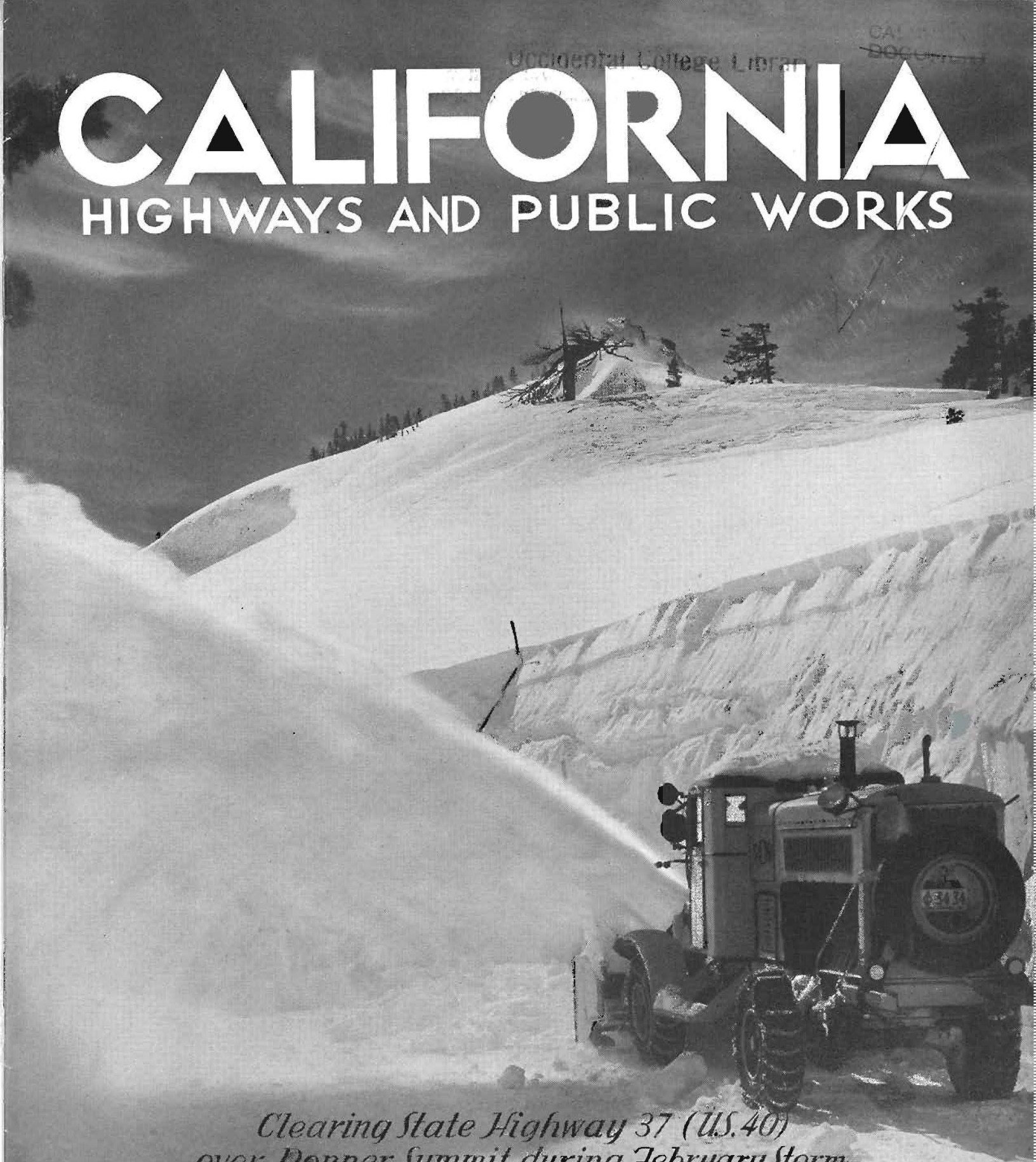
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



Clearing State Highway 37 (U.S.40) over Donner Summit during February Storm

Official Journal of the Department of Public Works

MARCH · 1938

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

EARL LEE KELLY, Director C. H. PURCELL, State Highway Engineer JOHN W. HOWE, Editor K. C. ADAMS, Associate Editor

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Vol. 16 MARCH, 1938 No. 3

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Safety Engineer Appointed To Head New Department in State Division of Highways

THE Division of Highways has added a Department of Safety to the headquarters' staff. Engineering investigation of the rising accident toll, together with public interest energized with anxiety and concern, has pointed to the need of a separate bureau or department to more closely observe and study the development of traffic problems.

Recognizing this need, Director of Public Works Earl Lee Kelly and State Highway Engineer C. H. Purcell began a study of a budget and the scope of operation for such a department late in 1937, culminating in the announcement of the organization of the department early in February this year.

PRIME PURPOSE

Increasing traffic with consequent increasing accident frequency, and the experience gained through the years of literally lifting traffic out of mud and dust, has gradually developed the conviction that a highway department has as a prime purpose the providing of a system of highways which will obtain a safe and rapid movement of hundreds of thousands of motor vehicles of many types in a constant and more accelerated movement as time progresses.

The department will in no way supersede nor conflict with such safety activities as are already under way, but will strengthen and augment those activities, combining its efforts with others in an endeavor through analysis and study of traffic statistics to advance the movement toward a goal of safe highway driving.

VICKREY APPOINTED

Effective March 1, Mr. J. W. Vickrey was appointed as Safety Engineer in charge of the new department. With the exception of a few months in 1920, Mr. Vickrey has been with the Division of Highways since April, 1917, and for approximately the past six years he has been District Engineer of District I at Eureka. He has a thorough knowledge of all

J. W. VICKREY

phases of highway work and is particularly well fitted by experience to handle the new department. As Safety Engineer, Mr. Vickrey will report directly to State Highway Engineer C. H. Purcell.

In a statement announcing the addition of the new department and the appointment of Mr. Vickrey, Mr. Purcell said:

"While the Division of Highways has been keeping pace with safety developments through its several departments, and as a matter of fact has collected more data on the subject than any other agency, the new department within the Division will coordinate and direct along this particular line.

ENTAILS MUCH STUDY

"In spite of the continued improvement of our highways, accidents seem to vary directly with the volume of traffic. Furthermore, traffic accident records indicate that something must be done about the driver and the pedestrian. Just what we may do is something that must be continually studied as a specific function of a safety engineer.

"Highway designs must be watched to see that no possible safety features are overlooked. The relation of traffic problems to other economic and social problems must be kept in mind. There are no all inclusive methods of traffic safety. They are still in the process of development.

DEMANDS COOPERATION

"It will be Mr. Vickrey's duty to assist the various departments of design, construction, and maintenance in furnishing and obtaining all possible information necessary for their work in order to promote safety on California's highways. This will mean cooperation with the various national, state, and local agencies now interested or engaged in this phase of the work. The work being done by other state highway departments and other safety engineers will be considered.

"Likewise the benefit of the California Division of Highways' experience along safety lines may be coordinated and made readily available to the various agencies which are now vigorously working on the problem of safety, particularly in connection with the awakening and educating of the driver to his responsibility.

"The results of technical studies, the Division's aims, endeavors, and accomplishments in building safer highways and reducing accidents must also be presented to the public for their enlightenment and approval.

HUMAN ELEMENT INVOLVED

"The problem may appear to be more sociological than engineering; however, the fact that 37,000 people a year are killed on the streets and highways of the United States has forcibly brought to the attention of the Highway Department that no stone should be left unturned that

(Continued on page 17)

Flood Fighters Save Levees

By S. H. SEARANCKE
Associate Hydraulic Engineer, Division of Water Resources

NORMALLY, in the Sacramento Valley, December is not regarded as a month of storms and high water. However the December just past proved itself an exception to the rule.

From the ninth to the thirteenth of that month storm clouds rolled over the watersheds tributary to the Sacramento River and expended themselves in a downpour of unusual intensity. Heaviest among the rainfalls recorded for twenty-four-hour periods were 7.75 inches at Kennett; 7.25 inches at Mineral; 11.61 inches at Brush Creek (Feather River watershed); 11.48 inches at Scales (Yuba River watershed) and 8.43 inches at Spaulding.

Even at the higher altitudes precipitation was in the form of rain, and since there was no blanket of snow to absorb and retard it, the runoff was torrential and the streams affected quickly rose to flood stages. At Red Bluff, Knights Landing, and Marysville record high water marks were established.

TORRENTS ATTACK LEVEES

The straining waters searched out whatever weaknesses there were in the river levees and kept men busy day and night plugging holes made by rodents, building up low stretches and protecting banks against the eroding action of the current. Human effort, however, was not a match for the waters at every point of attack. Here and there trickles broke through, which under pressure increased in size until they became like mill races tearing material from the levees and inundating farm lands.

Many such breaks occurred on both sides of the Sacramento River above Colusa, the escaping waters quickly filling up the Colusa basin, flooding thousands of acres of farm land, cutting off means of communication, drowning stock, entering homes, and bringing inconvenience and misery to hundreds of residents.

The Feather River also broke through at several points. From Hamilton Bend near Biggs a raging torrent swept westerly across country towards Butte basin, tearing off top soil, cutting deep washes and gullies, uprooting fruit trees, carrying away farming facilities and leaving piles of drift and debris in its wake.

WEIRS ARE OPENED

In contrast to the damage and distress prevalent further up the valley, residents of Sacramento and vicinity enjoyed the utmost security and freedom from alarm. By far the greater part of the flood waters of the Sacramento and Feather rivers escaped through Fremont Weir about twenty miles above Sacramento and made their way harmlessly to the bay by way of the Yolo Bypass.

The situation was further relieved for Sacramento by the opening of the gates of Sacramento Weir, thus making provision for the excess of the waters of the American River. The flood crest which reached record stages at stations on the upper river produced only moderate gage heights at the city of Sacramento.

FARMERS HARD HIT

In due time the water in the river channels receded, the inundated lands drained, and normal farming operations again became possible. But it was obvious there could be no security so long as the levee breaks remained open to permit further inundation by each succeeding freshet.

The breaks must be closed, but that was an expensive undertaking and who was going to foot the bill?

The farmers most concerned were the least able to pay. Two of the breaks occurred in levees which are maintained by the Division of Water Resources and these were repaired as a matter of routine. Others had occurred in levees for which the California Debris Commission and the Reclamation Board jointly were responsible, and these were repaired. But there were still many breaks in localities where neither the War De-

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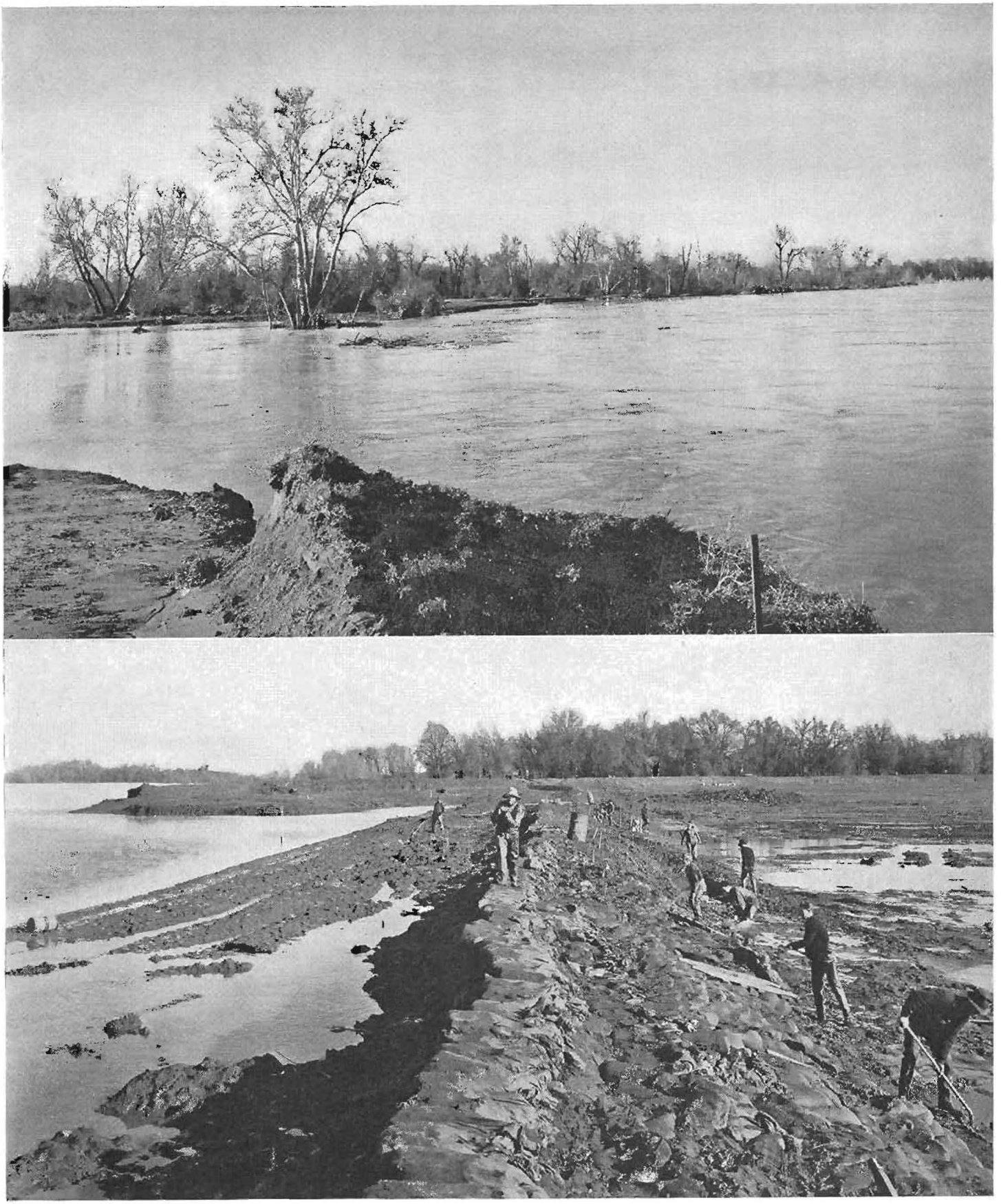
Flood waters of Little Chico Creek rage through orchard on Cornell Ranch near Lone Pine Avenue in Butte County.



When the Sacramento River went on a rampage last December. Upper picture was taken on Phelan Ranch near Chico in Butte County and shows huge break in the Sacramento River levee and portion of hundreds of inundated acres. The lower photograph was taken at approximately the same spot after the levee closing operations had begun. The sacking job prevented overtopping of the newly built fill during later storms.

OLD BRIDGES ARE MENACE

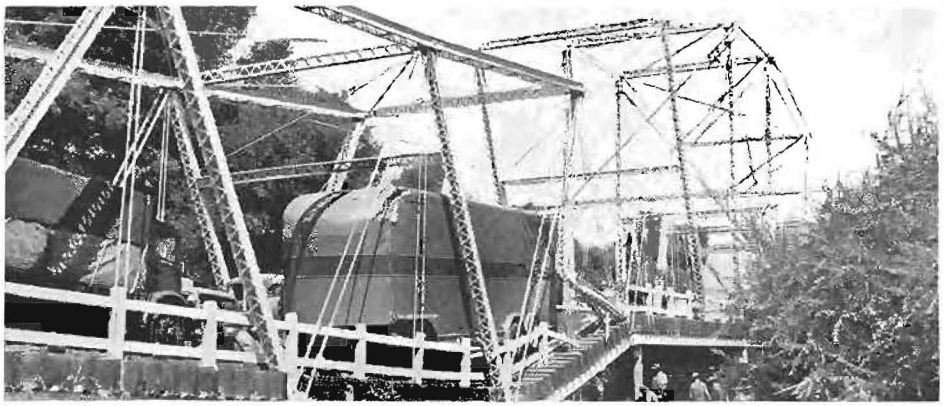
By F. W. PANHORST, Bridge Engineer

DURING the past few years there have been many cases where heavy vehicles have crashed into bridges on the State Highway System resulting in the complete collapse of the spans or otherwise causing their failure.

What would happen if a huge truck, weighing 60,000 lbs. going at the rate of 30 miles per hour, crashed into a supporting member of an elevated water tank?

The result can easily be imagined. Obviously the water tank is designed only to sustain a vertical load and the comparatively small horizontal force exerted by wind pressures. The same is true of a bridge. In other words, no matter how sturdily a bridge is constructed, regardless of the fact that it can carry safely the heavy loads which represent a vertical force placed upon the structure, it does not follow that the same bridge can withstand an equal or greater force in a horizontal direction.

At top, gasoline tank truck crashes Pit River Bridge near Dunsmuir and burns.



Center, overloaded truck causes collapse of San Joaquin River Bridge in Merced County.

TRUCK DEMOLISHES BRIDGE

Many of the bridges on the State Highway System are of the through truss type, in which the supporting members extend above the deck of the structure. The more serious accidents have occurred in connection with through truss bridges of narrow roadway width.

Unless proper precautions are taken by vehicles when crossing such structures, one of the side members may be struck, causing the complete collapse of the span. The seriousness of such an occurrence can readily be seen for it may not only cause loss of life and property damage, but in all probability may block all traffic until the span can be reconstructed.

