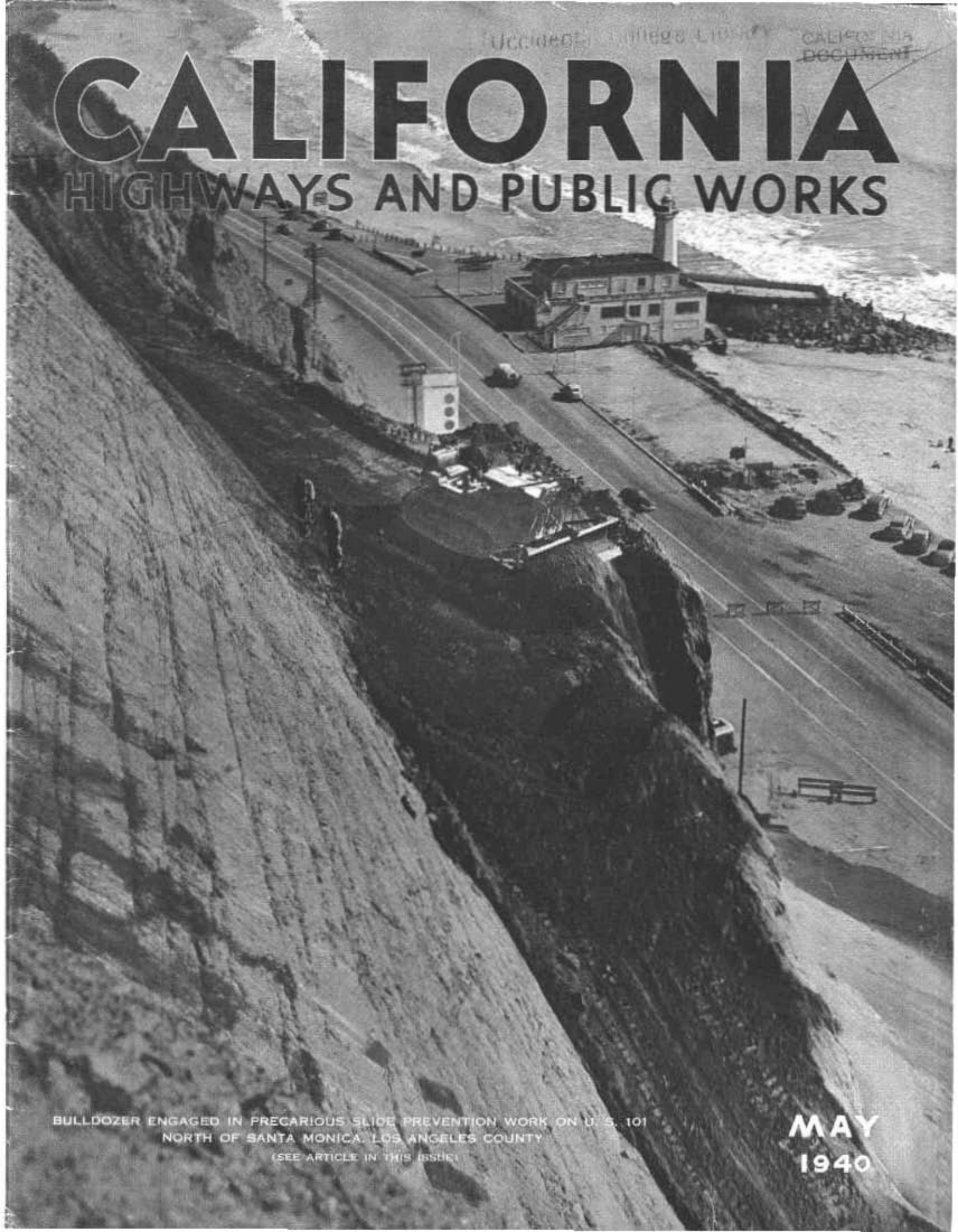
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



BULLDOZER ENGAGED IN PRECARIOUS SLIDE PREVENTION WORK ON U. S. 101 NORTH OF SANTA MONICA, LOS ANGELES COUNTY
(SEE ARTICLE IN THIS ISSUE)

MAY
1940

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

FRANK W. CLARK, Director C. H. PURCELL, State Highway Engineer J. W. HOWE, Editor K. C. ADAMS, Associate Editor

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California Highway Program Requires More Federal Aid For Projects Within Cities

By C. H. PURCELL, State Highway Engineer

During the latter part of last January, State Highway Engineer C. H. Purcell went to Washington upon invitation of the Roads and Highways Committee of the House of Representatives to express his views on the subject of Federal Aid to States for highway construction and to discuss provisions of a bill now pending in Congress to authorize the Reconstruction Finance Corporation to make loans at cost for highway work to States which are in a position to borrow such funds. In the following article Mr. Purcell deals with the highway situation in California in relation to the measure now being considered by Congress.

THERE is pending in Congress a bill, known as the "Highway Right of Way Act of 1940," which proposes legislation of vital importance to California. Briefly, the measure provides that the U. S. Commissioner of Public Roads may acquire in the name of the Federal government real property required by any State in the construction of any road project which will be a post road or will foster interstate commerce, aid in national defense, facilitate the use of the mails or promote the general welfare.

Further, the bill authorizes the Reconstruction Finance Corporation to make loans to States, municipalities or other public bodies at cost to finance or aid in financing the acquisition of rights of way for road projects which will accomplish the purposes above enumerated.

The act provides that the Attorney General of the United States shall institute and carry on all condemnation proceedings for the acquiring of necessary rights of way on highways declared to be Federal routes.

C. H. PURCELL

MORE FEDERAL AID NEEDED

Under the provisions of the bill, Reconstruction Finance Corporation loans would be backed by 40-year revenue bonds which would be redeemed by States, municipalities or other bodies from highway toll collections or other available revenues.

The procedure would be similar to that under which the State of California borrowed $70,000,000 from the Reconstruction Finance Corporation to build the San Francisco-Oakland Bay Bridge. Through the sale of Bay Bridge bonds, the government's loan in this instance has been repaid with a profit of $2,000,000 for the Reconstruction Finance Corporation.

I am particularly desirous that California be permitted to borrow Federal funds at cost or that increased Federal aid be given to our municipalities for highway improvements.

The importance to our State of the bill now before Congress is that the California Division of Highways now is launched on a program of constructing express highways in congested metropolitan areas where the cost of rights of way are prohibitive from the standpoint of the State's financial ability to pay.

HIGH RIGHT OF WAY COSTS

We feel that there are a great number of cities and metropolitan areas where regional highways are of as much importance to a national system as to the individual States. We are contributing to this national system and we have reached a point where we must have credit assistance. What stops this development is the large cost of right of way.

In the first place, it is difficult to finance a project which represents a large right-of-way cost. The ordinary banking channel is an expensive one to start with and it is often the better project which is turned down. The Federal Government has the organization to investigate these projects through the Public Roads Administration and the authority to do business through the Reconstruction Finance Corporation. We believe that projects can be offered—we know they can in California—that will return the investment if we can obtain assistance in the right-of-way acquisition.

Property bond issues for such ventures have not been a success, and we can not resort to this means of financing. It is too often true that the

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Funston Avenue Approach, tunnel in distance, before being opened to traffic.

Funston Aven To Golden G

By LARRY BAR
California Highw

L. BARRETT

ON MAY 28, 1937, the world's longest bridge span across our Golden Gate was opened to traffic and the watery bonds which had hampered the free flow of communication between San Francisco and the California north coast country were forever broken.

With the dedicating on April 21 of the Funston Avenue Approach to the Golden Gate Bridge, a new and modern freeway through the historic Presidio of San Francisco, we have provided additional facilities for still more unrestricted traffic flow between San Francisco and the Redwood Empire to the north.

This new highway presents direct connection between the Golden Gate Bridge and many of the principal residential sections of San Francisco. It provides the shortest connection with through city arterials to two of the three main highways down the peninsula.

Aside from its purpose as a public traffic utility, the building of this approach to the highway across the Gate represents the success of the American democratic form of government, which is based upon theories of cooperation and compromise. The building of the short two miles of this new freeway is an example of the practical application of these democratic theories.

Six separate public agencies of the American people were involved in construction of the project:

The United States Army, over whose lands the greater portion of the highway was placed;

The City and County of San Francisco, whose citizens were most vitally interested in the added facil-

Colorful Dedication Scenes

WITH brilliance and color, international in flavor, the new Funston and Nineteenth Avenue Approaches to the Golden Gate Bridge were formally dedicated and officially opened to traffic Sunday, April 21. Thousands of people participated in the day's events, many of them arriving in spectacular Cavalcade formations from various parts of the Pacific Coast, the largest being from the Redwood Empire, Mission Trails and Southern California.

Dominant in the presentations, each of which was brief, were expressions of friendly good-will and the importance of construction of more highways, for the promotion of perpetual peace and for mutual benefit.

The dedication ceremonials were staged by the Mayor's Citizens Committee of San Francisco, headed by Supervisor John M. Ratto, chairman.

Operating plan and script were designed and executed by the Redwood Empire Association, the General Manager and staff of which served in technical and productive capacity, San Francisco being a part of and Southern Gateway to the Redwood Empire.

Importance of the Funston and Nineteenth sectors, in the Pacific Coast International and National Highway Systems was emphasized by the speakers, who complimented those who financed the several units respectively, namely: California Highway Commission and State Department of Public Works; U. S. Public Works Administration; City and County of San Francisco; Works Progress Administration (section through Golden Gate Park); the engineers, contractors and those labor groups actually performing the work.

Motif for the Funston Avenue Dedication Ceremonial, formal in nature, was the promulgation of friendly relations between Canada, Mexico and the United States, and exchange of visitors between these nations and the Pacific Coast States.

"Wedding of Pacific Coast travel interest" was the theme for the Nineteenth Avenue dedication.

Speakers for the Funston Avenue Dedication included: Supervisor

(Continued on page 21)

ue Approach ate Span Open

RETT, Chairman, ay Commission

ity and who allocated a large portion of the city's share of ½-cent gas tax funds for the work;

The Golden Gate Bridge and Highway District, whose directors saw in the new approach a greater bridge service;

The Public Works Administration, which provided funds for nearly one-half the cost of the work;

The California Highway Commission by whose authority State highway funds were allotted to provide the remaining necessary funds;

The California Division of Highways whose Engineers designed and supervised construction of the project.

Two years of negotiation by the city, the bridge district, the War Department and the State were required before an agreement was reached that the road should be built by the Division of Highways. During these negotiations many difficulties were met and overcome through cooperation and compromise by the several agencies involved, and on July 27, 1938, the United States War Department issued a permit to the State for construction of the new route across the Presidio.

The plans finally adopted met the requirements of the Army in crossing the Presidio Grounds; the city of San Francisco in connecting with arterial street improvements between Golden Gate Park and the Presidio; the Golden Gate Bridge and Highway District in satisfactory connections with its approach viaduct, and the State in the matter of construction standards of the State Highway System.

As I said, the Army permit was issued on July 27, 1938. Seventeen days later, on August 13, the State

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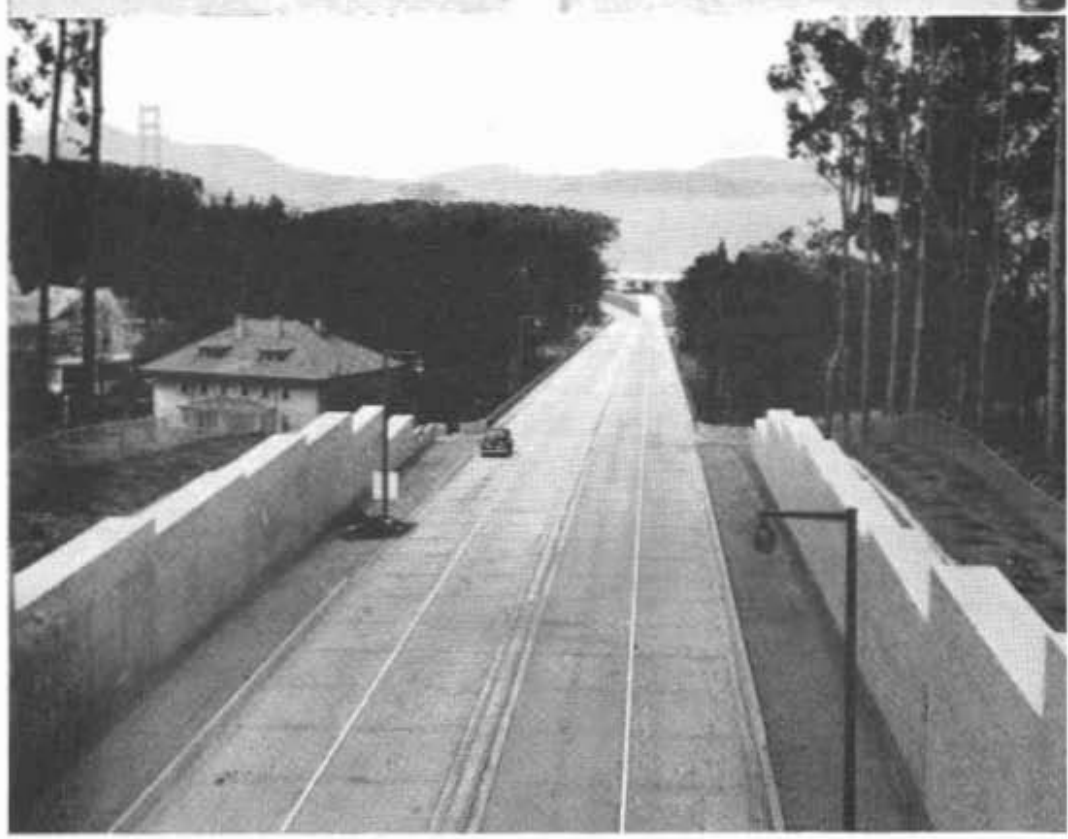


Top—Dedication dignitaries. Left to right—Amerigo Bozzani, Highway Commissioner; Hector M. Escalona, Consul General of Mexico; Director of Public Works Frank W. Clark, J. Gordon Smith, representing British Columbia; Larry Barrett, chairman, and L. G. Hitchcock of Highway Commission. Bottom—New Funston Avenue Approach looking toward Golden Gate Bridge, tower of which is seen in left background.

California Snow Survey Assures An Ample Water Supply This Year

By FRED H. PAGET, Associate Hydraulic Engineer

SUPERVISED and coordinated by the State Department of Public Works, the annual survey of California's snowpack has just been completed throughout the Sierra Nevada.

Employees of the State Division of Water Resources made the snow surveys in the Rubicon Watershed, tributary to the American River, also on Mount Shasta, and in the Alpine Lake region of the Stanislaus River watershed. In all other areas the surveys were made by cooperating organizations interested in knowing the amount of water in the mountain snowpack.

Rangers of the eleven National Forests and the four National Parks covering the Sierra, made measurements in their districts. The power companies, the irrigation districts, and the municipalities sent their own men to the watersheds supplying the water for their activities. The Division of Irrigation of the Soil Conservation Service helped pay some of the expenses.

SKI PATROLS

From the Klamath to the Kern, ski patrols of two or three men—never one man alone—penetrated deep into the snow country to visit each of the 230 established snow measuring stations. Starting from some 70 strategically chosen starting places scattered along the snowline, about 150 men in all took part in this year's survey.

Some of the trips were completed and measurements made in one day, but most of the men were out longer. In the vast winter-locked watersheds of the Kings and Kern Rivers, the ski patrols were out 18 and 14 days, respectively. Overnight they sought shelter in the cabins provided along their routes, stocked before the onset of winter with food, fuel and bedding. Carrying on their backs the hollow aluminum measuring tubes, they visited each measuring station in turn and there made measurements strictly in accordance with instructions printed on the map of the snow course.

ENCOUNTER STORMS

Those parties forced to start early to complete their schedule on time, were caught in the mountains by the big storm at the end of March. Those that were at high elevations holed up in the shelter cabins for several days and waited for the blizzards to subside before venturing to complete their trips. Lower down, where it was not so cold and it was snowing and raining together, some of the parties took shelter on the worst day, but some worked right through, storm or no storm.

Descriptive of some of the trips are the following accounts taken from the routine reports turned in by the snow surveyors:

"We started in the rain on the 28th—on the 29th we skied into Chiquito Meadow and measured that course in the rain. It turned to snow soon. We went to Jackass Meadow and stayed there overnight. The snow was very wet and dragged on the skis all the way. The 30th we measured Jackass Meadow course, then went into Clover Meadow. It turned quite cold, but we wanted to clean up the measuring so we measured the course in the snow before changing our wet clothes. This was the third day we were wet. It snowed all night. On the 31st we realized that it would be well to let the snow settle—but did not want to sit around and delay our return one day. We decided to try it a mile or two and see how it went. We started at dawn. The sun came out. * * * Snow fell from the trees in large patches—down our necks. The going was the toughest yet. We sank ten or twelve inches going up 1500 feet increase in elevation in the seven miles to the course and took seven hours. * * * We returned in three and a half hours, using the packed down tracks made going up. Got in just at dusk."

"We started out on the 28th and got back on the 1st; had tough going all the time and were wet through most of two days."

"We had very bad breakable crust coming back from Piute—I took a very easy fall and sprained my ankle. I made it down the rest of the way quite slowly, but that night and the next day my ankle was pretty sore and swollen. It is getting along all right, though."

"* * * says the trip was so hard that he does not want to go again at this time of the year. They had to walk down hill in soft rotten snow, and could not slide any day."

"All in all we had a very nice trip, although we had to lay over five days due to storms and even then traveled two days during storms.* * * We had another "bear episode" in the cabin at Glenn Flat. He practically cleaned out all the grub. He must have been at the height of a pre-hibernation hunger fit, as he even ate the soap and candles. We were lucky enough to be carrying a little with us, so didn't suffer any for lack of food, regardless of Mr. Bear."

REPORTS FILED

Upon the return of each ski patrol to its base, the notes of the snow surveys were transmitted to Sacramento by letter mail, air mail, telephone, telegraph and radio. At the office of the Division of Water Resources the figures were checked, tabulated and analyzed and each fragment of information fitted into its place in one vast mosaic to form a true picture of the whole.

