CALIFORNIA HIGHWAYS

A BULLETIN ISSUED BY THE CALIFORNIA HIGHWAY COMMISSION FOR THE INFORMATION OF ITS EMPLOYEES AND THE PUBLIC

Vol. 2 DECEMBER, 1925 No. 12

ON THE SKYLINE BOULEVARD—A scene like this is hardly to be expected a few miles from the San Francisco city limits. The view was taken in the San Mateo hills on a section of state highway recently completed and opened to traffic. (Photo by A. W. McCurdy.)

Happy New Year

CALIFORNIA HIGHWAYS

HARVEY M. TOY, Chairman;

N. T. EDWARDS and LOUIS EVERDING, Commissioners.

ROBERT M. MORTON, State Highway Engineer.

W. F. MIXON, Secretary.

We are pleased to permit publication of any of the matter contained herein or to loan cuts, and this privilege is extended newspapers and periodicals without restrictions.

FRANK B. DURKEE - - - Editor

P. O. Box 1103, Sacramento, California.

Vol. 2 DECEMBER, 1925. No. 12

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HIGHWAY OFFICIALS STAND FIRM FOR FEDERAL AID

CALIFORNIAN HEADS RESOLUTIONS COMMITTEE AT DETROIT MEETING.

WITHOUT a dissenting voice and with all states save Florida and Washington represented, the American Association of State Highway Officials, at its annual convention in Detroit, reiterated its position strongly endorsing the federal aid highway policy. Harvey M. Toy, of the California Highway Commission, was chosen chairman of the important resolutions committee, and the following resolution, offered by him, was unanimously adopted:

> Whereas, the appropriations now authorized by congress for the purpose of carrying out the provisions of the Federal Highway Act do not extend beyond the fiscal year to end June 30, 1927; and
>
> Whereas, appropriations beyond said fiscal year 1927 should be authorized for such periods in advance as to enable the state highway departments to so plan their construction as to best utilize such appropriations when they shall become available; now, therefore, be it
>
> *Resolved,* that it is the sense of this association that congress at its ensuing session should authorize further appropriations for said purpose for the fiscal years to end June 30, 1928 and 1929, respectively, and that the appropriations so authorized should be at the rate of eighty million dollars for the cooperative construction of rural post roads and eight million dollars for the construction of forest roads for each of said fiscal years 1928 and 1929.

Other Resolutions.

In addition to the above, the committee offered a number of important resolutions which were adopted by the convention, as follows:

> That no reduction be made in the present mileage of federal aid roads;
>
> That a change be made in federal aid practices providing for increasing the limits of aid in certain instances (Colton Bill, H. R. 6133, 68th Congress 2d Ses.);
>
> That a uniform system of marking roads be adopted;
>
> That the use be generally made of the uniform questionnaire to determine responsibility of contractors as reported by the joint committee on uniform questionnaires;
>
> That the state of New York and Governor Smith of that state be congratulated on the forward step taken in voting a bond issue of $300,000,000 for grade crossing elimination;
>
> That the salary of the chief of the Bureau of Public Roads be materially increased.

DECEMBER 1925

California Highways

VOL. 2 NO. 12

INPROVED QUALITY AND DESIGN INCREASE STRENGTH OF CALIFORNIA HIGHWAY PAVEMENTS

By R. M. MORTON, State Highway Engineer.

THE RAPID INCREASE in tonnage and volume of traffic carried by the highways of today has demanded that engineers exercise the utmost skill and ingenuity in providing additional strength without prohibitive increases in cost.

In the design of concrete pavements, there are two ways in which additional strength to withstand traffic impact may be secured. One method is to increase the thickness and to improve the design of the cross section so that the greatest strength will be at the point where loading is the heaviest. Increased thickness means increased cost and economic considerations prevent unlimited improvements in this direction.

The other method of increasing the strength and wearing power of pavements is by improving the quality of the concrete used in them, and, as this method gives added strength at a very slight increase in cost, it should be utilized as far as possible.

The early four-inch concrete pavements, fifteen feet in width, were laid with uniform thickness. Traffic ten years ago was light, passing of vehicles only occasional and much of the traffic moved along the center of the roadway. Increased volume of traffic results in vehicles meeting and passing frequently; in fact, on some roads, almost continuously. Traffic is forced to travel in lanes, and, on a two-way road, the outside wheels are near the edge of the pavement. This heavy loading along the edge led to the thickened edge section, which was shown to be the most efficient type by the Pittsburg tests in California and by the Bates road test in Illinois. The thickened edge is now used on all new concrete pavements in California.

Pavements Must be Wider.

Increases in volume of traffic have been accompanied by increases in speed and the old width of fifteen feet, providing only 7½ feet for each line of traffic, has become inadequate and unsafe. Observation and experience demonstrate that ten feet should be allowed for each line of traffic on a two-way road. This is now standard practice on new state highway construction and on reconstruction in California.

The longitudinal center joint has been adopted in California as a means for preventing longitudinal cracking. No attempt has been made to hinge the panels together by dowelling across this center joint. Thickness has been increased to nine inches at edges and along the center joint, reducing to a six-inch thickness two and one-half feet in from the edge and center. In reconstruction, the same section is used with a five-inch minimum thickness over the center of the old pavement.

Increased Strength by Improved Quality.

During the last two years much progress has been made in increasing the strength of the pavement by improving the quality of the concrete. This has been accomplished by more careful and rigid field and laboratory control of the materials and methods used, and by modernizing the design of the mixture. The amount of cement used, six sacks per cubic yard of concrete, has not been increased.

In earlier construction, the compressive strength of concrete at twenty-eight days ranged from 1800 to 2200 pounds. During the present year, the strength has averaged from 3500 to 5000 pounds per square inch on various projects. Cores drilled from pavements in the 1920 study, at ages of one to five years, gave strengths of about 3800 pounds per square inch. Year-old cores, from pavement laid last year, show strengths above 5000 pounds per square inch and average strengths for ninety-day cores, drilled from pavements laid this year, range from 4500 to more than 6000 pounds. This increased strength of concrete is had at little, if any, added cost and gives a substantial additional factor of safety in the pavement.

Reconstruction of Pavements.

Asphaltic concrete is used principally in reconstruction work and its use, in suitable locations, provides an economical means of utilizing the supporting strength of the old pavement. The design of the cross section is worked out in each case to best meet local conditions. In some places, the old pavement has been widened by adding 2½ feet of cement concrete on each side and an asphaltic concrete surface is laid over old base and the new concrete. A more usual practice is to construct new concrete shoulders 2½ feet to 8 feet in width along one or both sides of the old pavement at a grade of two to four inches above the old surface. Asphaltic concrete is then laid between the new shoulders, utilizing the old pavement as base.

Where soil conditions are favorable, the old fifteen-foot pavement has been reconstructed and widened to twenty feet by constructing 2½ feet of asphaltic concrete base on the sides of the old pavement and then by surfacing the full twenty feet of width with an asphaltic concrete wearing surface. So far, there has been no evidence of any tendency for separation along the joint between the old concrete and new asphaltic base.

Improvements in Asphaltic Mix.

An effort is being made to improve the design of asphaltic concrete mixtures to prevent corrugating and displacement under traffic. A reduction in the amount of asphalt used for heavy traffic pavements, below the amount considered necessary ten years ago, has been found highly desirable. The penetration of the asphalt has been reduced to 50° or lower. In the average surface mixture, the asphaltic cement used is generally about 5 per cent to 5.5 per cent or slightly higher. Coincident with a decreased asphalt con-

(Continued on page 12.)

New concrete pavement twenty feet wide with thickened edge and center expansion joint.

A Study of Traffic on California State Highways

By G. R. Winslow, Maintenance Engineer.

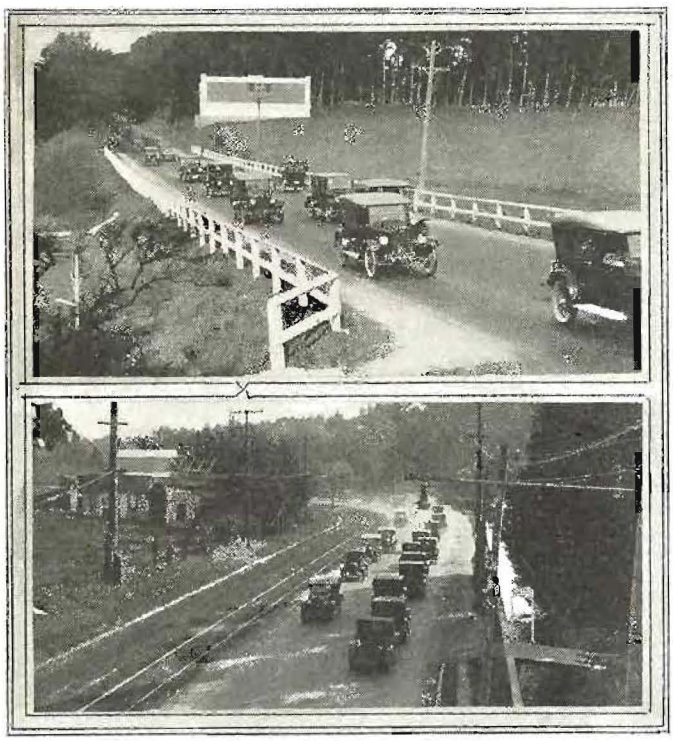
"THOUSANDS tread on thousands' heels." How many of these thousands must be provided for? How many must we design for? How best distribute maintenance funds, that all roads shall be equitably treated? These are problems ever before the road builder.