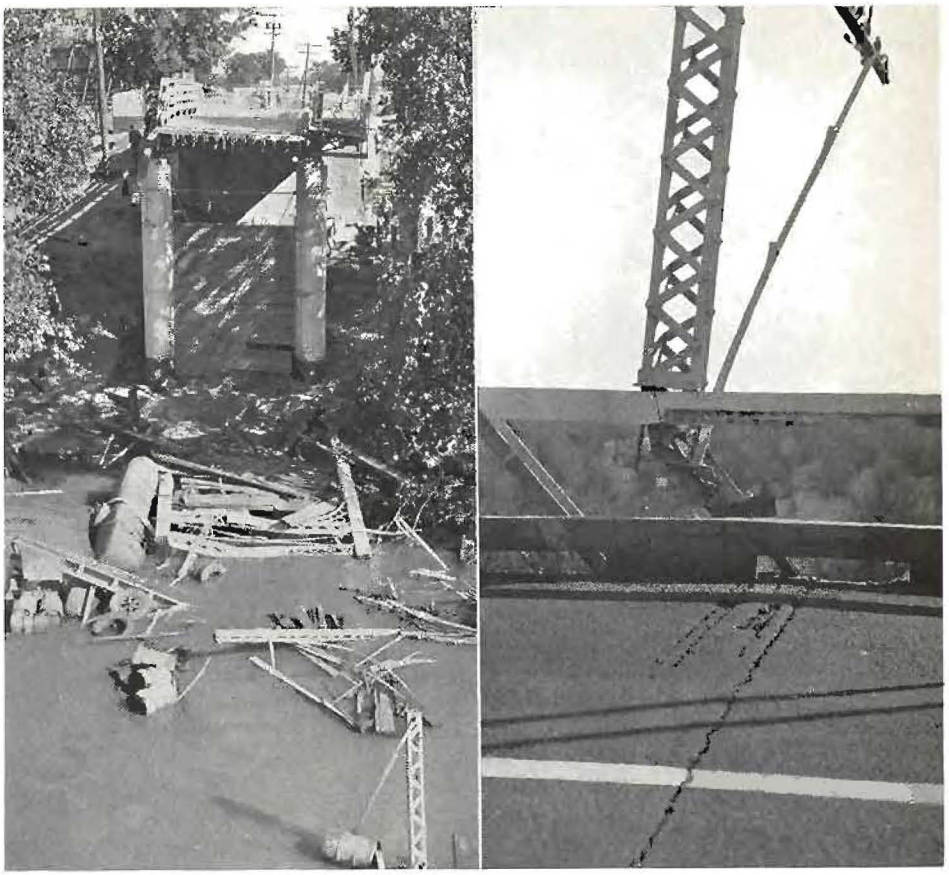
On October 20, 1937, a truss span over Woods Creek on the Oak Flat Road was demolished by a truck carrying two large pontoons to be used in the construction of a gold dredger. The truss was in good condition and strong enough to carry safely legal loads under normal circumstances. The evidence establishes the fact that an end post member of the truss was struck by an overhanging pontoon and knocked from its supports. The result was that the complete span fell into the creek with the truck on it as shown in the accompanying photograph.

A short time before, on September 23, 1937, the westerly arm of the

Lower, truss span over Woods Creek on the Oak Flat Road demolished by truck.

swing span of the San Joaquin River Bridge on the Pacheco Pass Road collapsed under a combination of excess loads, excessive speed and the striking of some of its truss members. This bridge had been posted for reduced load and speed limit. The collapsed span with the trucks on it is shown in the accompanying photograph.

On December 2, 1937, a heavy load requiring extra high clearance tore out the portal framing and damaged the end post of a timber truss bridge over Yager Creek on the Trinity Road between Red Bluff and Fortuna. This span had been strengthened temporarily by placing supports under the center of each beam. It was only for this reason that the trusses did not collapse. It was possible in this case to place supplementary bents under the floor beams and maintain traffic over the bridge, subject, however, to the probability of these temporary supports being washed out during any flood that might occur during the winter.



Left—Sacramento River Bridge at Red Bluff collapses. Trucks and steel framework are shown in river. Right—Tower on San Benito River Bridge near Hollister damaged by truck.

RED BLUFF SPAN COLLAPSES

The collapse of the Sacramento River Bridge at Red Bluff in October, 1936, was described in the newspapers and technical journals at the time it occurred, as was also the failure of the timber arch span over Rock Creek in Mendocino County, which occurred April 21, 1937.

While the failure of the Rock Creek Bridge was discovered before any damage was done to vehicles, it was necessary to stop all heavy traffic for several weeks while a temporary structure was being built across the canyon. This materially affected the hauling of supplies into the communities along the Redwood Highway.

Twice within six weeks, heavy trucks got out of control on the Pit River Bridge, 14 miles north of Redding on the Pacific Highway. In both cases large gasoline trucks were wrecked and caught fire on the bridge causing death or serious injury to the drivers.

The bridge, being of concrete, was not seriously damaged although it is quite likely that its service life may be impaired. If it had been one of the many light steel structures still in use on the State Highway System it would undoubtedly have been demolished. One of the photographs shows the truck after it had burned on the bridge and also shows a considerable length of concrete handrail which was knocked out. The holes in the end of the tank were made by the bullets of traffic officers in an effort to allow the gasoline to escape and prevent a serious explosion.

Yager Creek Bridge in Humboldt County. Note broken end post.

MANY WEAK BRIDGES

Many near failures have occurred. The accompanying photograph shows a vertical member of one of the

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Major Construction Under Way on Coast Highway Through Malibu Ranch

By A. D. GRIFFIN, District Office Engineer

FROM the standpoint of combined recreational, scenic and commercial values, the "Coast Highway," State Highway Route 60, between El Rio in Ventura County and Doheney Park in Orange County, is undoubtedly one of the most important traffic arteries in California. This highway, frequently called the "Roosevelt Highway," and sometimes referred to by the Federal route number designation of "U. S. 101 Alternate," for its entire length of 120 miles follows along the ocean front or in proximity thereto.

During the past fifteen years, as fast as funds could be made available, State highway construction contracts have been carried out opening up sections on new location, or improving existing road facilities so that, with the exception of about twelve miles within the boundaries of the Malibu Ranch, we now have a highway with three or more traffic lanes along the coast on modern high standards of alignment and grade.

FOUR LANES

From Las Flores Canyon, the easterly boundary of the Malibu Ranch, through Santa Monica Bay cities, city of Los Angeles and city of Long Beach to Laguna Beach in Orange County, the pavement has a minimum width of four lanes with ample shoulder width on both sides for the parking of vehicles. For a considerable portion of this distance the pavement is full width between curbs providing for six lanes of moving traffic with lanes adjacent to the curb for the parking of vehicles.

The 12-mile section of the Coast Highway within the Malibu Ranch from Encinal Canyon to Winter Canyon, with its narrow twenty-foot pavement or oiled surfacing, with dangerously sharp and curving alignment and restricted sight distance over vertical curve summits, is the last section of the Coast Highway to come up for improvement. The land through which it passes, while splendid potential subdivision property, is at the present time used for the most part as grazing or agricultural land and there exists little or no local traffic to be served. Therefore, there has not been the resultant pressing need for highway improvement, as has been the case in metropolitan areas where heavy local traffic caused intolerable congestion before capacity was increased.

However, during recent years, through traffic has been steadily increasing. Particularly is this true of commercial traffic because trucking concerns operating between Ventura and Los Angeles have found the Coast Route cheaper and quicker to operate over than the inland routes with their longer and steeper grades.

ORIGINAL LOCATION IN 1921

The original location through the Malibu Ranch was made in 1921 when standards of alignment and grade were much lower than at present. Between Encinal Canyon and Walnut Canyon there are several sections of road on curving alignment dangerous for modern high speed traffic. Some of the curves have radii as short as four hundred feet. As traffic speeds and traffic volume have increased, serious accidents have become more and more frequent, and the need for improvement of the old road to modern standards has become a vital necessity.

The Division of Highways now has two road construction contracts and two bridge construction contracts in progress on the Coast Highway through the Malibu Ranch, which in value total approximately $500,000. The Macco Construction Company of Los Angeles is the contractor for the road work on both contracts between Walnut Canyon and Encinal Canyon, which total 4.78 miles in length, and for which the allotment is $392,000. The contractors for this highway improvement work have concentrated a large amount of heavy grading equipment on the job in order to move as quickly and economically as possible the 473,000 cubic yards of roadway excavation to be handled in making this improvement.

CONSTRUCTION EQUIPMENT

Included in the construction equipment are ten 95 h.p. Caterpillar tractors, seven 14 cubic yard capacity carry-all scrapers, together with several rooters and sheepsfoot rollers. The Macco Construction Company is well equipped to carry out grading operations in accordance with the State Division of Highways standard specifications for placing roadway embankments in thoroughly compacted layers.

Other construction operations started during the short time that work has been in progress consist in the installation of drainage structures, the moving and resetting of property fences and the construction of detour connections and temporary surfacing over new work for the accommodation of public traffic. The specifications require that all construction operations are to be so carried out that the traveling public can move with complete safety through construction with a minimum of inconvenience and delay. To this end all possible use is made of the existing highway. The Macco Construction Company organization is to be commended for its splendid cooperation with the State in the most difficult problem of handling public traffic.

COMPLETION THIS SUMMER

The State Division of Highways is represented on the contract by C. N. Ainley and Earl A. Parker, Resident Engineers, with a staff of experienced assistants. Their estimates indicate that on both contracts all work will be entirely completed early this coming summer.

Concurrently with the two highway contracts, there are also in progress

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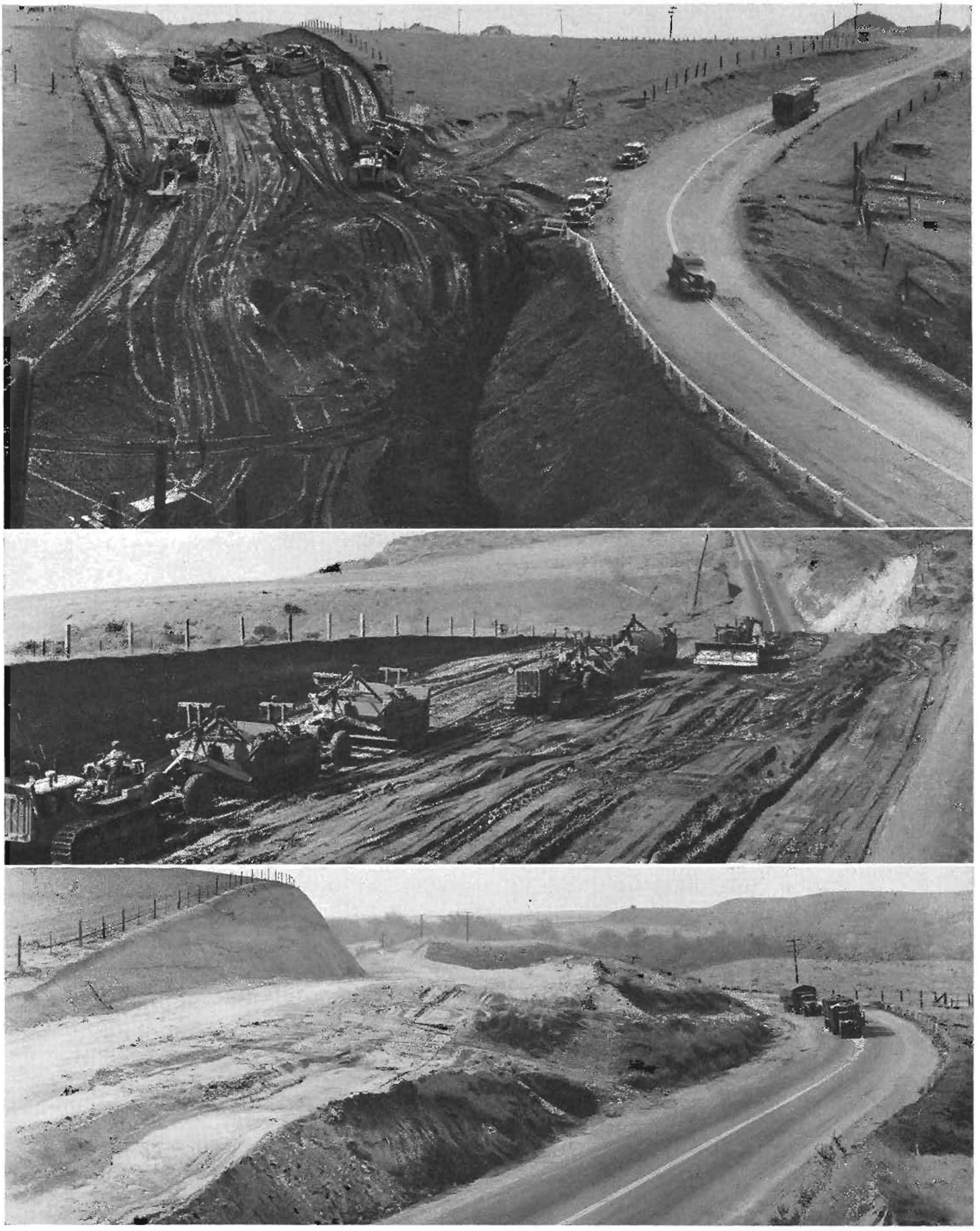


Construction scenes on Coast Highway through Malibu Ranch. Upper—Reconstruction at Encinal Canyon to eliminate reversing curves on old alignment. Center—Grading operations with modern heavy equipment to provide eighty-foot width of roadbed. Lower—Looking westerly from Walnut Canyon toward Zuma Creek, showing grading on new alignment.

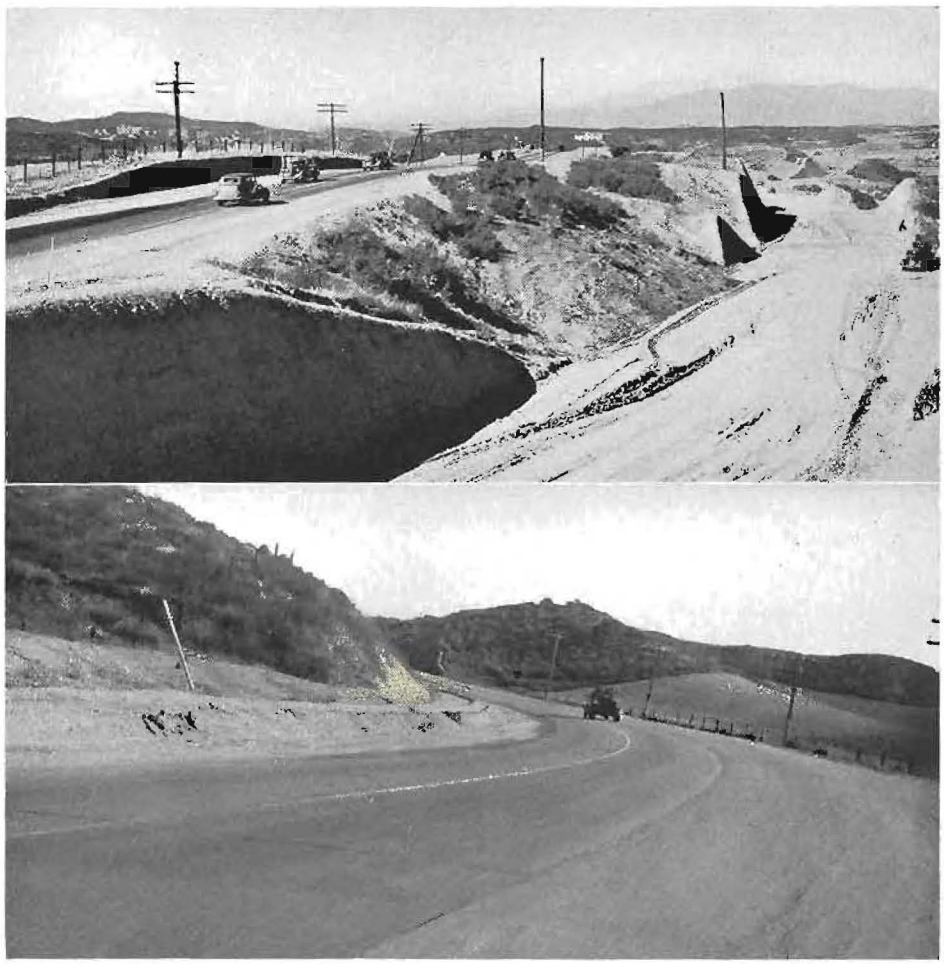
State Highway Route 26 North of Beaumont Being Realigned

By A. EVERETT SMITH, Assistant Highway Engineer

A PROJECT is now under way on State Highway Route 26 between Beaumont and the Northerly Boundary of Riverside County to correct conditions that slow up traffic movement and tend to create traffic hazards.

At the location of the project, the terrain is composed of high table land cut in numerous places with deep arroyos or washes. Over this a concrete pavement was placed in 1925, constructed to a rolling grade line with winding alignment where necessary to minimize construction costs. However, it was built to engineering standards for that time and was adequate for the light traffic and the 35-mile speed limit.

Recent contract construction under which improvement has been made to other major portions of this route in northern Riverside County has included work on four sections.



Upper—Eliminating dangerous curves on State Highway Route 26. Lower—A seven hundred foot radius curve that will be abolished by new alignment.

