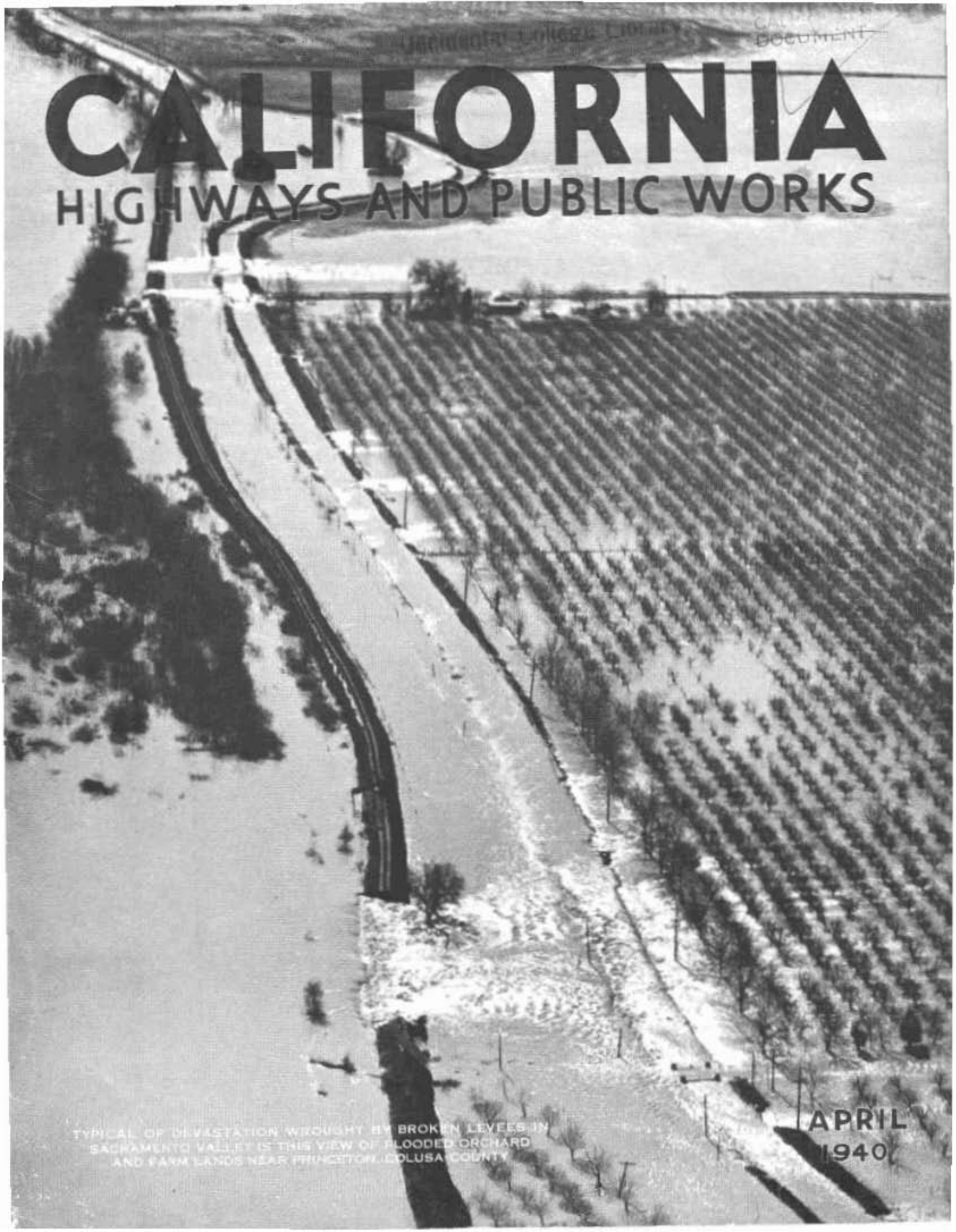
CALIFORNIA

HIGHWAYS AND PUBLIC WORKS



TYPICAL OF DEVASTATION WROUGHT BY BROKEN LEVEES IN SACRAMENTO VALLEY IS THIS VIEW OF FLOODED ORCHARD AND FARM LANDS NEAR PRINCETON, COLUSA COUNTY

APRIL
1940

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

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

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Vol. 18 APRIL, 1940 No. 4

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State Speeds Program to Restore Damaged Levees and Aid Work of Farm Land Rehabilitation

By FRANK W. CLARK, Director of Public Works

GOVERNOR CULBERT L. OLSON moved rapidly this month in gearing the State machinery to top speed for the rehabilitation of areas in Northern California damaged by the severe floods of late February and early March. By proclamation, Governor Olson declared a state of emergency to exist within the boundaries of the Sacramento River Basin and its tributaries and ordered the Department of Public Works to make an immediate survey of the extent of flood damage and to recommend necessary steps for rehabilitation.

Meanwhile, before flood waters had ceased pouring through the levee breaks caused by the flood, the Director of Finance on March 15 made available to the Division of Water Resources $60,000 from the State Emergency Fund for immediate repairs on the levee system of the Sacramento River and its tributaries. The danger of further flooding from subsequent storms made immediate repair work of the utmost urgency and the Division of Water Resources had crews at work the day following the appropriation of emergency funds.

That this danger was not over-emphasized was borne out by the storm which again caused floods in the upper Sacramento River Basin on March 29 and 30. While this storm was of less intensity than the former it caused a rise in the Sacramento River sufficient to break through patched levees in four places where previous breaks occurred and on which emergency work was in progress. A rapid rise in the Yuba and Feather rivers also seriously threatened reclamation districts in the vicinity of Marysville which had escaped inundation by the previous flood.

GOVERNOR TOURS FLOODED AREA

Governor Olson also made a personal tour of inspection of the damaged area and declared that he felt immediate consideration should be given by the State to rehabilitation work and for a permanent program of flood control. He declared that permanent steps must be taken to curb the rivers of Northern California to assure the development of the Central Valley. He said:

"We have in our great Sacramento and San Joaquin valleys an empire of more than 9,000,000 acres of the finest agricultural lands. It is an area of productivity and of actual and potential wealth such as can be found in very few favored places on the face of the earth. It is a heritage given into our keeping. Less than 1,000,000 people live in this resourceful area and the majority of the present population is located in the larger cities and towns.

"There is no question that ten times this population could find a livelihood, a useful and satisfactory existence, and opportunity and happiness in these wonderful valleys. Today most of this area is held in large tracts away and above the requirements of family farming. It is held in large part by large corporations and by absentee landlords, who themselves have no intention and in fact no means, to put this land to its highest and most productive use.

"It does not take a great deal of imagination to visualize the future of this empire. It will be a land of wealth and contentment, of farms and orchards and homes tilled and lived upon by a satisfied and salf-sustaining people.

MUST HARNESS STREAMS

"It is to this end and with the vision of the future in mind, that we must commence immediately to harness and control these great streams, which today cause too much damage and send their waters and their power to the sea without bringing their full blessings and benefits to our State and our people."

On March 20 the Federal government through the U. S. Army Engineers office in Sacramento, made available $100,000 for emergency repair work on the levees of the Sacramento River Flood Control Project and this amount was matched the same day by the State Reclamation Board.

With $200,000 available the California Debris Commission took over the work of closing the breaks in the levees along the Sacramento River above Princeton which had been initiated by the Division of Water Resources. The Division continued the work of making a temporary closure in the break of the west levee of the Sutter By-pass at Reclamation District No. 70.

635,000 ACRES FLOODED

In the report to Governor Olson on flood damage which was compiled by the Department of Public Works it was estimated that 635,000 acres of land in the Sacramento Valley were inundated by the floods of late February and early March and that there was $12,041,600 in property damage in 35 counties in Northern California.

The survey shows that in the 35 counties reporting damage ranged from as much as $1,744,000 in Sutter County to as little as $3,300 in Modoc County. Sonoma County stood second in the list with damages estimated at $968,600 and Glenn County third with $932,000. Other counties reporting more than one-half million dollars in damages were Solano with $879,800; Butte with $831,900, Shasta with $685,200, Yolo with $589,600 and Colusa with $552,900.

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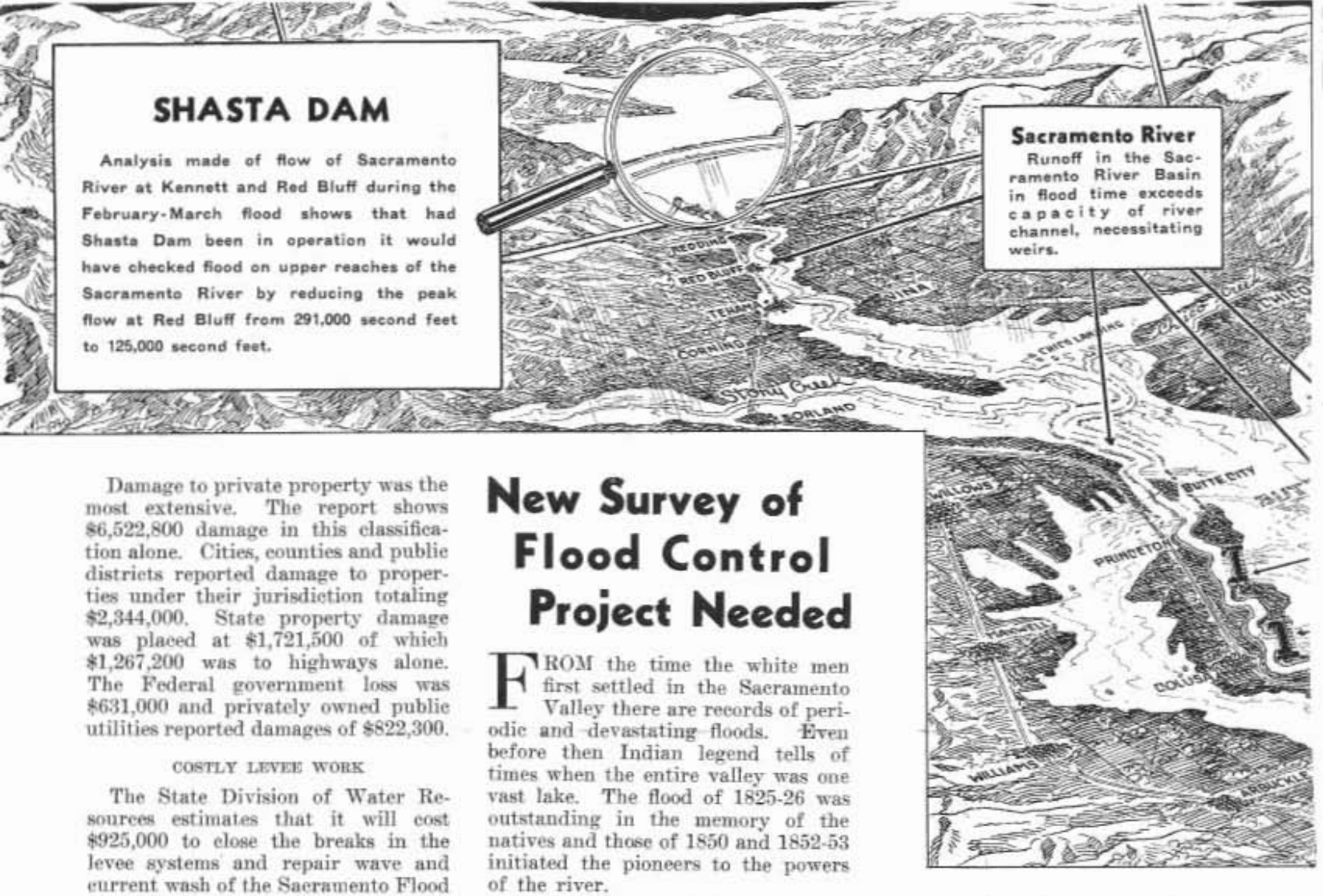
SHASTA DAM

Analysis made of flow of Sacramento River at Kennett and Red Bluff during the February-March flood shows that had Shasta Dam been in operation it would have checked flood on upper reaches of the Sacramento River by reducing the peak flow at Red Bluff from 291,000 second feet to 125,000 second feet.



Damage to private property was the most extensive. The report shows $6,522,800 damage in this classification alone. Cities, counties and public districts reported damage to properties under their jurisdiction totaling $2,344,000. State property damage was placed at $1,721,500 of which $1,267,200 was to highways alone. The Federal government loss was $631,000 and privately owned public utilities reported damages of $822,300.

COSTLY LEVEE WORK

The State Division of Water Resources estimates that it will cost $925,000 to close the breaks in the levee systems and repair wave and current wash of the Sacramento Flood Control Project alone. Of this amount, U. S. engineers estimate that $563,000 will be required for immediate emergency repair work in filling levee breaks.

The report recommends that in order to make the Sacramento Flood Control Project effective that in addition to rehabilitation work it will be necessary to complete Project levees immediately to full grade and cross section. It also recommends that new surveys of the Project be instituted by the State immediately and that an emergency expenditure of $2,900,000 be made to cover the repairs required before the next flood season.

For immediate repairs in addition to the $200,000 already made available, $363,000 additional Federal and State funds will be required. This amount was estimated as necessary for closure of levee breaks previous to the flood of March 29 and 30 which caused considerable additional damage. No estimate has been made as yet of what will be required to repair the additional damage.

(Continued on page 4)

New Survey of Flood Control Project Needed

FROM the time the white men first settled in the Sacramento Valley there are records of periodic and devastating floods. Even before then Indian legend tells of times when the entire valley was one vast lake. The flood of 1825-26 was outstanding in the memory of the natives and those of 1850 and 1852-53 initiated the pioneers to the powers of the river.

In 1862 the entire central valley was one vast lake and river boats went overland to Stockton rescuing stranded people from the ranches along the way. With these devastating floods in mind, men early began the study of methods to check the Sacramento River.

Early efforts at flood control were largely private and in many cases so constructed that in protecting one section of the valley, they caused heavier damage to other sections.

The Sacramento River system is approximately 250 miles long and drains an area of 26,150 square miles. The floor of the Sacramento Valley from Red Bluff to the mouth of the Sacramento River at Collinsville is approximately 150 miles long with an average width of 30 miles. It is generally flat and before levee systems were built restraining the river it was largely subject to flooding during the rainy season.

From 1856 to 1884 hydraulic mining in the tributaries of the Sacramento River added to the flood menace by washing millions of tons of debris into the river channels and partially filling them.

Prior to 1910 Sacramento Valley land owners had built flood control works at a cost of 8 million dollars and by 1924 had expended a total of $39,000,000 for this purpose. There were repeated efforts by local State and Federal groups to develop a general Sacramento Valley flood control program. These efforts, however, were unsuccessful until 1910 when the Jackson report proposed a flood control project which is essentially the same as the project now in operation. This project was adopted by the State in 1911 and by the United States with limited financial participation in 1917, and in its present form by the United States in 1928. The engineering plan for the present project provides for an intricate system of levees, by-passes and weirs, which take advantage to the largest extent possible of the natural overflow troughs.

