles east of the Oakland Municipal Airport. The section under construction extends from 50th Avenue to a point 1,600 feet south of Hegenberger Road and is 2.3 miles in length. 300,000 cubic yards of saturated marshland mud and clay were excavated from the roadway site and placed to form dikes adjacent thereto to confine hydraulic fill within the roadway and to form graded waste banks on either side of the freeway, the one on the west to be used as the embankment for a two-lane outer highway. Some 890,000 cubic yards of hydraulic fill are being pumped into the roadway section from a borrow area in San Francisco Bay approximately one and one-half miles north of Bay Farm Island (near Alameda) and about five miles from the project.

The work being done on this project consists of the construction of an overloaded embankment providing for an ultimate six-lane divided roadway, and the rough grading of an embankment to serve as a two-lane outer highway. The work includes the removal of varying depths of unsuitable foundation material and the construction of graded waste banks. An imported hydraulic dredger fill material consisting of sand was used to replace the excavated material and to construct the freeway embankment.

Drainage

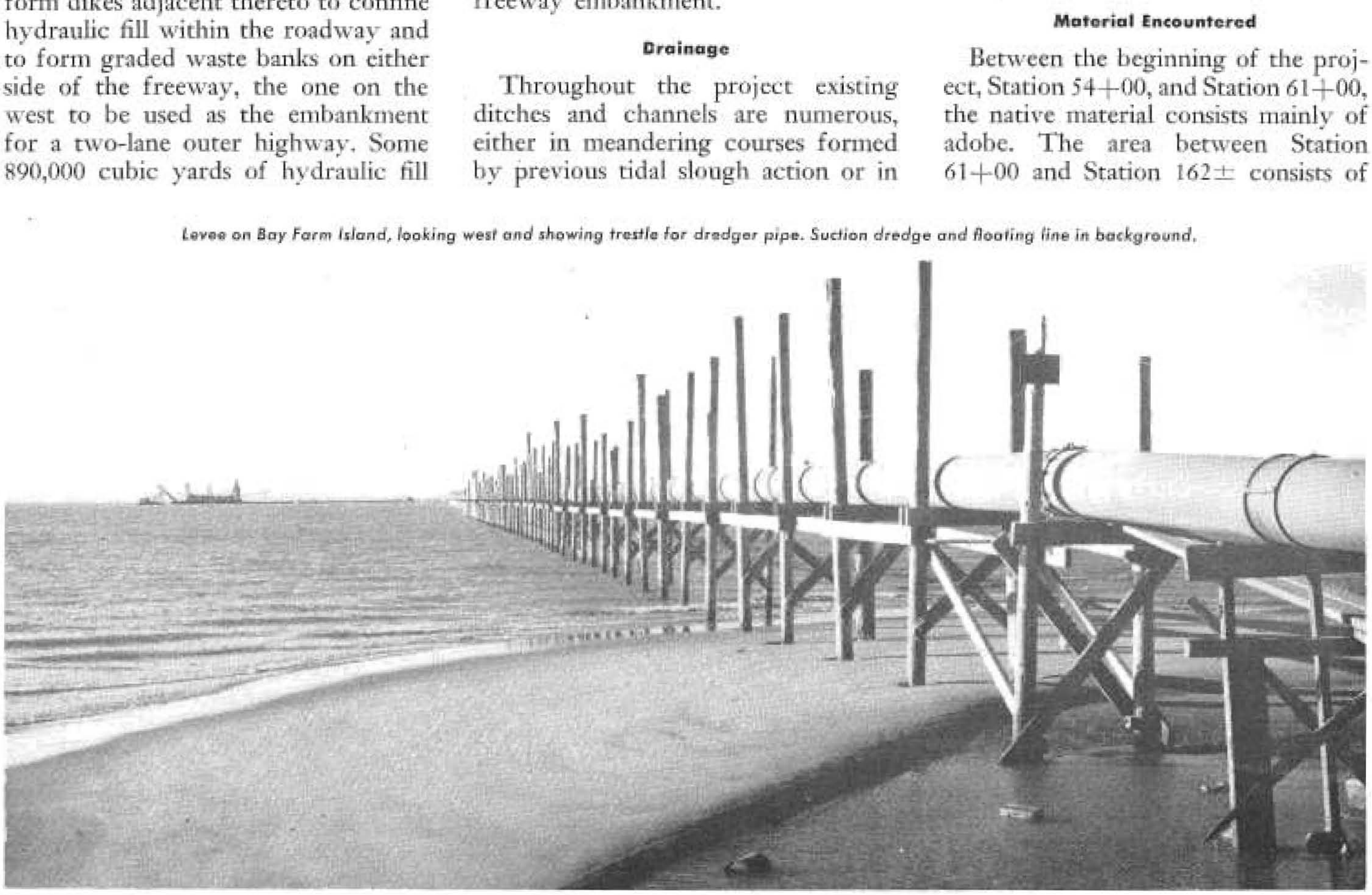
Throughout the project existing ditches and channels are numerous, either in meandering courses formed by previous tidal slough action or in improved channels to provide for storm water runoff. In general, the drainage requirements on the project were worked out in cooperation with the City of Oakland, and the location and capacity of the proposed through culverts were determined in line with their plans for future construction and revision of their existing storm drain system to the east of the freeway.