WORK STARTED IN 1934

Between January and June in 1934 the Division of Highways had under way a contract for grading and surfacing two miles between Cabazon and Whitewater. This project provided for the elimination of 45 dips which had been placed in the roadbed to carry storm water across the highway. At 42 of these dips the grade of the highway was raised and drainage taken care of by means of bridges and culverts and the others were eliminated by changes in alignment. The old 16-foot concrete pavement, on a 25-foot roadbed, was replaced by plant-mixed oil treated crushed rock surfacing, 36 feet wide, laid on the new raised subgrade.

A year later nearly 17 miles of the existing 16-foot concrete pavement between one mile east of Beaumont and Whitewater was widened to 20 feet and the shoulders widened to eight feet on each side of the pavement.

Between June of 1936 and January, 1937, two short portions were improved between the San Bernardino County line and Beaumont covering a distance of about 2.4 miles. These two sections dovetail with the improvement now under way and the project consisted of changing the grade line to eliminate the short steep pitches at many points so as to provide better sight distance over vertical curves.

A new plant-mixed surfacing 20 feet wide, was placed on the reconstructed roadbed. At locations where the cost of a change in grade was prohibitive, the pavement was constructed 40 feet wide to provide four lanes for traffic, so that passing of the slow moving vehicles was made possible.

The present construction operations are at two separate locations, and are for the purpose of correcting undesirable conditions that still exist.

IMPROVEMENT BENEFITS

The improvement will provide two-fold benefits.

1. **Alignment improvement: The existing alignment has a 700-foot minimum radius curvature, whereas**

the new location will have a minimum radius curvature of 3,000 feet.

2. Gradient improvement: The existing road has numerous short and sharp vertical curves with a maximum grade of 5.94 per cent. The new grade provides for longer and less abrupt vertical curves and a maximum grade of 4.25 per cent.

In addition to the alignment and gradient improvements, the project includes the following features:

A dip will be eliminated over which passes storm water from a branch in the San Timoteo Creek with its resultant deposits of debris entailing hazard to traffic. These storm waters will be carried under the road on new location in a double 10- by 7-foot reenforced concrete box culvert.

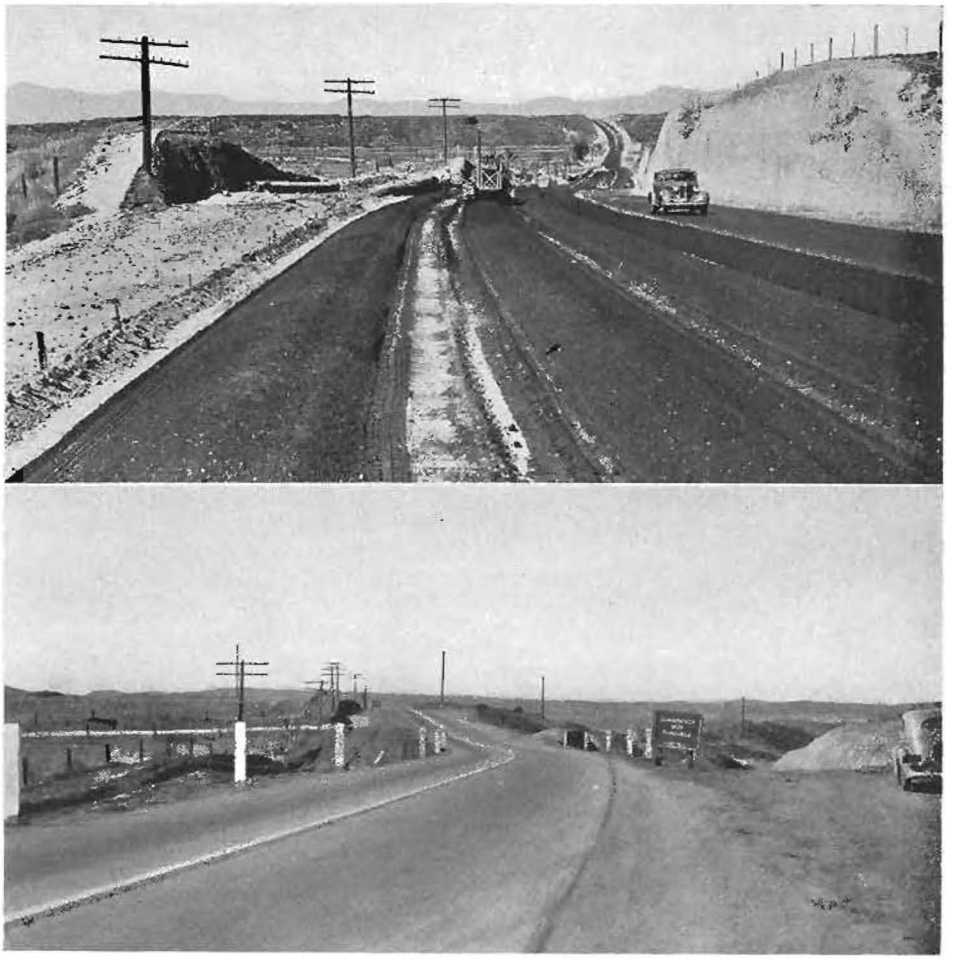
The subgrade will be made of sand blended with native material and mixed with oil by the road-mix method. A 38-foot roadbed paved with a 22-foot width of plant-mixed surfacing, bordered by an 8-foot shoulder of road-mix surfacing adjacent to each side will be provided.

Oswald Brothers of Los Angeles are the contractors performing the work included under this contract and construction operations are proceeding satisfactorily with the equipment and crew which they have placed on the job.

LARGE TRAFFIC VOLUME

This route carries a large volume of traffic traveling between the Los Angeles metropolitan area and the Coachella and Imperial Valleys. During seasonal periods, heavy traffic travels between the Los Angeles area and Palm Springs. This also being the main truck route between Los Angeles and the Imperial Valley, numerous trucks and trucks and trailers, many loaded to maximum legal limits, use this route, with a recorded maximum of over 700 in one day. To this is added the constantly increasing number of out of state automobiles, converging on this road from the two transcontinental highways entering California at Blythe and Yuma.

On many highways the improvements as noted above would mean a little more speed, a little more safety, or a little more motoring comfort, but on this route these improvements are particularly significant. Through traffic is very heavy. Trucks, heavily laden, going up the steep grades, shift to lower gears, and consequently progress at very slow speeds.



Upper—Construction on stretch of highway between Redlands and Beaumont. Lower—Highway north of Beaumont looking toward Redlands.

LIMITED SIGHT DISTANCE

Limited sight distances, due to poor alignment and abrupt, vertical curves, make it extremely dangerous for automobiles to pass. The result is that long lines of traffic form behind the slow moving trucks and await a favorable opportunity to pass. Further, the danger element is ever present by the nervous driver who can not wait for proper sight clearance before passing.

With the completion of this construction, the heavy commercial vehicles will move at a more uniform rate of speed by reason of easier grades. Automobiles will have normal opportunities to pass the slower vehicles, due to increased sight distance, and traffic movement in general will be greatly facilitated.

"But, my dear. I haven't spoken for ten minutes."

"No, Henry, but you've been listening in a most aggravating manner, and I'm not going to stand for it."

Old Bridges Are Menace

(Continued from page 5)

trusses on the bridge over the San Benito River near Hollister. This member was struck by a truck with such force that it was practically demolished and, in the process, additional and unusual stresses were caused to the other members of the truss.

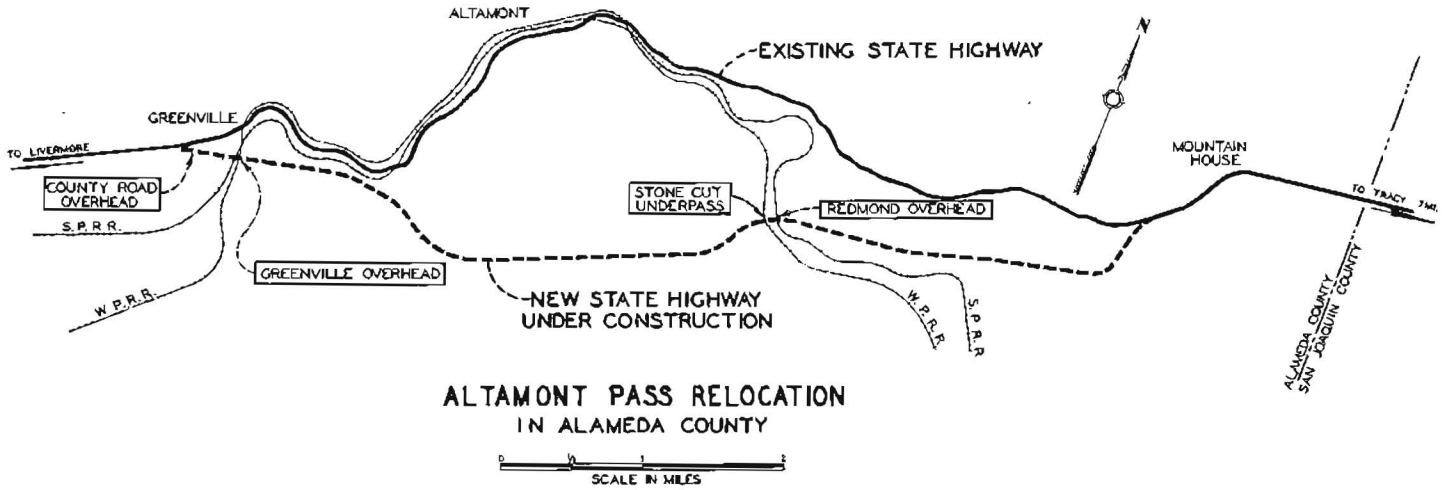
There are over 2000 bridges on the State Highway System which are either weak, narrow, or have dangerous approaches. It will be a period of several years before all such bridges can be replaced. In the meantime it is necessary that the traveling public, and particularly drivers of heavy trucks, use extreme caution in approaching narrow bridges or passing other vehicles on them.

Coxswain—Take this Oar!
Stroke—Oar What?

New Altamont Pass Will Be Ready for Opening of 1938 State Fair

AT THE present rate of progress all indications are that the new route through the Altamont Hills between Livermore and Tracy will be open to traffic by Labor Day, September 5.

The grading work is about 70 per cent complete and the three grade separation structures are 50 per cent complete. Very little of the large scale operations which are under way can be seen from the existing road as the new route follows an entirely different alignment from Mountain House to Greenville, as can be seen by the accompanying route map.



The existing road, which was adequate at the time it was constructed, has for the past few years been unable to satisfy the demands of modern high speed traffic. Because of the limited sight distance and tortuous curves, fast traffic is forced by slow moving vehicles to slow up on the two-way road. Many accidents have occurred on this stretch of road because of attempts by motorists to pass the slow moving traffic. The new road will provide for two lanes of traffic in each direction separated by a four-foot dividing strip.

At Greenville, approximately three miles east of Livermore, the new highway jumps over the tracks of both the Western Pacific and Southern Pacific Railroads at a point where the railroads are close together. The separation of grades is being effected by means of one overhead structure which will span the tracks of both railroads.

At Redmond, or Stone Cut, approximately three miles east of Greenville, the highway again crosses both railroads by passing under the Western Pacific tracks and over the Southern Pacific tracks at a point where the railroad tracks are only a few hundred feet apart but are at a different elevation.

The overhead structure at Greenville provides for two twenty-three foot lanes of highway traffic and two three-foot wide pedestrian walkways. The highway lanes, each of which will accommodate two lines of traffic, will be separated by a center curb four feet in width which will separate traffic in opposite directions.

GREENVILLE OVERHEAD

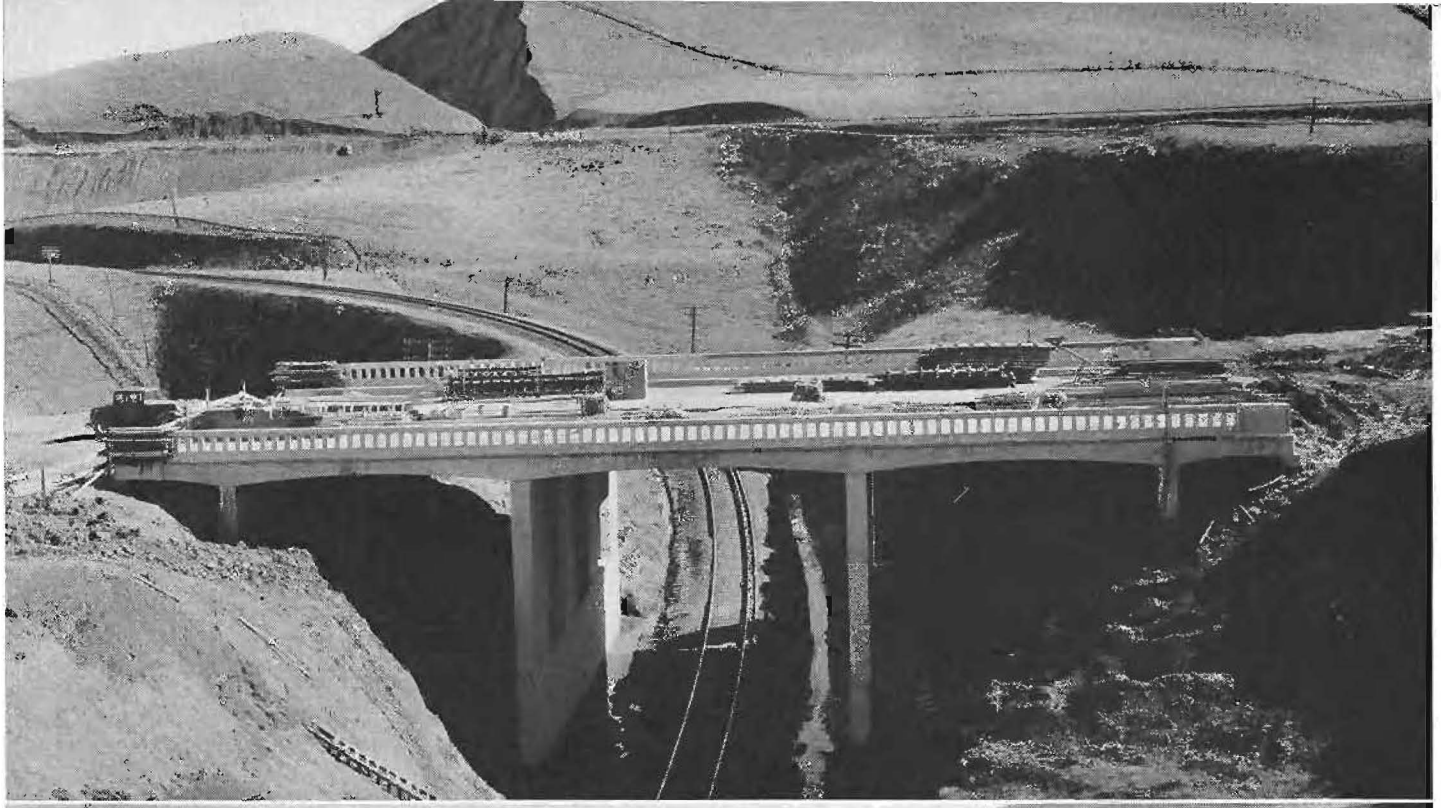
The Greenville Overhead is being built entirely of reinforced concrete with a total length of 458 feet consisting of eight spans 49 feet in length, one approach span at the west end 50 feet in length and a cantilever approach span at the east end 16 feet in length. The reinforced concrete girders are designed continuous over the supporting columns which are 60 feet in height. Provision is made in the design to provide for the existing track and one future track for both the Western Pacific and Southern Pacific Railroads.

At Redmond the new highway passes under the Western Pacific tracks approximately 40 feet below the grade of the railroad. This necessitated the construction of a reinforced concrete arch to support the railroad tracks and span the double two-lane highway. Each highway lane is 24 feet in width and is separated by a 4-foot center curb which will effectively divide the traffic. Pedestrian walkways are also provided on both sides. The length of the arch barrel is approximately 35 feet, flanked by retaining walls at each end parallel to the highway center line to retain the high railroad embankment.

Several hundred feet from the Western Pacific Underpass the highway crosses over the tracks of the Southern Pacific Railroad by means of a reinforced concrete bridge. The structure is designed continuous over supporting columns and provides two 23-foot highway lanes with a 4-foot dividing strip. The Redmond Overhead will have an overall length of 120 feet consisting of three 32-foot spans with two 12-foot centilever approach spans.

COUNTY ROAD OVERPASS

In addition to the separation of grades between the new highway and the railroad tracks, a separation structure is also provided to carry State Highway traffic over an existing

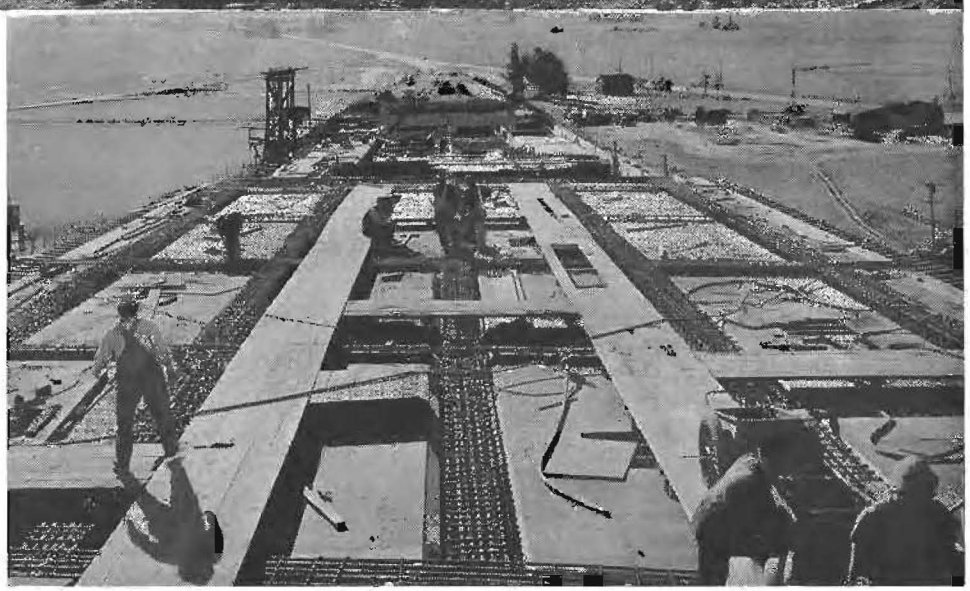


county road at Greenville. Through traffic will thus enjoy complete protection from intersecting traffic.

