CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

Kennett Dam, Key Unit of Central Valley Project

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Central Valley Project Unit Bids Opened. Kennett Dam Site Approved by U. S.

By EARL LEE KELLY, Director of Public Works

THE past few months have witnessed developments of major importance in the progress of the Central Valley Project promising an early start in actual construction operations. The final selection and approval of the Kennett dam site on the upper Sacramento River, the receiving of bids on initial construction contracts, the completion of preliminary steps in the negotiations for the necessary acquisition of water rights on the San Joaquin River, and increasing demands for electric power in northern and central California which point to a ready market for the hydroelectric power to be produced at Kennett, are some of the outstanding developments which have occurred.

In an undertaking of the magnitude of the Central Valley Project, the problems involved preparatory to actual construction getting under way are unusual in number and complexity. The necessary surveys and explorations which must be made prior to the preparation of final plans and specifications alone present problems of unusual magnitude.

ABOUT TO LET CONTRACTS

But in addition to the engineering problems involved in the preparation of plans for the several physical units of the project, there are legal, economic and financial problems to be solved which in some instances involve even greater difficulties. It is gratifying therefore, to realize that these preparatory phases of the work have now reached a point when contracts for actual construction work are about to be let and there is promise that additional construction contracts will follow shortly.

Following several years of constant endeavor to obtain Federal recognition and financing of the project, the first allocation of Federal funds for construction of the project was announced by President Roosevelt on September 10, 1935, in the amount of $20,000,000 from the Emergency Relief Appropriation of 1935. This was superseded by a second executive order issued by the President on November 16, 1935, which in effect provided $15,000,000 to start construction of the storage reservoirs on both the Sacramento and San Joaquin rivers and other units of the project. On December 2, 1935, President Roosevelt approved the recommendation of Secretary of Interior Harold L. Ickes, that the Central Valley Project be constructed as a Federal reclamation undertaking, declaring it to be "feasible from engineering, financial and agricultural standing."

$6,000,000 FOR FRIANT

In addition to the allocation of funds by President Roosevelt, the 74th Congress in the first Deficiency Bill passed in June, 1936, appropriated $6,900,000 for the continuation of the project with the provision that $6,000,000 be used for the construction of Friant reservoir and irrigation facilities therefrom in the San Joaquin Basin.

It is understood that the Presidential allocation has been reduced until it now stands at $4,500,000. Hence, there is apparently on hand at the present time $11,400,000 less expenditures made for preparatory work to date. These funds will be available until June 30, 1937, and present indications are that these will be either actually spent or encumbered before that date.

It is specified that the funds allocated and appropriated to the project shall be reimbursable in accordance with the Reclamation Laws, which by precedent will require execution of contracts providing for repayment in forty years. President Roosevelt officially approved the beginning of construction before repayment contracts are executed.

PREPARATORY WORK STARTED

A little over a year has elapsed since work was started on the Central Valley Project by the Federal Government. Starting in November, 1935, the United States Bureau of Reclamation, designated as the construction agency, has since been actively engaged in the investigations and studies preparatory to construction. A force of 200 to 300 men have been employed on the work in California under the direction of Walker R. Young, Construction Engineer, with the headquarters office in Sacramento.

In addition to the final location survey covering the dam sites, reservoir basins and conduit units and detail explorations of the dam sites, the Bureau of Reclamation has been making comprehensive engineering studies to check the plans for the project as formulated by the State. At the same time work has been proceeding on the preparation of final plans and specifications, appraisal of rights of way and water rights and the negotiations for their acquisition.

The Water Project Authority of the State of California is actively assisting and cooperating with the Bureau as the official administrative agency of the State, created by the Central Valley Project Act of 1933 and charged with the responsibility

of constructing the Central Valley Project. This administrative agency as designated by law comprises the Director of Finance, the Attorney General, the State Treasurer, the State Controller and the Director of Public Works.

WATER AUTHORITY PERSONNEL

In addition to the writer who has the honor to be its chairman, its present membership comprises A. E. Stockburger, U. S. Webb, Chas. G. Johnson and Harry B. Riley. The State Engineer, Edward Hyatt, is Executive Officer of the Authority and Deputy State Engineer A. D. Edmonston is acting secretary. The technical work of the Authority is handled by the engineering staff of the Division of Water Resources of the State Department of Public Works, under the State Engineer.

The work of the State has included not only the designation and approval of the general engineering plans for the project, but also the negotiations for the acquisition of water rights and rights of way. Other important activities are concerned with the disposal and sale of water and electric power to be made available by the project. In addition the Water Project Authority has been diligently continuing efforts directed to the securing of further appropriations and necessary authorizations from the Federal Government to continue the construction of the project expeditiously.

KENNETT DAM SITE APPROVED

One of the most important events in the progress of the Central Valley Project was the final selection and approval of the Kennett dam site for the storage unit on the Sacramento River, announced by Mr. John C. Page, Commissioner of the Bureau of Reclamation, from Washington, D. C., on January 25, 1937.

With the initiation of work on the project by the Bureau of Reclamation in November, 1935, some of the earliest work undertaken was the extension of explorations at the Kennett dam site. Additional explorations were essential before final designs could be prepared. At the same time the bureau engineers considered it advisable to investigate other sites for storage on the upper Sacramento River. Accordingly, explorations were extended in great detail at the Kennett site and two other sites, the Table Mountain dam site located between Redding and Red Bluff, and the Baird dam site located immediately below the confluence of the McCloud and Pit rivers, were also explored.

At the Kennett dam site alone, the exploration work of the bureau has included 5663 lineal feet of tunnels and shafts, 7358 lineal feet of diamond drill core borings, and 187.5 feet of special Calyx drill borings with cores 3 feet in diameter. This is in addition to the preliminary exploratory work by the State which involved 1415 lineal feet of tunnels and 4299 lineal feet of diamond drill borings.

FINAL SELECTION GRATIFYING

Exploratory work on these three sites was not completed sufficiently for a final determination of feasibility and comparative merits until December, 1936. Although the bureau's consulting board concluded that a dam could be built at any of the three sites considered, the economic analyses made by the bureau led to the final conclusion announced by Commissioner Page that the Kennett dam site is "superior from an economic standpoint."

The final selection and approval by the Bureau of Reclamation of the Kennett dam site for the storage unit on the Sacramento River is most gratifying, as it completely vindicates the State Engineer in his selection of this great reservoir as the key unit of the project. Kennett Dam and Reservoir was selected as the major storage unit of the Central Valley Project by the State Engineer in the report to the State Legislature in 1931, as a result of intensive investigations and studies carried on over a period of ten years.

All possible reservoir sites in the Sacramento River Basin, including those on the main tributaries as well as on the main stream, were carefully considered. Funds were not available during the State's investigations to carry out explorations to the extent required under modern engineering standards before dams of the tremendous size of Kennett Dam can be properly designed and constructed.

OTHER SITES EXPLORED

However, a considerable amount of exploratory work including tunnels and borings was carried out by the State and additional explorations were made by the United States Army Engineers to determine the sufficiency of the foundation and the cost of con-

Low Bids Received on Initial Contracts

Initial contracts covering actual construction of works for the Central Valley Project were advertised for bids in January and early February of this year. They cover in general two items: first, construction of the first 4 miles of the Contra Costa Conduit; and second, construction of camp facilities at the Friant dam site.

The following summarizes the data on the low bids received on each contract:

Description of work	*Date of bid*	*Name of low bidder*	*Amount bid*
Contra Costa Conduit (first 4 miles)	March 1, 1937	Haas, Doughty & Jones and Marshall & Stacy, San Francisco	$102,646
Office Bldg., Dormitories and Residences Schedules 1 and 2	March 5, 1937	Guy E. Hall, Los Angeles	44,021
Schedule 3		Lawson Constr. Co., Los Angeles	44,385
Steel Tank	March 3, 1937	Western Pipe and Steel Co., San Francisco	3,350
Duplex Cottages	March 4, 1937	Lawson Constr. Co., Los Angeles	63,043
Testing Laboratory, Garage and Fire House	March 6, 1937	A. C. Tornell, Tracy	17,195
Streets, Water and Sewer Systems, etc.	March 15, 1937	A. J. Clausen, Berkeley	24,967

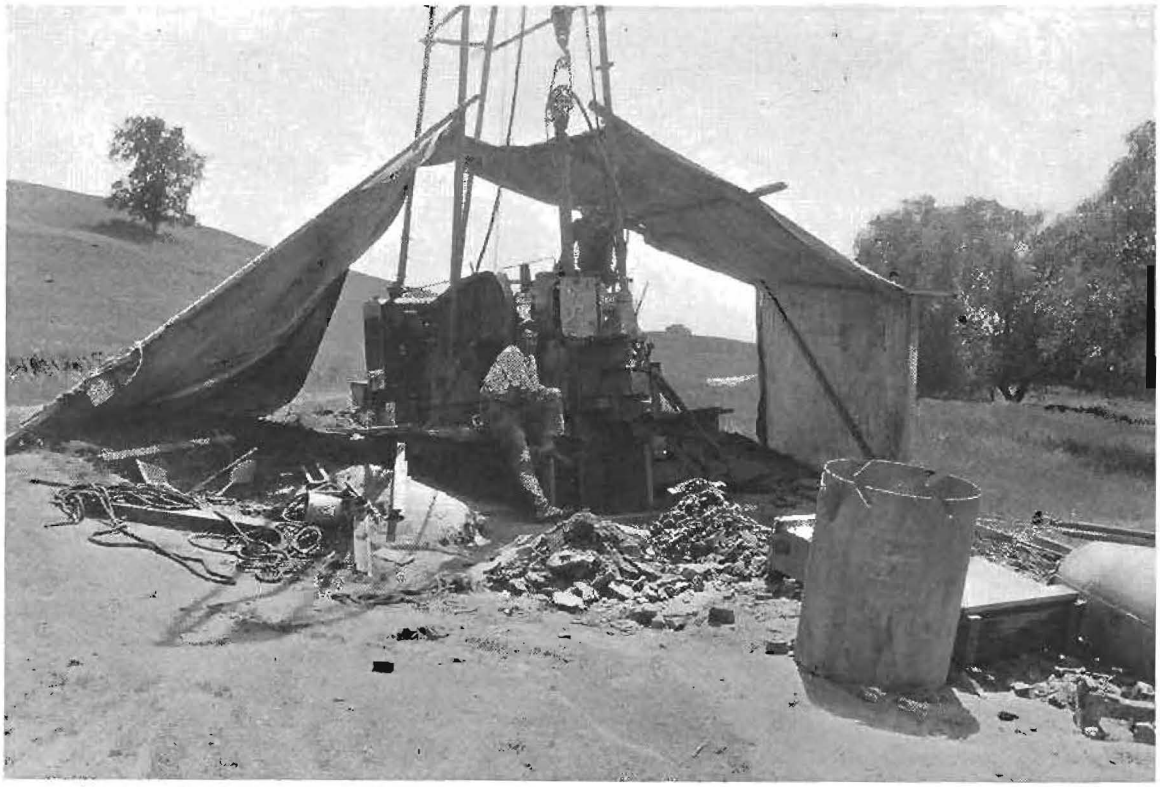
Typical area of irrigated orchards and vineyards in Tulare County, flourishing before the water supplies were exhausted. This view was taken in 1923.

The same area as the picture above viewed in 1936. Trees and vines have died and been removed due to failure of water supply. 200,000 to 400,000 acres of highly developed and producing lands will be saved from a like fate by water supplies to be furnished by the Central Valley Project.

structing a dam. Explorations were also made at the Table Mountain dam site which was selected by the State during the preliminary investigations as worthy of consideration. The Baird dam site was also investigated, but owing to a lack of funds was not explored.

These original studies and investigations were reviewed by eminent consulting engineers employed by the State and also by the engineers of the United States War Department who rendered further material assistance by carrying out additional explorations at that time.

The Kennett dam site was chosen by the State as a result of the preliminary studies and investigations on the basis of a clear showing of its greater economy and superiority in accomplishments as compared to any other possible storage site. The more extensive investigations made by the bureau during the past year also have been reviewed by a Board of Consulting Engineers employed by the



Calyx core drilling machine used to explore the rock foundations at the Kennett dam site. This drill removes a core of rock 3 feet in diameter, permitting a man to be lowered into the hole to examine the rock in place.

State. The conclusion reached by this Board substantiates the original conclusions as to the superiority of the Kennett site.

RAILROAD TO BE MOVED

The selection of the Kennett site as announced by Commissioner Page is conditioned upon the working out of satisfactory and prompt arrangements with the Southern Pacific Company for removing 22 miles of railroad from the reservoir site and relocating it at a higher elevation. However, it is believed that there should be no undue delay on this account. The Southern Pacific Company already has expressed its willingness to the proposed change. Final location surveys have been completed for the new route and plans and specifications have been prepared. Contracts can be advertised for the construction of the railroad in its new location as soon as a satisfactory agreement is arranged.

The storage capacity of Kennett reservoir and the height of dam therefor has not been finally decided as yet. However, at least, 3,000,000 acre-feet of storage will be provided requiring a dam about 420 feet in height above low water. The dam will be constructed of concrete and will involve a mass of masonry comparable to that in the recently completed Boulder Dam on the Colorado River.

RESERVOIR VITAL UNIT

Kennett reservoir is the most vital unit of the project because it will furnish the bulk of the water which will be made able in both the Sacramento and San Joaquin valleys. It will be operated for many useful purposes. A portion of its capacity will be reserved during the winter and early spring months for control of floods, thus reducing flood flows and providing increased flood protection to the lands and communities subject to flood hazards bordering the Sacramento River.

Waters released from the reservoir will flow down the Sacramento River, providing first, a full supply for all rights to the use of water from the Sacramento River; second, sufficient water to maintain adequate depths for commercial navigation as far up stream as Chico Landing and possibly to Red Bluff if coupled with additional channel improvement; third, a full supply to meet all of the demands in the Sacramento-San Joaquin delta area, including a sufficient flow to maintain fresh water in the delta channels and prevent invasion of salt water thereinto; fourth, a supply for industrial, municipal and agricultural purposes in the upper San Francisco Bay area; and finally fifth, sufficient water for exportation to the San Joaquin Valley to adequately meet the deficiencies in water supply in the areas facing abandonment through water shortage.

INITIAL CONSTRUCTION CONTRACTS

Initial contracts covering actual construction of works for the Central Valley Project were advertised for bids in January and early February of this year. They cover in general two items; first, construction of the first 4 miles of the Contra Costa Conduit; and second, construction of camp facilities at the Friant dam site.

The Contra Costa Conduit is designed to furnish urgently needed water supplies to industries, municipalities and agricultural and suburban lands in a portion of Contra Costa County. It will serve an area of 50,000 to 60,000 acres mostly within the recently organized Contra Costa County Water District, embracing the lands fronting the lower San Joaquin River and Suisun Bay between Oakley and Crockett, and the Ygnacio and Clayton valleys, and including the cities of Antioch, Pittsburg, Martinez and Concord.

This section of Contra Costa County is notable for its heavy industrial development with industries producing products of over $100,000,000 in annual value. It also contains a large acreage of agricultural lands already highly developed largely to orchards and vineyards. The conduit will have a capacity in the initial section of 275 second-feet, a length of about 50 miles, and will require pumping plants to lift the water to an elevation sufficient for delivery to the area to be served.

ACQUISITION OF WATER RIGHTS

The plans for the Central Valley Project for utilizing the flow of the San Joaquin River, by storage regulation in Friant Reservoir and diversion therefrom through the Madera and Friant-Kern canals, to serve the areas of deficient water supply in the upper San Joaquin valley, require as a prerequisite the acquisition of the present rights to the use of these waters.

The plans contemplate: first, the purchase of the rights to water now used and appertaining to so-called "grass lands" irrigated for pasture; second, acquisition of the right to utilize the water now used on and appertaining to lands irrigated for crops, by providing in exchange therefor a substitutional water supply furnished by and through the San Joaquin pumping system; and third, acquisition of the right to utilize surplus waters, by appropriation or by compensating such interests as may have valid claims thereto.

The policy of the Water Project Authority is and will be to settle with the owners

of all water rights affected on a fair and equitable basis.