The project provides for the construction of numerous small ditches or channels to replace disturbed water courses and to provide drainage relief for lands where sloughs are intercepted by embankment construction. Larger ditches or channel changes are excavated at Elmhurst Creek, Damon Slough and East Creek Slough.

Material Encountered

Between the beginning of the project, Station 54+00, and Station 61+00, the native material consists mainly of adobe. The area between Station 61+00 and Station 162± consists of

Levee on Bay Farm Island, looking west and showing trestle for dredger pipe. Suction dredge and floating line in background.



Damon Slough, looking south, showing completion of first link of hydraulic fill.

tidal marshes, and clay loam is encountered between Station 162± and Station 172+00, the end of the project. In the tidal marsh area between Station 61± and Station 162±, the soft blue mud varies in depth from four to twelve feet. The average depth is about five to six feet. Underlying the soft mud is a layer of clay with some sand and gravel stratas in places.

Johnson Western-American, contractors on the project, used three 1.5 cubic yard floating clamshell dredges to excavate the cut along the freeway. The bottom width of the excavation is 100 feet and the side slopes are 1½ to 1. The average cut is approximately six feet. To eliminate any possible slipouts into the excavated section, the mud and clay are placed five to ten feet out from the top of the cut and permitted to dry out prior to shaping it into levees with draglines for confinement of the hydraulic fill. The roadway excavation began on July 15, 1947, and was completed on January 14, 1948.

Dredging Operations

On May 7, 1947, a permit was obtained from the War Department to dredge to a depth of 30 feet an area approximately 3,000 feet wide and 6,380 feet long, comprising 323 acres, 1,200 feet west of privately owned tidelands in San Francisco Bay at Bay Farm Island, Alameda, California. Borings in this area performed by district laboratory forces showed that there were excessive mud deposits in certain locations, so dredging was confined to areas containing material of a sandy nature.

Dredging is being done by the dredge *Olympia* which was launched in 1913 but completely rebuilt in 1945. The stout seven-inch wooden frame hull measured 150 feet x 40 feet x 13 feet and draws nine feet of water. As is usual on dredging jobs, Johnson Western-American keeps the dredge working around the clock, but shuts down for maintenance and repairs on Sundays.

Job of Digging

Digging is being done by a five-blade basket type Simon steel cutterhead, 6.5 feet in diameter at the end of an 86-foot ladder. The ladder is able to work in 50 feet of water although the average depth being dug on this job is only 28 feet. A 40-foot "A" frame guyed to a 50-foot gallows supports the ladder. The intake pipe attached to the ladder has a 12-foot long flexible rubber joint where the connection is made to the pipe on the dredge leading to the pump.

The pump is 76 inches in diameter and is powered by a 2,500 h.p. motor. The intake pipe is 24 inches in diameter and discharges into a 30-inch pontoon line. A booster pump powered by a 4,000 h.p. motor on the dredge *Papoose*, located approximately 9,000 feet from the suction dredge pumps the dredger material to the site of the fill, which is approximately 25,700 feet from the dredging area. Thirty-inch and 24-inch pipe are used in the pump line, and where roads are encountered 36-inch and 42-inch concrete pipes are used under the roads as conduits for the dredger pipe.

While the dredge is working in the borrow pit, it is anchored by three-ton swing anchors supplemented by a trailer anchor on the digging side as it swings over a 270-foot arc in making a cut. A 1⅛ inch cable is used on the swing line. Within the hull at the stern are two 70-foot steel spuds. The one on the starboard side is the working or digging spud, while the port spud is used for moving or setting the dredge in position.