This structure is of reinforced concrete and provides for two 24-foot roadways separated by a 4-foot dividing strip. Two 3-foot sidewalks provide a safe crossing for pedestrians.

The completed project will cost approximately $1,160,000 of which the railroad separation structures represent an expenditure of $260,000.

Contractors on the three projects are: Mountain House to Greenville, grading and surfacing, Granfield, Farrar and Carlin, San Francisco. Overhead over Southern Pacific and Western Pacific at Greenville, A. J. Raisch, San Francisco. Overhead over Southern Pacific at Redmond and undergrade under Western Pacific at Stone Cut, Heafey-Moore Co., Frederickson & Watson Construction Co., and Frederickson Bros., Oakland.



Construction scenes on Altamont Pass project. Upper—Redmond overhead nearing completion. Center—View of Redmond overhead in foreground and Stone Cut railroad trestle in background. Lower at work on Greenville overhead.

Three Major Improvements on Pacific Highway Completed

By E. J. BASSETT, District Office Engineer

COMPLETION of a series of three major projects on the Pacific Highway entering Redding from the north marked the conclusion of an improvement which has long been under consideration. It accomplished the elimination of an indirect routing and the discarding of a dangerous section of alignment on which numerous casualties of varying degree have been a source of increasing concern during the past 17 years.

The first project of the recent improvement involved the construction of a 795-foot plate girder bridge with a 34-foot concrete deck, and 3-foot sidewalks on each side. Due to the design of the structure, requiring concrete supports set on the approach fills, the end spans were of the cantilever type and were counterbalanced each with two 37,000 pound weights pending the completion of the structure under a subsequent contract. The bridge is supported by seven concrete piers, 108 feet on centers, founded on bedrock, the footings being set into the rock to a depth of from 3 to 6 feet.

SECOND PROJECT

The second project consisting of the grading and paving of 0.91 mile of the new route, from Trinity Street in Redding to Sulphur Creek, was begun in the spring of 1935 and was dedicated and opened to the public on December 18th.

The initial phase of this contract covered the alteration of the southerly channel of the river which was used as a diversion canal by the Anderson-Cottonwood Irrigation District between their dam and tunnel intakes. Plans called for the filling of this channel in building up the southerly approach fill 65 feet in depth, and for the construction of a concrete-lined channel around the toe of slope on the island under the bridge.

Irrigation requirements made the construction of the new channel mandatory before construction of the embankment, which, necessarily, was delayed until completion of the north approach. Excavation was accomplished with a power shovel which dug its own road down the 65-foot river bluff.

WATER CONTROL

The lining of the channel change with Portland cement concrete 6 inches in thickness was accomplished under trying conditions occasioned by the gravelly soil on the island and high spring water levels of the river.

Water from the river channel was excluded by means of earth dykes and the channel change dewatered with two 4-inch and one 6-inch pumps. Weep holes were built into the paved slopes to relieve the hydrostatic pressure during construction. The channel change is 417 feet in length with a 14-foot bottom and minimum 13-foot depth with 1:1 side slopes.

The second phase involved the grading of the roadway north of the river and the construction of the approach fills to the bridge. Material for embankment was obtained principally from gravel bars in the river and from dredger tailings adjacent to the bridge.

APPROACH PROBLEMS

It was necessary that the northerly approach be constructed first as material for the south approach was available only on the north side of the river and must be hauled across the bridge. Access to the structure at the north end was accomplished by means of a temporary wooden span pending construction of the abutment and remaining section of the cantilever span. Material for the south approach was hauled across the bridge and dumped from the end of the suspended span into a stockpile and was moved into place with bulldozers and compacted with a sheep's foot roller and a 10-ton 3-wheel roller. The maximum subsidence of this embankment after two wet winters is 0.5 of a foot.

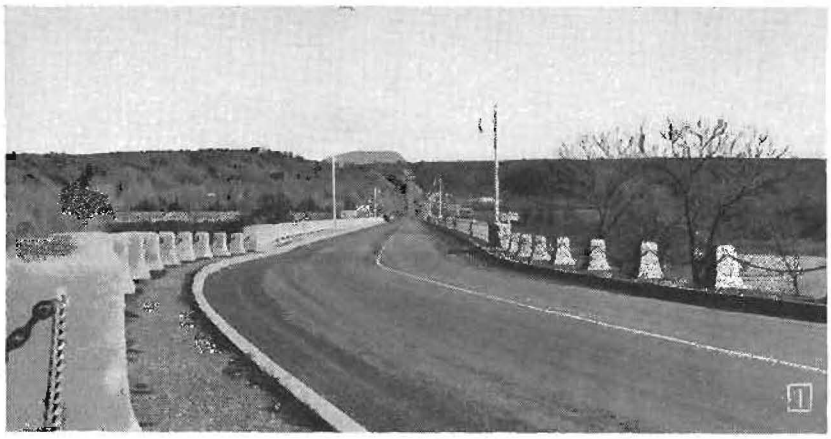
The widening and paving of that portion of the project on Market Street in the city of Redding constituted the third phase. The existing 50-foot street, which had long been a serious bottleneck on this important highway, was widened to 80 feet with a 56-foot concrete pavement of standard thickness. A paved wye connection was made with Riverside Drive and the intersection at Trinity Street revised and replaced. The removal of dwellings and the replacement of private improvements were done under a cooperative agreement with the city of Redding.

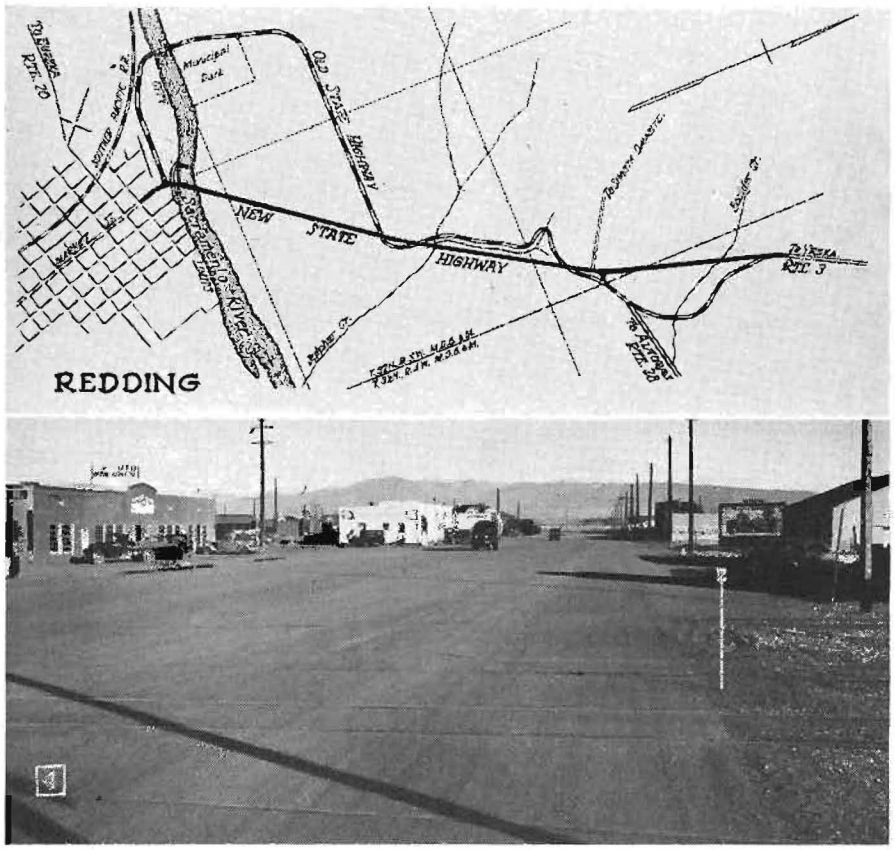
48-FOOT ROADBED

The last phase consisted of paving and finishing north of the river. Gravelly material was used as a subbase across the low-lying flat, followed with a crusher-run base 0.45 foot in thickness and a road-mixed surface course 0.25 of a foot in thickness. The resulting roadbed is 48 feet in width throughout, with a paved width of 32 feet at the northerly bridge head, tapering in 330 feet to a 22-foot pavement for the remaining 3400 feet.

The third project from Sulphur Creek to Boulder Creek Hill, with a revised connection to the Redding-Alturas lateral, was started in September, 1936, and completed in July, 1937. Some delay was experienced during the winter months, but, despite a four months' shutdown, the work was completed within two weeks after the allotted time had expired.

Construction was on entirely new alignment of high standard and relegated to oblivion the crooked and narrow Sulphur Creek grade where many serious accidents had occurred. It also eliminated two short, narrow concrete bridges which were replaced by culverts. The roadbed section provided for a 38.4 foot roadbed with a road-mixed surface 0.21 of a foot in





Scenes on newly completed project on Pacific Highway. 1. New bridge with chain guard in Shasta County. 2. Stretch of recently completed highway in Modoc County. 3. Section of new highway on Sulphur Creek Hill in Shasta County. 4. Street scene entering Alturas on new highway. Center, map of project.

thickness placed on a crusher-run base 0.5 of a foot in thickness. An imported selected material sub-base 0.88 of a foot in depth was placed prior to paving operations over the native red and yellow clay characteristic of the locality.

EXCELLENT ALIGNMENT

The outstanding features of these projects are the high standard of alignment realized; the improvement in roadbed width; the dispatch with which the work was accomplished in slightly over two years; and the saving in distance. By referring to the tabulation, it will be seen that in the first grading project the saving in distance was greater than the length of the new work. For the combined projects the saving is approximately 30 per cent.

Following the contract program a beautification project was set up from Federal funds with an anticipated expenditure of $10,000. The work consisted in part in the construction of a chain guard along both approaches to the bridge and along the wye connecting with Riverside Drive. This improvement not only serves as a safeguard for motorists and pedestrians, but adds a definite artistic touch to the bridge setting.

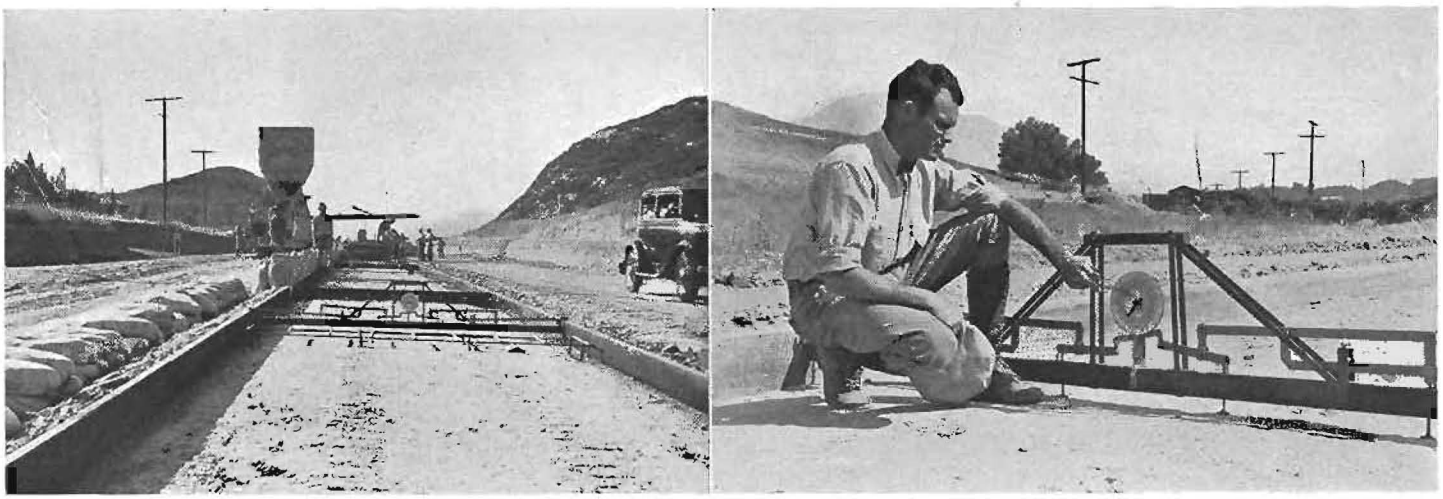
In addition to the chain guard, extensive plantings of shrubbery on the slopes of the approach, the installation of a watering system and the planting of shade trees along a stretch of 3400 feet north of the bridge give promise of future shade

(Continued on page 23)

Device Accurately Measures Concrete Pavement Volumes

By EARL WITHYCOMBE, Assistant Construction Engineer, and
WILLIAM F. FAUSTMAN, Assistant Engineer

DURING the past several years there has been an apparent need for some means of rapidly and accurately measuring the volumes involved in the placement of Portland cement concrete pavement. Any dependable method that would help to definitely determine the scope of responsibility for yield, or reduce to a minimum the unknown variables, would unquestionably be desirable. When such a device also incorporates the qualities of speed and accuracy with less tedious book checking, it would have a decided advantage.



Left—Volumeter in use on 10-foot pavement subgrade. Right—C. N. Wilczek, designer, operating Volumeter.

Such an apparatus, termed a "Volumeter," has recently been designed, built, and used, by C. N. Wilczek, engineering assistant on Contract 87VC17-67VC32, road VII-L.A-9-LA, working under the supervision of W. J. Calvin, resident engineer.

HOW DEVICE IS MADE

The device consists essentially of a light wooden or metal beam, spanning the subgrade from side form to side form, on which is mounted a system of compound levers, actuated by "feet" which rest on the subgrade. The levers in turn actuate an indicator on a dial quite similar to that used on a milk scale. The dial is graduated to read directly the volume of concrete per 25-foot length of pavement, corresponding to the depths at the point of measurement.

In order to construct this device, it was necessary to select a straight-grained piece of timber, 2 by 3 inches and 11 feet long. Holes were bored in it edgewise, one near each end and four spaced about 2 feet apart in between. Through these holes, automobile valve stems were inserted to act as feet to rest on the subgrade. To the upper ends of the valve stems were fastened the ends of levers in a compound lever system designed to automatically add or subtract the reading above or below theoretical subgrade, as determined by the relative positions of the six valve "feet."

The resulting component of the lever action is carried through the entire system and summed algebraically in one lever arm in the center. A wing-nut adjustment is built into each half of the lever system by means of which the dial can be set to read normal for any desired section, after the feet have been set in correct relative position.

HOW IT WORKS

A 7-inch dial is used as a registering device, with a revolving hand fastened to a pinion which is in turn actuated by a rack fastened to the central lever arm. The ratio of the pinion is such that the hand makes three complete revolutions within the limits of the rack, which made it difficult to count the revolutions as they occurred. This was overcome by placing a vertical slit in the face of the dial and a small hand on the end of a bolt through the rack. The small hand assumes a definite position up or down the vertical slit for each position of the central lever arm, thus making it possible to tell at a glance the number of revolutions made by the revolving hand.

The dial is calibrated so that one complete revolving represents an average subgrade difference of .02 foot, which is the allowable tolerance. There are three circles of numbers and three corresponding sections on the vertical slit. The inside circle is

red and represents from normal to .02 foot high. The corresponding section on the slit is also red and is calibrated in half-hundredths, as is the middle white section which is correlated with the outside white circle. The blue circle and section indicate between .02 foot and .04 foot low.

VOLUMETER IS ACCURATE

Thus by noting the position of the small sliding hand the operator knows which of the three circles to read. They are calibrated in hundredths of a cubic yard per 25 feet of pavement and it requires 20 degrees of arc to change the reading .01 cubic yard, which difference represents about .001-foot average variation of subgrade.

Numerous tests were made against a string, and in every instance where the measurements were made to the nearest quarter of a hundredth, the "Volumeter" checked precisely. Although it was checked before and after each time used, it was never found to be out of adjustment after having been once set.