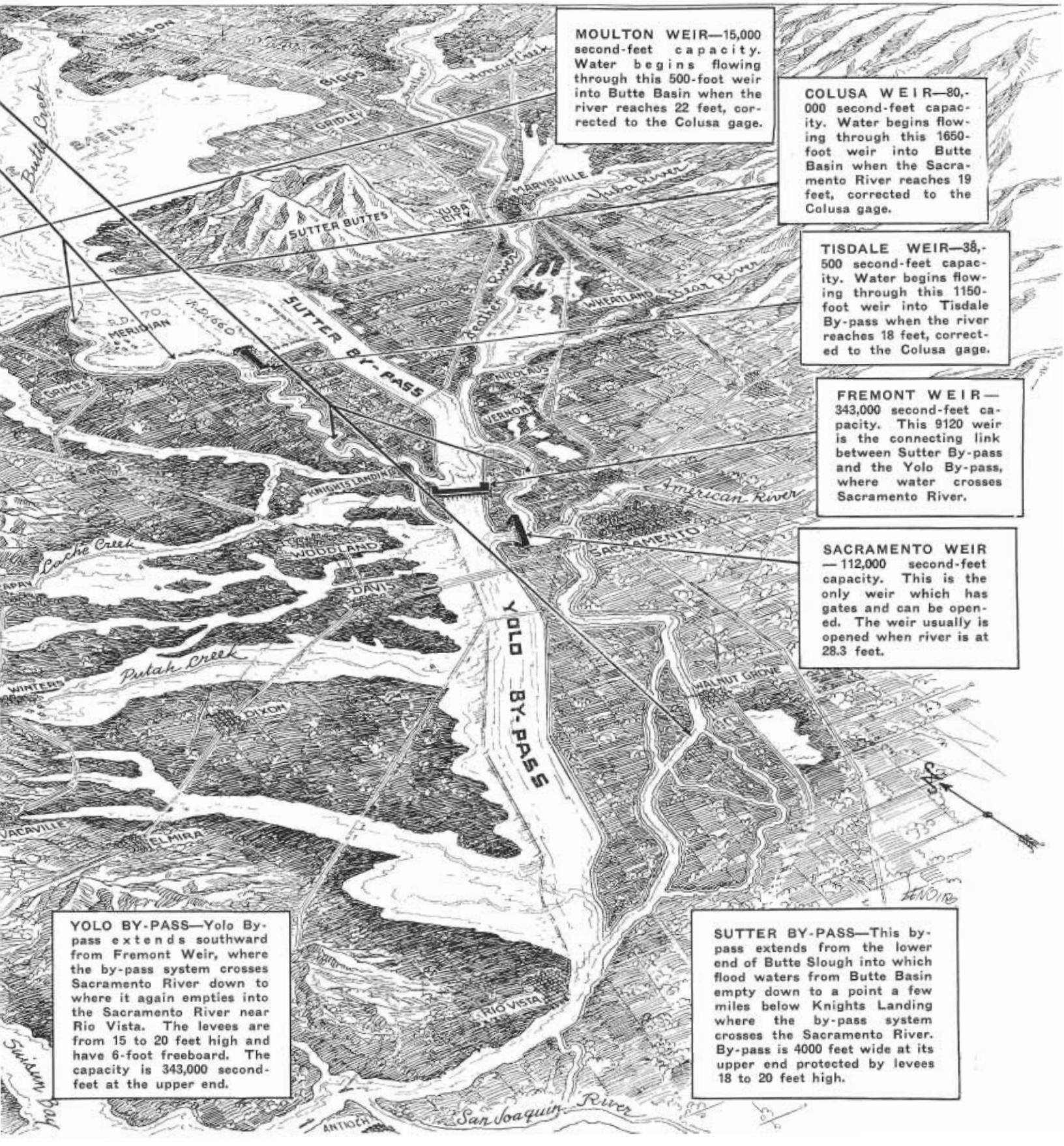
In designing the project, it was determined that some system must be devised which would take care of a

flow of 600,000 second-feet at the mouth of the Sacramento River at Collinsville. As the total capacity of the Sacramento River at Sacramento, even with its present levees is only 110,000 second-feet, it was immediately evident that overflow channels of sufficient capacity to carry the additional water would be necessary.

Starting at the head of the valley where the slope of the river is greater than farther down the valley, the trough of the Sacramento River was found sufficient to carry most of the flood waters in that region. From Red Bluff to Jacinto such levees as exist are private. The river trough capacity in this stretch is estimated at 260,000 second-feet. The records of heaviest runoff show that the river exceeds this amount only once in about 40 years.

The Sacramento River Flood Con-

(Continued on page 11)



State Speeds Program to Restore Damaged Levees

(Continued from page 2)

The District Engineer, U. S. Engineers Office, Sacramento, advised the Division of Water Resources that the location and cost of emergency repair work on the levees of the Sacramento River Flood Control Project were:

11 breaks on the west side, Sacramento River, between Princeton and Glenn—$50,000.

5 breaks on the east side, Sacramento River, from Princeton to the south boundary of Parrott Grant—$60,000.

1 break on the west side of Sutter By-pass at Reclamation District No. 70—$115,000.

2 breaks on the west side of the Yolo By-pass at Reclamation District No. 2035—$16,000.

2 breaks on the west side, Yolo By-pass at upper Hastings Tract, $7,000.

2 breaks on west side of Yolo By-pass, south levee of Lindsey Slough—$15,000.

4230 feet of breaches on the west side of the Sutter By-pass and north side of Tisdale By-pass at Reclamation District No. 1660—$300,000.

The estimates cover only expenditures necessary to return the actual breached portion of the levees to the height that obtained before the flood. In addition to this work much additional work will be necessary on other portions of the levee system where, while the levees did not actually break, much damage was caused by wave and current wash. The cost of this additional work is estimated at $362,000.

Governor Olson and officials view levee break north of Princeton. In group, Governor Olson, Director of Public Works Frank W. Clark, E. Vayne Miller, Reclamation Board, State Engineer Edward Hyatt (pointing).

FEDERAL AID SOUGHT

Following the flood, preliminary inspection indicated that considerable damage had occurred to several of the Federal Aid Highways in the northern part of the State and in the vicinity of San Francisco.

Because of unusual intensity of the storm, its devastating effect upon the Federal Aid Highway System and the magnitude of the necessary restoration work, the State Highway Department requested emergency financial assistance from the Federal Government for reconstruction of highways and bridges on the system of Federal Aid Highways which have been damaged or destroyed by floods, hurricanes, earthquakes or land slides, and has been allocated $338,410.

Following the filing of the preliminary application for such emergency relief funds, representatives of the United States Public Roads Administration and the California Division of Highways conducted a joint field inspection of the damaged Federal Aid Highway System and collaborated in determining the nature and extent of necessary restoration measures.

This joint inspection indicated that major damage amounting to approximately $584,000 had occurred on portions of Federal Aid Highway Routes on the Redwood Highway; the Pacific Highway north of Redding; and the Trinity Lateral; the Feather River Route; and the Williams-Ukiah Highway; and portions of the Roosevelt Highway along the coast in San Mateo County, which is a recent addition to the Federal Aid Highway System.

It is proposed that the work of reconstruction of the damaged roads and bridges and of corrective measures to prevent repetition of such destruction will be performed by contract. If the State's application for emergency relief highway funds is approved by the Federal Government, the work will be financed jointly with State and Federal funds on the ratio of approximately 42 per cent State and 58 per cent Federal money.

SHASTA DAM NEEDED

Earlier analysis of the effectiveness of Shasta Dam in reducing floods of the nature of the one of February-March, 1940, on the upper Sacramento River were substantiated. Analysis made by the State Division of Water Resources of the regulatory effect which the Shasta Reservoir of the Central Valley Project would have had on the flows of the Sacramento River at Shasta Dam and at Red Bluff had the reservoir been constructed and in operation during the recent flood.

In this analysis it was assumed that the Shasta Reservoir would have been operated not only for flood control but also to meet the basic requirements of navigation, irrigation and salinity control and for the generation of electric power.

The analysis shows that the peak discharge of 182,000 second feet on

(Continued on page 31)

State Highways Suffer Severe Damage from Floods and Slides

By C. H. PURCELL, State Highway Engineer

FOR the second time in a three-year period, State highways in Northern California have suffered severe damage.

As a result of the storm from February 25 to 29 several of the major routes and most of the secondary roads were closed to traffic for periods varying from a few hours to several days. The estimated cost of repair and protection of highways so damaged is $1,267,200.

Damage to highways during the March storm has not yet been estimated.

A review of records prior to the storm of December, 1937, revealed that only once—in January, 1909—had there been as great a rainfall in a similar short period for the preceding forty years or more. During the recent storm new high water marks were recorded for the Sacramento River and several other major streams. In reviewing the damaged areas it was particularly noted that the unusual volume of water in normally minor watercourses blocked drainage structures with boulders and debris and frequently caused considerable damage.

Rainfall was general throughout the area affected during the month of February and was especially heavy in several localities for the five-day storm period. The following information taken from United States Weather Bureau records supplements details previously published in the March issue of this magazine:

RAINFALL RECORDS

Location	County	Rainfall in inches Feb. 25 to 29	Total for February
Ben Lomond	Santa Cruz	12.65	22.37
Cloverdale	Sonoma	9.10	15.95
De Sabla	Butte	17.20	24.64
Inskip	Tehama	22.07	32.71
Lake Spaulding	Nevada	13.71	24.85
Redding	Shasta	8.34	14.57
St. Helena	Napa	9.15	14.10

Fortunately, there was little snow on the ground at the lower elevations to increase the run-off, as was the case in 1937. Even so, water was over the highways at many locations for the first time in the memory of the maintenance forces.

During and following unusual storm periods the work of the Division of Highways forces divides into four phases in the following order:

1. Protection and assistance to traffic.
2. Protection of the roads and structures.
3. Emergency repairs to permit traffic to move.
4. Permanent repairs, including correction or protection work, when feasible to prevent recurrence of damage.

DETOURS LOCATED

As a result of experience gained during the 1937-38 storm period instructions were issued shortly thereafter to the maintenance forces to scout all available detours. The condition of bridges and surfacing on such detour routes was noted and sketch maps prepared. Signs required to properly direct traffic in emergency were then secured and placed in stock. At the beginning of each winter season the detour situation is reviewed and changes noted. This preparation paid dividends in time saved and in public convenience during the recent February storm.

Left—Site of Big Butte Creek Overflow Bridge on State Highway between Butte City and Biggs. Right—Ruins of deck of bridge carried down stream 1000 feet.

The warning and protection of traffic during the storm was a major responsibility. Slides blocked the roads and sinks or slipouts developed almost instantaneously at many points. A continuous patrol was maintained in such areas so that barricades and lights might be placed with little delay. In flooded areas there was always the possibility that bridge approaches or even the structures might wash out. It was necessary to place markers to designate the traveled way where the water was shallow, and to provide flagmen and patrol cars or trucks to help traffic until overflow water definitely closed the particular road.

(Continued on page 22)

1. View of washed-out trestle approach to Scotia Bridge across Eel River on U. S. 101.
2. Eel River flood waters damaged this section of U. S. 101 at Greenlaw Bluffs north of Dyerville.
3. Wash-out on State Highway 42 in Santa Clara County.
4. Surface and embankment washed out at approach to bridge east of Butte City in Glenn County.
5. Looking west at Chipps Creek to damaged bridge on State sign Route 24, Plumas County.
6. Highway embankment on State Sign Route 32, Tehama County, washed out by heavy rains.
7. Showing highway shoulder cut away to pavement edge on U. S. 299, Trinity County.
8. This rock slide blocked two lanes of the Los Gatos-Santa Cruz highway in Santa Cruz County.

9. Patties Creek overflows the Feather River State Sign Route 24 in Butte County.

10. Section of State Highway 99 destroyed by flood, in Solano County.

11. Washed-out rip-rap at southerly end of sacked concrete protection on State Sign Route 16 in Yolo County due in part to overflow from clogged culvert and high water in Cache Creek.

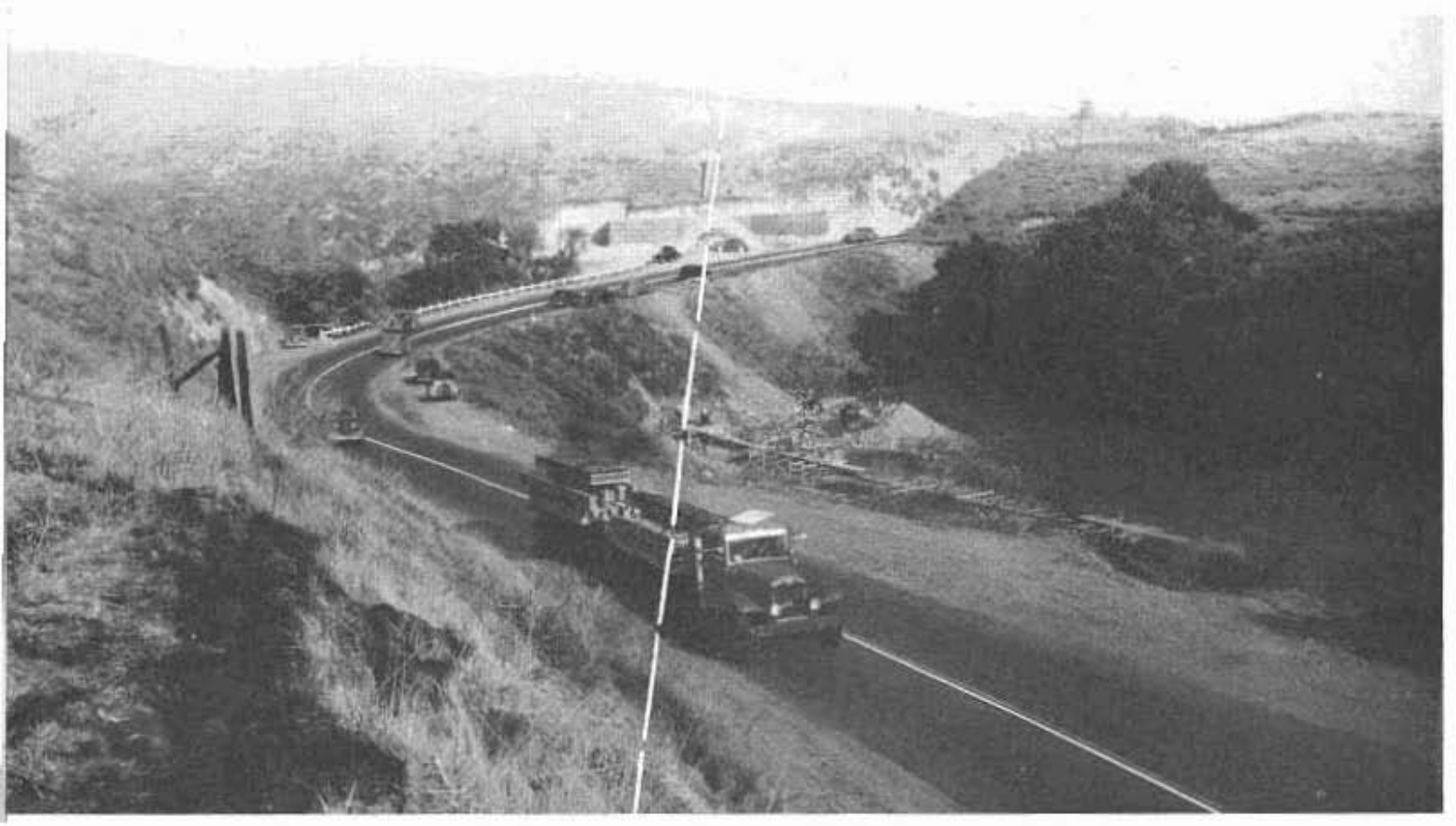
12. East approach to county constructed bridge across Sacramento River east of Redding, State Sign Route 44, swept away by turbulent waters.

13. North approach to State highway bridge north of Redding on U. S. 99 undermined by Sacramento River flood waters.

14. Flood waters of Greenwood Creek washed out this section of Greenwood Creek bridge, State Sign Route 1 Mendocino County.

15. This picture shows slide area on State Sign route 1, San Mateo County. This slide occurred on Pedro Mountain.

16. Maintenance crews clearing slide on State Sign Route 1, Sonoma County, ten miles above Jenner.



This view of Roosevelt Highway improvement project was taken at Escondido Creek looking easterly.

Construction on Coast Highway

By WILLIAM H. MOHR, Assistant Engineer

THE scenic coast highway from Santa Monica northwesterly to Oxnard and Ventura will have another contract completed this fall which will eliminate the many traffic delays and accidents which have occurred on this road in the past few years. To the traveling public this route is better known as the Roosevelt Highway and is designated with federal route markers as U. S. Highway No. 101 Alternate.

For this improvement, a contract 3.74 miles in length was awarded on October 17, 1939, for that portion of the coast highway in Los Angeles County between Solstice Creek, which lies two miles north of Hollywood's Malibu Beach Colony, and Walnut Canyon, near Point Dume. This project joins at Walnut Canyon the contracts to the northwest which were constructed in 1938.

In the past few years this section of the Coast (Roosevelt) Highway has carried a great deal of traffic over its two-lane road with short radius curves. There have been many serious accidents and the increase of traffic density has resulted in a tying up of vehicles during the summer on week-ends and holidays.

CURVES ELIMINATED

This contract is being built on modern standards with the elimination of short radius curves but follows the existing location in general. The only major deviation from existing alignment is across Latigo Point, between Encondido and Solstice Canyons, where the relocation is northerly of the existing location approximately 800 feet.