A radio phone is used for communication between the dredge and the booster pump, and a telephone line

Elmhurst Creek, looking south and showing outlet of dredger pipe. Tractor on left used for moving and placing pipe and reinforcing levee.

connects the booster pump with the placement area. When any leak develops in the pipe or levee, or when an emergency arises, the pumping can be stopped by telephonic message.

Due to the fluid condition of the excavated material, some difficulty is encountered in trying to maintain the levees which contain the dredger fill. It is necessary to patrol them constantly and to reinforce the weak spots as they appear with draglines and tractors with bulldozers.

Plans for the project provide for the placing of an overload or surcharge of additional embankment material to accelerate settlement. The added thickness varies from two to four feet above profile grade and is proportioned from the preliminary soil survey data. Records of subsidence are being kept during and subsequent to embankment construction so that the later removal of overload may be properly coordinated with the cessation of fill settlement. The overload is to be removed as part of a subsequent grading and paving contract and the material will be utilized in contiguous embankments.

Settlement platforms consist of one-half inch pipe set on 3 foot x 3 foot x 3 inch wooden platforms. They were placed in the excavated area prior to the placing of the hydraulic fill, and were located on centerline approximately 1,000 feet apart. The top of the pipe is kept above the top of the fill by the addition of lengths of pipe as the fill height is increased. To date, weekly checks on the elevations reveal only minor settlement.

An average of about 12 percent solids is usually contained in the material dredged; or putting it another way, 13.9 cubic yards of hydraulic material have to be dredged to get one cubic yard of fill. The dredge pumps an average of approximately 700 cubic yards in place per hour. The final shaping of the sand fill to planned section is being done by D8 tractors and 12 cubic yard carryalls.

Bridges will be required at Elmhurst Creek (O_4 95+99.97), Damon Slough (O_4 126+32.24), and East Creek Slough (O_4 163+08). They will be two-lane structures at the outer highway and twin two-lane structures at the freeway. It is planned to let these structures to contract during the summer of 1948.

Paving of the dredger fill will be provided for in a future contract.

Johnson Western-American are the contractors on this $900,000 project and are represented on the job by C. McCoy, Dredging Superintendent, and L. J. Sullivan, General Superintendent.

The project is being constructed under the general supervision of Jno. H. Skeggs, Assistant State Highway Engineer, and directly by R. P. Duffy, Assistant District Engineer, Operations, and F. W. Montell, Resident Engineer.

Technical Aid

One measure of the progressiveness of a state highway department is found in the character of its relationships with county and other local highway agencies. One kind of relationship exists in the general supervision, established in law, of certain local activities by the State; of this we have a number of successful examples. Another consists of the extension of specialized technical services by the State to the local units. A splendid example of this is the assistance being given by the California Division of Highways to the counties of the State on the program of county bridge improvement now under way, financed with the aid of federal and state funds. Engineers of the bridge department assist in preliminary investigations, in the review of plans and estimates, in the preparation of specifications and with consultation throughout the construction period. They also assist with the analysis and repair of old structures. The program is a cooperative one, and the counties are encouraged to handle as much of the engineering as possible themselves. Opportunities for this kind of helpful coordination are abundant, and progressive state highway departments will accept them up to the limit of their capacity.

Editorial in Better Roads, December, 1947

Volume Changes Of P. C. C. Affect Pavement Design

Continued from page 21 . . .

anticipated and/or the characteristics of the aggregate available may dictate. For example, if a pavement is planned in an area subject to a wide annual temperature range and construction is to be carried on during the cool season, expansion joints will be provided. For the same job constructed during the summer months the expansion joints may be omitted.

There are certain unsolved problems introduced by the elimination of expansion joints, i.e., how shall bridges be protected from the pressure exerted by the adjacent slabs? Axial stresses that may be allowable in the pavement slab may not be tolerable in the bridge members. Some type of expansion joint seems to be the obvious solution, yet the introduction of space of sufficient magnitude to be effective in this direction would probably seriously reduce the efficiency of adjacent weakened plane joints. A somewhat similar problem arises at the ends of projects where the new pavement meets the existing surfacing.