In the days when traffic was numbered in tens or in hundreds, reliance was placed upon the judgment of the "oldest inhabitant" or other local authority. But traffic has grown and the time has come when guesses must give way to facts. "Heavy" and "light" are but comparative terms and a traffic that seems heavy to one, to another is light. More accurate information is required, hence the traffic count.

In California, even before the days of state highway construction, San Joaquin and Los Angeles counties began to make counts of traffic on improved county roads. At a point in Fresno County, the State Highway Commission has a record of traffic for almost every year from the beginning of its activities. These early records provide much valuable and interesting information, but the data collected are not standardized and are not comparable with the present census.

First General Counts in 1920.

The first general traffic count on California highways was taken in 1920 by the United States Bureau of Public Roads in connection with its investigation of the state highway system. Two years later, the bureau renewed and expanded this census, working in cooperation with the California Highway Commission and several of the counties. Records were taken at 240 representative stations on state highways, over 100 of which were identical with those used two years before, and at 190 places on county roads tributary to state highways. Stations were classed as *intensive* and *extensive*. At intensive stations, the count continued throughout the twenty-four hours of the day, trucks were weighed, tires measured, and drivers questioned. At extensive stations, only the number and types of vehicles were recorded, and observations were limited to daylight hours.



Moving traffic on the state highway south of San Francisco.

In making the count, vehicles were classified as passenger cars, light and heavy trucks, empty and laden, trailers, busses, and horse-drawn. The census was made a few days at a time at a given station, but the count was not taken simultaneously throughout the state and several months elapsed before the work was completed. (For a more complete description see, "A Report of Traffic on State Highways and County Roads in California, 1922.")

In 1924, the California Highway Commission made a count at about 300 stations on the state system. These stations included practically all on the state highway, used two years before. The count was taken from 6 a.m. to 10 p.m. on the Sunday and Monday nearest the middle of the months of April, June, August, October and December. This count was supplemented by records of ferries, plant quarantine stations, and the Yosemite National Park. The data secured were substantially the same as that taken previously at extensive stations, except that, at some of the typical stations, the December count included a record of the paths of vehicles.

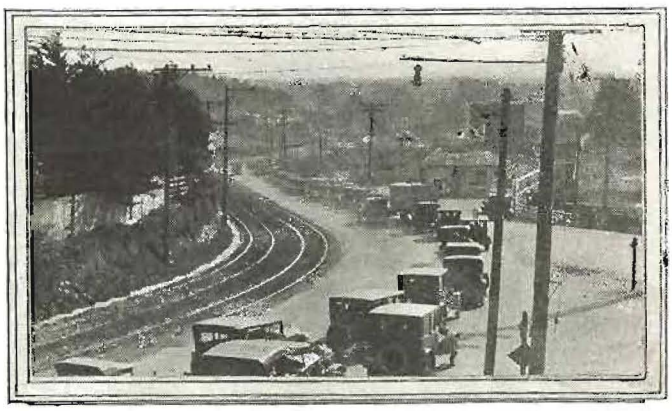
The pavement was divided into one-foot lanes by short painted lines, each third or fifth line being slightly longer to permit of ready recognition. Record was made of the lanes crossed by the left wheel of each passing vehicle during periods of minimum and maximum traffic. The purpose of this observation was to determine the distribution of traffic over the width of the pavement and the extent to which the paths were affected by such factors as road curvature, superelevation, high crown, width of pavement, condition of shoulders, trees and guard rail.

Maintenance Forces Make Counts.

In 1925, a census of traffic was made from July 12th to 18th, inclusive, for sixteen hours daily. A few additional stations were added to those previously used.

Both in 1924 and 1925, the counts were made by the maintenance forces in so far as they could be spared for the work. Records were kept on specially prepared forms so cross-ruled that the horizontal lines represented hours of the day, and the vertical

(Continued at right of map, page 6.)



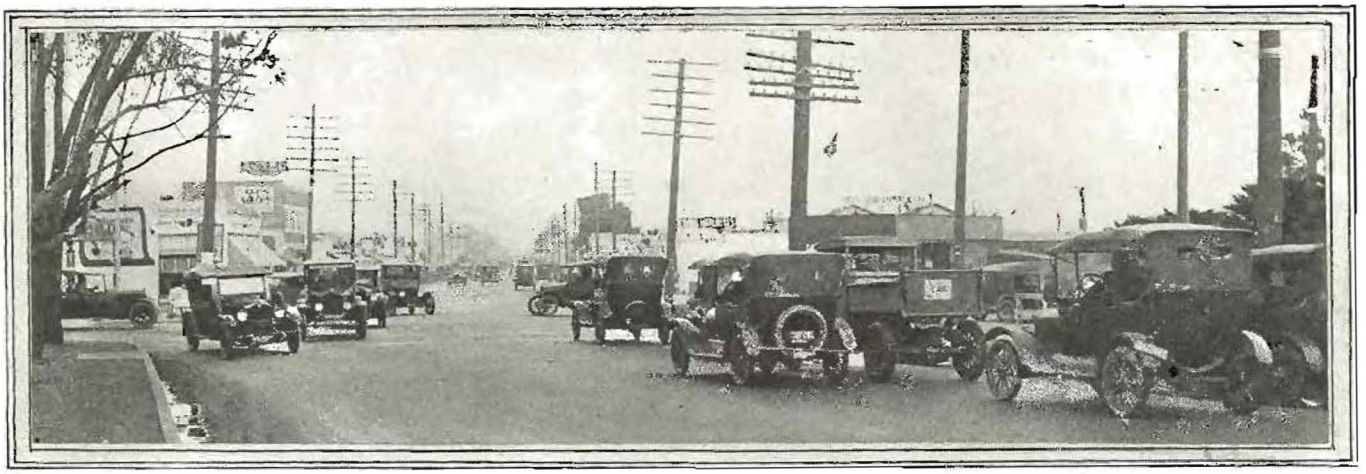
Vehicles sometimes line up for miles when a traffic jam occurs on the Peninsula Highway.

Read This Twice.

Time is the only wealth which can not be replaced.

Good roads save time and thereby produce wealth.—*Anon.*

Some folks cusses 'bout de cos' o' good roads, but dey learnt *how* to cuss travelin' over *bad* roads!—*Hambone.*



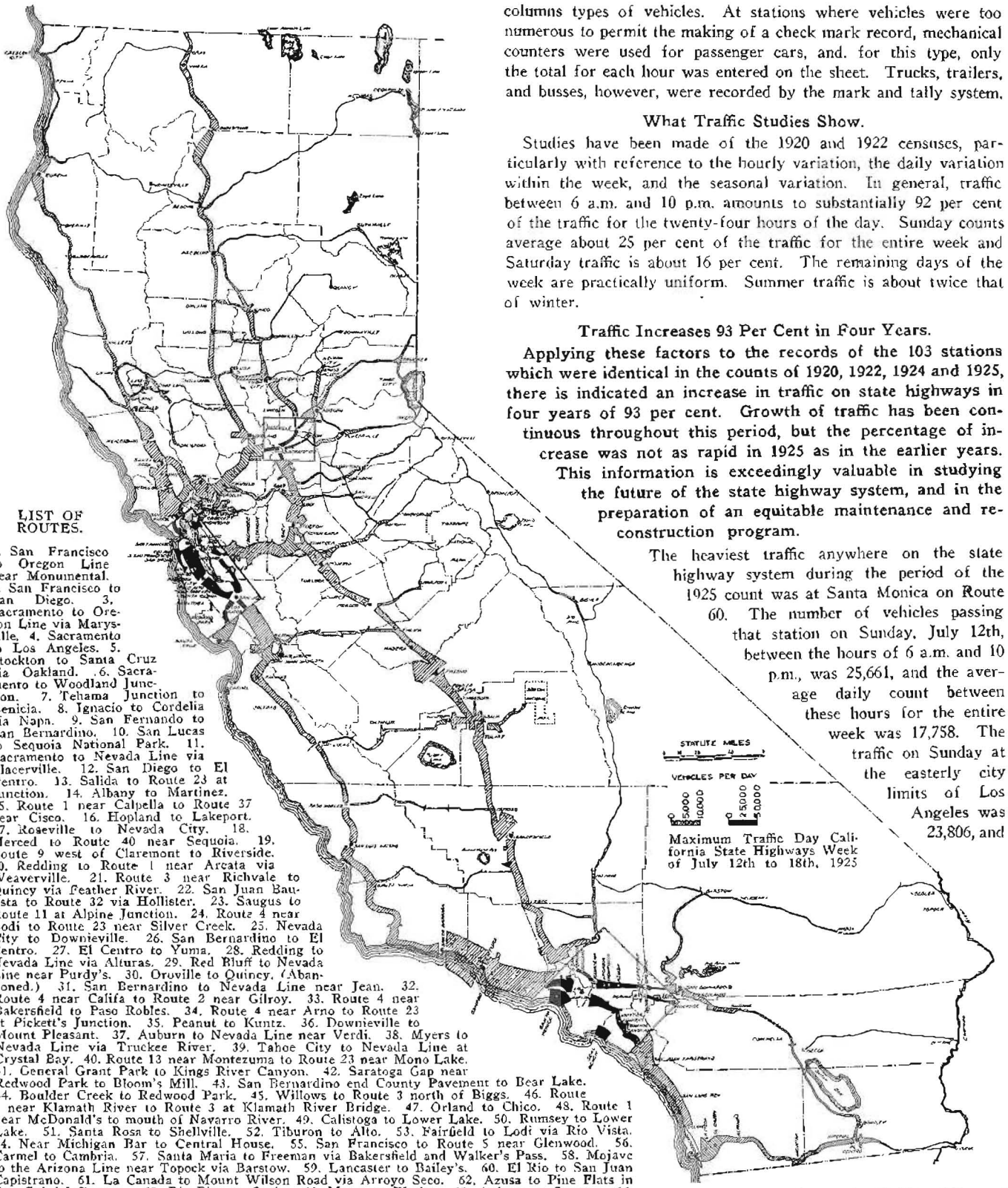
Traffic on the state highway (Whittier Boulevard), Los Angeles County; a fifty-six foot street and one of the heaviest traveled state highways.