An interesting comparison of the proposed improvements is given as follows:

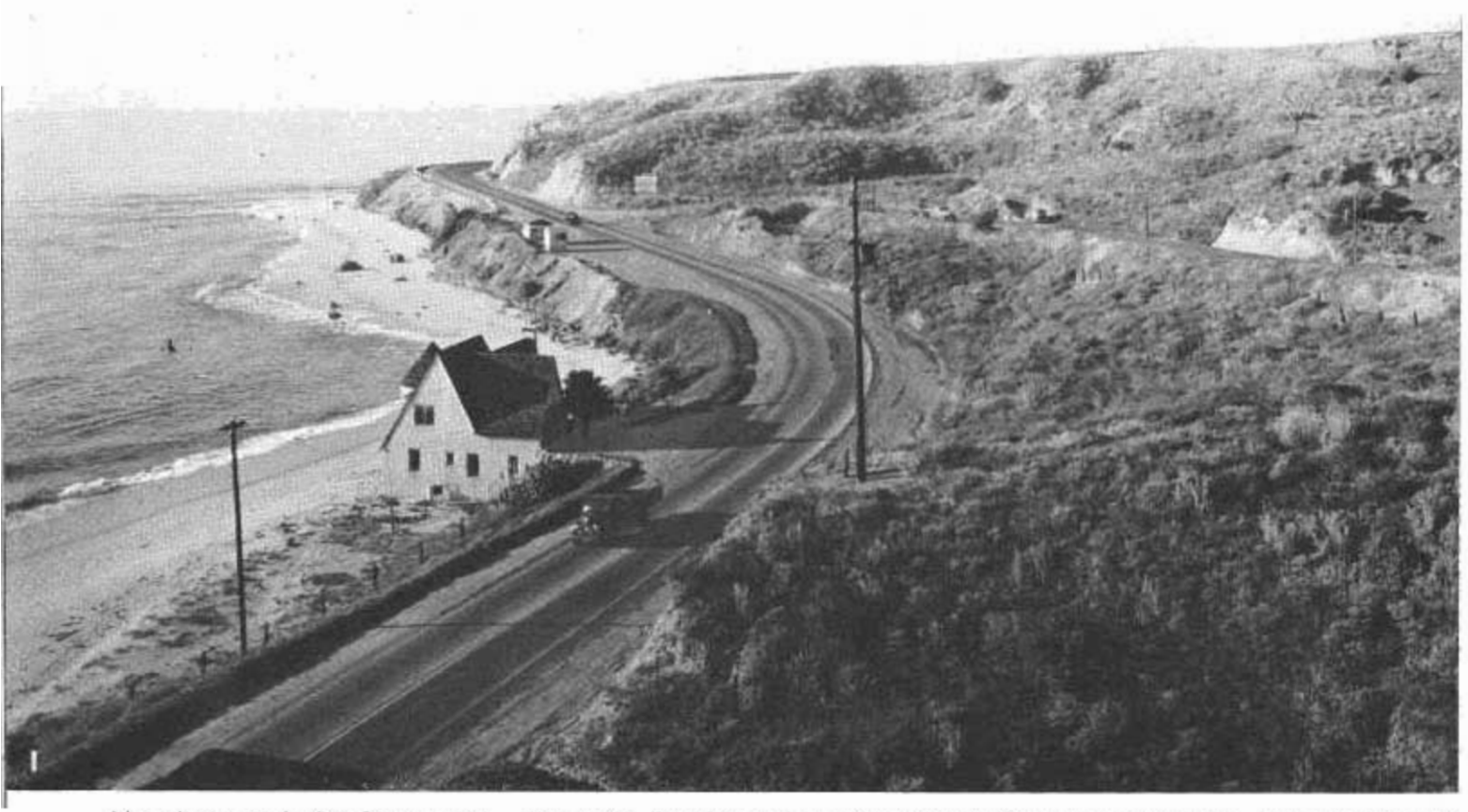
Feature	Existing	Proposed
Total Curves	14	5
Minimum Radius	250'	2500'
Curves, 500' Radius or under	3	0
Curves, 1000' Radius or under	7	0
Total Central Angles	402°	62°

HEAVY EXCAVATION NEARING COMPLETION

Work was started on this contract October 30, 1939, and is progressing according to schedule. The contract calls for some 400,000 cubic yards of roadway excavation, the major portion of which has already been made. The black adobe surface was removed and wasted but the remainder of the excavated material after being tested was found to be satisfactory for placing in the embankments. Modern, specially built, dirt moving equipment is being used on this job to make the large cuts which are found at Latigo Point and Ramirez Hill. For this purpose, Woolridge scrapers of 15- and 18-cubic yards capacity are being drawn by 105- and 110-horsepower tractors respectively.

New type six-cylinder Diesel tractor pulling 15-cubic yard scraper on Roosevelt Highway construction.

View of construction activities at summit cut between Latigo and Escondido Canyon.



Line change at Latigo Canyon road. New center line shown along right edge of picture eliminates sharp curve around point.

Proper compaction is being obtained in the embankments by the use of five 10-foot sheepsfoot tampers.

The relocation of the highway at Ramirez Hill and Canyon eliminates the last of the narrow winding road which was built through the Rindge Estate and first located in 1921. To cut through this hill over 100,000 cubic yards of earth have been removed, most of which has been used to construct the embankments on either side. This pioneer road was necessarily narrow and followed the contours of the rolling hills so as to cause a minimum of excavation at that time.

BRIDGES WIDENED

The bridges which lie within the limits of the present contract at Solstice and Escondido canyons have already been widened by the Bridge Department under previous contracts. The width of the completed structures is 76 feet from curb to curb with a 4-foot portland concrete cement center dividing strip to conform with the highway cross section on this contract.

A 10 by 10-foot reinforced concrete box culvert has been completed underneath the new highway at Ramirez Canyon. This underpass will permit cattle which graze in this vicinity to cross the highway without danger to themselves or traffic on the coast highway. The old road is used as an approach to this underpass, which is large enough for persons and vehicles.

The 12 by 13-foot reinforced concrete arch culvert in Ramirez Creek has been extended 255 feet to pro-

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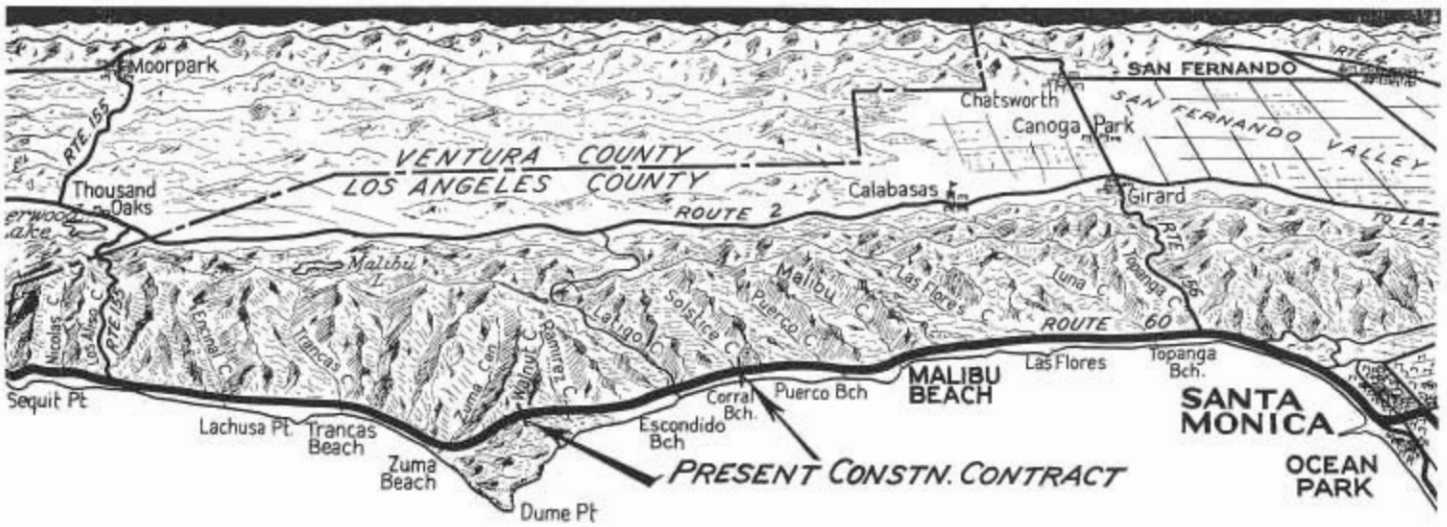

New Survey of Flood Control Project Needed

(Continued from page 3)

trol Project actually begins on the east side at the Butte-Glenn County line and on the west side at a point not far above Jacinto. Overflow through natural channels which empty into the Butte Basin reduce the flow of the river above this point from 260,000 second-feet to 160,000 second-feet. The levees along this section are as yet below standard, either as to grade, section, or both, and are scheduled for further work under the project construction program.

It was in this section of the Sacramento Flood Control Project where most of the breaks occurred in the storm of late February and in the second storm late in March.

RECLAMATION POSSIBILITIES

Butte Basin is a region largely devoted to pasture lands and gun clubs where the State has flowage rights and consequently damage from flooding is of a minor nature.

The project was designed with the assumption that this area might at some future time be reclaimed and flood waters carried through it in a levee channel leading from a point near Butte City to the upper end of the Sutter By-pass. The storage capacity of the basin as now used is estimated at about a half million acre-feet which has an important effect on floods from the upper Sacramento River. About 130,000 acres in the basin could be reclaimed and may be when Shasta Dam is completed. Estimates indicate that flood flows through Butte Basin will be reduced substantially by the 500,000 acre-feet flood storage capacity of Shasta Reservoir and make it possible to confine the flow to the levees.

At a point about 8 miles above Colusa the Moulton Weir discharges into the Sutter Basin. This is the first of a series of works which has been built into the levee system to reduce river flow at flood times. It is 500 feet long and when the river level rises to 22 feet, corrected to the Colusa gage, it automatically begins pouring out over the weir which is designed to reduce river flow by 15,000 second-feet. The river capacity between levees from this point down to the Colusa Weir, which is just above Colusa, is 145,000 second-feet.

COLUSA WEIR

The Colusa Weir is 1650 feet long and begins to function when the river reaches a stage of 19 feet (Colusa gage). It has a capacity of 80,000 second-feet and reduces the river flow past Colusa to 65,000 second-feet.

The surplus waters from these weirs and from the natural overflow upstream all empty to the eastward into Butte Basin which has a run-off capacity of 185,000 second-feet at its lower end.

At the junction of the Sacramento River and Butte Slough, part of the water which has been released from between the levees higher up again flows back into the Sacramento River

(Continued on page 30)

Equipment engaged in repairing levee break along Sutter By-pass near Meridian.

Cement Experiments Through the Ages

By LESTER C. MEDER, Assistant Physical Testing Engineer

The following is the first of a series of articles dealing with the development of cement through centuries of experiments dating back to early Assyrian, Egyptian, Grecian and Roman periods and progressing to the present day portland cement. A second article will appear in a later issue of this magazine.—Ed.

HISTORICALLY, portland cement ranks as a comparatively recent discovery. The earliest structures known were built of rammed earth, sun dried brick, or stone blocks set without the aid of cementing material, stability depending wholly upon mass and design. Asphalt or bitumen from natural deposits was probably the earliest adhesive material used, its first extensive use being attributed to the Assyrians.

The earliest structures using a mortar as it is now understood are found in Egypt. The mortar used in building the Great Pyramid was a mixture of sand and a cementitious material, composed of approximately 80 per cent gypsum and 20 per cent lime. This mixture of lime and gypsum was not a manufactured product, but rather an impure gypsum as found in nature. Examination of the mortar shows it to be a mixture of overburned and underburned material. It is not hard to picture the difficulties early masons must have encountered.

As the Egyptians discovered the use of gypsum, the Greeks discovered the use of lime, and in turn, both discoveries were passed on to the Romans.

CEMENT DISCOVERIES

It is not known just how the discovery of puzzolanic cement—the first truly hydraulic cement—came about. However, it seems reasonable that the Romans, in preparing a lime mortar, inadvertently used some volcanic ash for sand, and noticing the greater hardness or strength of the resulting mixture, continued and expanded its use as experience and long service demonstrated its superior qualities as a binding material.

Thus, we see the development of four cements by four widely different cultures: Asphalt or bitumen by the Assyrians, gypsum by the Egyptians, lime by the Greeks, with its evolution into puzzolanic cement in the hands of the Romans.

The remarkable hardness of the walls and the durability of the structures built by the early Romans has led to the impression that the builders possessed secrets long lost. However, such is not the case. After considerable study and comparison of analyses, it has been decided that the secret lies not in the composition but rather in the thoroughness of mixing and ramming. Modern work confirms this. Examination of ancient mortars shows a remarkably close and dense texture, and the presence of unhydrated lime in the interior shows the mass to be impervious to air or moisture. It was the practice to mix a sticky mass of hydrated lime and finely powdered volcanic ash, add the rock and sand and then tamp the mass with heavy weights for hours. It is hard to picture a modern structure being fabricated in such a manner, particularly with the prevailing wage scale.

EARLY EXPERIMENTS

When Europe passed into the Dark Ages with the almost complete cessation of building the development of cements was neglected and practically forgotten.

In 1756 an Englishman, John Smeaton, was called upon to build a cut stone lighthouse on Eddystone Rock. Knowledge of hydraulic cements, or cements that would set and harden under water, was at that time extremely meager. After much experimenting Smeaton found that the best results were obtained from a lime that contained considerable clay as an impurity. Thus, inadvertently, was hydraulic lime discovered.

Out of Smeaton's work came the knowledge that a better cement could be made from the soft clayey limestones than the hard, dense limestone. At first, the material was only lightly burned to expel the carbon dioxide, use being made of only the material that slacked in water, no attempt being made to fuse the material, and then grind it to a fine powder.

ROMAN CEMENT

Investigations of a desultory nature followed for some years. In 1794 it was found that hydraulic cement could be made by calcining nodules of argillaceous or clayey limestone and finely grinding the resulting clinker. To this type of cement was given the name "Roman Cement." This cement, being quick setting, was extensively used in construction in the tidal zone and under water. It is very similar to the Rosendale cement used in the construction of the Erie canal in New York, in the early part of the nineteenth century.

There is much confusion in the history of the development of portland cement during the early part of the nineteenth century, a period in which bricklayers and builders were burning and preparing their own mortars. The properties of these different mortars depended largely upon the impurities in the limestone from which the lime was prepared, and the temperature at which it was burned. The resulting cements varied from hydraulic limes to "Roman Cement."

In about 1812, Vicat found that an artificial hydraulic lime could be prepared by calcining an inti-

(Continued on page 27)

New State Office Building Opened and Fully Occupied in Sacramento

By W. K. DANIELS, Acting State Architect

GENERAL occupancy of the new State Business and Professions Building, begun on January 15th, 1940, signified the completion of another much needed State structure and when the flags were raised on March 8th following, the building was fully occupied, evidencing the need for taking this step to provide proper office space for governmental functions rightfully located in the Capital City of Sacramento.

Under Governor Olson's administration and under the leadership of Frank W. Clark, Director of the Department of Public Works, it has become the policy and will continue to be the policy of the Division of Architecture to design and plan State structures with maximum simplicity, economy, practicability and efficiency being borne in mind at all times.

In this respect I believe we have accomplished our objective.

The building itself cost approximately $1,375,000 to construct. This is equivalent to $5.66 per square foot for gross floor area, which is a very conservative cost for this class of construction. It is structurally designed in reinforced concrete to resist fire and earthquakes and maximum daylight is afforded through large window openings. Complete air-conditioning will provide proper cooling in summer and warming in winter, supplying a change of air eight times an hour under normal conditions.

A great deal of study has been given to efficient office layouts providing color schemes beneficial to the eyes; freedom of movement in the corridors, stairways and elevators and scientific acoustical treatment throughout to absorb sound.

The architectural design and planning create dignity, beauty and charm by the application of simplicity to the exterior and directness of plan arrangement to the interior.

View of entrance to new State Business and Professions Building.

We all appreciate the fact that no one person can accomplish alone the construction of a project of this nature and I wish at this time to express my appreciation for the cooperation received by our organ-

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View of new Turlock grade crossing overpass which was officially dedicated on April 5.

Turlock Overhead Dedicated

WITH appropriate ceremonies, the new $300,000 overpass on U. S. 99 at Turlock was officially dedicated on Friday, April 5, by Director of Public Works Frank W. Clark, representing Governor Culbert L. Olson, and State Highway Commissioner Iener W. Nielsen of Fresno.

This completed project removes one of the last major traffic hazards on the main highway between Sacramento and Los Angeles.

A program of music by the Turlock High School band and addresses by State and local officials highlighted the dedicatory program. A luncheon at Hotel Carolyn tendered by the Turlock Chamber of Commerce and civic organizations preceded the ceremonies at the overpass.

