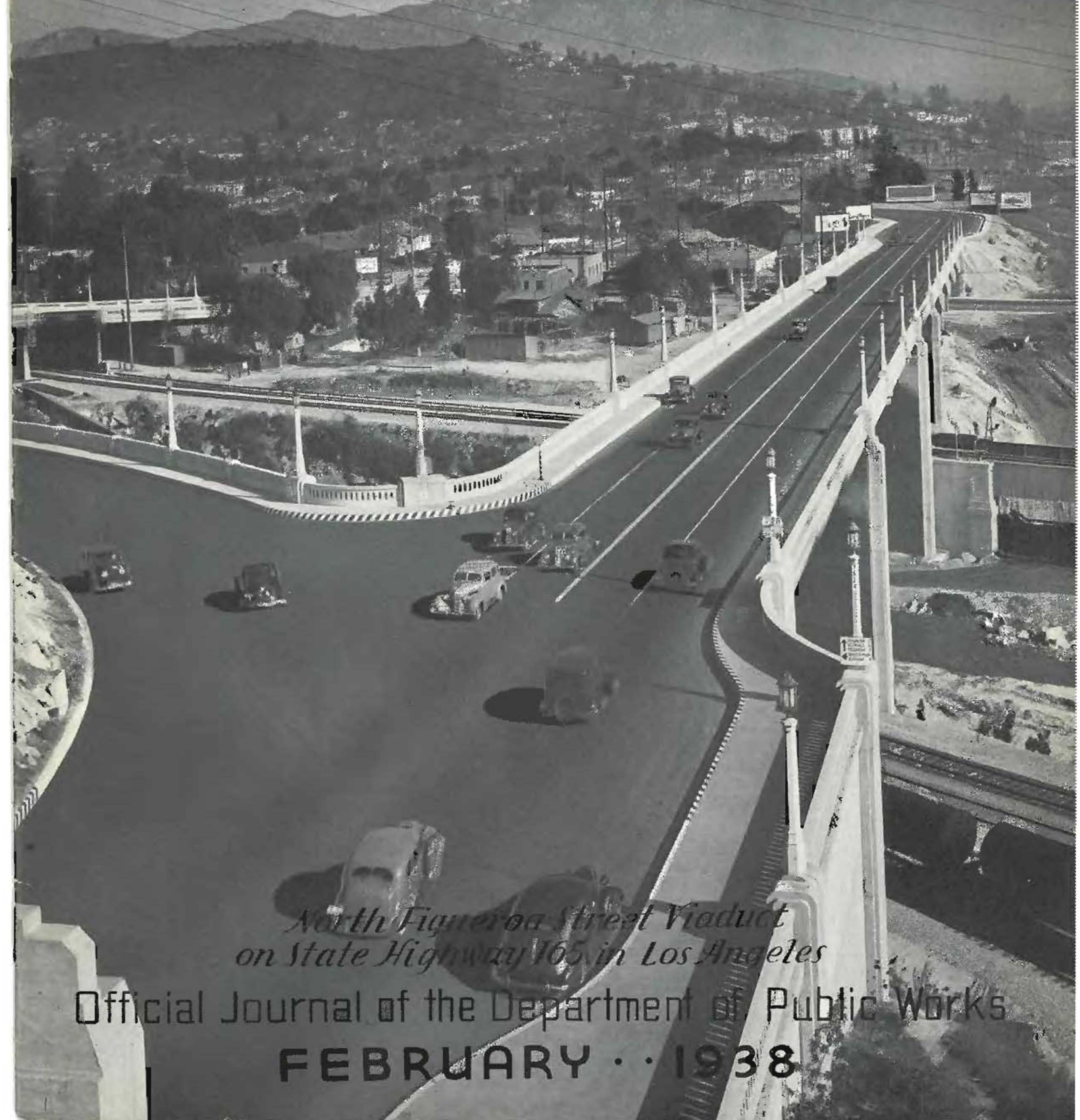


CALIFORNIA

HIGHWAYS AND PUBLIC WORKS



*North Figueroa Street Viaduct
on State Highway 165 in Los Angeles*

Official Journal of the Department of Public Works

FEBRUARY · · 1938

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

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California Must Spend Many Millions in Order to Keep Pace With Traffic Demands

INTO the midst of the present furor over the proposal before the Congress to drastically reduce the Federal Aid Appropriation for highways, let us introduce and consider the present condition of the State highway systems of the various states. If there be any basis whatever for a reduction in highway expenditures, it must rest upon the premise that adequate highway facilities are now in existence throughout the nation.

The actual facts make any such an inference incredible.

For instance, reliable information proves that obsolescence, inadequacy and depreciation render at least half of the 14,000 miles in the highway system of California incapable of safely and satisfactorily serving the traffic they now bear, and conditions in California are neither better nor worse than the other States of the Union.

For proof let us examine the extent of completion of the system in this State point by point.

SOME VITAL QUESTIONS

Has California a complete and adequate network of major roads with no further need for reconstruction due to tortuous and dangerous alignment, excessive grades, or obsolescence?

Is there no further necessity for widening narrow and hazardous widths to safely accommodate the large buses, trucks and other commercial vehicles using our highways in conjunction with an ever expanding traffic?

Are all of our antiquated roads, originally located by oxcart methods, satisfactorily relocated to the required modern standards of safety in width, grade and curvature?

Have all dangerous crossings at grade with railways and important highways been provided for?

Have by-passes been provided around every important metropolitan community to avoid and mitigate the attendant traffic congestion?

Is every bridge on the State highway system of ample width and load carrying capacity to adequately serve even the present traffic to which it is subjected?

AND THE ANSWER IS "NO"

The answer to this series of questions by any well informed citizen of this State is, of necessity, an emphatic, "No!"

As a matter of fact none of these objectives has been realized, nor is there any reasonable possibility of their attainment in the near future, especially if there is any curtailment of highway finances, which even now are proving inadequate for the task.

It may help to convey some conception of the magnitude of the problem facing the highway authorities of this State, if we consider the current estimated cost of modernizing our present highway system.

At the present writing, statistics indicate that approximately 4600 miles of the present system should be rebuilt immediately to adequately and safely handle the traffic to which those roads are subjected.

It is estimated an expenditure of \$100,000,000 will be required for this purpose.

Traffic figures further indicate that about 1200 miles of the present system should be widened to provide divided

(Continued on page 12)

Highway System Inadequate For Needs of Today

By C. H. PURCELL
State Highway Engineer



Intersection of U. S. 99E with Southern Pacific Railroad in Roseville. Such traffic blockades as this are frequent.

Progress on Highways

By GEORGE T. McCOY, Assistant State Highway Engineer

THE RECENT inspection trip through the east and midwest undertaken by a group of engineers from the Division of Highways in connection with their attendance at the 1937 convention of the American Association of State Highway Officials in Boston was valuable in its revelation of the progress being made in the solution of highway problems.

Each of these engineers made a written report of his observations. The consensus of opinion revealed by these reports is that while California can justly be proud of her State highway system, nevertheless from the standpoint of all around traffic service, this State does not lead the procession in modernization of highway facilities and much is to be learned from the progressive achievements in other States.

While in Massachusetts the group saw about 200 miles of the Massachusetts highway system. The trip included the new North Shore Divided Highway north of Boston, some of the roads around Lexington and Concord and a section of the Worcester-Boston highway.

Of particular interest is the new North Shore Highway, of which all Massachusetts engineers are justifiably proud. It will eventually connect with more adequate facilities the metropolitan area of Boston with that of New York, if the other two states, Rhode Island and Connecticut, across which it will pass, follow the same standards of construction.

All important road intersections are designed with a modified clover leaf type construction which greatly reduces traffic congestion at those points.

An appreciable mileage of divided roadway with frequent grade separations of intersecting roads has helped materially in reducing the congestion previously experienced on the main turnpikes radiating from Boston. The use of a wide division strip was particularly noticeable. On most of these recent improvements dividing strips



GEORGE T. McCOY

of from 20 feet to 30 feet in width have been used. These are bordered by flat sloping curbs and the attractiveness of the entire road is enhanced by the grass-sodded and planted strips and side slopes.

MASSACHUSETTS HIGHWAY SYSTEM

The most noticeable features of Massachusetts' recent construction are extensive use of a patented, bituminous pavement and almost exclusive use of granite curbing. The pavements of this patented type have an extremely harsh surface with about the same riding quality as the most severe of the non-skid work placed on our Sacramento-San Francisco road in the vicinity of Dixon.

The granite curbing is used on both sides of the dividing strip, the only concrete curbing being the pre-cast white cement curbing used on the noses of the strip.

NEW YORK IMPRESSIONS

Leaving Massachusetts after the convention, they spent one day with the New York Highway Department, during which time they saw the new

Express Highway in New York City and about 200 miles of Parkway on Long Island.

The most impressive thing about the trip over New York highways was the boldness reflected in the location, design, and cost of the work. Great sums of money have been spent for beautification on the Parkways, all of which have an extremely wide right of way, usually about 600 feet.

From their observation and contacts, the group concluded that the New York authorities, both political, administrative, and engineering, and the people of the State in general have been more thoroughly educated to the problems of highway transportation in the vicinity of a great metropolis, than is found either in the middle west or on the Pacific Coast, even though the problems of highway transportation and vehicular movement are very similar in New York, Chicago, Los Angeles and San Francisco.

New York, by its construction of bridges, tunnels, elevated roadways and parkways is certainly far ahead of any other city or State visited on the trip in solving highway transportation problems.

COMPLICATED JOB

Mr. Robert Moses, Commissioner of the Department of Parks of the City of New York, assigned the engineer in charge of the job to escort our group over the west side improvement project which required a reclamation of 132 acres of land, with an assessed valuation of \$23,760,000.

Mr. A. W. Brandt, Commissioner of Highways of New York State, accompanied them on the tour.

This project demanded the practical rebuilding of an entire railroad system, the only all-freight route into Manhattan, elevating it in certain sections, depressing it in another, and covering it in a third by an express highway for motor traffic.

It involved also the development of



Part of the West Side Improvement project along the Hudson River in New York City, showing Riverside Drive Park and shoreline in the foreground connecting with the elevated West Side Express Highway which extends along the waterfront from 72d street almost to the southern end of the city.

Riverside Drive into one of the finest parkways in the nation.

The project calls for a "nonstop" highway from the Battery at the tip of Manhattan to Westchester County. Only at strategic points can this highway be entered, featured by separated grade crossings. This route runs almost its entire length directly along the Hudson River.

IMPRESSIVE ACHIEVEMENT

The Riverside Parkway alone from 72d Street to Dyckman Street is 6.7 miles in length and has 34-foot separated roadways, with six grade separation structures. It has a maximum grade of 4 per cent and a 2000-foot minimum radius of curvature on the main highway. There is a minimum vertical sight distance of 500 feet.

The entire West Side highway project includes that section from the Battery to 72d Street, which comprises an elevated express highway only; the section from 72d to Dyck-

man Street, just below the Harlem River, which involves the Riverside Park system; and the Henry Hudson Parkway from Dyckman Street across the double-deck Henry Hudson Bridge over the Harlem River through the Bronx and into Westchester County.

The whole project constitutes an impressive achievement of planning and execution.

GREAT BRIDGES BUILT

The George Washington Bridge across the Hudson River, the Triborough Bridge across the East River and connecting roadways are perhaps the outstanding examples in this country of highway construction running into large costs. Enormous traffic volumes and congestion in the confined limits of Manhattan Island justify the huge expense for these improvements. They are featured by traffic lanes, separated on and off ramps, separated cross-traffic, sometimes with two and three level road-

way crossings, to take care of a huge volume of traffic and permit of speedy, safe and comfortable flow of vehicles.

Without such facilities traffic would be compelled to submit to hours of delay, moving through terrific traffic jams with their accompanying hazards.

Many bridges have been built across the East River to Long Island, some are free of tolls and on others nominal charges are made. These bridges connect to modern, high standard, divided highways with few road intersections except those of the so-called clover leaf type.

By this method of separation of the grades of two highways, the intersecting roads pass over the speedways on artistically constructed concrete arches faced with imported cut stone; the avenues of entrance into the speedways consist of accelerating lanes which allow incoming traffic to pick up speed to that of the traffic of the main highway and gradually



Clover leaf design grade separation typical of many in New Jersey by which vehicles are enabled to make turns at intersections without interfering with through traffic and congestion is eliminated.

pinch in without causing apparent congestion.

MOST MODERN DEVELOPMENT

The parkways on Long Island, which are especially outstanding by reason of their roadside development and separations from conflicting cross-traffic, permit a rapid and comfortable flow of traffic from the residential communities of Long Island into the main city, and to recreational facilities and extensive public beaches in this area.

Our engineers had one day in New Jersey, leaving New York through the Holland Tubes going south over New Jersey's Skyway and over U. S. No. 1, New Jersey's Route No. 25, to New Brunswick, returning on State Routes through Bound Brook, Plainfield, Elizabeth, and the Oranges to the George Washington Bridge.

In New Jersey the most outstanding construction feature is the large number of grade separations where important highways intersect, the most elaborate being the intersection of Routes 2 and 4 just east of

Arcola. This intersection combines long "Y" connections with an inner clover leaf design.

FINE DIVIDED ROADWAYS

New Jersey also has some very fine examples of divided roadways, provided with an unusually large number of openings in the dividing strip which seem in a way to offset to a large degree the safety sought for.

The highway department is now using a minimum width of 22 feet for the dividing strips and is thinking of adopting 35 feet as a minimum. On all of the 22-foot strips, curbing is provided on both sides; while on the 35-foot separation such as Route 23, the curbing has been omitted. The State is now experimenting with a new fluted faced reflecting type curb and has just recently awarded the first contract for a 20-mile installation.

In discussing the divided roadways with Mr. Giffin, State Engineer of Surveys and Plans, he expressed the conviction that the width of the divided strip should either be sufficient to be of practical benefit as a safety

zone in covering the turning or crossing vehicle or drop to a minimum of four or six feet, and that little was to be gained by intermediate widths of, say, ten or twenty feet. The State engineers have also concluded that the 4-lane divided roadway for rural roads represents the ultimate in efficient operation and that rather than add additional lanes, new parallel routes should be constructed.