California Traffic Census, July 12th to July 18th, 1925, Showing, by Divisions, the Mileage and Average Traffic Density of Each Route in Terms of Vehicles per 16 Hour Day.

*Routes	Div. I		Div. II		Div. III		Div. IV		Div. V		Div. VI		Div. VII		Div. VIII		Div. IX		Div. X		Total	
	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density	Miles	Average density
1	335	789					77	3,085													412	1,218
2							69	7,496	273	2,594			170	5,574							512	4,244
3			191	1,508	105	1,721															296	1,580
4											213	2,104	54	1,877					85	2,531	352	2,172
5							98	3,412											21	2,443	119	3,241
6																			15	3,057	15	3,057
7			26	1,070	94	1,419													46	2,137	166	1,563
8							34	1,728											4	2,451	38	1,804
9													44	4,672	19	1,813					63	3,810
10									6	96	104	833									110	793
11					111	866															111	866
12													74	1,488	36	1,059					110	1,348
13																	15	10	117	512	132	455
14							22	3,825													22	3,825
15	22	460			37	874															59	719
16	19	502																			19	502
17					41	1,481															41	1,481
18											56	443							5	309	61	431
19													2	500	19	2,582					21	2,384
20	13	103	69	104																	82	104
21					6	306															6	306
22									15	940											15	940
23													70	942			277	204	17	56	364	339
24																			127	175	127	175
25					35	93															35	93
26															150	743					150	743
27															35	265					35	265
28			65	108																	65	108
29			69	313																	69	313
31															76	483					76	483
32							26	701			57	672									83	681
33									32	425	53	334									85	368
34																			106	168	106	168
35			31	63																	31	63
36					10	10															10	10
37					97	731															97	731
38					55	343															55	343
39					12	484															12	484
40																	14	123	58	310	72	274
41											14	60									14	60
42							20	282													20	282
43															40	422					40	422
44							8	1,142													8	1,142
45					32	359															32	359
46			12	144																	12	144
47					17	427															17	427
48	12	125																			12	125
49							17	440													17	440
51							23	1,284													23	1,284
52							4	785													4	785
53																			57	689	57	689
54																			9	146	9	146
55							21	1,555													21	1,555
57									17	30											17	30
58															165	179					165	179
60													19	11,753							19	11,753
64															92	41					92	41
65					8	227															8	227
66																			4	1,537	4	1,537
67									10	1,544											10	1,544
68							5	4,402													5	4,402
Totals	401	715	463	765	660	946	424	3,207	353	2,096	497	1,240	433	3,822	632	521	306	191	671	875	4,840	1,366

*See next page, left of map, for description of routes.

TRAFFIC DENSITY, MAXIMUM DAY, WEEK OF JULY 12-18, 1925



Maximum Traffic Day California State Highways Week of July 12th to 18th, 1925

LIST OF ROUTES.

1. San Francisco to Oregon Line near Monumental. 2. San Francisco to San Diego. 3. Sacramento to Oregon Line via Marysville. 4. Sacramento to Los Angeles. 5. Stockton to Santa Cruz via Oakland. 6. Sacramento to Woodland Junction. 7. Tehama Junction to Benicia. 8. Ignacio to Cordelia via Napa. 9. San Fernando to San Bernardino. 10. San Lucas to Sequoia National Park. 11. Sacramento to Nevada Line via Placerville. 12. San Diego to El Centro. 13. Salida to Route 23 at Junction. 14. Albany to Martinez. 15. Route 1 near Calpella to Route 37 near Cisco. 16. Hopland to Lakeport. 17. Roseville to Nevada City. 18. Merced to Route 40 near Sequoia. 19. Route 9 west of Claremont to Riverside. 20. Redding to Route 1 near Arcata via Weaverville. 21. Route 3 near Richvale to Quincy via Feather River. 22. San Juan Bautista to Route 32 via Hollister. 23. Saugus to Route 11 at Alpine Junction. 24. Route 4 near Lodi to Route 23 near Silver Creek. 25. Nevada City to Downieville. 26. San Bernardino to El Centro. 27. El Centro to Yuma. 28. Redding to Nevada Line via Alturas. 29. Red Bluff to Nevada Line near Purdy's. 30. Oroville to Quincy. (Abandoned.) 31. San Bernardino to Nevada Line near Jean. 32. Route 4 near Califa to Route 2 near Gilroy. 33. Route 4 near Bakersfield to Paso Robles. 34. Route 4 near Arno to Route 23 at Pickett's Junction. 35. Peanut to Kuntz. 36. Downieville to Mount Pleasant. 37. Auburn to Nevada Line near Verdi. 38. Myers to Nevada Line via Truckee River. 39. Tahoe City to Nevada Line at Crystal Bay. 40. Route 13 near Montezuma to Route 23 near Mono Lake. 41. General Grant Park to Kings River Canyon. 42. Saratoga Gap near Redwood Park to Bloom's Mill. 43. San Bernardino end County Pavement to Bear Lake. 44. Boulder Creek to Redwood Park. 45. Willows to Route 3 north of Biggs. 46. Route 1 near Klamath River to Route 3 at Klamath River Bridge. 47. Orland to Chico. 48. Route 1 near McDonald's to mouth of Navarro River. 49. Calistoga to Lower Lake. 50. Rumsey to Lower Lake. 51. Santa Rosa to Shellville. 52. Tiburon to Alto. 53. Fairfield to Lodi via Rio Vista. 54. Near Michigan Bar to Central House. 55. San Francisco to Route 5 near Glenwood. 56. Carmel to Cambria. 57. Santa Maria to Freeman via Bakersfield and Walker's Pass. 58. Mojave to the Arizona Line near Topock via Barstow. 59. Lancaster to Bailey's. 60. El Rio to San Juan Capistrano. 61. La Canada to Mount Wilson Road via Arroyo Seco. 62. Azusa to Pine Flats in San Gabriel Canyon. 63. Big Pine to Oasis. 64. Mecca to Blythe. 65. Auburn to Sonora. 66. Manteca to Route 5 near Mossdale School. 67. Pajaro River to Route 2 near San Benito River Bridge. 68. San Francisco to San Jose. 69. San Rafael to San Quentin. 70. Ukiah to Mendocino State Hospital. 71. Oregon Line near Chetco to Crescent City.

columns types of vehicles. At stations where vehicles were too numerous to permit the making of a check mark record, mechanical counters were used for passenger cars, and. for this type, only the total for each hour was entered on the sheet. Trucks, trailers, and busses, however, were recorded by the mark and tally system.

What Traffic Studies Show.

Studies have been made of the 1920 and 1922 censuses, particularly with reference to the hourly variation, the daily variation within the week, and the seasonal variation. In general, traffic between 6 a.m. and 10 p.m. amounts to substantially 92 per cent of the traffic for the twenty-four hours of the day. Sunday counts average about 25 per cent of the traffic for the entire week and Saturday traffic is about 16 per cent. The remaining days of the week are practically uniform. Summer traffic is about twice that of winter.