Mayor Roy N. Day of Turlock acted as master of ceremonies at the overpass and President E. Glenn Drake of the Chamber of Commerce presided at the luncheon. Speakers at the luncheon and dedication included Senator J. C. Garrison of Modesto; Byron Scott, Secretary of the Highway Commission; District Highway Engineer R. E. Pierce of Stockton; Fred W. Panhorst, Bridge Engineer of the Division of Highways; Leo Smith, Public Works; Assemblyman Hugh P. Donnelly, C. C. Crowell, Chairman, Stanislaus Board of Supervisors, and Franz Sachse, assistant Public Works Director.

Senator Garrison read the following telegram from Governor Olson:

"I sincerely regret that official business in the southern part of the State keeps me from being with you in Turlock today. We can be justly proud of our great highway system, and I should have enjoyed participating in the ceremonies of opening the Turlock overpass to the use of the public. I congratulate your community and those who helped in this important additional safety factor on our publicly owned and maintained highway system."

Miss Shirley Raymus and Miss Betty Green, Drum Majorettes of the Turlock High School band, wielded shears to cut a blue and gold ribbon stretched across the overpass, thus throwing the structure open to traffic.

In his dedicatory address, Director Clark took occasion to praise Senator Garrison and Assemblyman Donnelly as "two public servants whose every vote is controlled by the true welfare of their district and of the State and not by the dictates or demands of any particular pressure group or individual."

Speaking of Turlock, Clark said,

"This community is a living, breathing example of the ideal for which Governor Olson stands. For a great many years now you have recognized that public ownership of your water and power resources is an essential element of your prosperity. Here in Turlock, and in your neighboring community of Modesto as well, your water rate, your power rate, your tax bills and your prosperity are daily reminders that the common good is best served by the public control of our great resources.

"We, in Sacramento, know that one example such as that set by your community and you, its citizens, is worth a thousand speeches. We know, and I am sure that you know, that the low water rates that help your farmers to survive when others go under are in large part due to the fact that the power you generate at Don Pedro Dam helps to pay the bill for the water.

"I think you will agree with me when I say that the State of California has done a pretty good job with the many vast enterprises it has undertaken. It was public money and public enterprise that built the San Francisco-Oakland Bay Bridge, and it was public money and public enterprise that built the overpass we are building today. This overpass is a unit in a public utility larger than any other in the State—the California State highway system."

The railroad crossed by the overpass is the main Southern Pacific line down the valley, carrying fast passenger trains, with heavy freight traffic, especially during the harvest season. Since 1929 there have been seven accidents at this crossing in which one person was killed and three were injured. It is thus obvious that the construction of this overhead separation will provide a safeguard to the traveling public as well as making an appreciable saving of time.

The structural features of the project were described in an article in the November, 1939, issue of "California Highways and Public Works," at which time the project was about 75 per cent complete.

Studies showed that an overhead structure was more desirable than an underpass owing to the high water table in this area. The completed separation presents a pleasing example of modern structural design. A 50-foot roadway provides for four lanes of vehicular traffic over the tracks, while two sidewalks provide for pedestrian travel. The structure is approximately 1250 feet long, and rises above the flat valley to clear the main line Southern Pacific tracks by 23 feet.

Starting from a dangerous right-angle crossing of the tracks in 1913, the alignment has been gradually improved to facilitate the movement of the heavy highway traffic of more than 6000 vehicles per day, but it was not until a Federal grade separation allotment was obtained in 1938 that the danger of crossing the tracks at grade could be removed. The contract was awarded to the Union Paving Company on February 8, 1939.

The final cost of the separation will be about $295,000, with $287,000 spent for the structure and about $8,000 expended on railroad work.

The separation provided about 83,000 man-hours of work, not counting the labor expended in furnishing the materials for the project. There were 6200 cubic yards of concrete, 1,648,000 pounds of structural steel, and 696,000 pounds of reinforcing steel used in the structure.

A subsequent contract for 0.3 miles of four-lane divided highway approach work was also awarded to the Union Paving company on January 30, 1940, and the work has progressed to the point where one of the two divided highway strips was available for use at the time of the dedication ceremonies.

A total of $13,000,000 has been spent on grade separation work in California since 1935. Of this amount $1,294,000 has been spent on this route, the Golden State Highway, (U. S. 99), at the following locations:

Union Avenue at Bakersfield	$97,000
Oil Junction at Bakersfield	60,000
Famoso Underpass	293,000
Delano Underpass	124,000
Calwa Overhead at Fresno	193,000
Livingston Underpass	232,000
Turlock Overhead	295,000

Opening this link in the main highway (U. S. 99) between Sacramento and Los Angeles leaves one crossing at the southerly city limits of Fresno as the only remaining main line grade crossing on the route north of Los Angeles not yet separated.

Ribbon cutting scene at dedication of Turlock overpass. Left to right: Mayor Roy M. Day, Turlock; Assemblyman Hugh Donnelly, Betty Green, Director of Public Works Frank M. Clark, Shirley Raymus, Supervisor Charles C. Crowell, Highway Commissioner lener W. Nielsen, Fresno.

Proposed Cut-off Between Rio Vista and Lodi Will Shorten Distance 11.1 Miles

By R. E. PIERCE, District Engineer

THE Legislature of 1921 added a road to the State Highway System designated as Rio Vista to Lodi, which was described as follows:

> "The improved county road extending from the town of Rio Vista in the county of Solano to the City of Lodi in the county of San Joaquin, crossing the Sacramento River at Rio Vista, thence crossing Brannan, Andrus and Tyler islands to the San Joaquin County line between Tyler and Staten Island, thence crossing Staten Island to the main land in San Joaquin County on to the improved county highway in San Joaquin County; thence through Thornton in a general easterly and southerly direction to the City of Lodi."

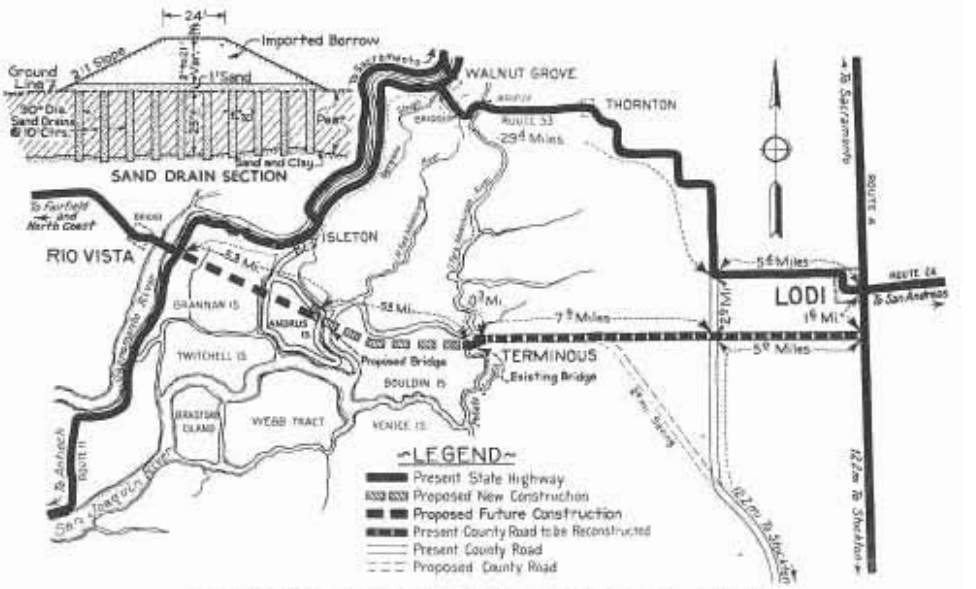
A glance at the map will indicate the very indirect and tortuous designated route that was followed. The stretch from Isleton to Walnut Grove along the top of the Sacramento River levee has never been improved beyond oiling the top of the levee, partly due to the fact that the levee is below the grade established by the State Reclamation Board and partly because a county-built paved highway extends between the same points on the other side of the river. This is also a State highway, having been taken into the State system in 1933.

In addition to the poor alignment, three drawbridges are involved; one across Georgiana Slough, one across the North Fork of the Mokelumne River, and one across the South Fork of the Mokelumne River. All these bridges are substandard in strength, width and speed, and all have sharp right-angle turns on their approaches.

In view of all the poor features of this road it was always considered more as a local road and a more direct route has been under consideration for many years.

In 1933 the Legislature changed the 1921 act, omitting any reference to intermediate points; simply tieing in from Rio Vista to the State highway near Lodi.

Following this a general route was decided upon, using the existing



Sketch map shows proposed Rio Vista-Lodi cut-off.

county road known as the Kettleman-Terminous Road from Terminous to Route 4, south of Lodi. From Terminous to Rio Vista it was planned to run by a very direct route across Bouldin, Andrus, and Brannan Islands. During the 1935-37 biennium the first unit on the new location, a drawbridge across Potato Slough at Terminous and the east approach was constructed. This eliminated a county operated ferry here, but due to there being nothing but a few miles of indifferent county road along the levee on Bouldin Island, its use was limited to local traffic.

Nothing further was done during the 1937-39 biennium.

In the present biennium funds have been set up to build the road across Bouldin Island and construct a drawbridge across the Mokelumne River. A short section of road to the west of the bridge is planned to connect with the county road leading to Isleton from whence the present paved State highway from Isleton to Rio Vista will be used temporarily, until funds are available to finish the direct route to Rio Vista.

During the construction of the east approach fill to the Potato Slough bridge considerable difficulty was experienced after the fill was ten to twelve feet high by rapid settlement and heaving of the peat land on either side, as well as a movement of the Slough levee towards the channel. This seemed such a threat to the safety of the levee that any further filling was stopped and a pile trestle, 327 feet long, was placed from the levee easterly.

The Highway Testing Laboratory personnel have for some time been installing the so-called sand drains as a means of achieving a more rapid stabilization of unstable soils under fills. It was considered that an excellent opportunity is available here for comparing the effects of using these drains on the new west approach to the existing Potato Slough Bridge with the fill on the east approach built without sand drains.

If the test proves effective it is thought that most, if not all, of the trestle approach originally planned here and on the two approaches to

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"Burning of the Minnie A. Caine"

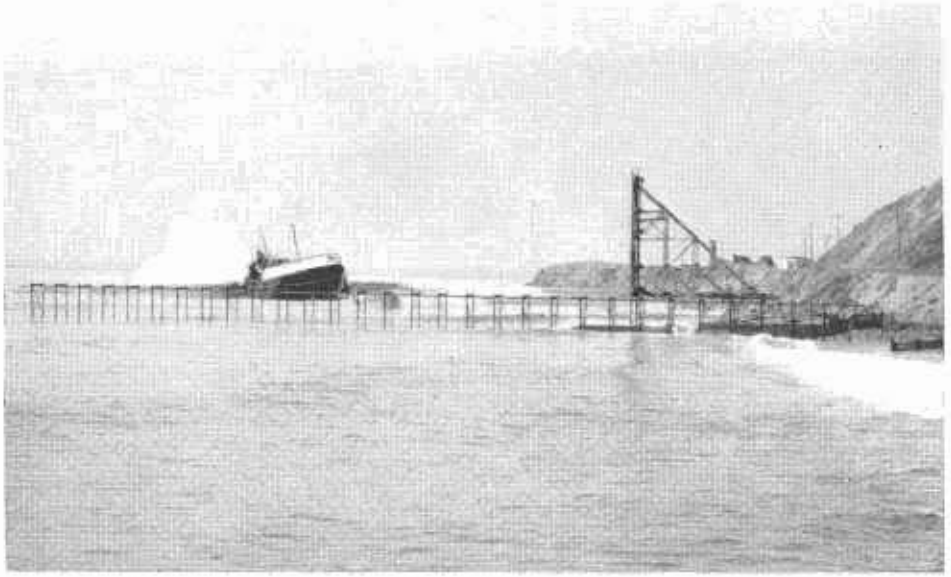
IN THESE days of sea battles and scuttling of ships, it is no wonder if residents of the Santa Monica Bay district, who might have been awakened in the early morning hours of December 22, 1939, were startled to see a two hundred fifteen foot vessel aflame from bow to stern, and only a few yards off shore. To the State Highway maintenance forces, however, even though the work was quite unusual, the burning of the "Minnie A. Caine" was only another one of those jobs that they might be called upon to do any hour of the day or night to protect our highways from destruction. The story goes like this—

The history of the "Minnie A. Caine," an 880-ton, four-masted schooner dates back to 1900, for, it was in that year this wooden windjammer was built in Seattle, Wash. It was in service between Seattle, Australia, South Africa and Japan for several years, but in 1931, Captain Olaf C. Olson purchased the boat, and anchored it six miles off the Santa Monica Pier where it was used as a fishing barge until September of 1939.

ROMANTIC HISTORY

Some of the earlier romance of the boat is told in a novel written in 1929 by Joan Lowell and titled "The Cradle of the Deep." In it, she states that her father was captain of the boat, and described some thrilling adventures that occurred during the first seventeen years of her life that she was on board the ship, and that finally the "Minnie A. Caine" had burned at sea. However, in an interesting article appearing in the December, 1939, issue of the Readers Digest, it was brought out that shortly after the book was published, its claim to authenticity had been questioned, and it soon developed that the boat had not actually burned as related in Miss Lowell's book, but was still on the seas.

In fact, the "Minnie A. Caine" was still in use as a fishing barge until the afternoon of September 24, 1939, when, following directly upon the break of four days of unprecedented hot weather in Southern California, a storm of hurricane proportions struck the Malibu coast north of Santa Monica, and the boat broke its anchor chain in the seventy-mile-an-hour gale, and drifted northerly some seven miles until it grounded approximately one hundred yards from Roosevelt Highway, near the intersection of Sunset Boulevard.



Menacing sandbar was forming between ship and shore when this picture was taken

WRECK ENDANGERS HIGHWAY

All of the patrons of the boat had been removed by small boats before the worst of the storm struck, leaving Captain Olson and five members of the crew aboard. A most spectacular and heroic rescue was made by members of the Life Guard Service in getting these six men to shore. Captain Olson was the last man to leave the boat.

When the storm abated, tugs attempted to pull the barge from the sands, but were unsuccessful. The vessel, therefore, remained in this position, and it was only a few days before the ocean built a sand bar

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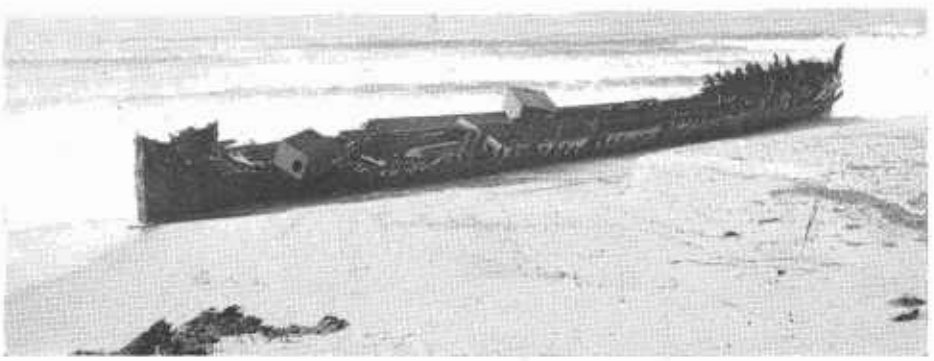


All that remained of "Minnie A. Caine" after burning

Painting Problems Involved In Maintenance of Bay Bridge

By C. S. HAMILTON, Associate Bridge Engineer

BACK in 1935 when it came time to paint the San Francisco-Oakland Bay Bridge, then approaching completion, there was considerable speculation as to what effect salt spray, fog and weather conditions generally would have upon the paint formulae specified for use.

Application of the fourth coat on the original contract started in June, 1936, and was about finished by the end of the year; hence, a large percentage of the bridge surface has had a service exposure of approximately three and one-half years.

During 1936, about 60,000 gallons of paint were applied under the original painting contract. It was to be expected that with such a volume of paint and the urgency of completion under often adverse weather conditions, and conflict with concurrent contracts, occasions would arise on which a 100 per cent performance from the application viewpoint would be impossible. With this perspective, it is not exaggeration to say that the materials and procedures contemplated by the contract specifications have been entirely satisfactory.

The bridge was opened to traffic on November 12, 1936, and as of March 31, 1940, a total of 32,680,961 vehicles have crossed the structure.

MAINTENANCE BEGAN IN 1937

Maintenance painting operations were started on October 1, 1937, with a small crew of one foreman and ten painters. This force has been increased at intervals and the present crew now numbers two foremen and thirty painters. The present conception of the maintenance problem contemplates an ultimate crew of about forty-five painters. It is expected that this complete force will be gradually built up in the next two years.