PARALLEL ROAD TREND

The tendency in highway construction in New Jersey leans toward a policy different from that encountered in any other State visited or from that now in general use as applied to California. Where modern 20-foot pavement has reached a point of saturation, from the standpoint of traffic, intersections and constructed roadside activities, such as market centers, etc., their general plan seems to be to allow this road to exist as it is and to construct a parallel highway.

A four-lane divided section is used on the new alignment where the problems of intersections can be more

easily solved and right of way costs, as far as the readjustment of existing facilities is concerned, are not prohibitive.

MICHIGAN VISITED

From New Jersey the group went to Michigan and viewed the famous Wayne County concrete road construction in the vicinity of Detroit. Wayne County lays claim to being the originator of concrete road construction. The multiplication of this type of highway has been prolific. Portland cement concrete is the Michigan standard type of pavement construction, but very few sections have the oiled or surfaced shoulders now standard construction in the West.

Two planes were brought down from Lansing and our little delegation was flown to the upper peninsula across the Straits of Mackinac where the Michigan Highway Department hopes to eventually build a bridge connecting the upper and lower peninsulas of the State.

BROAD HIGHWAYS

Ample width of right of way secured years ago on some of the main traffic arteries radiating from Detroit, permitting comprehensive and satisfactory expansion of the highway of

both divided and undivided types, was perhaps the outstanding feature of some of the highways visited in Michigan. This pertains especially to roads in the immediate vicinity of Detroit and lying within Wayne County.

An interesting and attractive example of fitting a highway into the landscape, and of developing the roadside with native material, is the Lakeshore Road on the upper peninsula of Michigan running westerly from St. Ignace along the northerly shore of Lake Michigan.

SERVICE TO MOTORISTS

In Michigan are some of the oldest divided roadways seen on the trip, some of them having been in service for ten to fifteen years.

The Michigan Highway Department is paying more and more attention to service to motorists in the way of road information and roadside picnic and rest facilities. This is particularly true in the northern half of the State where a large per cent of the traffic is recreational. The highway department has spent a considerable amount of money in developing the roadside parks in this area.

In Chicago the group stopped one day for a trip over the new Chicago-

Milwaukee road just being completed by the States of Illinois and Wisconsin. This is a high type divided road with a 30-foot dividing strip and in Illinois has been curbed on both sides, while in Wisconsin the curbing has been omitted.

CHICAGO'S LAKESHORE DRIVE

Confronted with a situation similar to that of New York, Chicago has developed the Outer Drive or Lakeshore Drive, consisting partly of an elevated roadway and of a divided parkway with side service roads.

Observing the movement of traffic on this six-lane road, on which traffic lights are so arranged and coordinated as to permit unobstructed and uninterrupted flow for considerable distances, caution is impressed against expansion which runs into too many lanes. Observations would indicate that efficiency is considerably reduced and hazard increased.

Throughout this eastern trip and particularly in the States of Massachusetts, New York, and New Jersey, the most noticeable feature to the visitors from California was the excellent appearance of the highways, even though close observation indicates less attention to maintenance. This is

(Continued on page 27)



Numerous grade separation structures like the above provide safe traffic movement on the New York Parkway systems in city and suburban areas. The overpass bridges are built of steel and faced with imported cut stone blocks.

Highway Accomplishments in California in 1937

By RICHARD H. WILSON, Office Engineer

CONSTRUCTION and maintenance operations of the California Division of Highways are based upon budgetary set-ups for biennial periods of two fiscal years.

The present biennium, including the 89th and 90th fiscal years, began July 1, 1937, and extends to June 30, 1939. Thus, the calendar year of 1937 was composed of the closing six months of the biennium including the 87th and 88th fiscal years and the first quarter of the current biennium.

The total for construction projects placed under way during the calendar year does not represent normal activities for any one fiscal year for both the closing quarter of one biennium and first quarter of a new biennium are usually under the average for the other quarters as, in one instance, the work consists of getting under way the few remaining projects of a biennium and in the other case unavoidable uncertainties tend to delay early progress in advertising projects for bids.

MILLIONS FOR HIGHWAYS

Even under these conditions, however, the construction and maintenance activities of the California Division of Highways during the calendar year of 1937 amounted to \$29,217,600 in contracts awarded and work orders approved for day labor in improvement to the State's highways.

Of this figure, \$19,509,900 was the cost of contracts and day labor construction put under way during the year and financed from State and federal funds. Financing this work required \$12,921,400 in funds allocated to the Division of Highways from the State's gasoline tax and motor vehicle registration fees and \$6,588,500 in funds on which reimbursement will be had from federal moneys apportioned to California.

The \$6,588,500 in federal funds consists of regular Federal Aid, Works Program funds, Grade Cross-



RICHARD H. WILSON

ing and Feeder Roads funds for the fiscal year ending June 30, 1938.

SEGREGATION TO FUNDS

Segregation to the various funds from which the money for the \$19,509,900 in construction has been allotted is shown in the following summation:

Regular Federal Aid for fiscal years ending June 30, 1937 and 1938.....	\$5,003,800
Works Program Highway funds	563,700
Federal Grade Crossing funds for fiscal year ending June 30, 1938..	934,800
Federal Feeder Road funds for fiscal year ending June 30, 1938..	86,200
State highway fund.....	12,921,400
Total	\$19,509,900

The total amount of construction

and maintenance placed under way between January 1, 1937, and December 31, 1937, and provided for under the total of \$29,217,600 is divided to the various classes of the Division's activities as follows:

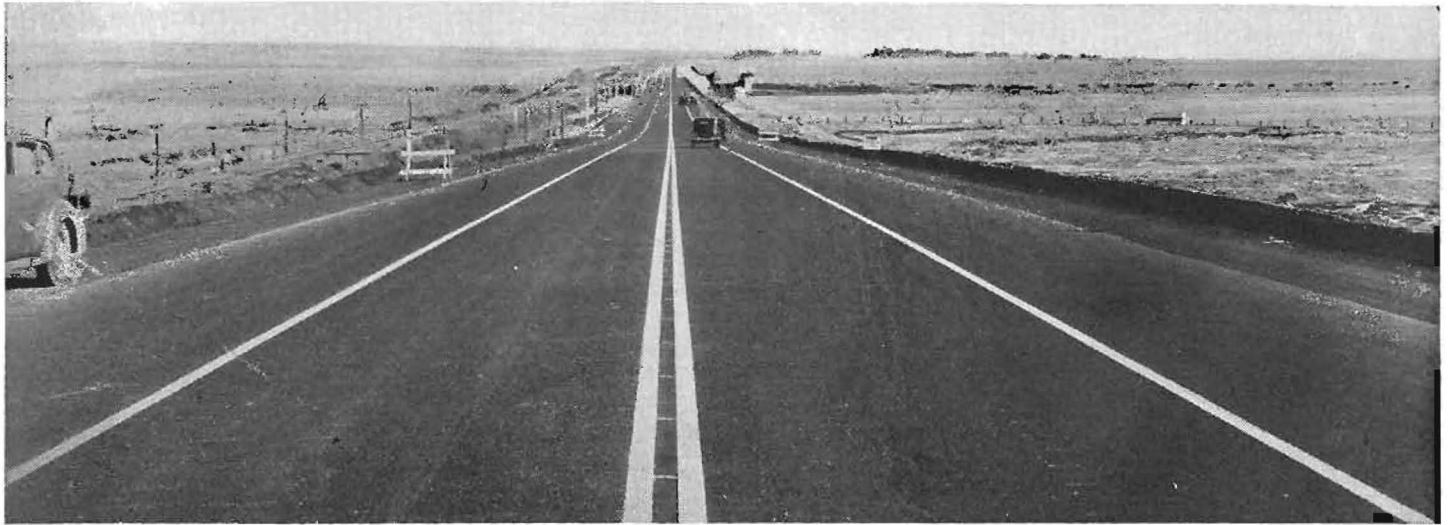
Construction and reconstruction	\$19,509,900
Maintenance	9,557,700
Maintenance and Operation of San Francisco-Oakland Bay Bridge..	150,000
Total	\$29,217,600

CONSTRUCTION PROGRESS

Progress of construction activities in improvement to the State highway system, which provided for a total of 1,212 miles of highway graded, surfaced, paved or oiled and 50 bridges and grade separations constructed, is shown in the following tabulation giving the type of improvement together with the mileage for each type:

Type of Improvement	Miles
Pavement	126
Plant-mix surfacing.....	174
Road-mix surfacing.....	99
Oiled Gravel Surfacing (armor coat, etc.).....	438
Untreated gravel or stone surfacing	2
Graded roadbed.....	30
Dust Oil roadbed.....	179
Shoulder construction or oiling	164
Bridges and Grade separations	(50)
Miscellaneous contracts.....	---
Total	1,212

The type designation in the above tabulation gives the kind of surfacing on the completed improvement and in each instance includes the necessary grading required for any given project. In certain cases the grading and drainage structures have been the major portion of the projects, but the improvement has been included under the surface type.



Type of highway built last year. Looking south from new Santa Margarita River Bridge in San Diego County showing new forty-foot asphalt concrete pavement.

Listed shoulder improvements include contracts which involved work on shoulders only.

June 30, 1937, marked the close of the budgetary biennium for the 87th-88th fiscal years and July 1st the beginning of the current biennium including the 89th and 90th fiscal years and during the closing six months of the last biennium contract construction in the amount of \$3,830,500 practically closed out the available funds from that and preceding biennial periods.

CONTRACTS SPEEDED

On May 4th, the State Legislature adopted and the Governor approved the budget, and on May 10th, the first contract to be financed from funds provided for the current biennium was awarded by the Director of Public Works. The Division of Highways was so well prepared to immediately advertise for bids projects which were to be financed under the budget for the current biennium that by July 1st contracts in the amount of \$2,248,900 had been awarded.

This activity in placing construction contracts under way has been continued during the past six months to the end that by December 31st contracts amounting to \$10,154,100 and financed from budgeted funds for the current biennium, federal grade crossing and feeder road funds had been awarded.

It is hoped that construction activities on State highways will continue at this rate during 1938. However, should Congress comply with the recommendations of the President

that Federal Aid apportioned to the States for highway improvement during the fiscal year ending June 30, 1939, be canceled, the construction activities of the Division of Highways would be curtailed by some \$8,000,000.

ALTAMONT PASS

In regard to the construction placed under way during 1937, the following brief descriptions are given of a few of the larger and more important improvements.

In Alameda County, construction on improved alignment of the State highway connecting Oakland and the bay area with Stockton and the upper San Joaquin Valley via the Altamont Pass was begun early in the summer and is progressing rapidly.

The project has involved some of the heaviest grading ever undertaken by the State, including the movement of nearly 2,000,000 cubic yards of earth in the excavation of the roadway and necessitating about 30,000,000 stations yards of overhaul. The new routing of this heavily traveled arterial lies to the south and east of the existing highway, is about 8.4 miles in length, and will provide four lanes of bituminous treated rock surfacing with the opposing lines of traffic separated by a curbed dividing strip four feet wide.

GRADE SEPARATIONS

In the construction of this new route it has been necessary to provide four grade separations, two each with the tracks of the Southern Pacific and Western Pacific Railroads. Two of these separations are accomplished

by a single overhead structure near the westerly end of the project at Greenville. The second separation with the Southern Pacific Railroad is an overhead crossing at Redmond and the second with the Western Pacific Railway is a subway at Stone Cut. The central dividing strip is carried through the three structures.

The construction of this project is one of the most important improvements made to the State highways in Northern California in recent years and its completion will eliminate from the State system the narrow, tortuous route of the old road through the Altamont Pass on which traffic congestion has greatly increased in recent years. It is estimated that the cost of this improvement, including the grade separations will amount to about \$1,200,000.

CUESTA GRADE PROJECT

Another heavy grading job in connection with the revision in alignment of a main artery is the project involving the reconstruction of the Coast Route at the Cuesta Grade about six miles north of San Luis Obispo. Here again, the widening of the crooked two lane highway was found to be impracticable and a new routing is being constructed on the southerly side of the canyon.

The new road will provide for four lanes of bituminous rock surfacing with opposing traffic ways separated by a curbed dividing strip and curvature standards designed for modern trunk highways. It will be 3.3 miles long, extending from San Luis Obispo

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CONCRETE PAVEMENT SLAB WARP AND ITS PREVENTION

By C. S. POPE, Construction Engineer

This is the first of two articles dealing with highway concrete pavement distortion and measures for its prevention and relief which have been prepared by C. S. Pope, Construction Engineer of the Division of Highways. The second installment will be published in the March issue of *California Highways and Public Works*.

DURING 1932 a Portland cement concrete pavement was constructed between Williams and Maxwell on a foundation of some twelve inches of bank run gravel.

On completion the pavement presented a smooth and pleasing riding surface, but within a few weeks time a noticeable roughness became apparent which became so pronounced as to be the subject of inquiry by Director of Public Works Earl Lee Kelly.

Investigations were undertaken by the Materials and Research Laboratory at the request of the District Office and the Construction Department. A rather complete report by Assistant Testing Engineer O. J. Porter indicated the following conditions:

LABORATORY REPORT

1. The subsoil over which the gravel blanket had been laid showed high shrinkage and swell when subjected to loss or additions of moisture.

2. The gravel blanket itself was composed of material not entirely free from changes in volume following changes in moisture content.

3. Expansion joints which had been placed across the pavement at intervals of about 60 feet were imperfectly sealed against the infiltration of rain water.

4. The moisture content of subsoil and of gravel blanket under expansion joints greatly exceeded the normal moisture content under the mid-point of paving slabs.

5. The ends of slabs at expansion joints had raised from $\frac{1}{2}$ inch to 1 inch due to expansion of the underlying soil—the amount of expansion varying with the percentage of moisture.

Mr. Porter found that by introducing water at the mid-point of slabs through core holes drilled



Compacted imported borrow removed to show membrane seal intact.

through the slab to equalize moisture content in the subsoil at all points under the pavement, and by resealing the joints effectively, the surface of the pavement gradually returned to a true plane.