SLIGHT VARIATIONS

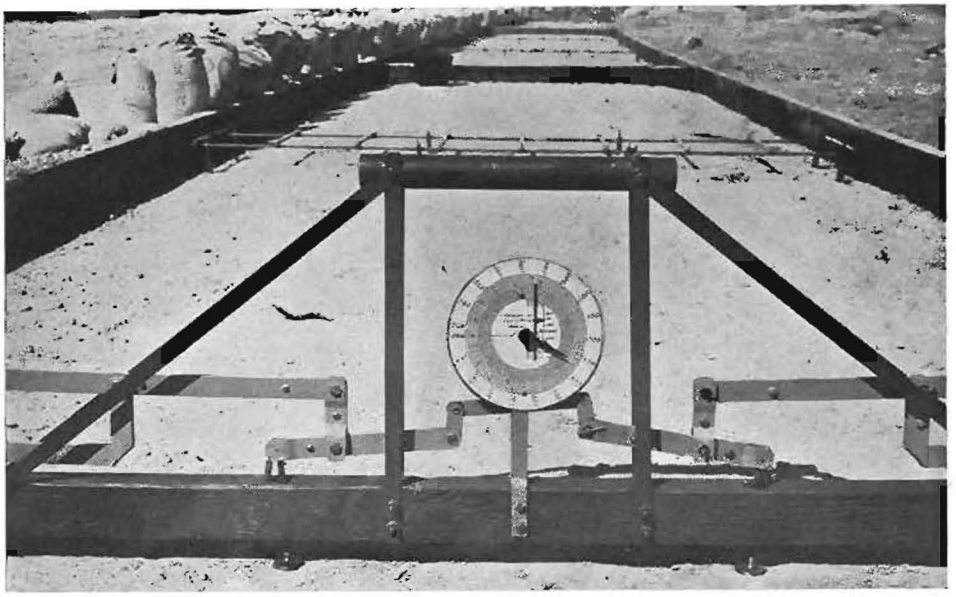
In four check tests for accuracy, in which various individuals operated the machine, the results were as follows:

In the first test, 700 feet, there was .33 cubic yard difference in the two totals of about 155½ cubic yards, or 0.21 per cent variation. The second test, 1250 feet long, showed .18 cubic yard difference in the two totals of about 285½ cubic yards, or about 0.06 per cent variation. The third test, 600 feet long, registered .25 cubic yard difference in two totals of about 140½ cubic yards, or 0.18 per cent variation. The fourth test showed a difference of .25 cubic yard in two totals of about 395 cubic yards in a distance of 1800 feet which gave 0.06 per cent variation.

In only one instance was the check test made by the same individual who ran the original test and in this case the results were the poorest. It is obvious that the human factor has no effect on the readings.

The subgrade conditions in the second test were much better than in the other three. Also the fact that the error is not cumulative makes the shorter tests more severe.

In point of time, one man can easily and accurately determine the volume contained in a half mile of subgrade in one hour and actually measure it every 25 feet.



Closeup view of Volumeter showing the design of its construction.

EXCEPTIONS

The point has been raised that were the grade to be .02 foot high on one foot and .02 low on another, the "Volumeter" would register normal and thus fail to locate high grade, which is quite true. There are two reasons why no provision was made for the apparatus to register such conditions. In the first place the specifications require the use of the scratch templet. Secondly, the present-day methods of cutting subgrade with a machine preclude the probability of any great extent of subgrade being cut to such extremes. Therefore, the slight advantage to be gained did not warrant the additional complication in design.

On the contract where the "Volumeter" was first tried out, Mr. Wilczek was assigned as plant assistant. Using the absolute volume method of determining the theoretical batch weight, he has found that indications thus far make it appear necesasry to add approximately 0.5 per cent to the "Volumeter" quantities to obtain proper yield; presumably to allow for any additional amount required because of slight waste or variation on the finish.

ADVANTAGES OF DEVICE

The apparent advantages in the use of this device are as follows:

Variations because of personal differences are eliminated, and the calculations of one person can readily be checked by another.

The device is exceedingly accurate and fast.

It requires less book recording and checking.

It is quite simple to operate and relatively foolproof.

Its action is positive. If the operator has checked the adjustments, and is willing to glance at the feet and two suspension arms, to eliminate any chance of poor contact with the subgrade or side forms, he knows the reading must be correct.

Another important advantage is that by using the "Volumeter" and having accurate batch weights, the size of the batch need not be changed after having once been carefully determined. And finally, the results are unquestionably more satisfactory to both the contractor and the engineer for the reason that any disagreement as to quantities is practically eliminated. It is a well-established fact that no two men "stab" alike when ordinary methods are used.

Inasmuch as this first machine was designed for 10-foot pavement, the problem now is to make one that will stretch from eleven to twelve feet, and back again at will, for use on the proposed new lane widths. This should be merely a problem of further study in design, and it is believed that the use of the "Volumeter" is another step forward in pavement construction methods.

New Wilson Way Underpass in Stockton Is Open to Traffic

WITH impressive dedicatory ceremonies conducted by the Native Sons of the Golden West order, with Eldred L. Meyer of Santa Monica, Grand President, presiding, followed by talks by Governor Frank F. Merriam and Director of Public Works Earl Lee Kelly, the recently completed Wilson Way Underpass in Stockton was thrown open to the public on Saturday morning, February 19, 1938.

San Joaquin County and city officials joined with representatives of the State administration and the Division of Highways in commemorating the occasion.

The Governor in his talk stressed the need of safety in the building of roads. He said while many highways are constructed at tremendous expense, they soon pay for themselves through reduced mileage and lessened operating expense to users. He added that such highways could not be built in the future unless gasoline tax funds are zealously guarded and diversion of them to purposes other than highway construction and maintenance is prevented.

Following the dedication the guests were entertained at a luncheon in the Hotel Wolf. Mayor Ralph W. Fay presided and talks were given by Mr. Kelly and Governor Merriam.

The underpass carries State traffic on U. S. 99 and U. S. 50 under the tracks of The Atchison, Topeka and Santa Fe Railroad.

Wilson Way serves to by-pass the business district and carries traffic on both U. S. 99, which is the principal north and south artery in the interior valley of California, and on U. S. 50, which coincides with U. S. 99 from Sacramento to Stockton and through this new underpass and then turns west on Charter Way and through the underpass completed last year under the Southern Pacific and Western Pacific railroads.

The signing by President Roosevelt of the Emergency Relief Appropriation Act of 1935, made available funds for expenditure of Works Progress grade separations. Wilson Way Underpass is one of the structures now completed by the State under this act.

TWO 24-FOOT ROADWAYS

The crossing consists of a depressed portion 906 feet in length, providing two 24-foot roadways separated by a five-foot safety curb and two 4-foot 6-inch pedestrian sidewalks, all flanked by retaining walls the full length of the depressed portion.

Reinforced concrete construction was used throughout with the exception of the spans carrying the railroad tracks which are made of steel.

Division of the roadway area into two two-lane roadways by means of the safety curb, is in accordance with modern safety practice, providing as it does two traffic lanes for vehicles traveling in the same direction.

The safety curb also becomes of economic value, for it permitted the use of intermediate piers to support the vehicular bridge and track span superstructure. Had it been necessary to span the entire roadway from retaining wall to retaining wall much heavier bridge superstructure would have been required with consequent increased cost.

SAFETY PRECAUTIONS

Another feature of this structure which increased the safety to through traffic was the extension of the safety curb for a distance of between 250 and 300 feet each way from the depressed portion; this making it impossible for traffic to cross directly in front of the depressed portion or turn into the underpass until through

Wilson Way Underpass in Stockton which was dedicated by Governor Frank F. Merriam on February 19, 1938.

Governor Merriam cuts ribbon at Wilson Way dedication. Left to right: Edward J. Neron, Deputy Director of Public Works; District Highway Engineer R. E. Pierce, Brigadier General H. H. Morehead, Harry A. Hopkins, Chairman California Highway Commission; George T. McCoy, Assistant State Highway Engineer; Senator Bradford S. Crittenden, Director of Public Works Earl Lee Kelly, Governor Frank F. Merriam, Mayor Ralph W. Fay, Jr., of Stockton, George H. Moore, State Printer; Assemblyman Chas. M. Weber, Eldred L. Meyer, Grand President, Native Sons.

traffic is clear of the blind part of the structure.

As is usual in the case of undergrade crossing structures, with depressed portions below natural ground line, drainage of water entering the roadway had to be provided for. To this end two electrically operated pumping units, to operate alternately, were provided to pump from a sump located below the point of lowest grade line.

To provide additional safety for night traffic adequate lighting equipment to illuminate the roadway for the entire length of the depressed portion has been provided. For illuminating the roadway areas outside the limits of the vehicular bridge and track spans, electroliers supported on the retaining walls flanking the roadway are provided, and for the areas beneath the vehicular bridge and track spans superstructure, lighting units mounted in recesses cast in abutments and piers have been pro ided.

The total construction cost for the underpass is approximately $250,000, including the cost of engineering.

All necessary rights of way for the project were furnished by the city of Stockton and San Joaquin County, the latter providing $25,000 of the total required sum of $100,000.

The highway was constructed by the State Division of Highways under contract with Earl W. Heple, of San Jose.

C. L. Sweet was resident engineer, representing the Bridge Department of the Division of Highways.

J. W. Vickrey to Head New Department

(Continued from page 1)

might lead to a reduction of this appalling death rate. There can be no question but what the problem of highway safety in all its possible aspects, including the driver's part, is vitally linked with a highway department."

Proffering their cooperation, Mr. Fred D. Parr of San Francisco, president of the California Safety Council; Mr. Franklin Lowney of Los Angeles, executive vice president; and Mr. Paul H. Buchholz of San Francisco came to Sacramento to participate in the official launching of the new safety engineering department of the Division of Highways.

Bay Bridge Traffic Decreases

A DROP in February traffic of approximately 78,000 vehicles crossing the San Francisco-Oakland Bay Bridge from the previous month's total was revealed in a report filed by State Highway Engineer C. H. Purcell with State Director of Public Works Earl Lee Kelly. February's total was 594,378 as compared to 672,433 for January.

Total for February a year ago was 667,563 vehicles, showing a decrease of approximately 73,000 vehicles during last month from the corresponding period in 1937.

Sixteen days of bad weather in a 28-day month were factors in February's reduced traffic. Low point occurred on February 13, a Sunday, when 17,617 vehicles crossed the span. High point was on Sunday, February 27, with 25,742 vehicles. February 9, the day of the heavy wind, 19,116 vehicles used the bridge. The daily average was 21,228 vehicles.

The only classification of vehicles to show an increase last month over January was tricars, when a total number of 845 used the span, compared to 798 in the preceding month.

Comparative figures follow:

	Total Jan.	Total Feb.	Total Since Opening
Passenger Autos	633,115	558,239	11,120,381
Auto Trailers	649	513	18,578
Motorcycles	2,117	1,497	39,931
Tricars	798	845	10,745
Trucks	24,239	22,983	374,327
Truck Trailers	883	878	24,218
Buses	10,632	9,423	123,140
Total Vehicles	672,433	594,378	11,711,420
Extra Passengers	170,440	146,941	2,543,459
Freight Lbs.	55,840,498	54,078,501	858,115,019

Problem of Slipouts Studied By State Highway Engineers

By A. W. ROOT, District Materials Engineer

THE large maintenance expenditure involved in the repair and correction of embankment failures, commonly referred to as "slipouts," along the Redwood Highway and other routes in District I, has led to a careful study and analysis of this particularly aggravating and perplexing problem.

Special attention is now being given to the prevention of these slipouts during the design of all grading projects and it is the practice to make foundation investigations wherever a heavy fill is proposed, and particularly where a slide area is traversed. This investigation is conducted by the District Materials Engineer, and consists of a study of drainage and soil formation, together with subsurface conditions obtained by soil tube borings. The necessary treatment is then designed for each individual case and included in the construction plans.

CAUSES OF SLIPOUTS

There are several distinct causes of slipouts, probably the most common being that the shearing strength of the foundation soil is so low that the weight of the fill causes lateral movement. As the low shearing strength of the soil is usually the result of excess water, the fill foundation may often be stabilized by the installation of proper drainage structures. The project discussed below is an example of such a case.

In 1934 a survey was made for relocation of a portion of the Redwood Highway from Trinidad to McNeill's Ranch, Road I-Hum-1-J. At that time the existing highway crossed Mill Creek just north of Trinidad, on a circuitous route with a series of very sharp curves. It was proposed to eliminate these hazardous curves by crossing the creek on a direct route on a line with a long tangent at the northerly side of the creek. This line, however, crossed a large active slipout on the south slope of Mill Creek which included part of the existing traveled way and extended down the slope almost to the creek. As the slipout in the existing road was active it was apparent that the foundation would not support the proposed heavy fill without special treatment.

View across Mill Creek, Humboldt County, showing course of new road alignment.

TRESTLE IDEA ABANDONED

Consideration was given to constructing a timber trestle across this unstable area but the estimated, approximate cost of $50,000 for such a structure was prohibitive as it was impossible to decrease the quantity of roadway excavation without greatly lowering the standards of alignment and grade. Design was therefore continued on the embankment type of construction across Mill Creek, with foundation stabilization for the high fill which would have a maximum height of 52 feet at centerline.

Borings were made during April, 1935, to determine soil conditions and locate subsurface water. The location of the borings is shown on the accompanying sketch, the profile showing the depth of those holes located along centerline.

The borings indicated that the slide was relatively shallow, consisting of a mass of saturated, plastic, stony, bluish-gray clay overlying a firm, soft, gray shale formation. Water appeared to be entering the clay stratum from the hillside to the right, making it soft and unstable and creating hydrodynamic pressure which aggravated the lateral movement.

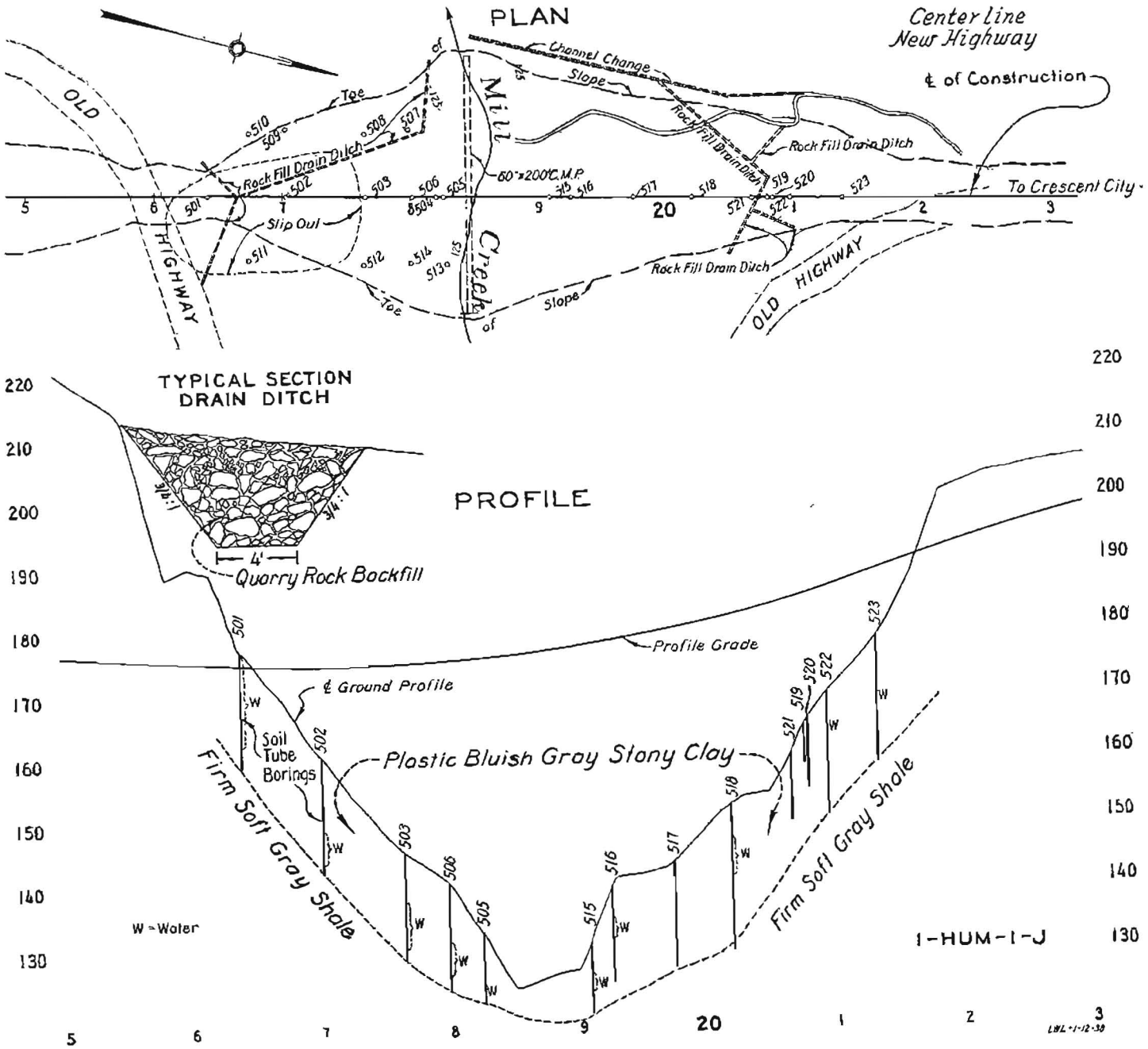
SYSTEM OF DRAINS

From the data thus obtained, a system of drains was designed to provide outlets for the water and to partially dehydrate the wet stratum of clay. This drainage was planned as part of the grading and surfacing contract on which bids were received January 13, 1937.

Work was started on the contract in January, 1937, and the drainage system at Mill Creek, constructed as shown on the sketch, was completed in May, 1937. The drainage treatment was completed substantially according to the preliminary plans and consisted of 305 lineal feet of rock-filled drainage ditch with an average depth of 16 feet on the south slope of the creek, and 226 lineal feet on the north slope, with average depth of six feet.