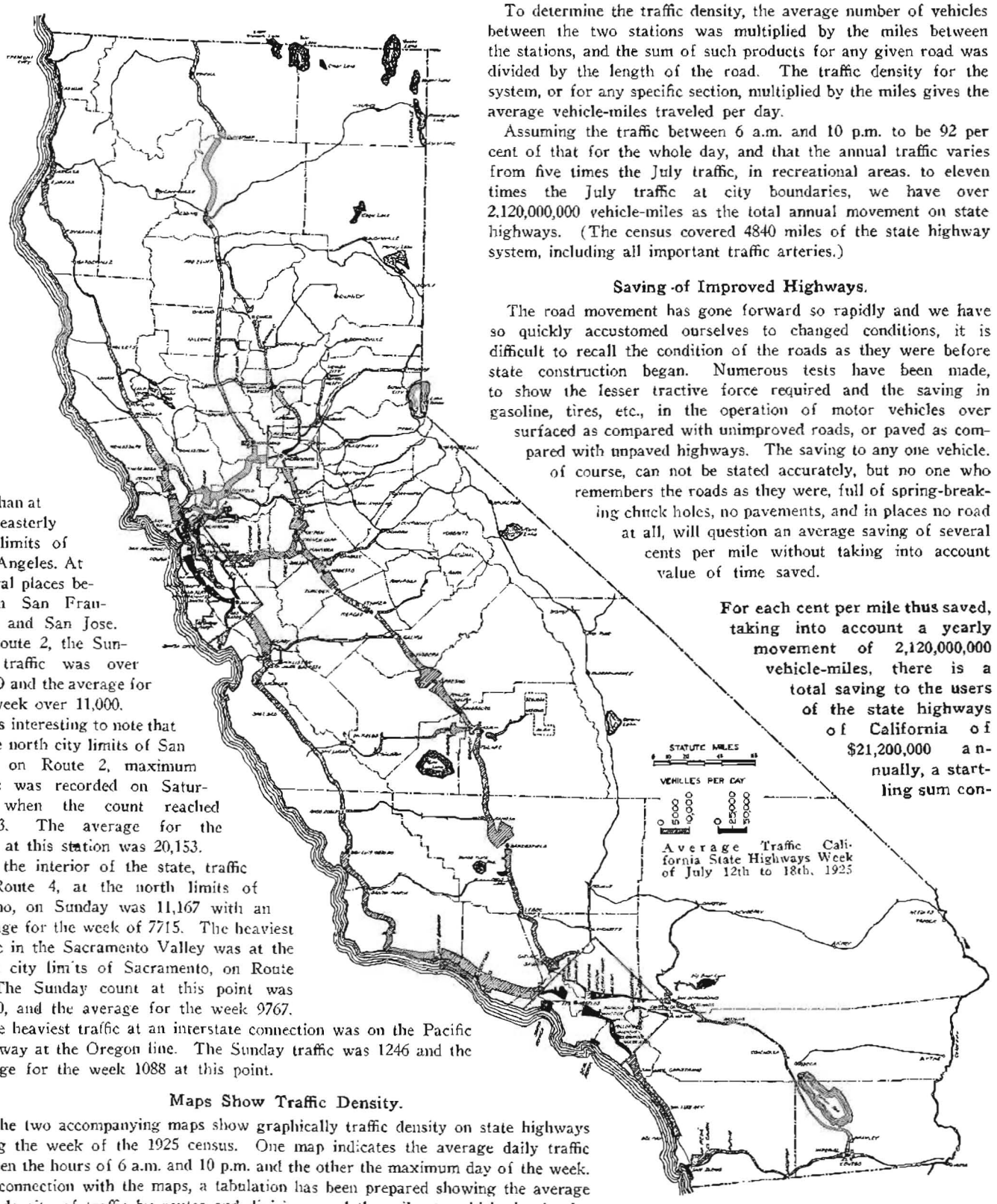
Traffic Increases 93 Per Cent in Four Years.

Applying these factors to the records of the 103 stations which were identical in the counts of 1920, 1922, 1924 and 1925, there is indicated an increase in traffic on state highways in four years of 93 per cent. Growth of traffic has been continuous throughout this period, but the percentage of increase was not as rapid in 1925 as in the earlier years. This information is exceedingly valuable in studying the future of the state highway system, and in the preparation of an equitable maintenance and reconstruction program.

The heaviest traffic anywhere on the state highway system during the period of the 1925 count was at Santa Monica on Route 60. The number of vehicles passing that station on Sunday, July 12th, between the hours of 6 a.m. and 10 p.m., was 25,661, and the average daily count between these hours for the entire week was 17,758. The traffic on Sunday at the easterly city limits of Los Angeles was 23,806, and the average for the week 20,457. West of Hollywood, on Route 2 at its junction with the Lankershim road, the traffic was but slightly

(Continued at left of map, next page.)

AVERAGE TRAFFIC CALIFORNIA HIGHWAYS, 1925 CENSUS



Average Traffic California State Highways Week of July 12th to 18th, 1925

less than at the easterly city limits of Los Angeles. At several places between San Francisco and San Jose. on Route 2, the Sunday traffic was over 22,000 and the average for the week over 11,000.

It is interesting to note that at the north city limits of San Jose, on Route 2, maximum traffic was recorded on Saturday when the count reached 22,623. The average for the week at this station was 20,153.

In the interior of the state, traffic on Route 4, at the north limits of Fresno, on Sunday was 11,167 with an average for the week of 7715. The heaviest traffic in the Sacramento Valley was at the north city limits of Sacramento, on Route 3. The Sunday count at this point was 10,140, and the average for the week 9767.

The heaviest traffic at an interstate connection was on the Pacific Highway at the Oregon line. The Sunday traffic was 1246 and the average for the week 1088 at this point.

Maps Show Traffic Density.

The two accompanying maps show graphically traffic density on state highways during the week of the 1925 census. One map indicates the average daily traffic between the hours of 6 a.m. and 10 p.m. and the other the maximum day of the week.

In connection with the maps, a tabulation has been prepared showing the average daily density of traffic by routes and divisions, and the miles to which the density pertains. In preparing this tabulation, it has been assumed that the increase or decrease in number of vehicles between one station and the next was uniform throughout.

To determine the traffic density, the average number of vehicles between the two stations was multiplied by the miles between the stations, and the sum of such products for any given road was divided by the length of the road. The traffic density for the system, or for any specific section, multiplied by the miles gives the average vehicle-miles traveled per day.

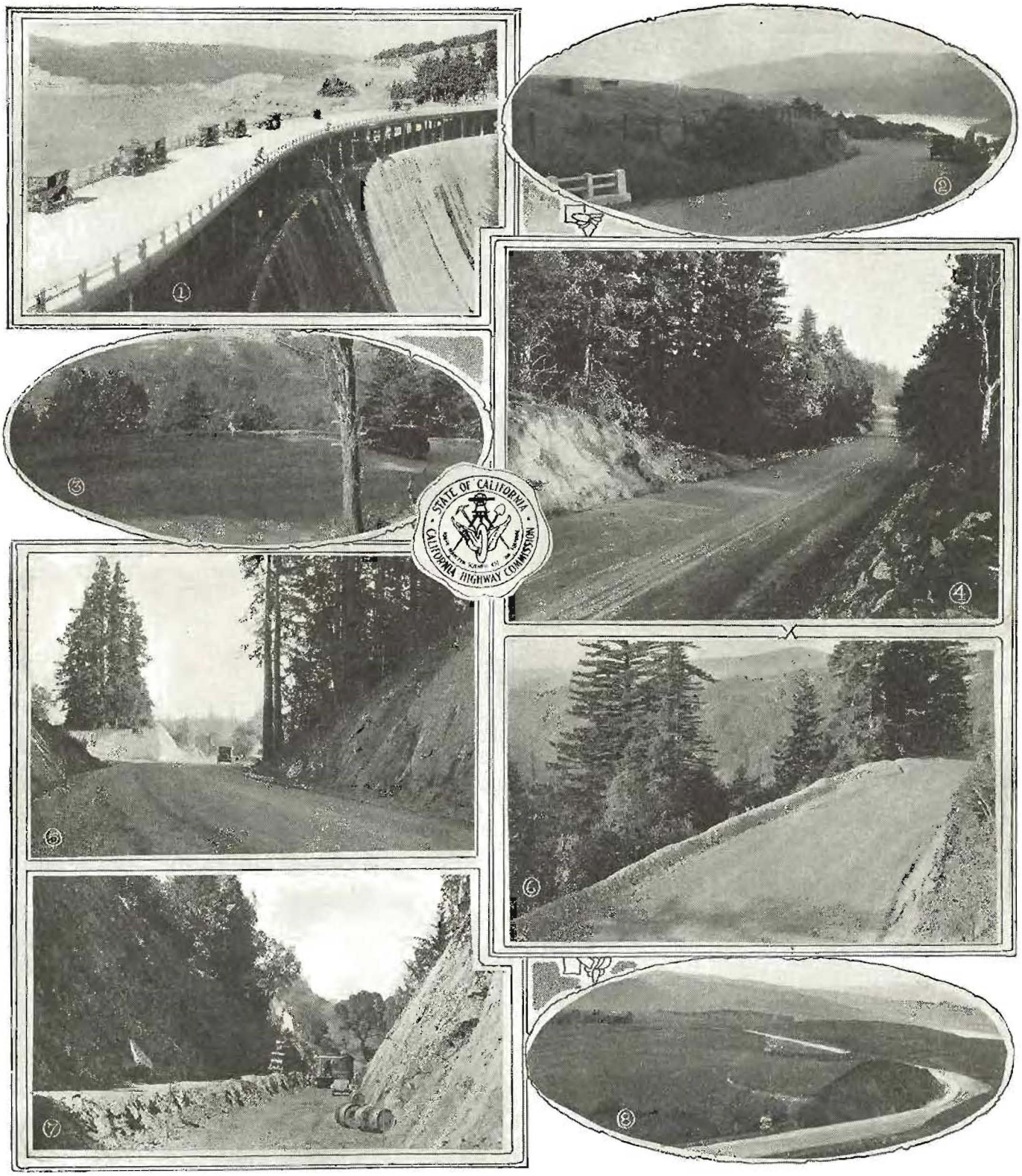
Assuming the traffic between 6 a.m. and 10 p.m. to be 92 per cent of that for the whole day, and that the annual traffic varies from five times the July traffic, in recreational areas. to eleven times the July traffic at city boundaries, we have over 2,120,000,000 vehicle-miles as the total annual movement on state highways. (The census covered 4840 miles of the state highway system, including all important traffic arteries.)

Saving of Improved Highways.

The road movement has gone forward so rapidly and we have so quickly accustomed ourselves to changed conditions, it is difficult to recall the condition of the roads as they were before state construction began. Numerous tests have been made, to show the lesser tractive force required and the saving in gasoline, tires, etc., in the operation of motor vehicles over surfaced as compared with unimproved roads, or paved as compared with unpaved highways. The saving to any one vehicle. of course, can not be stated accurately, but no one who remembers the roads as they were, full of spring-breaking chuck holes, no pavements, and in places no road at all, will question an average saving of several cents per mile without taking into account value of time saved.