During the investigations by the State of the Williams pavement, the Portland Cement Association undertook a cooperative investigation of paving warp on a much wider scale. This investigation included California, together with the States of Kansas, Missouri, Minnesota, and Texas, and the writer became the California representative on the gen-

eral committee reporting to the National Research Board. The reports submitted by the various States included written matter, diagrams, drawings, and photographs comprising several hundred pages.

CONCLUSIONS OF STUDY

The conclusions arrived at in the California study constitute the subject matter of this article and are as follows:

A. Soil or Other Conditions Which Prevent or Cause Warping

1. Warping on sandy subgrades is practically negligible.

2. Warping on silty subgrades is usually dependent upon the amount of clay in the silt and on its ability to absorb water.

3. Warping is most severe on clay type or plastic soils (such as adobe in California) which are known to be of an expansive nature and which at the time of surfacing with paving have a moisture content so low that it may be readily increased through leakage at the joints. (See Figure 1 on page 23.)

B. Causes of Warping

1. Warping of concrete pavement slabs as indicated by high joints has been caused by swell of sub-soil in a zone extending about 5 feet each side of expansion or other through joints. Tests indicate that increase in moisture content of subgrade of as little as 5 per cent between that found under the center of the slab and that found under the zone adjoining the expansion joint will cause a warping of the pavement of as much as $\frac{1}{2}$ inch.

2. Warping of slabs is influenced by rainfall where joints are not fully waterproofed and where the moisture



These pictures show three progressive operations in laying Portland cement concrete pavement. Upper—Membrane seal in place ready for imported borrow. Center—Motor grader spreading imported borrow over membrane seal. Lower—Imported borrow in place on membrane seal ready for grading and paving operations.

content of the subgrade under the slabs varies in percentage throughout the lineal dimension of the highway.

3. Warping is often seasonal or cyclic in pavements where the admission of additional moisture to the sub-

grade through joints or by other means is not prevented.

C. Methods of Preventing Warping

Warping has not occurred on concrete pavements constructed in Cali-

fornia by the following methods:

1. Designing the grade line so that highly expansive soils were either not included in the subgrade or were removed and replaced by other soil of a nonexpansive nature.

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New concrete bridge over the south overflow channel of Big Tujunga Wash.

Realignment at Sunland Completed

By P. A. McDONALD, Assistant Highway Engineer

STATE Highway Route No. 9, or Foothill Boulevard, as the name would imply, follows along the base of the mountains, starting at the city of San Bernardino, extending westerly through the foothill towns and city of Pasadena to a junction with State Routes 4 and 23 at a point just below the Newhall Tunnel at the westerly Los Angeles city limits.

It not only serves to carry through traffic from the San Joaquin Valley and points north to San Bernardino and points east, and vice versa, but forms an important part of the metropolitan Los Angeles highway system, enabling through traffic to by-pass the downtown Los Angeles traffic congestion.

Recently completed in Los Angeles city and forming an important link in that portion of the route between Pasadena and the junction with Route 4 near the Newhall Tunnel, is a section of Foothill Boulevard, between Fenwick Street and Terra Bella Street. It is 2.90 miles in length, lying adjacent to the community of Sunland, and approximately four miles northeasterly of the city of San Fernando. The new highway location effects a saving of 2500 feet over the previous distance traveled.

DANGEROUS CURVES ELIMINATED

This work, completed under two Department of Public Works contracts, consisted of reconstructing the old narrow, inadequate traveled way built in 1921 on a curving and dangerous alignment as measured against present day traffic requirements and higher speed. Two dangerous right angle turns were eliminated, and a new bridge constructed, crossing over the south or overflow channel of the Big Tujunga Wash, in addition to extensive reconstruction work in widening and utilizing the major portions of the existing bridge across the north or main channel of this wash.

Formerly this wash carried the runoff from a large area in the mountains northeast of Pasadena with resulting tremendous floods in time of heavy storm, but with completion in recent years of a flood control dam eleven miles above the highway, the possibility of future danger from heavy flows has been largely eliminated.

WASH BRIDGE RECONSTRUCTED

In addition to the two right angle turns that existed on the old traveled portions of Route 9, the old align-

ment at the north end of the bridge over the Big Tujunga Channel followed along a dangerous curve of 250 feet radius. Easterly of the Big Tujunga Wash the alignment of the old roadway was curving with reverse curves of 600 foot radius and limited sight distance.

The new Foothill Boulevard section provides a minimum radius of curvature of 1100 feet, with only one curve of this minimum located at the north end of the bridge over the main channel of the Big Tujunga Wash.

This structure, originally constructed by the Department of Public Works in 1921, consisted of sixteen reinforced concrete simple girder spans on mass piers and abutments, with concrete railings, and a twenty-one foot width roadway with no sidewalk. It has been extensively reconstructed, and four spans eliminated reducing the overall length by some 200 feet. The reconstructed width provides a clear 44 foot roadway with an additional 2½ foot sidewalk width.

At the westerly end of the project, junction is made with the existing Foothill Boulevard near Terra Bella Street through a curve of 1600 foot radius. Thus all sharp, dangerous, curving alignment and right angle turns are eliminated and sight dis-



Typical view of completed roadway. Big Tujunga Canyon in background.

tance improved, which conditions heretofore made this a section of highway where frequent traffic accidents occurred.

The improvement was designed and constructed in such a manner as to utilize a considerable portion of the old improvements, at the same time providing a new highway built to present recognized standards. The improvement throughout was graded to a minimum width of 60 feet increased to a width of 74 feet between curbs through subdivided land.

Where improvement follows a new location, two strips of standard Port-

land cement concrete pavement were placed, and where new construction follows along the old center line, the existing 15 foot Portland cement concrete pavement was improved by placing a second story of asphalt concrete.

Roadway shoulders throughout were further improved for a distance of ten feet on either side of pavement by the road-mix method.

The entire improvement was let in two contracts, one contract for grading and paving in the amount of \$121,320 awarded to C. O. Sparks & Mundo Engineering Company, March

31, 1937; and the second for the construction of the two bridges in the amount of \$124,900 awarded to Byerts & Dunn, on the same date as the highway contract. Work of grading and paving was completed on January 14, 1938, and the bridge work was completed January 18, 1938.

Resident Engineer A. D. Hunting of the Southern Bridge District supervised construction operations for the State under the bridge contract, and Resident Engineer W. J. Calvin of the District VII office of the Division of Highways represented the State on the highway contract.



View easterly over new bridge across Big Tujunga Wash overflow channel. Old sharply curving alignment shown to right foreground and left background of new construction.

Highways to Cost Many Millions to Make Them Safe

(Continued from page 1)

multi-lane roads. These are the major arteries of commerce of the State, and the financial problem is complicated by the expensive right of way problems and high structural standards necessarily a part of modern highways of this type.

The cost of doing this work is estimated at \$200,000,000 minimum.

UNSAFE HIGHWAYS AND BRIDGES

In addition, planning surveys indicate the necessity for relocating over 1000 miles of existing highway to provide adequate standards of alignment, grade and sight distance to successfully and safely serve the ever increasing traffic needs.

It is estimated that \$50,000,000 will be required for this task.

Finally, of the 3300 odd bridges upon the State highway system, careful condition surveys have disclosed that approximately 2300 are inadequate, either structurally or because of dangerous approaches or narrow widths, and should be rebuilt.

The cost of this item is estimated at \$70,000,000.

Indeed, there are 400-odd bridges of the above number, so structurally unsound as to require restrictive posting for limited loads and speeds. These constitute hazardous menaces to traffic for there is always someone willing to take a chance with an overload. Too often the result of such an arrogant disregard of this restrictive warning is the collapse of an entire structure with all the attendant blockage of traffic until a new structure can be built.

HUGE FUND REQUIRED

These bridges are being replaced as rapidly as limited funds permit, but to replace or adequately repair them all would require \$10,000,000.

In summary, we find that approximately \$420,000,000 could economically and justifiably be spent, in this State alone, for road and bridge construction. There is not included in the above amount any sum for the construction of those highly expen-



From top to bottom—A danger spot on heavily traveled U. S. 101 near Santa Barbara. Guard rail emphasizes the narrowness of this coast connection in San Mateo County. Another impediment to smooth flow of traffic near Sunol, Alameda County. Alignment such as this is both a bottle-neck and hazard on Redwood highway near Petaluma, Sonoma County.

sive systems of elevated highways so frequently proposed for metropolitan areas, even though there may well be sound economy and merit in the suggestions. This amount represents the sum which should be spent now, to modernize our roads for present conditions, and does not constitute an attempt to estimate the cost of completing our highway system.

Since the inception of State highways in 1912, there have been numerous and repeated efforts to estimate the cost of completing the system, as of some particular period or time. Any such attempt is foredoomed to failure, for the simple reason our highway problems are not fixed and unchanging, but are as dynamic and unpredictable as the motor vehicle itself.

The bare statement that there were 77,000 motor vehicles in California in 1912, while today there are 2,600,000 odd conveys no adequate idea of the basic changes in highway design made necessary by this increase.

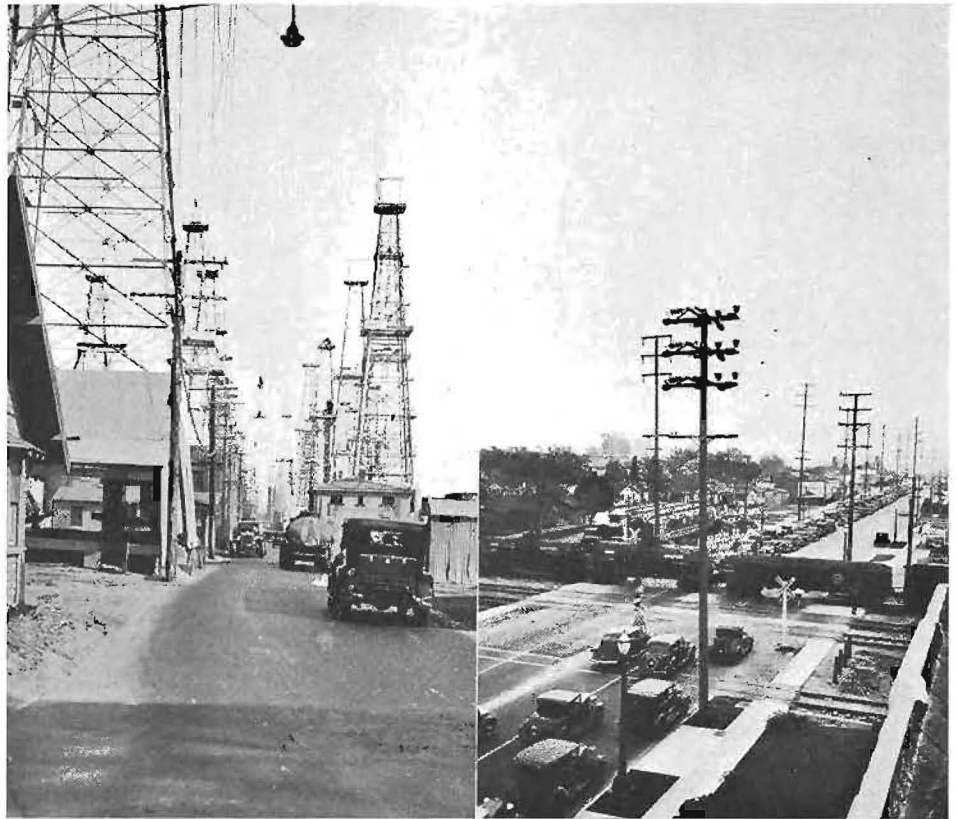
If the 2,600,000 autos, trucks, busses, etc. upon our highway today, were of the same weight, speed and capacity as the 1912 models, we would not have so complex a traffic and accident problem.

HIGHWAY OBSOLESCENCE

That an appreciable portion of our present problem is due to obsolescence rather than depreciation can not be denied. Nevertheless, there can be no justifiable criticism upon the basis that present conditions should have been better anticipated in the highway construction programs of the past.

If a highway engineer in 1912 had been so bold as to attempt the construction of roads to present day standards of alignment, grade and width, the small mileage of construction possible from the limited funds then available would have been indefensible, for the important consideration then was "to get traffic out of the mud"; quantity instead of quality was the watchword.

The plain truth is that all forms of transportation in America have progressed at such speed in the last three decades, as to incur what might at first appear to be an overwhelming obsolescence charge. However, it may be said without fear of successful contradiction, that no highway ever built has failed to pay for itself many times over, especially if the traffic



Left—Old "Speedway" in Venice illustrates expensive problem in road modernization. Right—Autos blocked by train on Santa Monica Boulevard.

using it has become so numerous and congested as to merit its replacement with a higher type.

The railroads of this country are another form of transportational medium faced with obsolescence problems but railroad executives are in a position to prohibit the purchase of heavier engines or cars and faster passenger locomotives until the roadbed and structures have been strengthened sufficiently to successfully and safely handle the heavier loads and higher speeds. The railroad designer is also in a position to know exactly the speeds and loads for which he must design. How different from this is the lot of the highway executive and designer, who not only have little control over either the amount, the weight, or the speed of the traffic which uses the facilities they build, but who must, in addition, strive to anticipate the future designs of the motor vehicle manufacturer, who himself is unable to furnish a satisfactory and trustworthy prediction. Add the further complication of population shifts and concentrations, and the wonder is we have so small a highway obsolescence factor.

Last year, in California, it is esti-

mated that motor vehicles traveled approximately 17 billion vehicle miles, on the State highways alone.

If each operator had paid only 3 cents per mile for this privilege, the income in that year would have amounted to \$510,000,000, which is a larger sum than is estimated as required to modernize our present system.

It is estimated that the average motorist in California pays less than two mills per mile for the privilege of using the highway system.

Considering that experiments indicate a $3\frac{1}{2}\%$ per mile savings between driving upon an earth road and a surfaced pavement, it would appear that highways are a pretty sound investment, and that there is ample justification for accelerating, rather than decelerating, our highway expenditures.

"Waiter, there's a splinter in my cottage cheese."

"What do you expect for a dime, the whole cottage?"

Customer—Didn't I get my last haircut in this shop?

Barber—I think not, sir. We've only been in business two years.