The present condition of the painted surface fully justified the initial preparation of the surface for painting by thorough sandblasting, and the selection of the formulae for the various coats.

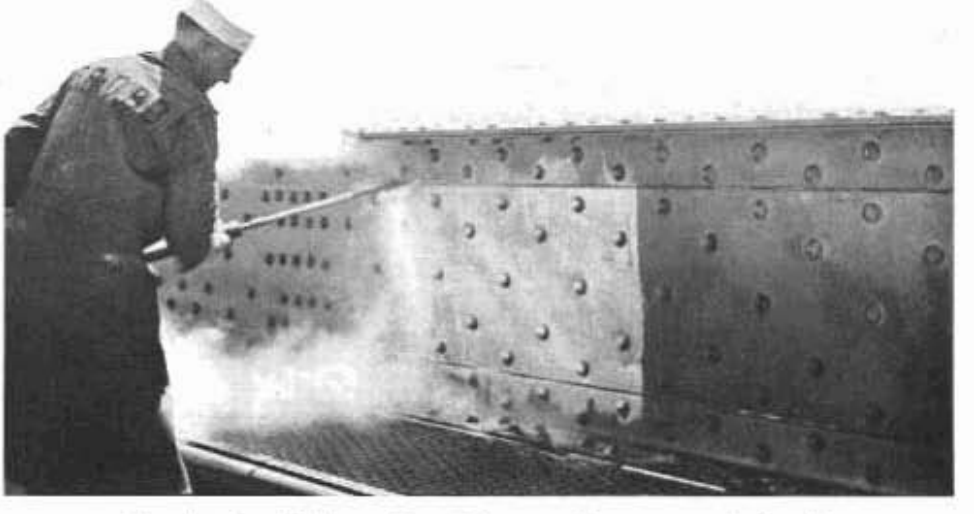
Some failures have occurred but the percentage of the total surface affected to date has been gratifyingly small and distinctly not of a nature to cause alarm. Certain of these failures, by virtue of complete job records, can be traced to conditions pertaining to the time of application and are obviously of small concern when confined to minor areas. Failures of this characteristic type would not raise the question of adequacy of either materials or technique.

Other types of failure, again of small extent, can be attributed to improper selection of materials for the particular exposure. One such type is the breakdown of paint film from the action of salt spray on the lower deck roadway steel on the low truss spans at the Oakland approach. Another is the breakdown of film on certain well-defined areas on the upper deck floor system which is attributed to acid corrosion arising from SO_2 present in the exhaust gases of diesel trucks operating over the lower deck of the bridge.

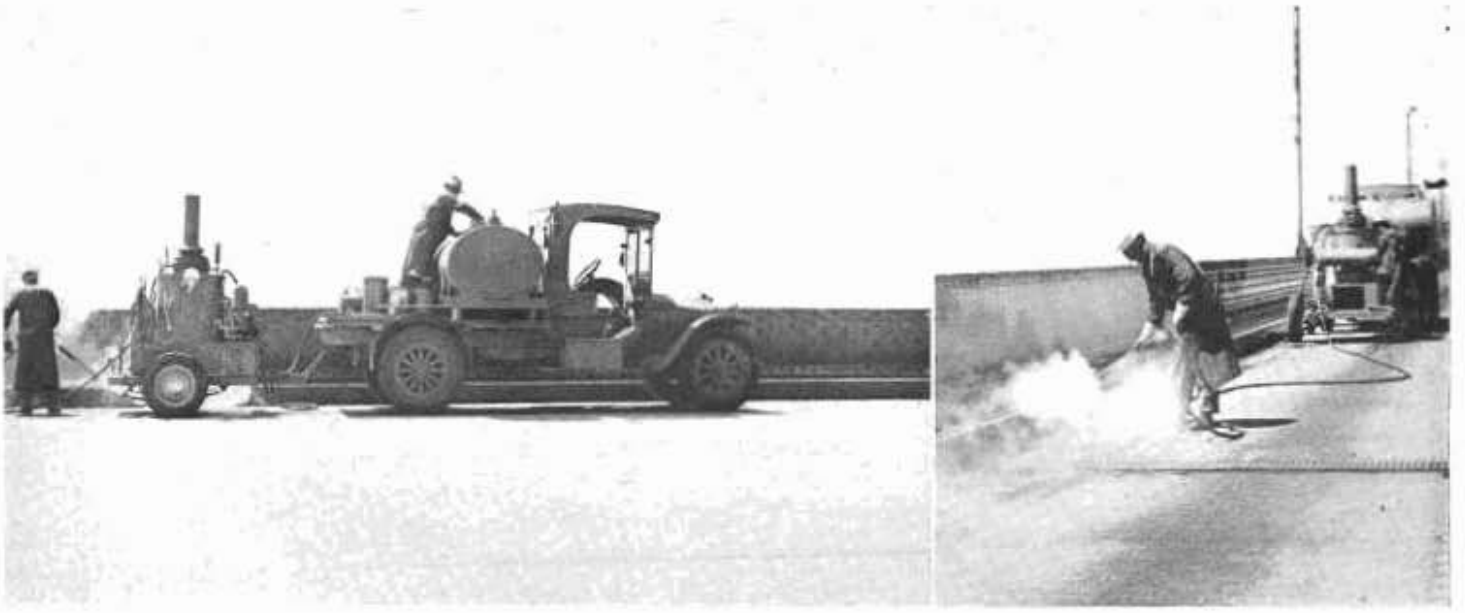
Both of these latter type failures could hardly have been anticipated prior to service experience nor, if anticipated, could the limits of surface liable to such attack been so well defined as to warrant a change in materials to protect those particular areas. Observation and correction of both conditions is the proper function of maintenance.

NEW FORMULA ADOPTED

In the case of the salt spray attack, this is largely accomplished at the present time by the substitution of coal tar products for metal oxides in the vulnerable areas. In the case of the areas affected by SO_2, the breakdown noted had seldom proceeded beyond the two top films. This indicated a change in formulation of the final coat to provide increased acid resistance. Experience of approximately one and one-half years with the new formula can



Cleaning Bay Bridge surfaces before applying new coat of paint



These pictures show painting crews at work on San Francisco-Oakland Bay Bridge.

hardly be conclusive but has indicated a satisfactory performance.

In a few instances a graphite paint has been applied as a final coat on parallel surfaces for comparative test. A small amount of this was purchased by brand name and the remainder under standard specification of the Division of Highways of the State of California.

Experience to date with the red lead and oil paints for the first three coats has been generally satisfactory. The slow drying characteristic operates to reduce the available suitable painting weather for these paints but maintenance painting can generally be scheduled to overcome this objection in part. The lead and oil formulae of the original contract are being used on maintenance and no change is contemplated at this time.

CLEANING NECESSARY

One of the problems of maintenance painting is the preliminary cleaning of the surface prior to paint application. Obviously this is necessary in any location but even more pertinent in a location similar to the San Francisco-Oakland Bay Bridge where, in addition to normal dust, surface deposits have a high soot content from industrial plants and salt deposits from marine spray. This preliminary cleaning may average better than fifty per cent of the cost of maintenance painting.

For the past six months, the bridge has been cleaning accessible surfaces

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Bay Bridge Traffic Again Increases

MARCH vehicular traffic on the San Francisco-Oakland Bay Bridge continued to set the high pace which was first notably evidenced in February, Director of Public Works Frank W. Clark reported to Governor Olson.

"Increased traffic," Clark said, "apparently coincides with materially improved general business conditions in the bay area as reported by the San Francisco Chamber of Commerce and of course the reduced tolls have had their beneficial effect. Gross traffic for the month was 964,360 vehicles, as compared with 822,914 a year ago. This is an increase of 17 per cent. If the traffic to Treasure Island is eliminated the growth is even greater and increased from 658,272 in 1939 to 945,895 in 1940. This increase is 43 per cent."

The total tolls collected were less than the revenues for the same month a year ago. In March, 1939, $422,904 were collected, and this year, $354,816.

The San Francisco-Oakland Bay Bridge was only exceeded by the Delaware River Bridge in Philadelphia in traffic carried in February and undoubtedly maintained this position in March. The comparison with other leading toll structures of the United States for February is shown below:

Structure	Vehicles Carried February, 1940
Delaware River Bridge, Philadelphia	877,502
San Francisco-Oakland Bay Bridge	842,070
Holland Tube, New York	786,638
Triborough Bridge, New York	579,160
George Washington Bridge, New York	420,137
Golden Gate Bridge	260,882
Lincoln Tube, New York	246,330

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

	March 1940	March 1939	February 1940	Total Since Opening
Passenger autos and auto trailers	879,559	738,813	767,371	30,091,658
Motorcycles and tricars	3,301	3,037	2,699	138,173
Buses	17,990	15,705	15,380	490,791
Trucks and truck trailers	46,612	47,138	40,984	1,448,443
Others	16,898	18,221	15,636	511,896
Total vehicles	964,360	822,914	842,070	32,680,961

Deaths in Traffic on Increase

Traffic deaths are going up again! A nation-wide survey revealed that the traffic death toll in February increased 10 per cent over the corresponding month in 1939, marking the fifth consecutive month in which the total has exceeded the same month of the preceding year.

Motor vehicle fatalities in February totaled 2170 lives, an increase of 200 over the 1970 deaths in February, 1939, the sharpest increase registered since March, 1937. For the first two months of this year 4800 persons were killed, a 5 per cent increase over 1939.

More Improvement on U. S. 50 East of Folsom Is Undertaken

WORK is now under way on another unit of the contemplated reconstruction on the Sacramento to Placerville section of Transcontinental Route U. S. 50 and it is anticipated that traffic will be routed over the new work early this fall.

This is the second unit and is located in Sacramento and El Dorado counties, between 3¾ miles east of Folsom and 2¼ miles east of Clarksville. The first unit, extending from 1¼ miles west of El Dorado to Clark's Corner, was completed in 1938 and covered by articles in "California Highways and Public Works" in December, 1937, and July, 1938.

The existing road which will be superseded by the present construction consists of a 12-foot x 4-inch portland cement concrete pavement, the Sacramento portion of which was built in 1915 and the El Dorado County portion in 1920.

In 1929, 3-foot x 4-inch oil-treated rock borders were added. There are many short radius horizontal curves, some with radii as short as 100 feet, and many sharp vertical curves with very limited sight distance.

The narrow width and poor alignment and grades make the present road entirely inadequate to meet the traffic requirements of the larger numbers of cars and the higher speeds which now prevail.

INCREASED TRAFFIC

During the summer months the ordinary commercial and passenger traffic between Sacramento and Placerville is greatly augmented by and increasing amount of travel to the American River and Lake Tahoe recreational areas. Due to the increasing popularity of snow sports during the past few years the winter

Shovel engaged in heavy excavation work in rock cut on realignment east of Folsom.

This is another view of construction on U. S. 50 between Folsom and Clarksville in El Dorado County.

traffic has also increased.

In order to meet more adequately the demands of this increased traffic traveling at higher speeds, the new road has been generally designed for a minimum passing sight distance of 1,600 feet and a minimum non-passing sight distance of 350 feet.

At one vertical curve, where it was impossible to obtain the desired sight distance, four traffic lanes were provided in order to maintain the same design standard as was used for the rest of the project. The minimum radius of curvature is 1,500 feet except at the connections to the old road and the maximum grade rate is 7 per cent. The new alignment is much more direct than the old, resulting in a distance saving of about 1.9 miles. The total length of the new project is 5.84 miles.

The project is being surfaced with plant-mixed surfacing, 22 feet by 0.21 feet, on crusher run base 23 feet wide by 0.4 of a foot thick. Preliminary investigations and soil tests of material to be encountered in roadway excavation indicated that over a large part of the project it would be necessary to cover the inferior materials for the full roadbed width with a layer of selected material before placing the crusher run base and surfacing. This material is being selected from roadway excavation within the limits of the project.

Drainage facilities required are mostly of standard types. There were several springy areas within the limits of the project where perforated metal pipe underdrains were provided to care for the drainage. During construction several more areas of this type were encountered and it has been necessary to increase the amount of underdrain construction considerably.

At the crossing of Carson Creek, after a comparative study of several types of structures, it was decided that the most economical installation would be a triple 10-foot x 10-foot reinforced concrete box culvert, 103 feet in length. Due to the excellent foundation conditions, it was possible to eliminate the customary bottom slab in designing this structure.

The contractor is making rapid progress on the project and it is now anticipated that the grading will be completed about May 1 and that the entire contract will probably be finished in August.

The total cost of the project will be about $240,000. The contractor is the firm of Hemstreet and Bell and the resident engineer for the State is Mr. J. W. Corvin.

State Highways Suffer Severe Damage

(Continued from page 5)

During a storm it is possible to limit the damage by keeping drainage channels clear, removing drift which might clog or damage structures, and similar preventive measures. Every man not required for the protection of traffic was assigned to this work. At least $20,000 was expended during the storm period simply for protection of traffic and the highways.

During and immediately after the storm work was concentrated at points on major traffic routes where serious damage blocked the road. A few such cases may be mentioned:

At Brisbane, on the Bayshore Highway south of San Francisco, some 60,000 cubic yards of material from the landslide at that point came into the road section, blocking three lanes of this four-lane road. This road carries an average daily traffic of approximately 25,000 vehicles and interference with the free flow, even for a few hours, is a serious matter. The slide occurred at 2 o'clock in the morning and before daylight a large power shovel and trucks were at work on its removal. It was necessary to handle this heavy traffic under one-way control for a two-day period.

At Scotia bridge on the Redwood Highway, high water in the Eel River undermined the footings of two bents and 75 feet of the north approach collapsed. This blocked through traffic on this important route, as the only available detour was difficult even for passenger cars and impossible for heavy trucks. The collapse occurred during the night of February 28. The replacement trestle, which is some 60 feet in height, was placed in service March 4.

Most of the interference with traffic in the Colusa and Meridian territory was due to flood water from the Sacramento River which escaped through breaks in the levee system. Damage to the State highways from this source was negligible in comparison to losses sustained by reclamation districts and private property in that area. There was, however, considerable damage by streams immediately tributary to the Sacramento River in Glenn and Butte counties.

Hambright Creek overflowed north of Orland and damaged the bridge approaches and portions of U. S. 99 at that point. At Stony Creek Bridge on State Highway Route 47, west of Hamilton City, about 200 feet of the approaches and the slope protection was washed out. Between the Sacramento River and Chico on the same route, the south shoulder and portion of the pavement was washed out to a depth up to four feet for a distance of two miles by the overflow from Pine Creek and other streams. The cost of repairs on this route is estimated to be $15,000.

BRIDGES WASHED OUT

East of Butte City, on State Highway Route 45, two bridges, totaling 240 feet in length, were washed away. One of these was over the Sacramento River Overflow Channel and the other over Big Butte Creek Overflow. Approaches to two other bridges and considerable road surfacing were lost on this same section. The damage was due primarily to flood waters which escaped from the Sacramento River. Nearly $38,000 will be required to restore damaged road and structures on the 32 miles on this route, or an average of nearly $1,200 per mile.

For the balance of the State highway routes in the Sacramento Valley, from the Shasta County line in the north to the Solano County line in the south, some $15,000 will be required for repairs at scattered locations. This, of course, does not include cost of excessive repairs to road surfaces which will develop on many sections as a result of the inundation and saturation of the surface and subgrade.

There are occasional unusual accidents which incur heavy expense. A case in point is the damage to both trusses of the Douglas City Bridge across the Trinity River on Route 20. A gold dredge washed from its working pond some distance above the bridge, broke the lower chord of one truss, bent the same member of the second truss, and otherwise damaged the bridge before wrecking itself again a pier. The cost of repair of the bridge is estimated at $50,000.