For each cent per mile thus saved, taking into account a yearly movement of 2,120,000,000 vehicle-miles, there is a total saving to the users of the state highways of California of $21,200,000 annually, a startling sum considering the state's investment in improved highways to date is only about $100,000,000.

PICTURES CAN ONLY APPROXIMATE BEAUTY OF THE SKYLINE



VIEWS ON THE SKYLINE BOULEVARD DOWN THE SAN FRANCISCO PENINSULA—(1) Bridge across Crystal Spring Dam. (2) Past the Spring Valley lakes. (3) Wide parking places are provided at scenic points. (4) The wide, smooth roadway through a virgin forest. (5) Near the La Honda road. (6) The view toward Half Moon Bay and the Pacific. (7) Construction scene on the recently completed section. (8) The highway in northern San Mateo County. (Photos by A. W. McCurdy.)

NEW SECTION ADDS 12.3 MILES TO SKYLINE BOULEVARD

By A. W. McCurdy, Assistant Division Engineer, San Francisco.

MAKING accessible a district of distinct scenic attractiveness, thirty-three miles of the Skyline boulevard have been graded and surfaced and are now open to travel. Acceptance by the California Highway Commission of the section built under the contract of J. P. Holland has made the La Honda road, in San Mateo County, the present southern terminus of this new state highway down the San Francisco peninsula.

Opening of the La Honda connection has created much interest among residents of San Francisco, San Mateo, Santa Clara, and Santa Cruz counties for the reason that, while incomplete, the boulevard is now available as an alternate route into San Francisco. Congestion on the present Peninsula highway has made additional highways highly desirable.

The completed section of the Skyline route now extends from the intersection of the Great highway and Sloat boulevard, in San Francisco, along the low hills that border Merced Lake, southward into San Mateo County. It passes along the ridge forming the eastern watershed of the Spring Valley lakes, providing a magnificent panorama of ocean and bay, and of the city of San Francisco.

A feature of the location is the spectacular crossing of the massive concrete dam at the outlet of Crystal Lake. A reinforced concrete bridge was built across the crest of this dam, unique in design, because the approaches, in each direction, are the reverse of the arc of the dam. Three sweeping curves were necessary in the bridge in a total length of 608 feet. The width is thirty feet.

Forested Area Attractive.

From the bridge the highway ascends Half Moon Bay hill and from there to the La Honda summit passes through a section of unusual beauty. The natural forestation includes madrone, pine, oak, and magnificent redwood. At an elevation of 2000 feet there is an inspiring view of the ocean to the westward, with beautiful rolling hills in the foreground. To the east, may be seen lower San Francisco Bay and the cities of upper Santa Clara Valley.

Farther south, the highway climbs to a maximum altitude of 2342 feet passing through a heavily timbered area where redwood predominates. It is hard to believe this virgin wilderness, prior to the coming of the road accessible only on foot or horseback, is but twenty-five miles from San Francisco. The boulevard continues through a region of interesting topography which recalls the higher mountains and the Humboldt coast as one beautiful view follows another.

A wider road bed with extra parking space has been provided at points of particular interest.

The Skyline boulevard, designated as Route 55, was added to the state highway system by the bond issue of 1919. Its importance as a possible future traffic outlet for San Francisco was recognized and, in 1922, it was included as a secondary road in the federal aid system. The time undoubtedly will come when it will carry a considerable part of the peninsula traffic.

Four Contracts Completed.

To date, four Skyline contracts, the last of which was extended to provide a connection with a paved cross county road to better serve traffic, have been completed and accepted by the commission, as follows:

P. L. Burr, of San Francisco, grading and surfacing 7.42 miles, forty and thirty feet in width; awarded in January, 1922; accepted in October, 1923; 185,000 cubic yards of excavation; cost $252,000.

P. L. Burr, of San Francisco, grading and surfacing 13.42 miles; width of roadway thirty feet; awarded November, 1922; completed January, 1924; 316,000 yards of excavation; cost $426,000.

J. H. Shepherd, of Stockton, construction of the Crystal Springs Dam bridge; awarded, July, 1923; accepted January, 1924; cost $52.000.

J. P. Holland, of San Francisco, grading and surfacing 6.4 miles; (original contract) awarded March, 1924. Extension 5.94 miles, granted June, 1924; contract accepted November, 1925; total yardage moved 600,000; total cost $541,000.

The total expended on the route to date is approximately $1,300,000. One contract for placing guard rail is now under way.

Modern Machinery Used.

The Holland contract, recently accepted, had many interesting features, not the least of which were the dispatch and efficiency with which the work was conducted. Automotive and steam equipment was used throughout, as high as five power shovels operating at one time. During one period of two weeks, 42,202 cubic yards of material were moved and placed in embankment. The maximum number of men employed was 106, and the thorough organization of the crew was evident at all times.

Joint District Aids Project.

Progress in the building of the Skyline has been materially aided by Joint Highway District No. 1, composed of San Francisco, San Mateo, Santa Clara, and Santa Cruz counties. This district has procured and deeded to the state rights of way and also has borne the expense of necessary fencing.

High standards have been adhered to on all completed sections. Between Sloat boulevard and the La Honda road, there are only four curves with a radius of less than 200 feet, and in most instances much wider curves have been used to permit the longest possible vision of the road ahead. The maximum grade is slightly in excess of 6 per cent; most of it is much less. Near San Francisco the grade has a width of forty feet. The minimum is thirty feet.

The crushed rock surfacing is kept smooth by constant maintenance. A heavy guard rail is being erected at various points along the route for protection of motorists during foggy weather.

The route has been surveyed for its entire length to Woodwardia, a distance of 28.8 miles beyond the La Honda road. Plans have been completed for the section from the La Honda road to Saratoga Gap, 13.9 miles, and are partially completed for the remaining 14.9 miles.

Maintenance Planned.

At Woodwardia, the Skyline connects with the Los Gatos-Santa Cruz state highway and also with the county road to Santa Cruz via Soquel. Traversable sections between La Honda road and Woodwardia will be taken over for maintenance on January 1st.

HIGHWAY LIGHTING DEMONSTRATED.

A demonstration of highway lighting was conducted by the Westinghouse Electric Company on the Peninsula Highway during the recent Western Road Show in San Francisco. With the cooperation of the Pacific Gas and Electric Company, sixteen highway lighting units were placed along the highway in the vicinity of San Bruno.

"Nora, you were entertaining a man in the kitchen last night, were you not?"

"That's for him to say, ma'am. I did my best."—*O. B. Bulletin.*

CONTROL OF CONCRETE—FIELD TESTS AND COMPUTATIONS—CONSTRUCTION DEPARTMENT STANDARDS

By C. S. Pope, Construction Engineer, and C. L. McKesson, Materials and Research Engineer.

PROMPTED by many requests from within and without the State Highway organization, the Construction Department has decided to publish, in the Bulletin, the department's instructions for the control of concrete mixtures. These instructions are known as "Construction Department Standards," and apply only to work coming directly under the department's supervision.

The instructions are included within each pad of the construction department's standards. Form R-16 Revised, Daily Report of Concrete Construction, where they may be readily referred to by engineers on the job.

The instructions are as follows:

1. Read carefully Section III of the Manual of Instructions of the Construction Department.

2. The following field testing equipment will be necessary and will be furnished by the Laboratory on requisition:

1 set of 8" Tyler standard sieves of the following mesh sizes: No. 3, No. 10, No. 20, No. 30, No. 40, No. 80, No. 200 and pan.

Plate screens, 16" square, punched with round openings of the following sizes: 2½", 2", 1½", ¾" and ½".

1 quartering canvas, 18" x 24," for sampling rock and sand for sieving.

1 percentage scale weighing to five pounds, Fairbanks-Morse No. 485 recommended.

A 50-foot metallic tape.

A 2-foot rule.

A supply of report forms, R-16. Revised.

NOTE.—In addition to the equipment listed above, each resident engineer should have one platform scale weighing to 150 pounds or an accurate spring balance having a capacity of at least 50 pounds.

3. The resident engineer should secure or construct quarters adjacent to bins or material storage in which field testing can be carried on and in which equipment will be properly cared for. It should include a work table and shelves or racks upon which equipment can be stored. Some additional equipment which may be obtained locally will be found desirable. This will include a dozen tin bake pans about 10 x 12 inches, a sheet of galvanized iron about 3' x 10', on which aggregates may be dried, a galvanized bucket, and a one cubic-foot measuring box.

Sieve test for sand.

Ascertain source of sand and check up laboratory reports to determine whether sand has been *approved for use*. Secure 25-pound average sample of sand by digging into stock piles at various places. If a sampling tube is used, a smaller sample will be satisfactory. Quarter sample down to about one-fourth and weigh out exactly five pounds. Dry separately in pans or on galvanized iron sheet. Weigh after drying and determine percentage of water in sand.

$$\text{Water content } (\%) = \frac{\text{Wet weight—Dry weight}}{\text{Dry Weight}} \times 100 \quad (1)$$

Add enough dry sand to bring sample up to five pounds and sieve first through a No. 3 sieve, then in succession through finer sieves and record as follows:

Sieve Analysis	Total per cent retained (Cumulative)	Per cent passing (= 100% — Per cent retained)
No. 3 Sieve		
No. 10 Sieve		
No. 20 Sieve		
No. 30 Sieve		
No. 40 Sieve		
No. 80 Sieve		
No. 200 Sieve		

(2)

(Five-pound Fairbanks scales No. 485 give percentages passing by direct reading.)