These Highways and Bridges Are Far From



(1) Section of Route 110, Tuolumne County, oxcart standards for modern traffic.

(2) Auxiliary props serve as temporary expedients to permit use of old bridge in Ventura County.

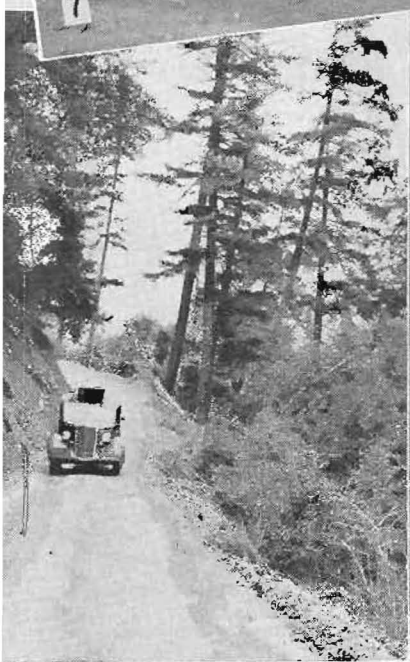
(3) Tortuous alignment emphasizes inadequacy of this road in Ventura, near Santa Paula.

(4) Little space left for stream flow by this prop supporting old truss over Jack Peters Creek.

(5) and (11) Route 20, Trinity County, large expenditures required to rebuild roads of this type to modern standards.



Safe for Traffic They Are Forced to Carry



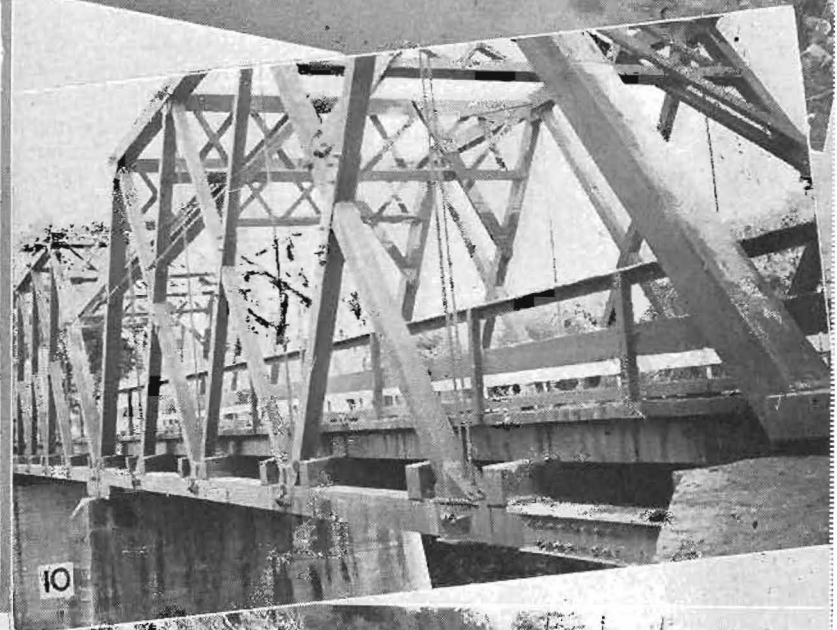
(6) Dangerous alignment and inadequate bridge on Route 198, San Diego County.

(7) Visual warning of traffic limitations on Niland-Mecca Road, Imperial County.

(8) Section in Madera County badly in need of reconstruction on south entrance to Yosemite Park.

(9) Route 17, entering Nevada City, showing constricted alignment.

(10) Emergency repairs to antiquated wooden structures of this type can not long endure.



Livingston Subway Will Abolish Dangerous Railroad Crossing

By C. J. TEMBY, District Office Engineer

CONSTRUCTION of 1.9 miles of State highway on Route 4, U. S. Highway 99, at Livingston, Merced County, including an under-grade crossing of the Southern Pacific Railroad tracks is now under way.

This improvement will eliminate the existing dangerous highway crossing of the Southern Pacific Railroad tracks at grade. The existing crossing presents a dangerous traffic condition because of poor alignment, narrow right of way and restricted visibility.

The present highway is in general parallel to the railroad right of way on either side of the crossing, making the crossing of the tracks at a skew

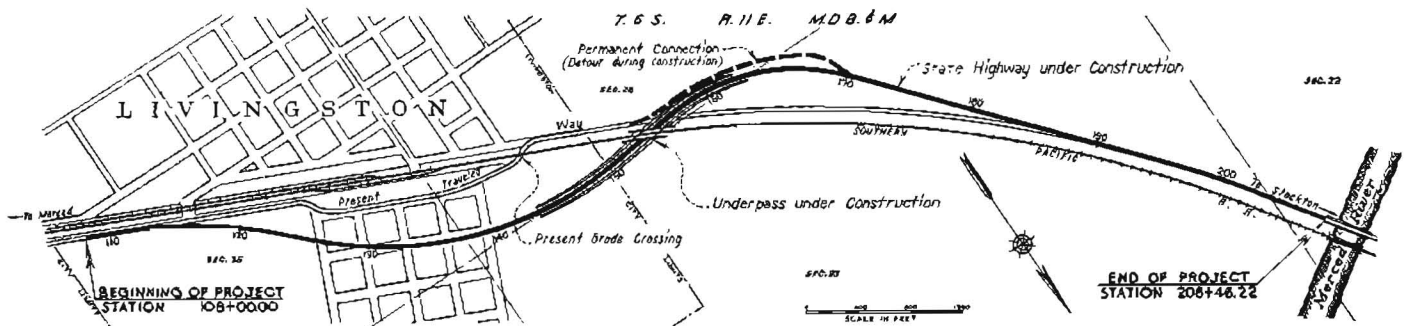
spectively, to a connection with the existing highway 1.0 mile north of Livingston.

The undergrade crossing is on a skew of 35 degrees with the railroad tracks. The structure is 61 feet wide, having four traffic lanes 12 feet wide, two lanes each for traffic in opposite directions separated by Portland cement concrete curbs 7 feet wide. Sidewalks 3 feet wide are to be provided on each side of the subway. The curb and island separations between traffic lanes are to be extended out of the subway about 1500 feet each side of the railroad tracks.

The Portland cement concrete pavement slab in the bottom of the

SAVING IN DRIVING TIME

The construction program requires that the Southern Pacific Railroad route trains over shoo-fly track construction to the west of existing tracks. The highway traffic will be routed over detour to be provided parallel to and west of the northerly end of the proposed work. Upon completion of the new highway, the road used as a detour during construction will be used as permanent connection to existing streets southerly to serve traffic desiring to move to or from the main section (business and residential) located west of the railroad tracks.



This sketch map shows location of present Livingston grade crossing and location of new underpass and realigned highway.

of about 45 degrees through reversing curves, having 300-foot radii. To the south of the existing grade crossing, the present highway is routed over a city street of the commercial section of Livingston, with restricted width, which creates a traffic hazard.

HAZARDOUS CONDITION

This hazardous condition will be eliminated by construction on new alignment, starting at a point about 0.5 mile south of Livingston on Route 4 easterly from the railroad tracks, along unimproved street free of buildings or other obstructions, crossing the railroad right of way on tangent with reversing curves of 2800 feet and 1500 feet radius at south and north approach, re-

subway is designed 36 $\frac{3}{4}$ inch (maximum) thick to counteract uplift resulting from hydraulic pressure of ground water. Adequate pipes are provided to drain water from the subway depression to a sump equipped with pump to boost the water to surface drains.

A main canal of the Merced Irrigation District is crossed about 350 feet south of the railroad crossing. The water in this canal will be carried across the highway in Portland cement concrete siphon.

The roadway approaches to the subway will consist of a graded roadbed 39 feet wide, and Class "B" Portland cement concrete pavement 23 feet wide, the first two traffic lanes of proposed separated four traffic lanes.

Although no saving in distance is to be effected by this construction, an appreciable saving in driving time will be made.

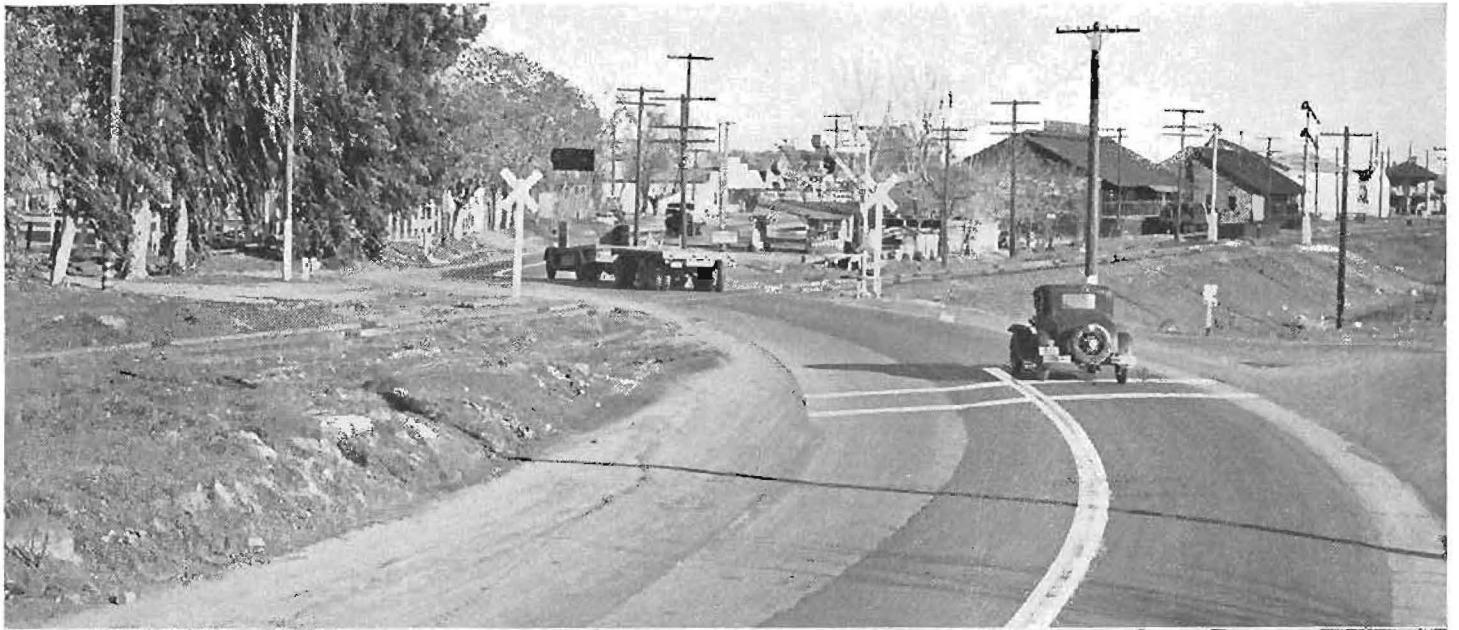
Grades of the subway are 4 per cent with a vertical curve 500 feet long in depression.

CHANGES IN ALIGNMENT

A comparison of the existing and proposed alignment is as follows:

	Existing	Proposed
Total length.....	9778'	10048'
Total curvature.....	198° 42'	140° 27'
Minimum radius curve.....	300'	1500'
Maximum radius curve.....	8669'	6000'
Total length on tangent.....	4058'	4081'
Total length on curve.....	5720'	5965'
Skew angle R. R. crossing.....	45°	35°

(Continued on page 27)



This "S"-turn grade crossing hazard in Livingston, Merced County, is being eliminated. Upper view shows railroad crossing looking southerly toward Livingston and center one shows traffic blockade caused by train. Lower—Excavation for Livingston underpass. Permanent detour on right.

New Highway In Mojave Breaks Bad Bottleneck

By MERLE W. ELLIS
Assistant Highway Engineer

WITH the completion of construction through the town of Mojave on December 1, 1937, under a contract awarded to S. A. Cummings of San Diego on August 17, 1937, a previously existing bottleneck to commercial and pleasure bound traffic has been eliminated from the Los Angeles-Reno road.

Mojave is located one hundred and five miles north of metropolitan Los Angeles on the western edge of the Mojave Desert at the junction of Routes 23 and 58.

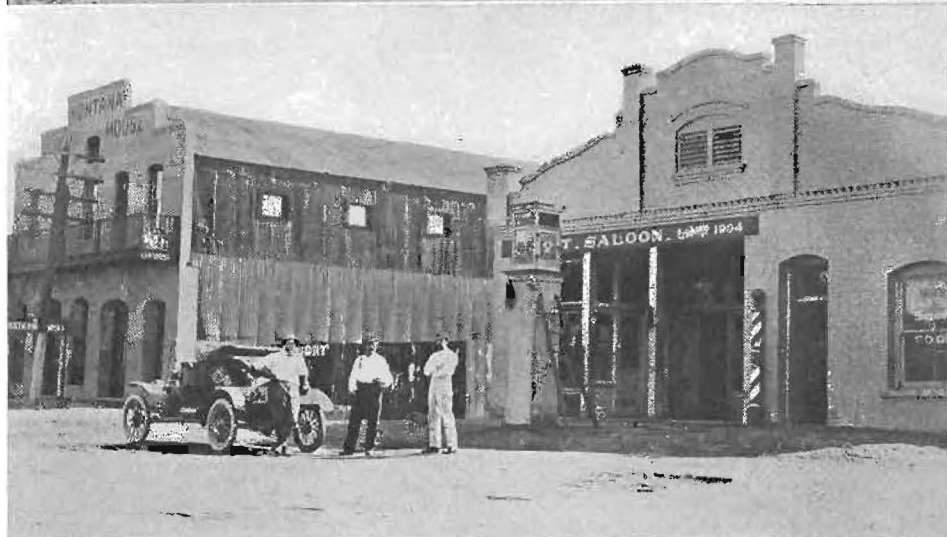
The beginning of Mojave dates back to 1876 when its present location was chosen for the site of a construction camp to accommodate workers engaged in the completion of the Southern Pacific Railroad between Los Angeles and Bakersfield.