One of the most important responsibilities of the Water Project Authority has been the negotiations for acquisition of these water rights on the San Joaquin River. In preparation for these negotiations, many months of intensive surveys, investigations and studies have been required to obtain the basic facts as to the present use of these waters, and to define and determine the ownership and validity of the rights thereto. These surveys and studies have been confined chiefly to the portion of the San Joaquin River between Friant and the mouth of Merced River.

NEGOTIATIONS NOW PROCEEDING

Conferences have been held and preliminary negotiations have been initiated with several of the owners of the water rights proposed to be acquired. The bulk of the grass land water rights proposed to be purchased are owned and controlled by Miller & Lux, Incorporated, and affiliated companies. These interests also own or control lands assumed to be riparian and having rights to uncontrolled surplus waters.

As a result of extended negotiations, a proposed contract has been drafted for purchase of these Miller & Lux rights. This proposed contract, as submitted by Miller & Lux, Incorporated, is now being considered by the Bureau of Reclamation. It contains a definite offer from Miller & Lux to sell the rights specified for $2,500,000. The Water Project Authority at a special meeting on February 4. 1937, approved the form of contract and the terms and conditions contained therein without giving any expression as to the reasonableness of the asking price.

KENNETT HYDROELECTRIC PLANT

Incidental to the main objective of Kennett reservoir of furnishing urgently needed water supplies for many purposes, a large amount of hydroelectric power will be generated by the waters released therefrom. Present plans call for an installation of about 300,000 kilovolt amperes. This hydroelectric plant will be capable of generating on the average annually about a billion and a half kilowatt hours of electric energy. A transmission line will extend from the plant about 200 miles to the vicinity of Antioch which is the approximate load center of the northern California power market. About one-sixth of the output will be required in the operation of the project for pumping in the San Joaquin Pumping System and the Contra Costa Conduit. The balance will be available for disposal in the general power market.

MARKET FOR KENNETT POWER

It is anticipated that there will be a ready market for Kennett power when it becomes available. The electric power demands in northern and central California have been rapidly increasing during the past two years already requiring the provision of additional output capacity. Studies made by the State indicate that the entire power output from Kennett can be absorbed within a period of six to eight years after it becomes available.

The Central Valley Project Act of 1933 contains specific provisions governing the disposal and sale of electric power to be produced by the project. Under the terms of the act, power may be sold to privately owned electric utilities as well as municipalities and other public agencies, but preference is granted to municipalities and public agencies in the case of equivalent offers considering the cost of facilities required for delivery.

REQUESTS ALREADY RECEIVED

Preliminary requests have been received from several municipalities and public agencies and also from the Pacific Gas & Electric Company for the power to be produced at Kennett when it becomes available. Among the public agencies from which requests have been received are the cities of Redding, Sacramento, Lodi, and Stockton, Sacramento Municipal Utility District, the Bidwell Utility District, Reclamation District 2068, El Camino Irrigation District, and the East Contra Costa Irrigation District. In addition, several other irrigation and reclamation districts have indicated a desire to obtain power.

Recently in a communication received from President James B. Black of the Pacific Gas & Electric Company, the company states its readiness and willingness to take delivery of all the electric power that can be produced at the Kennett plant. It is apparent, therefore, that the hydroelectric power output at Kennett will find a ready market and that the revenues from the sale of power to be produced by the Central Valley Project will be fully realized as anticipated.

Careful engineering investigations and studies will be made of methods of disposal of Kennett power including a consideration of the general plans and costs of facilities required and determination of rates to be charged. It is essential that the power output be disposed of as rapidly as possible after it becomes available. To realize this objective, it may prove financially advantageous to the project for the electric power therefrom to be disposed of partly to public agencies and partly to the privately owned electric utility, but with the preferential

Three foot diameter cores taken out by Calyx drill at Kennett dam site typifying the hard solid rock foundation upon which Kennett dam will be placed.

rights granted public agencies in Central Valley Project Act receiving first recognition.

PRESIDENT RECOMMENDS $15,000,000

President Roosevelt in his budget message to Congress has recommended an additional appropriation of $15,000,000 to carry on the construction of the Central Valley Project. This recommended appropriation is now being considered for action at the present session of Congress. The Congressional representatives of California have expressed confidence that favorable action may be expected.

It is most gratifying that the Central Valley Project has a staunch supporter in Mr. John C. Page who was appointed Commissioner of the Bureau Reclamation by the President on January 25, 1937. Mr. Page previously had been Acting Commissioner following the death of Dr. Elwood Mead in January, 1936. He is thoroughly familiar with the conditions in California, has a keen realization of the water problems which must be solved and the vital necessity of the Central Valley Project. He has been quoted as stating: "I think the Central Valley Project will do more good than any other project ever undertaken by the Federal Government."

Commissioner Page is a man of action. The important developments in the progress of the Central Valley Project since the first of the year, including the final selection and approval of the Kennett dam site and the receiving of bids for intial construction contracts, have come since his appointment as Commissioner.

Increase In Autos

An increase of 8.9 per cent in the number of automobiles registered in California in 1936, as compared with 1935, is announced by Howard E. Deems, registrar of vehicles.

In 1935 the total was 2,015,018, and in 1936 it was 2,178,038.

Registration of all fee paid vehicles jumped from 2,254,828 in 1935 to 2,448,925 in 1936, an increase of 8.16 per cent. Motorcycles increased from 8861 to 9816, an increase of 10.78 per cent. Pneumatic trailers showed an increase of 19.58 per cent increasing from 88,814 to 106,204. Solid tire commercial trucks and solid tire trailers showed decreases of 31.11 and 8.53 respectively, being accounted for, Deems said, by the change-over from solid to pneumatic tires.

Transfers of ownership increased 14.06, going from 736,350 in 1935 to 839,857 last year.

About two-thirds of all the automobiles in the world are operating on American streets and highways, with the United States holding first rank with 26,211,052 on the basis of last year's registration. This is an average of one vehicle for every five persons. New Zealand ranks next with a ratio of one to eight; Canada, one to nine; Australia, one to 11; France, one to 20; United Kingdom, one to 23; Denmark, one to 28; Sweden, one to 39; Uruguay, one to 41; Norway, one to 46; China only one vehicle to 8,920 persons; India, one to 3,463; Turkey, one to 1,924; and Poland, one to 1,283.

Low Tolls Raise Bay Span Travel, Reduce Receipts

WHILE the number of motor vehicles using the San Francisco-Oakland Bay Bridge in February was 92,480 in excess of the January total, due to the lowering of automobile tolls, settlement of the maritime strike, and five fair-weather holidays during the month, the income of the bridge last month was $36,082.47 less than that for January, according to Director of Public Works Earl Lee Kelly.

The new 50-cent toll rate and the fact that February had but 28 days may be taken into consideration, Director Kelly said, in comparing last month's revenues with those for January.

The income for February was $348,009.80 as against $384,092.27 for January.

FREIGHT TRAFFIC GROWS

It is believed the ending of the maritime strike on February 5 accounted for an increase of 2057 trucks and 6,778,594 freight pounds. The total number of trucks using the bridge last month was 18,785 and the pounds of freight transported amounted to 41,173,165.

"A total of 667,563 vehicles crossed the bridge during February," Director Kelly said, "an increase of approximately 28 per cent over January. Had the February holidays been rainy, traffic for the month would have been considerably less. The total vehicles for January was 575,083. February traffic brought the total number of vehicles using the bridge since its opening on November 12 to 2,577,895."

Comparative figures for the months of January and February as submitted to Director Kelly by Chief Engineer C. H. Purcell are:

	Passenger Autos	*Auto Trailers*	*Motorcycles*
Total January	550,106	545	1,615
Total February	640,251	502	1,860

	Trucks	*Truck Trailers*	*Buses*
Total January	16,727	1,458	4,230
Total February	18,785	1,810	3,842

	Extra Passengers	*Total Vehicles*	*Freight Lbs.*
Total January	93,119	575,083	34,394,571
Total February	105,276	667,563	41,173,165

Central Valley Project Plans Inspire Editor

(*Editorial from San Diego Herald*)

California's vast Central Valleys Water Project, greater than the famous Boulder Canyon Dam development, is ready for construction. The bid-opening on the Contra Costa conduit, first unit of the $170,000,000 project, is less than three weeks away. The "go signal" has been flashed! The builders are ready!

Soon thousands of men will be at work on the huge, 500-mile waterway; millions of dollars in Federal funds will be pouring into California trade channels.

Just what does this giant building program mean to California business and industry? More, perhaps, than the great majority of Californians comprehend. Here are the "concrete" facts and figures—showing just what the big job will require in materials and labor:

6,528,000 cubic yards of concrete.
20,809,000 pounds of reinforcing steel.
114,543,000 pounds of structural steel.
6,496,000 barrels of cement.
5,863,000 cubic yards of rock.
3,302,000 cubic yards of sand.
38,311,000 cubic yards of excavation.
186,224,000 man-hours of labor

A stimulating prospect, that! And the story is only half told in the estimates of immediate material benefits, for the Central Valleys Project will bring permanent, lasting benefits to every section of California.

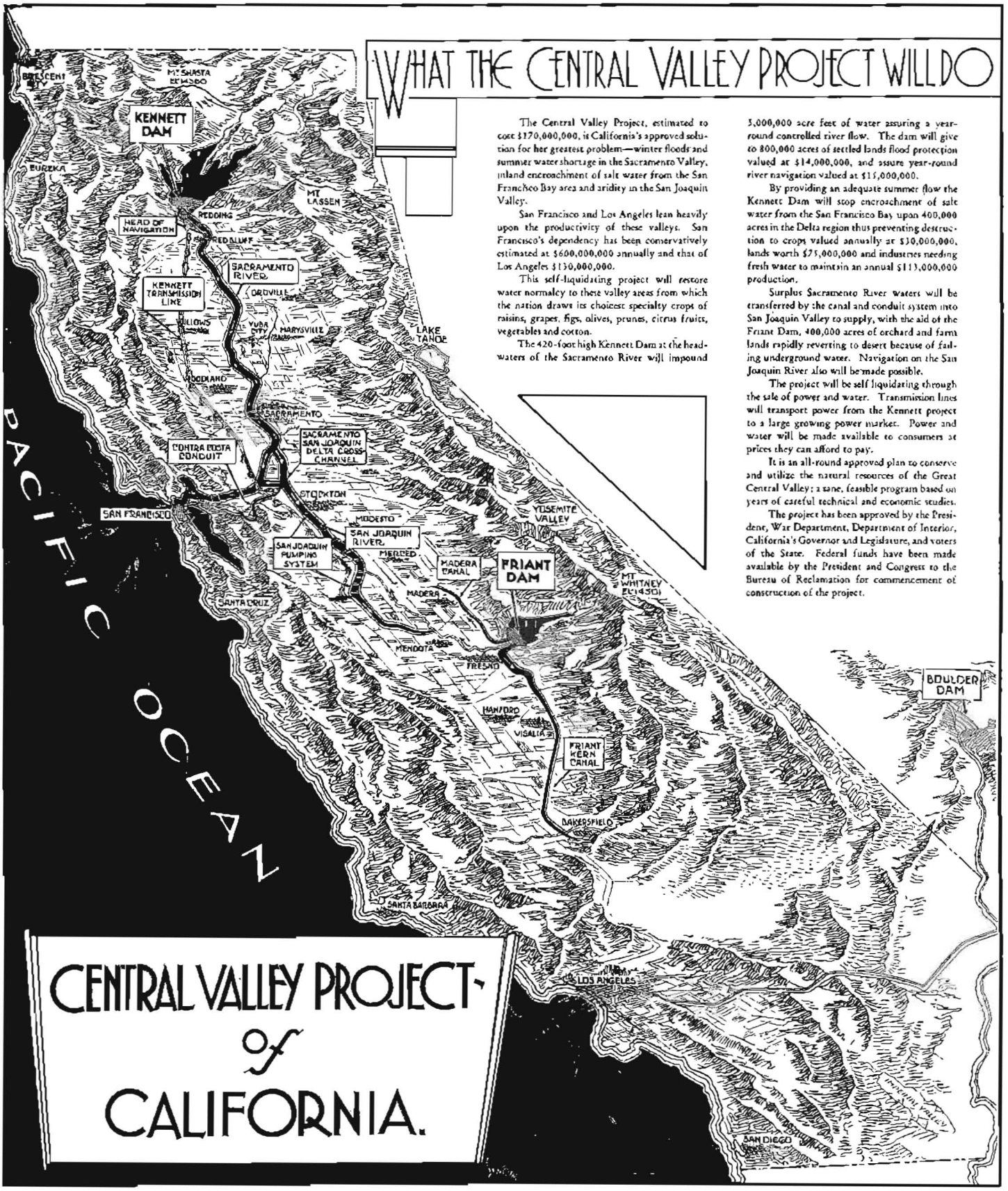
NOW, LET'S POUR CONCRETE!

Automotive Taxes Grow

Federal taxes imposed upon automotive products rose 14.2 per cent last year, reaching a total of $338,100,126, according to Bureau of Internal Revenue figures. The amount was more than $42,000,000 greater than for 1935 and set an all time high.

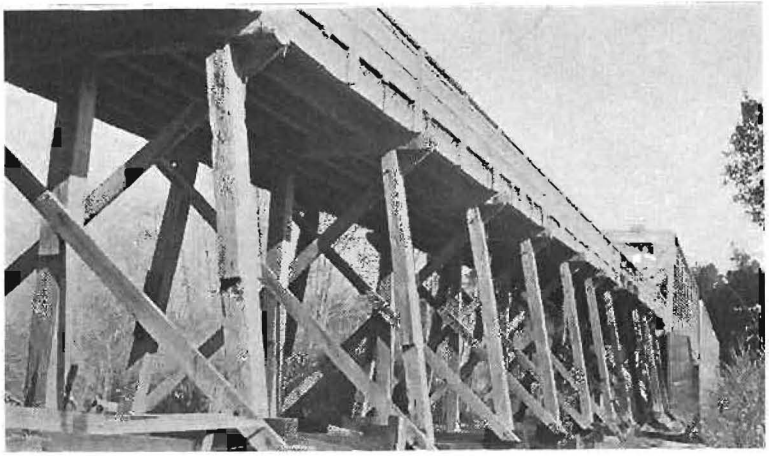
The major factor both in the total collected and the increase over the preceding year was the Federal gasoline tax of one cent per gallon Congress is being urged to eliminate it. This tax, enacted in 1932 as a "temporary" measure, cost motorists last year a total of $186,321,448, or 55 per cent of the total Federal automotive tax bill.

Federal gasoline tax revenues last year increased $14,057,967 over the 1935 total, accounting for about one-third of the total increase in Federal automotive taxes.


WHAT THE CENTRAL VALLEY PROJECT WILL DO
The Central Valley Project, estimated to cost $170,000,000, is California's approved solution for her greatest problem—winter floods and summer water shortage in the Sacramento Valley, inland encroachment of salt water from the San Francisco Bay area and aridity in the San Joaquin Valley.
San Francisco and Los Angeles lean heavily upon the productivity of these valleys. San Francisco's dependency has been conservatively estimated at $600,000,000 annually and that of Los Angeles $130,000,000.
This self-liquidating project will restore water normalcy to these valley areas from which the nation draws its choicest specialty crops of raisins, grapes, figs, olives, prunes, citrus fruits, vegetables and cotton.
The 420-foot high Kennett Dam at the headwaters of the Sacramento River will impound 5,000,000 acre feet of water assuring a year-round controlled river flow. The dam will give to 800,000 acres of settled lands flood protection valued at $14,000,000, and assure year-round river navigation valued at $15,000,000.
By providing an adequate summer flow the Kennett Dam will stop encroachment of salt water from the San Francisco Bay upon 400,000 acres in the Delta region thus preventing destruction to crops valued annually at $30,000,000, lands worth $75,000,000 and industries needing fresh water to maintain an annual $113,000,000 production.
Surplus Sacramento River waters will be transferred by the canal and conduit system into San Joaquin Valley to supply, with the aid of the Friant Dam, 400,000 acres of orchard and farm lands rapidly reverting to desert because of failing underground water. Navigation on the San Joaquin River also will be made possible.
The project will be self liquidating through the sale of power and water. Transmission lines will transport power from the Kennett project to a large growing power market. Power and water will be made available to consumers at prices they can afford to pay.
It is an all-round approved plan to conserve and utilize the natural resources of the Great Central Valley; a sane, feasible program based on years of careful technical and economic studies.
The project has been approved by the President, War Department, Department of Interior, California's Governor and Legislature, and voters of the State. Federal funds have been made available by the President and Congress to the Bureau of Reclamation for commencement of construction of the project.
KENNETT DAM
MT. SHASTA
MT. LASSEN
REDDING
HEAD OF NAVIGATION
RED BLUFF
SACRAMENTO RIVER
KENNETT TRANSMISSION LINE
ORDVILLE
WILLOWS
YUBA CITY
MARYSVILLE
OROVILLE
LAKE TAHOE
SACRAMENTO
SACRAMENTO SAN JOAQUIN DELTA CROSS CHANNEL
CONTRA COSTA CONDUIT
STOCKTON
SAN FRANCISCO
MODESTO
SAN JOAQUIN RIVER
SAN JOAQUIN PUMPING SYSTEM
MERCED
MADERA CANAL
FRIANT DAM
YOSEMITE VALLEY
MT. WHITNEY
MADERA
SANTA CRUZ
MENDOTA
FRESNO
HANFORD
VISALIA
FRIANT KERN CANAL
BAKERSFIELD
BOULDER DAM
SANTA BARBARA
LOS ANGELES
SAN DIEGO
PACIFIC OCEAN
CENTRAL VALLEY PROJECT of CALIFORNIA.