This year, due to the many warm storms that reached California from the Pacific tropics, rain repeatedly fell

A thirsty snow surveyor gets himself a drink. Using his ski pole (Photo No. 1), he dunks a ball of snow into the open stream channel, draining a satisfying draught from the saturated, spongs-like ball of snow (Photo No. 4). The joys and sorrows of snow surveying. Making a measurement while the wind howls and a blizzard rages (Photo No. 2). The same snow weighing operation with California Sunshine starting the snow surveyor on his way to acquire a healthy coat of tan (Photo No. 3).

at altitudes where under normal conditions most of the winter's precipitation occurs as snow. Due to this, the snow line at the first of April was unusually high, there being practically no snow below elevation 6000 feet. Above this, the snow cover gradually increased with elevation until at the 7500 foot contour it was practically normal. Above elevation 7500 feet, the snowpack was almost everywhere above normal.

On the whole, considering the opposing effects of the lack of low snow coupled with excess quantities up on top, and taking the Sierra north and south, there is this year about three-quarters of a normal snowpack. This is a much better snow crop than last year's, but not so heavy as that of two years ago. It insures ample water for all of California's needs during the coming summer and carries little threat of floods even at the peak of the snow melting period. Because of the quantities of snow at high elevations the late summer flows of most streams should be good.

The menace of salinity in the rich

(Continued on page 21)

Pomona Grade Separations Will Provide New Highway Connection

WITH the opening to traffic of the West Pomona grade separation project, an important highway connection for the adjacent through highways was placed in service and another congested and hazardous grade crossing situation was materially relieved. This newly opened section of highway is a portion of the proposed relocation of State Highway Route 77, which is the route connecting with U. S. 60 at Pomona and running south through Corona to connect with U. S. 395 at Elsinore.

This project included the construction of the one-half mile highway connection between Holt Avenue, U. S. 60 and Fifth Avenue, which carries the State highway route running through Fullerton to Pomona; an overhead structure over the Southern Pacific Railroad tracks; widening the existing overhead over the Union Pacific Railroad tracks; and the connecting approach roads. The construction of the railroad structures and a portion of the highway connection was included in the Federal Grade Separation Program. This separation project will enable through traffic on U. S. 60 and southbound traffic to by-pass a very congested grade crossing in the heart of Pomona.

Inasmuch as a considerable portion of the traffic is now able to by-pass the congested crossing in town as well as to avoid the heavy city traffic, a real saving to the traveling public will result, both in time, human life and property.

The Southern Pacific Railroad overhead was an entirely new continuous reinforced concrete girder structure 235 feet long. The seven-girder bridge crosses the railroad at a high skew with a span of 48 feet. Another span of 53 feet has been provided to accommodate future additional tracks. One of the ramps to Valley Boulevard curves down and crosses back under this structure. The minimum roadway maintained through the length of the project consists of two 25-foot traffic lanes separated by a 4-foot concrete-curbed dividing strip.

The widening of the Union Pacific Railroad overhead was accomplished by placing three continuous reinforced concrete girders on each side supported on separate extensions of the existing piers. The length of the structure was also increased from 115 to 135 feet by the addition of a short cantilever span on each end. The widening provided approximately 20 feet on each side of the roadway, giving two 35-foot lanes on each side of the dividing strip. This allows for an extra accelerating lane on each side to accommodate vehicles coming onto the main highway from the side approaches.

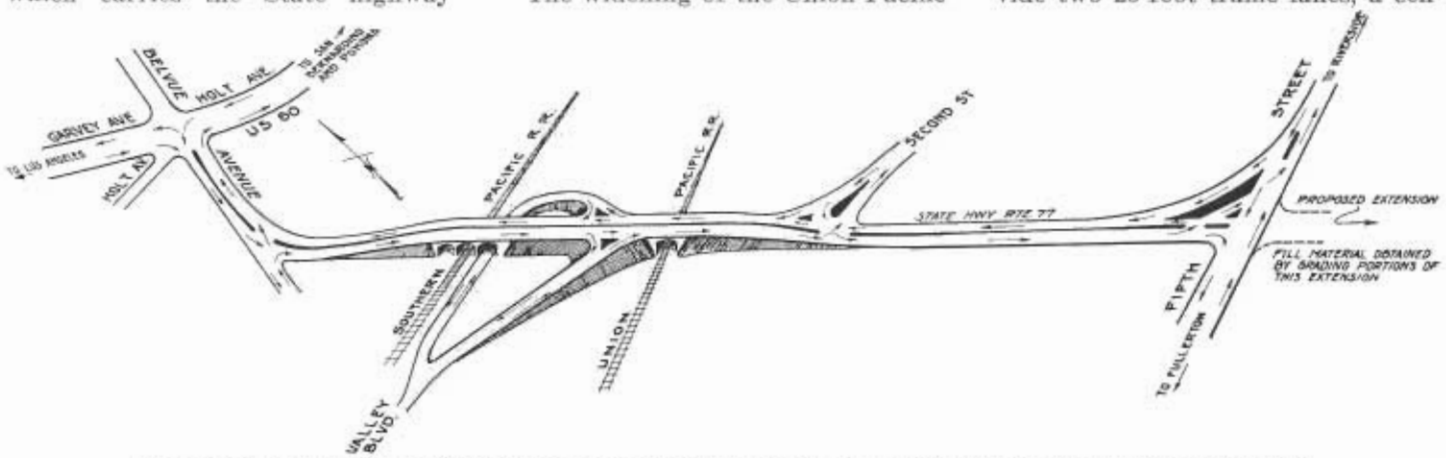
Because it was necessary for the roadway to rise above the flat valley to clear the railroad tracks by more than 22 feet, extensive fills were necessary to carry the main roadway and approach ramps up to this elevation. The material for these fills was obtained by doing the grading on two sections of the proposed extension of the project to the south. The material was taken out of two small cuts through low hills at a distance of about three and one-half miles from the structures.

The completion of this work incidental to obtaining the fill material will result in cheaper construction cost when the remainder of the relocation is completed.

The main highway connections to the overheads were graded to a minimum width of 64 feet to provide two 25-foot traffic lanes, a center dividing strip, and a seven-foot shoulder and berm on each side.

Between the two structures, an eleven-foot accelerating lane with concrete curb and gutter were used in place of the seven-foot shoulders, to permit vehicles coming onto the main highway from the side approaches to gain sufficient speed to get into the main traffic stream without the hazards which accompany breaking into a fast moving traffic line while traveling at a slow speed. All the side approach roads are two lanes with a 26-foot width between curbs.

The contract for the work on both the overheads and their highway connections was awarded to John

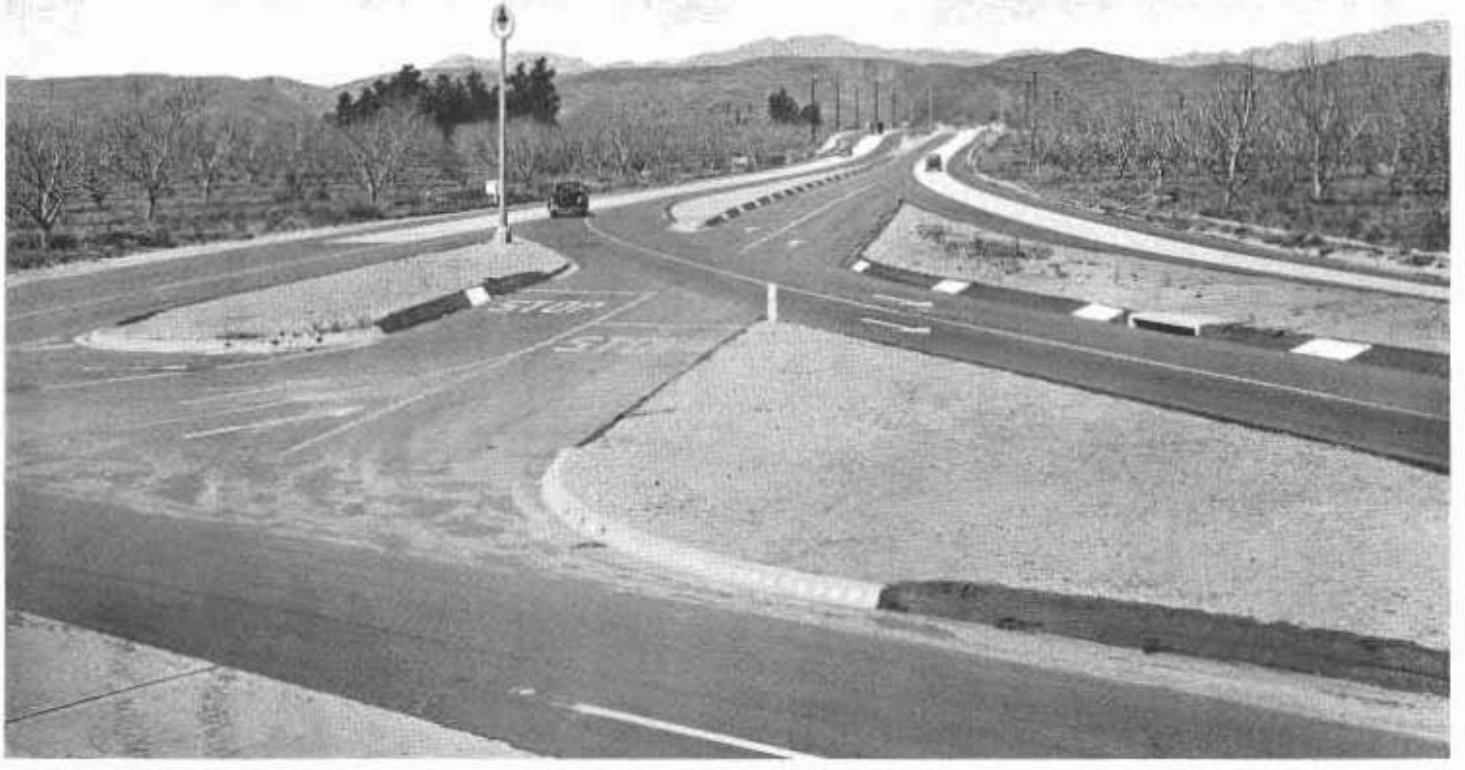


This sketch map shows locations of new Pomona grade separations which will eliminate traffic congestions.

Pomona grade separations. Southern Pacific underpass on left. Top of Union Pacific underpass can be seen in right background.

Strona of Pomona on March 14, 1939. The structures were opened to traffic on March 19, 1940. The total cost of the entire project, the separation structures combined with the roadway and approach fill work, was $196,000, of which about $175,000 was furnished from a Federal Grade Separation Allotment.

The cost of the new Southern Pacific Railroad overhead was about $56,000 while the cost of widening the existing Union Pacific Railroad overhead structure was about $18,000. P. R. Watson was Resident Engineer, assisted by engineers assigned to the project by District VII to supervise the highway work.



South channelization of approach to Pomona grade separations. Highway Route 19, Pomona to Fullerton, in foreground.

View of Kern County's equipment and crews on section of Ducor Cut-off in Kern.

Counties Cooperate on Highway

THE improvement of the Orange Belt Scenic Highway extending along the easterly side of the San Joaquin Valley from General Grant Park southerly to Bakersfield has been of great interest to the people of Tulare and Kern counties for many years.

To attain a better transportation route over an entirely new alignment, which would eliminate several grade crossings and at the same time shorten the distance between Ducor and Bakersfield by approximately five miles, has been the dream of citrus fruit growers and motorists for a long time. So anxious were residents in the communities along the Orange Belt Scenic Highway to have this improvement started and carried on to an early completion that the two counties through which the proposed improvement would pass offered their assistance in constructing portions of this State highway.

In Supervisor Jay Brown's district, in Tulare County, it was agreed to furnish equipment and labor to grade a stretch of highway 1.2 miles in length, involving some 115,000 cubic yards of excavation. This section of the highway, while comparatively short, involved the heaviest excavation per mile on the entire 32 miles included on what is known as the Ducor Cut-off, extending from Ducor to the vicinity of Bakersfield. Tulare County has recently completed the work undertaken by it and an excellent job has resulted.

In Kern County, Supervisor W. R. Woollomes agreed to grade and install drainage structures, including a bridge, on a 3½ mile section between Poso Creek and the Famoso-Woody Road. The Kern County work is now progressing rapidly and excellent results are being obtained. In both Kern and Tulare counties the work is being done in accordance with State plans and specifications, and on both jobs the State has provided an inspector.

The work by both counties has been carried on most harmoniously, the counties cooperating with the State to the fullest extent. Such fine cooperation can only result in advancing by many months the completion date of this portion of the Orange Belt Scenic Highway.

Both counties have elected to use on the jobs undertaken by them the most modern road building equipment. Tulare County put to work six large tractors, with four carry-alls ranging in size from 6 cubic yards to 13 cubic yards capacity, together with tow graders, rooters and other equipment. Kern County purchased a new ¾-cubic yard shovel for its job and furnished five dump trucks, two 4-cubic yard wheeled scrapers, together with pull graders, motor patrols and other units. The use by the county supervisors of the best equipment available has not only resulted in a good job on the State highway but is reflected in the fine county road work to be found in their respective districts.

The sections on which work is being done by the counties are on a location made by the State. Plans and specifications were prepared by the

Division of Highways. The plans provide for a 36-foot graded roadway with oil treated surfacing 22 feet wide. The highway has been designed for minimum sight distances of 2300 feet, which will permit fast traffic to drive safely. A bridge 40 feet in length and with 26-foot roadway designed by the Bridge Department will be built by Kern County at Little Creek.

Supervisors Brown, Allumbaugh and Woollomes have given the work their personal attention.

Top—Crew finishing cut slope on Kern County's section of cut-off. Center—Graded roadway nearly completed. Bottom—Shovel purchased by Kern County for project.

New Sidehill Viaduct Will Break Bottleneck On Santa Cruz Highway

By I. T. JOHNSON, Resident Engineer

WORK recently was started on the construction of a sidehill viaduct just south of Los Gatos on the Santa Cruz Highway as Unit No. 2 of a project designed to break the short bottleneck created by the recent completion of the four-lane highway from that point south, crossing the Coast Range Mountains.

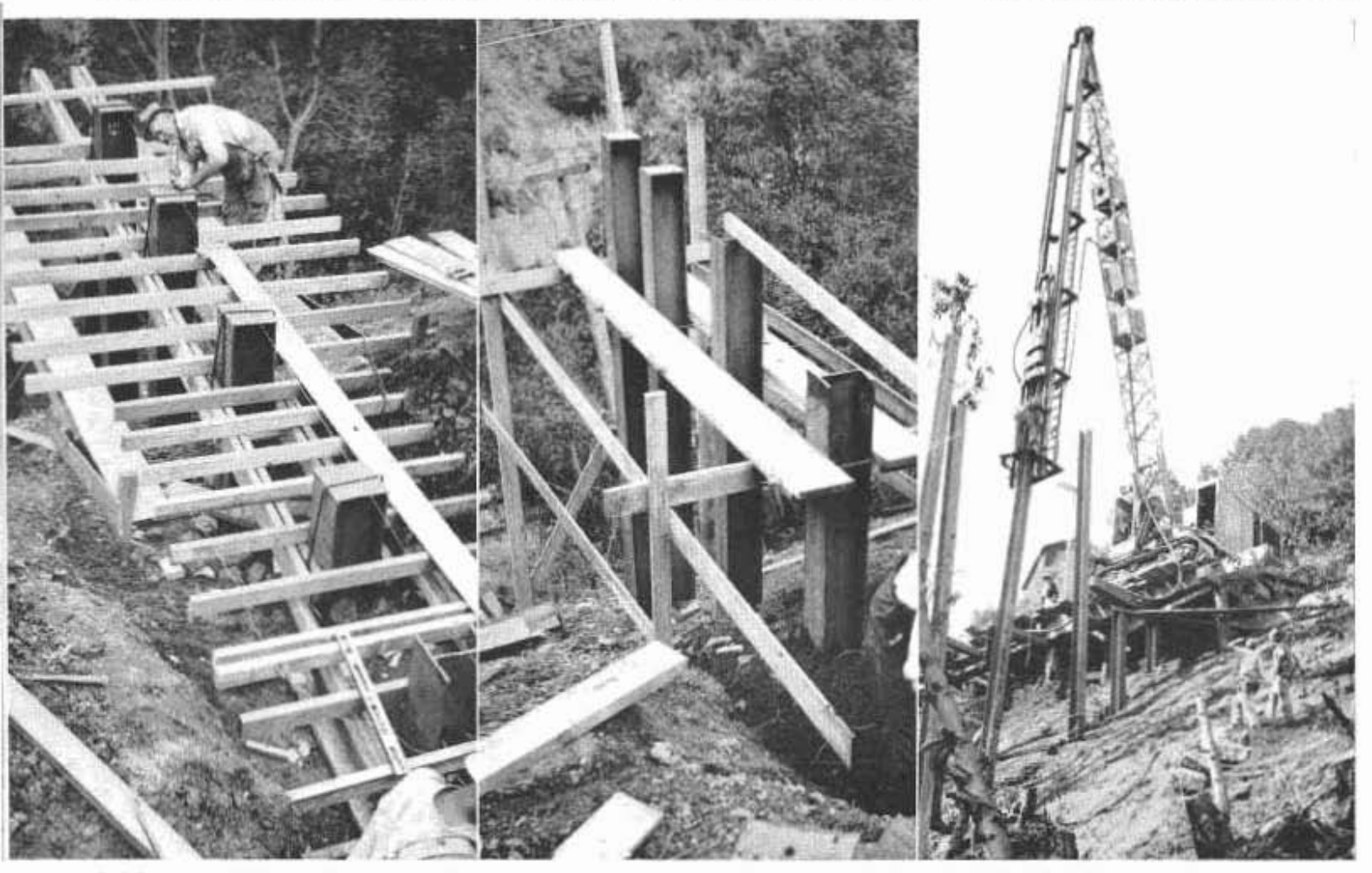
The viaduct is situated near the center of a section of narrow, twisting roadway approximately two miles in length lying on the west canyon slope of Los Gatos Creek, just south of Los Gatos. Below the highway location is situated the main line railroad track serving Santa Cruz. The narrow canyon and the presence of the railroad, creek, water flume, power and 'phone lines, as well as the highway and a high-pressure water line have made location and construction of this section unusually difficult.