The trenches were excavated with dragline and backfilled with clean quarry rock from three to twenty-four inches in diameter. When the trenches were first opened up, a large amount of impounded water was

Rock Fill Drain Ditch Method of Preventing Slipouts



released but after standing a short time there was only a small flow of water in the ditches, making it possible to eliminate the perforated metal pipes usually placed in such drainage ditches.

FILL WITHSTANDS STORM

The total cost of the foundation stabilization under this fill (which contains 48,500 cubic yards) was $3,330, which was somewhat lower than the preliminary estimate, as firm material was encountered in a portion of the ditches at lesser depth than originally contemplated. The contract was completed in October, 1937, and after a winter of unusually heavy rainfall there has been no movement of this fill.

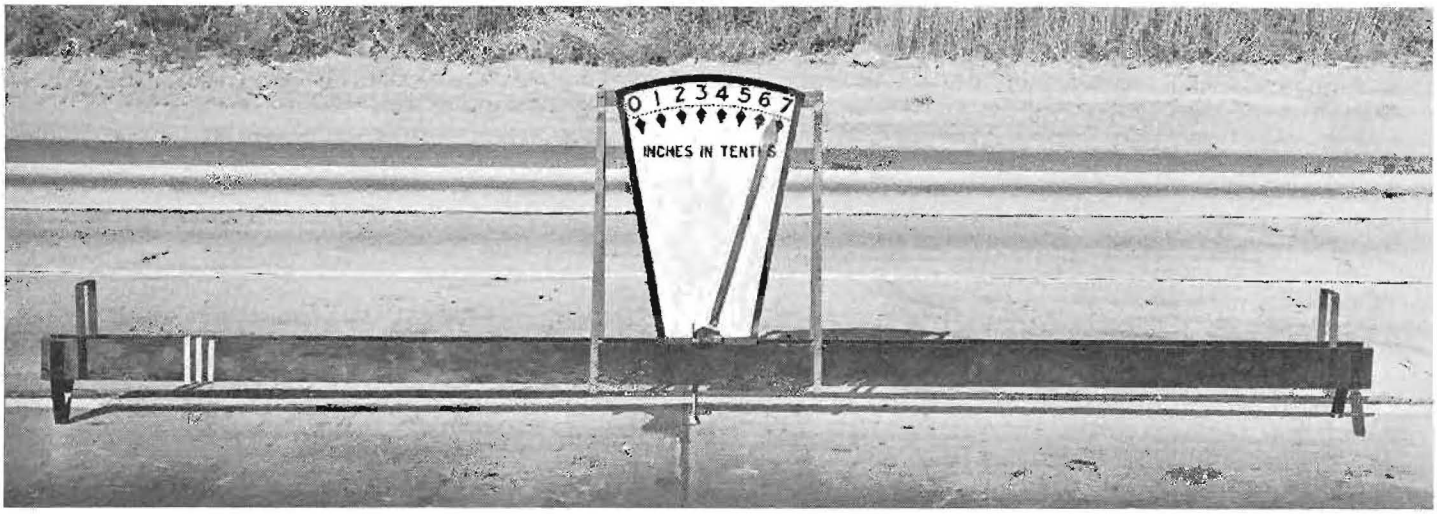
Similar corrective treatment is being applied to other unstable areas in the district, on which fills are to be constructed, the method of attack being based on a detailed study of each location.

It is believed that by thorough preliminary investigation, especially by means of borings, and a carefully planned drainage treatment most of the costly slipouts so costly to the Division of Highways can be prevented in the future.

CONCRETE PAVEMENT SLAB WARP AND ITS PREVENTION

By C. S. POPE, Construction Engineer

This is the second of two articles dealing with highway concrete pavement distortion and measures for its prevention and relief. Accompanying this article is a table showing projects on which warp was prevented by the use of subgrade treatment and membrane seal.



Device developed by Division of Highways for measuring amount of pavement warp at expansion joints. This pavement in Orange County has a 4-inch select material base, but no membrane. The joints are much improved since 1934.

THE value of the membrane seal type of highway construction under which, because of the expansive nature of the soil, a membrane seal of heavy asphaltic oil is placed under a layer of imported borrow on which the Portland cement concrete pavement is constructed is shown in the tabulation of projects so constructed in various districts, entitled "Projects on Which Warp was Prevented by Use of Subgrade Treatment and Membrane Seal."

The significance of roughness records shown on the accompanying tabulation as taken by roughometers used by the California Division of Highways is approximately as follows:

Index of 10 or under is a very smooth pavement producing little or no vibration in a car at any speed—riding comfort, 90-100.

Index of 15 is such a surface as is obtained on a well finished asphalt concrete—roughness perceptible—riding comfort, 75-90.

Index of 25 indicates a poorly finished surface—quite rough for concrete, and roughness quite marked—riding comfort, 60-75.

Index of 35—many city streets show this degree of roughness—side sway often quite marked—riding comfort, 50-75.

Index of 50—very poor surface, high joints, or other defects, riding comfort less than 50 in a scale of 100.

SELECTED EXAMPLES

Selected examples of the effect of the membrane in controlling moisture content are shown by the following:

L.A-60-Tor & D is reported as having an average distortion of one-tenth inch at joints which is practically negligible. The selected material placed over the membrane showed a moisture content of about 11 per cent and the subsoil under the membrane a moisture content of about 22 per cent. The presence of the membrane and the imported borrow undoubtedly protected the subgrade from any local increase in moisture due to leaky joints and made unnecessary any extra care in pouring the expansion joints to keep them well sealed.

On project, L.A-168-B & C, a section on rather sandy soil was laid without seal but with a layer of imported borrow to increase the bearing power of the material under the pavement slab. The movement of the slab ranged from .02 inch to .17 inch, and the moisture content in the selected material being about 10 per cent and in the subsoil about 20 per cent. On another section of the same project where expansive soil was present, a bituminous seal ¼ inch in thickness was placed under the imported borrow and the movement was reported as ranging from between .02 inch to .09 inch, with a moisture content in the selected material as high as 12 per cent and in the subsoil about 27 per cent.

The device developed in District VII by J. M. Lackey, Assistant Construction Engineer, for measuring the

amount of warp at expansion joints is also shown.

EXPANSION JOINTS

Minnesota reports that seepage drains constructed under expansion joints proved unsuccesful in preventing the movement of joints and this concurs with the California experience on similar construction.

Experience also confirms the value of equalizing the moisture under the entire length of the slab. The determinations of density of subgrade soil and its relation to moisture content as undertaken in Minnesota points the way to a very interesting phase of this work.

The practice in California is to obtain the relative density of the soil of the subgrades as constructed, which means that the weight of the soil in the subgrade is compared with the maximum weight which can be obtained for a sample compacted to a standard density.

It is quite likely that investigation along the lines of obtaining relative densities of soils of varying moisture content will shed considerable light on the proper density to which soils should be compacted in using the proper moisture content, since the moisture content, as we know, affects not only the bearing power of the soil but also its swell and a rational balance between the importance of these two factors would, no doubt, lead to better design.

It is to be pointed out in the California construction that the swell or shrinkage of subgrade under the impervious membrane, except as it affects bearing power, is more or less

(Continued on page 28)

PROJECTS ON WHICH WARP WAS RELIEVED OR PREVENTED BY USE OF SUBGRADE TREATMENT AND MEMBRANE SEAL

Date	County-Route-Section	Soil designation and characteristics					Thickness Imp. borrow	Bituminous membrane		Roughness Index		Warp Oct., 1937
		Kind	Shrink	Swell	Bearing power			Grade	Amount	On Compl.	Oct., 1937	
					Wet	Dry						
.....	None.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1931	Col-7-B, C*	Clay	5 to 7%	.....	Not recorded		12"	None	None	13.7 to 35±	.....	Slight
1933	Ala-5-B.....	Adobe, clay, etc.	4.5	.....	.....	.....	4" cr. run	94+	.....	17.5	.....	None
1933	SCl-68-A, B.....	Adobe, clay, silt	6.4	.....	.....	.....	4" cr. run	90-95	0.5 gal.	12.2	.....	Slight
1933	SCl-68-B.....	Adobe	10±	.....	.....	.....	12"	90-95	0.5 gal.	11.9	.....	None
1934	SCl-2-P.A.....	Adobe, clay	3.4	.....	.....	.....	12"	90-95	0.5 gal.	7.2	.....	Slight
1934	S.B.-2-J.....	Adobe	5.0	7.0%	.....	.....	9"	E	0.6 gal.	4.7	.....	0.12" max.
1935	S.B.-2-D, E.....	Shale, clay	8.0	.....	.....	.....	9"	E	0.7 gal.	9.0	.....	0.12" max.
1936	S.B.-2-F.....	Adobe, clay, shale	8.8	5.5	25#	85#	9"	E	0.7 gal.	5.2	.....	0.12" max.
1937	Mon-2-H, I.....	Adobe	2.9	4.7	17	88	9"	E	0.7 gal.	.....	.....	0.12" max.
1933	Ker-4-A.....	Adobe	5.0	.....	.....	.....	9"	90-95	0.6 gal.	7.1	.....	None
1935	Ker-4-F.....	Clay	2.1	4.3	.....	.....	12"	E	0.6 gal.	.....	.....	None
1933	L.A.-19-B.....	Adobe, clay	5.0	.....	.....	.....	10"	E	0.75 gal.	11.1	8-10	0.03-0.04"
1035	Ora-43-B.....	Clay	.....	4.8	9	121	12"	E	0.7 gal.	5.6	7.4	.....
1935	L.A.-60-D.....	Clay	.....	4.5	6	70	12"	E	0.5 gal.	9.8	18.6	0.07-0.12"
1936	Ora-43-B.....	Adobe	3.5	8.1	4	256	12"	E	0.7 gal.	7.1	13.0	None
1936	L.A.-172-C.....	Adobe	3.0	7.0	5.2	154	18"	E	0.65 gal.	12.0	16.1	None
1936	L.A-168-LA, B.....	Adobe	.....	1.4	10.5	145	12"	E	0.7 gal.	5.5	16.1	Slight
1936	Ven-60-A.....	Adobe	.....	3.7	12.0	154	12"	E	0.7 gal.	7.8	5.8 to 8.5	None
1936	L.A-Ora-171.....	Adobe	4.2	6.3	3.0	168	12"	90-95	.....	.....	.....	Slight
1937	L.A-188-A.....	Adobe	.....	5.5	6.0	140	12"	E	0.7 gal.	.....	.....	None
1937	Ven-2-B (a).....	Adobe	7.5	6-20	4.5	380	24" adobe	3" plant-mix envelope	.....	.....	.....	None
	Ven-2-B (b).....	Adobe	7.5	6-20	4.5	380	24" adobe	90-95 membrane envelope	.....	.....	.....	None
1937	L.A-9-A.....	Adobe	.....	6-7.3	7.5	150	8"	E	0.7 gal.	.....	.....	None
1937	L.A-179-A.....	Adobe	1.4	5.4	6.0	186	8"	E	0.7 gal.	.....	.....	None
.....	None.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	None.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1936	Sol, Nap-7-8-F, G, H, A.....	Adobe, clay, shale	6.2	12.0	Not recorded		18"	E	0.4 gal.	25.9	.....	None reported
1937	Sol-7-C, Vac,D.....	Adverse	5.4	12.5	3	84	18"	E	0.4 gal.	.....	.....	None reported
1937	S.D-12-S.D.....	Clay	3.6	7.0	3	54	9"	E	0.5 gal.	.....	.....	None reported

* This project is the Williams project described in text. Roughness varied as shown in first year. Warp previous to treatment varied from 0.5 inch to 1.0 inch.

New Construction on Coast Highway

(Continued from page 6)

two bridge reconstruction and widening projects. John Strona of Pomona is the contractor for the reconstruction of the Zuma Creek Bridge and the Trancas Creek Bridge. H. R. Lindicke is the State's Resident Engineer on this bridge project, for which the construction allotment is $35,000 and the date of completion March 30, 1938.

J. S. Metzger and Son of Los Angeles is the contractor for the widening of the Corral Creek Bridge, the Solstice Creek Bridge and the Escondido Creek Bridge, which work is under the supervision of Resident Engineer G. H. Miller. The construction allotment for this bridge project is $47,000, and date of completion is August 1, 1938.

NARROW BRIDGES WIDENED

All five existing narrow bridges are to be widened to a uniform width of 76 feet between curbs, and two three-foot wide sidewalks are provided on both sides of the roadway for the use of pedestrians. A central dividing strip four feet wide on the bridge roadway is a part of the bridge reconstruction to fit in with the divided roadway design for the adjacent highway improvement.

The central dividing island will consist of two Portland cement concrete curbs spaced four feet apart with a one-inch plant-mixed surfacing between them. The purpose of the plant-mixed surfacing is to prevent weeds from growing in this area and also to shut off surface water which might otherwise soak into the subgrade below to the detriment of the adjoining surfacing and pavement.

DOUBLE TRAFFIC STRIPES

In some locations where business and residential developments have already started on abutting property and where further private improvements are anticipated in the near future, the separating strip with the raised curbs will be omitted. In its place two double traffic stripes, four feet apart, will be painted, and raised white arrows, over which traffic can easily cross, will be constructed between the traffic stripes. This is the type of construction which we have used with considerable success on other projects in Los Angeles County under similar conditions where construction of a curbed central dividing strip would be inappropriate.

Twelve-foot widths of plant-mixed surfacing are being provided adjacent to the central dividing strip, and adjoining this plant-mixed surfacing eleven-foot strips of Portland cement concrete pavement of standard 0.75-foot-0.55-foot-0.75-foot cross-section are planned.

Wherever it is possible so to do, old existing twenty-foot wide Portland cement concrete pavement is preserved and utilized by second-storying and widening operations so that it will fit in with the planned fifty-foot total width of pavement and surfacing. Throughout the project earth shoulders and roadway gutters will be oil treated and tops of cut slopes will be rounded.

RIBBON OF WHITE

Mabel Miller Freeman

At break of day we motored away
With a jest and a lilt of song.
No thought gave we to that ribbon of white
Dividing the traffic from left to right,
As we merrily motored along.

Through a bank of fog at eventide
Our steps we retraced that night.
With landmarks gone, and we alone,
How thankful then for that ribbon of white,
A light to guide us home.

At life's glad morn, so careless and free,
No thoughts for landmarks, we;
But when shadows fall, at death's drear night,
Faith in our God is the ribbon of white
That leads to Eternity.

(Gratefully dedicated to the person who originated the idea of the painted white line on the boulevards.)

SCENIC VIEW PROVIDED

There is one feature in connection with the new location between Encinal Canyon and Trancas Creek which should be particularly commented upon. In this two-mile section we had the choice of carrying out new construction following approximately along the existing highway, which for a considerable distance is on low-lying beach land, or to adopt a new alignment somewhat landward and at a considerably higher elevation.

It was decided to carry out construction on the "High Line," because this would make possible the creation of a perpetual view out over the ocean for travelers on the highway. Had the construction been carried out revamping the existing highway along the beach, it would have been only a few years before the erection of beach residences, garages and other private improvements on the ocean side of the highway would have completely shut off most of the view of the ocean.

Before final decision was made to adopt the "High Line," the matter was taken up with Mr. T. R. Cadwalader, trustee in federal bankruptcy proceedings for the Marblehead Land Company, the owners of the Malibu Ranch. After careful studies of the situation on the ground, Mr. Cadwalader and his associates arranged for the restriction of all future building operations on the area between the new "High Line" location and the existing highway, so that view southerly from the highway to the shore line of the Pacific Ocean would never be obscured.

OCEAN PANORAMA

This portion of the work over the "High Line" route between Encinal Canyon and Trancas Canyon, with the "daylighting" of all cut banks between the highway and the ocean, has now been completed. As one rides over the newly graded roadway, one is impressed by the scenic beauty of the ocean panorama and the justification for the "High Line" con-

(Continued on page 28)

New Geyser Is Attraction on Inyo Highway

STATE Highway District IX has a geyser of its own. On December 17, 1937, there was a rumbling in the vicinity of Casa Diablo, which lies approximately 45 miles north of Bishop, and a full fledged geyser broke forth approximately 350 feet from the center line of Route 23, which is the Los Angeles to Reno highway.

Since that date it has continued unabated, throwing its plumy spray to a height of 80 feet. During the cold weather the spray froze as it hit the ground and formed the beautiful figures which can be seen in the picture. Luckily the prevailing winds have only in a few instances veered to such an extent as to cause this spray to descend upon the highway and freeze. Maintenance men of the Division of Highways keep a close watch at this point so that in the event the spray does freeze on the highway, suitable protective measures can be taken.

The area adjacent to this geyser contains many hot springs and small vents which discharge steam and peculiar odors into the atmosphere. At the base of this geyser there existed an old Indian hot spring that for many years has been used as a steam bath.