It is the purpose of this paper to direct attention to those physical characteristics of Portland cement concrete that have influenced the design of pavements composed thereof to the end the engineers of the Division of Highways and others interested in the problem may be advised to the extent of present knowledge on the subject. The design that employs Portland cement concrete to the best advantage as a paving material is yet to be developed and it is hoped a wider dissemination of fundamental data will encourage discussion and stimulate interest in this field.

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[6] Why Concrete Pavements Curl, E. N. R., Vol. 121, page 800.

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[8] Report of Highway Research at Pittsburg, California, Plates 19 and 21.

[9] Structural Efficiency of Transverse Weakened Plane Joints, P. R., Vol. 24, No. 4.

[10] A Discussion of Jointing Practice in Concrete Pavements, P. C. A., July, 1939.

[11] California Construction Department, Circular Letter of June 10, 1947.

Appreciation

JOHN M. DESCH
57 Post Street
San Francisco 4, California

Mr. C. H. Purcell, Director
California Highways and Public Works
P. O. Box 1499
Sacramento, California

Dear Mr. Purcell: It has been my pleasure and privilege to have owned and driven a car since 1916 throughout the State of California and we have watched with great interest the development of our highways. We take this opportunity of stating very briefly that we all owe you and your staff a vote of thanks for the fine highways you have given us, and we are looking forward to the many improvements in our highway system that are now under contract and consideration.

Yours very truly,

JOHN M. DESCH

A Warning

Continued from page 23 . . .

4. U. S. 50 (portions of) from San Francisco to the Nevada border via Oakland, Tracy, Stockton, Sacramento and Placerville.
5. Numerous other sections of our State Highway System where the volume of traffic will require the freeway program of development at the earliest possible time.

If you are a realtor and there is a question in your mind as to any possible present or future access restrictions along the State Highway System, don't guess. Ask your state highway right of way agent. He will be pleased to serve you.

Freeway Projects And Known Effect On Land Values

Continued from page 15 . . .

limited freeway where one 30-foot opening is allowed for ingress and egress to the through lanes of traffic. Located on this outer highway is a store, service station, garage, restaurant and the property owner's residence. Obviously, without this short stretch of outer highway, you would have a minimum of six openings into the through lanes of traffic—one each for the restaurant, garage, residence and store, with two for the service station—or at most, the elimination of one of these openings through consolidating the opening to the garage with one of the openings into the service station.

This type of plan is not expensive to carry out because as a general rule, you are converting an existing state highway into a limited freeway if you have a situation of this kind and the widening program will necessitate moving most of the buildings back. You merely move back a few more feet and in return for the state constructing the outer highway you are justified in asking the property owner to either donate or accept a nominal payment for the necessary land for the outer highway because of the added safety and convenience to his customers through divorcing the turning movements insofar as possible from the through traffic.

The outer highway of course provides for movement of traffic in both directions, with ample parking space in front of the garage, store and restaurant to permit vehicles which enter from the county road to park and turn around and leave via the same route.

Certainly this type of development, will not in my opinion depreciate the value of the subject property for roadside business use, especially when you take into consideration that with the construction of thousands of miles of this type of highway throughout the Nation, the traveling public will soon become adjusted to the use of this type of facility to reach roadside business establishments.

(To be continued)

Church Is Moved

Continued from page 31 . . .

the structure on jacks, pulling the rails, filling the four-foot space between the foundation and existing walls with brick, removing all supports, finishing the basement and reconnecting all utilities.

A large number of elderly spectators and "sidewalk superintendents" were always present, a large percentage of whom were members of the church. There was considerable skepticism among the "sideliners" as to the feasibility of completing the job successfully. However, they were quite obvious in displaying their satisfaction in seeing the job finished and it was a pleasure to observe. The statement was made that 20 years hence a person would have a difficult task in convincing anyone the church had not always rested in its present location, but was two blocks distant.

Monterey Street Overpass

The contractor for the freeway which includes the Monterey Street Overpass structure and one mile of roadway approaches is The Guy F. Atkinson Company of South San Francisco. The contract price for the entire project is $1,341,822. The bid price for the contract item number 76, "Moving and Relocating The German Lutheran Cross Church," is $98,700. The contractor was required to move the building to the new site, construct a new basement, and replace all heating, plumbing, electrical and other facilities removed from the old basement, with everything to be in as near its original condition as possible. The actual moving of the church was subcontracted to The Star House Movers, Inc. of Los Angeles for the sum of $66,700, which included repairing all damage to the building and its facilities, caused by their operations.