TOURIST ROUTE

This route serves the beach and resort areas of the Santa Cruz vicinity and is used by a large number of tourists and vacationists. Traffic has been increasingly heavy on this highway and increased highway widths and improvements apparently serve to stimulate further traffic flow from the bay area.

The difficulty of achieving a satisfactory and economical location for a four-lane roadway, as well as of obtaining sufficient funds for construction, necessitated delay in completion of the adopted design. The canyon slopes for some distance were too steep to permit embankment widening, while the other areas required both extensive channel revision and waste of excavation to obtain the desired location.

Studies were undertaken last sum-



Driving steel "H" piles with crane driver and forming pile bent caps before pouring reinforced concrete caps on sidehill viaduct project south of Los Gatos.

mer to determine the best way of obtaining satisfactory roadway width through approximately 1000 feet of steep, narrow canyon where the railroad track paralleled the only possible location. Various types of retaining walls and cribbing were investigated, but were rejected owing to the relatively high costs and because of foundation problems. Studies indicated that a sidehill viaduct structure designed to utilize the old road width and provide additional width as required for the full section would be the most satisfactory solution.

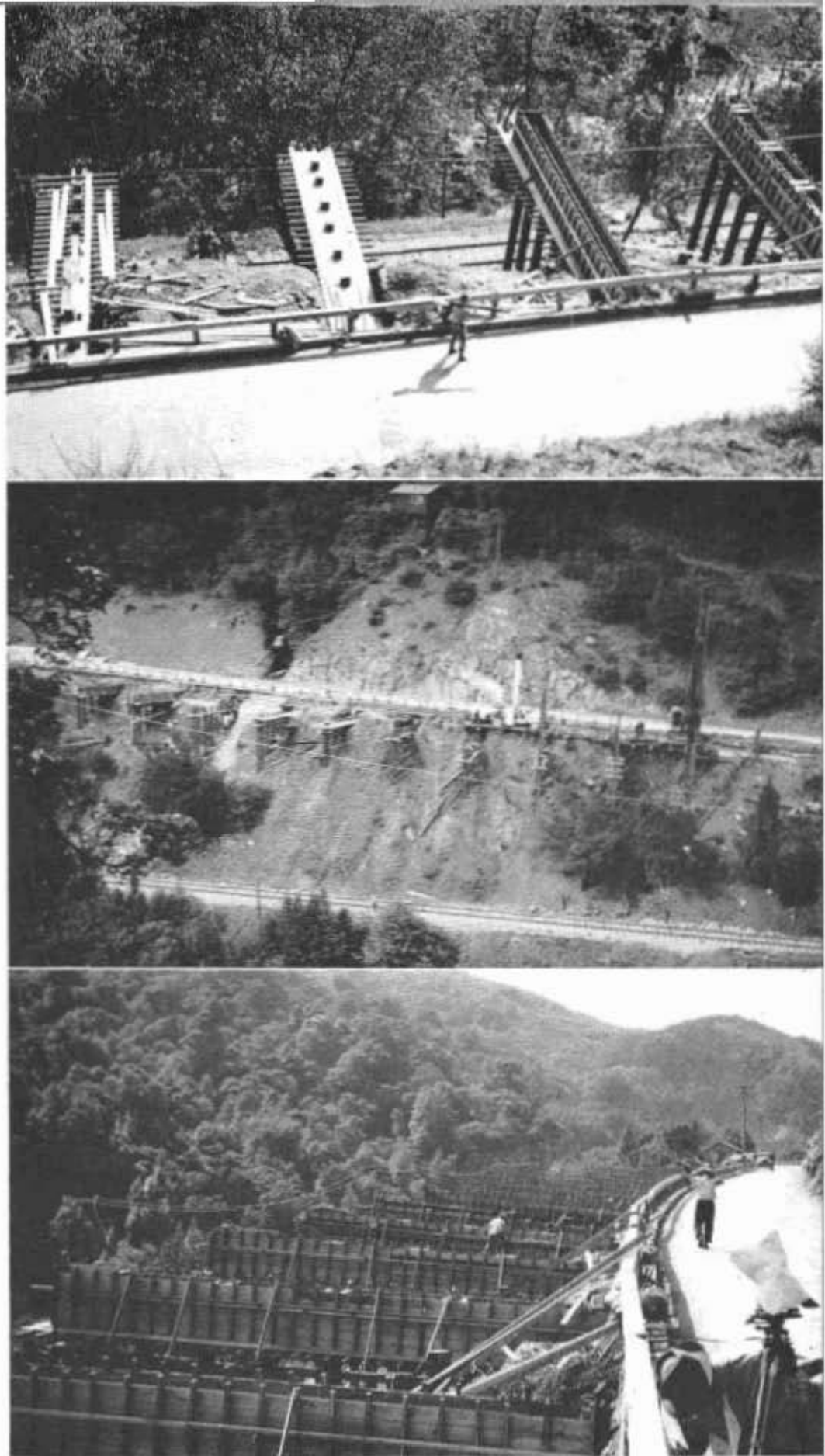
CONCRETE DECK ROADWAY

The structure adopted consists of a reinforced concrete deck roadway carried on lines of rolled steel beams on concrete caps. Bents are located at 25-foot intervals radially and consist of steel "H" piles driven to 32 tons bearing. The number of piles used in each bent varies with the width of structure desired at that location. Four different widths were used throughout the length of bridge. A narrow sidewalk and standard concrete railing on the east or creek side complete the structure.

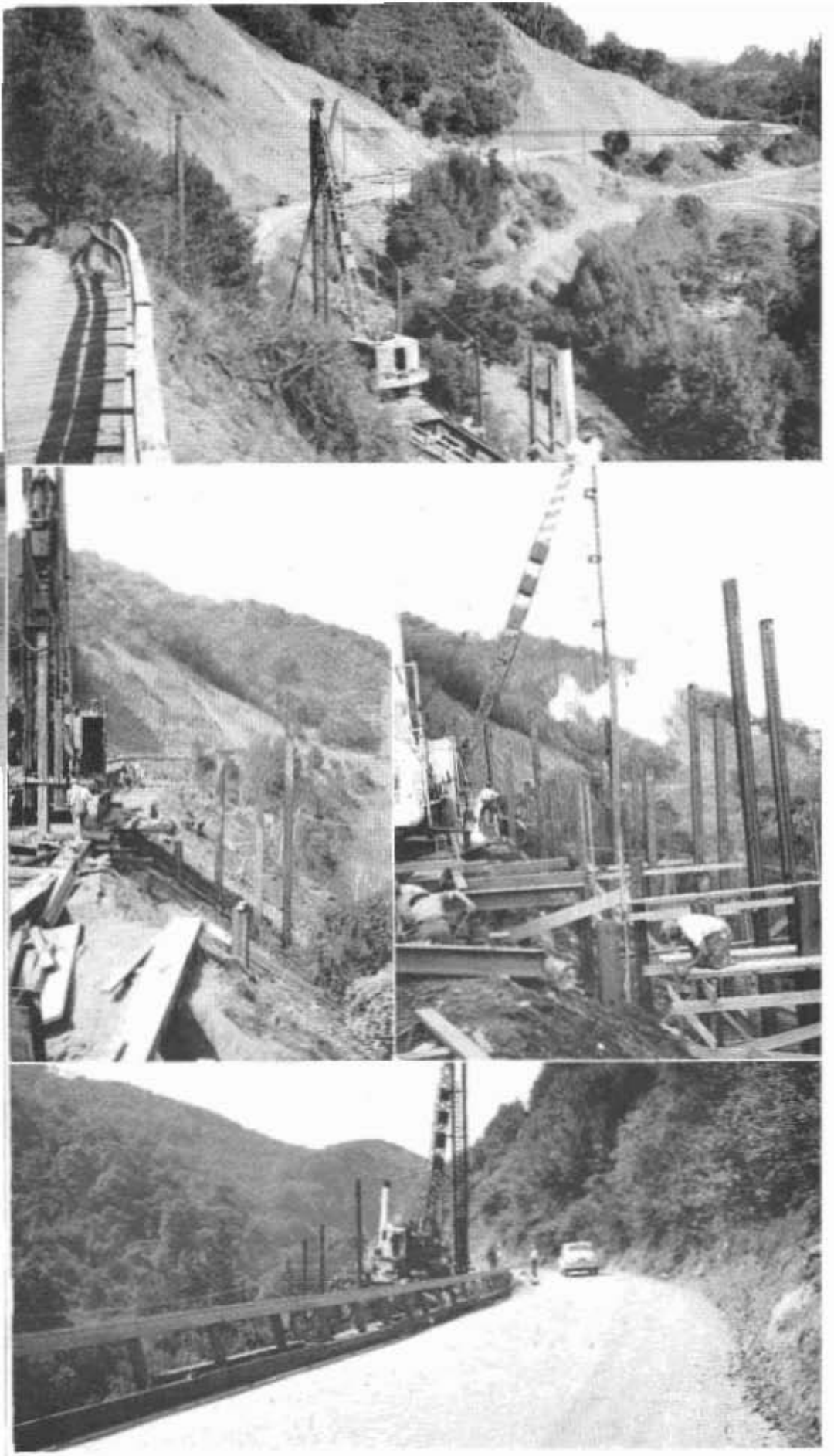
Preparatory to construction and final design, an investigation crew drilled sample holes for determining the nature of the subsurface material and probable length of piling required. This investigation showed the bank to be talus to considerable depths deposited from the adjacent mountain slopes. The formation in this vicinity has been badly shattered by earth movements and can not be clearly classified. The San Andreas fault is located approximately ten miles south of the project. All investigations emphasized the necessity of avoiding heavy cutting at the viaduct location to reduce slide menace and further unbalance the excavation items.

PILE DRIVING OPERATIONS

Several methods of handling pile driving operations were considered for this project owing to the extremely limited room available for construction purposes. On the one hand it was necessary to provide an ample roadway for traffic; while on the other hand no falsework was permitted on the canyon slope below the roadway to reduce slide dangers to railroad operations. The contractor finally decided to use a crane driver operating from a narrow bench just



Forming of concrete caps on steel "H" piles. Center view shows difficulty of widening in narrow canyon due to proximity of railroad track.



Views showing viaduct pile driving operations. Completed roadway will be 50 feet wide.

below the traveled roadway having the outside track carried on blocking with a minimum of falsework. The only other solution would have required a skid driver 90 feet long with resulting difficulties in operation, owing to the varying gradient and superelevations. The alignment for the viaduct comprises three horizontal curves and three vertical curves with connecting transitions.

Driving the steel piles proved to be a considerable problem. Penetrations varied as much as 25 feet in two adjacent piles in a single bent. A special "wrench" was used to hold the piles from twisting in the rocky formation, built of 6-inch "H" section and powered from a crane drum. Considerable tendency to drift from position was observed while driving a given pile and was overcome by either blocking the pile or removing the obstruction, if accessible. The piles required varied from a minimum of 8 to 10 feet in length to a maximum of 62 feet.

Project Unit No. 1 consisting of grading and surfacing, contains the following approximate amounts of work:

335,000 cubic yards excavation.
1,700,000 station yards overhaul.
10,000 tons crusher run base.
6,500 tons plant mixed surfacing.
900 cubic yards concrete and masonry construction.

Project Unit No. 2, the sidehill viaduct, contains the following approximate amounts:

420,000 lbs. steel piling and beams.
310,000 lbs. reinforcing steel.
1,700 cubic yards reinforced concrete.
25,000 lbs. miscellaneous steel.

FOUNDATION PROBLEMS

For this structure, the principal construction problem is naturally one of foundations. The steel and concrete superstructure construction offer but slightly more than usual difficulty, although embodying several new and unique details for adjusting the steel beams for length and grade. The concrete is handled from mixing trucks into place by bottom-dump bucket swung from a 1-yard shovel crane. The structural steel is to be erected from the temporary roadway

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Prevention of Slides as A Safety Factor

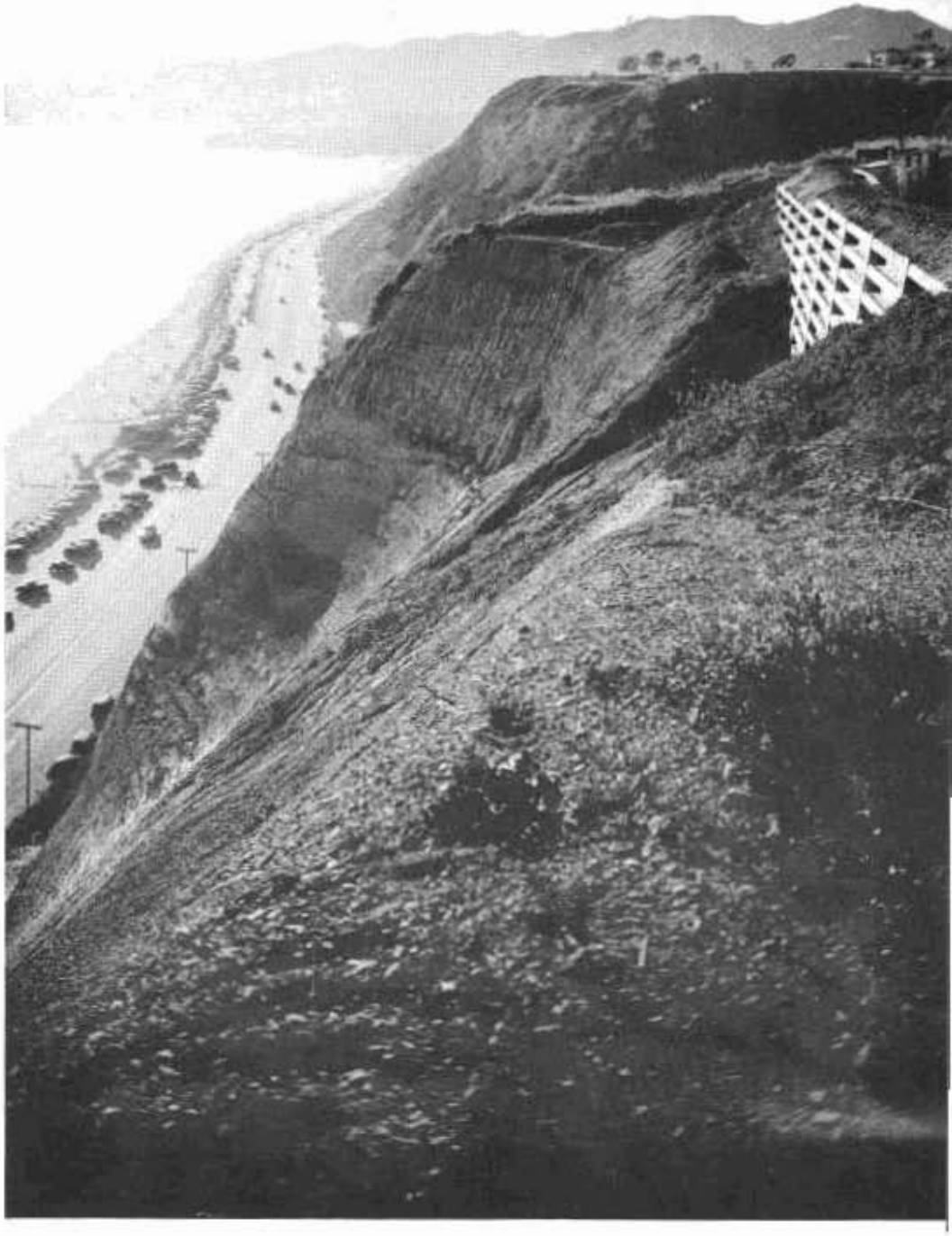
By DOUGLAS H. GREELEY
Assistant District Maintenance Engineer

ONE of the most popular highways in the State, carrying as many as thirty thousand vehicles a day follows the coast westerly from the city of Santa Monica. For a distance of several miles, high palisades flank the highway on the land side, extending over two hundred feet high much of the way. This formation, almost vertical in many locations, is a constant problem to highway maintenance. Sedimentary in character and composed of shale, clay and silt, the unstable portions repeatedly cause slides that are dangerous to traffic and costly to remove. The present pavement of the Roosevelt Highway consists of forty feet of asphaltic concrete, the inner shoulder being fourteen feet in width while the one on the ocean side often extends as far as fifty feet.

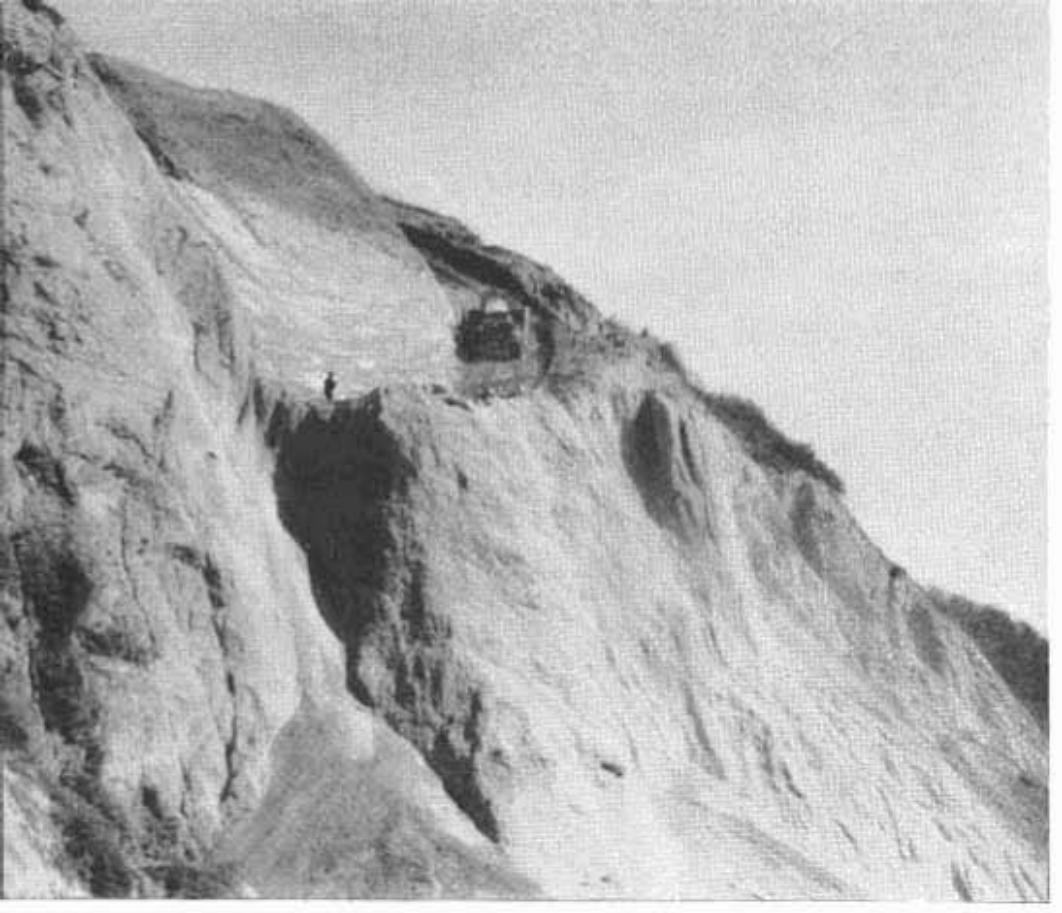
Storms are usually more severe in the Santa Monica area than elsewhere in the Los Angeles basin and this fact, together with the topography and sparse vegetation, greatly increases the difficulty.