Compare the sieve test results with the grading specifications for fine aggregate, and, if corrections are necessary, promptly notify the contractor in order that same may be made.

Swell of sand due to moisture content.

Measure exactly one cubic foot of sand from stock piles without drying, dumping sand loosely in measuring box from a shovel held just above the edge of the box. Before moving the box, strike off with a straightedge. Weigh wet sand. Dry this sand on galvanized iron sheet and weigh carefully. Replace sand in measuring box loosely as above described. Add enough sand which has been dried separately to fill measuring box and strike. Weigh sand in box. Per cent swell of sand due to moisture will be calculated as follows:

(a) Weight of cubic foot moist sand (as received)_____
(b) Weight of same sand after drying _____
(c) Weight of one cubic foot dry sand _____

Referring to weights by reference characters: % Swell of sand due to moisture $= \frac{c-b}{c} \times 100.$ (3)

Caution—After filling measuring box with loose sand, any movement of the box or jarring will lower surface of sand. *Do not refill* before weighing.

Sieve analysis of coarse aggregate.

In order to insure uniformity in concrete, it is usually specified that coarse aggregate shall be furnished in two sizes to be kept in separate stock piles. In such cases, both sizes of aggregate shall be sampled and sieve analyses made as described for sand except that much larger samples shall be tested. One hundred pound samples should be tested when possible, and twenty-five pounds shall be the minimum size of coarse aggregate samples.

After making sieve analysis of both sizes of coarse aggregate, determine the proportionate quantities which will most nearly give the combined grading specified for coarse aggregate. Make a combined sample, 300 to 500 pounds, in the proportions believed to be correct. Mix thoroughly and quarter down to one cubic foot. Then make moisture and void determinations of the combined sample as hereinafter described and after this, a screen analysis on the same combined coarse aggregate sample.

Coarse aggregate segregates readily in handling, and when it is supplied in one size, great care should be taken to see that every sample screened is typical of the material to be used.

Combined Mixture.

The combined mixture should be computed from the fine and coarse aggregate sievings. The data noted in the combined mix column shall be the typical mix run during the day. Sieve results need not be tabulated closer than one-half per cent.

Moisture content of coarse aggregate.

Determine as for sand except that this determination is best made on a large sample, 25 to 100 pounds.

Information regarding moisture content in the sand and coarse aggregate should be sent immediately to the assistant at mixer in order that the water per batch may be adjusted accordingly.

Void determinations.

The purpose of screen analysis is primarily to determine whether material conforms to a predetermined grading which is known to be associated with a low percentage of voids. The yield of concrete is largely dependent upon percentage of voids in aggregate, therefore voids shall be determined in the field.

To make this test, it is necessary that you know the specific gravity of the material. This will be shown on the material test report, but in case your record does not show it, wire or write the laboratory for the information. With specific gravity of aggregate known, proceed as follows:

(e)=Weight of one cubic foot loose measure of dry sand or coarse aggregate.

(f)=62.4 X specific gravity of material.
Apparent volume is volume measured dry and loose.

$$\text{Absolute volume} = \frac{e}{f} \times \text{apparent volume.} \quad (4)$$

$$\text{Voids} = \text{apparent volume—absolute volume.} \quad (5)$$

$$\%\ \text{Voids} = \frac{\text{Voids in cubic feet}}{\text{Apparent volume in cubic feet}} \times 100 \quad (6)$$

Design of concrete mixtures.

The more important considerations entering into the design of concrete mixtures are:

Workability	Uniformity
Strength	Economical use of Cement
Density	

In our specifications the amount of cement for Class "A" concrete is fixed at six sacks per cubic yard. In order to secure maximum strength, density and reasonable workability, the grading of coarse and fine aggregate should be that which, within specification limits, will give the lowest percentages of voids.

The amount of fine aggregate should be kept at the minimum which will provide sufficient mortar to fill all voids in coarse aggregate and which will provide the small surplus necessary for finishing. With ordinary coarse aggregate, the amount of sand required will be about 20 per cent more than enough to fill the voids in the coarse aggregate.

Concrete consists of cement, sand and rock particles with voids or interstices between the particles filled with water or air.

This may be expressed in the following formula:

$$\text{Volume of concrete} = C+S+R+V \text{ and} \quad (7)$$

$$\text{Volume of concrete} - V = C+S+R \quad (8)$$

In this formula, V is the space occupied by water and air, usually referred to as "voids." C is the "*absolute volume*" of cement the voids all being included in V. S and R refer, respectively, to *absolute volumes* of sand and rock. This formula for *absolute volumes* has been mathematically derived from a consideration of *apparent volumes* or volumes as they appear when measured, and may be accepted as correct.

Yield of concrete.

The combined volume C+S+R in Formula (8) has been found by experience to be about .82 of the volume of the concrete. This factor may vary slightly with the *complaisance* of materials which is their faculty of fitting together in a dense mass. In general, it may be accepted as covering average laboratory conditions. For convenience, this ratio of the combined value of C+S+R to the volume of concrete has been termed the "coefficient" of yield and may be expressed as follows:

$$\text{"Coeff."} = \frac{C+S+R}{\text{Vol. of Conc.}} \quad (9)$$

and by transposing, we have the "yield," or volume, of concrete as follows:

$$\text{Volume of concrete} = \frac{C+S+R}{\text{Coeff.}} \quad (10)$$

In field work there are losses due to low subgrade, spreading forms, etc., and from experience, it has been found that the following values should be assumed:

For concrete paving Coeff. = .88
Concrete in forms Coeff. = .85

These values may require slight adjustment from time to time due to difference in *complaisance* or other conditions. The yield should be checked carefully and adjustments made when necessary to keep the yield at exactly one cubic yard for each six sacks of cement.

Cement usually contains slightly less than 55 per cent voids, but for convenience the voids may be assumed to be 55 per cent. Voids in sand and coarse aggregate are to be determined as above. Following is an example of method of calculating yield:

Assumed mixture.

	Cu. ft. absolute volume
1 cubic foot (apparent volume) cement =	0.45
1.73 cubic feet (apparent volume) sand (voids 34%) = 1.73 X .66 =	1.14
3.82 cubic feet (apparent volume) coarse aggregate (voids 38%) = 3.82 X .62 =	2.37
Total absolute volume	3.96

$$\text{Cubic feet concrete per sack of cement} = \frac{3.96}{.88} = 4.50$$

Yield for six sacks = 4.50 X 6 = 27.00 cubic feet

These apparent volumes are *dry loose* measure. If material is measured wet, allowance in measuring must be made for swell.

In measuring batch boxes to set a mix, measure the sand as it comes from stock pile, but always correct for swell due to moisture content and in reports give cubic feet of both dry and wet material.

The following table gives yield of concrete with various percentages of voids in aggregate. The coefficient .88 is sufficiently high to provide concrete to fill irregularities in carefully constructed subgrade which has been struck to *full* depth with a template.

Where concrete is placed in forms and no extra volume need be provided for, the coefficient .88 may be reduced to .85.

After the mix is set in this manner, a careful check of cement and of the actual yield may sometimes require slight readjustment of the mix. Variations in voids in either sand or gravel will be immediately reflected by increasing or diminishing the yield of concrete.

Void determinations shall be made daily or more often if material shows variation.

CONCRETE PROPORTIONS.

Six sacks per cubic yard.

Sand* Voids	Rock Voids. 35%	36%	37%	38%	39%
32	1-1.56-3.77	1-1.59-3.80	1-1.63-3.81	1-1.72-3.77	1-1.78-3.77
33	1-1.57-3.78	1-1.60-3.81	1-1.63-3.82	1-1.69-3.84	1-1.76-3.79
34	1-1.61-3.77	1-1.64-3.80	1-1.68-3.81	1-1.73-3.82	1-1.77-3.84
35	1-1.63-3.77	1-1.64-3.80	1-1.69-3.82	1-1.75-3.83	1-1.80-3.84
36	1-1.63-3.80	1-1.67-3.81	1-1.72-3.83	1-1.78 3.84	1-1.81 3.85
37	1-1.65-3.80	1-1.68-3.83	1-1.71-3.86	1-1.78-3.86	1-1.82-3.87
38	1-1.68-3.80	1-1.71-3.83	1-1.74-3.86	1-1.79 3.87	1-1.84-3.89
39	1-1.69-3.82	1-1.74-3.83	1-1.79-3.84	1-1.80-3.86	1-1.85-3.90
40	1-1.70-3.83	1-1.75-3.85	1-1.80-3.86	1-1.83-3.86	1-1.88-3.90
	40%	41%	42%	43%	44%
32	1-1.82-3.78	1-1.87-3.80	1-1.90-3.80	1-1.94-3.84	1-1.97-3.88
33	1-1.82-3.82	1-1.87 3.83	1-1.91-3.84	1-1.94-3.88	1-1.97-3.91
34	1-1.83-3.83	1-1.88-3.85	1-1.92-3.86	1-1.96-3.90	1-1.98-3.93
35	1-1.84-3.85	1-1.88-3.88	1-1.89-3.93	1-1.92-3.96	1-1.98-3.97
36	1-1.86-3.87	1-1.91-3.88	1-1.95-3.90	1-1.97-3.95	1-2-3.98
37	1-1.87-3.89	1-1.94-3.88	1-1.97-3.92	1-1.98-3.97	1-2-4
38	1-1.89-3.90	1-1.95-3.90	1-1.98-3.93	1-2-3.98	1-2-4
39	1-1.90-3.92	1-1.95-3.93	1-1.98-3.97	1-2-4	1-2-4
40	1-1.92-3.93	1-1.95-3.97	1-2-3.98	1-2-4	1-2-4

*Voids in loose material.