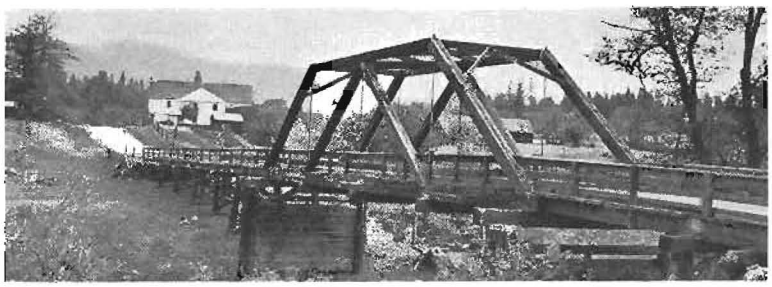
250 Old Bridges on Must Be Replaced

By GEORGE T. McCOY,



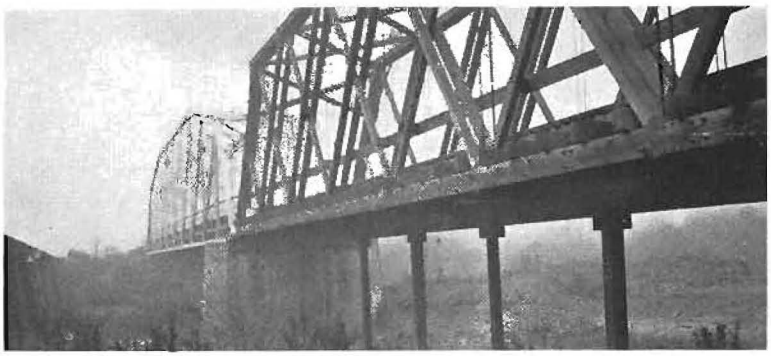
Smith River bridge, Del Norte County, built in 1907 of poor material.

Oregon Gulch timber bridge, Trinity County, not safe for legal loads.



Hayfork Creek bridge, Trinity, is old, narrow and posted.

Built in 1884, one of spans of this bridge at Red Bluff recently was knocked down by truck.



Supports under this timber truss on Yager Creek, Humboldt, wash out every year.

COSTLY upkeep of several hundred old and unsafe highway bridges has created for the Division of Highways a very serious maintenance problem.

There are some 3280 bridges in the State road system and of these about 250 are posted as unsafe for smaller loads than those allowed by the California Motor Vehicle Code.

Approximately 1000 were not built in accordance with modern structural standards and have deteriorated to a point where constant inspections and repairs are necessary to afford safety to traffic. In other words, there are 250 highway bridges which should be replaced immediately and 1000 more which should be replaced in the near future, say in the next ten or twelve years. This makes a total of over 1200 bridges which should be rebuilt if legal loads are to be carried over these bridges in safety, and most of this work should be done in the first and not the last period of the ten to twelve years.

SEVEN MILLIONS NEEDED

The estimated cost of replacement of the bridges requiring immediate attention is approximately $7,000,000.

The estimated cost of replacements that should be made within the next ten or twelve years amounts to $25,000,000, or a total of $32,000,000.

A major bridge construction program may be the only solution of the problem.

Many of these old bridges were inherited by the State when the Legislature added 800 miles of county roads to the State system in 1931 and an additional 6800 miles in 1933. They are approaching the time when they will have to be replaced by new structures. Maintenance of them, a burden of which the counties were then relieved, is becoming more expensive each year.

OLD BRIDGES COLLAPSE

Several of these ancient structures have collapsed in recent years due to abuse from overloaded trucks, notably the Bear Creek bridge at Merced, the Santa Maria River bridge, the Kings Slough bridge in Fresno County and the Sacramento River bridge at Red Bluff.

Others are still being used as posted bridges, but the Division of Highways would be compelled to maintain a twenty-four hour watch on all of them in order effectually to prevent careless drivers from ignoring the warning signs against limited loads.

Some of these structures are used by motor buses carrying children to schools and the Division of Highways is continually faced with worry over the condition of such bridges.

State Highways Immediately

Assistant State Highway Engineer

Maintenance of all bridges on the best traversible roads along the existing State highway routings was taken over by the highway department in 1926. The length of the State system at that time was somewhat less than 6600 miles. With the additions of approximately 7600 miles and other adjustments in the system which have been made from time to time, the present mileage of the State highway system totals 13,900 miles, including highway routes through incorporated cities.

ELEVEN PER CENT POSTED

On the State system the 3280 bridges total about 469,000 lineal feet—88 miles of bridges 20 feet long and over. Of this length of bridge structure, 11 per cent are posted for limited loads.

A highway is no stronger than its weakest link, and the links are bridges. It is not the length of a weak bridge that is important but the fact that most of them impair the carrying capacity of many miles of adjacent highway. Although signs are placed at each weak structure warning the public of the reduced load limits, it has been found impossible entirely to prevent heavy loads from crossing over with attendant danger to the careless drivers ignoring the warning and other vehicles which follow.

NO FUNDS FOR SITUATION

In addition to all the posted and structurally weakened bridges above referred to, about half the remainder, or some 1000 bridges are, although structurally sound, too narrow to afford the safety to traffic which is to be expected in a highway built in accordance with modern ideas of highway construction.

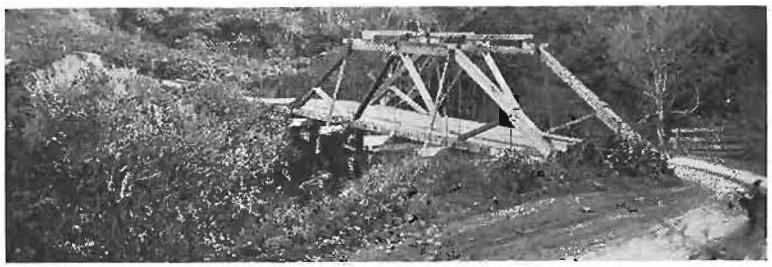
From a structural standpoint alone there is found to be slightly over 2000 bridges built to modern standards, either by the State itself or by other political bodies using equivalent standards of design and construction. However, the lack of funds in past years has many times forced the use of more temporary forms of construction and the time for reconstructing some of these bridges is again approaching.

On the present State highway system will be found such structures as the old suspension bridge over the Feather River at Bidwells Bar built in 1856, the bridge over the Sacramento River at Red Bluff built in 1884 of wrought iron and a host of structures, large and small, built without competent supervision in the early years of the present century from competitive designs which sacrificed everything possible to economy.

A great number of older bridges are on poor highway alignment, or the proper location of the highway itself requires that the bridge crossing be changed.

(Continued on page 22)

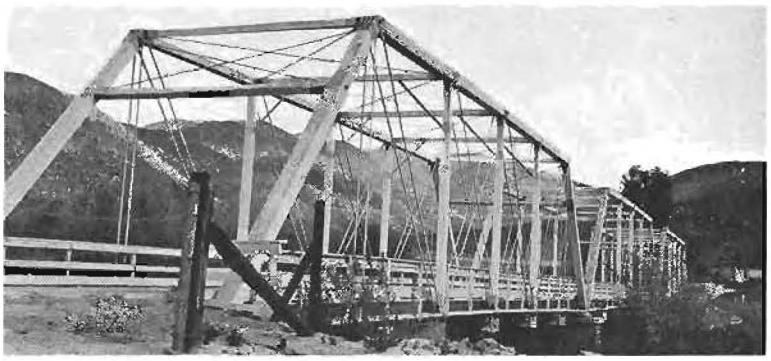
This bridge near Blairsden, Plumas, can be knocked down if hit by truck.



This 40-year old bridge over Elk Creek, Mendocino, has been cause of several severe accidents.

Dangerous structure with narrow roadway near Hopland, Mendocino.

Klamath River bridge, near Seiad. Siskiyou, could not withstand blow from truck or auto.



Type of combination truss span across Cottonwood Creek, San Diego, that is dangerous because roadway is too narrow.

"Caution" Signs Used to Show Potential Motoring Hazards

By F. M. CARTER, Assistant Maintenance Engineer

THIS is the third in a series of articles dealing with highway signs used by the Division of Highways to protect and facilitate traffic on California State highways and has to do with the "Caution" type of the warning group.

This type of the warning group is a square with two sides vertical, yellow background with black letters or symbols. In a few cases because of wording required a rectangle is used. The caution type sign is used only for conditions where there is a potential operating hazard which requires vehicles to proceed with caution. This type, however, unlike the slow type, does not necessarily require a reduction of speed.

Every caution type sign should bear a message indicating the kind of hazard. This message should always be brief and simple. A few of the potential hazards where this type of sign should be used include:

1. Highway intersections.
2. Highway construction or repairs.
3. Other temporary highway conditions.
4. Pedestrian zones.
5. Hospital zones.
6. School zones.
7. Railroad advance warnings.

SCHOOL ZONE RULES

The majority of the "Caution" signs are reflectorized for night travel. An exception to this is the school zone sign because this condition rarely presents a potential hazard after dark.

When the school grounds are not adjoining and the motorist is not able to see whether the children are at play or on their way home from the grounds, then such placement causes disregard and is a detriment to the use of these signs elsewhere.

The Vehicle Code says that the speed of any vehicle shall be fifteen miles per hour when passing a school building, or the grounds thereof, contiguous to the highway during school recess or while children are going to or leaving such school during opening or closing hours, or when the playgrounds of any such school are in use by school children.

When you see the yellow square "School Zone," watch out for children. On State highways where the road is paved this "Caution" type sign is always accompanied by pavement markings reading "School Xing."

PORTABLE SIGNS

One of the most used portable signs of this caution type is the "Men Working" sign used by highway maintenance crews to advise the motoring public to watch out for these men. In many cases these signs read "Men and Equipment Working" and it is necessary to place them at the termini of long stretches of highways to cover the movement of the equipment. Such signs are removed immediately when such work has ceased and extreme caution should be observed when such signs are in place. A red flag is always used with such signs.

Other important signs of this type are the "Slide Area" and the "Slippery When Wet." In certain sections new construction etc., slides and falling rock may encroach on the traveled way and the "Slide Area" sign which is always reflectorized advises the motorist to watch out for such slides and falling rocks on pavement.

NEED FOR CAUTION

The "Slippery When Wet" sign commands immediate caution. These signs are placed where a slippery condition may be caused by moisture on the pavement mixed with dust or when wind blows clay from adjoining cuts or area. In some cases the surface of the pavement itself presents the slippery condition when wet because of its smoothness. Such locations are resurfaced as soon as economically possible to a nonskid surface.

Many locations have conditions that border on the use of a slow type sign and then a "Slow" sign is placed in advance of the caution type sign. The caution type sign is always placed after such a slow sign to advise the motorist why he should proceed slowly.

At intersections the sign with the lowest effect and inconvenience commensurate with the hazard should be used. The development of protection of intersections is in the following order:

1. Caution type sign.
2. Slow type sign.
3. Stop sign.
4. Traffic signals.
5. Rotary traffic development.
5. Grade separations.

INTERSECTION SIGNS

The use of the "Cross Road" and "Side Road" should be restricted to intersections with roads which are improved to an extent that there is likely to be a fairly large volume of traffic entering the through highway from the side route, or where some unusual feature makes it advisable that the intersection be called to the motorists attention. The use of these signs should be limited so that they will command attention when placed. A "Cross Road" or "Side Road" sign should never be placed in advance of a "Stop" sign. The policy as to "Stop" signs and traffic signals will be discussed in a later article.

For maintenance purposes, temporary caution type signs are used temporarily to show unexpected conditions such as "Fresh Oil," etc. Such temporary signs are removed as soon as the condition is corrected.

MOTORISTS WILLING TO OBEY

Requests for new wordings on this type of sign are the most frequent. Every condition brings forth new

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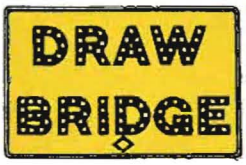
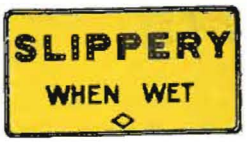
"Caution" Group of California Road Sign System



Placed 400 feet in advance of all draw bridges to permit vehicles to come to full stop if bridge is open. Traffic should slow down.



Placed at strategic points on highways where the type of pavement creates a hazard when wet.

Placed at strategic locations where hazard of slippery pavement is sufficient to warrant a reduction in speed.

Used in desert or seacoast areas where sand is blown over highway. Cautions traffic to proceed slowly.

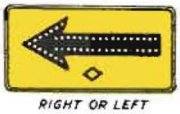
Set 400 feet in advance of busy intersections. Used only where volume of cross traffic is sufficient to create real hazard.

Used in mountain or hilly sections where land slides or loose rocks frequently block highways. Traffic should go slowly.

This sign is placed 400 feet in advance of a side street to indicate to motorist he is approaching a side thoroughfare and should slow down.

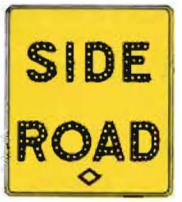
Placed at end of area marked by a "Slide Area" sign. Traffic may resume normal speed beyond this sign.

Placed approximately 500 feet in advance of dips or depressions in highway occasionally under water. Hooded when not needed.



This sign is made with either right or left arrow. Placed in head on position to mark a sharp turn.

Placed about 400 feet in advance of all schools when school grounds are contiguous to or face highway. Maximum speed 15 miles.



Placed 400 feet in advance of side roads that end at highway and do not continue across. Used only where traffic warrants.

Placed in advance of fire stations as warning to traffic to go slowly and be on alert for fire fighting equipment

This sign is placed in advance of hospitals when the grounds of same are contiguous to the highway.

Advance warning sign for single track railroad grade crossing. Used 400 feet in advance of rails in rural areas; 200 feet in advance in cities.

Placed 400 feet in advance of intersections where slow speed is necessary to stop when pedestrians are in crosswalks.

Placed about one-half block in advance of important or heavily traveled intersections in cities. Reduced speed necessary.

Advance warning for double track (two or more) railroad grade crossing. Used in place of above sign for grade crossing having more than single track.

February Storm Damage to Highway System Totals $1,000,000

By T. H. DENNIS, Maintenance Engineer

TWO unprecedented storms during the month of February wrought damage to State highways and bridges that will cost the Division of Highways approximately $1,000,000 to repair, a sum almost equalling that expended for similar work during the entire 1935–36 winter season.

Most of the destruction occurred in the counties of San Diego, Orange, Los Angeles, Ventura and San Bernardino.

Creeks and streams that remained within their banks in the past, even during the severest of winters, and which in summer are almost dry water courses, flooded out of their beds during February and swept over highways, undermining pavements and damaging bridges.

Expenditures for removal of earth slides, replacement of fill slip-outs and emergency repair of washouts and like damage this winter will amount to about $1,300,000 and, in addition, it is necessary to replace several bridges which were totally destroyed or seriously damaged. This sum and that spent during the 1935–36 winter season represent twice the storm damage normally expected, as based on several years' previous experience.