Since the storms of 1938, very severe ones occurring in March and again in December, it has been found advisable in several instances to terrace a high cliff from which a slide appears probable, thereby often moving less material and eliminating the hazard to traffic. This can be accomplished during good weather at a cost considerably less than possible in stormy weather. The method also eliminates the probability of a closed highway, this being an important consideration on a road as heavily traveled as the Roosevelt Highway.

The accompanying pictures show a cliff two hundred feet in height situated one-half mile west of Santa Monica Canyon. Water seepage, probably from lawn and flower garden irrigation above, caused several portions to fall. Due to this hazard it was decided that approximately



This photograph shows a completed section of slide prevention work near Santa Monica where retaining wall prevents slides from blocking State Highway seen at base of unstable cliff. Highway traffic was endangered by these Palisades.



Clearing summit of Santa Monica Palisades of dangerous slide material

five thousand cubic yards of material should be removed by terracing, all work to be done by a ninety horsepower tractor and bulldozer. After placing a high dike along the centerline of the pavement to prevent material striking any vehicle, a slope was carried down to a single terrace approximately eighty feet above the pavement. To do this necessitated a close approach to a street above, and the bin-type metal cribbing subsequently placed is clearly shown in the picture. This work was rather spectacular since the bulldozer was capable of pushing a large amount of material over and the public displayed considerable interest in watching it.

It is believed that this work, preventative in character, has cost less than a large slide removal, and the traveling public is no longer subjected to the hazard the unstable cliff caused.

Cost to the Maintenance Department for the clearing of slides of the magnitude possible at this particular point more than justifies the expenditure of funds here for slide prevention.

Golden Gate Span Approach is Dedicated

(Continued from page 3)

submitted the project to the federal Public Works Administration and within six days received the acceptance of the project for construction as a PWA docket. A call for bids on the first contract was immediately published by the Division of Highways and within six weeks from acceptance by the PWA, on October 3, 1938, construction operations on the grading contract were begun.

The project as planned and built extends from the intersection of Lake Street and Park-Presidio Boulevard on the south side of the Presidio to a braided connection with the main approach viaduct of the bridge, a net length of approximately 1½ miles. The total length of construction, including the four on and off ramps at the bridge approach, is slightly over two miles.

In consideration of the right of way given by the Army it was necessary that drainage from the roadway should not empty onto Presidio property; that the highway be tunneled under the golf course, and that Presidio roads be carried under the freeway.

These requirements necessitated construction of two master drainage systems, one emptying into Mountain Lake at the south end of the project and the other into the bay at the north end.

The most spectacular construction feature of the project was the tunnel. This structure was built by the cut and cover method, the reinforced concrete tunnel being built in open cut and the ground returned to its original contours by placing a fill over it. The tunnel is 1300 feet in length, built for four lanes of traffic and is provided with a ventilating shaft 24 feet square.

Through the Presidio grounds three reinforced concrete viaducts were constructed as units of the highway. These viaducts carry the freeway over ravines and across Presidio Roads. Viaduct "A," south of the tunnel, crosses West Point Avenue; Viaduct "B," some 500 feet north of the tunnel, is the longest of the three and crosses Kobbe Avenue. This structure provides a striking entrance for Fort Winfield Scott. Viaduct "C" is about 250 feet north of "B" and crosses Storey Street.

The four ramps, which make the connections to the main bridge approach, provide for traffic distribution by means of modern braided design. This braided design is such that no cars, whether leaving or going onto the main approach, can cross the line of opposing traffic.

Throughout its length this new highway provides the best in modern arterial construction, namely, two wide lanes for traffic in each direction, separated by a central dividing strip. In conformance with present arterial safety standards of the Division of Highways, these lanes are eleven and twelve feet in width.

As chairman of the California Highway Commission, which allocates all State highway funds, I have been most interested in the financing of this million dollar project.

While the final total cost of the six

contracts under which the new freeway has been built have not as yet been computed, it is estimated that the entire work will cost approximately $1,169,000. PWA Federal funds and State highway money were used in financing all six contracts and on three of them the city of San Francisco contributed from its share of ½-cent gas tax funds.

Costs of each of the contracts are as follows:

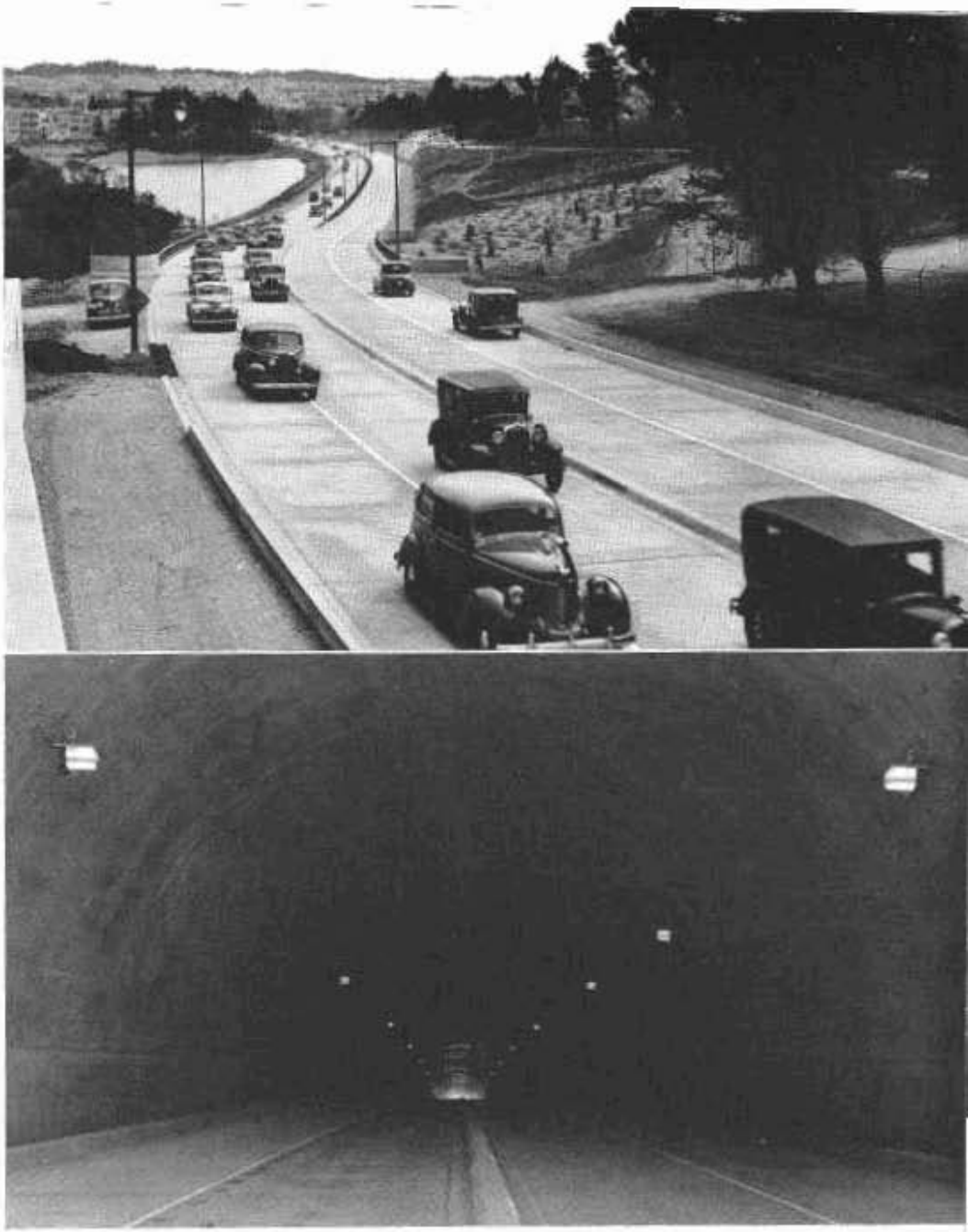
Grading, tunnel and drainage	$580,000
Viaducts A, B, & C	225,000
Viaduct F (Approach Ramp)	55,000
Underpass D, viaduct connection E, and 2 pedestrian undercrossings	97,000
Paving and lighting	172,000
Landscaping	40,000
	$1,169,000

Construction features on the project were numerous. A rough idea of the size of the undertaking may be obtained by looking at a few of the quantities of materials involved.

The entire project involved 508,000 cubic yards of roadway excavation and tunnel backfill and 60,000 cubic yards of structure excavation; 40,000 cubic yards of concrete went into the tunnel, viaducts, structures and pavement; 2500 tons of reinforcing steel was used in the concrete construction; drainage pipes totaled 21,000 lineal feet; and the base for road work required 10,000 tons of rock.

Much credit is due to all who had a hand in planning and constructing the project and on behalf of the California Highway Commission and the Division of Highways may I thank particularly members of the San Francisco Board of Supervisors and the city's engineering staff; Colonel Caples and Major General Simmonds of the United States Army, the directors and engineering staff of the Golden Gate Bridge District and Mr. K. A. Godwin and his associates of the Public Works Administration.

The contractors whose organizations performed the actual construction should also be included among those who contributed to the cooperative efforts in the completion of this highway. Grading, construction of the tunnel and drainage structures were operations performed under contract by the Macco Construction Company. Contracts for construction of four viaducts were awarded by Director of Public Works Frank W. Clark to the Union Paving Company. The underpass and viaduct connections were built under a contract awarded to M. J. Lynch. The paving and lighting contract also was awarded by the Director to the Union Paving Company and landscaping is being done under contract with the Leonard Coates Nurseries.



Upper—Traffic starts over Funston Avenue Approach. Lower—View of tunnel under golf course in U. S. Presidio.

IMPROVED HIGHWAYS IN U. S.

There is a total of 11,070 miles of improved highways exceeding two lane widths in the United States, according to figures compiled by the American Association of State Highway Officials. Only two states, Montana and Wyoming, have no roads exceeding two lane widths. New York leads in three lane widths with 926 miles, Pennsylvania is second with 905 miles. Illinois has 548 miles of four lane highways, and Michigan is second with 394.

California has 74 miles of five lane roads and 49 miles of six lane. Michigan leads the six lane classification with 101 miles, and the eight lane with 22 miles.

"What's your room mate like?"
"Nearly everything I own."

Visitor (at dam site): And did they put the dam down to the bottom of the river?
Engineer: No, madam, they left two inches open so the fish could swim through.

California Highways Are Being Built for Mobility and Safety

By J. W. VICKREY, Safety Engineer

EUROPEAN news commentators have been warning us of late that casualties on the war front are far greatly exceeded by traffic fatalities on the highways of the United States. This is shocking news to Americans, who believe that the country is safety minded—who are convinced that the nation is established for the privileges of life, liberty, and the pursuit of happiness.

That life in the most progressive country in the world must meet dangers and hazards in excess of those that exist upon the war fields of Europe is a condition hard to conceive and hard to believe.

Progress in invention and science has given us the automobile and its necessary copartner motor highways; but the same progress has developed a complex problem which demands all the resources of science and human ingenuity in its solution.

National Safety Council

HEAVY DEATH TOLL

When thinking people began to realize that annually upon the highways of the United States over 30,000 people were killed and in excess of 100,000 were permanently crippled, a determination arose that something should and must be done.

This realization that a problem existed did not admit that prior to the realization of the problem road engineers and enforcement officers had not been endeavoring to give safe movement to the motorists upon the public roads, but rather that additional study and a more careful analysis of the problem at hand must be made.

"Let's get the facts," said the engineer. "We have reports of all accidents," said the enforcement officer. "We will study them," said both together; "undoubtedly they contain valuable information."

And so accident reports have received careful scrutiny and from their study has been brought to light the fact that more than three-quarters of all the accidents on rural State highways are chargeable to the driver, to the human element involved.

Causes of accidents that might be attributed to the condition of the automobile, or the machine, amount to approximately 10 per cent, and causes that might be charged to the roadway, to another 10 per cent. It must be remembered, however, that while mechanical failure of the machine may be the cause, the condition of that machine is definitely in control of the owner.

Again, it must be recognized that while causes chargeable to the condition of the roadway may exist, in many cases if the motorist upon that roadway conducted himself with care and caution the accident would not have occurred.

It is quite evident that the driver must receive the greatest amount of attention in the solution of the problem of traffic safety, and rightly he should. On the other hand, however, there should be no lessening of responsibility that rests upon the shoulders of the automotive engineer or the highway engineer. In fact, there is every reason why these two important figures in the traffic world should work in closer harmony. The automotive engineer has developed and pushed progress in automotive manufacturing far in excess of that which is available to the road builder. The condition is brought about by simple economics—the moneys available.

There are 100,000 miles of public roadways in California. To improve all these roads in the same ratio as has been the improvement of the automobile, is an impossibility. Funds are not available. The road engineer appreciates this fact far better than does the average citizen, for the engineer constantly has before him the problem of expending the funds available for the best interests.

MOBILITY AND SAFETY

The Division of Highways of the California Department of Public Works has mobility and safety as forefront prerequisites in the construction of State highways. Thousands of miles of highways have been constructed and reconstructed to give safe and expeditious transportation for passengers and commodities.

In 1912 narrow, shallow roadways were built to meet the conditions of that time. The 30-mile-per-hour top speed light motor equipment upon the roadway was well provided with adequate road surfaces under the construction program of that day. But automotive travel increased and speeded up as the years passed by—mobility and safety were being challenged.

The Division of Highways studied this problem and two years ago announced a basic change in the stand-

ard highway design. A minimum width of traffic lane in the future would be 11 feet, for two-lane road 22 feet. Traffic requirements on the majority of roads are not expected to demand an increase in the number of lanes over the two-lane pavement.

MULTIPLE-LANE HIGHWAYS

The multiple-lane highway will continue to be the exception rather than the rule. In locations of high congestion, where multiple-lane highways of four or more lanes are needed, separating curbs or even divided highways are being constructed. In order that traffic on the inner lane of the separated roadway may have freedom of movement, these lanes are being constructed to a width of 12 feet.

In conformance with the 11-foot basic lane width now being used by the Division of Highways, bridges and grade separations must be reconstructed proportionately wider. Structures on two-lane highways now have a clearance between curbs of 26 feet, while structures on divided roadways will have a clearance of 27 feet between curbs for each directional roadway. Adoption of this increased basic roadway width and the divided highway for multiple-lane roads will necessarily raise the cost per unit length of highway construction, thus curtailing to some extent at least further possible construction mileage.

The California Division of Highways has decided that, although the wider traffic lane alone can not solve the accident problem, it is still a contribution to highway safety which must be made and is a part of a policy which will be economically solved from the savings of obsolescence alone.

But there are additional safety elements which are constructed in the highways of California other than the reconstruction of roadways —simple elements, which, however, bear greatly upon the safety question. For instance, there is the white traffic stripe—simple but effective.

The annual cost of the installation of traffic stripes, single, double, and two-color type, is approximately one-quarter of a million dollars. This safety feature, however, rests entirely upon the use which is made of it by the human element upon the roadway—a definite responsibility upon the motorist.

Drivers NOT Autos Causing Fatalities

Automotive engineers have made today's motor car the SAFEST vehicle in the history of the industry.

It is almost entirely free of mechanical imperfections, has marvelous braking power, is built of the toughest metals and is equipped with safety devices that take the operation of the automobile itself almost completely out of the field of hazard and chance.

But the one field into which engineers can not reach is the HUMAN MIND.

Let one incautious, incompetent or foolhardy driver get behind the wheel of the safest automobile ever built, and he can turn it into an ENGINE OF DESTRUCTION.

Let a liquor-sodden driver, or a reckless driver heedless or ignorant of safe-driving rules, or a mentally or physically incompetent FOOL operate an automobile, and he will offset all science.

Worse, he will nullify the SAFE DRIVING of the hundreds of other people who must use the same streets and highways he uses.

He will force safe, sane and courteous drivers into ditches and against concrete and metal abutments.

Safe driving is not a mechanical problem, but a HUMAN PROBLEM.

It is not a question of brakes, or tough metals, or safety glass, or even of laws or penalties.

It is a matter of BRAINS.

Not engineering, but EDUCATION, can stop highway slaughter.

Not automobiles, but PEOPLE—reckless, stupid and DRUNKEN people—are responsible for the stark annual HARVEST OF DEATH on the highways.

Drive safely, and live and LET LIVE.

—Los Angeles Examiner.

HIGHWAY SIGNING

Another traffic investment is the $100,000 spent yearly for the signing of highways, both in the installation of new signs and the maintenance of old signs. The reflectorized sign, now being placed upon our roadways, is definite warning of both day and night conditions which exist. Again, the value of these signs rests entirely upon the use made of them by the motorist.