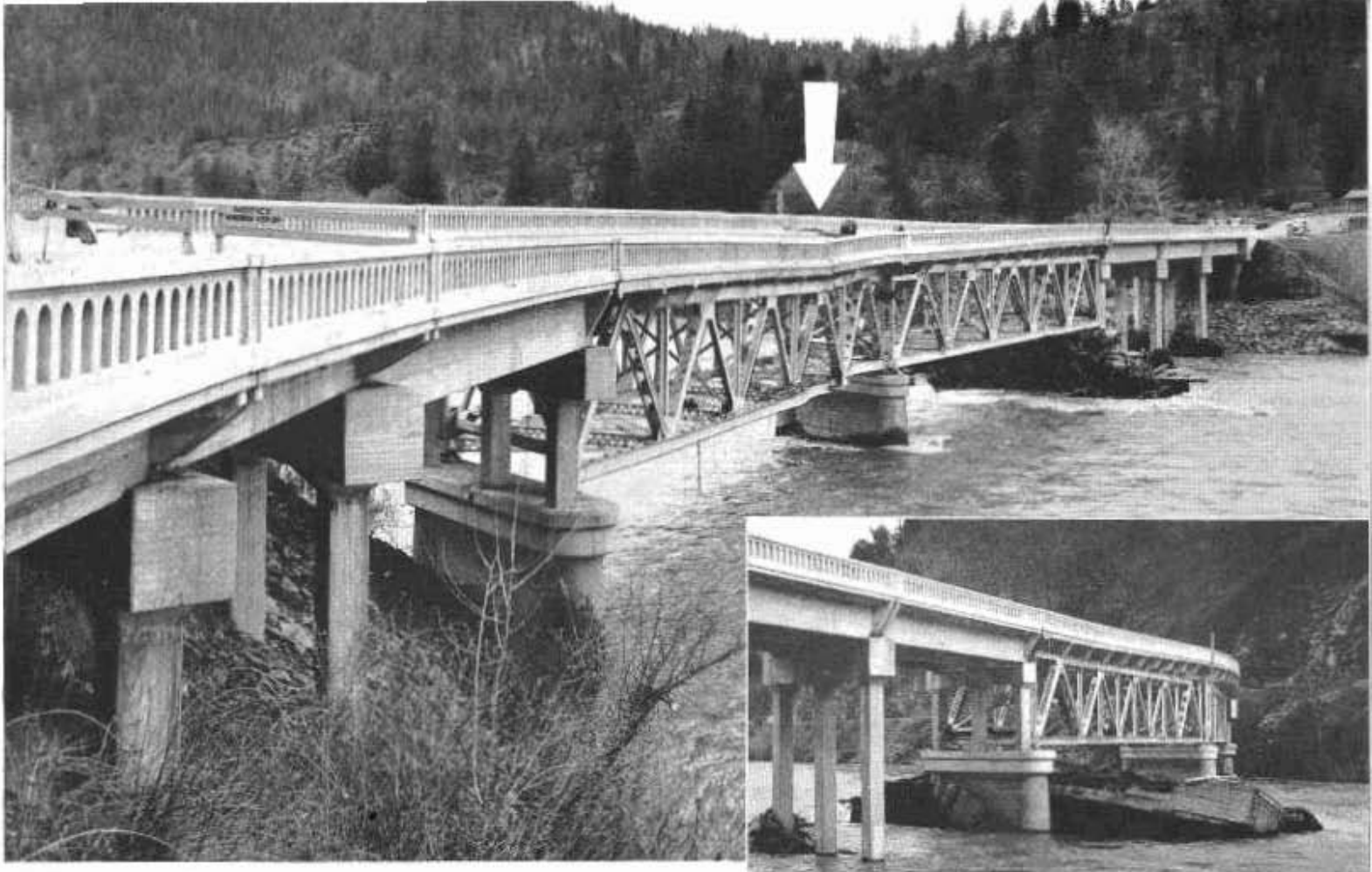
The estimates for restoration of road and structure damages include an allowance for correction or protection work wherever it appears such work will prevent recurrence of the damage. Naturally, severe flooding of slopes and fills and excessive amounts of water in the soil caused failures at locations which appeared entirely safe. At other places, the possibility of damage was inherent in the construction.

TRAFFIC DEMANDS

The demands of motor traffic for highways on high standards of alignment and grade have brought about construction of deep cuts and heavy fills. The most desirable locations in rugged country are usually immediately adjacent the major stream, and frequently are over unstable ground. In such circumstances the extent of measures at the time of construction to insure against slides or slipouts is debatable. Frequently, if full correction or protection were undertaken at the time of construction, the improvement could not be undertaken for lack of funds. More attention is constantly being given to doubtful situations prior to and during construction of new roads. The fact remains, however, that a certain amount of trial and error has been well justified in the past in work of this kind. It is more economical in the long run to suffer a certain amount of damage and inconvenience during the stabilization of cut slopes, for example, rather than expend the extra amounts required to flatten all slopes at the time of construction. It must be remembered, also, that experience of high water stages may be misleading.

FEATHER RIVER HIGHWAY

During the eight-year period that construction of the Feather River Highway was under way, there was no indication that the road would be endangered by high water. It was expected that heavy slides would develop during the weathering of the slopes, but the damage that occurred both in 1937 and 1940 could not reasonably have been guarded against. Once a heavy fill section has been lost by slipout the cost of correction is bound to be greater than any casual inspection would indicate. The simple



Flood-Damaged Highway Bridge across Trinity River near Douglas City. Arrow points to weakened section.

This view shows wrecked dredger washed against bridge piers.

process of replacement of the fill is out of the question. The added load on the unstable foundation would only make future trouble more certain.

A case in point is the slipout on the Redwood Highway north of Cloverdale. Nearly 300 feet of the road settled 30 feet at this location. Before cost of correction can be estimated accurately or work undertaken, it is necessary to determine the elevation of the slippage plane and of firm ground. Well borings are now being taken for this purpose. If foundation material is found at any reasonable depth, the correction work will consist of removal of the overlying unstable material. Backfilling will consist of a layer of rock perhaps five feet in depth for the full width of the fill, including suitable drains. The fill can then be replaced with assurance that the road will not again slip out.

The financing of repair of damage such as occurred in both 1937-38 and the recent storm is a serious problem. All funds estimated to be available during a biennial period are budgeted well in advance and all programs of work are planned accordingly. Reserves for slide removal and repair of storm damage are provided, but only on the basis of a normal year. A damage of one and one-quarter million dollars in a five-day period is beyond normal expectancy. Because of the location and nature of the damage this year, very little of the repair work can be deferred.

The Federal Government, in recognition of its responsibility in connection with the Federal Aid road system, has provided a fund to assist the States in financing repair of damage resulting from extraordinary storms. Their regulations restrict the use of such funds to replacement of fills and structures which may be washed away or destroyed, including correction and protection to prevent recurrence of the damage. Unfortunately, from the State's point of view, only a limited number of projects can qualify under these regulations, which include the further requirement that the State shall contribute at the same rate as on regular Federal Aid work. In California, this rate is 42 per cent of the cost. The estimated cost of projects which qualify under the regulations is $583,499. Even with Federal assistance, however, a very small reserve is available to carry on storm damage repair for the next fiscal year. It is evident that adjustments must ultimately be made in the program to provide further funds before the 1940-41 winter season.

The damage in the Sacramento Valley area has been described in some detail because of the very large flooded area. The damage in all areas is listed by routes in the accompanying tabulation. The estimates given are approximate, based on experience with similar work, pending opportunity to make surveys and study measures to be taken at the points of major damage. The amounts required may be increased or decreased when more complete detail is available.

Cost of Repairing and Replacing Highways and Bridges Da

Route	Limits	Type of Work: Slide removal	Bridge repairs or replacement	Replacement, washouts, slip-outs and other work	Total
District I—Eureka					
1	Sonoma Co. line to Oregon line	$25,025	$5,000	$172,855	$202,880
15	Jct. Route 1 to Colusa County line	7,175	------	19,945	27,120
16	Hopland to Lakeport	7,000	------	1,700	8,700
20	Arcata to White Bar Creek	2,000	------	2,500	4,500
35	Alton to Peanut	4,000	------	1,000	5,000
46	Weitchpec to Hamburg	------	------	2,000	2,000
48	Navarro River to Sonoma County line	5,250	------	1,250	6,500
49	Sonoma County line to Jct. Route 15	800	------	1,550	2,350
56	Sonoma County line to Westport	3,350	7,900	900	12,150
70	Ukiah to Talmadge	900	------	200	1,100
81	Jct. Route 1 to Jct. Route 71	200	------	------	200
84	Willow Creek to Weitchpec	------	------	1,000	1,000
89	Middletown to Upper Lake	1,100	------	5,900	7,000
	Subtotals	$56,800	$12,900	$210,800	$280,500
District II—Redding					
3	Glenn County line to Oregon line	$2,500	$33,600	$9,160	$45,260
7	Glenn County line to Red Bluff	------	------	1,150	1,150
20	White Bar Creek to Millville	10,225	94,100	213,980	318,305
21	Jarbo Pass to Jct. Route 29	12,000	------	68,550	80,550
28	Redding to Nevada State line	1,325	200	5,990	7,515
29	Peanut to Jct. Route 73	2,950	------	5,110	8,060
35	Peanut to Douglas City	2,500	------	2,500	5,000
46	Hamburg to Jct. Route 3	1,380	------	50	1,430
47	Butte Co. line to Jct. Route 29	------	------	2,000	2,000
72	North of Weed	------	------	325	325
73	Jct. Route 29 to Oregon line	400	------	2,675	3,075
82	Etna to Jct. Route 3	175	------	------	175
83	Jct. Route 21 to Jct. Route 29	4,700	------	28,855	33,555
209	Shasta Dam to Jct. Route 3	------	------	1,000	1,000
	Subtotals	$38,155	$127,900	$341,345	$507,400
District III—Marysville					
3	At Sacramento & N. of Biggs	------	------	$600	$600
6	Napa County line to Sacramento	------	------	5,000	5,000
7	Jct. Route 6 to Tehama Co. line	------	------	2,550	2,550
15	Lake County line to Williams	$1,400	------	650	2,050
17	At Wise Power House	290	------	------	290
11	Walnut Grove to Hood and Sportsman Hall to Strawberry	1,140	------	1,600	2,740
21	Oroville to Jarbo Pass	1,500	------	------	1,500
25	Nevada City to Downieville	2,160	------	------	2,160
37	Colfax to Gold Run	75	------	450	525
38	Near Floriston & Eagle Falls	750	------	------	750
45	Willows to Jct. Route 3	------	$15,200	2,900	18,100
47	Orland to Chico	------	------	15,300	*15,300
50	Jct. Route 15 to Sacramento	8,000	------	30,750	38,750
65	Placerville to Auburn	225	------	------	225
83	North of Sierraville	------	------	300	300
87	Woodland to Oroville	------	------	1,660	1,660
88	Jct. Route 87 to Jct. Route 15	------	------	2,750	2,750
90	Winters to Madison	------	------	1,750	1,750
	Subtotals	$15,540	$15,200	$66,260	$97,000
District IV—San Francisco					
1	Golden Gate Bridge to Mendocino County line	$6,000	------	$103,000	$109,000
5	Santa Cruz to Los Gatos	5,000	------	------	5,000
	Hayward to Mountain House	2,500	------	------	2,500
6	Napa to Calistoga	4,500	------	3,400	7,900
14	Richmond to Pinole	2,500	------	5,000	7,500
32	Watsonville to Merced County line	5,250	------	------	5,250
42	Big Basin to Waterman Gap	2,700	------	3,000	5,700
44	Boulder Creek to Big Basin	1,800	------	------	1,800
49	Calistoga to Lake County line	1,250	------	------	1,250
51	Sebastopol to Shellville	------	------	2,200	2,200
52	Alto to San Quentin	200	------	------	200

* Revised estimates for bridge replacements has increased this item to $38,000.

maged During February Storms Will Amount to $1,267,200

Route	Limits	Type of Work: Slide removal	Bridge repairs or replacement	Replacement, washouts, slip-outs and other work	Total
District IV—San Francisco—Continued					
55	South of Saratoga Gap	------	------	$500	$500
56	Watsonville to Sonoma County Line	$17,000	$1,000	70,700	88,700
56	Jenner to Mendocino County line	5,750	2,000	5,000	12,750
67	Watsonville to Monterey County line	1,500	------	------	1,500
68	At Brisbane and Francisquito Creek	12,000	------	1,000	13,000
69	San Quentin to San Rafael	100	------	600	700
102	Rutherford to Jct. Route 6	4,500	------	------	4,500
103	Geyserville to Calistoga	1,000	------	400	1,400
104	Jenner to Shellville	8,650	------	32,000	40,650
105	Half Moon Bay to San Mateo	400	------	------	400
106	Pinole to Martinez	2,500	2,000	------	4,500
107	Dublin to Sunol	500	------	------	500
108	Mission San Jose to Livermore	1,000	------	------	1,000
116	Santa Cruz to Waterman Gap	11,600	------	------	11,600
	Subtotals	$98,200	$5,000	$226,800	$330,000
District X—Stockton					
7	Vallejo to Yolo County line	$6,000	------	$1,500	$7,500
8	Napa County line to Cordelia	500	------	------	500
53	Rio Vista to Suisun	------	------	300	300
74	Benicia to Vallejo	300	------	------	300
90	Vacaville to Yolo County line	------	------	1,000	1,000
99	Rio Vista to Ryer Island Ferry	------	------	27,000	27,000
101	Jct. Route 53 to Dixon	------	------	1,000	1,000
208	Black Point to Vallejo	------	------	500	500
65	Amador County line to Tuolumne County line	600	------	------	600
65 & 13	Vicinity of Sonora	600	------	------	600
65 & 40	Vicinity of Groveland	2,500	------	------	2,500
18	Merced to Yosemite Nat'l Pk.	7,000	------	------	7,000
4 & 5	San Joaquin and Stanislaus Counties	------	------	3,000	3,000
23 & 24	In Alpine County	500	------	------	500
	Subtotals	$18,000	------	$34,300	$52,300

COMPLIMENT FROM NEVADA

State of Nevada
Department of Highways
Division of Traffic and Safety
Carson City, Nevada

Department of Public Works,
Sacramento, California.
Attention: John W. Howe, Editor.

Dear Sir:

We have just received the two copies of your January issue of "California Highways and Public Works." Needless to say, the writer, as well as others in the Traffic and Safety Division, has consistently admired the way in which this publication is issued and we consider it a privilege to be included on your permanent mailing list.

Again thanking you for the courtesy extended, we remain

Sincerely yours,

ROBERT A. ALLEN,
State Highway Engineer.

By: (Signed)

BERNARD C. HARTUNG,
Director Traffic and Safety Division.

Beauty Preserved

The outdoor advertising companies of Austin have agreed to preserve the scenic beauties of the drives along the Colorado River. The companies agreed not to erect any signs of any description along the many miles of road leading from Austin to the Marshall Ford Dam so that the beauty of the countryside will not be marred. The agreement was made voluntarily by the companies. The absence of signs should make Austin's scenic drives among the most beautiful in the state.—*Texas Parade.*

Small Boy—Daddy was run into by an automobile and he wants to know if you'll let him have groceries on credit?

Grocer—Has he got a good lawyer?

Mike was smoking in the waiting room of a railway station. A porter said to him: "Don't you see that notice on the wall: 'No Smoking Allowed?'"

"Yes, I do," answered Mike, "but how can I kape all the rules? There's another sign on the wall, 'Wear Beauty Corsets.'"—The Tennessee Road Builder.

APPRECIATES MAGAZINE

Los Angeles, Calif.

March 21, 1940

Editor California Highways
and Public Works,
Sacramento, California.

Dear Sir:

Will you please continue sending me your Official Journal of the Division of Highways and Public Works. I have found much valuable information in this publication relative to our great highway system and some of the problems encountered by your Department to make our great state one of the easiest to travel in.

If more of our citizens knew more about how much your department accomplishes for the good of the state there would be less "crabbing" about the taxes they are asked to pay. Thank you for last year's issues.

R. HAASE,
3935½ La Salle Ave.,
Los Angeles, Calif.

"With a single stroke of a brush," said the school teacher taking his class around the art gallery, "Joshua Reynolds could change a smiling face to a frowning one."

"So can my mother," said small Willie.

"Burning of the Minnie A. Caine"

(Continued from page 17)

between it and the shore. The craft and the sand bar then acted as a groyne, and early in December, 1939, heavy swells accompanying high tides caused the waves to start battering and cutting into the highway embankment for a distance of approximately seven hundred feet. Cutting action continued for four days, and decreased only after five hundred tons of rip rap had been placed at the toe of the slope, but almost four thousand cubic yards of berm and shoulder had already been washed out to sea.

A study of the wave action during high tides indicated very clearly that the ocean swells striking along the port side of the ship diverted the water and caused a concentration of wave action at the point where the highway was being damaged. It was then realized that the ship was a serious menace to the highway, and should the high tides, which were forecast to recur about the last of December, be accompanied by a strong wind, the entire highway would be threatened at that point. Immediate steps were taken to have the menace removed.

While "Minnie A. Caine" was forming sand bar, tidal currents threatened highway.

BOAT SET AFIRE

It was decided that the most satisfactory way to dispose of the boat under the circumstances was by burning. The matter was discussed with Captain Olson. His approval was secured, and he offered to cooperate with the Division of Highways maintenance forces. As soon as abandonment papers had been filed by Captain Olson, and the necessary permits secured from several agencies, final arrangements were made for the conflagration.