TABULATION OF DAMAGE

The estimated total damage for the two storms---one during the week of February 6 and the second a week later—in the southern highway districts is as follows:

District	*Headquarters*		*Amount*
V	San Luis Obispo		$60,000
VI	Fresno	Roads	60,000
		Bridges	75,000
VII	Los Angeles		210,000
VIII	San Bernardino		115,000
XI	San Diego		80,000
			$600,000

For the other six districts, and including the cost of snow removal, some $300,000 was required in addition during the month of February.

This year has been peculiar to the extent that, while cost of snow removal has been heavy, only normal damage to highways has occurred in the northern part of the State, while the portion from Monterey and Tulare counties south has borne the brunt of destructive storms.

The highways in Ventura, Los Angeles and Orange counties in District VII suffered more damage than in any other section. Rainfall for the season had exceeded normal and more snow was on the ground in the Lake Arrowhead and Big Pines areas. The warm rains of February 6 and 7 caused an especially heavy run-off in the Santa Ana drainage district.

RECORD BREAKING RAINFALL

The second storm a week later, coming while the streams were still swollen with flood water and the ground saturated, resulted in immediate run-off and further flooding. The damage consisted of earth slides, earth and debris over pavement and shoulders of highways, loss of roadway and shoulder embankment and loss of stream and shore protection work. The estimated cost of repair damage in Los Angeles County alone is $210,000.

In these counties, as elsewhere, streams that heretofore had kept within their banks due to adequate bank protection work, could not carry the debris washed into them and consequently overflowed, inundating highways, undermining them and in some cases sweeping away large sections of pavement.

STREAMS OVERFLOW

In detail, the severest damage in District VII, Los Angeles, was as follows:

ROUTE 4, Weldon Canyon Cut-off and Ridge Route—20,000 cubic yards of slide material.

ROUTE 2, on the main road to San Diego—south of Tustin, a large culvert was flooded and the pavement adjacent thereto was undermined. South of Irvine, a stream paralleling the road washed out 500 feet of shoulder support, and also destroyed 1500 feet of pipe and wire protection work.

At Bear Creek, south of Galivan, the pavement was covered with water to a depth of four feet, and several feet of sand was left on the pavement and shoulders when the water receded.

North of San Clemente, at Trabuco Creek, a section of highway three hundred feet long was washed out to a depth of thirty feet, and protection work at the Trabuco Creek bridge was destroyed. Some 25,000 cubic yards of filling material, replacement of pavement, and stream protection work is necessary at this location.

DETOUR THROUGH ORANGE GROVE

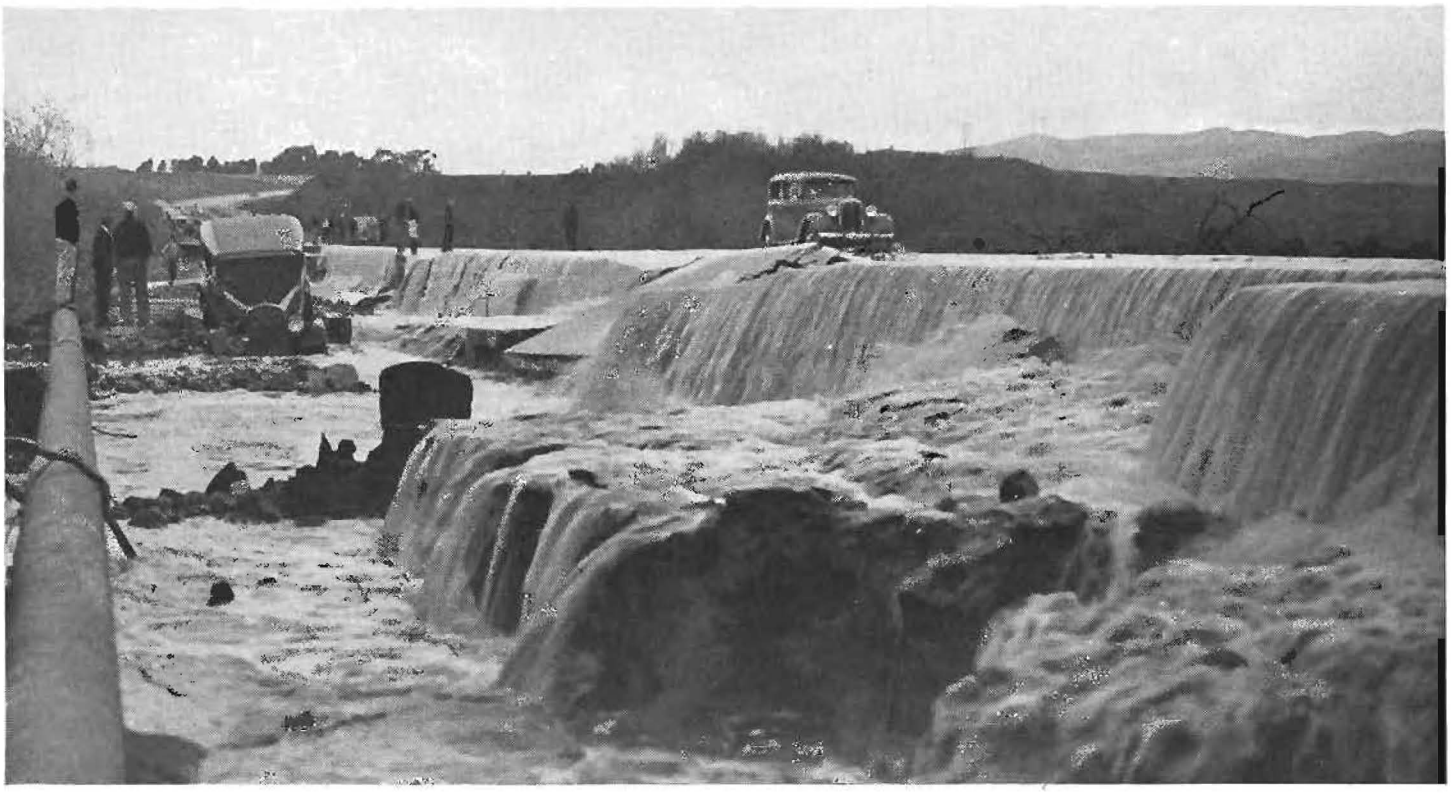
As there were no parallel roads over which traffic could be detoured, it was necessary to secure permission to pass light traffic through the adjoining orange grove over a plank road constructed for the purpose. Truck traffic was routed to Newport, thence south to Dana Point and San Diego.

ROUTE 60, at San Juan Creek, about sixty feet of three-lane pavement, as well as about seventy-five feet of the pile wing wall and the entire road embankment, was washed out to a depth of thirty feet.

ROUTE 64, two and one-half miles east of San Juan Capistrano, two hundred feet of the west approach fill to San Juan Creek bridge was washed out. The road was also closed by slides in the mountain section to the east. West of Santa Monica, the road was closed for several hours by some 25,000 cubic yards of slides.

HEAVY SLIDES

The Laguna Canyon road was damaged by high water, and heavy slides occurred in San Gabriel Can-



San Mateo Creek becomes miniature Niagara 20 miles north of Oceanside, San Diego County, and washes away highway pavement and shoulders.

yon, as well as Decker and Grimes Canyon routes.

ROUTE 43, through Santa Ana Canyon—some $10,000 is required to clean debris from pavement, to replace lost embankment, and to repair the fence and brush type of protection work.

ROUTE 79, in Ventura County—some $4,000 is required to clean debris from pavement.

ROUTE 138, Ventura to Maricopa highway. This road was closed by 50,000 cubic yards of slide material. The estimated cost of slide removal and clearing out the drainage system is $30,000.

ROUTE 2, in Ventura County—the sum of $9,000 is estimated cost of cleaning mud from pavement and cleaning drainage ditches, etc.

DISTRICT VIII HARD HIT

Rainfall in San Bernardino and Riverside counties broke all records in February, resulting in damage in District VIII amounting to $115,000.

In San Bernardino a total of 25.50 inches of rain had fallen, and 8.64 inches was added in February when the heaviest storms occurred on February 6th and February 14th.

With the Coast Highway to San Diego closed and the Santa Fe Railroad service to San Diego tied up, the only route open to traffic between Los Angeles and San Diego was by the inland route through Riverside, Elsinore and Fallbrook. Highway crews struggled night and day to keep this important traffic, as well as traffic between Los Angeles and Imperial Valley, moving without serious interruption.

The Santa Ana Canyon route leading from the west end of Riverside County into Orange County was closed for two days following the February 6 storm and for several hours following the February 14 storm. This condition was caused by the Santa Ana River overflowing and inundating the highway to a depth of approximately three feet. Portions of the highway along the river bank were partly washed away.

The Ortega Highway leading from Elsinore to San Juan Capistrano was closed by numerous slides and probably will remain closed for thirty days.

The Imperial Highway between Temecula and Warner Hot Springs was closed for seven days as a result of one of the pile bents in the Temecula River bridge being washed away.

The Pines-to-Palms Highway leading from Hemet through the San Jacinto mountains to the Coachella Valley was closed by numerous washouts where the San Jacinto River parallels the highway. Three bridge approaches were also washed out on this route, necessitating many thousands of yards of backfill. The probable period of closure on this route will be thirty days.

DEBRIS FILLED STREAMS

The foothill road between the Moreno and Hemet valleys suffered considerable damage when the San Jacinto River flowed beyond the capacity of its channel and due to great deposits of silt and gravel washed upon this highway from Massacre Canyon, the loss of a portion of the south approach to the San Jacinto River bridge necessitated considerable backfilling. This route was closed to traffic for two days.

The new Jack Rabbit Trail between Riverside and Beaumont was closed for one week by many slides. While the road was opened after about seven days of work it will be some time yet before all of the slides are removed.

The highway from San Bernardino to Imperial Valley was closed for a few hours during each of the heavy storms where the highway is crossed

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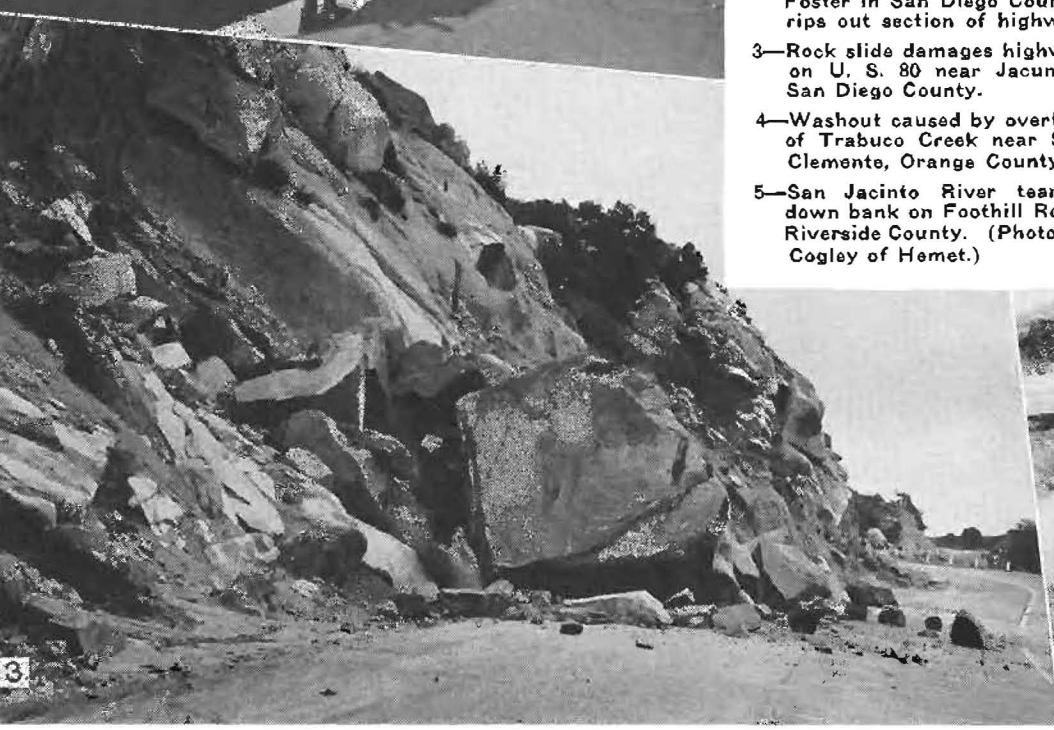
Scenes of Flood Damage to State Highways



1—Highway shoulders destroyed by ditch flood waters between Galivan and Irvine, Orange County.

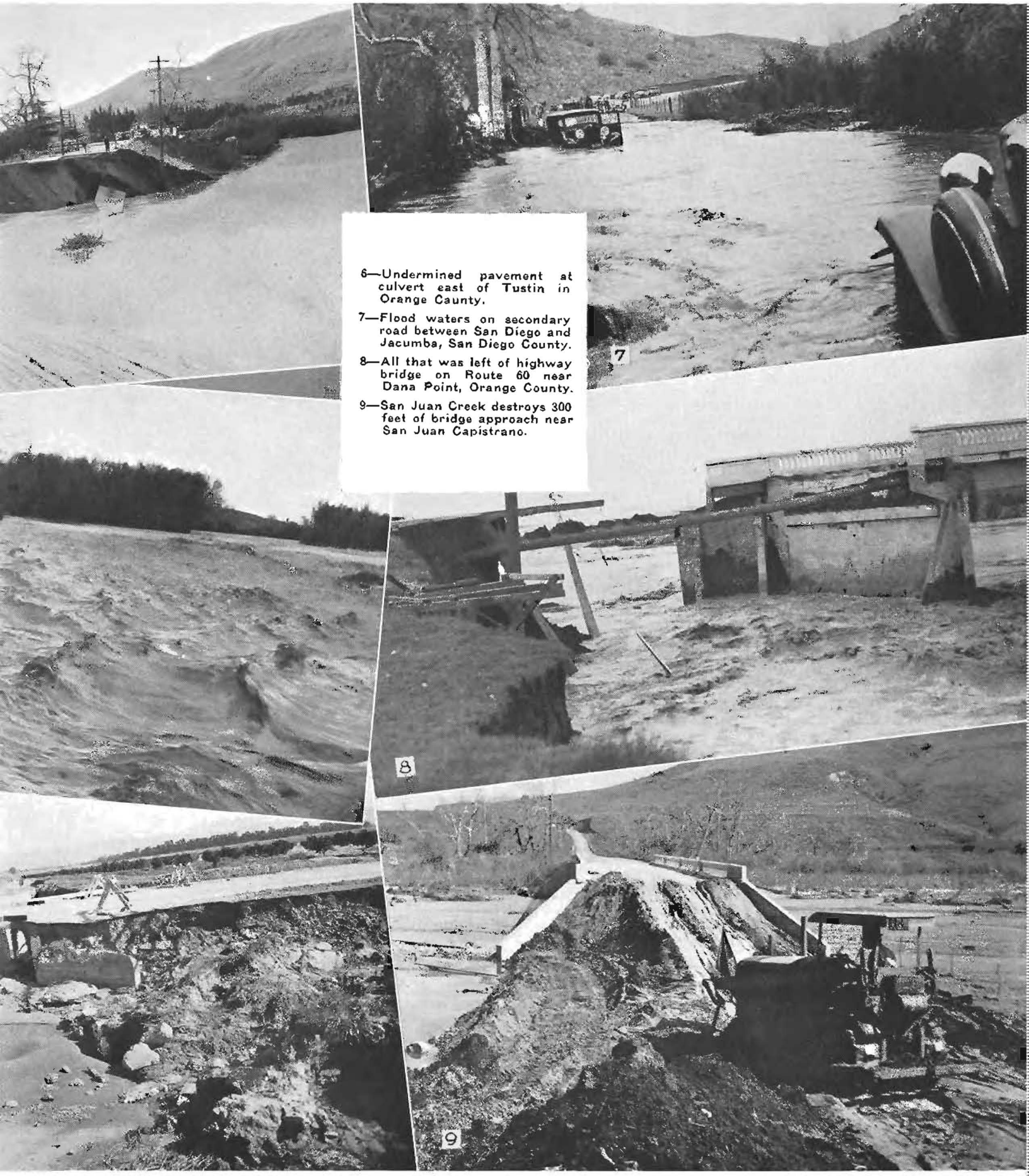
2—San Vicente Creek, near Foster in San Diego County, rips out section of highway.