These two safety features depend entirely upon the willingness to be controlled. But there are still other simple features which more or less control by physical barrier. For instance, thousands of feet of guard rail are placed on the highways of California and hundreds of sight posts. To these can be added now, on multiple-lane roads, the dividing island feature as well as separated highway planting. Another controlling physical barrier is the development of channelization used at intersections of congestion and hazard.

Early in 1938 the Division of Highways created a new unit known as the Department of Traffic and Safety. The department in no way supersedes or conflicts with safety activities already under way but strengthens and augments these activities, combining its efforts with others in an endeavor to analyze and study traffic statistics to advance the movement toward the goal of safe highway driving.

RECURRING ACCIDENTS

All new highway design is studied by the Department of Traffic and Safety to see that no possible safety features are overlooked. The relation of traffic problems to other economic and social problems is also kept in mind. It is well known that there is no all-inclusive method of obtaining traffic safety. The methods are still in the process of development.

During the last two years it has been the Department's opportunity to make careful studies of accident reports available so as to determine sections of high accident frequency. These points of recurring accidents may be located upon old roadways or upon more modern highways. When located, careful study is made of existing conditions and the causes indicated upon the accident reports.

(Continued on page 28)

WHAT IS RIGHT OF WAY WORTH?

LESS than half of what the State of California offered to settle for in the first place, a price of $420, was ascertained today by a superior court jury to be a fair value of 18.10 acres of land owned by Thornhill Francis Broome near Point Mugu.

The State agreed to pay Broome $950 for the same parcel before the case went to trial. After 10 days in court, listening to the testimony of expert witnesses for both sides, a jury of 11 persons deliberated four hours and found that $420 would be a fair value.

The State condemned the property in order to realign portions of Roosevelt Highway.

When Cliff Young, a Ventura member of the jury, became suddenly ill Tuesday, attorneys stipulated that the 11 remaining members of the jury would be permitted to make the decision. Foreman Raymond A. Ellis read the verdict at 8.20 o'clock last night. The trial opened March 19 and was continued from time to time.

Broome, owner of thousands of acres of land south of Oxnard, brought to the stand among other witnesses:

Edward H. Allen, Los Angeles appraiser, whose estimation of value and damages was $29,725, and Charles B. Frisbie, civil engineer and appraiser of Los Angeles, whose value and damage report was $32,-050.

State Division of Highway witnesses included:

W. P. Thomsen, mining engineer and appraiser of Pasadena, who testified the land was worth $600; William C. Ramelli, Ventura realtor and appraiser, value $54, and James S. Fulkerson, Sr., realtor and appraiser of Ventura, value $59. None of the State's witnesses believed the land had been damaged.

Broome's attorneys were Vincent Morgan of Los Angeles and Charles Blackstock of Oxnard. Clifford D. Good was attorney for the State.—*Ventura County Star-Free Press, April 4, 1940.*

WHAT price real estate? The question has been at issue before a Ventura County jury in a local highway condemnation matter.

Two appraisers, witnesses for the land owner, set valuations on the strip in question at $29,725 and $32,-050, respectively.

Appraisers who testified as expert witnesses for the Highway Department set valuations, respectively, of $600, $54 and $59.

After hearing testimony and arguments for two weeks, the superior court jury brought in a verdict fixing the amount at $420.

Recently in Santa Cruz County a jury decided on $3,000 as the proper price for land needed to extend a street; there the property owner had asked $40,000. Following the announcement of the verdict, Judge James L. Atteridge turned to the jurors, and remarked:

"I am about to discharge you from duty on this trial and I want to commend you for your verdict. Recently there has grown up here a racket in these condemnation cases, and in this case there was offered some of the wildest and most chimerical testimony as to the value of property that I have ever heard. Now, as a frequent trier of matters of fact, I regard some of that testimony as an insult to the intelligence of a person."

Similar expressions are being heard in Los Angeles County, where condemnation proceedings have been frequent. In fact, the board of supervisors there is reported right now planning to make a survey of all court records in condemnation matters, compiling the sworn statements of valuations which property owners make in these cases. These would then be referred to the assessor for his guidance and would be produced when protests were made on tax assessments on these properties.

What price real estate? Well, it depends greatly on who is doing the appraising. And when. And why. —*Ventura County Star-Free Press, April 5, 1940.*

THE American Right of Way Association News highly commends Judge James L. Atteridge for his very timely statement made in dismissing the jury after it had rendered a verdict in the case "City of Santa Cruz vs. Wilson."

We also commend the publisher of the Santa Cruz Sentinel for giving the remarks of the judge headline attention on page one of the issue of February 20, 1940. It is hoped that more California newspapers will take up the defense of the already heavily-burdened tax payer and exert their influence in stamping out the notorious practice of professional perjurors conducting themselves in the manner referred to in Judge Atteridge's comments.

It is to be hoped that the judges of the superior courts of the counties of California will likewise recognize this growing racket on the part of certain unscrupulous property owners and professional witnesses. We say "professional witnesses" because we would not honor these individuals with the term "expert witness" or "expert appraiser." We have reached a deplorable situation in the superior courts of this State when certain property owners can actually buy any type of valuation testimony they desire from certain so-called "experts," and their attorney will use such testimony.

Racketeering in connection with trials in condemnation proceedings for acquisition of private property for public use has grown into a profession in the larger metropolitan areas and is also flourishing in various counties in the State of California. It is, unfortunately, a growing evil which should be curbed by fair-minded juries and by courts with the courage of their convictions.

It is the purpose and aim of the American Right of Way Association to fight to the last ditch in its endeavor to eliminate these leeches who are attempting to bleed the last drop of blood out of the public treasuries.—*American Right of Way Association News, April, 1940.*

APPRECIATION

March 18, 1940.

Editor, California Highways
and Public Works
Sacramento, California

Dear Editor:

I have before me, two copies of your very fine journal, December 1939, and January 1940, showing the remarkable work under construction or completed by the department.

I have been so impressed by the many fine features in this little magazine that I am mailing these two numbers to my brother in Twin Falls, Idaho, who is quite interested in this work from a mechanical standpoint, whereas, my interest lays more in the scenic parts, etc.

I would greatly appreciate if I could be favored in receiving some more copies of your fine journal.

I am,

Very Truly Yours,

RALPH EMERSON WOODS,
106 Millar Avenue,
San Jose, California.

AN ENGINEER WRITES

CITY AND COUNTY OF
SAN FRANCISCO

Department of Public Works

Editor
California Highways
and Public Works
Sacramento, California

Dear Sir:

For some time past your official journal was regularly mailed to me, as I was engaged on highway work for the City of San Francisco as Designer and Civil Engineer.

Please return my name to your mailing list, if possible, as I find your magazine very interesting and instructive. I should especially appreciate it if you would send me a copy of the February and March issues, if available.

I wish to thank you for your past courtesies.

Very truly yours,

A. V. BOWHAY,
Assistant Engineer,
Room 367, City Hall.

UNITED STATES ASIATIC FLEET
SUBMARINE SQUADRON FIVE
U. S. S. CANOPUS (Flagship)

Manila, P. I., Feb. 6, 1940.

California Highways
and Public Works
P. O. Box 1499
Sacramento, California

Gentlemen:

While aide to the Commandant at the Navy Yard Mare Island, Cal., I received your monthly publication on California roads and development and upon my detachment it has continued to be sent me at 1034 Encino Row, Coronado. Since my departure from the coast in October it has been forwarded to me on the Asiatic Station.

Yours truly,

J. WILKES, U. S. N.
U. S. S. Pickerel
c/o Postmaster
San Francisco, Cal.
Comdr. U. S. Navy

San Francisco, Cal.,
March 23, 1940

California Highways
and Public Works
Sacramento, Cal.

Gentlemen:

I would greatly appreciate being placed on the list of subscribers for your very interesting publication of California Highways & Public Works. I have been able to borrow an issue occasionally but when a copy like that for March appears there is not even one to borrow. If possible, the March issue will be appreciated.

Yours very truly,

OSBORN ANDERSON,
Public Roads Admin.,
Federal Office Bldg.,
San Francisco, Cal.

California Highways
and Public Works
Sacramento, California

Gentlemen:

It has been my pleasure to receive California Highways for many years. I have always enjoyed it. So much, in fact, that it has always been passed on to others after having examined it thoroughly from cover to cover.

One gentleman, in particular, is such a loyal fan that he protests when I delay in providing him with my copy. Would it be possible to have a copy mailed to him direct each month?

Very sincerely yours,

FLOYD TOWER,
315 Montgomery Street,
San Francisco, Cal.

California Highways
and Public Works
Sacramento, California

Gentlemen:

I just yesterday became cognizant of the publication by your Department of the magazine entitled "California Highways and Public Works." The issue I saw was the November issue and contains material of very great interest.

I think the plan and method of informing the citizens of your extensive and valuable efforts to be most worthy.

Will you kindly place my name on your mailing list beginning with the November number, and oblige

Yours very truly,

H. B. BLAKELEY,
Room 602, Hall of Records,
Los Angeles, California.

Department of Public Works
Sacramento
California

Dear Sirs:

I visit all of the high schools in Fresno County and in one of them I recently came across your Journal. I presume you are sending this to all the high schools and if so I wish to commend you on this very fine service.

If you can spare a couple more copies I would very much appreciate it if you would send both Superintendent Edwards and myself this particular issue and put us on your list for this very fine publication.

Sincerely yours,

LOUIS P. LINN,
Assistant Superintendent.

Funds For Additional Highway Projects Allocated By State

THE California Highway Commission has voted funds aggregating $1,200,000 for inclusion in the State highway budget for the current biennium of eleven major construction projects, and allocating $546,000 for 43 minor improvement and betterment projects.

When the budget was first prepared for the current biennium, it was based upon collections from the gasoline tax, diesel oil tax, and motor vehicle registration fees for the previous biennium plus the estimated normal increase from these revenues. During the present biennium, however, collections of revenue from the gas tax, registration fees, and diesel oil tax have shown greater increases than estimated at the time the budget was prepared.

It is on the basis of this greater increase of revenue and of savings accrued to Division of Highways funds because of advantageous bid prices on contracts which have been awarded by the Director of Public Works for State highway construction, that the Commission was able to vote funds for the $1,200,000 in new major projects.

WILL IMPROVE BRIDGES

On a similar basis, the Highway Commission voted $236,000 from diesel oil tax funds for reconstruction or improvement of five more bridges which are posted for restricted loads or speeds.

At the beginning of each biennial period, the Commission in adopting the State highway budget provides specified amounts for minor improvements and betterments on the State highway system. From time to time, the Commission allocates portions of these funds to specific small projects as the need for such betterment and minor improvement arises and proper season for the work arrives.

The $1,200,000 voted for additional major construction projects provided for the following proposed work.

For grading, paving, and right of way on portions of Ramona Boulevard in Los Angeles County, between Mission Road and West Covina, Road VII-L.A.-26, $200,000. This amount supplements $560,000 included in the budget for right of way and improvement to modern arterial standards of this heavily traveled suburban highway.

For grading and paving the Coast Route in Santa Clara County between Llagas Creek and Gilroy, IV-SCl-2-C, $175,000. This will provide for the continuation to Gilroy of the three-lane pavement which has been constructed south from San Jose as far as Llagas Creek.

An amount of $150,000 for constructing a bridge and approaches across the Kern River at the westerly entrance of Bakersfield, VI-Ker-58-L, of the secondary State highway between Bakersfield and the Coast Route at Santa Margarita.

For paving the 7.3 miles of relocation of U. S. 40 in Solano and Yolo counties between 1.3 miles north of Dixon and 1 mile east of Davis, X-Sol, Yol-7,6-I,A,E, the sum of $140,000. A contract is now in progress for grading this new section of the main highway between Sacramento and San Francisco, and bids will be opened May first for construction of a grade separation near Davis. Future contracts will be let for construction of two bridges within the limits of the project.

For constructing a structure separating the grades of the El Camino Real (U. S. 101) and University Avenue, IV-SCl-2-A, at the entrance of Stanford University at Palo Alto, the amount of $78,000. This structure is estimated to cost $170,000 and the city of Palo Alto will furnish $92,000 from its share of ½-cent gas funds.

An amount of $71,000 for grading and surfacing on Bellflower Avenue in Los Angeles County, between Spring Street and Arteria, VII-L.A-169-A.

In Kern County, funds in the amount of $100,000 were voted for grading and surfacing portions of the secondary route which leads northerly from Famoso to Porterville, between Famoso Road and the North County Boundary, VI-Ker-129-B.

For grading and surfacing a portion of the State highway which leads from Baker in San Bernardino County to Death Valley, the sum of $45,000 to be used between the south boundary of Inyo County and Shoshone, IX-Iny-127-P

OTHER APPROPRIATIONS

For further improvement to the State highway which leads from Fresno to General Grant Park and the Kings River Canyon, an additional amount of $81,000 was voted, making a total of $217,000 budgeted, for grading and surfacing between Squaw Valley and a connection with the existing road in the National Forest, road VI-Fre-41-T,U.

The sum of $75,000 was voted for additional grading and surfacing in Los Angeles and Ventura counties on the Santa Paula lateral, VII-L.A,Ven-79-Various locations.

In Orange County, for the Main Street Extension, between Route 60 and Route 43, at Newport Beach, VII-Ora-184-A,NptB, $85,000 was voted to supplement the $75,000 in the budget. The work will include grading, surfacing and a bridge across Newport Bay.

The $236,000 from additional diesel oil tax funds for reconstructing or strengthening posted bridges which was voted at the meeting of March 29 included allocations to the following projects:

In Mendocino County, bridges across Ferguson Gulch and McNamee Creek, I-Men-56-A, will be replaced by fills and culverts; $65,000 is provided for this work. On the same route in Mendocino County the bridge at Greenwood Creek, I-Men-56-C, will be reconstructed for $21,000.

The sum of $90,000 was provided for the bridge and approaches across the San Gabriel River in Los Angeles County on Artesia Boulevard, VII-L.A-175-B. Also in Los Angeles County, between West Covina and Azusa, $40,000 was allocated for bridge and approaches across Dalton Wash, road VII-L.A-62-D.

In San Luis Obispo County, $20,000 was allocated for bridge and approaches across Arroyo Grande Creek, V-SLO-56-E, on the secondary highway between Pismo and Guadalupe.

Colorful Scenes at Dedication

(Continued from page 2)

Warren Shannon, President Board of Supervisors and President Golden Gate Bridge and Highway District; Paul E. Mudgett, President Redwood Empire Association; Colonel Thomas A. Terr, 9th Corps Area of the Presidio; Lawrence Barrett, Chairman California Highway Commission, speaking for the entire Commission; State Director of Public Works Frank W. Clark, officially representing Governor Olson; The Honorable Hector M. Escalona, Consul General of Mexico; E. G. Rowebottom, Minister representing Provincial Government of British Columbia, Canada; Miss Martha Sprague, daughter of and officially representing Governor Charles H. Sprague of the State of Oregon; Kenneth Godwin, Western Director of Public Works Administration, officially representing the President of the United States and PWA Administrator Carmody of Washington, D. C.; Alfred J. Cleary, Chief Administrative Officer, representing Mayor Angelo J. Rossi, who was ill in the hospital; Assemblyman Thomas Maloney, Chairman of the San Francisco legislative delegation; and William O. Thorniley, Seattle, Olympic Peninsula, representing Governor Clarence Martin of Washington.

Spokesmen for the Nineteenth Avenue Dedication were: Major J. Gordon Smith, Commissioner for the Provincial Government of British Columbia, Canada; The Consul General Escalona of Mexico; Miss Martha Sprague, representing the State of Oregon; William R. Lawson, State Director of Works Progress Administration; Fred Beer, President California Mission Trails Association; Leo Hemmett, President Alta-California Incorporated; Mr. Mudgett, President Redwood Empire Association; Clyde Healy, Assistant City Engineer, San Francisco; Chief Administrative Officer Cleary; Chairman Barrett of the California Highway Commission; and William O. Thorniley, Seattle, Olympic Peninsula representing Governor Clarence Martin of Washington.

Smith: You say you flunked that course again? How come?

Jones: Well, what do you expect? They asked the very same questions again.

Heavy April Traffic on Bay Bridge

APRIL proved to be another month of heavy traffic on the San Francisco-Oakland Bay Bridge, Director of Public Works Frank W. Clark reported to Governor Olson. The total number of vehicles crossing fell just under the one million mark.

The increase over the same month a year ago was 114,487 vehicles, or 13.5 per cent. If the exposition traffic last April is eliminated, the net bridge traffic shows an increase of 256,560 vehicles, or 37.8 per cent.

The total vehicular revenue was less in April, 1940, than a year ago by $84,879.

April traffic on the San Francisco-Oakland Bay Bridge and comparative figures are:

	April 1940	April 1939	March 1940	Total since opening
Passenger autos and auto trailers	874,469	767,327	879,559	30,966,127
Motorcycles and tricars	3,788	3,467	3,301	141,961
Buses	17,970	16,407	17,990	508,761
Trucks and truck trailers	49,231	44,790	46,612	1,497,674
Others	18,346	17,326	16,898	530,242
Total vehicles	963,804	849,317	964,360	33,644,765

Snow Survey Assures Ample Water Supply

(Continued from page 5)

agricultural Delta of the Sacramento and San Joaquin Rivers will be negligible this summer. The two high stream flow periods, one at the end of February and the other at the end of March, flushed from the Delta stream channels the last lingering remnants of the salinity that had gained a foothold during the low water period of last summer. Suisun Bay is now flushed out and fresh water extends down as far as Carquinez Bridge. To again penetrate into the Delta the salinity has a long upstream fight and with the low water flow of the two great rivers promising to be three times as great as it was last year the salt water will probably only reach the very lowest sections of the rivers on each side of Sherman Island. Irrigation of the fertile Delta lands from the sloughs and channels surrounding the islands should be permissible with perfect safety until the end of the irrigation season.

A tabulation of all the snow measurements, together with forecasts of flow from most of the Sierra watersheds, are contained in the Snow Survey Bulletin issued by the Division of Water Resources on April 10th. Copies of this bulletin may be had from the Division upon request.

New Sidehill Viaduct Will Break Bottleneck on Santa Cruz Highway

(Continued from page 12)

by the same method. These operations are undertaken as infrequently as practicable, allowing the preparatory work to run several weeks between pours of concrete, in order to reduce interference to public traffic as much as possible.