The foregoing instructions are based on a few simple, common sense rules, the correctness of which has been proved in actual practice. Since their adoption as a standard, the average strength of the state's concrete pavements has been increased from approximately 2500 pounds per square inch, at 28 days, to about 4000 pounds per square inch. In practical effect, if computed according to Older's Corner Break Formula, this is equivalent to thickening the edge of the pavement about 26 per cent without adding any material or incurring additional expense.

The Construction Department, therefore, has ample reason to believe that the system of control installed under its direction is a success, and that the new concrete pavements on California state highways, as a whole, will compare favorably with similar work elsewhere.

NOVEL PLAN FOR CHECKING SLOPES.

BECAUSE of the many and various materials encountered in excavation, and a limited width of right of way on the new Coast Highway through the Malibu Ranch, it has been necessary to employ numerous slope angles for cut banks, ranging from ¾ to 1, to 1½ to 1, reports Division VII.

In checking the various slopes, a 5-foot straightedge is employed with cleats attached at the proper angle. They are arranged in such a way that when a cleat is held horizontal as shown by an attached level, the straightedge is on the proper slope.

The straightedge is provided with six cleats on each side and can be used to measure the angle of twelve different slopes.

WHAT THE DIVISIONS ARE DOING

DIVISION I.

HEADQUARTERS, WILLITS.

T. A. BEDFORD, DIVISION ENGINEER.

Counties of Del Norte, Humboldt, Mendocino, and Lake.

WHILE not in charge of the work, Division I is directly affected by the opening of the Forest highway over Oregon Mountain on the Grants Pass-Crescent City connection. Steam shovels "broke through" during November and recently the highway was opened to traffic by the Bureau of Public Roads. The narrow and dangerous county road is now eliminated, facilitating traffic over the Oregon section of the Redwood Highway.

The San Quentin Prison Camp working in the Smith River canyon has about completed the grading eastward to Adams Station, the beginning of the Forest highway contract. Clearing and trail gangs already have started work west of Myrtle Creek, in the direction of Crescent City. This will be the next section to be built by this camp.

Improve Maintenance Station.

Improvement of the new maintenance station at Fortuna has been begun with the building of a truck shed and erection of fencing. Protection of equipment used in the vicinity during rainy weather is imperative. Foreman H. L. Harmon is in charge of this section.

The Butterfield-Sears Company, contractors on the widening and straightening project at Leggett Valley, fifty miles north of Willits, on the Redwood Highway, have practically completed their six-mile project and are moving out the equipment which has been in service there. One power shovel is being held to remove slides during the winter and to prepare for surfacing operations next spring.

DIVISION II.

HEADQUARTERS, REDDING.

H. S. COMLY, DIVISION ENGINEER.

Counties of Siskiyou, Modoc, Trinity, Shasta, Lassen, Tehama, and northern Plumas.

COMPLETING a continuous pavement down the west side of the Sacramento Valley from Red Bluff to Davis, the new state highway through the town of Corning has been finished and opened to traffic. Through the business section of the city the street is paved for its full width, and for the remainder of the 1.5 miles, twenty feet wide. It is of the cement concrete type. The state and the municipality of Corning cooperated in financing the project. Polk and Polk of Chico were the contractors.

DIVISION III.

HEADQUARTERS, SACRAMENTO.

F. W. HASELWOOD, ACTING DIVISION ENGINEER.

Counties of Butte, Colusa, El Dorado, Glenn, Nevada, Placer, southern Plumas, Sierra, Sutter, Yuba, and northern Sacramento and Yolo.

ON DECEMBER 15th, traffic began passing over the new pavement between the American River bridge and North Sacramento, placing in use the new subways and eliminating two grade crossings. This section has the heaviest travel of any in Division III. The new pavement is of cement concrete, thirty feet in width and seven inches thick. Minor details will require about thirty days for completion.

A new power shovel shortly will be added to the equipment of the Nevada Contracting Company, contractors on the grading project between Floriston and the Nevada line. Progress to date has been slow due to breakdown of equipment and bad weather.

The Irey and Holden contract for 5.8 miles of grading and surfacing east of Placerville on the Lake Tahoe route is scheduled for completion early in January. The work has been finished with the exception of a rocky cut 1000 feet in length.

Driving of piles for the construction of three timber trestles bridges on lateral roads east of Willows and west of Chico has been completed. Opening of the bridges will greatly facilitate winter travel.

Maintenance Importance Increases.

The first foreman's cottage to be erected in Division III will be located on the recently acquired maintenance station site in Marysville. It will be occupied by Foreman J. E. Stevens who will be moved from Wheatland. The Marysville yard soon will be an important station when additional state routes are taken over for maintenance on January 1st.

A storage shed for equipment is being erected at the Arbuckle maintenance station on the west side highway.

Improvements authorized for the new station at Colfax, Placer County, include a storage shed 30 x 100 feet; sleeping quarters for eight men, kitchen-dining room, and living room.

Surveys have been made for the extension of the state highway through the town of Truckee via Birkhalter street.

Prior to the closing of the road by snow, Bishop and Brooks completed their surfacing contract between Tahoe City and the Nevada line, 11.6 miles along the north shore of Lake Tahoe. Slowly the highway about the lake is being improved on up-to-date standards.

The new storage shed at Truckee has been completed and all equipment safely housed for the winter. The building on the new maintenance site is 30 by 80 feet.

DIVISION IV.

HEADQUARTERS, SAN FRANCISCO.

JOHN H. SKEGGS, DIVISION ENGINEER.

Counties of San Francisco, Marin, Sonoma, Napa, Contra Costa, Alameda, Santa Clara, Santa Cruz, and San Mateo.

PLACING of cement concrete shoulders on either side of the existing pavement on the Peninsula highway has been completed by the Federal Paving Company, and placing of quarry waste rock shoulders to widen the roadway to fifty feet is now in progress. Culverts also are being extended. Inclement weather

(Continued on next page.)

PAVEMENT STRENGTH INCREASED

(Continued from page 3.)

tent it has been found feasible to increase the amount of very fine stone dust in the mixture apparently with beneficial results.

Experiments have demonstrated that the slipperiness of asphaltic concrete pavements is reduced by the omission of the flush coat and this has been omitted on asphalt pavements laid during the last two seasons.

DIVISION REPORTS

(Continued from page 12.)

has delayed resurfacing of the old pavement between the new shoulders, which will be done with asphalt concrete.

Widening Achieved.

The widening work accomplished in Contra Costa County, on the trunk highway leading to the site of the new Carquinez Straits bridge, is attracting much attention as the project nears completion. The old fifteen-foot concrete pavement has been widened to thirty feet with asphalt macadam shoulders and similar surfacing has been applied to the old pavement where necessary.

Alignment has been improved and the flow of traffic over this section facilitated. Vertical curves on a 6 per cent grade have been lengthened from 200 feet to 600 feet, greatly improving sight distance.

Considering the cost of the work, it may be considered an outstanding achievement in highway widening.

Considerable oiling of shoulders, ditching, and grading work remains to be done, but practically all of the new roadway is open to traffic.

Overflow of adjacent lands due to extreme high tides along the Bayshore highway has been averted by the early completion of bridges and tide gates. Contractor D. A. Foley is rapidly finishing the project.

New Guard Rail on Skyline.

The new guard rail which is being erected at various places along the Skyline boulevard by S. A. Martindale is already noticeable. This improvement will define the limits of the traveled roadway during heavy fogs and at night.

Use of detour roads has been eliminated on the Redwood highway between Santa Rosa and Healdsburg, where Contractor J. V. Galbraith is completing the last mile of the second half of the twenty-foot "second-story" concrete pavement. Traffic is now being handled on the half of the pavement first completed. This important reconstruction project is now scheduled for early completion.

DIVISION VI.

HEADQUARTERS, FRESNO.

J. B. WOODSON, DIVISION ENGINEER.

Counties of Fresno, Madera, Merced, Mariposa, Kings, Tulare, and Kern, north of the Tehachapi.

APPROXIMATELY 400 prisoners and five power shovels are now rushing the Merced Canyon project connecting with the Yosemite National Park, and opening of the highway to traffic early next summer is assured. Moving of the Folsom camp from the Kern River Canyon east of Bakersfield to its new location near El Portal was completed during the month under the direction of Superintendent Ralph W. Brown.

Widening of the state highway between Buhach and the Merced River has been completed by Contractor H. H. Peterson, who has moved his equipment and crew to Ventura, where he will begin a similar contract in Division VII.

The Warren Construction Company is surfacing with asphalt a section of the trunk highway through the town of Delano, Kern County.

Stewart and Bland, Fresno contractors, have a power shovel at work on the Sequoia Park entrance improving the alignment in anticipation of heavy traffic over this road next summer.

With the exception of the convict jobs, all of the work under way in the division is classed as reconstruction.

DIVISION VII.

HEADQUARTERS, LOS ANGELES.

S. V. CORTELYOU, DIVISION ENGINEER.

Counties of Los Angeles, Ventura, Orange, San Diego, and eastern Kern, south of Mojave.

WITH the completion of 5.6 miles of "second-story" concrete pavement between San Juan and Galivan, all of the old fifteen-foot pavement in Orange County has been eliminated. The new twenty-foot pavement with rock borders is a great improvement over the old highway.