OLD BOOM DAYS

The site of Mojave was chosen as the location for the camp by reason of its location at the eastern foot of the Tehachapi grade over the Sierra Nevadas. During the railroad construction days, Mojave flourished as a rip-roaring construction camp; but upon completion of the railroad, the population of the desert town dwindled until only few persons remained.

It was not until 1907 that the boom days of Mojave were again revived, and at that time the town was host to the scores of workers who were engaged in the construction of the Los Angeles Aqueduct. Upon completion of the aqueduct, it again dwindled to its former comatose state, existing as a division point for railroad employees, but gradually becoming better known to early motorists as a desert town on the road to Reno or Bakersfield.

In 1935, Mojave again made the front lines due to the discovery of gold at its front door. The influx of eager miners added to the density of



Upper—Main Street of Mojave in 1909. Harvey House on left. Center—Mojave, July 25, 1912, showing the only street light, a lantern placed in the square tower. Lower—Mojave December 1, 1937, after new construction. Picture taken at approximately same place as photo in 1909 was taken.

through traffic, and Main Street of Mojave became a metropolitan boulevard as far as its traffic was concerned.

Early roads to this area were of the usual dirt type, seldom graded,

narrow, deep rutted, a bog during the wet seasons and a sea of flour-fine dust during hot weather. It was not until 1922, after acquisition by the California Highway Commission of the

(Continued on page 28)

Trees Used For Snow Fences Are Proving Worth

By E. S. WHITAKER
Assistant Landscape Engineer

DISTRICT II this year has placed over 57,000 feet of new snow fencing, after a detailed study of prevailing wind directions and cross drafts as shown by snow drifting onto the traveled way. This new fencing, made of lath and wire, augments fences which have been in place, in some instances for many years, and has been installed at a considerable cost in the belief that man-created drifts off the traveled way are much easier to cause than naturally formed drifts on the roadway are to dispose of.

Maintenance costs on snow fencing are high, due to damage by wind and snow weight, by stock, fire, and deterioration. An ideal condition would be had if fences could be placed and forgotten, or could upon being damaged replace themselves. As this is a quality not present in inanimate material, and because plant life is to a certain extent endowed with this quality, the Maintenance Department has this year begun the establishment of rows of trees which will form shelter belts to act as snow fences.

TREE PLANTING PROBLEMS

Naturally, the planting of trees for this purpose can not be accomplished at every point along the roadsides where drafts cause snowdrifts on the roadway. There are many factors to be considered before work can be done, among them: soil conditions, or lack of soil; physical features, especially man-made, such as intersecting roads which afford long, uninterrupted sweeps of wind; cut banks which in themselves cause a back-swirl of wind force so that the burden of snow is deposited; or logged-off areas which terminate in a forest wall which deflects wind and builds up a drift; inability to secure permission to plant trees in the proper locations because of agricultural use of the land and the very permanency of the



Upper—Trees planted parallel to snow fence will form drift shelter when winds whine down from Mt. Shasta. Center—Trees planted across the front of snow fences on this sidehill. Lower—Wind carried snow up and over this hillside, causing one of heaviest drifts on the road. Six rows of trees are planted up the side of this hill.

planting itself. There are places, however, where all conditions are as favorable as may be had, and at these locations trees will be planted.

The idea is not new; there are many well-established shelter belts and

windbreaks throughout the country and these have been in use for snow protection in the Eastern States for years. But in California the areas with snowfall in such quantity as to

(Continued on page 22)



Another highway project completed last year. El Cajon Boulevard in San Diego.

Taft to Maricopa Highway Opens With Ceremonies

OFFICIAL dedication and opening of the new link on State Route 138 between Maricopa and Taft was celebrated on the afternoon of January 9.

If a straight line is drawn on the map of California from Oakland to Los Angeles it will very nearly coincide with Route 138 for a distance of approximately 100 miles from Maricopa to Coalinga in Kern County. For this reason, all the communities on the west side of the San Joaquin Valley are greatly interested in any improvement of this route, believing it ultimately will be accepted as the shortest, fastest and safest highway between the large metropolitan areas of the State.

OLD ROAD DANGEROUS

The old road between Maricopa and Taft was an 18-foot Portland cement concrete road originally constructed by Kern County, on an alignment which had many dangerous and horizontal curves. The average traffic of over 2000 machines daily, combined with the heavy hauling for oil field development work, made this reconstruction necessary.

When surveys for this improvement were started, the engineers of the Division of Highways were faced with the problem of getting the most direct line between the two towns that would miss all of the oil wells, with which this area is thickly studded.

For a preliminary study, an aerial survey was made, which furnished a map on a scale of 1000 feet to the inch. Using this map, the most direct possible line was secured economically without loss of time for preliminary topography. The final location has one four mile tangent and a minimum horizontal curve reduction of 2000 feet. There is one 300-foot piece of 5 per cent grade. All the other grades are 3.6 per cent or under, with long sight distances on the vertical curves. The final line makes a saving in distance of approximately three-quarters of a mile.

Specifications for grading on this road followed the California Highway standard, requiring earth

Highway Accomplishments in 1937

(Continued from page 7)

Creek at the bottom of the grade to Cuesta Siding. The cost, together with an overhead crossing over the Southern Pacific tracks near the northerly end of the project is estimated at about \$861,000.

WORK IN SAN DIEGO COUNTY

Extensive improvement to the main highway between San Diego and Los Angeles was undertaken during the year between the Las Flores Underpass and the Orange County Line in northern San Diego County.

This improvement has involved four contracts and has consisted of the reconstruction of the route, with the widening of the bridge across San Onofre Creek and construction of an overhead crossing over the tracks of The Atchison, Topeka and Santa Fe Railway near San Onofre. The larger of the two road jobs consisted of constructing pavement on new alignment for eight miles between the Las Flores Underpass and San Onofre and the second paving contract provided for reconstruction on the 2.6 miles be-

tween San Onofre and the northerly boundary of San Diego County. The total cost of these improvements will be approximately \$680,000.

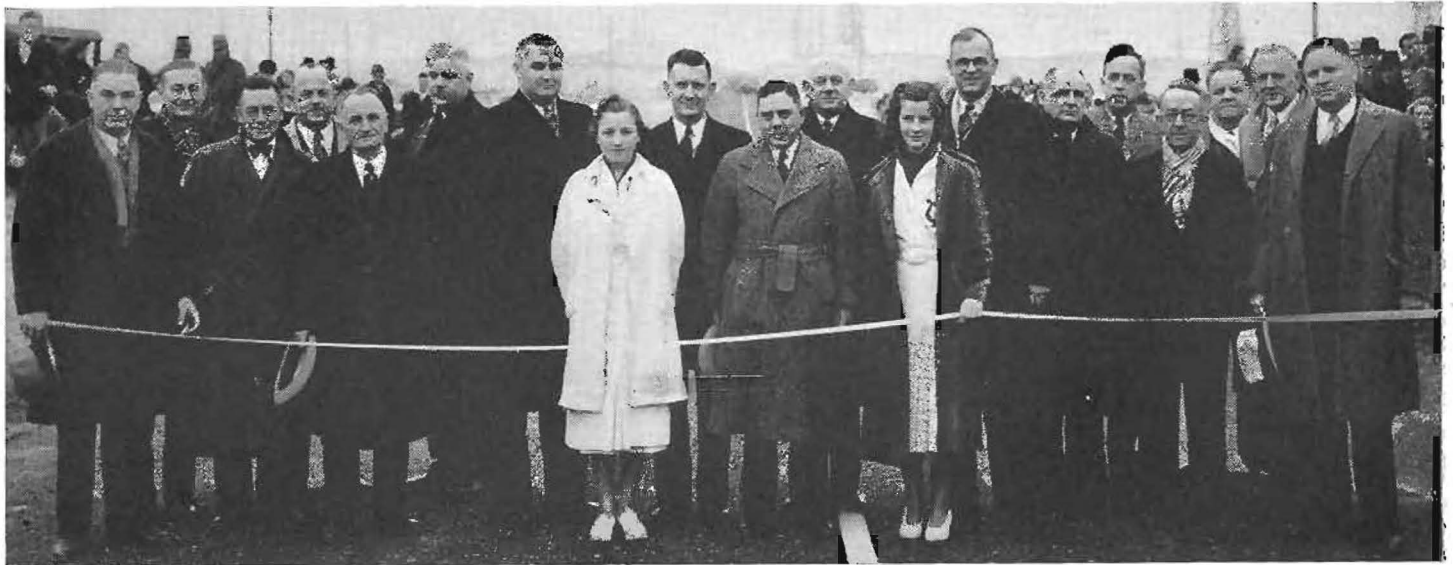
NEW MONTECITO HIGHWAY

Another important improvement to the main coast highway includes the construction of a four lane divided thoroughfare through Montecito just south of Santa Barbara. The new section of highway through this beautifully developed community provided the construction of a planted parting strip dividing the two main traffic lanes and on each side, but separated from the main highway by landscaped parking, service roads for local traffic.

In Monterey County the State is constructing a modern bridge across the Salinas River at Soledad to more adequately care for the ever increasing traffic on the Coast Route between Los Angeles and San Francisco. This new structure will cost some \$326,000.

Two improvements of interest to

(Continued on page 24)



Official group at dedication of Taft-Maricopa Highway. Left to right—Judge J. R. Anderson, Maricopa; Fred Grumm, Engineer Surveys and Plans, Sacramento; R. H. Wilson, Office Engineer; Frank Balfour, Right of Way Agent, Los Angeles; Highway Commissioner W. T. Hart, Carlsbad; Fred W. Panhorst, Bridge Engineer, Sacramento; Highway Commissioner Robert S. Redington, Los Angeles; Senator Jack McBride, Ventura; Harry A. Hopkins, Assistant Director Public Works; Chairman H. R. Judah, Highway Commission, Santa Cruz; Highway Commissioner Paul G. Jasper, Fortuna; Mayor Ed Lehman, Maricopa; J. G. Standley, Principal Assistant Engineer, Sacramento; O. G. Miller and M. H. Lytle, Maricopa; L. D. Batchelder, Taft Chamber of Commerce; Supervisor Stanley Abel, Taft; Miss Maryalyn Anderson, left, and Miss Mary Lou Miller of Maricopa were ribbon holders.

work to be spread and rolled in 8-inch layers, but since this is in a dry area, water was not needed in construction of fills below the top two feet.

In addition, a special provision was written which eliminated the requirement of a roller in case the contractor elected to move his earth with tractors and pneumatic tired carry-all equipment, and also provided that such equipment should spread the material in layers not to exceed 4 inches in thickness before compaction, and route the equipment uniformly over the full width of the embankment.

Approximately 200,000 yards of embankment were placed by the contractor in this way. The value of this method was demonstrated by the fact that compaction tests on completed embankments in every case gave results of over 100 per cent as against the 80 per cent minimum required in the specifications.

The contract was carried out by the Griffith Company of Los Angeles, which completed this work one month in advance of the schedule.

Supervisor Stanley Abel of Kern County was master of ceremonies at the dedicatory celebration held at a point on the highway midway between Taft and Maricopa. Assistant Director of Public Works Harry A. Hopkins formally opened the highway by severing a ribbon held by the Misses Maryalyn Anderson and Mary

Lou Miller of Maricopa. On the evening before the dedication, a banquet was served by the Taft Chamber of Commerce and the Maricopa Exchange Club in Taft, complimentary to the California Highway Commission and the engineers of the Division of Highways.

Present at the ceremonies of dedication were some two thousand citizens of Kern County, Highway Commissioners Robert S. Reddington of

Los Angeles, W. T. Hart of Carlsbad and Paul Jasper of Fortuna, and the following officials of the Division of Highways: George T. McCoy, Assistant State Highway Engineer; J. G. Standley, Principal Assistant Engineer; R. H. Wilson, Office Engineer; Fred J. Grum, Engineer of Surveys and Plans; F. W. Panhorst, Bridge Engineer; L. V. Campbell, City and Cooperative Engineer; and R. M. Gillis, District Engineer.



View of recently dedicated Taft-Maricopa Highway looking southerly in direction of Maricopa.

Trees for Snow Fences Will Save Money in Future

(Continued from page 19)

entail considerable expense for removal, to maintain traffic flow, are generally located in a forest or, at least, a wooded area. Forests and trees in natural habitats are an evolution and have become of size through a relatively slow process, and planted trees under these conditions will also be slow of growth. When drifts form across the traveled way, immediate control is desired, and such control does not permit of waiting for trees to grow. Hence the snow fences—expensive, but quickly effective.

Again, however, down and cross drafts are caused mainly by the earth's contours and as long as the surrounding topography remains the same, drifts at certain points are inevitable.

ECONOMICAL PLAN

Snowdrifts, while they may be expected to recur at the same locations year after year, are inconstant objects, varying in depth with the season, and can not be treated as were the drifting sand dunes of the Colorado Desert, by building roads on top of them. Roads must be maintained through them, with an ever-continuing annual expense to keep them open to traffic. Therefore, a wait of a decade for tree growth which will control snow drifting, with a cost considerably less both for establishment and maintenance than that now required, is considered a wise and economically advisable plan.

At the locations in District II where planted, on Route 3 north and south of Weed, several species of pine and two of cedar were used. The pines are Jeffrey, Coulter, Austrian, Scotch, and Stone. The cedars are Incense and *Chamaecyparis lawsoniana*, both being native to the region. The use of these species of pines is experimental, to learn which of those that are cold or drought resistant and rapid growers will do best where short, hard winters and long, dry summers are the year's usual weather offering.

Scooter Pot Is Something New



G. E. Hudson and E. N. Tenocher operating Scooter Pots.

A device, which he calls a "Scooter Pot," to expedite the pouring of cracks and expansion joints in highway pavement has been designed by Ernest Wasson, highway maintenance foreman at Los Alamos, in District IX.

Mr. Wasson uses a wheel from a vacuum cleaner, a skate or a child's scooter, which he attaches to a standard pouring pot by means of a piece of strapiron running from the handle down the side of the pot and extended slightly to the front and one side. The wheel is offset about $1\frac{1}{2}$ inches so as to run free of the pavement. The wheel supports the entire weight of the pot and contents, relieving the operator of back strain, allowing him to pour from an upright position and making pouring more accurate.