No work is permitted on Saturdays, Sundays or holidays that could interfere with traffic flow, as the narrow roadway is at best considerably below demand. It is anticipated that the project will be completed in August, 1940. Heafey Moore Company and Fredrickson Watson Construction Company have the contracts for both units of the project.

Cement Experiments Through the Ages

By LESTER C. MEDER, Assistant Physical Testing Engineer

The following is the second of a series of articles on the history, manufacturing processes, testing, and types of Portland cement. The first article briefly summarized the history of cement, the winning and preparation of the raw materials up to the stage where they were ready to be burned into cement clinker.

FIGURE 1 shows a typical flow sheet for the entire manufacturing process. Figure 2 shows, in detail, the temperatures developed and the reactions or changes that take place in the kiln.

By following Figure 2 along with the text, it will be possible to get a clearer picture of the process.

As mentioned, a slurry of the raw materials mixed with 30 per cent to 40 per cent of water enters the kiln. As this slurry moves slowly forward, motivated by the rotation of the kiln, the drying material is picked up by chains that assist in transferring the heat from the ignited gases to the mix, thereby aiding in the evaporation of the free water.

As long as there is an appreciable amount of free water present, the temperature can not rise above 212 degrees Fahrenheit, the boiling point of water.

After the free water has all been evaporated, the temperature of the mass rises rapidly to 840 degrees Fahrenheit, at which temperature the magnesium carbonate is calcined, with the loss of carbon dioxide, a gas.

As this compound is an impurity, and present only in limited amounts, it affects the heating rate but little. As the temperature increases beyond this point, the chemically fixed water in the clay is driven off, and there is a definite change in that material.

When the temperature of the mass reaches about 1650 degrees Fahrenheit, the limestone is decomposed or calcined with the loss of carbon dioxide, or chemically speaking—

$CaCO_3 + heat \rightarrow CaO + CO_2$.

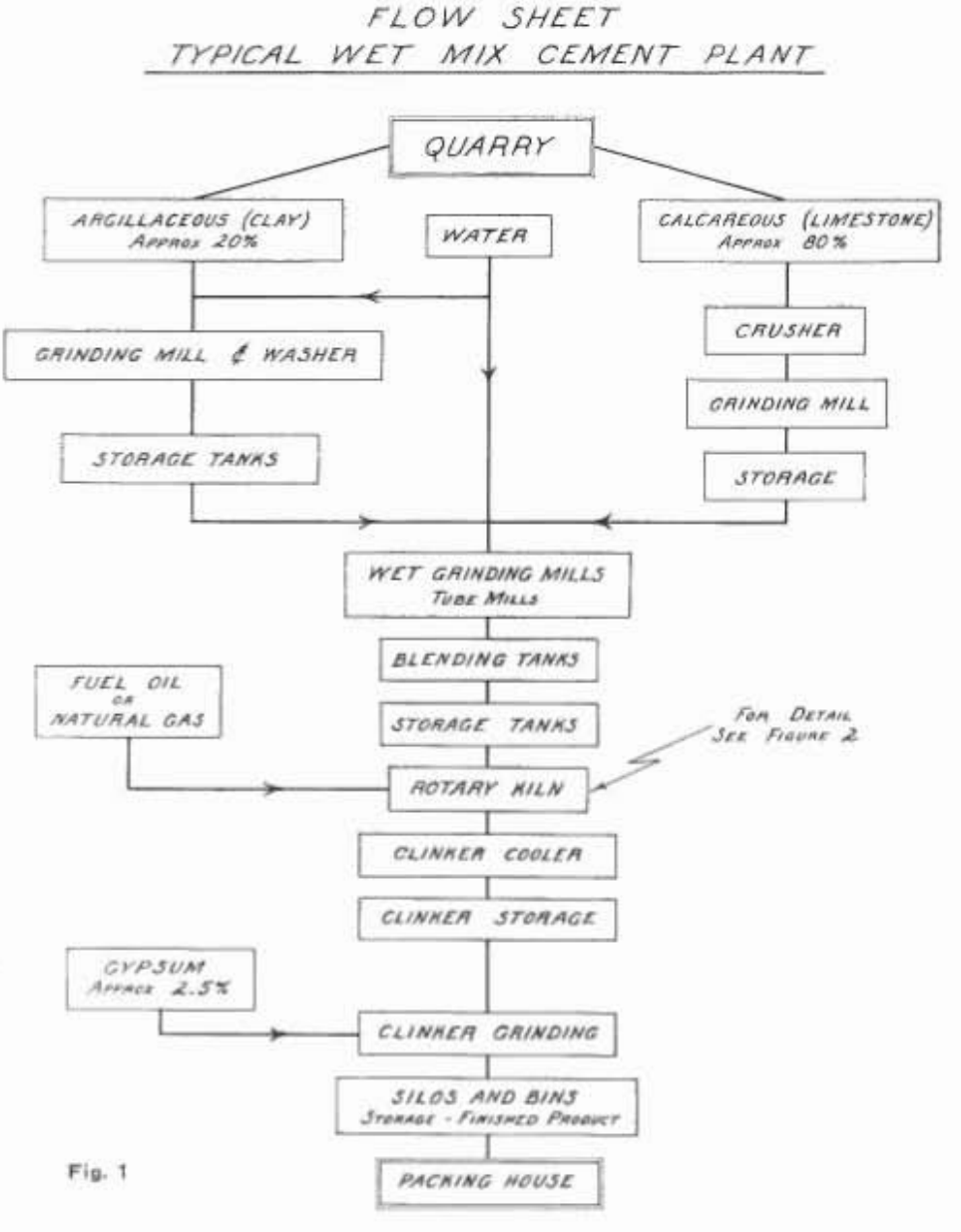


Fig. 1

As the clay and limestone are being broken up, they are constantly recombining with each other to form new compounds. At first the speed of these reactions is slow, but as the temperature increases, the reaction speeds increase greatly. It must be remembered that while the silica is very inactive at low temperatures, it acts as

a strong acid anhydride at high temperatures, and readily combines with the lime which is basic in character. These reactions form, in turn, the mono-calcium silicate, then the di, and finally the tricalcium silicate. At about the time these reactions are progressing, some of the calcium oxide is reacting with the alumina and iron oxide to form the calcium aluminates and calcium alumina ferrites that can be petrographically identified in cement clinker. These reactions can be readily followed by reference to Figure 2.

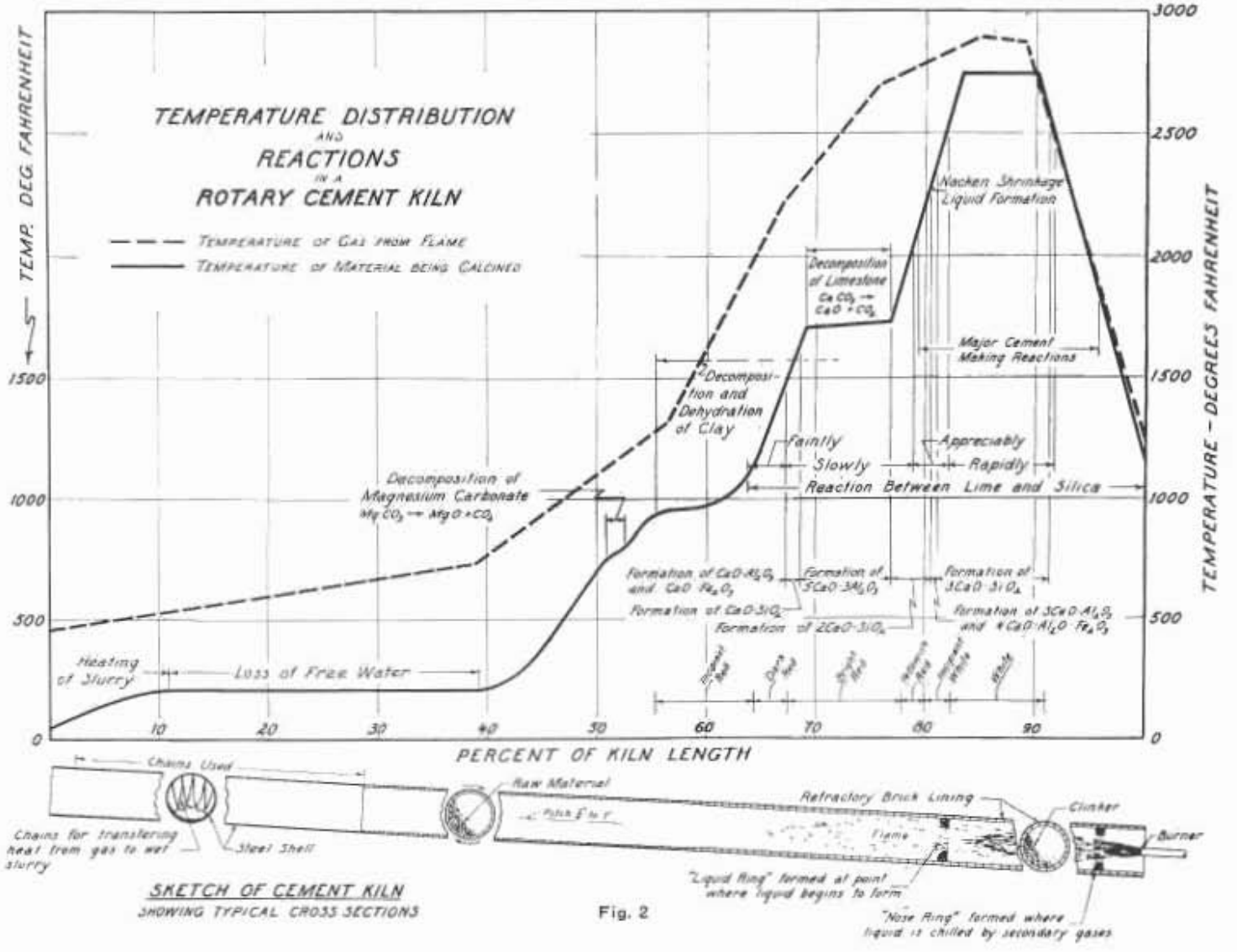
Contrary to popular belief, the raw materials are not completely melted in the manufacture of clinker. In fact only a small percentage of material is actually melted. The first indication of melting occurs at about 2300 degrees Fahrenheit. At this point there is a considerable shrinkage, known as the "Nacken Shrinkage," and named after the first observer, Nacken. At this point, a ring of the material adheres to the wall of the kiln, and forms a semibarrier by cementing or sticking to the higher melting point compounds. This is known as the "liquid ring."

The percentage of melt is roughly proportional to the amount of iron, aluminum, magnesium and alkali oxides present in the mix.

As this mixture of 30-40 per cent sticky liquid with 70-60 per cent solid materials moves slowly toward the discharge end of the kiln the major reactions come to completion. The clinkered material then passes out of the influence of the primary gases, or gases from the flame, and into the influence of the secondary gases, or the cold air entering the kiln directly. This rapidly cools the clinker. At the point where the liquid freezes, or solidifies, there is formed the "nose ring," a semibarrier similar to the liquid ring described above.

The formation of these rings sometimes causes considerable trouble, particularly when the clinker is being made from a mix that contains considerable fluxing material, or low melting oxides. Ring formation or growth can sometimes be controlled by adjusting the length of the flame. If this fails the "nose ring" can be spaded out manually by the use of heavy steel spades with long handles, and the liquid ring can be shot out by heavy projectiles fired from a special, large caliber gun. In extreme cases, the kiln must be stopped, cooled

(Continued on page 29)



SKETCH OF CEMENT KILN
SHOWING TYPICAL CROSS SECTIONS

Fig. 2

Typical stretch of recently realigned highway between Lake Britton and Burney Falls on Sierra Way.

Picturesque Forest Highway

By E. J. BASSETT, District Office Engineer

WITH the completion of the California Forest Highway project on the Mt. Shasta-Mt. Lassen National Forest Highway, from a point 5 miles north of the junction of State Highway Routes 83 and 28 to a point near Cayton, the last link of Forest Route 77 was made available to the public.

This route is the most northerly section of the Sierra Way, a scenic highway, which, when completed in its entirety, will follow the Sierra Nevada Mountains from Mt. Shasta City to a point near Bakersfield, affording ingress to a great variety of recreational areas for those seeking pleasure trips, hunting, fishing, snow sports and rest. It will make access to the Lassen Park loop in Lassen Volcanic National Park much easier for visitors from the north and northeast.

Consisting of three separate contracts, construction on California Forest Project 77-J, was started in August, 1937, when the contract for grading the 5-mile unit was awarded to A. Teichert & Sons, Inc., of Sacramento. The work consisted of grading a 30-foot roadway preparatory to subsequent surfacing operations, involving the handling of 142,100 cubic yards of roadway excavation and 15,000 cubic yards of imported borrow, the latter being used principally over short sections of shallow fills where it was impracticable to use the heavy rock excavation common to this volcanic region.

In addition to the grading items, drainage structures consisting of corrugated metal pipes varying from 18 to 36 inches in diameter were placed throughout the project.

BRIDGES CONSTRUCTED

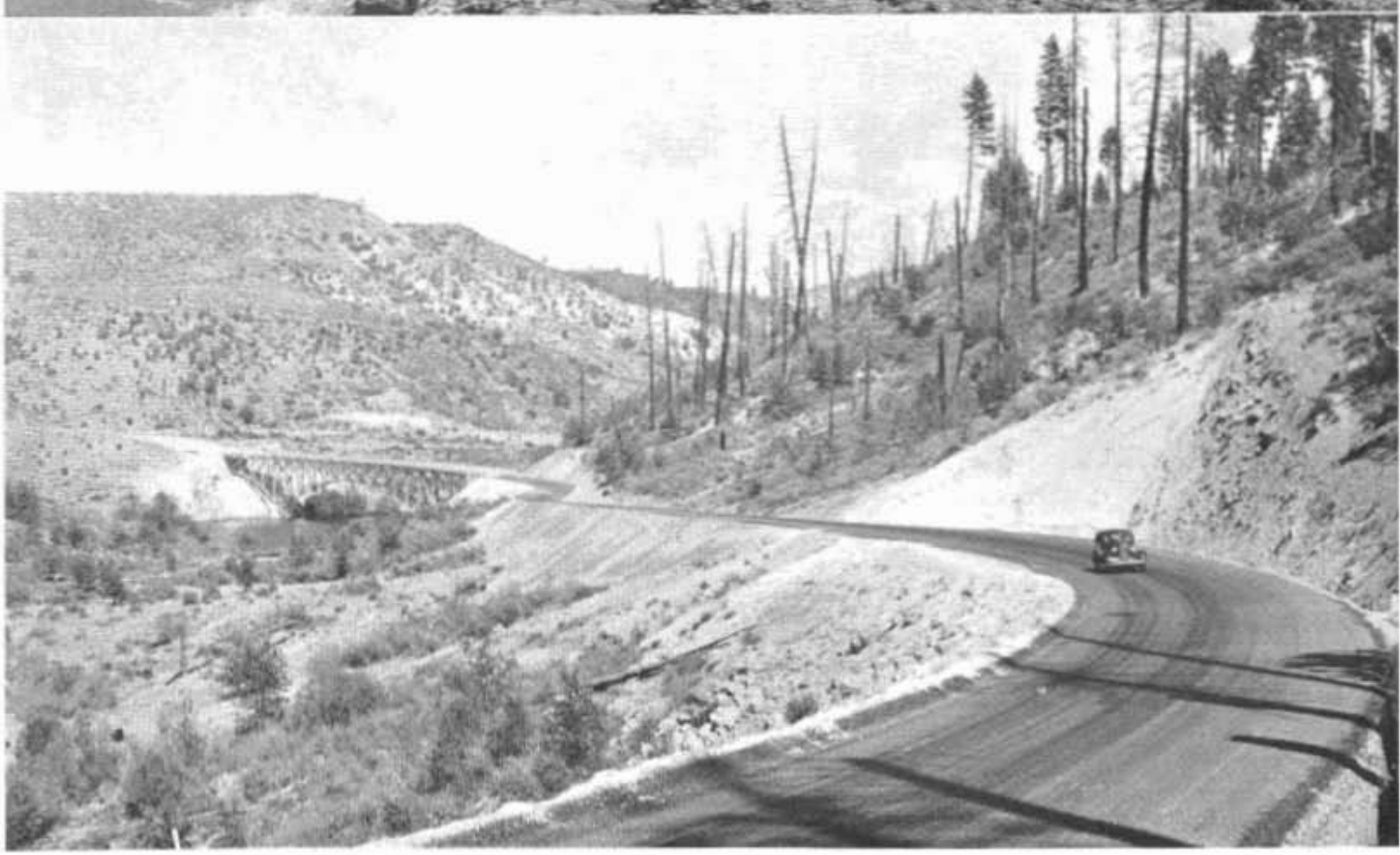
A reinforced concrete rigid frame bridge with a span of 38.42 feet and a clear roadway of 24 feet was constructed across Cayton Creek. The hand-rail is of redwood timber supported by concrete posts cast with the curb.

The grading project was completed in July, 1938, at a cost of $128,991.24, including engineering. Boyd E. Sylvester, Chief Engineering Inspector Superintendent of the Bureau of Public Roads, was Resident Engineer for the project.

During approximately the same period, Project 77-J1, involving construction of a steel bridge across Lake Britton, an artificial lake formed by the Pacific Gas & Electric Company's Pit 3 dam across the Pit River was in progress at a point known as "The Narrows." Awarded to C. J. Montag & Sons, of Portland, Oregon, work was started in August, 1937, and completed in October, 1938.

The bridge, as constructed, consisted of two 40-foot approach spans and a 500-foot steel span made up of a 100-foot anchor arm at each end, two 75-foot cantilever arms, and a

(Continued on page 28)



Upper—New bridge across Lake Britton. Lower—Looking northwesterly down grade towards Pit River Bridge across Lake Britton

Highways Need More Federal Aid

(Continued from page 1)

property which is to be benefited is destroyed. A revenue bond issue through private capital is likewise out of the picture.