IMPROVEMENTS ON PACIFIC HIGHWAY COMPLETED

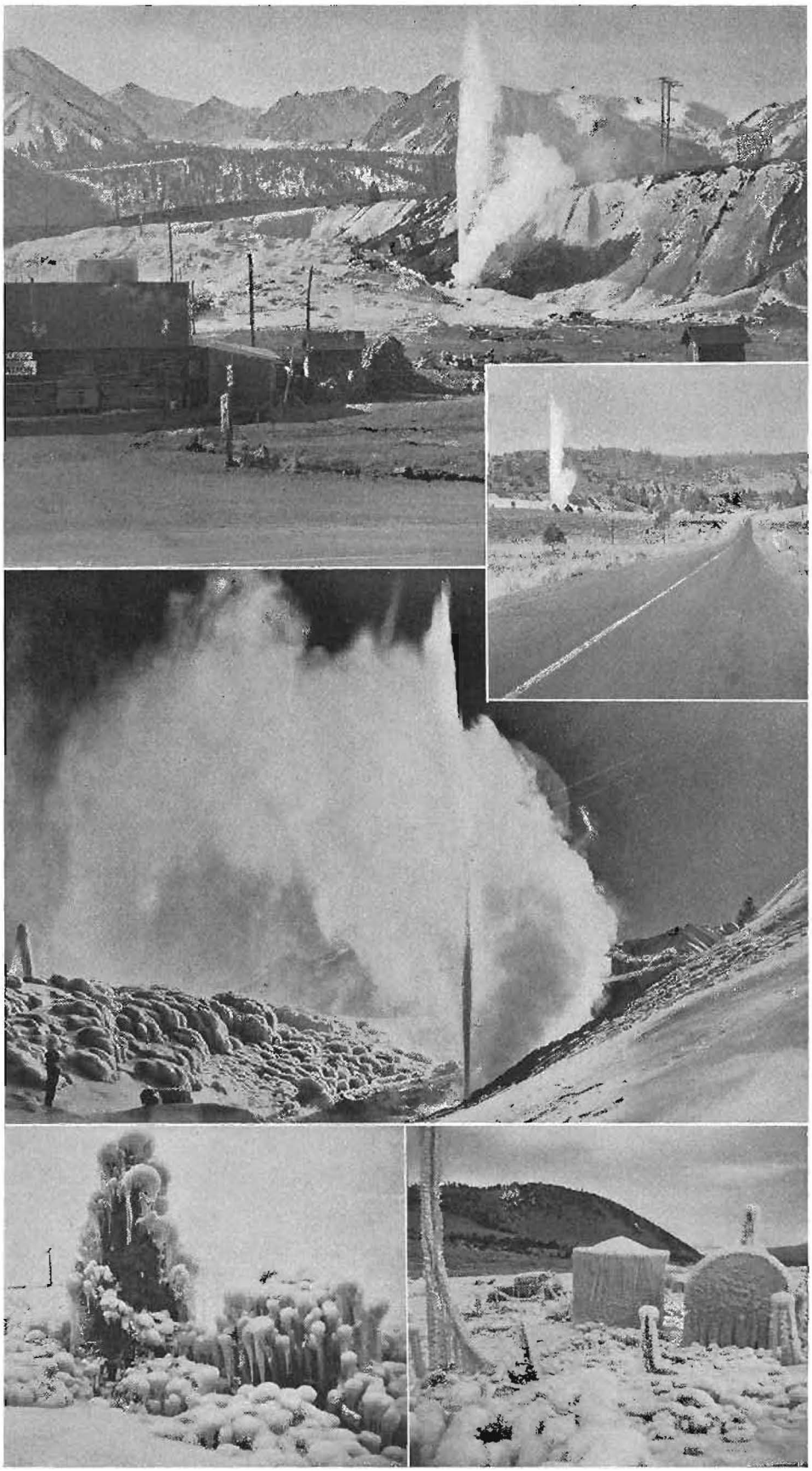
(Continued from page 18)

and beauty for residents and tourists alike.

A comparison of pertinent features of this series of projects follows:

	Cost	Length	Decr. Length	Curvature Old No.
Bridge Project	$163,392	---	---	---
1st Grading Project	96,686	1.05	1.10	4
2d Grading Project	105,705	1.77	0.27	15
Beautification	10,011			
	$375,794	2.82	1.37	

	Curvature Old Deg.	Curvature New No.	Curvature New Deg.	Min. Radii Old	Min. Radii New
Bridge Project	---	---	---	---	---
1st Grading Project	320°	1	56°	50'	500'
2d Grading Project	760°	2	57°	130'	2500'
Beautification	---	---	---	---	---



Views of geyser in action on State Highway Route 23. Note ice creations formed by freezing spray and proximity of geyser to highway.

Truck Checking Station Opened on Ridge Route

BUILT primarily to insure safety for traffic over the new Ridge Route between Los Angeles and the San Joaquin Valley, a complete weighing and truck checking station has been established by the Division of Highways, to be operated by the State Highway Patrol.

Located at the head of the Grapevine grade into the San Joaquin Valley, this station will not only guard against overweight loads, but will also enable the traffic officers to insure that trucks using this mountain route are in good order, and that all their braking equipment is working properly.

HUGE WEIGHING SCALES

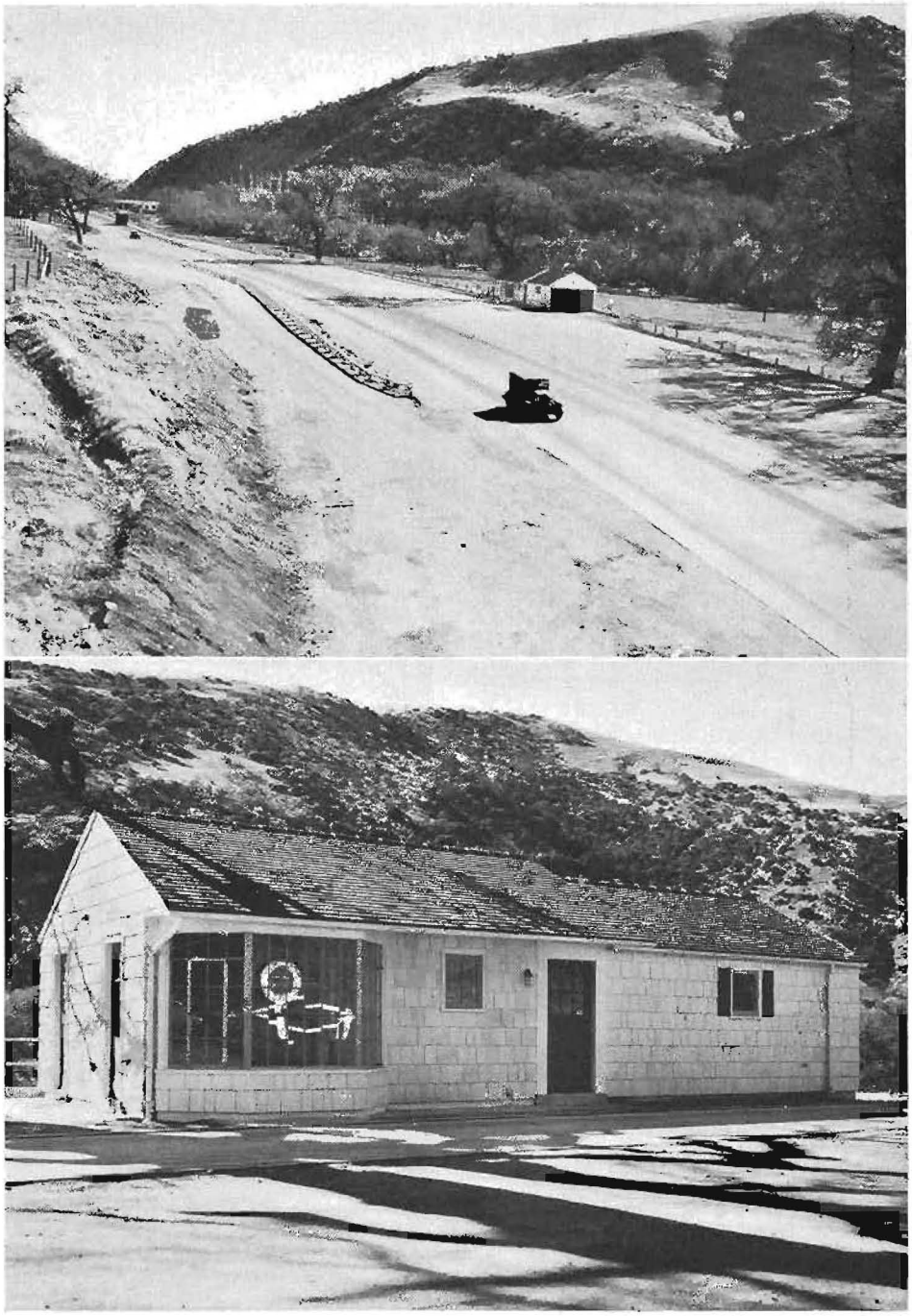
Since the location is somewhat remote from any town and a 24-hour use is planned, the weigh house, designed by the Division of Architecture, provides not only an office for the scale dials, but a 12 by 14 foot room, which may be used as quarters for the patrolmen, and a 16 by 20 foot garage for their machines. The house is heated by gas, taken from the neighboring pipe lines, and water is supplied from a well, with a continuous pressure system.

The scales have a large recording dial, visible through the window of the house and will stamp the registered weight on a record card. The dial records to 80,000 pounds, and in addition to this, the scales can weigh up to 130,000 pounds, which amply covers the maximum load of 68,000 pounds for any combination of vehicles and loads specified by the State law. The scales have a truck platform 60 feet long.

PARKING FACILITIES

Since the California law requires that brake tests be made on a grade of less than 1 per cent, a level Portland cement concrete lane 10 feet wide and 250 feet long was constructed on a road at the side of the main highway. In addition to the main traveled way at this point, which has a Portland cement pavement an area of approximately three acres was paved with a light layer of bituminous treated rock to provide ample parking facilities and permit the scale house to be set well back from the highway traffic.

The original plans for this station were made at the time that the highway was graded past this point, and completion of the scales now makes this complete facility available for the patrolmen. Plans are now being made for flood-lighting of the entire area, which will include mercury vapor mazda lights over the scale house, and sodium vapor lights to illuminate the parking grounds and brake testing runway.



General view of weighing and brake testing station near Fort Tejon in Kern County. Roadway on left protected by guard rail is provided for brake testing runway. Lower—Closeup view of scale house, showing dial clearly visible from outside the house.

Nearly twice as many automobiles and trucks are in use in the United States as there are telephones. Latest 1937 estimates place the automobile registration close to 30,000,000 while telephones number 15,200,000.

Highway Bids and Awards for February, 1938

CALAVERAS, STANISLAUS, TUOLUMNE and AMADOR COUNTIES—Diesel Oil to be applied to Roadside vegetation, a length of 175.5 roadside miles. District X, Routes 5, 13, 34, 54, 65, various sections. J. P. Breen, Sacramento, $3,500; Lee J. Immel, Berkeley. $3,575; Oilfields Truck Co., Bakersfield, $4,725. Contract awarded to Sheldon Oil Co., Suisun, $3,112.50.

HUMBOLDT COUNTY—Six miles south of Scotia, a reinforced concrete slab bridge across Jordan Creek consisting of 6—22 ft. spans, 1—24 ft. span and 1—15 ft. span on concrete piers with steel pile foundations to be constructed, and approximately 0.19 mile to be graded and surfaced with Plant Mixed Surfacing. District I, Route I, Sections D, E. Earl W. Heple, San Jose, $38,403.75; Poulos & McEwen & M. A. Jenkins, Sacramento, $38,756,25; Mercer-Fraser Co., Eureka, $41,758.50; A. Soda & Son, Oakland, $41,794; John Burman & Sons, Eureka, $44,970; F. J. Maurer & Son, Inc., Eureka, $45,325.25. Contract awarded to E. E. Smith, Eureka, $36,917.

LASSEN COUNTY—Construct three timber bridges with concrete decks on concrete pile bents on Buntingville-Wendel Road. District II. Lassen Feeder Road, Section FAS No. 10. Franzini & Fredenburg, San Rafael, $13,575.50; J. P. Brennan, Redding, $14,011.50; A. Soda & Son, Oakland. $14.901; John Rocca, San Rafael. $15,131; W. K. Van Bokkelen Construction. Oakland, $16.499. Contract awarded to M. A. Jenkins, Sacramento, $12,539.50.

MADERA COUNTY—Four miles south of Madera, reinforced concrete bridge across Cottonwood Creek Overflow. District VI, Route 126, Section A. E. S. and N. S. Johnson, Pasadena, $9.416; Palo Alto Road Materials Co., Palo Alto, $8,850; A. Soda and Son, Oakland, $9,737; J. S. Metzger & Son. Los Angeles, $8,664; Valley Construction Co., San Jose, $9.436. Contract awarded to Franzini & Fredenburg, San Rafael, $7,998.50.

MARIN COUNTY—Between San Geronimo and one mile north of Fairfax, about 1.5 miles in length to be graded and surfaced with armor coat. District IV, Feeder Road. Poulos & McEwen, Sacramento. $68.-997; Macco Construction Co., Clearwater, $78,720; A. Teichert & Son Inc., Sacramento, $99,446; J. L. Conner and Sons, Monterey, $77.384; Johnston Rock Co., Stockton, $94.976; Chas. L. Harney, San Francisco, $83,688.40; Pimbo Bros. & Co., San Francisco, $66,999.90; Rock & Gravel Trucking Co., Oakland, $89,081.80; Eaton & Smith, San Francisco, $82,197.60; Young & Son Company, Ltd., Berkeley, $83,525.40; Fredericksen & Westbrook, Lower Lake, $67,831.50; N. M. Ball Sons, Berkeley, $77,-869.60; Guy F. Atkinson Company, San Francisco, $89,914. Contract awarded to Granfield, Farrar & Carlin, San Francisco, $63,943.

MERCED COUNTY—Between 1.7 miles east of Los Banos and easterly boundary about 8.9 miles in length, to be graded and untreated crushed gravel or stone borders to be constructed. District X, Route 32, Section C. J. A. Casson, Hayward, $147,590.20; Union Paving Co., San Francisco, $180,330.50; Granite Construction Company, Ltd., Watsonville, $159,-344.80; Claude C. Wood, Stockton, $166.-729.80; Warren Southwest, Inc., Los Angeles, $162,466.10; Piazza and Huntley, San Jose, $149,256.35. Contract awarded to Fredericksen & Westbrook, Lower Lake, $144,472.35.

NAPA COUNTY—Between Oakville and Calistoga, about 6.2 miles in length. to be graded and surfaced with crusher run base and Armor Coat. District IV, Silverado Trail. Granfield, Farrar & Carlin, San Francisco, $73,576; Harold Smith, St. Helena, $58,534; Claude C. Wood, Stockton, $63,366.80; J. R. Reeves, Sacramento, $66,-593.25; A. Teichert & Son, Inc., Sacramento, $69.837.80; E. A. Forde, San Anselmo, $64,009.60; Poulos & McEwen, Sacramento. $61,367; Piazza & Huntley, San Jose, $70,891.45. Contract awarded to Rock and Gravel Trucking Co., Oakland, $54,363.50.

ORANGE COUNTY—Between Orange and Olive, about 1.0 mile in length to be graded and paved with Portland Cement Concrete. District VII, Route 181, Section A. Claude Fisher Co., Ltd., Los Angeles, $44,250; Sully-Miller Contracting Co., Long Beach, $44.928.95; Los Angeles Paving Co., Los Angeles, $42,990.20; Dimmitt & Taylor. Los Angeles, $46,356.50; E. L. Yeager, Riverside, $51,902.50: United Concrete Pipe Corp., Los Angeles, $43.815; Warren Southwest, Inc., Los Angeles, $42.192.50; B. G Carroll, San Diego, $40,486.25; Griffith Co., Los Angeles. $41,923.60; Geo. R. Curtis Paving Co., Los Angeles. $41.187.50: Ansco Construction Co., Inc., Long Beach. $42.-198.20; J. E. Haddock, Ltd., Pasadena. $39.236.75. Contract awarded to Vido Kovacevich, South Gate. $38,929.

SAN BENITO COUNTY—Between Paicines and Tres Pinos, about 4.7 miles in length to be graded and Road Mix surface treatment and Class "B" seal coat applied. District V, Route 119, Sections D, E. Geo. K. Thompson & Co., Los Angeles. $90,-701.40; Union Paving Co., San Francisco, $84,745.50; Granfield, Farrar & Carlin, San Francisco, $80.701.30; Claude C. Wood, Stockton, $82,046.10; Pearson, Minnis & Moody, Los Angeles, $83,280.50; Poulos & McEwen, Sacramento, $84.079; Piazza & Huntley, San Jose, $87,262.70; L. C. Karstedt, Watsonville, $87,357.10; Mountain Const. Co., Sacramento. $89,911.45; Earl W. Heple, San Jose, $96,499.90; Harms, Bros., Litchfield, $93,359.90; C. F. Robbins, Los Angeles, $87,542.60; J. L. Conner and Sons, Monterey, $72,896.45 ; A. S. Vinnell Co., Alhambra, $107,100.85; Young & Son Company, Ltd., Berkeley, $72,860.50. Contract awarded to N. M. Ball Sons, Berkeley, $72,758.

SAN DIEGO COUNTY—On Douglas Street, in the city of San Diego, between Eagle Street and University Avenue, about 0.2 mile in length to be graded and surfaced with Plant-mixed surfacing. District XI, Route San Diego, Section City Street. Harry L. Foster, San Diego, $22,312.75; R. E. Hazard & Son, San Diego, $18,721.25; B. G. Carroll. San Diego, $18,979.50. Contract awarded to V. R. Dennis Const. Co., San Diego. $16,885.30.