Unanimity of opinion has been expressed by everyone who followed the work regarding the excellent manner in which the job was planned and executed. The building is only a shell devoid of partitions and the bracing resulting therefrom. There were only four cracks in the outside brick walls and a nominal number in the inside plaster, far less than were expected. Struts were placed in the windows of the main floor on the southeast side which have a flat top. However, none of the windows was removed, except those in the basement, nor was any window glass cracked, or broken. The Star House Movers are to be congratulated.

Maintenance

Continued from page 1 . . .

$11.83 per ton, while bituminous mixes, which could be purchased at $2.65 per ton in 1941, now sell at $3.69 per ton. These prices reflect an increase of 80 percent and 40 percent, respectively. Other maintenance materials show similar increases, crushed rock having risen from $1.50 to $2.50 per ton; rock screenings, $2.20 to $3.40 per ton; and lumber from $45 to $74 per thousand board feet during this six-year period.

Equipment also follows a similar pattern, rental rates for state-owned equipment increasing 24 percent between 1941 and 1947, while equipment rented from outside sources increased 40 percent. Since the division is only equipped to meet normal needs, at least 20 percent of our equipment rental expenditures go to outside sources, resulting in an average over-all increase of 27 percent.

Another factor affecting our maintenance work is the average age of our employees, which is now 50.7 years, that of the superintendents being 57 years; foreman, 50 years; equipment operators, 47 years; and laborers, 54 years. These men are excellent workmen and will equal, day in and day out, the output of younger men. However, maintenance operations present many emergency demands, such as those imposed by storms and snow removal. Obviously, the repeated demands of such emergencies, which usually involve night work, would tax the recuperative vigor of even younger men.

To sum up the situation, it is apparent that our maintenance dollar of 1947, which is expended 50 percent for labor and 25 percent each for materials and equipment rental, is now but 60 percent of its 1941 equivalent.

F. Walter Sandelin Is Reappointed to Highway Commission

Governor Earl Warren on January 19th reappointed F. Walter Sandelin of Ukiah, Mendocino County, to a second four-year term as a member of the California Highway Commission.

When the new Highway Commission was created in 1943, the appointees drew straws to determine their staggered tenures of office. Commissioner Sandelin drew the short term and was reappointed by the Governor in January, 1944. His latest appointment expires January 15, 1952.

Commissioner F. Walter Sandelin

Commissioner Sandelin is a hotel proprietor in Ukiah, a member of the Redwood Empire Association Transportation Committee, and past president of the Ukiah Chamber of Commerce and the Ukiah Rotary Club. He has been active in highway development in the Redwood Empire counties for many years.

EARL WARREN
Governor of California

•

CHARLES H. PURCELL
Director of Public Works

•

A. H. HENDERSON
Deputy Director

•

HIGHWAY COMMISSION

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R. M. GILLIS	Assistant State Highway Engineer
F. W. PANHORST	Assistant State Highway Engineer
J. W. VICKREY	Assistant State Highway Engineer
R. H. WILSON	Assistant State Highway Engineer
T. E. STANTON	Materials and Research Engineer
T. H. DENNIS	Maintenance Engineer
A. M. NASH	Engineer of Surveys and Plans
EARL WITHYCOMBE	Construction Engineer
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R. H. STALNAKER	Equipment Engineer
H. C. McCARTY	Office Engineer
J. C. YOUNG	Traffic Engineer
I. O. JAHLSTROM	Principal Bridge Engineer
STEWART MITCHELL	Principal Bridge Engineer
E. R. HIGGINS	Comptroller