GAS TAX REVENUES LARGE

What is wrongly referred to as a "gas" tax, we look upon as a service charge for the use of the highways. The service charge for the use of our highways produces annually in California approximately $17,000,000 to the Federal Government. This service charge as represented here is paid by the population largely in the low-income brackets.

The Federal Government collects nationally a total of $300,000,000 to $350,000,000 annually from this "gas tax" or service charge on the use of State highways, exclusive of the Federal excise tax, which the motorist pays on parts, tires, oil and other commodities. This service charge is willingly paid, the same as the State service charge, for the use of roads, provided this fund is used exclusively for the improvement and development of our highway transportation system.

We are all penalized for diversion of highway funds by the Federal-Aid Highway Act so that all this money, since the passage of the Hayden Cartwright Act, goes into the highway transportation system. We in California, by constitutional provision, can not use it for other purposes.

The great need in this national system, and particularly in metropolitan areas, would seem to justify an increase in the Federal Aid to the States rather than discussion of a decrease. It is only fair and just that the Federal Government use these funds in the development of this system. This is practically the only successful pay-as-you-go transportation enterprise in existence and this development can go on as a pay-as-you-go proposition if the Federal Government sees that this great service charge fund gets back exclusively into the transportation system.

The State of California has contributed to the Federal-Aid Highway System since 1926 approximately $35,000,000 for right of way, at the same time receiving Federal Aid of approximately $95,000,000. These figures are cited to show that, while the popular belief is that Federal Aid is on the basis of a 50-50 cooperation, the contribution for right of way is a real financial contribution to the building of a national system of highways. Other States have had similar experience. We feel that the Federal Government is doing a great deal for us and it is not set forth to show we are not appreciative of it but to show the actual situation and the financial relationship between the State and the Federal Governments.

In most States the greater portion of the gasoline tax originates within the cities, because of the larger registration in these urban areas. In the case of California, this State contributes from the one-cent Federal gasoline tax a total of $34,000,000 biennially or $17,000,000 annually and receives returns from Federal highway aid some $8,000,000 annually (4-year average 1938-1941 fiscal years).

METROPOLITAN PROBLEM

We recognize the fact that we must have a national system and we are not criticising the return to States which receive less than they produce, but we do feel the spread is a little large unless we can have some relief from the Federal Government toward our metropolitan problem.

Now we are asking that, in these metropolitan areas, the Federal Government assist in bringing about a solution of a problem that no State or city can solve by voting property bonds. The handling of this solution should be through the proper road organization of the Federal Government in coordinating its entire Federal Aid System, of which these connecting city streets are an integral part. Furthermore, unemployment, to a large extent, exists in these metropolitan areas, and money spent in this manner would bring about much relief.

In our opinion, Federal Aid has been of mutual assistance from the standpoint of both the States and the Federal Government. We are making full use of Federal Aid in placing approved projects under contract. As the appropriations become available, we will show a favorable record of expenditure of these funds by the time the next appropriation is authorized by Congress.

PLANNING SURVEY

California is faced, like many of the other States, with the problem of obsolescence of our highways due to increase in the speed of the motor vehicles, the increase in numbers, and our increase in population, to a minor extent. The United States Bureau of Public Roads, now known as the Public Roads Administration, cooperated in a state-wide planning survey covering a study of the entire system.

The facts developed in this study revealed that, upon the completion of our present State system, replacement of the rural State Highway System, due to obsolescence and depreciation, is falling behind at the rate of 151 miles of road surface and 38 bridges each year. The question is a serious one, involving this consideration, as well as one of multiple lanes to care for the increased traffic volume and increased population.

Roads in California, as in other States, are of national importance. Recently, the Army took over part of our system south of San Francisco for Army maneuvers. This road south of San Francisco in the Santa Cruz area was temporarily closed to public use, which shows the importance of highways in a national defense plan. This road is a part of the Federal-Aid Highway System and was constructed with Federal and State funds. This indicates the part played by a well-laid-out system of highways in maneuvers which the Federal Government has seen fit to inaugurate.

The second installment of Mr. Purcell's article will appear in the June issue of this magazine.—Ed.

Teacher: "Who can tell me what the former ruler of Russia was called?"

Class (in unison): "Tsar."

Teacher: "Correct; and what was his wife called?"

Class: "Tsarina."

Teacher: "What were the Tsar's children called?"

There was a pause and then a timid voice in the rear piped up: "Tsardines."

Highway Bids and Awards for the Month of April, 1940

BUTTE COUNTY—Across Butte Creek overflow, about 12 miles northwest of Biggs, construction of a reinforced concrete slab bridge. District III, Route 45, Section A. C. A. Dunn, Klamath Falls, Oregon, $18,367; Engineers, Ltd., Sacramento, $21,879. Contract awarded to M. A. Jenkins, Sacramento, $16,391.

BUTTE AND TEHAMA COUNTIES—Between Pine Creek and Singer Creek about 0.5 mile to be graded and surfaced with plantmixed surface. District III, Route 3, Sections D,A. Piazza and Huntley, San Jose, $17,183. Contract awarded to Claude C. Wood, Lodi, $14,828.

GLENN COUNTY—Across Sacramento River Overflow, one mile east of Butte City, construction of a reinforced concrete slab bridge. District III, Route 45, Section C. Harold Smith, St. Helena, $13,255; C. A. Dunn, Klamath Falls, $13,843. Contract awarded to M. A. Jenkins, Sacramento, $13,235.

KERN COUNTY—At various locations between Mojave and Ricardo and between 4.6 miles and 4.3 miles west of Mojave, about 8.4 miles to be graded and surfaced with plant-mixed surfacing. District IX, Kern County, Routes 23, 58. Basich Bros., Torrance, $62,591; E. L. Yeager, Riverside, $68,132; R. E. Hazard & Sons, San Diego, $69,719; Valley Construction Co., San Jose, $76,913. Contract awarded to G. W. Ellis, North Hollywood, $60,023.

LOS ANGELES COUNTY—On Rosemead Blvd., between Fairview Avenue and Locksley Drive, about 0.2 mile roadbed graded, surfaced with plant mix and roadmix and surface treatment. District VII, Route 168, Section C. A. S. Vinnell Co., Alhambra, $9,603; Geo. J. Bock Co., Los Angeles, $9,864; Dimmitt & Taylor, Los Angeles, $10,074; Griffith Co., Los Angeles, $10,347. Contract awarded to Vido Kovacevich, South Gate, $9,406.

LOS ANGELES COUNTY—Over Arroyo Seco Parkway at Meridian Avenue, a reinforced concrete bridge to be constructed and the approaches to be paved with portland cement concrete. District VII, Route 205, S.Pas. Oscar Oberg, Los Angeles, $22,413; J. E. Haddock, Ltd., Pasadena, $22,471; Oberg Bros., Los Angeles, $22,719; Wm J. Disteli, Los Angeles, $23,237; Row Construction Co., Pasadena, $23,764; Contracting Engineers Co., Los Angeles, $24,326; Carlo Bongiovanni, Los Angeles, $24,855; Dimmitt & Taylor, Los Angeles, $24,992; A. S. Vinnell Co., Los Angeles, $25,912; Byerts & Dunn, Los Angeles, $26,449; Claude Fisher Co., Los Angeles, $27,092; Chas. J. Dorfman, Los Angeles, $27,790; Fred E. Potts Co., Los Angeles, $28,652; V. L. & W. B. Jacobson, Los Angeles, $29,979; Baruch Corp., Los Angeles, $30,813. Contract awarded to J. S. Metzger, Los Angeles, $22,252.

MARIN COUNTY—Between Myrtle Avenue in San Rafael and San Quentin Wye, about 1.3 miles to be graded and surfaced with plant mixed surfacing. District IV, Route 1. S.Rf. A. G. Raisch, San Francisco, $134,735; Lee J. Immel, Berkeley, $137,286; M. J. B. Construction Co., Stockton, $147,186; Guerin Bros., San Francisco, $159,004. Contract awarded to Chas. L. Harney, San Francisco, $131,259.

MENDOCINO COUNTY—Between Outlet Creek and Reeves Creek, about 4.5 miles to be surfaced with plant-mixed surfacing. District I, Route 1, Section F. Independent Construction Co., Ltd., Oakland, $37,902; J. R. Reeves, Sacramento, $39,842; Claude C. Wood, Lodi, $41,957; Oranges Bros., Stockton, $42,213; Piazza & Huntley, San Jose, $43,282; A. G. Raisch, San Francisco, $44,584; L. A. Brisco, Arroyo Grande, $46,736; E. A. Forde, San Anselmo, $50,638. Contract awarded to Marshall S. Hanrahan, Merced, $36,136.

MENDOCINO COUNTY—Portions between Wendling and Yorkville, about 2.5 miles to be graded and an armor coat applied. District I, Route 48, Sections B,A. Valley Construction Co., San Jose, $74,637; Piombo Bros., San Francisco, $79,511; J. L. Conner and Sons, Point Arena, $79,867; Louis Biasotti & Son, Stockton, $80,108; Harold Smith, St. Helena, $86,200; Guerin Bros., San Francisco, $87,389; Frederickson Bros., Emeryville, $87,402; Scheumann & Johnson and John Burman & Sons, Eureka, $90,927; Chas. L. Harney, San Francisco, $91,722; McNutt Brothers, Eugene, Ore., $97,237. Contract awarded to Parish Bros., Hollywood, $73,523.

MONO COUNTY —At Grant Lake, about 4 miles to be graded and roadmix surface treatment applied. District IX, Route 111, Section A. Claude C. Wood, Lodi, $60,441; A. S. Vinnell Co., Alhambra, $63,122; Basich Bros., Torrance, $77,069. Contract awarded to Isbell Construction Co., Reno, $59,424.

MONO COUNTY—Between West Walker River and Route 23, about 2.3 miles to be graded and roadmix surface treatment applied. District IX, Route 13, Section A. Claude C. Wood, Lodi, $42,353; Isbell Construction Co., Reno, $43,383; Rexroth & Rexroth, Bakersfield, $43,656; A. S. Vinnell Co., Alhambra, $46,534. Contract awarded to Basich Brothers, Torrance, $38,125.

MONTEREY COUNTY—At Big Sur River 29 miles south of Monterey, a reinforced concrete bridge to be constructed and about 0.27 mile of approaches to be graded and roadmix surface treatment applied. District V, Route 56, Sections E,F. Scheumann & Johnson, Eureka, $34,714; Albert H. Siemer & John Carcano, San Anselmo, $38,911; Caputo & Keeble, San Jose, $39,165; Trewhitt-Shields & Fisher, Fresno, $39,459; Harry J. Oser, San Francisco, $39,880; E. T. Lesure, Oakland, $41,234; R. G. Clifford, San Francisco, $45,995. Contract awarded to Victor L. & Wm. B. Jacobson, Los Angeles, $32,773.

RIVERSIDE COUNTY—Between Route 19 and Banning, about 6.1 miles to be graded and surfaced with plantmixed surfacing on cement stabilized base. District VII, Route 26, Sections A.,Bau.,B,Ban. Griffith Co., Los Angeles, $159,224; Matich Bros., Elsinore, $164,934; Warren Southwest, Inc., Los Angeles, $168,259; Claude Fisher Co., Ltd., Los Angeles, $168,721; Basich Bros., Torrance, $173,687; Daley Corp., San Diego, $179,135; V. R. Dennis Construction Co., San Diego, $179,316; A. S. Vinnell Co., Alhambra, $184,611; Geo. Herz & Co., San Bernardino, $194,022; Dimmit & Taylor, Los Angeles, $205,320. Contract awarded to Oswald Bros., Los Angeles, $155,667.

SACRAMENTO COUNTY—Between Isleton and Walnut Grove, about 8.1 miles to be graded, existing pavement widened with crusher run base and portions resurfaced with plant-mixed surfacing. District III, Route 11, Section D. J. R. Reeves, Sacramento, $62,566; E. A. Forde, San Anselmo, $65,772; Heafey-Moore Co.-Frederickson & Watson Construction Co., Oakland, $66,761; Lee J. Immel, Berkeley, $67,392; M. J. B. Construction Co., Stockton, $68,391; Independent Construction Co., Ltd., Oakland, $69,434; A. Teichert & Son, Sacramento, $69,470; A. G. Raisch, San Francisco, $72,124; Chas. L. Harney, San Francisco, $77,546. Contract awarded to Jones and King, Hayward, $61,612.

SAN DIEGO COUNTY—Across San Diego River near Lakeside, a reinforced concrete bridge 1010 feet in length to be constructed. District XI, Route 198, Section B. M. H. Golden, San Diego, $89,465; V. R. Dennis Construction Co., San Diego, $93,961; Sordal & Bishop, Long Beach, $95,640; Byerts & Dunn, Los Angeles, $97,784; A. Soda & Son, Oakland, $98,460; J. S. Metzger & Son, Los Angeles, $99,500; Macco Construction Co., Clearwater, $101,532; Contracting Engineers Co., Los Angeles, $105,968; J. E. Haddock, Ltd., Pasadena, $109,927; Griffith & Co., Los Angeles, $111,832; Carlo Bongiovanni, Los Angeles, $131,532. Contract awarded to B. G. Carrol & Harry L. Foster, San Diego, $89,132.

SHASTA COUNTY—A reinforced concrete bridge and approaches across Olney Creek, 3.6 miles south of Redding to be constructed. District II, Route 3, Section A. Scheumann & Johnson, Eureka, $16,736; E. E. Smith, Eureka, $16,946; Harold Smith, St. Helena, $17,029; R. M. Price, Huntington Park, $17,126; James E. Anderson, Visalia, $18,405; A. T. Beckett, Oakland, $20,192. Contract awarded to A. Frederick Anderson, Oakland, $16,435.

SHASTA AND SISKIYOU COUNTIES—Between Antler and Big Canyon, about 32 miles, screenings to be stock piled. District II, Route 3, Sections C,D,A. Hein Bros. Basalt Co., Redding, $13,253; Hayward Building Material Co., Hayward, $14,503. Contract awarded to Shea & Beebe, Hawthorne, Nevada, $11,453.

SOLANO COUNTY—Constructing highway embankments on various sections between 1.2 miles north of Rio Vista and Ryer Island Ferry. District X, Route 99, Section A. Claude C. Wood, Lodi, $5,320; C. C. Steele, Rio Vista, $5,390; Sheldon Oil Co., Suisun, $5,530. Contract awarded to Oranges Bros., Stockton, $5,320.

SOLANO COUNTY—Construct one ferry ramp and repair ferry hull at Cache Slough and construct two ferry ramps and repair ferry hull at Steamboat Slough. District X, Routes 99, 100, Section A,A. Pomeroy Sinnock, Stockton, $9,499; Frank Legg, San Francisco, $13,603. Contract awarded to F. Kaus, Stockton, $7,583.

TEHAMA COUNTY—Between Red Bluff and six miles north about six miles to be graded and surfaced with a cement stabilized base and a plant-mixed surfacing and two reinforced concrete bridges to be constructed. District II, Route 3, Section C. United Concrete Pipe Corp., Los Angeles, $217,489; Fredericksen & Westbrook, Sacramento, $218,582; Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $223,729; Granfield, Farrar & Carlin, San Francisco, $227,887; A. Teichert & Son, Inc., Sacramento, $228,477; The Utah Construction Co., San Francisco, $249,877; Eaton & Smith, San Francisco, $250,796; McNutt Bros., Eugene, Oregon, $297,004. Contract awarded to Jones & King, Hayward, $210,291.

YOLO COUNTY—Causeway across Yolo By-Pass about 5 miles west of Sacramento, the south half to be redecked. District III, Route 6, Section B. E. E. Smith & N. M. Ball Sons, Berkeley, $115,479; M. J. B. Construction Co., Stockton, $118,545; Heafey-Moore Co.-Fredrickson & Watson Construction Co., Oakland, $119,887; Campbell Construction Co., Sacramento, $119,953; MacDonald & Kahn, Inc., San Francisco, $128,192. Contract awarded to Lee J. Immel, Berkeley, $111,870.

Highways Built for Mobility and Safety

(Continued from page 17)

The analysis of 236 reported traffic studies and the results accomplished by corrective measures completed, in so far as accidents are concerned, seem to indicate that accidents have been reduced in these definite locations approximately 36 per cent over the previous year.

In many cases simple corrections were made, the installation of an

additional sign, more definite and carefully planned striping, the installation of lights or signals, correction in surfacing, changes in alignment and grade, installation of guard rail, changes of superelevation on curves so as to make it more easily traversed, installation of channelization, and, in two cases, the mere trimming of trees has eliminated hazardous, blind locations.

Experience writes the definition of traffic safety for the highway engineer. The California Division of Highways is utilizing all the experience available, deriving that experience from careful observation and detailed study of accident records.

The Division of Highways is committed to a program of the construction of safe highways for careful drivers within the limits of the funds available—as provided by the motorists of the State.

Picturesque Forest Highway

(Continued from page 24)

150-foot suspended central span. The lower chords of the central sections were designed in the shape of an arch for appearance.

Excavation for the four piers was accomplished through the use of steel sheet piling, unwatering being accomplished with electric and gas pumps. Piers were founded on solid rock except for one small gravelly area where steel rails were driven as an added precaution. Concrete was placed under water by means of bottom dump buckets using a Class "A" mix.

The anchor piers of reinforced concrete support one end of the approach spans. The two main piers, also of reinforced concrete, were founded under water with the deck level 67 feet above average lake level. The deck is of light-weight reinforced concrete with a 24-foot clear roadway and two 2.5-foot sidewalks.

The erection of structural steel was handled by means of a high line consisting of a 1¾-inch main cable with an 850-foot span. Practically all members were erected in pairs using a heavy timber spreader. The two halves of the suspended span were placed as cantilevered continuations of the cantilever arms. The tension in the top chords and compression in the bottom chords set up during this operation were carried across the ends of the suspended span by jacks set in telescopic chord members. The jacks were set in a neutral position when the telescopic members were erected. However, little jacking was necessary, the central points meeting very well as the steel lay. Priming up of both chords in both trusses was done within a few hours and the jacks released, converting the central 150-foot section of steel into a simple suspended span. The placing of the steel structure required 8 weeks.

The cost of the bridge structure was $201,491.22, including engineering.