According to Mr. Wasson, pouring is speeded up at least 30 per cent by the use of his device.

Realtor—Now here's a beautiful home overlooking the lake.

Buyer—Where's the lake?

Realtor—That's what we're overlooking.

Pavement Slab Warp and How It Can be Prevented

(Continued from page 9)

Placing a bituminous seal on the expansive soils sufficiently impervious to prevent passage of moisture from above to the subgrade, and constructing thereon a blanket course of non-expansive material sufficiently thick to avoid perforation by form stakes, etc., of the bituminous membrane placed on the original soil, and also of sufficient thickness to distribute the load of traffic over a greater area where decreased bearing power of subfoundation due to natural moisture content is to be expected. (See Figures 2-4.)

California has not up to the present time undertaken to insure that the moisture content of expansive soils be brought to such condition at the time of construction that there will be no tendency for the subgrade to take up further moisture. Our reasons for avoiding this type of construction are that the traffic borne by California roads, especially the truck traffic, is extremely heavy, and we feel it essential that the bearing power of the subgrade in contact with the concrete pavement should be maintained as high as possible.

D. Restoration of Warped Pavements

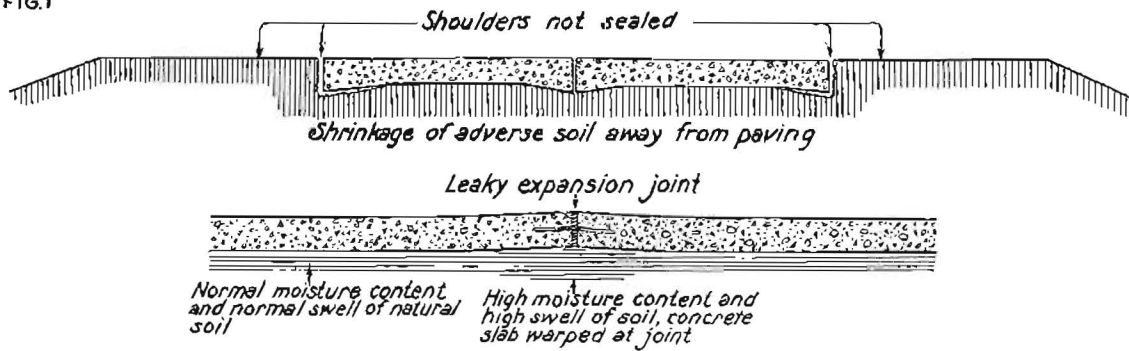
While the mud jack has been used with a certain amount of success for the restoration of warped pavements to original true grade, the method is expensive and experience in Minnesota, Kansas, Texas, and California indicates that increasing the moisture content of the subgrade to a uniform amount or to the proper amount for the location will remove the causes of unequal expansion of subgrade. To maintain such a satisfactory condition, it is necessary to insure tight joints in the pavement where membrane seal is not used, and it is thought that by use of the asphalt-latex joint seal recently perfected by the Materials and Research Laboratory that this may be accomplished. (See Figure 3.)

Observations in California, Texas,

(Continued on page 27)

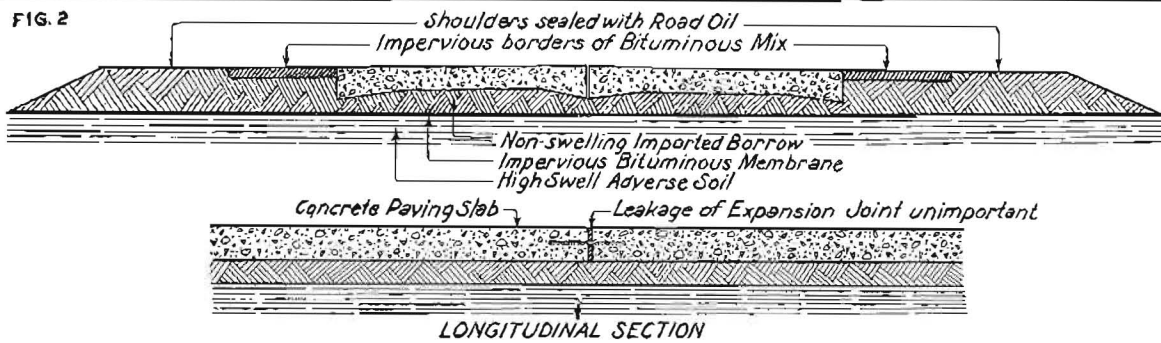
Action of Adverse Soil on Concrete Pavement

FIG. 1



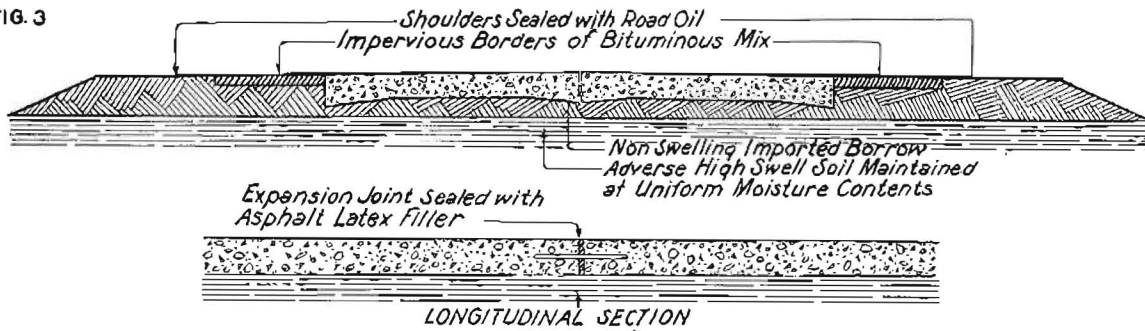
ACTION OF ADVERSE SOIL ON CONCRETE PAVEMENT WHERE NO SUB-GRADE TREATMENT IS USED

FIG. 2



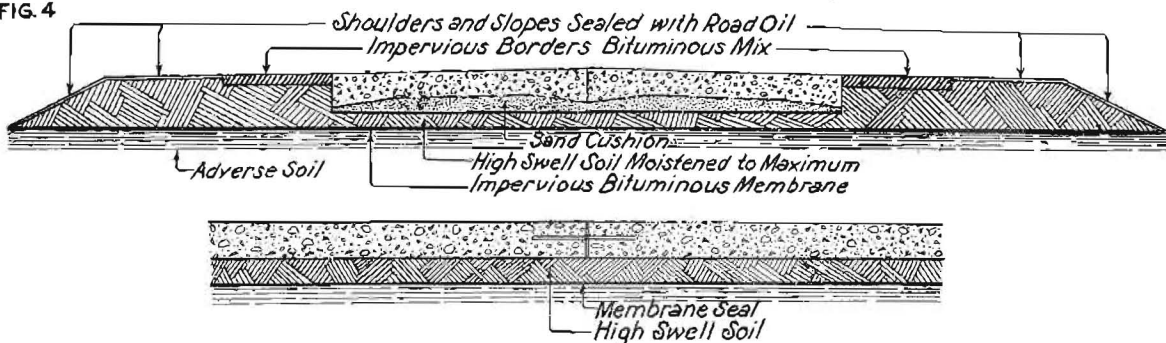
ACTION OF ADVERSE SOIL ON CONCRETE PAVEMENT WHERE ADEQUATE PROTECTIVE MEASURES ARE USED ~ BITUMINOUS MEMBRANE METHOD

FIG. 3



ACTION OF ADVERSE SOIL ON CONCRETE PAVEMENT WHERE ADEQUATE PROTECTIVE MEASURES ARE USED ~ SEALED JOINT METHOD

FIG. 4



PROTECTIVE MEASURES OVER ADVERSE SOIL WHERE IMPORTED BORROW NOT AVAILABLE



Typical section of new highway between Fresno and Herndon.

Highway Accomplishments in 1937

(Continued from page 20)

Southern California motorists are now in progress in San Bernardino County, the one providing for the widening of the pavement on twenty-one miles of the Foothill Boulevard between the Los Angeles County line and San Bernardino and a similar improvement to the Los Angeles-El Centro Route on 19.3 miles between the Los Angeles County line and Colton. These two widening projects are estimated to cost about \$740,000.

In the construction of divided roadways the Division of Highways placed under contract this last fall an important project south of Bakersfield on the Los Angeles-Sacramento arterial.

This construction provides for two lanes of pavement between Grapevine Station and ten miles south of Bakersfield to be placed parallel to and west of the existing highway. The two roads will be separated by a twenty-foot landscaped parking and upon completion all south-bound traffic will use the new pavement and north bound traffic will travel on the present highway. The improvement is 19.1 miles in length and about \$500,000 will be expended on its construction.

On the highway over the Santa Cruz Mountains between Los Gatos and Santa Cruz an improvement similar to the modern highway built two years ago between Inspiration Point and Scott Valley on the western slopes of the mountains is now under way on the easterly side between Los Gatos and Inspiration Point.

The engineer's estimate for the grading portion of this project included the largest quantity of roadway excavation ever included in a State highway contract—2,183,000 cubic yards. Drainage structures to be constructed under this contract will require 12,500 cubic yards of structure excavation; 2,600 cubic yards of Portland cement concrete; 310,000 pounds of bar reinforcing steel; and a total of 26,500 lineal feet of various size of corrugated metal pipe for culverts and underdrains. The surface will be bituminous treated rock constructed 46 feet wide by the road-mix method. The cost of this contract will be slightly over \$1,000,000.

Two needed improvements were placed underway on sections of the Redwood Highway. One, between Sapp Creek and Pepperwood School in Mendocino County, providing 3.1 miles of new surfacing has been completed and on the other, in Humboldt County, the highway is being reconstructed and surfaced for three miles between Stegemeyer Bluffs and Myers. These two contracts will total \$431,000.

On the Ukiah-Taboe lateral the highway between Tarke and one mile south of Sutter City is being constructed on an entirely new alignment with a new concrete bridge across the Sutter By-Pass. Cost of this work, including the 5.5 miles of highway and the 4,143-foot trestle, will amount to \$383,500.

One of the largest bridge contracts to be awarded during 1937 was for

the new plate girder bridge across the Sacramento River at Red Bluff. This structure, consisting of two 143-foot, one 126-foot, two 108-foot and two 96-foot spans on concrete piers and abutments with steel pile foundations, will cost approximately \$270,000.

Two contracts were let for new pavement on the West Side Pacific Highway, one for 5.8 miles between Delevan and Logandale in Colusa and Glenn counties and the other on 7.0 miles between Willows and Orland in Glenn County. This new pavement will cost nearly \$426,000.

Nearly \$833,000 is being expended for the construction of four much needed grade separations in addition to those mentioned in connection with other work. One is being placed under the tracks of the Union Pacific on Rosemead Boulevard, near Pico in Los Angeles County; one under The Atchison, Topeka and Santa Fe Railway on Wilson Way in Stockton; a third under the Southern Pacific at Redding; and the fourth under the same railroad at Livingston in Merced County.

Other important work has included continuation of the construction program on the Rosemead Boulevard-Cerritos Avenue thoroughfare between Pasadena and Long Beach; further widening of the coastal highway in Los Angeles north of Santa Monica; improvement of the Santa Paula lateral in Ventura County; and realignment of the Valley Route from Jahant Corner to one mile north of Galt in San Joaquin and Sacramento counties.

Highway Bids and Awards for January, 1938

ALAMEDA COUNTY—Between Mountain House and Contra Costa County line, about 4.1 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Feeder Road. Bodenhamer Construction Co., Piedmont, \$55,957; J. A. Casson, Hayward, \$61,778; Pacific States Construction Co., San Francisco, \$59,343; Claude C. Wood, Stockton, \$62,117; Piazza and Huntley, San Jose, \$59,888; Fredericksen & Westbrook, Lower Lake, \$62,127; A. J. Raisch, Los Gatos, \$66,691; Jones and King, Hayward, \$61,174; E. A. Forde, San Anselmo, \$59,563; Granfield, Farrar and Carlin, San Francisco, \$59,133; Oilfields Trucking Company, Bakersfield, \$58,011; Union Paving Co., San Francisco, \$63,683; Lee J. Immel, Berkeley, \$68,489; A. Soda and Son, Oakland, \$67,255. Contract awarded to George French, Jr., Stockton, \$53,245.

DEL NORTE COUNTY Between Wilson Creek and Last Chance slide, about 20 miles to be graded and seal coat applied and reinforced concrete slab bridge to be constructed. District I, Route 1, Section B. Poulos and McEwen, Sacramento, \$142,297; N. M. Ball Sons, Berkeley, \$167,772; Fredericksen & Westbrook, Lower Lake, \$104,335; United Concrete Pipe Corp., Los Angeles, \$163,772; Williams & Douglas, Kalispell, Montana, \$146,912; Mercer Fraser Co., Eureka, \$160,653; McNutt Bros., Eugene, Oregon, \$167,721. Contract awarded to Hemstreet & Bell, Marysville, \$132,154.00.

FRESNO COUNTY—About 3 miles south of Sanger, a steel girder bridge consisting of five 74-foot spans and two 65-foot spans and approaches to be constructed. District VI, Feeder Road. A. Soda and Son, Oakland, \$60,539; Bodenhamer Construction Co. and W. E. Van Bokkelen Construction Co., Oakland, \$72,452. Contract awarded to Earl W. Heple, San Jose, \$57,845.

LOS ANGELES COUNTY—An under-grade crossing to be constructed, consisting of steel girder track span on concrete abutments and approximately 0.49 mile of roadway to be graded and paved with Portland cement concrete and shoulders and service road to be surfaced with plant-mixed surfacing. District VII, Route 168, Section B. Byerts and Dunn, Los Angeles, \$140,733; Griffith Company, Los Angeles, \$137,111; Carlo Bongiovanni, Los Angeles, \$139,990; Oswald Bros., Los Angeles, \$124,706; John Strona, Pomona, \$136,388; Oscar Oberg, Los Angeles, \$131,934; Metropolitan Construction Co., Los Angeles, \$139,220; Gibbon & Reed Co., Burbank, \$146,710; Claude Fisher Co., Ltd., Los Angeles, \$130,841; J. P. Knapp, Oakland, \$143,240; Vido Kovacevich, South Gate, \$124,318; Dimmitt & Taylor, Los Angeles, \$128,674; United Concrete Pipe Corp., Los Angeles, \$132,630; J. E. Haddock, Ltd., Pasadena, \$134,469; Fred E. Potts Co., Los Angeles, \$145,026; V. R. Dennis Construction Co., San Diego, \$138,731. Contract awarded to C. O. Sparks and Mundo Engineering Co., Los Angeles, \$122,852.20.