3—Rock slide damages highway on U. S. 80 near Jacumba, San Diego County.

4—Washout caused by overflow of Trabuco Creek near San Clemente, Orange County.

5—San Jacinto River tearing down bank on Foothill Road, Riverside County. (Photo by Cogley of Hemet.)

s During Abnormal Rain Storms in February



6—Undermined pavement at culvert east of Tustin in Orange Caunty.

7—Flood waters on secondary road between San Diego and Jacumba, San Diego County.

8—All that was left of highway bridge on Route 60 near Dana Point, Orange County.

9—San Juan Creek destroys 300 feet of bridge approach near San Juan Capistrano.

February Storm Damage to Highway System Totals $1,000,000

(Continued from page 13)

by the Owl Wash on the desert below Banning.

BRIDGE IS SAVED

The Owl Wash is a very elusive stream which meanders around over a debris cone above the highway and very often crosses the highway at points other than where the concrete bridge is located. Great deposits of gravel and boulders were left on the west approach to the bridge. State Highway equipment was stationed at this bridge for the purpose of towing traffic through the water and debris.

Where this route crosses the Santa Ana River two miles south of San Bernardino, washing of the river into the north approach caused serious concern. A shipment of piling and bulkhead timbers were secured from the coast and a bulkhead 200 feet in length hurriedly constructed to protect the approach fill against subsequent storms. Due to strikes no timber in excess of two inches in thickness was available in any of the Southern California timber yards. Timbers were eventually located in the Santa Fe yards at National City and were hurriedly transported to the bridge site by truck.

The Palm Springs Highway between Whitewater and Indio was closed below Palm Springs for a period of several days due to the loss of two miles of pavement when Palm Canyon Wash went on a rampage. Telegraphic permission was secured from Washington, D. C., to route State Highway traffic for a period of sixty days over an old road crossing the Indian Reservation. It is possible to reconstruct the two miles of pavement in its old location.

MANY LAND SLIDES

The Barton Flats Highway leading from Redlands into the San Bernardino mountains was seriously damaged by many slides. At this writing it was not possible to determine the amount of material on the highway as most of the earth slides are covered by snow. Some of the large fills are seriously damaged where culverts were insufficient in size to carry the entire flow of the streams. This road may be closed for a total of sixty days.

The Crest Drive to Lake Arrowhead and Big Bear Lake resorts was open practically at all times except at Dry Creek where a bridge approach was washed away. Here the road was closed for a period of two days. This route, however, has many slides which must be removed during the next thirty days.

The desert routes on the Mohave desert experienced practically no damage.

At the time the first heavy February storm took place, four power shovels were at work in District VII on slides resulting from previous storms of lesser intensity. Eight additional shovels have now been employed and are at work removing slides and repairing washed out fills and bridge approaches.

UNUSUAL RAINS

A review of conditions in San Diego and Imperial counties in District XI where a rainfall of 9.03 inches in a 12-hour interval was recorded, of which the greater portion fell within two or three hours, reveals that damage to State, county and city highways was extensive.

Damage in San Diego County to the State Highway System has been estimated at $80,000. This storm wrecked one forty-five foot timber bridge, and washed out six bridge approaches, some of them on the main coast highway.

PAVEMENT UNDERMINED

Several sections of pavement were undermined to such an extent that they required replacing. All culverts and dips ran full and several washed out, including one large concrete dip and one rubble masonry overflow dip. Practically all roads were at least partially blocked by slides, mostly rocks. Rocks, some of them ten feet through, slipped onto the highway in many places.

Maintenance crews were on the job continually, and patrolmen were out all night. By 10 p.m., February 6, nearly every truck in the Maintenance Department was out, pulling motorists from dips, placing barricades and lanterns to warn the public of washouts and slides, and trying to keep drainage structures open. The first indication of serious trouble came about midnight when reports came in simultaneously that the approaches to one bridge on the Coast Highway, U. S. 101, and another on U. S. 395, near San Diego, were washing out.

PATROLS ON JOB

One crew arrived just as the pavement slab at the Sorrento Bridge fell after a car had passed over, and narrowly averted a serious accident by getting lights and barricades up before the next motorist arrived. Fortunately the patrols were able to place warning lights in sufficient time to avoid serious accidents, at several places. Several hundred motorists were towed from dips.

Immediate steps were taken to open the main highways. At the Sorrento Creek Bridge, where thirty feet of the north approach was washed out at approximately midnight, replacement was in progress by 6 a.m. Rock rip-rap was taken from adjacent sea walls to check the water, and thirty-eight hours after the washout the first traffic was allowed to cross. During this time another approach partially washed out on the route over which the fill material was being hauled, and by prompt action a second break was checked.

The highway maintenance crews worked long hours, and many of the foremen and others worked continually through two days and one night. Contractors on State Highway projects were of great assistance in furnishing equipment and crews to the Maintenance Department, and it was through their cooperation that traffic was reestablished promptly in several instances.

SAN JUAN BRIDGE LOST

In District V, with the exception of the loss of the bridge across the San Juan River west of Simmler, on Route 58, the main damage in Monterey, San Luis Obispo, and Santa Barbara counties was due to slides. It is estimated that it will be necessary to move some 150,000 cubic yards of material to replace the roads in their original conditions. Route 57—the Cuyama lateral—with some 24,000 cubic yards, Route 56—along the coast—with nearly 60,000 cubic yards, and

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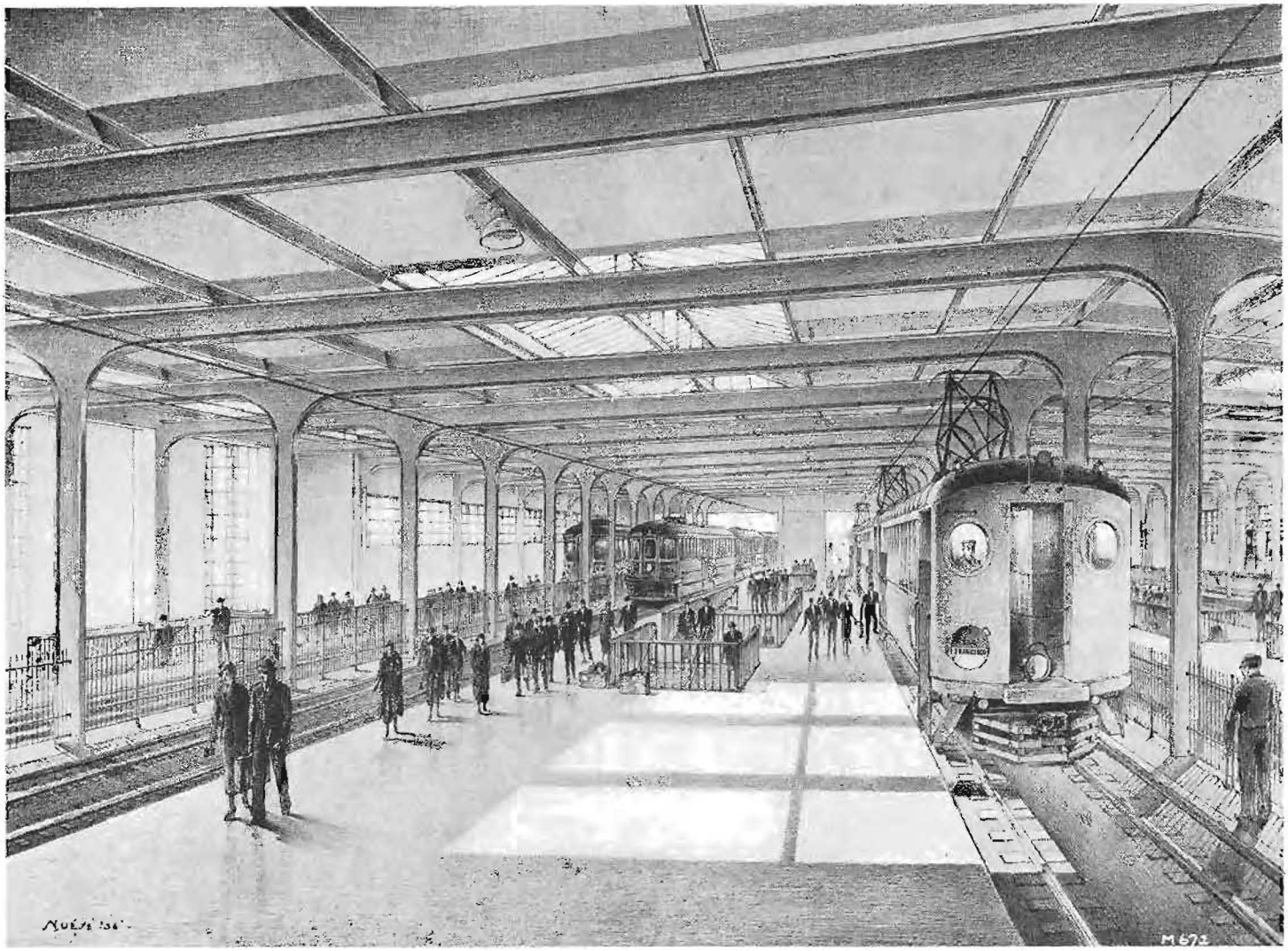


Interurban Train Platforms for San Francisco Terminal of Bay Bridge

INSTALLATION of interurban facilities on the San Francisco-Oakland Bay Bridge is expected to be completed by the summer of 1938, according to Chief Engineer Charles H. Purcell.

Work on the construction of the San Francisco Interurban Terminal, the design of which is shown in the accompanying architect's drawing, is now under way.

All tracks and loading platforms in the terminal will be entirely roofed for a length of 700 feet, with large skylights and windows providing ample lighting.

Because the Bay Bridge trains will arrive at the terminal every minute during the rush hours, the present congestion caused by the 35,000,000 annual commuter traffic between the East Bay and San Francisco is expected to be eliminated by the more uniform distribution of passengers.

Plans call for six tracks arranged in pairs with platforms between alternate trains, with an over-all station width of 164 feet. Two inner platforms will each be 27 feet in width and two outer platforms will each have a width of 14 feet. Fences between the pairs of tracks will prevent passengers from crossing them, to their danger.

Each platform will have a system of 7 ramps or stair connections to the mezzanine concourses, from which commuters will leave the terminal building.

The ramps and stairways will be spaced along the entire length of the loading platform so as to serve an entire train and to give passengers a minimum walking distance.

Safety Enforced by Bridge Squad

A total of 1241 cars were stopped and their drivers warned during the month of February on the San Francisco-Oakland Bay Bridge; while 99 arrests were made for various violations, according to a report submitted by Captain Rudy Schmoke, head of the Bay Bridge Detail, to Raymond E. Cato, Chief of the California Highway Patrol, in a campaign to make the bridge not only "the finest but the safest highway in the world."

Teacher: "Where is the capital of the United States?"

"All over the world."

States Not Ready for Divided Highways Because of High Cost

By MURRAY D. VAN WAGONER, Highway Commissioner of Michigan

Taking as his subject, "Are the States Ready to Assume the Economic Problems Involved in Starting a Program for Divided Highways?" Highway Commissioner Murray D. Van Wagoner of Michigan answered the question with an emphatic "no" in an address he delivered before the Administrative Problems Group of the convention of American Association of State Highway Officials in San Francisco. His discussion of the topic, in part, follows:

SEVERAL months ago a great national magazine, in an article on "Foolproof Roads," put us highway commissioners on what we gently refer to as the well-known "spot." The American people were told that fifteen billion dollars had been invested in their road system but that the road builders had fumbled the ball. We were taken to task for using paint in the middle of the road, for widening our two-lane highways to three lanes, and for other efforts we have made in the interest of public safety and orderly traffic.

Since the appearance of that article, there have been others but I have not yet noticed any in defense of highway administrators. Subsequent literary output relating to the same general subject material has taken on a very humble, apologetic aspect.

While I realize that I can not speak for the American Association of State Highway Officials, I would suggest that we need to make no apology to the motoring public of America on our stewardship as administrators of the greatest highway system in all the world. This attitude does not blind itself to the reality that this system is far from perfect and that there is need for more and better highways and highway structures. But it is an attitude that says to the motoring public that it has fared well for all the obstacles it has thrown into our pathway either directly or through its chosen legislative representatives.

For all the space that was taken in this article to chastise the State highway officials of the 48 States, I would emphasize that the conditions it cited were those prevailing largely within the corporate limits of our great industrial centers. It is significant that, until three years ago, we as State highway officials were powerless to remedy traffic congestion in these cities through new construction on our several Federal Aid programs. It is just as significant, at least in Michigan, that the greatest advance that has been made in correcting such conditions has been registered since we were permitted to do something about the matter.

Doubtful if Needed

"All this evidence leads to the unalterable conclusion that the States are not yet ready to assume the economic problems involved in starting a program for divided highways. It is doubtful that such a program is even needed in most of our States. In most of the others, it appears that State highway authorities do not have sufficient control over highway revenues to meet the enormous costs of this type of a program.

"At the same time, I am not so pessimistic that I think the day will never come when such a program will be possible. It is my opinion that we State highway authorities, in future planning, should make provisions for such a program by insisting upon adequate design and adequate right of way. This is particularly true with regard to the design and construction of new highways."

DIVIDED HIGHWAYS DEMANDED

But it is not for me to launch into a lengthy discourse as to the efforts to which we State highway officials have gone to build safety into our highways and highway structures. I am here to talk to you about the economic feasibility of instituting a nation-wide, divided highway program.

The demand back of the divided highway of course is the demand for greater safety on our highways. The theory of the divided highway is that it eliminates or reduces merical friction. In less technical language, it forces drivers to stay apart from each other even though they haven't the sense to do it voluntarily.

Now we will all admit that the divided highway is a noble public safety objective. At this time, it appears to be the ultimate in highway safety, at least to so many States whose revenues are so restricted that they are lucky to build hard-surfaced roads, much less superhighways that are divided.

However, there appears to be some exaggeration as to what the divided highway can accomplish in highway safety. Special studies made by the Michigan highway planning survey on divided and undivided highways bear out this common exaggeration. Let me cite, as a typical trunkline embraced in these studies, records on US-112 between the cities of Wayne and Ypsilanti, Michigan.

SURPRISING STATISTICS

The figures cover accidents between these two cities on this trunkline for the first six months of 1936. From the west city limits of Wayne to the Wayne County-Washtenaw County

line, a distance of 8.86 miles, the trunkline is a four-lane divided highway. From the county line to the east limits of Ypsilanti, a distance of 2.97 miles, the highway is a four-lane, undivided road.

The records show that there were 24 accidents the first six months on the divided highway and 12 accidents on the undivided highway. Inasmuch as the mileage was different, we reduced the accident rate to terms of million vehicle miles.

We find that there was an average of 2.18 accidents per million vehicle miles on the four-lane divided highway for the first six months of the year and an average of 3 accidents per million vehicle miles on the four-lane undivided highway for the same period. In other words, dividing the highway meant a reduction of only 82/100 in the accident rate per million vehicle miles.

MORE SURPRISING FIGURES

The injury and death rate comparisons are even more surprising. On the divided highway we found an injury rate of 2.36 persons per million vehicle miles whereas on the undivided section the rate dropped to 1 person per million vehicle miles. There were no deaths recorded on the undivided section while the death rate on the divided trunkline was 18/100 per million vehicle miles.

This trunkline, as I have explained, was not singled out with any desire on our part to obtain a prearranged conclusion but is typical of several included in the highway planning survey studies. The trunkline in this area is not the heaviest-traveled artery in the State but is among the heaviest traveled. The estimated yearly traffic density ranges from 2,400,000 to 4,000,000 vehicles on the trunkline between these two Michigan points, depending on the particular section under observation.

The report did show that there were five head-on collisions on the undivided section of the highway while no such accidents were reported on the divided section. The head-on collision commonly rates next to the grade crossing accident as the most serious yet there were no deaths on the undivided section and a death rate of 18/100 per million vehicle miles on the divided section. Perhaps we are to draw the conclusion that drivers will find a way to injure and kill themselves even if we remove the possibility of head-on collisions.