SAN LUIS OBISPO COUNTY—A timber bridge across San Juan Creek about 38 miles east of Santa Margarita, consisting of 16—19' 0" spans on pile bents, and about 0.3 mile of roadway to be graded and road mix surface treatment applied. District V, Route 58, Section C. Earl W. Heple, San Jose, $25.616; Valley Construction Co., San Jose, $24,916; Edward Green, Los Angeles. $26,800; V. R. Dennis Construction Co., San Diego, $27,497.50; A. Soda & Son, Oakland, $28,626.50; Rexroth & Rexroth, Bakersfield, $28,684.50; R. R. Bishop, Long Beach, $33,-963.30; J. E. Burrell & Son, Long Beach, $35,078.07. Contract awarded to S. A. Cummings, San Diego, $23,898.

SANTA CLARA COUNTY—A reinforced concrete overhead structure over Madrone Drive, about 5 miles south of Los Gatos consisting of 1—43' 1" span, 1—50' 0" span and 1—41' 1" span on R. C. Bents and abutments. District IV, Route 5, Section C. Palo Alto Road Materials Co., Palo Alto, $36,280.30; Carl N. Swenson Co., San Jose, $38,787.70; W. K. Van Bakkelen Construction, Oakland, $38,841; Heafey-Moore Co., & Fredrickson & Watson Construction Co., Oakland, $39.468; A. Soda and Son, Oakland, $40,799; Earl W. Heple, San Jose, $40,506; F. Knus, Stockton. $41,191; B. A. Hawkins & Co., San Francisco, $41,197; E. T. Lesure, Oakland, $41,818; Guy F. Atkinson Company. San Francisco, $42,529; Peter J. McHugh. San Francisco, $43,-671.20: Albert H. Siemer & John Carcano. San Anselmo, $44,098; A. J. Raisch, San Jose, $44.540.50; John Rocca, San Rafael, $45.947; F. C. Amoroso & Sons, San Francisco. $49,902.52. Contract awarded to C. W. Caletti & Co., San Rafael, $36,031.

VENTURA COUNTY—At Big Sycamore Creek about 0.7 mile in length. to be graded and paved with Portland Cement Concrete. District VII, Route 60, Section A. Dimmitt & Taylor. Los Angeles, $97.510.50: Claude Fisher Co., Ltd., Los Angeles, $84,-496: Geo. J. Bock Co., Los Angeles, $75,-923.75; Geo. R. Curtis Paving Co., Los Angeles, $85,020.50; United Conc. Pipe Co., Los Angeles, $94,629.95; Los Angeles Paving Co., Los Angeles, $84.400; J. E. Haddock, Ltd., Pasadena, $80,724. Contract awarded to Macco Construction Co., Clearwater, $75,862.25.

VENTURA COUNTY—Between La Cross and Oakview, about 1.7 miles in length to be graded and paved with Portland Cement Concrete. District VII, Route 138, Section A. United Conc. Pipe Corp., Los Angeles, $119.602; Los Angeles Paving Co., Los Angeles. $132,273.80; C. R. Butterfield-Kennedy Co., San Pedro, $108.870; Geo. J. Bock Co., Los Angeles, $99.430.50; A. S. Vinnell Co., Alhambra, $119,100; Claude Fisher Co., Ltd., Los Angeles. $103,081.50; Basich Bros., Torrance, $99,744.50; Pearson-Minnis & Moddy, Los Angeles, $91,797; C. O. Sparks & Mundo Eng. Co., Los Angeles. $94.233; Macco Const. Co., Clearwater, $107,676.50; Griffith Co., Los Angeles, $110.417.50; Geo. K. Thompson Co., Los Angeles. $132,931; Geo. R. Curtis Pavg. Co., Los Angeles, $95.914.50; Oswald Bros., Los Angeles, $108,027. Contract awarded to J. E. Haddock Ltd., & Crow Bros., Const. Co., Pasadena, $89.-825.25.

A young boy, undergoing an examination for a position, came across the question, "What is the distance of the earth from the sun?" He wrote his answer as follows: "I am unable to state accurately, but I don't believe the sun is near enough to interfere with a proper performance of my duties if I get this clerkship."

He got it.

Customer—I like this dog but I think his legs are too short.

Storekeeper—Too short? Why they touch the ground, don't they?

CONSTRUCTION work by the Bureau of Reclamation on the Project was somewhat delayed by weather conditions. However, work was continued and considerable progress made on the construction of the Contra Costa Canal and the government camp for the Shasta dam. The opening of bids for a diversion tunnel and temporary relocation of the Southern Pacific Railroad at the Shasta dam site, which had been set for February 21st, was postponed to March 14, 1938, due to a delay in the determination of wage scales for the work. Bids were opened during the month for pumping equipment for Contra Costa Canal and for materials for the lining of the first section of this canal.

IRRIGATION DISTRICTS

Annual reports on the operation of irrigation districts for the past year are now being received which indicate generally improved conditions throughout the State. Despite the severe freezes of January, 1937, and continued cold spring weather, conditions during the remainder of the season were favorable for growing and harvesting of crops. Total precipitation for 1937 was 122% and total snowfall 152% of the 41 year average, thus affording ample water for irrigation.

WATER RIGHTS

Supervision of Appropriation of Water.

Eleven applications to appropriate were received during January, 22 were approved and 6 were denied. During the month 18 permits were revoked and the rights under 9 permits were confirmed by the issuance of license. Since October 1st, 1146 reports have been received from permittees and 477 reports have been received from licensees. These are in process of study with a view to determining the proper course of action.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

During the past month activities have been wholly in the office assembling the field data gathered during the summer months in order to compile a report showing the diversions, acreage irrigated, stream and return flows in the Sacramento and San Joaquin Valleys.

The sampling of water in the delta for salinity is being carried on at all regular stations to record the retreat of salinity.

CALIFORNIA COOPERATIVE SNOW SURVEYS

In the latter part of January and early February the first snow surveys of the season were made at key courses throughout the major drainage basins on the west side of the Sierra. Those snow surveys made on January 25, 26 and 27 showed that a definite shortage in the snow pack existed at that time, the water content at most of the snow courses surveyed being but one-half of the normal supply for that time of the year. On January 28th the first of a succession of storms arrived from the Gulf of Alaska, and for almost three weeks the snow pack in the Sierra was added to daily.

Measurements made on the 6th, 7th, and 8th of February showed that the snow pack in most of the watersheds was up to normal, and although no further surveys have been made since then, the fact that there was considerable snowfall after the last surveys were made, would indicate that healthy conditions maintain as regards the amount of snow pack for this season of the year.

Precipitation records for various sections of the State compiled to the end of January indicated an excess of precipitation so far this season in most of the watersheds north of the Tehachapi Range, with a shortage of about 35% in Southern California.

FLOOD CONTROL AND RECLAMATION

Maintenance of Sacramento Flood Control Project.

This period was marked by a series of storms commencing on January 29th and extending to date, with short periods of fair weather following the 15th. Very heavy winds occurred in the period February 16th to 21st. The streams and by-passes were all at fairly high stage, necessitating heavy patrols and some work for emergency protection. Payroll during this period was heavier than at any other time since this office has been in charge of project maintenance. All of the project works were successfully cared for, but considerable damage was done to the east Sutter By-pass levee by wave wash, sections of a number of bridges were floated out, and the dyke at the lower end of the east levee borrow pit was washed out.

The Sacramento weir gates were opened at 10:30 a.m. on February 11th, when the Sacramento River gage at I Street read 27.7. The water at Sacramento fell one foot during the first hour the gates were open, and at 1:00 p.m. was at 26.1 on the gage, after which it fell slowly. Closure of the gates commenced on March 3d.

Relief Labor Work.

During this period about 70 relief laborers have been employed in patrolling levees, removing debris and miscellaneous emergency work.

Emergency Levee Repairs.

The continued rain during this period delayed greatly the completion of the emergency levee repairs under Executive Order No. E 177. At this date the work is approximately 40 per cent complete and is proceeding as the weather will permit. Work has been completed at Robinson Bend on the Feather River, at the Phelan ranch on the Sacramento River in Butte County, and on the Little Chico Creek. Good progress is being made in the closure of breaks on Antelope Creek and at Gerber, and on Battle Creek in Tehama County.

Flood Damage Survey.

The State Engineer has been requested to survey and report on flood protective works and the cost of making emergency repairs thereto. This office has been assigned the collection of data in thirteen northerly counties of the Sacramento Valley, including San Joaquin, Contra Costa and Solano. This work is well under way and a report will be submitted on March 5th.

February, 1938, Storm and Flood.

The rainfall commencing on January 29th resulted in some fairly high flood stages, the height at Colusa reaching the same as in the December flood. The crest heights reached were as follows: Red Bluff, 20.5 on February 3d; Colusa, 25.3 on the 4th; Red Bluff, 24.85 on the 8th; Colusa, 26.9 on the 11th; Knights Landing, 32.0 on the 12th; Red Bluff, 23.1 on the 14th; and Colusa, 26.2 on the 15th. The Sacramento River at the I Street Bridge was at relatively high stage all during the month of February, 13.5 on the 1st, 20.1 on the 28th, and crested at 27.7 on the 11th. The opening of the Sacramento weir gates on the 11th within a short time reduced the height to 26.1. The American River was relatively low, cresting at 15.1 at Folsom on February 11th.

Sacramento River flood waters pour into Yolo Bypass through Sacramento weir on morning of February 11.

FLOOD FIGHTERS SAVE LEVEES

(Continued from page 2)

partment, the Reclamation Board, nor the Division of Water Resources had authority to make expenditures and where there was no organized reclamation or levee district.

Butte, Glenn, Shasta, and Tehama were the counties hardest hit in this respect. Seeing that it was necessary to take action on their own behalf, each of these counties organized a flood control committee and from these four committees there was made up a super-committee to facilitate cooperative action. This committee made a complete survey of the damage that had to be repaired. With this data on hand, a delegation was sent to Sacramento to plead their case before Governor Merriam, urging him to declare the necessary repair work an emergency which should be financed from State funds.

At the State Capitol the delegates found a sympathetic listener. After investigation by the State Engineer, the Governor determined to issue an order for $150,000 on the State Emergency Fund to be applied to the closing of levee breaks on the Sacramento and Feather rivers and their tributaries. The fund was made available to the Division of Water Resources on January 15, 1938.

Actual construction in the field was commenced on January 16 under the supervision of Col. A. M. Barton, Reclamation Board, and State Engineer Edward Hyatt, Bureau of Water Resources, with Robert L. Jones, Deputy State Engineer in charge.

FIFTY-SEVEN BREAKS

On January 17 the Division of Water Resources opened an office in Chico in charge of Martin H. Blote, Associate Hydraulic Engineer, to facilitate supervision of work at the various points. The necessary equipment was rented and the work proceeded. There were some fifty-seven breaks to be filled, some of them on the main rivers and some on tributary creeks, but with the amount of equipment available it looked as though a few weeks should see the work completed.

Unfavorable weather, however, had still to be reckoned with. Another storm broke and the upper Sacramento again rose to flood stages. By this time some of the breaks had been completely closed, many more had not been touched; but the largest of them all, a 1200-foot break on the Sacramento River near Chico was partially filled.

It would be disastrous to have the water top this fill, move out the new material and inundate a second time. To prevent such an occurrence, large crews of men worked day and night filling sacks with earth and building them into a barrier to hold back the steadily rising water. Inch by inch the water rose and inch by inch the barrier was built up to keep ahead of it.

WORK PROGRESSING

After many exhausting hours of labor under the most adverse conditions, when the flood finally reached its crest, the waves were lapping over the top of that quivering mass of mud which in some places was as much as nine feet in height. It had just sufficient stability to hold up against the pressure and fortunate it was that the tide turned when it did.

Needless to say, this storm greatly impeded the progress of the work even after recession of the high water. Granted a continuance of the present favorable weather, a few more weeks will see all the breaks closed and the levees in condition to withstand the next high water.

Since the original storm, rains have delayed the completion of the levee repairs by twenty-two days.

Concrete Pavement Slab Warp and Its Prevention

(Continued from page 21)

unimportant, if such swell or shrinkage occurs throughout the entire lineal dimension of the highway, and not in localized alternate locations such as occurs where expansion joints are allowed to feed the subgrade with fresh moisture from time to time.

CONCLUSIONS DERIVED FROM STUDIES

1. Pavement warp or distortion occurs after each increase or decrease in moisture content of *adverse soils* and is more or less continuous. (Adverse soil is a term used herein to describe any soil which will change volume with the addition or subtraction of contained moisture.)

2. Texas reports many miles of pavement laid on adverse soil warp badly at joints and elsewhere at times.

3. Minnesota reports 9 per cent of its concrete pavements warps either from ice lenses or swelling soils.

4. This State also reports that if soil is already at plastic limit, additional water will not swell the soil but ice lenses which will distort the pavement will form.

5. Drainage trenches under expansion joints proved ineffective to prevent warp in tests made in Minnesota, Missouri, and California.

6. Equalizing moisture in subgrade of adverse soils reduced warp in Missouri, Kansas, Minnesota, Texas, and California.

7. Heavy impervious paper laid on adverse subgrade in contact with pavement proved of no value since rupture of the paper often occurred at joints which then admitted water.

8. Oil mixed with adverse soil (grade not given) increased moisture holding capacity and swell of soil.—Minnesota.

9. Tar at 1½ gallons per square yard laid on adverse subgrade in contact with pavement proved of no value in Minnesota, as did heavy asphaltic oil, Grade E, in California since rupture of this type of membrane at joints admitted water.

10. Gravel 12 inches to 24 inches thick under pavements in Minnesota prevent warp but in California 12 inches of gravel proved ineffective at Williams, and it is thought that 18 inches to 24 inches will be needed on bad soil if membrane is not used.

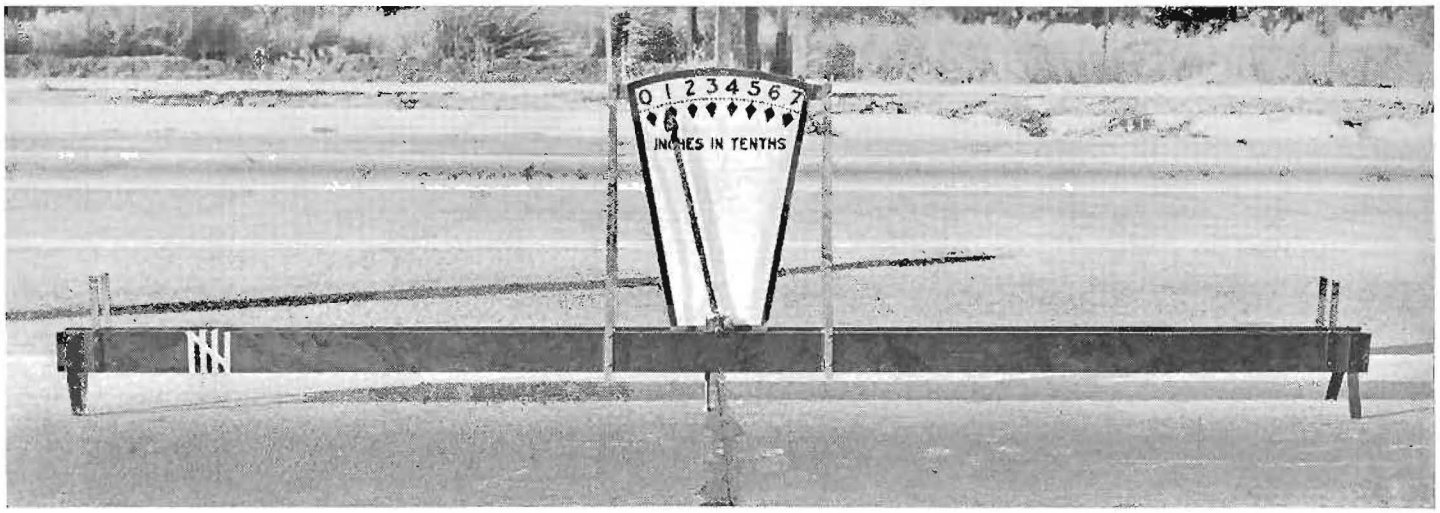
11. Copper seals at joints were ineffective in Minnesota and California to prevent leakage at joints and subsequent warp of pavement.

12. Warp has been prevented in Kansas and Missouri by keeping subgrade of adverse soils at plastic limit moisture content.

13. Warp has been reduced in Minnesota by repouring expansion joints with softer asphalts. California found such treatment not permanent where asphalt seals are used.

14. California has prevented warp, where due to moisture change in adverse soil, by constructing a bituminous blanket of 7/10 gallon per square yard of E grade asphalt on the subfoundation, covering same with a rolled course of nonswelling imported borrow usually 9 inches thick, and constructing concrete pavement thereon.

15. California has relieved warped concrete pavements by bringing the subfoundation to uniform moisture content or by placing on the pavement a cushion course of nonswelling, well-cemented crusher run base not less than 4 inches in thickness and constructing thereon a surface of not less than 3 inches of cut-back plant-mix or asphalt concrete.



Five-tenths gallon asphalt membrane under 12-inch imported borrow. Here for several hundred feet joints were from 0.07 inch to 0.12 inch high. Weakened plane joints were the highest.

NEW CONSTRUCTION ON COAST HIGHWAY

(Continued from page 22)

struction with the ocean view perpetually guaranteed is fully substantiated.

When the new highway through the Malibu Ranch is completed between Walnut Canyon and Encinal Canyon early next summer, the traveling public will have a modern, divided highway of high standard, which should put an end to the tragic and distressing accidents which have all too frequently occurred in the past upon the old road. This new highway will provide a safe and enjoyable ocean drive, of which the State Division of Highways organization can justly be proud.

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