Weather service bureaus were consulted, and they advised that conditions would be most favorable for burning on the night of December 21, 1939, when an off shore breeze would be blowing. Plans were therefore laid for the burning at that time, and during the evening six hundred gallons of fuel oil and gasoline were spread over the boat. By 1 a.m. everything was in readiness for the blaze. All cars and onlookers were cleared from the highway for a distance of two hundred yards each way, and a gasoline soaked rope which had been laid over the deck and out across the sand bar was ignited. There was no explosion, and the flames spread over the boat very slowly. By daylight the deck and a portion of the stern had burned, but the hull was not much more than charred.

BEACH LINE RESTORED

As it became evident during the morning that if more oil was not added, the flame would soon go out, leaving the hull still in a position to continue to deflect the surf and cause further erosion, additional quantities of the fuel were rushed and pumped into the ship that afternoon. This time, fifty-four hundred gallons of crude oil were fed to the flames, it immediately ignited, and in a few minutes the hull was burning rapidly. The heat was terrific, but the hull which was twenty-seven inches thick was also water-soaked, and in order that the burning would be complete, another twenty-eight hundred gallons of oil was ordered, and pumped into the fire later that day. The following morning, the ship was burned to the sand line, leaving only the keel and a small portion of the hull below the water. What fire remained was quenched as soon as the tide came in, but the fire had now done its work. The days of the once proud and sturdy "Minnie A. Caine" had come to an end.

The waves of the incoming tide washed the sand from within and around the keel, and it started to float. This allowed the shore currents to work on the offending sand bar, and in three days it was entirely removed. The keel by that time was washed up to within thirty-five feet of the roadway embankment to a point where it was no longer a menace. With these obstructions removed, it was only a few days more before the eroded beach was rebuilt to normal by the addition of almost four feet of sand, and the task was then considered successfully completed.

This work was done in District VII, in which S. V. Cortelyou is the District Engineer.

The Evolution of Cement

(Continued from page 12)

mate mixture of chalk and clay. This, being the first attempt to modify or control the composition of the raw material, might be considered as the principle forerunner of the manufacture of portland cement.

ASPDIN INVENTS PORTLAND CEMENT

In 1824, Joseph Aspdin, a Leeds, England, builder, was granted a patent for his process which consisted of calcining a mixture of quick lime and clay in a lime kiln, and crushing the resulting lumps into a fine powder. He used a much lower temperature than is now used, and his product must have been of an inferior quality.

Aspdin is usually credited with the invention of portland cement, a product which he named "Portland Cement," because it resembled the stone from the famous quarries at Portland, England.

Some time after this, Isaac Charles Johnson, another Englishman, observed that the ground overburned lumps in kilns, previously discarded, made much better cement than the usual product, although it was slow setting. Using these nodules as a basis for study, he found the correct proportions of limestone and clay to use for a higher type cement. In 1851 he took over the old deserted Aspdin plant, where he began to manufacture portland cement.

RECENT IMPROVEMENTS

It would appear that Johnson was the first to recognize the importance of the chemical composition of the raw material, and of the higher temperatures necessary for actual clinkering of the material. Basically his cements were very similar to those now used. The more recent improvements have been along the line of refinements in processes, the uniformity of products, and the modification of the chemical composition to meet special conditions.

Portland cement is defined as "the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous material, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum."

It is the purpose of this paper to unravel the above definition, and to put it in terms readily understandable by those not intimately concerned with the manufacturing of cement.

The manufacturing of cement starts at the quarries where the raw materials are found. These raw materials are of two types: (a) Calcareous, or those rich in calcium carbonate such as limestone, marl, or chalk, and (b) argillaceous, or those high in alumina, iron oxide and silica, such as clay, shale, slate, or slag. The proportions that are taken of these materials depends entirely upon their chemical composition being usually in the ratio of approximately 80 per cent lime to 20 per cent clay or shale. Occasionally a cement rock is found in which occur all of the elements necessary for cement. In such cases, only small additions are made to insure a product of uniform composition.

CALIFORNIA DEPOSITS

The raw materials in the quarries vary greatly with the location. In California the lime quarries vary from great deposits of nearly pure calcite to deposits of oyster shells under sea water. In any form they are all great storehouses of calcium carbonate ($CaCO_3$).

For the economical manufacture of cement, the quarry must be within an economical hauling distance for the mill, and the mill must be near a railroad.

Each company develops its own most suitable method of winning the material from the quarry. This varies from the "glory hole" method of mining, where the rock is blasted from the sides of the quarry to fall into great rock chambers, from whence it is gravity loaded into railway cars or trucks in tunnels underneath, to the barge hauling of material dredged from under water. One company mines its material from underground by the "block cave" method of mining. Another used endless belts to transport the raw material from the quarry to the mill. The most decisive factor in choosing the method of mining and of transportation is that of getting the material from the quarry to the mill at the least possible cost per ton.

WET AND DRY MIX PROCESSES

Once the raw material is at the mill, it is passed through crushers and various types of grinders which rapidly reduce it to a powder after which it is stored in bins.

There are two processes in use from this stage, the "dry mix" process, and the "wet mix" process. As the "wet mix" is slowly replacing the former type, perhaps it would be better to describe the "wet mix." The two methods differ essentially in the final stages of the raw material grinding, and the length of the kiln, it being nec-

(Continued on page 29)

Job Well Done

Throughout the "plague of waters" central and northern California has been suffering for the last week or so, two State departments have rendered outstanding service to the public.

They are the Highway Department and the Highway Patrol. Long hours, strenuous work under the most difficult conditions have meant nothing to the men of these two departments in their successful efforts to keep the highway open and SAFE for travel.

Except where the floods have entirely blotted out the roads, traffic, even in the stricken areas, has been kept moving in splendid fashion.

Orchids to both the patrol and the highway departments. They deserve 'em.

—San Francisco Call-Bulletin.

Lodi-Rio Vista Cut-off Will Be Mileage Saving

(Continued from page 16)

the Mokelumne River Bridge can be eliminated at a considerable saving in cost.

The laboratory under day-labor authorization has now completed the sand drains and the placing of certain equipment to record the progressive settlement of the fill, water pressure, etc.

A contract has been awarded to Mike Malfitano & Son of Pittsburg for placing 40,000 cubic yards of fill, which will be barged to the site and placed for a distance of about 3100 feet west of the bridge.

The special provisions for this contract provide among other things that the embankment nearest the bridge be done first, but the right is reserved to suspend the placing of embankment materials here when so ordered for a period not to exceed 12 days. During this time embankment materials may be placed on the westerly part of the job.

It is also provided that not over 500 cubic yards of embankment be placed in any 24-hour period and that the rate of placing shall not exceed 100 cubic yards per hour. Also after the first layer one foot in depth is placed all subsequent layers shall not be over four inches in depth. The reason for these stringent regulations is to prevent, if possible, the side displacement of the soil under the fill such as occurred during the construction of the east approach, several years ago.

The 30-inch vertical sand drains were placed in the easterly 1000 feet of the project, spaced on 10-foot centers, each alternate row staggered. They are approximately 25 feet in depth.

The completion of this entire project will be delayed until the results of this test section are known, as the length of the approach trestle to the new bridge planned over the Mokelumne River and the west approach to the existing Potato Slough Bridge and the height of the fill on the balance of the project will depend upon the results of this test.

The project when completed will shorten the distance from U. S. 99 near Lodi 11.1 miles and will shorten the distance from Stockton 12.7 miles. The ultimate project with a proposed county road change near Stockton will shorten the distance from Stockton to Rio Vista 14.7 miles.

In Memoriam

Harold Emil von Bergen

Harold Emil von Bergen was born in Petersburg, Nebraska, on July 7, 1904, the son of J. F. and Anna Schultz von Bergen.

He received his elementary and high school education in the public schools in the State of Nebraska; came to California after graduation from high school in 1924 and worked for a year in pipe line maintenance with the Pacific Gasoline Company in Taft. He entered Oregon State College in 1925, graduating therefrom with the class of 1929 with the degree of Bachelor of Science in civil engineering. He affiliated with Theta Chi social fraternity in college.

After graduation from Oregon State College, Mr. von Bergen was employed for nine months by the Reclamation Commission of the State of Oregon on drafting and dam analysis. He returned to California in March, 1930, and accepted a position as Junior Engineer of Hydraulic Structural Design with the Division of Water Resources, Department of Public Works, State of California, in connection with the administration of the recently enacted Act Governing the Supervision of Dams. He left the Division of Water Resources in July, 1933, and took a position with the U. S. Forest Service at Quincy, California, as chief of a surveying party, returning to the Division of Water Resources in March, 1935, as Water Master on the Pit River stream system.

Mr. von Bergen was a man of strong physique and gloried in the outdoor functions of his work. His untimely demise was due to accidental death in the line of duty by drowning when a boat capsized last February 28 while he was making a measurement of emergency flood flow in the Sacramento By-Pass.

Mr. von Bergen was married in Reno, Nevada, on April 1, 1934, to Frances Evelyn Rooney of Sacramento. He is survived by his widow and his daughter, Della Ann von Bergen, both of Sacramento, his mother, Anna S. von Bergen, five sisters, Alice von Bergen, Mrs. Katherine Ohlman, Mrs. Grace Jensen, Mrs. Elizabeth Phillips, and Mrs. Clara Meyers, and two brothers, Arthur and Max.

Harold Emil von Bergen was elected a Junior Member of the American Society of Civil Engineers on July 14, 1930, and in 1936 was elected an Associate Member.

Construction on Coast Highway is Under Way

(Continued from page 10)

vide sufficient width for the new alignment. The embankment has also been raised 18 feet above the old road at this location and widened to allow the new standard width.

At Latigo Creek, to provide drainage under the highway embankment, a 7 by 9-foot reinforced concrete arch 213 feet long has been constructed.

CENTER DIVIDING STRIP FOUR FEET WIDE

This contract calls for the construction of a divided roadway having a four-foot central longitudinal division strip with two lanes of traffic on each side. This four-foot wide central dividing strip will be constructed of portland cement concrete curbs which are five feet high and have a $1\frac{1}{2}$:1 slope. In the center between the curbs there will be placed one-foot of top soil, 27 feet wide, in which ice plants will be planted at a later date.

There will be a 11-foot wide pavement lane next to and on each side of the center strip which has four feet of plant mix surfacing on top of a foot of selected material. On each side of the center and just outside the above mentioned lane there will be constructed Portland cement concrete lanes 11 feet wide of standard thickness.

TO BE COMPLETED DECEMBER 1940

John Strona, who submitted a low bid of $245,786.80, is the contractor on this job. Mr. C. N. Ainley is the Resident Engineer in charge of construction on this contract. At the present rate of construction work will be completed by December 1, 1940, which is within the allotted contract time.

Mose was trying to describe to his friend the kind of fish he had caught. "I tell you," he exclaimed, "it was that long! I never saw such a fish in my life!"

"I believe you," answered his friend.

"Are you a good carpenter?"

"Yes."

"Then how do you make a Venetian blind?"

"You stick your finger in his eye."

The Evolution of Cement

(Continued from page 27)

essary to use a long kiln for the "wet mix" due to the large amount of water to be evaporated before the temperature of the material can be raised to temperature necessary for clinkering. The chemistry of the two types is the same.

In the "wet mix" the raw materials, after being reduced to a powder, are mixed in a stream of water, and passed through a tube mill where the clay and the limestone, proportioned by analysis, are thoroughly mixed, and pulverized by the countless impacts of heavy steel balls falling in a revolving steel tube. The material flows out of this mill as a slurry containing from 30 per cent to 40 per cent of water. It is then conveyed into large blending tanks, in which the material is mixed and kept in suspension with large revolving rakes, and compressed air bubbling up through the mass.

CHEMICAL ANALYSIS MADE

Chemical analysis is made of the many such storage tanks. From the figures thus obtained a mixture is made from the various tanks, which, when burned in the kiln, will give a product of the desired analysis. This mixture is then pumped into storage tanks from which it is fed in measured amounts into the kiln where it is burned into cement clinker.

The kiln itself is a riveted steel cylinder that varies in length from 60 to 100 feet for the "dry mix" plants to over 500 feet for the "wet mix" plants, and from 6 to 15 feet in diameter. The lower or discharge end of the kiln is lined with a highly refractory material to protect it from the blast of the flame. Higher up, because of the much lower temperatures, fire brick is used as a liner. The kiln has a pitch, or drop of three-quarters of an inch per foot of length. It revolves very slowly upon large steel trunnions being driven by an electric motor connected through reducing gears to a great ring gear that encircles the kiln. The material or slurry to be burned enters the kiln at the upper end, while the oil or gas for the burning is introduced under pressure at the lower end creating a tremendous heat, and a stream of hot gases that flow in the opposite direction to the flow of the raw material. As the kiln revolves, the raw mix slowly travels downward from the point of entry to the lower end of the kiln where it emerges as a granular material known as cement clinker. It is the chemical processes that take place in this kiln under the high temperatures that convert the mechanical mixture of limestone and clay into the clinker which subsequently becomes portland cement after being finely ground.

This is the first installment of Mr. Meder's article on cement. The second will appear in a later issue.—Ed.

A Citation

County of San Mateo
Redwood City
April 1, 1940.

Mr. Frank W. Clark,
Director of Public Works,
Sacramento, Calif.

Dear Mr. Clark:

During the recent heavy storms there was a great deal of damage done to the State highways in this county, but due to the efforts of Mr. William Holbrook, in charge of maintenance in this vicinity, immediate repairs were made and traffic delays were reduced to a minimum.

I wish to highly compliment Mr. Holbrook on the efficient manner in which this repair work was done.

Very truly yours,

Frederick Peterson,
County Executive.

The decrepit old car rolled up to the toll bridge.

"Fifty cents," called out the gateman.

"Sold," replied the driver.

Flood Lesson

The Sacramento Valley flood should not pass without emphasis being put upon the lesson it teaches.

If it were possible to total up all the millions of dollars worth of damage this "Ol' Man River" has done since civilization came into its broad valley we are sure the amount would vastly exceed the 170 million dollars which is being spent now to control it.

When the Central Valley Project is completed disastrous floods like the present one will be a thing of the past. Waters will be caught behind the gigantic Shasta Dam and held for beneficial release as needed for irrigation and power. Excess waters, instead of flowing uselessly out to sea, will be shunted into the lower San Joaquin Valley to augment the lesser supply of the San Joaquin River.

In brief, this great inland drainage system will be harnessed and controlled to serve social needs instead of being permitted to continue as a menace to life and property.

The cost of doing it is great, yes, but only initially. Over the long range it will be returned to the people again and again.

So, the lesson of the flood is that man need not necessarily continue to be a helpless victim of unruly nature.

—*San Francisco News.*

REQUEST FROM MODESTO

STANISLAUS COUNTY SCHOOLS
Modesto, California

March 29, 1940

Editor California Highways and Public Works,
Sacramento, California.

Dear Sir:

I recently had the pleasure of seeing and reading several of your little magazines "California Highways and Public Works" and was very interested in the type of material presented in them, particularly the pictures used. It is of a type we are anxious to obtain for our Visual Department, to be used both as general reference material and also, if possible, to re-photograph the pictures and make slides of them.

I understand the magazine is sent when requested and if this is so, I would greatly appreciate being put on your mailing list. Also, if back numbers are available, I would be glad to get all possible.

Yours very truly,

B. W. GRIPENSTRAW,
Supervisor Visual Education.

New Survey of Flood Control Project Needed

(Continued from page 11)

and the river capacity from this point south to Tisdale Weir is 72,000 second-feet.

Below the confluence of Butte Slough and the Sacramento River the excess water from the Butte Basin flows into the upper reaches of the Sutter By-pass. The by-pass here is designed to carry 178,000 second-feet of water. It is 4,000 feet wide at the upper end and confined between levees 18 to 20 feet high.

TISDALE WEIR

The Tisdale Weir which is located approximately half way between Colusa and Knights Landing is 1,150 feet wide and begins to overflow when the river reaches a stage of 18 feet (Colusa gage). Excess water from the TisdaleWeir flows into the Tisdale By-pass, an artificial channel 1,000 feet wide and 4.4 miles long. It crosses the Sutter Basin and empties into the Sutter By-pass. It has a capacity of 38,500 second-feet and consequently the capacity of the Sutter By-pass from its junction with the Tisdale By-pass to Nelson Bend where excess water from the Feather River flows into the by-pass is 216,500 second-feet. From Nelson Bend to Fremont Weir where the by-pass system crosses the Sacramento River, the Sutter By-pass is 7,000 feet wide and has a capacity of 416,500 second-feet. The Sacramento River reduced by the outflow through the Tisdale Weir is designed to carry only 33,500 second-feet from Tisdale to Fremont Weir which is located several miles below Knights Landing.