NOT A CURE-ALL

This study on Michigan trunkline US-112 gives proof that the divided highway does reduce the accident rate but it does not offer sufficient proof for us to regard this type of development as a cure-all for the accident problem. I would emphasize that all surveys have shown that the human factor is still the greatest factor in highway accidents. All the divided highways in the world will not eliminate this controlling factor.

Now we come to a consideration of the costs of constructing divided highways. Here the controlling factor is the amount of money needed to purchase additional right of way.

Before detailing some of our experiences with right of way costs in Michigan, it is well to state my belief that any divided highway program should presuppose the necessity for adequate right of way. In my opinion, the 3 or 4-foot safety island does not answer the problem of divided highways but rather increases it.

The narrow safety island gives no protection to the motorist at intersections whatever. A motorist intent upon crossing the highway at an intersection will depend upon the island for protection from automobiles rushing at him from his right or left. But how can the island offer him any protection when it does not even cover the length of his automobile?

COST IS HEAVY

We all know that any method of separating highways with a strip of land involves certain engineering problems such as adequate drainage. These problems mean heavy expenditures. As long as we must meet these basic problems under any plan of divided highways, it is my contention that we should do the job right. In other words, give the motorist a parkway that will protect him at intersections as well as along other sections of the highway. If we are to do the job, let us have adequate right of way and adequate design.

It is fundamental in an economic discussion of the problem that divided highways are justified only along highway sections of heavy traffic density. These sections are generally found either inside our great industrial centers or within the immediate vicinity of these metropolitan areas. It is in such areas that right of way costs are the highest.

It has been our experience in Michigan with approximately 80 miles of divided highways on the state trunkline system that this type of construction will cost from $100,000 to $600,000 a mile. In one instance, at least, these costs in my state have been considerably higher. I refer to Woodward Avenue in the city of Detroit, which, as US-10, has been characterized by one of our leading engineering publications as the most magnificent trunkline entrance into an American city.

EXPENSIVE IMPROVEMENT

Three years ago the State Highway Department started out to restore Woodward Avenue to the 120-foot width originally planned for it by the pioneers of Detroit. We have just completed that job, a 2½-mile project that cost in the neighborhood of $14,000,000. Today Greater Woodward Avenue for 2½ miles starting at Grand Circus Park has a 90-foot roadway of concrete base and sheet asphalt surfacing, 7½-foot brick-surfaced parking areas, and 15-foot sidewalks.

Today Woodward Avenue has a minimum 120-foot right of way all the way from Detroit to Pontiac, 25 miles distant, with the exception of a short section through the city of Birmingham. Outside of Detroit and Highland Park this highway becomes a divided road with the center parkway varying from 40 to 70 feet in width. Here the right of way branches out to 204 feet.

Right of way costs on the 2½-mile area of Woodward Avenue within the city of Detroit approximated $10,000,000 alone. Property condemned by the court for the widening included some of the most valuable real estate holdings in the entire city.

It is granted that the right of way costs on Woodward Avenue were the exception rather than the rule in their enormous amount. But I have explained that right of way is the controlling factor in making the cost of divided highway construction in Michigan range from $100,000 to $600,000 a mile. Compare this cost, then, with the average of $75,000 to $80,000 a mile required for simple four-lane, undivided widening construction.

Let us see if it is economically feasible for the States to initiate a divided highway program. In the prepara-

(Continued on page 22)

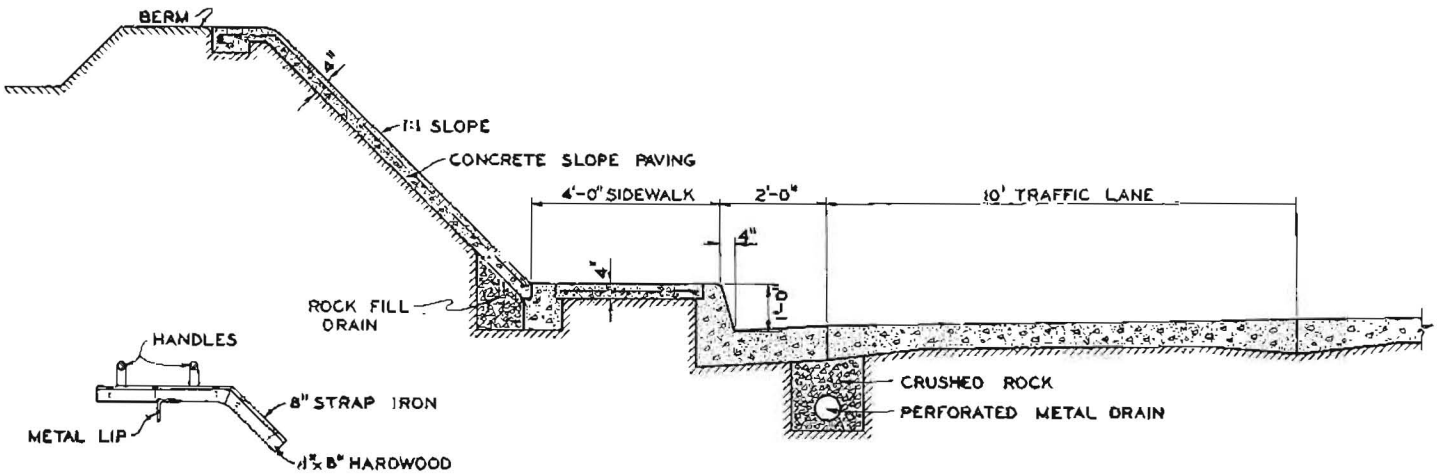
Improved Drainage Designs Used On 41 Grade Crossing Projects

By HARVEY D. STOVER, Bridge Designing Engineer

DURING the present biennium, the Division of Highways has constructed 41 different grade crossing projects in California for which the Federal Government appropriated $7,318,141 in pursuance of its Works Progress program.

An important feature of any grade crossing undertaking is the provision of adequate drainage and control of ground water and runoff.

Improved designs for drainage construction have been followed by the Division of Highway engineers in the extensive grade separation program it has carried out.



SECTION THROUGH DEPRESSED PORTION OF UNDERPASS

SUGGESTED FINISHING TOOL

In level areas where highway and railroad approach and intersect at approximately the same elevation it is usual practice to depress the highway on light grades and pass under the railroad. The drainage area involved is considerable and provision must be made against possible flooding from any cause.

When ground water is present and roadway is protected by reinforced concrete sidewalls and concrete pavement thickened to withstand the hydrostatic pressure. Walls and pavement are surrounded by a membrane waterproofing seal. Additional protection at expansion joints is provided by flexible strips of copper cast into the concrete.

Side slope drainage, runoff and seepage, is intercepted by perforated metal drains located in ditches along the bottom of the slopes. The bottom of the ditch is covered with a six-inch layer of gravel, the drain is placed and the ditch is then completely filled with gravel ranging in size from one to three inches. Drains lead to drain boxes at the bottom of the depressed roadway.

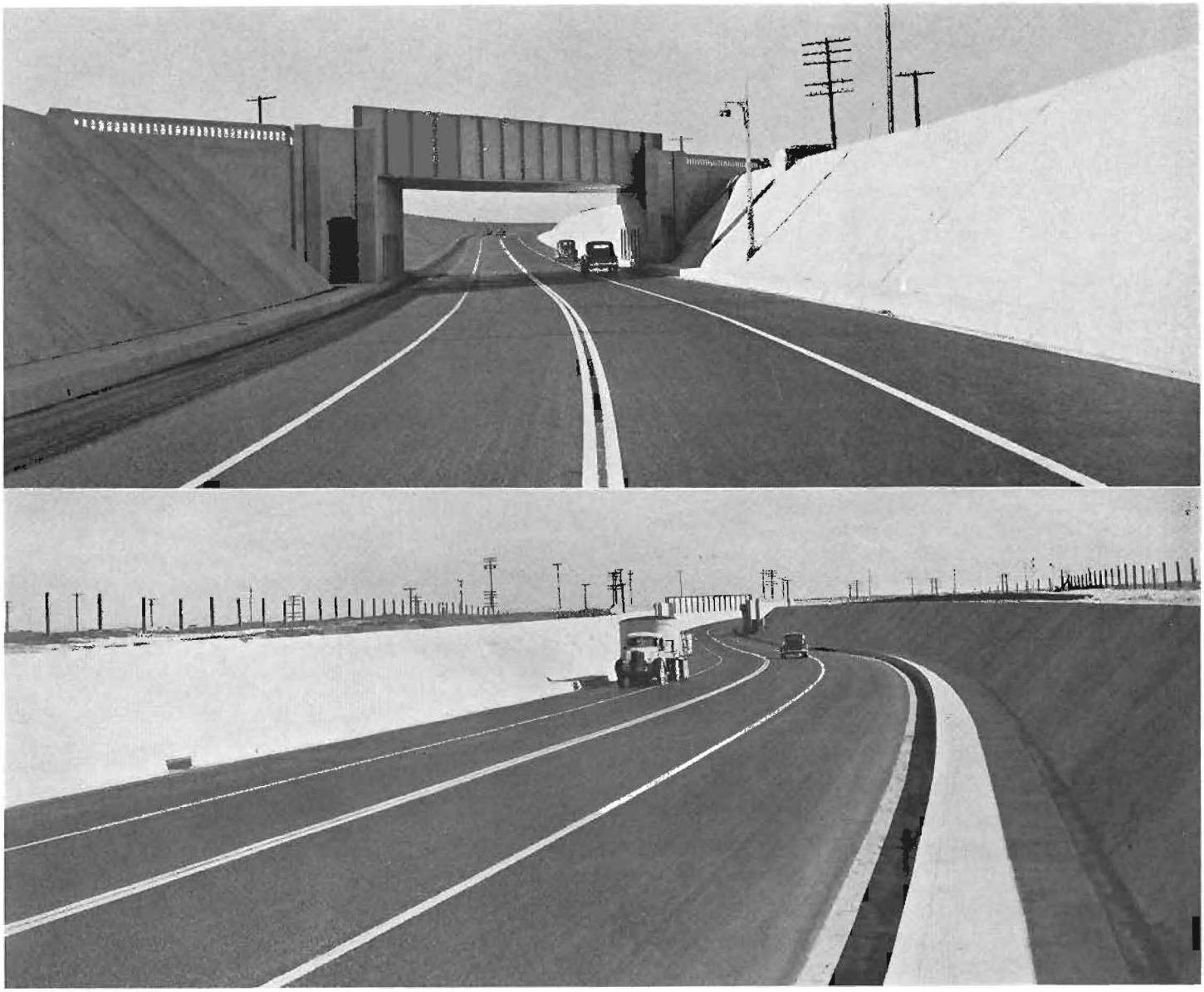
Pavement runoff is intercepted by catch basins placed at intervals along the curbs at both sides of the roadway, and carried through pipes to the drain boxes.

Drainage water is carried through pipes from the drain boxes to the sump from which it is disposed of by pumping into the nearest available natural drainage channel or storm sewer. The sump pumps are usually installed in pairs and are of the submerged vertical centrifugal type driven by electric motors. The operation is automatically controlled by float switches.

Pump capacities vary according to the drainage area and amount of rainfall anticipated. In localities where short periods of very heavy rainfall occur at intervals it is more economical to provide storage than to install large capacity pumps. A concrete reservoir connecting with the sump is constructed under the roadway to store the heavy runoff. Normal size pumps can then empty the reservoir after the peak runoff has subsided.

The section through the depressed portion of underpass as illustrated is typical of many of the Division of Highways designs. Where sandy material is encountered that erodes easily, it is the general practice to slope pave the cuts on one to one (1:1) slope; however, where the material encountered has stability, the side slope is made on one and one-half to one (1½:1) slopes and the slope paving is omitted.

The perforated metal drains at the sides of the paving are necessary only when considerable ground water is encountered, in which case it intercepts the water and makes it possible to maintain dry subsoil under the paving. Additional drain at center of paving has been found necessary in some locations.



Two views showing close-up and approach to recently completed Famosa grade separation project in Kern County involving a bridge over Poso Creek, a cattle pass, a bridge over Lerdo Canal and subway beneath railroad. Pumps and storage space assure subway will be kept dry.

Subway at Famosa Eliminates Grade Crossing Problem

WITH the opening to traffic on January 28, of the new subway at Famosa, in Kern County, another dangerous grade crossing has been eliminated on the State highway valley route between north and south.

The former highway crossed the tracks of the Southern Pacific Railway about one mile north of Famosa. The new alignment brings the highway 700 feet west of the tracks for a distance of about half a mile from the subway, and involves four structures, a bridge across Poso Creek, a cattle pass, a bridge over the Lerdo Canal, and finally the subway proper, under the Southern Pacific tracks. In the last named structure, steel plate girders carry two tracks over a clear roadway width of 44 feet on a 35 degree skew. No center pier is used.

Special precautions have been taken to see that the subway will be kept dry. In addition to the two pumps, each capable of lifting 800 gallons per minute through a 35 foot head, water storage space has been secured under the pavement with a capacity of 120,000 gallons, to give ample safety factor for the pumps to handle water at times of extreme rainfall.

The Griffith Company of Los Angeles was the general contractor for the work.

Cub Reporter: "I'd like some advice, please, on how to run a newspaper."

Editor: "You've come to the wrong person, son. Ask one of my subscribers."

"Waiter here's a half a buck for you."

"Yes, sir. Do you want to reserve a table?"

"No. When I bring my girl friend in here tonight, tell us they're all reserved."

250 Old Bridges on State Highways Must Be Replaced Immediately

(Continued from page 9)

New highways or highway connections are continually being built which require the building of new bridges. A study of State highway bridges constructed since June, 1927, shows that less than 40 per cent of the money allocated for bridges and grade separations has been used to replace bridges that were structurally weak.

The expenditure of no greater funds than have been spent annually for bridges in the past would do all the necessary bridge replacement outlined above, provided they can be spread out over several years more. Each year will see a larger number of bridges added to those which have to be posted for reduced load limits.

MAINTENANCE COST HIGH

The effort to carry on with the highway bridges in their present condition is constantly increasing the cost of maintenance. Uneconomical betterments and widening of roadway are making bridges safe for increased loadings so they can serve a few years more until money for their reconstruction, or for the reconstruction of the adjacent highway, can be obtained. With all this work goes the continuance of the risk of serious accidents — accidents of usually a much more serious nature, and productive of much more publicity than those occurring elsewhere on the highway.

Existing traffic conditions make it impossible to postpone the present progress in the reconstruction of highway bridges, and, if the cost to the public over several years and the responsibility for the safety of those crossing the bridges is given proper consideration, the expenditure for this purpose must be materially increased during the next few years.

Old, weak and otherwise unsatisfactory bridges are being replaced and repaired as rapidly as money is available but funds are insufficient to adequately take care of the situation. Many more than the 250 bridges now posted for restricted loads should be posted on general principles, inasmuch as they are potential hazards even though they can normally carry legal limit loads.

This refers to bridges which are of such construction that they could be struck and wrecked by trucks and automobiles. They may be of such narrow width that accidents would be caused by two cars attempting to pass each other.

DANGER TO SCHOOL BUSES

Many of these posted bridges are on primary highways and by their reduced load limits work a hardship on the transportation of farm produce, manufacturing and the trucking organizations. This is also a more serious situation when one considers the large school buses now used on practically all of the highways and which carry a large number of students.

Almost any day one may see articles in the papers outlining accidents in which autos colliding with narrow bridges have caused the death or injury of the occupants.

One recent article told of the collapse of such a bridge when a structural member was struck by a light passenger car. That bridge had been posted for a restricted load limit and the warning had been ignored. The passage of a heavier load had weakened the whole structure almost to the point of collapse and the impact of the lighter car caused the structure to fall. Such a failure of posted structures is a constant hazard.

The bridge situation on the State highway system is consequently so serious as to require that sober thought and consideration be given to the expenditure of a large sum of money to permit the carrying of legal loads over all our bridges, and prevent fatalities which might be caused by inadequate highway structures.

"Say, pop, did you go to Sunday school when you were a little boy?"

"Yes, son, regularly."

"I'll bet it won't do me any good, either."

"Are you a fellow who is bothered with flat feet?"

"Am I? I've been arrested by just one flatfoot after another."