LOS ANGELES COUNTY—In North Hollywood at the Division of Highways Shop Yards, shop building to be painted. District VII. John H. Axton, Lynwood, \$1,202; J. P. Carroll Co., Inc., Los Angeles, \$1,275; Hoelzel Ehmig Co., Los Angeles, \$1,305; H. J. McKinley, Beverly Hills, \$1,390; David Wein, Los Angeles, \$1,680; Wm. Gelfan, Los Angeles, \$1,820; D. Zelinsky & Sons, Inc., Los Angeles, \$1,826; Klaas Brothers, Los Angeles, \$1,940. Contract awarded to Stanley F. McGrath, West Los Angeles, \$976.00.

LOS ANGELES COUNTY—Bridges across Corral Creek, Salstice Creek, and Escondido Creek at points about 16 miles north of Santa Monica to be widened. District VII, Route 60, Section A. Oscar Oberg, Los Angeles, \$54,582; John Strona, Pomona, \$49,970; Byerts & Dunn, Los Angeles, \$58,486; J. E. Haddock, Ltd., Pasadena, \$51,382. Contract awarded to J. S. Metzger & Son, Los Angeles, \$46,779.50.

LOS ANGELES COUNTY—An under-grade crossing under the tracks of the Southern Pacific Railroad near Rudell Station and approaches to be constructed. District VII, Route 168, Section C. Oscar Oberg, Los Angeles, \$111,540; Metropolitan Construction Co., Los Angeles, \$131,710; Geo. J. Bock Co., Los Angeles, \$119,915; Claude Fisher, Ltd., Los Angeles, \$121,553; John Strona, Pomona, \$113,112; Fred E. Potts Co., Los Angeles, \$120,454; Dimmitt & Taylor, Los Angeles, \$113,336; C. O. Sparks and Mundo Engineering Co., Los Angeles, \$120,837; Griffith Co., Los Angeles, \$118,313; Vido Kovacevich, South Gate, \$110,922; J. E. Haddock Co., Ltd., Pasadena, \$112,308. Contract awarded to United Concrete Pipe Corp., Los Angeles, \$109,853.50.

MERCED COUNTY—Seven timber bridges on timber pile bents and a corrugated metal pipe culvert at points about ten miles to sixteen miles southeast of Merced. District X, Feeder Road. Earl W. Heple, San Jose, \$28,346; Rexroth & Rexroth, Bakersfield, \$28,449; Palo Alto Road Materials Co., Ltd., Palo Alto, \$28,708; C. B. Cameron & Son, Merced, \$28,848; F. Kaus, Stockton, \$29,504; J. S. Metzger & Son, Los Angeles, \$29,941; A. Soda and Son, Oakland, \$32,607; N. M. Ball Sons, Berkeley, \$32,975; E. A. Howkins & Co., San Francisco, \$33,565; M. A. Jenkins, Sacramento, \$27,836; John Rocca, San Rafael, \$35,272; Bundesen & Lauritzen and Delta Dredging Co., Pittsburg, \$35,940. Contract awarded to E. G. Perham, Los Angeles, \$25,628.20.

ORANGE COUNTY—At Oso Creek, about 0.9 mile to be graded and surfaced with plant-mixed surfacing and a reinforced concrete bridge to be constructed. District VII, Route 2, Section A. Griffith Company, Los Angeles, \$47,659; J. E. Haddock Co., Ltd., Pasadena, \$46,141; C. R. Butterfield-Kennedy Co., San Pedro, \$53,483; Sully Miller Contracting Co., Long Beach, \$44,077; N. Perscallo, Los Angeles, \$63,096; Claude Fisher Co., Ltd., Los Angeles, \$53,678; V. R. Dennis Construction Co., San Diego, \$43,651; Mojave Corp., Los Nietos, \$42,807. Contract awarded to C. O. Sparks and Mundo Engineering Co., Los Angeles, \$42,581.50.

SAN DIEGO COUNTY—A reinforced concrete slab bridge across Sweetwater River between National City and Chula Vista on Highland Avenue, consisting of eighteen 22-foot spans and two 7-foot 6-inch spans on cast in place concrete pile bents. District XI, Feeder Road. Contracting Engineers Co., Los Angeles, \$45,696; Griffith Co., Los Angeles, \$46,556; Gibbons and Reed Co., Burbank, \$47,232; Byerts & Dunn, Los Angeles, \$46,861; S. A. Cummings, San Diego, \$44,242; Werner & Webb, Los Angeles, \$50,765; John Strona, Pomona, \$50,326; B. O. Larson, San Diego, \$43,826; V. R. Dennis Construction Co., San Diego, \$39,729; B. G. Carrol, San Diego, \$42,255. Contract awarded to M. H. Golden, San Diego, \$38,553.11.

SAN JOAQUIN COUNTY—Between Bacon Island Ferry and Mandeville Island

Ferry, about 5.5 miles to be graded and surfaced with untreated crushed gravel or stone. District X, Feeder Road. Claude C. Wood, Stockton, \$29,880; Louis Biasotti & Son, Stockton, \$30,036; E. A. Forde, San Anselmo, \$31,391; George French, Jr., Stockton, \$31,443; A. G. Raisch, San Francisco, \$31,494; Clausen and Corfield, Berkeley, \$32,301; Piazza & Huntley, San Jose, \$33,095; Beerman & Jones, Stockton, \$33,350; Bodenhamer Construction Co., Oakland, \$33,764; A. Soda & Son, Oakland, \$34,537; Lee J. Immel, Berkeley, \$34,850; J. R. Reeves, Sacramento, \$39,219. Contract awarded to Fredericksen & Westbrook, Lower Lake, \$28,789.50.

SANTA CLARA COUNTY—Between north line of Las Uvas Rancho and Croy Road, about 3.9 miles to be graded, surfaced with gravel base, and armor coat applied. District IV, Feeder Road. Granfield, Farrar & Carlin, San Francisco, \$73,244; Fredericksen & Westbrook, Lower Lake, \$78,987; Piombo Bros. & Co., San Francisco, \$79,305; Poulos & McEwen, Sacramento, \$81,409; A. Teichert & Son, Inc., Sacramento, \$87,273; Pacific Truck Service, Inc., & L. C. Karstedt, San Jose, \$89,460; Chas. L. Harney, San Francisco, \$95,476; Guy F. Atkinson Co., San Francisco, \$104,879; Young & Son Co., Ltd., Berkeley, \$83,152; Hanrahan Company, San Francisco, \$81,663; J. L. Conner and Sons, Monterey, \$74,865; Crow Bros. Construction Co., Los Angeles, \$78,774. Contract awarded to Bodenhamer Construction Co., Oakland, \$71,873.77.

SANTA CRUZ COUNTY—A reinforced concrete girder bridge across Salsipuedes Creek, about 1/4 mile northeast of Watsonville, consisting of one 40-foot span and two 30-foot spans, and about 0.23 mile of roadway to be graded and surfaced with crusher run base topped with armor coat. District IV, Route 67, Section A. A. Soda and Son, Oakland, \$27,751; B. A. Howkins & Co., San Francisco, \$26,819; John Carcano, San Rafael, \$26,957; Clausen & Corfield, Berkeley, \$27,793; Valley Construction Co., San Jose, \$28,531; Granite Construction Co., Ltd., Watsonville, \$28,749. Contract awarded to Earl W. Heple, San Jose, \$24,851.90.

VENTURA COUNTY—Construction of a truck shelter at the El Rio Maintenance Station between Ventura and Oxnard. District VII, Route 2, Section C. Alfred A. Jacobson, Pasadena, \$5,888; Contracting Engineers Co., Los Angeles, \$6,265; George Macleod, Ventura, \$6,458; Hansen & Izer, Ventura, \$6,594; Victor L. and Wm. B. Jacobson, Los Angeles, \$9,380. Contract awarded to Standard Construction Co., Los Angeles, \$5,652.

Q. & A. DEPARTMENT

Q. We want you to settle an argument. When does a pedestrian have the right of way?

—Constant Reader.

A. When he's being rushed to the emergency hospital in an ambulance.

"Did anybody drop a roll of bills with a rubber band around them?" asked an old gentleman in the train.

"Yes, I did," said several voices.

"Well, I just picked up the rubber band," said the old gentleman calmly.



THE Bureau of Reclamation announced during the month that the Southern Pacific railroad through the Shasta Dam site would be relocated so that work can progress on dam construction. The relocation will involve about a half mile of new line, more than half of which will be a tunnel under the right abutment of the dam site. Bids for the construction of this tunnel will be opened near the end of February. The Bureau also announced that bids will be received soon for sixteen pumps for the Contra Costa Canal and for materials for the lining of eight miles of this canal. Work has continued and good progress is being made on the construction of the Contra Costa Canal and the government camp for Shasta Dam. Surveys and the preparation of plans for the Shasta Dam and the relocation of the Southern Pacific Railroad for Shasta reservoir have continued and considerable progress was made on surveys for the San Joaquin pumping system and canals for the project.

IRRIGATION DISTRICTS

New construction, repairs and replacement of structures are being carried out in many of the districts during the winter months while plants are shut down, and district forces are available for the work. A number of cooperative projects are also being undertaken with WPA or other Federal assistance, thus providing needed employment and at the same time accomplishing necessary betterments to the district systems at minimum cost.

Woodbridge Irrigation District has signed an agreement with the East Bay Municipal Utility District by which the prior rights of the irrigation district to flow of the Mokelumne River are recognized and fixed in amounts ranging from 30,000 to 45,000 acre-feet per year. A suit brought to determine the relative water rights has been dismissed.

The construction of the Lake Gregory Dam in San Bernardino County, owned by the Crest Forest County Water District, is approaching completion with the exception of the riprapping on the upstream face of the

structure and the concreting of the spillway lining. The completion of this part of the work will probably be dependent on weather conditions.

WATER RIGHTS

Supervision of Appropriation of Water.

Twenty-five applications to appropriate were received during December, 25 were approved, and 7 were denied. The rights were confirmed under 10 permits and 17 permits were revoked.

Inspection reports are in the course of preparation covering projects which were investigated during the past field season, and during November 223 reports were received from permittees and licensees, which reports are under study for the purpose of determining appropriate action.

SUPERVISION OF DAMS

Application for the approval of plans and specifications for construction of the Laguna Dam of The Irvine Company, Tustin, California, was filed on January 5, 1938. This dam is to be an earth fill structure 34 feet in height with a storage capacity of 300 acre-feet, situated on an unnamed creek tributary to San Diego Creek which flows into Newport Bay in Orange County. The estimated cost is \$23,000.

Application for approval of plans for the alteration of the Kunkle Dam of the Pacific Gas and Electric Company, situated on Kunkle Creek tributary to West Branch of North Fork of Feather River in Butte County, was received on December 22, 1937. This application was approved by the State Engineer on January 3, 1938.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

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

CALIFORNIA COOPERATIVE SNOW SURVEYS

With several feet of snow in the mountains as a result of the storm period January 15th to 20th, Rangers of the Plumas Na-

tional Forest were instructed in the details of making snow measurements at the new snow courses established this year in that area.

In the office, work has continued on compilation of precipitation and runoff data and the working up of the natural flows that occurred during the past season. The actual historical figures compare well with those estimated in last April's snow survey bulletin.

CONN VALLEY PROJECT

Work was initiated during the month on investigations of the Conn Valley reservoir and dam sites in Napa County to determine the availability of the reservoir as a possible source of additional water supply for State institutions in Napa Valley. Investigations are being made of reservoir capacity, water supply, geology of the dam sites and possible cost of the project.

FLOOD CONTROL AND RECLAMATION

Relief Labor Work.

At the present time approximately 70 relief laborers are employed, cleaning out debris in Butte Slough, cleaning drains of the Pump No. 3 system, and removing debris from the Feather River near Nicolaus.

Sacramento Flood Control Project.

Work has been resumed on the construction of five timber bridges in the Dry Creek project near Wheatland.

The Reclamation Board has requested this office to remove certain levees in the Feather River overflow channel, which have been replaced by new set-back levees. This work is considered an emergency for immediate construction, and \$20,000 has been allocated. Actual construction is under way with five heavy bulldozers.

Emergency Levee Repairs.

On January 14th Governor Frank F. Merriam made available the sum of \$150,000 by Executive Order No. E 177, for use in making emergency repairs to levees in the Sacramento Valley outside of the Sacramento Flood Control Project. The work is being done under the general administrative direction of Colonel A. M. Barton, Chief Engineer and General Manager of the Reclamation Board, cooperating with the State Engineer. R. L. Jones, Deputy State Engineer, is in direct charge of construction.

State Highway Engineers View Eastern Roads

(Continued from page 5)

due to the abundant roadside vegetation growing right up to the pavement edge.

The absence of improved shoulders throughout the middle west and eastern States is very noticeable and gives the impression, which as a matter of fact it does, of narrowing up the effective driving width of the pavement.

On the entire trip the group reports they did not see anything that would approach the asphaltic construction of the West or any concrete roads which were built to better standards than those now being laid in California.

However, it would seem that the people of California can take a leaf from the book of experience of New York, New Jersey, and Massachusetts and give more consideration to the congested areas of the State, solving the problems by the construction of through boulevards with service roads on each side or agreements preventing abutting property from any contact with such speedways except at stipulated intersectional points where the clover leaf type of construction and accelerating entrance lanes would be placed.

In Memoriam Comte Edward O'Connell

Death, striking suddenly and unexpectedly, summoned Comte Edward O'Connell, Chief Clerk of the headquarters staff of District VIII, Division of Highways, San Bernardino, on January 24.