Mr. H. P. Hart, Associate Structural Engineer for the Bureau, was Resident Engineer.

TWELVE MILES OF ROAD

The third and last unit of construction, California 77-E5, H2, J2, consisted of the surfacing and sealing not only of the Lake Britton section, but two adjacent units to the north of Cayton. This project covered 12.2 miles in all, 5.0 miles of which were on Section J.

This work involved the placing of a 5-inch compacted base course consisting of 2-inch heavy crushed rock over the full subgrade section; a 3-inch compacted crusher-run surface course; and a bituminous surface course consisting of 25 pounds of ¾-inch crushed rock and .22 gallons 90-95 liquid asphalt as the first application, and 10 pounds of ⅜-inch crushed rock and .13 gallons of asphalt as the second application. The full thickness of pavement was used on parking areas, road approaches, and on a foot-path at the southerly end of Lake Britton bridge. The bituminous treatment was extended to roadway dykes at various locations.

On the remaining seven miles of the project where a base course had been placed under previous contracts the surface course and surface treatment only were applied. Final cost figures are not at present available, but the bid sheets indicate that the cost approximated $106,635, exclusive of engineering.

Hemstreet & Bell, of Marysville, were the contractors constructing the project. Mr. J. E. Wood, of the Bureau, was Resident Engineer.

UTAH ASKS FOR MAGAZINE

The State of Utah
State Road Commission
Salt Lake City

Mr. Frank W. Clark, Director,
California Highways and Public Works,
P. O. Box 1499,
Sacramento, California.

Dear Sir:

I would be very glad to have my name placed on the mailing list and receive the California Highways and Public Works magazine, as published each month.

Very truly yours,

L. WENDELBOE,
Mgr. Planning Survey.

The Evolution of Cement

(Continued from page 23)

This is a typical California cement plant situated at Redwood City

down, and men sent in to break out the mass.

PROCESS AND REACTIONS

A summary of the processes and reactions:

1. Evaporation of free water.
2. Dissociation of magnesium carbonate.
3. Release of combined water from the clay.
4. Dissociation of calcium carbonate.
5. Combination of lime and clay.

or, briefly drying, heating, decomposition, and reaction.

As the clinker reaches the end of the kiln it falls in a fiery cascade of small particles ranging from dust to two or three inches in diameter into the clinker cooler.

There are two fundamental theories that govern the method of cooling. One theory is that clinker should be cooled as rapidly as possible. Rapid cooling is accomplished by quenching the clinker with great drafts of cold air, or cascading it in revolving steel cylinders cooled with a spray of cold water. In other cases it is dumped in piles from buckets on endless chains, to be lightly sprinkled with water, and in extreme cases it is quenched by dumping into water, from where it is dragged by conveyor buckets.

The second theory is that the clinker should be cooled as slowly as possible in order that crystal compounds may come more completely to equilibrium. In carrying out this theory, the clinker is dropped into a secondary kiln and the temperature is raised by a partially atomized oil flame which generates a strong reducing atmosphere. The reducing atmosphere materially lowers the softening point of the clinker and allows high temperature reactions to continue. The clinker enters such a cooler at about 2450 degrees Fahrenheit, remains in it about an hour, and is discharged at about 1850 degrees Fahrenheit. At this stage it is lightly quenched with water, and then stockpiled.

When all operations are properly conducted excellent cement is made under either of these widely divergent cooling methods. The proponents of each method claim certain advantages in subsequent grinding. Easier grinding means cheaper grinding, and as clinker grinding is perhaps the second most expensive process in cement manufacture, any reduction of the cost of this operation is of major importance.

After the cement passes through the coolers it is stockpiled for storage until it is ground into cement.

This is the second installment of Mr. Meder's article on cement. A third one will be published in a later issue—Ed.

FAULT FORMATION AT FRIANT

A fault formation uncovered in the south bank rock at Friant Dam site has resulted in a change of plans which calls for an additional 30 feet of excavation in the south river bank, just above the river diversion flume. Since erection of the concrete placing trestle depends upon the bedrock depth, this change may delay construction of the trestle to some extent.

Progress in Research as Applied to Maintenance of Bituminous Surfacing

By F. N. HVEEM, Senior Physical Testing Engineer, Materials and Research Department

Research: Studious inquiry; usually critical and exhaustive investigation having for its aim the revision of accepted conclusions, in light of newly discovered facts.—Webster's Dictionary.

IN THE following discussion, research work is not necessarily limited to laboratory investigations.

A study of the relation between research and maintenance of bituminous surfaces may at first lead to the conclusion that, strictly speaking, organized research is not often aimed directly at solving the problems of the maintenance man. The maintenance man is usually a much harassed and busy individual, confronted with unlimited problems which loudly demand time and money for their solution. With a chronic shortage of funds and an endless task to perform, it is not surprising if he seems to have little time for theoretical considerations. Hence, for the most part, maintenance methods and operations are the result of experience gained through trial and error.

However, a broader consideration of the purpose of research indicates that, in the end, almost the sole purpose in seeking improvements is to reduce the cost of maintenance. Research is, of course, only a search for more satisfactory results, and the term "satisfactory" implies, for a pavement, durability and minimum maintenance expense.

Therefore, the researcher may be only a nuisance to the construction man, as innovations and changes in procedure are often troublesome and expensive. The only justification for any added expense must lie in a commensurate reduction in maintenance cost. This does not imply substitution of a more expensive type of pavement, only that improving the quality of a particular type might at times involve some additional expense. It is realized, of course, that really effective research should reduce both construction and maintenance cost, and make everybody happy.

Therefore, a discussion of the effect of research on maintenance can rightfully include all research related to the construction of highways. Discussing the progress under separate headings, the first consideration is

(1) Subgrade Difficulties. The need for adequate foundations has been emphasized by so many writers that one only states the obvious in stressing the need for good subgrades. While engineering opinion may differ widely on many subjects, there is no argument on this point.

The obvious need for roadbed drainage has brought about the construction of side ditches, which, while frequently effective, are very expensive in heavy cuts, and usually represent a traffic hazard. Research has shown, furthermore, that ground water does not always obligingly flow down hill, and therefore drainage by gravitational flow is not always possible.

The impossibility of draining out capillary water has led to another line of attack; namely, the stabilizing of adverse soils so that they will not be readily affected by water. The term "soil stabilization" has become about as all-inclusive and generally vague as the term "good engineering practice." That term has been cast as a sort of mantle of respectability over many a doubtful practice.

In its simplest form, "soil stabilization" is a judicious combination of existing natural soil, sand, gravel, or stone.

Another angle, largely investigated and developed by organizations seeking outlets for commercial products, involves the addition of artificial ingredients such as road oils, emulsions, portland cement, sodium and calcium salts. The intent in each case is to preserve some desirable state of equilibrium. Bituminous materials and portland cement are added to provide a water-resistant mixture that will not soften or lose supporting power from water action. The use of the various hygroscopic salts is based on the observation that many soils have satisfactory stability with a certain optimum moisture content.

Lack of support undoubtedly causes more road surface failures than any other one cause. Lack of support is usually due to two factors: first, the existence of a soil which is readily lubricated by water; second, the presence of moisture to provide the lubrication. Water may enter the subgrade either by capillarity or by penetration of a porous wearing surface.

The placing of seal coats to prevent the entrance of rain and snow water may at times defeat its ultimate purpose, as many older roadbeds of local material or water-bound gravel have reached a satisfactory equilibrium in which the moisture rising from the subsoil is dissipated by evaporation at a rate which prevents undue accumulation. If this evaporation is stopped by a tight seal coat, moisture may accumulate beyond the capacity of the soil, and an unstable subgrade or bituminous mixture may result. It should be realized that water in the vapor state is of much greater penetrating capacity than the liquid. Laboratory experiments have been made in which dense graded bituminous mixtures were placed in saturated sand, one specimen being covered with a seal coat and one left untreated. After one month's exposure in the open air, the specimens were tested for stability. In every case, the briquettes covered by a seal coat were less stable than those without seal. Furthermore, even though the sealed specimens had all suffered a loss in stability, they did not contain moisture greatly in excess of the unsealed specimens.

The existence of a reservoir of entrapped moisture beneath pavement slabs is evidenced by the profusion of plants on either side of the high-

ways in some of the arid regions. This fact leads to the speculation as to whether plants might not be utilized as wicks to draw the moisture from subgrades. It seems to be a problem for the agricultural expert or arboriculturist.

Resilient subgrades also produce pavement distress, and this condition is not so readily detected. Such soils will often show no definite breaking or rupture of the surface; nevertheless, continued bending and flexing of the pavement slab may develop surface waves or ripples in bituminous pavements which would be entirely satisfactory over a rigid foundation.

(2) Base Course Faults. The chief cause of trouble in base courses is undoubtedly lack of thickness. Lack of funds has made many engineers tend to reduce or limit depths of base construction; while there may have been few cases that could be classed as over-design, there are many more cases where the base course is inadequate.

Another source of base failures is the use of clean rock over mud subgrades, which has often resulted in a complete lubrication of the base material; it is believed, however, that this error is not made so often of late years.

It is, of course, true that test methods and specifications originally established from research work can become outmoded with changed conditions, and may ultimately constitute liabilities rather than assets. For example, fifteen or twenty years ago, water-bound gravel or crushed stone construction was widely used, and designed to carry traffic without further treatment. It was, of course, essential for horse-drawn traffic that gravel roads be bound up tightly; hence materials needed cementing value. The need for high cementing value is no longer important, and in many cases the requirement can be dispensed with entirely. Failures in certain gravel or crushed stone bases can be charged to the attempt to meet the cementing value requirement. There is danger in the use of clay types of binder which may lubricate the stone when moisture contents are high.

(3) Aggregates Best Adapted. Since the early beginnings of bituminous construction, ideas about mineral aggregates have undergone some change. It is no longer considered sufficient or even essential to specify that an aggregate shall be hard, sound, durable, and well graded. While it is true that durability is required, it is realized that durability and hardness are not necessarily synonymous, and the term "well-graded" is rather indefinite. The open-graded and macadam types of construction require comparatively hard aggregate, but this requirement is of little importance in a dense-graded type of construction.

An important contribution of research toward reducing the problems of maintenance has been demonstration of the fact that mineral aggregates have widely varying surface characteristics which affect their capacity to retain an oil film in the presence of water, and which may affect the stability of the mixture. In the early days of bituminous construction, many of the failures were regarded as mysterious, and were the subject of much controversial discussion. It was customary to applaud the fortunate engineer who chanced to be in charge of work which turned out well, and to greatly criticize less fortunate individuals who were trying to construct oil roads with materials which, in the light of present knowledge, were definitely unsuited for the purpose.

The researcher has uncovered a great many facts about mineral aggregates which were unknown ten years ago, one result being to place the blame for certain failures where it belongs; not on the head of the hapless engineer or superintendent in charge, but on the type of mineral aggregate used. Many aggregates are definitely unsuitable for bituminous construction due to their tendency to lose asphalt in the presence of water. These aggregates are classed as hydrophilic, and should not be used without protective measures.

Researchers throughout the world are now busily engaged seeking more effective or more economical means for treating such aggregates and oils. Progress is being made, but a great deal of work remains to be done. In the meantime, most laboratories are trying to avoid unsatisfactory materials by accepting or rejecting the aggregates and soils on the basis of preferential wetting, swell, or stripping tests. These measures have undoubtedly resulted in tremendous savings in maintenance costs. Most states can cite experience with hydrophilic aggregates, and their use has invariably led to continuous maintenance expense.

In fact, it is not impossible that bituminous construction with lighter oils would have been discredited completely if this phenomenon had not been recognized. There is reason to believe that the use of oil in road construction was delayed many years due to failures of this sort. The petrolithic method, described by Prevost Hubbard in 1908, involved the use of heavy asphaltic oil mixed with loose earth and compacted with a sheepsfoot roller. While some of the projects were very satisfactory, others failed, as may now be surmised, due to the use of unsuitable soil types. Apparently the method fell into disrepute as a result of a few failures.

Any discussion of the subject of hydrophilic and hydrophobic aggregates must necessarily become much involved if the problem is to be treated with any sort of fairness or accuracy. There are few people qualified to speak with anything like authority on the subject of free surface energy, and the factors which encourage or discourage the adsorption and retention of liquid films.

There are no simple means yet available for classifying mineral aggregates in terms of suitability for bituminous construction. Aggregates may be identified according to petrographical or mineralogical classifications, but suitability for bituminous work does not parallel such groupings. Some generalizations may be made, if it is kept in mind that there are frequent exceptions. For example, reports from various states and countries show that granitic rocks may be either very good or comparatively poor. The same is true of limestone and most other types. Generally speaking, limestone, basalt, and trap rock are satisfactory, while quartz, chert, and rhyolite may well be viewed with suspicion. However, the only way to be sure is to test each individual material.

(4) Bituminous Materials. It is difficult to cite any important research applied to bituminous materials which has thus far borne definite fruit in the way of improved specifications which will guarantee bituminous materials entirely suited for the purposes of highway construction. Most of the present test procedures have been in use for many years, and

were established for reasons which are no longer important.

While there is almost universal agreement that existing standard tests throw little light on the suitability of oils and asphalts for road building purposes, nevertheless it has been found to be by no means a simple matter to devise acceptable methods which will approve all the suitable materials and reject all the poor ones. This problem is being studied and investigated in numerous ways by practically every important highway laboratory in the United States. There is every reason to hope that we are rapidly approaching a time when it will be possible to test a bituminous material on the basis of quality rather than by identification tests.

The most serious defect in bituminous materials is lack of durability, with consequent deterioration of the pavement due to cracking, ravelling, and disintegration. While the evidence is often contradictory, there is a certain amount of correlation between over-heating and cracking of the asphalt in the refinery, and failure due to hardening and brittleness on the road. Tests such as the Oliensis spot test, solubility in petroleum ether, and many others, have been proposed or adopted to eliminate the less durable asphalts. It is so far true, however, that asphalts which react adversely under these tests have in many cases a record of good service performance.

The problem is being approached from other angles. For example, Mr. Benson, of Kansas, has exposed thin, translucent films of asphalt to various accelerated weathering conditions, and observed changes in the character of the film under high magnification. Benson's studies suggest that asphalts in the pavement may undergo an alteration of structure described as coagulation, which materially impairs the binding value. This alteration may be reversible, so that upon extracting from the pavement, or remelting, the asphalt may revert to its original structure and the alteration no longer be evident.

One fact which adds interest to the problem is that many bituminous pavements built twenty to twenty-five years ago are still giving good service with no cracking or failures, while many recent jobs are in considerable distress. This trouble is fairly widespread, and has been reported by many states.

At the present time, asphalt technologists are in agreement that, for best results, bituminous pavements should be made using as soft an asphalt as possible, using as much asphalt as possible without loss of stability, and making as dense a mixture as possible. In past years, a large proportion of bituminous pavements became rough and wavy sooner or later because of unstable mixtures, usually due to an excess of asphalt. Stability tests were introduced as a check on this condition. It should be emphasized, however, that in attempting to obtain high stability, other properties may be sacrificed and mixtures produced that are too dry and brittle to withstand the effects of weather and traffic.

The relative merits of the numerous grades of slow, medium, and rapid curing products is a subject which could lead to considerable discussion. There apepars to be no point in strongly advocating the virtue of this or that type of material over another, inasmuch as satisfactory roads have been built with most all of the available products. It may be remarked, however, that the best material to use is the cheapest one which will serve the particular purpose, and when this consideration is put to the test, it is surprising how few cases are definitely unsuitable for the various slow curing oils, although it must be emphasized that the various cutbacks and emulsions very definitely have their place.

(5) Special Problems. One of the few special problems related to maintenance which has been the subject of some investigation concerns the design of premix materials for use in maintenance patching. In California, a great deal of the patching of existing pavements is made by means of dense graded premixed material stored in stockpiles. At intervals, certain shipments of this premixed material have been found to be unsatisfactory, either failing to set up, to bond to the old surface, or to remain stable under traffic. It appears that a patching material must have a rather nice balance of properties. It must be neither too fine nor too coarse, the oil can be neither too heavy nor too light, and the permissible aggregate gradation must evidently be kept within narrower limits than is essential for new construction.

For this reason, studies have been made in California attempting to analyze various stockpiled mixtures which have been found to be both satisfactory and unsatisfactory. While the work is by no means complete, and further evidence is desirable before making too positive statements, nevertheless the following grading tolerances are suggested which, with the average types of mineral aggregate, should furnish satisfactory mixtures for maintenance patching. The following tabulation gives the proposed gradation in terms of the U. S. Standard Sieve Series A.S.T.M. designation E-11-26, A.A.S.H.O. 1927:

	¾-Inch %	½-Inch %	⅜-Inch %	4-Mesh %
1-Inch	100			
¾-Inch	95-100	100		
½-Inch		95-100	100	
⅜-Inch	65- 85	80- 95	95-100	100
4-Mesh	50- 65	58- 73	65- 85	95-100
16-Mesh	30- 43	33- 45	38- 52	46- 67
50-Mesh	18- 27	18- 27	22- 30	25- 36
200-Mesh	6- 10	6- 12	8- 15	10- 17
Oil Ratio*	3.9-4.6	3.9-4.7	4.2-5.0	4.5-5.3

*For average types of aggregates.

The most satisfactory grades of liquid asphalt for premix patching material have been SC-4, ROMC-3, and MC-2, with the predominating preference in the order stated.

In Memoriam

Robert J. Eggert

Robert J. Eggert died at his home in Sacramento, April 5, 1940, at the age of 58. Surviving are his widow, Mrs. Edith Eggert, and three sons. He was a native of Archbald, Pennsylvania, and received his education in the public schools of that State.

In 1900, he started active work, being employed at various classifications and with several different concerns, until 1921, when he took an engineering position with the Division of Highways, becoming chiefly engaged in drafting work in District III. In 1927 he transferred to District X as an engineering draftsman, at which work he was engaged until death.

In his work, Mr. Eggert was a hard-working, conscientious employee, and a faithful public servant. He was a loyal friend, being well liked by his fellow workers and associates.

Midstate Chapter and District X of the Division of Highways feel the loss of its member and employee, and do hereby express to his widow and loved ones our deepest sympathy for their great loss.

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