States Not Ready for Divided Highways Because of High Cost

(Continued from page 19)

tion of this paper, I sent questionnaires to the various state highway authorities on this subject. Only 8 out of 29 reporting States have any divided highway mileage at all on their trunkline systems while 3 others have made definite plans for this type of construction on a limited scale in the future.

Most of the States reported the traffic density on existing roads did not warrant a divided highway program.

DIVERSION SERIOUS MATTER

While the American Association of State Highway Officials seriously deliberates the expensive problem of divided highways, the greatest danger to road-building that has ever faced us, continues at a merry pace. In 1935 the diversion of highway revenues for nonhighway purposes increased by $24,000,000 and reached the unprecedented level of $200,000,000—enough to build a 20-foot, hard-surfaced highway all the way from this city to New York City.

While the actual diversion of highway revenues for nonhighway purposes in my own State is negligible, we have the peculiar situation of a legislature having appropriated more highway money than is actually taken in. If the Michigan State Highway Department fully met all of its statutory obligations it would not have enough money to operate. Three-fifths of all our revenue is returned directly to the counties and the balance is obligated by other fixed, statutory requirements.

In view of the way in which highway revenues have been treated as a grab bag for every scheme of relief and tax reduction, it is a wonder that the State highway authorities of our country have come as far as they have in building the greatest highway system in the world.

A backwoods woman, the soles of whose feet had been toughened by a lifetime of shoelessness, was standing in front of her cabin fireplace one day when her husband addressed her.

"You'd better move your foot a mite, maw; you're standing on a live coal."

Said she, nonchalantly: "Which foot, paw?"

Expert Aid in Accident

Mr. Lester H. Gibson, District Engineer,
California Division of Highways,
San Luis Obispo.

Dear Mr. Gibson:

Recently I was an eye-witness to an accident which occurred about half-way between the top of Nojoqui Grade and Las Cruces Store on Route No. 101.

It is not my purpose to go into a discussion of the accident and its causes, but briefly to tell of the handling of the situation that arose by members of a State Highway crew that was working close by.

When a truck turned over, spilling its load of household goods over the highway, a flagman who was at hand took immediate charge. I being the first motorist to arrive, he gave me the job of helping the people out and taking care of some six persons ranging from seven to eighteen or twenty years of age. The second motorist arriving, he instructed to proceed towards Las Cruces and notify his Section Foreman to come up; the third motorist he stopped and instructed to prevent anyone coming near the truck's gasoline tank, to forestall any possibility of the gasoline becoming ignited and setting the truck on fire. In addition, he was routing traffic through both ways (the upset truck occupied not only one shoulder, but half the width of the pavement), allowing no one to park. * * *

Within five minutes of the time he sent for aid from his crew foreman, the latter arrived, followed by two men comprising a grader crew. This foreman took charge; inside of ten minutes he had a man and woman, who were caught in the cab, extricated; he had a mattress from the load spread out for the man who had been driving, and had determined that the only injury was a broken arm; had gathered the groceries and household goods off the roadway, and also the loose poultry. He then requested me to go on down to Las Cruces, notify the State Highway Patrol to send out an ambulance and officers.

I don't suppose it took him—from the time the accident happened—over thirty minutes to accomplish all of the above and have me on the way to telephone. The purpose of this letter is to express my admiration of the leadership displayed by the flagman and section foreman, whose names are unknown to me—for the way they handled this whole affair. You might say they took it "in their stride," as if such things were merely a part of the daily routine. Our State is to be complimented on the calibre of the men in its Highway Department. To me it was a revelation to see first-hand, how these men went into action without a wasted word or movement.

Sincerely yours,

(Signed) P. E. P. BRINE,
Santa Barbara, California.

Planning in Capable Hands

Gentlemen:

I would appreciate considerably your adding my name to your list of subscribers to your monthly publication.

I recently had an opportunity of looking over the last two copies and found them not only extremely interesting but highly instructive, and I was gratified to realize that our highway planning and maintenance is in such capable hands. Furthermore that there seems to be more interest taken in beautifying the landscape and banishing signboards.

Respectfully yours,

G. S. WORRELL.

Marvel of Improvement

Mr. S. V. Cortelyou, District Engineer,
Los Angeles, California.

Dear Mr. Cortelyou:

Because of the wonderfully improved condition of the road at McKevett crossing I am impelled to write you a word of praise for the success achieved in changing a terribly bad condition at this point to one of perfect delight to the traveler.

We, of course, are pleased with the new curve west of Saticoy and know we shall like the two new bridges being constructed on our highway but the job at McKevett crossing is such a marvel in improvement as to deserve special comment. We fully appreciate your accomplishment in this piece of work and would have you know that this is the whole-hearted expression of our people.

Respectfully yours,

M. H. BUTCHER,
Santa Paula, California.

Teaching Safety

Division of Highways,
Sacramento, California.

DEAR SIR:

Please enter my subscription to your departmental publication entitled CALIFORNIA HIGHWAYS AND PUBLIC WORKS. I wish to use it in my classes to teach SAFETY.

Sincerely,

ARTHUR E. LINDBORG,
Oakland, California.

Thanks from Observatory

Lick Observatory,
University of California,
Mount Hamilton, California.

L. T. Robinson,
Maintenance Superintendent,
State Highway,
San Jose.

My Dear Mr. Robinson:

During the past year you converted the dirt road between San Jose and here into a pavement that meets every reasonable demand of the traffic it is called upon to bear. The road is perhaps the most important factor determining the comfort of the people of this community. One can now, for the first time since the Observatory was established, count on making a clean, comfortable and safe trip to San Jose, and I think that none of us avails himself of that privilege without thought of the Division of State Highways, and of the men who have made such travel possible.

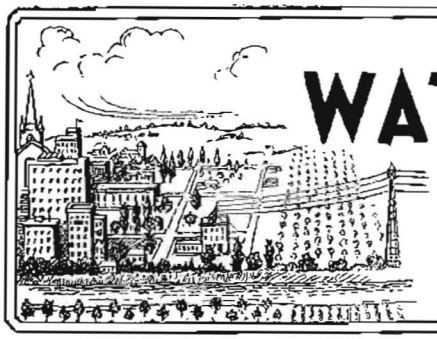
I wish further to say that to the best of my knowledge, every contact of our people with you and your men has been marked by the utmost friendliness and courtesy.

I may add that the enforced delay in writing permits me to thank you for your service to the Observatory during the exceptionally severe weather since January 1. At considerable effort you have kept the road free from snow, and the upper part has been put under control, to the advantage and safety both of the general public and of the residents of Mount Hamilton.

While it was my original intention to make this a personal letter, several members of the staff have suggested that I write you in expression of our common appreciation of the quiet, courteous and effective way in which you and your men have gone about your work. I therefore request that you regard this as a somewhat belated holiday letter in expression of the esteem of this community for the service you have rendered it.

Yours sincerely,

W. H. WRIGHT,
Director.



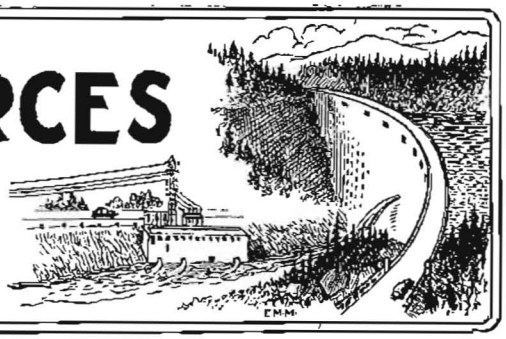
DIVISION OF WATER RESOURCES

OFFICIAL REPORT

FOR THE MONTH OF

February, 1937

EDWARD HYATT, State Engineer



On request of the Kern County Board of Supervisors, regarding organization of the new Kings River Delta Irrigation District, a field investigation was made to determine feasibility of the project. The district embraces an area of 3100 acres of developed land bordering the Kings River channel south of Stratford.

The Orange Cove Irrigation District, previously approved was organized at an election held February 16, 1937. The vote cast was 160 to 1 in favor of forming the district, indicating strong support of the Central Valley Project which will furnish a water supply to the area through the Friant-Kern Canal.

First steps toward construction of Imperial Valley Irrigation Districts power program were taken on February 15, 1937, with the opening of bids by the Bureau of Reclamation for construction of four drops and power plant structures on the All-American Canal.

FLOOD CONTROL AND RECLAMATION

Sacramento Flood Control Project

During this period two rain storms occurred which necessitated the operation of the three drainage pumping plants on the Sutter By-pass from February 5th to February 22d. A small amount of routine maintenance work has been done, including blading the roads on the levees. The dragline excavator has continued clearing the canals tributary to Pumping Plant No. 2.

During the two freshets in the upper Sacramento River, both of which crested at 23.1 feet at Colusa on February 6th and February 15th, the Butte Basin levee was patrolled and minor repair work done as needed. This consisted mostly of filling the deeper cracks caused by rain water drainage in the new levee, and dragging the levee crown to prevent side erosion from drain water.

Relief Labor Work

Clearing of the flood channels of the Feather River north of Marysville has proceeded with a relief labor crew of approximately 120 men. Several days were lost on account of rain, but, according to the new regulations, this is made up during the period. State Relief Administration Camp No. 7 in the Sutter Basin has furnished approximately 50 relief men during this period for clearing in the Tisdale By-pass.

Bank Protection Program

So far as has been observed, no difficulties have appeared in the bank protection work recently completed by the War Department, although twice in this period the water stage on the Sacramento has reached a point above the bank paving.

WATER RIGHTS

Supervision of Appropriation of Water

Twenty-four applications to appropriate water were received during January; 19 were denied and 14 were approved. During the same period 20 permits were revoked, and 2 licenses were issued.

The Cedarville Water Master District on Pine Creek in Surprise Valley, Modoc County, was created by Order of the Division of Water Resources, dated January 13, 1937. A petition signed by eighty per cent of the owners of the conduits lawfully entitled to divert water from Pine Creek, requesting that a water master be appointed for said District has been received by the Division and water master service will be rendered on the stream during the 1937 irrigation season. The District embraces 1280 acres of irrigated land served by 22 ditches. The decreed rights of the water users within the District total 16.5 cubic feet per second of water.

SUPERVISION OF DAMS

Amended application for approval of plans for construction of Mad River dam of the city of Eureka was filed on February 5, 1937. This structure is to be 110 feet in height with a storage capacity of 18,000 acre-feet. The estimated cost is $980,000. This application was approved on February 19, 1937.

The application for approval of plans for the enlargement of Danhauser dam, owned by P. C. Weber, Alturas, California, was approved on January 15, 1937.

Application for approval of plans for construction of the Mowich dam in Modoc County, owned by Everett E. Caldwell, Canby, was approved on January 25, 1937.

Amended application for approval of plans for construction of the Copper Basin dam of the Metropolitan Water District, Los Angeles, was approved on February 15, 1937. This dam is to be 180 feet in height and store 22,000 acre-feet.

Amended application for approval of plans for the construction of Gene Wash dam of the Metropolitan Water District, Los Angeles, was approved on February 15, 1937. This is to be a concrete arch structure 126 feet in height and storing 6,300 acre-feet.

Work on Judson dam, owned by the California Water and Telephone Company, to furnish equalizing storage for water distribution has been completed and the dam put into service.

Work is progressing satisfactorily on the construction of San Gabriel Number 1 dam of the Los Angeles County Flood Control District and on Cajalco dam of the Metropolitan Water District.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

Early in February, a storm caused a rapid rise in the streams in the Sacramento Valley, with the consequence that the flow at Sacramento increased from 10,000 c.f.s. on February 4th to a maximum of 63,000 c.f.s. on February 7th. This peak flow has gradually subsided and the flow at Sacramento is now about 25,000 c.f.s.

The storms in the San Joaquin Valley, during February, did not cause as rapid a rise in the San Joaquin River at Lathrop. The peak flow was reached there on February 22d, with a discharge of 15,200 c.f.s. The increase in the flow of the valley streams has caused a marked decrease in the salinity in the delta area.

California Cooperative Snow Surveys

In the latter part of January and early February the first snow surveys of the 1937 season were made at key courses throughout the major drainage basins on the west side of the Sierra. The collection of this data was made under exceptionally adverse conditions. The abnormally low temperatures (in individual cases the lowest of record), that prevailed during the month of January prevented any consolidation of the snow pack as it gathered in the mountains and traveling either by skis or webs, on account of the deep, loose, powdery snow, was a slow, laborious process. Operations were further hindered by the unsettled, stormy weather that began during the last few days of January and continued through the first week of February. Many highways normally open to traffic all winter were blocked by heavy snow drifts and telephone lines to many mountain resorts were down.

Harry A. Hopkins Resigns as Head of Highway Board

In order that he might be free to campaign for election to succeed the late Henry E. Stubbs of Santa Maria, Representative in Congress from the Tenth District, Harry A. Hopkins of Taft presented to Governor Frank F. Merriam on March 9 his resignation as chairman of the California Highway Commission.

Appointed a member of the Highway Commission by the late Governor James Rolph, Jr., in January, 1931, Mr. Hopkins was named chairman of that body in October, 1932, when Earl Lee Kelly of Redding was elevated to the office of Director of Public Works.

Mr. Hopkins has resided in Taft since 1909 and was that city's first mayor following its incorporation in 1910. As an organizer of the Kern County Chamber of Commerce, he served as chairman of that civic body's finance and highway committee and for many years has been interested in highway work. He is chairman of the administrative committee of the American Association of State Highway Officials.

CAUTION SIGNS USED TO SHOW MOTORING HAZARDS

(Continued from page 10)

wording. Obviously, it is very essential that the motorists should not be confronted with numerous caution signs having wording with which he is not familiar. If standards are maintained the motorist observes and reacts.

New signs like fresh paint attract attention because they are different, but the attention quickly fades if the motorist obtains the feeling that he is being subjected to too much information concerning how he should drive. Observations have proved the fact that, in general, motorists will obey warning signs when they are convinced that such signs are placed only at points where advance warning is needed for their safety.

It requires the misuse of only a relatively few signs to cause disrespect and weaken the effect of all signs.

"Was your friend shocked over the death of his mother-in-law?"

"Shocked! He was electrocuted."

How Traffic Accidents are Analyzed for Permanent Record

THE serious question of traffic accidents has always been of first importance to all departments of the Division of Highways. Its increasing complexity and the diversity of opinion expressed among those most deeply interested, pointed to the necessity of providing all the data available in such a manner and in such degree of detail that they could be studied in all the varying combinations.

A wealth of data had been accumulated at different times regarding totals for various types or classes or categories. Any attempt to use such data in reaching a satisfying conclusion invariably led to the inescapable fact that accidents result not because of the existence of many isolated circumstances but from certain combinations of circumstances, any one detail of which may vitally affect the worth of the conclusion reached regarding the real cause of accident.

AN ENGINEER ASSIGNED

At the beginning of the past year an engineer was assigned the duty of outlining and supervising the accumulating and analyzing of all available data concerning motor vehicle accidents on the rural portion of the State highway system.

His selection was a natural one, inasmuch as he was thoroughly familiar with highway traffic through his work during the State-wide transportation survey of 1934 and in supervising the regular traffic studies of the maintenance department. A study of motor vehicle accidents that fails to include the facts of the accompanying traffic loses much if not all of its value.

Through an arrangement of many years' standing the Department of Motor Vehicles has furnished the Division of Highways with copies of all reports received covering accidents that occur on the State highways. These reports are carefully studied and coded in such detail that practically every pertinent fact can be recorded on a tabulating machine card. It is only in this manner that it is possible to make the various complex combinations which are absolutely essential to such a study.

CONDITIONS PROMPTLY CORRECTED

In addition to the resultant tables which form the basis for conclusions along lines of general policy, the examination of individual reports makes possible the immediate correction of particular conditions which are shown to require attention. These matters are taken up directly with the various District Engineers for appropriate action.

As the reports accumulate they are regularly recorded and filed by county, highway route, and section; and in this manner any unusual concentrations are easily detected. Special studies are made of the reports for these points; and if from such study no definite cause can be found, a comprehensive survey of actual conditions is made in the field.

PERMANENT STUDY PROVIDED

This general procedure during the past year has resulted in the correction of many individual conditions of both major and minor importance, and the various analyses made have been of notable value in clarifying many questions which concern the design, construction, and operation and maintenance of the highways in the State.