Prominent in civic affairs in San Bernardino, president of the California State Employees' Association, past vice commander of the United Veterans of the Republic and a leader in the American Legion, Mr. O'Connell was widely known throughout the State. His active career ended in his forty-first year. Death was due to a heart attack.

The following tribute to Mr. O'Connell comes from Mr. E. Q. Sullivan, District Highway Engineer in San Bernardino:

"The untimely death of Mr. O'Connell has been a severe shock to myself and the entire State Division of Highways. His passing is mourned by everyone. He was of a buoyant, cheerful disposition. It is difficult to realize that he is no longer with us because of his apparent good health.

"Mr. O'Connell was head of the District VIII accounting department. The keeping of the accounts for the division of highways is a complex and difficult work. Mr. O'Connell handled his work in a manner to warrant complete confidence in his competence and integrity. He was truly a trusted assistant in the administration of District VIII accounting department throughout all the years.

Mr. O'Connell is survived by his widow, Floy; a son, Comte Jr., 13; two stepchildren, Dorothy Irwin and George Irwin, all of San Bernardino; his mother, Mrs. George O'Connell and three brothers.

Livingston Subway Will Abolish Crossing

(Continued from page 18)

New right of way was acquired for the entire length of the construction. The area traversed, for the most part, consisted of vineyard and orchard land. The right of way for this construction will cost approximately \$22,500.

The construction based on the contractor's bid plus estimated supplemental work, contingencies and engineering will cost approximately \$264,500.

The principal items of construction quantities and unit bid prices are:

Item	Quantities	Unit price
Roadway excav.....	57,000 c. y.	\$0.30
Overhaul --	750,000 st. yd.	0.005
Cl. "B" P. C. C. (pvmt)	5,380 c. y.	8.00
Cl. "B" P. C. C. (thick pvmt)	1,525 c. y.	7.00
Cl. "A" P. C. C. (str.)	1,210 c. y.	14.25
Cl. "A" P. C. C. (curbs, gut.)	1,115 c. y.	11.00
Bar reinf. steel.....	225,000 lbs.	0.053
Str. steel.....	218,000 lbs.	0.09
Douglas fir piles.....	10,400 ft.	0.25

Louis Biasotti & Son, of Stockton, California, are the contractors. W. J. Deady is Resident Engineer in charge for the State. Inspection is being handled jointly by the Bridge Department and District X.

Pavement Slab Warp in California and Prevention Methods

(Continued from page 22)

and other States indicate that the moisture content in subgrades not originally moisture treated gradually approaches the same moisture content as that in the subgrades which were originally moisture treated. We are not, however, prepared to say that

under California conditions where rainfall may not occur for several months a subgrade which was moisture treated would not vary in moisture content throughout the year. In fact, from our experience on the pavement near Williams which origi-

nally gave us trouble, we believe that the moisture content does vary from time to time. It appears that the experience in Missouri and Kansas confirms these conclusions.

(To be continued)

EXPLANATORY NOTES:

Adobe is the California designation of black clayey top soil showing high shrinkage or swell with moisture changes.

Shrinkage as used herein refers to lineal shrinkage in per cent of the specimen prepared under standard methods.

Swell as used herein refers to lineal swell in per cent of the specimen prepared under standard methods.

Bearing power is reduced to pounds per square inch for 0.2 inch penetration of testing disc.

Bearing power "wet" refers to a specimen which after standard preparation has been immersed in water for four days.

Bearing power "dry" refers to a specimen which has been properly moistened and compacted at 2,000 lbs. per square inch.

Roughness index is the roughness in inches per mile of paving as taken with "roughometer" attached to an automobile.

Thickness of imported borrow refers to compacted thickness.

Membrane is reported in gallons per square yard.

Warp is reported as the variation in decimal fractions of an inch of high joints above the true plane of the pavement.

New Highway Through Town of Mojave Eliminates Bottleneck

(Continued from page 18)

county road from Lancaster to Mojave, that a high type road to this locality was available. A fifteen foot concrete pavement was constructed in 1922 from the Los Angeles-Kern County line, south of Mojave, to the northerly city limits of Mojave. This was widened in 1935 by the addition of two eight-foot shoulders to afford a twenty-foot road width, and a portion of the street area was oiled to alleviate the dust nuisance.

HIGHWAY WORK BEGUN

To accommodate the increase in traffic within the town, the new construction, started on September 10, 1937, representing an expenditure of approximately \$28,000, affords a 57.5 foot width of plant-mixed surfacing bordered by 1.5 foot concrete gutters and 0.5 foot concrete curbs on both sides of the main street within the city limits. The previously constructed concrete pavement served as a partial base for the central twenty-two foot portion of the new surfacing.

In order that the bearing value of the additional base required would be commensurate with that of the existing concrete pavement, a trench seven feet in width and one foot in depth was constructed adjoining the concrete pavement and filled by thoroughly compacting therein the salvaged oiled shoulders. This was done by blading the existing oiled shoulders onto the concrete, remixing it to remove excess moisture and compacting it in the trench in very light layers so that maximum compaction would be obtained.

CONSTRUCTION PROBLEMS

The use of a flexible material in conjunction with rigid concrete to form the base of the wearing course introduced many problems as to the ultimate behavior of the pavement. The original subsoil was a clay with its attendant high capillarity. Under the concrete, no serious settlement was observed; hence, it was assumed that the subsoil was stable and that a foot of well-compacted asphaltic treated aggregate would be sufficient to pro-

vide rigidity if the subsoil remained in a state equal to that under the concrete.

The area adjoining the central twenty-two feet is dedicated to parking area and receives much lighter impact than the central portion. Throughout this area, the subsoil was removed to the depth of a foot below subgrade and backfilled with imported borrow of high stability, the whole slush-rolled to obtain maximum compaction.

TRAFFIC UNIMPEDED

Before placing the three inches of plant-mixed surfacing between the gutter lines, the concrete pavement and the seven feet of compacted shoulder material were given an application of one-tenth of a gallon per square yard of asphaltic emulsion. The remaining areas between the gutter lines were given a prime coat of approximately one-quarter of a gallon per square yard of liquid asphalt SC-2.

Curbs and gutters were of integral construction and at street intersections were constructed at entrances to garages, service stations and driveways to allow access for traffic.

By prior arrangement with the business men of Mojave, all through traffic was routed over adjoining streets and the entire project completed with but little inconvenience to the traveling public. The cooperation shown in allowing the main business street to be closed during construction was wholehearted and was reflected in returning to use at an early date the completed street at a lowered cost to the State.

Early pictures of Mojave were made available by the courtesy of John Nestor, postmaster of Mojave.

A struggling young author had called on a publisher to inquire about a manuscript he had submitted.

"This is quite well written," admitted the publisher, "but my firm publishes only work by writers with well-known names."

"Splendid," cried the writer. "My name's Smith."

Traffic on Bay Bridge Declines During January

ALTHOUGH traffic over the San Francisco-Oakland Bay Bridge showed a decline in the month of January as compared to December, it nevertheless exceeded its seasonal quota, according to Earl Lee Kelly, Director of Public Works.

A total of 672,433 vehicles crossed the span during January as against 723,281 for December. This is a decrease of approximately 50,000 vehicles from the preceding month, but an increase by the same amount over the estimated quota for January.

VEHICLES TOTAL ELEVEN MILLION

Total number of vehicles to cross the span since it was opened fourteen and one-half months ago was 11,117,042. There was a daily average of 21,691 vehicles crossing the bridge during January, bringing in total revenues of \$353,859.95

Best day of the month was New Year's Day, January 1, when 31,172 vehicles crossed the structure. Lowest day was January 3, a stormy day, with 18,831 vehicles.

January of last year, when a 65-cent toll was in effect, showed a decrease in traffic but an increase in revenue over figures for the same period in 1937. In January of 1937 there were 575,083 vehicles crossing the bridge, bringing in revenues of \$384,092.27.

A general decrease in all classifications of traffic was revealed in a comparison of January, 1938, figures with those of the preceding month.

COMPARATIVE FIGURES

Comparative figures follow:

	Total Dec.	Total Jan.	Total Since Opening
Passenger Autos.....	681,506	633,115	10,562,142
Auto Trailers.....	856	649	18,165
Motorcycles.....	2,077	2,117	38,434
Tri-Cars.....	977	798	9,500
Trucks.....	26,236	24,299	351,344
Truck Trailers.....	954	883	23,340
Buses.....	10,675	10,632	113,117
Total Vehicles...	723,281	672,433	11,117,042
Extra Passengers.....	189,480	170,440	2,396,518
Freight, Lbs.....	59,671,837	55,840,498	804,036,518

Visitor: "And what's your name, my good man?"

Prisoner: "9742."

Visitor: "Is that your real name?"

Prisoner: "Naw, dat's just me pen name."

STATE OF CALIFORNIA
Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK F. MERRIAM.....Governor

HARRY A. HOPKINS.....Assistant Director

EARL LEE KELLY.....Director

EDWARD J. NERON.....Deputy Director

CALIFORNIA HIGHWAY COMMISSION

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PHILIP A. STANTON, Anaheim
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DIVISION OF HIGHWAYS

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G. T. McCOY, Assistant State Highway Engineer
J. G. STANDLEY, Principal Assistant Engineer
R. H. WILSON, Office Engineer
T. E. STANTON, Materials and Research Engineer
FRED J. GRUMM, Engineer of Surveys and Plans
C. S. POPE, Construction Engineer
T. H. DENNIS, Maintenance Engineer
F. W. PANHORST, Bridge Engineer
L. V. CAMPBELL, Engineer of City and Cooperative Projects
R. H. STALNAKER, Equipment Engineer
E. R. HIGGINS, Comptroller

DISTRICT ENGINEERS

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F. W. HASELWOOD, District II, Redding
CHARLES H. WHITMORE, District III, Marysville
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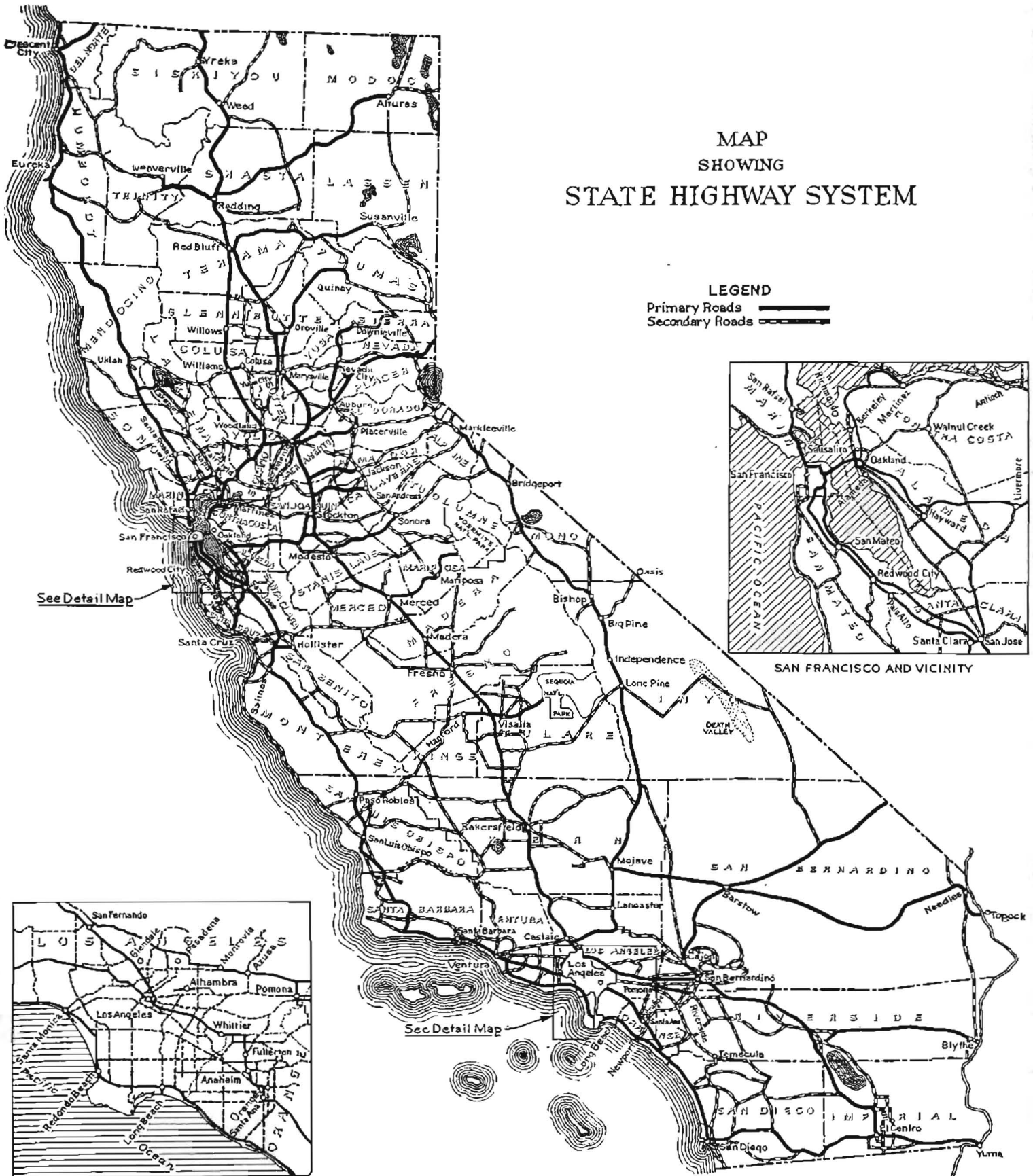
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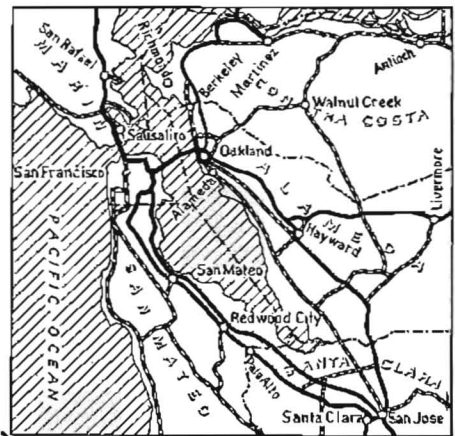
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