Right of Way Department

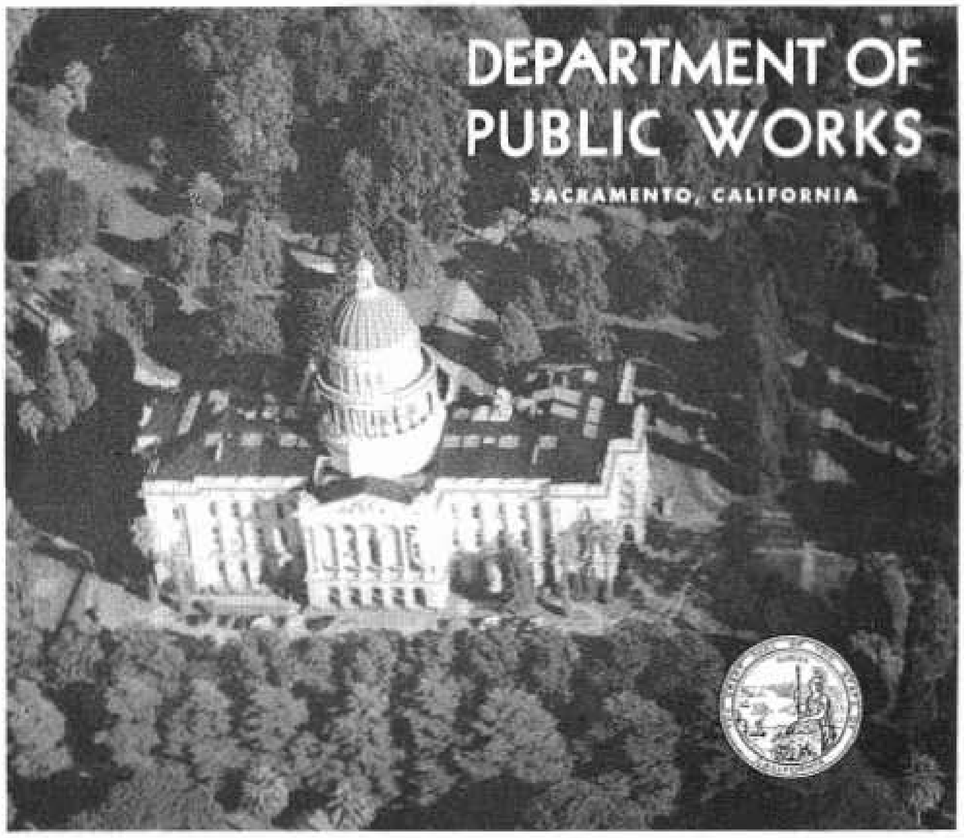
FRANK C. BALFOUR	Chief Right of Way Agent
E. F. WAGNER	Assistant Chief
R. S. J. PIANEZZI	Assistant Chief
E. M. MacDONALD	Assistant Chief

District IV

JNO. H. SKEGGS	Assistant State Highway Engineer

District VII

S. V. CORTELYOU	Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

GEORGE F. HELLESOE	District I, Eureka
F. W. HASELWOOD	District II, Redding
CHARLES H. WHITMORE	District III, Marysville
B. W. BOOKER	District IV, San Francisco
L. A. WEYMOUTH	District IV, San Francisco
L. H. GIBSON	District V, San Luis Obispo
E. T. SCOTT	District VI, Fresno
P. O. HARDING	District VII, Los Angeles
A. D. GRIFFIN	District VII, Los Angeles
E. Q. SULLIVAN	District VIII, San Bernardino
S. W. LOWDEN	District IX, Bishop
C. E. WAITE	District X, Stockton
E. E. WALLACE	District XI, San Diego
HOWARD C. WOOD	Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

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FRANK B. DURKEE	Attorney
C. R. MONTGOMERY	Attorney
LINCOLN V. JOHNSON	Attorney
GEORGE C. HADLEY	Attorney

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A. D. EDMONSTON	Assistant State Engineer
GORDON ZANDER	Water Rights Administration
T. B. WADDELL	Water Resources Investigations
G. H. JONES	Flood Control and Reclamation
W. H. HOLMES	Supervision of Dams
SPENCER BURROUGHS	Attorney
H. SEARANCKE	Acting Administrative Assistant
P. H. VAN ETTEN	Flood Damage Repair
J. H. PEASLEE	Irrigation Districts
R. L. WING	Topographic Mapping
T. R. SIMPSON	Water Rights Investigations
GEORGE B. GLEASON	Los Angeles Office

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W. K. DANIELS	Assistant State Architect (Administrative)
P. T. POAGE	Assistant State Architect (Design and Planning)

Headquarters

H. W. DeHAVEN	Supervising Architectural Draftsman
D. C. WILLETT	Chief Construction Engineer
CARLETON PIERSON	Supervising Specification Writer
FRANK A. JOHNSON	Principal Structural Engineer (State Buildings)
C. A. HENDERLONG	Principal Mechanical and Electrical Engineer
WADE HALSTEAD	Supervising Estimator of Building Construction

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