The assignment is a permanent one, for the study must be continuous. It is indispensable that there be at all times definite, dependable data, not alone on accidents in general but that this data may accurately reflect the conditions on the highways of California.

The tabulation of accidents and their causes on rural State highways for the year 1936 will appear with complete detail in the April issue of this magazine.

"It's true, isn't it, that the hand that rocks the cradle rules the world?"

"I don't find it so."

"G'wan! You know your wife is the boss."

"Yes, but being boss she makes me rock the cradle."

New Edge Cutting Device For Plant-Mix Oil Surface

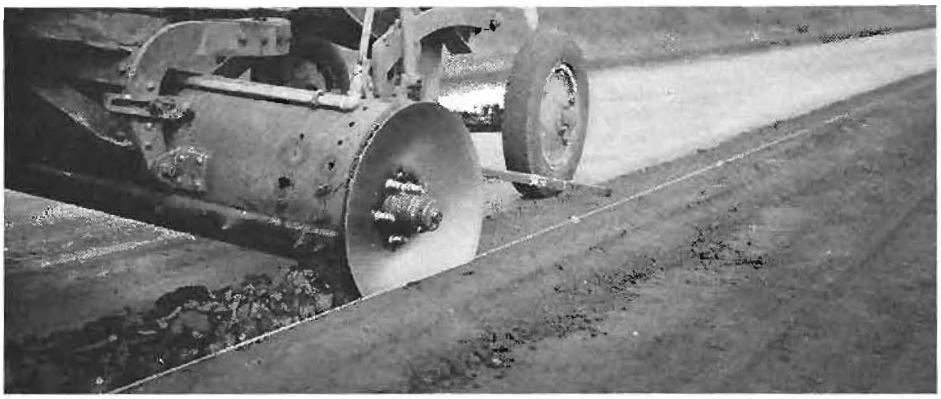
By J. C. ADAMS,
Resident Engineer

AN economical and time saving device for edge cutting of plant-mix oil surfaces of highways was recently developed in District V of the Division of Highways.

The new device was tried out successfully on an 8-mile road construction project between Soledad and Gonzales in San Luis Obispo county. This job consisted of 0.21 feet by 20 feet plant-mixed surfacing placed over the existing Portland cement concrete pavement or over 0.46 feet crusher run base, with 8 feet by 0.33 feet road-mixed borders.

Since no header boards are used on plant-mixed surfacing, an irregular border line often occurs at the pavement edge. To overcome this difficulty the edge-cutting device now in use was developed by the writer and the contractor, A. J. Raisch Company.

Disc attachment cuts compacted earth shoulders before placing plant-mixed surface on road.



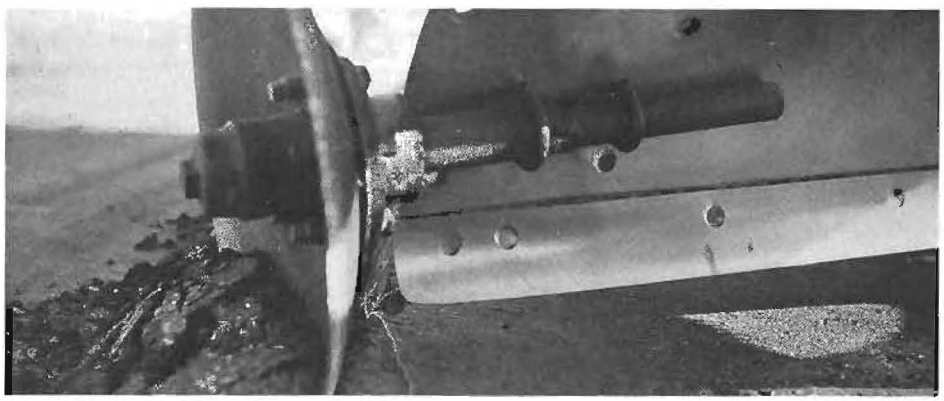
Close-up view of disc used for cutting dirt headers. It is fastened to auto axle and hub.

The device consists of an ordinary automobile axle and hub equipped with roller bearings, to which is fastened a 24-inch diameter farm disc bolted to the hub, for use as a cutting edge. A shank of the original axle, 20 inches long, supports the disc and is bolted to the moldboard of the power grader by two ¾-inch U-bolts. The overall length from the tip of the hub to the end of the shank is 30 inches. About 15 minutes time is required to attach and remove the assembly from the moldboard.

The first use of the disc attachment was in cutting a true edge along the earth shoulders prior to spreading the plant-mixed surfacing. The earth shoulders were previously watered and mixed by a spring-tooth harrow, after which they were rolled with a 12-ton roller. The shoulders were then cut while still green, and after drying out afforded a good lateral support and a well defined edge for the proposed paving.

The operator of the grader was aided in maintaining a true line during the cutting operation by stretching a chalk line between points placed at 400-foot intervals.

After the plant-mix surface was completed and before road-mixing the shoulders, the center line was re-run and points set at 400-foot intervals on tangents and 50-foot on curves. The oiled surface edge was then cut to form a true border for the oil-mix shoulders.



This is front view of disc cutting attachment showing U-bolt fastenings to moldboard.

Storm Damage to Highway System Totals $1,000,000

(Continued from page 16)

Route 80—through San Marcos Pass, with 7000 cubic yards, were closed to traffic temporarily.

Major damage in District VI, including Tulare and Kern, may be summarized as follows:

ROUTE 10, between Lemon Cove and Sequoia National Park, and east of Visalia—a total distance of some 25-miles—was affected by overflow water. The run-off was so rapid that existing drainage structures could not carry the flow. Sections of shoulders and roadway were washed out, and pavement undermined or damaged.

KAWEAH RIVER RAMPAGES

ROUTE 129, between Woodlake and the junction of Route 10—approaches to two bridges were washed out by flood waters in the Kaweah River. One structure collapsed and the approaches were washed out. The second bridge was moved downstream and lodged against two trees. The condition here was typical of conditions to be expected at locations where floods occur only once in several years. The accumulation of brush and debris brought down from the overflowed area above the highway chokes the waterway, with resulting overflow and damage.

ROUTE 131, Cottonwood Creek overflowed in the vicinity of Woodlake, damaging the bridge, as well as washing out shoulders and undermining the concrete pavement. East of Woodlake, water overflowed the pavement to a depth of four feet.

ROUTE 135, west of Earlimart, flooded and was closed to traffic.

KERN COUNTY DAMAGE

ROUTE 4, north of Famosa, on the Valley route—overflow water damaged shoulders.

ROUTE 142, closed to traffic temporarily when bridge across Pozo Creek was washed away. Traffic is being cared for over a temporary fill until a new bridge can be constructed.

Between Bakersfield and Glennville, on this same route, there was considerable damage due to flooding at locations where existing drainage structures were inadequate. The bridge at Glennville was damaged and made unsafe for traffic. Likewise, the road from Glennville east to about two miles from the Kern River Canyon route was closed to traffic.

ROUTE 57, between the entrance of the Kern River Canyon and Bodfish—the river flooded the highway to a depth of five feet at several places, with resulting loss of embankment and roadway. The estimated cost of replacement of fills, roadway, etc., is $25,000.

ROUTE 58, just west of Bakersfield—the bridge across Kern River Overflow Channel collapsed and considerable damage was done to road shoulders.

ROUTE 139, south from the junction with Route 58—overflow from the Kern River washed out approaches to two bridges.

Slippery Roads Are Made Safe For Motorists

(Editorial from Tulare Times)

Motorists traveling over the valley highway will notice that a "rough surface" is now being applied to many sections of pavement which previously were quite "slippery" in wet weather.

This is a particularly helpful improvement to safe driving and one on which the State Highway Department is deserving of especial commendation.

Our highway officials are doing everything in their power to make the roads safe for motorists. And if all drivers would respond with the same amount of thoughtful consideration for their own lives and limbs, the frightful traffic toll would soon reach the vanishing point.

"Give me a sentence with the word 'vermin'."

"Before I go fishing', I go vermin."

Dentist—Pardon me a moment, sir, I must have a drill.

Patient—Can't I even have a tooth fixed without a rehearsal?

"Cat's Whisker" On Bay Span Is Boon to Drivers

WHEN motorists passing through the toll gates of the San Francisco-Oakland Bay Bridge receive an electric shock as they pay their fare, it is not a practical joke played on them by a whimsical toll collector. It is, as a matter of fact, a serious problem, which Chief Engineer C. H. Purcell and his staff believe they have finally solved after much experimentation.

Automobiles, especially those traveling at a good rate of speed, gather an electric static which communicates itself through the body of the motorist when his fingertips touch those of the toll collector. The method adopted to eliminate this static at the toll gates of the San Francisco-Oakland Bay Bridge is based on the same principle used by gasoline trucks. These vehicles carry a chain which drags upon the road, thus grounding this static.

STATIC IS GROUNDED

In the case of the San Francisco-Oakland Bay Bridge No. 18 piano steel wire is used, approximately 1/20th of an inch in diameter and 14 inches high above the pavement. This wire has a coil spring bolted in a slot 4 inches long and about 1 inch deep and 2 inches wide set in the paving some few feet in front of the toll gate. This spring wire, known also as the "cat's whisker," terminates in a coil which is bolted to the concrete and grounded by an electric conductor.

The "cat's whisker" taps the front axle of the automobile as it approaches the toll collector and thus grounds the static so that the motorist and the collector may safely exchange fares.

Because of the delicacy of these wires, it is necessary to replace them every few days and a daily inspection is made.

All-steel bodied cars, having a large amount of rubber insulation, are the greatest offenders.

Some consideration was given to the so-called "squirt" idea to eliminate static, as used now in the New York Triborough Bridge. While this has its merits, according to Chief Engineer Purcell, it nevertheless has received considerable complaint.

Highway Bids and Contract Awards Made in February

ALAMEDA, CONTRA COSTA, SANTA CLARA COUNTIES—Furnish and apply Diesel oil to roadside vegetation about 111.5 roadside miles. District IV, various routes. Lee J. Immel, Berkeley, $3,741; Garcia Construction Co., Irvington, $4,095; Hayward Building Mtl. Co., Hayward, $4,575; Tieslau Bros., Inc., Berkeley, $4,320. Contract awarded to Pacific Truck Service, Inc., San Jose, $3,330.00.

CALAVERAS, STANISLAUS, TUOLUMNE, AND AMADOR COUNTIES—Applying Diesel oil to roadside vegetation over a distance of about 176 roadside miles, in District X, various routes. Garcia Construction Co., Irvington, $3,937; Lee J. Immel, Berkeley, $4,050. Contract awarded to Sheldon Oil Co., Suisun, $3,112.50.

MERCED, MARIPOSA, STANISLAUS, SAN JOAQUIN, CALAVERAS, AMADOR, TUOLUMNE COUNTIES—Applying Diesel oil to roadside vegetation over a distance of about 263 roadside miles District X, various routes. Sheldon Oil Co., Suisun, $5,246; Tieslau Bros., Inc., Berkeley, $6,390; Hayward Bldg. Mat. Co., Hayward, $7,101; Lee J. Immel, Berkeley, $6,136. Contract awarded to Pacific Truck Service, Inc., San Jose, $5,129.80.

RIVERSIDE COUNTY—Reconstruction of timber bridge across Santa Ana River near Prado District VIII, Route 77, Section E. George Herz & Co., San Bernardino, $11,900; Dimmitt & Taylor, Los Angeles, $9,872; Harry Friedman, Los Angeles, $11,818; Gibbons & Reed Co., Burbank, $11,826. Contract awarded to Son. California Roads Co., Los Angeles, $7,932.89.

SAN BENITO, MONTEREY, SAN LUIS OBISPO, AND SANTA BARBARA COUNTIES.—Apply Diesel oil to roadside vegetation District V, Routes 2, 22, 119, 10, 137, 58, 56, 147, 57, 80, 149, 56, various sections. Pacific Truck Service, Inc., San Jose, $7,827; Bradley Truck Co., Santa Maria, $8,158; Tieslau Bros., Inc., Berkeley, $8,410; L. A. Brisco, Arroyo Grande, $8,473; A. J. Clausen, Berkeley, $8,568; Western Motors Transfer, Inc., Santa Barbara, $10,363. Contract awarded to Bert Hale, Pismo Beach, $6,583.50.

SONOMA, MARIN AND NAPA COUNTIES—Furnish and apply Diesel oil to roadside vegetation about 118.5 roadside miles District IV, various routes. Basalt Rock Co., Inc., Napa, $6,825; E. A. Ford, San Anselmo, $6,450; Lee J. Immel, Berkeley, $6,925; Hayward Building Mtl. Co., Hayward, $8,250; Tieslau Bros., Inc., Berkeley, $7,300. Contract awarded to Chas. Kuppinger, Lakeport, $5,975.00.

"Can you imagine anyone going to bed with his shoes on?"

"Who does that?"

"My horse."

Patient (nervously)—And will the operation be dangerous, doctor?

Doc—Nonsense! You couldn't buy a dangerous operation for $40.

The White Line

Throughout the length of our great state
For your safety and mine,
Down the center of each highway
Is a broad white line.

Through heavy storm or densest fog
We drive without a care,
As we watch the center of the road,
Seeing the white line there.

How many wrecks have been averted
By drivers everywhere,
As they drove through crowded traffic
And the white line was there.

Sincerest thanks to road officials
For every post and sign,
But the thing that makes us safest
Is the broad white line.

—ANGIE DOWNES,
Santa Rosa, California.

Highways Made Beautiful

The State Highway Department deserves commendation for the manner in which it has been planting shrubbery along the barren cutbanks and grades of the new Nojoqui cutoff, as well as for retaining several pieces of property over which the old pavement made elbow bends, and converting these into park spaces. In a few years, the Nojoqui drive is going to be charming as a result of this planting work, if the shrubs and trees are kept properly watered during dry periods.

—Santa Maria Times

Plan Panama Highways

As a result of the recent ratification of the new treaty by the Congress of Panama governing the relations of that country with the United States, the Central American Republic is ready to proceed with the work of completing a 16-mile stretch of the Trans-Isthmian Highway, according to Leopoldo Arosemona, Secretary of the Department of Public Works and Hygiene of Panama.

Mr. Arosemona so announced at the Thirty-fourth Annual Convention of the American Road Builders' Association held at New Orleans. The new Panamian highway will be built through a mountainous country where the cost of excavation and filling is high.

He also said that another highway project which his government intends to launch at an early date is a 100-mile stretch between David and the Costa Rican border. This road will form a link in the Pan American Highway.

Bay Bridge Crew Gave Service to 2249 Machines

A TOTAL of 2249 vehicles have been serviced by the Maintenance Crew of the San Francisco-Oakland Bay Bridge since the structure was opened on November 12, 1936, to March 1, 1937, according to a report received by State Director of Public Works Earl Lee Kelly from Chief Engineer C. H. Purcell.

Of the 2249 vehicles serviced in the past three and a half months, 1294 included vehicles supplied with gasoline; 694 were vehicles towed because of engine trouble, accidents, etc.; 250 tires were changed; and 9 fires were put out.

February figures were:

Vehicles supplied with gasoline	305
Vehicles towed because of engine trouble or accidents	158
Tires changed	79
Fires	1
Total vehicles serviced for February	543

Average number of vehicles serviced per day for the month of February was 19.4. Average number for three and a half months, 20.6.

The total of 543 vehicles serviced for the month of February compares with 553 serviced for January.

Since the bridge was opened, there have been 43 accidents on the structure and its approaches. Twenty-seven of these accidents involved personal injury, with the total number of persons injured, 50. There were four accidents resulting in fatalities.

February figures are:

	On bridge	On approaches
Total accidents	4	8
Involving personal injury	3	2
Persons injured	9	3
Fatal accidents	2	0

In respect to last month's fatal accidents on the bridge, the drivers of the cars, Lewis George and L. M. Doyle, were charged with negligent homicide.

"More and more motorists crossing the bridge are learning the value of the maintenance-call boxes which are placed at intervals along the entire structure," Mr. Kelly said. "The Bridge Maintenance Service is for the convenience of motorists and we are anxious that they avail themselves of it whenever they are in difficulties on the structure."

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Department of Public Works

Headquarters: Public Works Building, Eleventh and P Sts., Sacramento

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JUSTUS F. CRAEMER.....Assistant Director

EARL LEE KELLY.....Director

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