FREMONT WEIR

The Fremont Weir is located in the south levee of the Sacramento River. It is 9,120 feet long and will carry 343,000 second-feet of water. It provides one of the complicated and sometimes confusing features of the by-pass system, for here water which has come down the Sutter By-pass flows into one side of the Sacramento River and out again on the other side. Meanwhile the Sacramento River between levees of increased size is capable of carrying 107,000 second-feet from its junction with the Feather River about a mile below Fremont Weir down to the Sacramento Weir which is located just above the confluence of the Sacramento and American rivers, north of the city of Sacramento. From the point where the by-pass system crosses the Sacramento River southward, it is called the Yolo By-pass. It is 8,000 to 13,000 feet wide in the portions having levees on each side and much wider in the lower reaches. Levees range in height from 15 to 20 feet with 6 feet freeboard. The capacity of the Yolo By-pass at the upper end is 362,000 second-feet down to the Sacramento By-pass.

This debris, washed up against Sutter By-pass levee, is all that remained of several farm structures after February floods.

An interesting feature of the plan is the Sacramento Weir and By-pass which transports Sacramento and American River flood waters into the Yolo By-pass. The Sacramento Wier, which is 2,000 feet long, is the only one of the five which has gates. The direction of the flow in the Sacramento River between the mouth of the American River and the Sacramento Weir is reversed when flood waters from the American River make it necessary to open the gates on the Sacramento Weir while the flow from the upper river is comparatively low. The gates of the Sacramento Weir are opened by order of the State Engineer when the river reaches a 28.5′ stage on the Sacramento River, I Street gage. The by-pass from the weir to the Yolo By-pass is two miles long and has a capacity of 112,000 second-feet.

BY-PASS SYSTEM

Below the confluence of the Sacramento By-pass and the Yolo By-pass, the latter is designed to carry 480,000 second-feet down to where Putah Creek empties into the by-pass from the west where the capacity is increased to 490,000 second-feet. From that point down to where the by-pass system again empties into the Sacramento River near Rio Vista the capacity is 500,000 second-feet.

In recent floods it was clearly demonstrated that the Sacramento Flood Control Project functions effectively as designed. However, the project was created on data collected during the flood of 1907 and several steps must be taken to remedy weaknesses

which were evident in the recent floods.

RESURVEY RECOMMENDED

In a report to Governor Culbert L. Olson on the recent flood it was recommended that a complete resurvey of the Sacramento Flood Control Project be made at once to determine the necessary modifications in the plans for the existing project. The report said:

"At many points in the upper valley floods reached unprecedented heights and at some points exceeded designed project capacities. While the levee failures were in uncompleted sections, question has been raised as to the adequacy of the project when complete, to protect the valley against floods of equal or greater intensity. Greater security by higher levees or additional bypasses has been suggested.

"No permanent solution of the recurrent problems of disastrous floods is possible unless plans for adequate flood protection are formulated and a means found for the construction of flood control works. The importance and necessity of legislation to authorize studies and the preparation of plans for flood control, and the appropriation of funds therefor, is evident. The cooperation of the State with the Federal agencies and local interests is necessary in order to work out the best plan and program for flood control in combination with water conservation and utilization.

"In addition to the necessity of planning and constructing adequate works for flood control, it is essential that provision be made for the proper management, operation and maintenance of flood control works which now exist or may hereafter be constructed. It appears evident that the failure of flood control works during the floods of recent years has been due, in many cases, to lack of proper management, maintenance and operation or at least insufficient activities with respect thereto. It is essential that the responsibility for the proper operation and maintenance of flood control works and the financing thereof be definitely fixed and regulated as may be found necessary.

"In the case of comprehensive projects for flood control such as the Sacramento Flood Control Project, it appears essential that the responsibility for the management, maintenance and operation of the project works be confined to a single agency. Under the present situation with responsibility for maintenance and operation resting among numerous agencies comprising the local districts and the State Department of Public Works, the successful functioning of the Sacramento River Flood Control Project works as designed is rendered uncertain. To avoid failure and assure adequate and efficient operation and maintenance of such a project, control should be centered in one agency and such agency should be furnished with ample authority and funds for the purpose."

Bay Bridge Painting Problems

(Continued from page 19)

prior to painting with a portable steam cleaning unit. This equipment is similar to, and probably more familiar as, the steam cleaning machine used in garages and other industrial plants for cleaning greases, oils, etc., from car chassis and engines. It is essentially a boiler with a flash-type heating coil generating low pressure steam. Hot water mixed with the steam in the heating coils acquires considerable velocity by virtue of the steam pressure and is directed by means of a hose and suitable atomizing nozzle upon the work to be cleaned.

Addition of a small percentage of suitable solvent expedites the removal of soil film even though it be cemented with road oils and grease. The solvent must be formulated to be noninjurious to the paint film in the proportions used. An excellent feature of this cleaning method is the lack of abrasion and removal of film which is otherwise in good condition.

So satisfactory has the first unit been that two more have recently been ordered for early delivery. It is believed that the use of equipment of this type is an innovation in bridge maintenance.

With some 15,000,000 square feet of steel surface to maintain, it is anticipated that work will be so scheduled as to cover most of this area on a five-year cycle. Due to location, some surfaces will furnish a longer life while a small percentage may require more frequent attention. The scheme of maintenance contemplates correction of paint film failure in its initial stages before attack has occurred on the steel surface. It is felt that this procedure will result in the lowest ultimate cost.

From the start of operations on October 1, 1937, to June 30, 1939, a total of 5,046 gallons of paint had been used. For the six months, June 30, 1939, to December 31, 1939, the gallonage was 3,913, indicating an acceleration of operation. Of the 3,913 gallons, 1,683 were red lead in oil; 1,850, aluminum; and the remainder of miscellaneous formulae.

Maintenance cost on painting in the fiscal year ending June 30, 1939, was $61,360.50. For the fiscal year ending June 30, 1940, the sum of $118,880 has been budgeted.

The San Francisco-Oakland Bay Bridge is maintained and operated for the California Toll Bridge Authority by the Division of Highways of the Department of Public Works. Governor Culbert L. Olson is chairman of the Toll Bridge Authority; Frank W. Clark is Director of Public Works; C. H. Purcell is State Highway Engineer, and Ralph A. Tudor, Principal Bridge Engineer in charge of maintenance and operation on the bridge.

State Speeds Program to Restore Levees

(Continued from page 6)

February 28 at Kennett could have reduced to 23,000 second feet below Shasta Dam and that the peak discharge at Red Bluff of 291,000 second feet on the same date could have been reduced to 125,000 second feet.

Thus, instead of having a peak stage of 32.2 feet at Red Bluff the flow would have been reduced to 24.5 feet and held at that stage for the duration of the storm. Such regulation of the river would have largely eliminated flood damage to Shasta County, which was estimated at $685,200 and materially reduced the flood damage in Tehama County, which was estimated at $378,200. This flattening out of the peak flow of the river also would have resulted in a consequent

lessening of the strain on the levee system in the section between Jacinto and Princeton, where the largest number of breaks occurred.

The following table shows the estimated effect of the operation of Shasta Reservoir for flood control on Sacramento River flows during the flood of February-March, 1940.

Below Shasta Dam

Date		Actual mean daily flow, in second-feet (1)	Mean daily controlled flow, in second-feet	Change in flow, in second-feet (2)
Feb.	27	120,000	95,000	— 25,000
	28	159,000 (182,000 peak)	23,000	—136,000
	29	89,200	36,200	— 53,000
March	1	56,200	83,900	+ 27,700
	2	41,300	96,800	+ 55,500
	3	31,700	102,500	+ 70,800
	4	25,900	46,800	+ 20,900

At Red Bluff

Date		Actual mean daily flow, in second-feet (1)	Controlled flow, in second-feet	Change in flow, in second-feet (2)
Feb.	27	150,000	125,000	— 25,000
	28	261,000 (291,000 peak)	125,000	—136,000 —167,000
	29	178,000	125,000	— 53,000
March	1	97,300	125,000	+ 27,700
	2	69,500	125,000	+ 55,500
	3	54,200	125,000	+ 70,800
	4	43,900	64,800	+ 20,900

(1) Assuming flow at dam same as at Kennett gaging station.

(2) Minus sign indicates decrease in flow. Plus sign indicates increase in flow.

State Office Building

(Continued from page 13)

ization from State agencies and from the various contractors, which is so vitally necessary for success in such an undertaking.

In turning this modern office structure over for occupancy and maintenance we hope we have accomplished the original desire, to have this building represent a pleasing and adequate addition to the Sacramento State buildings.

Prof: We have only a few minutes left. I should like to have someone ask me a question that is bothering him.

Stude: What time is it, sir?

Highway Bids and Awards for the Month of March, 1940

CALAVERAS, STANISLAUS, TUOLUMNE AND AMADOR COUNTIES—Furnishing and applying Diesel oil to 165.3 miles of roadside vegetation. District X. Oilfields Trucking Co., Bakersfield, $3,149; Lee J. Immel, Berkeley, $3,348; Close Building Supply, Hayward, $2,901; Pacific Truck Service, Inc., San Jose, $3,856. Contract awarded to Sheldon Oil Co., Suisun, $2,467.

INYO COUNTY—At Panamint Springs 1.12 miles grading and roadmix surface treatment. District IX, Route 127, Sections F & G. A. S. Vinnell Co., Alhambra, Calif., $8,129; Basich Bros., Torrance, $9,126; Santa Barbara Crane Serv., Santa Barbara, $9,979; Isbell Cons. Co., Reno, Nev., $11,313; Silva & Hill Cons. Co., Glendale, $11,470. Contract awarded to Geo. E. France, Visalia, $7,928.

LOS ANGELES COUNTY—Two undercrossings to be constructed, one a joint crossing under the tracks of the A. T. & S. F. Ry and the U. P. R. R. and the other under Fremont Avenue in South Pasadena; and the grading of a portion of Arroyo Seco Parkway and reconstructing Grevella Street and Fremont Avenue. District VII, Route 205, Sec. S.Pas. Dimmitt & Taylor, Los Angeles, $136,683; Carlo Bongiovanni, Los Angeles, $137,597; R. M. Price, Huntington Park, $138,301; Byerts & Dunn, Los Angeles, $142,175; Claude Fisher Co., Ltd., Los Angeles, $143,617; Person & Hollingsworth Co., Los Angeles, $144,487; Griffith Co., Los Angeles, $146,616; Sordal & Bishop, Long Beach, $155,562. Contract awarded to Oscar Oberg, Los Angeles, $135,684.

MERCED, MARIPOSA AND STANISLAUS COUNTIES—Furnishing and applying Diesel oil to 133.2 miles of roadside vegetation. District X, various locations. Claude C. Wood, Lodi, $2,222; Oilfields Trucking Co., Bakersfield, $2,484; Pacific Truck Service, Inc., San Jose, $3,019; Lee J. Immel, Berkeley, $2,494; Close Building Supply, Hayward, $2,242. Contract awarded to Sheldon Oil Co., Suisun, $2,211.

MODOC COUNTY—Between 4 miles north of Lake City and Fort Bidwell about 10.9 miles in length to be graded and surfaced with road-mix surfacing. District II, Feeder. Louis Biasotti & Son, Stockton, $80,022; Isbell Const. Co., Reno, Nev., $80,847; The Utah Const. Co., San Francisco, $80,981; Harms Bros. & N. M. Ball Sons, Berkeley, $81,156; Lee J. Immel, Berkeley, $81,695; Claude C. Wood, Lodi, $84,483; Parish Bros. & Brighton Sand & Gravel Co., Sacramento, $86,686; Frederickson & Westbrook, Sacramento, $89,710; Guerin Bros., San Francisco, $93,064; Oilfields Trucking Co., Bakersfield, $96,727. Contract awarded to Poulos & McEwen, Sacramento, $77,482.50.

RIVERSIDE COUNTY—Between three miles west of Blythe and Ash Street in Blythe, about 3.2 miles to be graded and road-mix surface treatment applied. District XI, Route 64, Sections E,Bly. G. W. Ellis, North Hollywood, $54,492; A. S. Vinnell Co., Alhambra, $55,208; E. L. Yeager, Riverside, $58,251; Warren Southwest, Inc., Los Angeles, $58,489; Valley Construction Co., San Jose, $59,832; Oswald Bros., Los Angeles, $60,611; Denni Investment Corp., Wilmington, $75,400. Contract awarded to Daley Corp., San Diego, $53,033.

SAN JOAQUIN COUNTY—West of Little Potato Slough Bridge at Terminous, about 0.6 mile in length, highway embankment to be constructed. District X, Route 53, Section C. Basalt Rock Co., Inc., Napa, $29,200; J. R. Reeves, Sacramento, $36,000; Claude C. Wood, Lodi, $37,200; Marshall S. Hanrahan, Merced, $39,520. Contract awarded to Mike Malfitano & Son, Pittsburg, $27,760.

SANTA CLARA COUNTY—Between Saratoga and Los Gatos, about 1.4 miles in length, to be graded and surfaced with plant mixed surfacing on gravel base. District IV, Route 42, Section 4. Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $69,556; Piazza and Huntley, San Jose, $69,872. Contract awarded to Caputo & Keeble, San Jose, $61,720.25.

SHASTA COUNTY—About one-half mile East of Redding, repair Bridge 26-41 across Sacramento River. District II, Route 20, Section C. Clifford A. Dunn, Klamath Falls, Ore., $17,414; Lord & Bishop, Sacramento, $23,460; M. A. Jenkins, Sacramento, $15,280; J. P. Brennan, Redding, $20,833. Contract awarded to Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $15,090.

SISKIYOU COUNTY—Between Bailey Hill and Oregon State line, about 1.8 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District II, Route 3, Section C. Claude C. Wood, Lodi, $125,531; Macco Construction Co., Clearwater, $127,176; Fredericksen and Westbrook, Sacramento, $131,380; A. Teichert & Son, Inc., Sacramento, $131,435; Granfield, Farrar & Carlin, San Francisco, $132,253; The Utah Construction Co., San Francisco, $133,272; Guerin Bros., San Francisco, $133,341; Heafey-Moore Co.-Fredrickson & Watson Construction Co., Oakland, $141,533; McNutt Brothers, Eugene, Ore., $142,968; Hemstreet & Bell, Marysville, $144,800; United Concrete Pipe Corp., Los Angeles, $159,500. Contract awarded to Parish Bros., Hollywood, $121,257.

SOLANO, SAN JOAQUIN, CALAVERAS, AMADOR, STANISLAUS, MARIPOSA AND TUOLUMNE COUNTIES—Furnishing and applying Diesel oil to 280.4 miles of roadside vegetation. District X. Claude C. Wood, Lodi, $5,236; Oilfields Trucking Co., Bakersfield, $5,674; Pacific Truck Service, Inc., San Jose, $6,378; Lee J. Immel, Berkeley, $5,545; Hayward Material Co., Hayward, $5,593. Contract awarded to Sheldon Oil Co., Suisun, $4,496.

SOLANO-YOLO COUNTIES—Between 1.3 miles north of Dixon and one mile east of Davis, about 7.3 miles to be graded and drainage facilities installed. District X, Routes 7 & 6, Sections I,A,E. Parish Bros., Hollywood, $129,444; Macco Construction Co., Clearwater, $138,302; Heafey-Moore Co., Fredrickson & Watson Construction Co., Oakland, $138,354; A. Teichert & Son, Inc., Sacramento, $139,568; M. J. B. Construction Co., Stockton, $140,159; Guy F. Atkinson Co., San Francisco, $144,054; Harms Bros. & N. M. Ball Sons, Berkeley, $145,548; J. R. Reeves, Sacramento, $145,743; Utah Construction Co., San Francisco, $151,170; Louis Biasotti & Son, Stockton, $152,415; Piombo Bros. & Co., San Francisco, $153,821; Claude C. Wood & Elmer J. Warner, Lodi, $154,011; Hemstreet & Bell, Marysville, $162,022; Fredericksen & Westbrook, Sacramento, $165,620; A. S. Vinnell Co., Alhambra, $167,082; Eaton & Smith, San Francisco, $180,317; Claude Fisher Co., Ltd., Los Angeles, $198,034. Contract awarded to Frederickson Bros., Emeryville, $127,301.

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