Reconstruction work is progressing rapidly on the Whittier boulevard and the new pavement is now open to traffic from Montebello to the Workman Mills road. Placing of concrete on the Philadelphia street extension, near Whittier, is under way.

Line Change Nearly Ready.

Placing of pavement on the San Onofre-San Mateo Creek line change has been completed and the rock surfacing of the long fill at the approach to the San Mateo Creek bridge is now under way. When open to traffic the new section will eliminate nearly a mile of distance and many curves, where numerous fatal accidents have occurred.

Two power shovels are now at work improving the alignment of the Mountain Springs grade east of San Diego, in San Diego and Imperial counties. Traffic is being handled over this section without difficulty.

The fill which will replace the old timber structure is nearing completion on the "Middle Causeway" on the Coast route, in Ventura County. Drainage structures included in the contract already have been finished.

Grading has been started at the southerly end of the Laguna-Serra project on the South Coast highway in Orange County and has progressed as far as Salt Creek, where it was found necessary to drive piles for the foundation of a twelve-foot arch culvert.

DIVISION IX.

HEADQUARTERS, BISHOP.

F. G. SOMNER, DIVISION ENGINEER.

Counties of Inyo, Mono, and eastern Kern County, north of Mojave.

THE surfacing of 7.5 miles between the Devil's Punch Bowl and Rush Creek, in Mono County, has been completed and a greatly improved highway is the result. George A. Clarge was the contractor.

Contractor Harry Wilson already is at work on the grading of 36.7 miles of the east of the Sierra trunk highway in Inyo and Kern counties. Rapid progress is reported on this contract which was recently awarded by the commission.

A forty-foot roadway is being graded between Mojave and the San Bernardino County line, a distance of 31.5 miles, by Supervisor J. I. Wagy of Kern County. The improvement is being made on the state survey. The new road will be taken over for maintenance on January 1st.

DIVISION X.

HEADQUARTERS, SACRAMENTO.

J. C. McLEOD, DIVISION ENGINEER.

Counties of Amador, Calaveras, Alpine, Tuolumne, Stanislaus, San Joaquin, Solano, and southern Sacramento and Yolo counties.

DIVISION X is gratified to announce that the state's part of the improvement of the southern entrance to Sacramento, on the Stockton boulevard, has been completed and opened to traffic.

(Continued on next page.)

DIVISION REPORTS

(Continued from page 13.)

In cooperation with the Central California Traction Company, a thirty-three foot pavement has been placed for a distance of one-half mile. A. Wallace was resident engineer.

The extension of the J. F. Knapp contract for the pavement of 2800 additional lineal feet through the town of Manteca, San Joaquin County, has been completed and good progress is being made by the city on its part of the project for the paving of the street full width. The state paved a twenty-foot strip in the center of the street.

Amador County Cooperates.

R. N. Murdoch has completed the grading of the Central House-Drytown section of the state highway. in Amador County, and the county is now surfacing the roadway with crushed rock.

Additional culverts have been placed on the Michigan Bar-Drytown section and also on the state highway between Ione and Jackson, in Amador County. The maintenance department expects to thus eliminate future drainage troubles.

Improvements have been authorized on the Stephens Bar bridge on the Big Oak Flat road in Tuolumne County.

AN ODE TO THE TESTING ENGINEER

There is one guy around in whom vices abound
Who turns all of our joy into ashes.
He sits in his den with a virulent pen
But instead of cuss words, he'll use dashes.
We send in our dope with a prayer and a hope
And make out the forms with precision;
Then meekly we wait till some far distant date
For this bird to hand out a decision.
We chop out a sheet of asphaltic concrete
That will last while the mountains abide
And he yells "It's too light and the dust isn't right"
For he revels in Tetrachloride.
We put down a street of enduring concrete
And as soon as its beauty he sees
With a calyx core drill he knocks holes in it till
It looks like an aged Swiss cheese.
And he ain't any saint when we send in some paint
With which we smear guard rails each season.
"Saponification!" He cries with elation
You're shy of zinc oxide and resin.
But some day I'll go out with some concrete so stout
It'll make all his henchmen look silly
That his doggoned old jack won't be able to crack,
Then I'll lie down and call for a lily.—With apologies from W. K. Wright.

FESTIVITIES OPEN KERN HIGHWAY

UNDER the direction of Bakersfield civic organizations, the new Kern River Canyon highway, connecting Bakersfield and Democrat Springs, Division VI, was dedicated and opened to traffic on December 20th. The 7.5 miles at the eastern end of this project were completed with convict labor. Previously, approximately 7.5 miles were built under contract, and 10 miles, immediately east of Bakersfield, were graded by the county, which also has improved a 17-mile section east of Democrat Springs. The entire highway, including the Walker Pass section, will come under state maintenance on January 1st.

State expenditures to date on this route have totaled about $1,000,000. The highway, known as the Walker Pass route, was added to the state system by the 1919 bond issue.

Rastus: "Boy, it was so cold whar I cum frum we used to frow water out de window and slide down on the icicle."

Mose: "You all talk nuff'ns. Whar I lib, it's so cold we gotter build fiahs under de cows to keep em fum givin' ice cream."

BRIDGE MANUAL COMMENDED

A NUMBER of letters have been received at headquarters commending the bridge department manual, which was recently issued in printed form for use of engineers in the field. The bridge department was particularly pleased with the letter which follows from one of the largest engineering firms in the country:

HARRINGTON, HOWARD AND ASH,
Consulting Engineers,
Kansas City, Mo.

California Highway Commission,
Bridge Department,
Sacramento, Calif.

Attention Mr. Harlan D. Miller.

Dear Mr. Miller:

We are just in receipt of your Manual of Instructions of the Bridge Department, California Highway Commission. Although I have been able to look it over only hastily, I am much impressed by its merit and wish to offer you my congratulations on its production. Such manuals certainly represent steps forward in the engineering profession. I am very grateful to you for sending us this copy, and remain

Very sincerely yours,

HARRINGTON, HOWARD AND ASH,
By (Signed) E. E. HOWARD.

UNDER PASS AUTHORIZED

THE CONSTRUCTION of an under pass under the tracks of the Southern Pacific railroad on the Bay Shore highway at South San Francisco has been authorized by the State Railroad Commission. The division of cost included in the commission's order is as follows:

State of California, 57.5 per cent; South San Francisco belt railroad, 4.5 per cent: Southern Pacific Company, 38 per cent.

The Southern Pacific Company has filed a petition for a rehearing of the commission's decision, protesting the percentage of cost of the grade separation to be borne by that company.

NOT A GOOD PREMISE

(Los Angeles Daily News)

TAKING the wind out of our winding state highways is objected to by the California Outdoor Art League on the grounds that it will be a destruction of the picturesque in scenery.

Every sympathy and aid should be extended to any group of people engaged in defending the crude and crass attempts of modern materialism to destroy natural beauty. But this move we find to be inadvisable, especially in that the straightening of state roads will probably not bring disenchantment to any appreciable degree. Too many curves are death curves, where lives of whole families are sometimes snuffed out. And, too, the straight line has its beauty in which the driver of the car can share, which is something he can not do when he must continually negotiate hairpin turns.

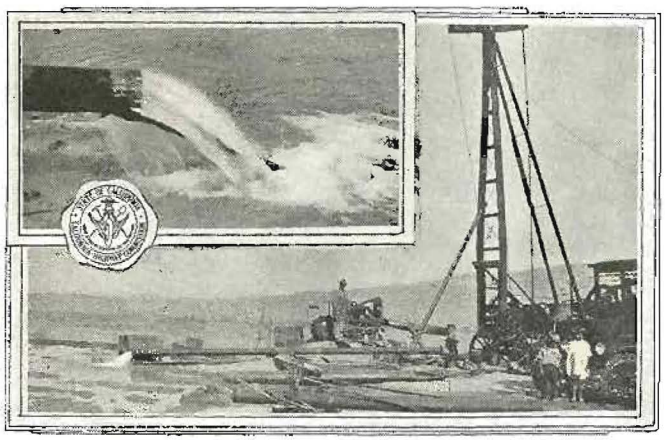
A maintenance superintendent in Division IV tells a story of a woman walking on some newly constructed shoulders. Two automobiles were approaching and as they passed Mrs. X, one had to swing over on the shoulder, a little. She addressed the driver in a rather loud tone of voice:

"What's the big idea of driving on the sidewalk—this was made to walk on."

The superintendent couldn't help laughing at the thought the shoulders were put there only for pedestrians.

Do You Know One?

Any girl can be gay in a nice coupe;
In a taxi they all can be jolly;
But the girl worth while is the girl who can smile
When you're taking her home in a trolley.



WELL IN THE SAND HILLS—Prospecting for water in the very midst of the Imperial County Sand Hills, Division VIII secured a flow of 500 gallons per minute. The water will be available for use of contractors during paving operations, bids for which are pending. The well is the only water in miles.

BRIDGE DEPARTMENT NEWS

WORK is progressing on the construction of an under-grade crossing having a 30-foot roadway and a 5-foot sidewalk, under the Sacramento Northern tracks near West Sacramento in Yolo County. The plans call for a 35-foot steel girder beam and concrete deck span on concrete abutments. C. M. Butts is resident engineer.

Construction of a reinforced concrete bridge across Merced River near El Portal has been begun. The completed structure will consist of three 58-foot reinforced concrete spans on concrete piers and abutments. The roadway will be 24 feet wide and a 4-foot sidewalk will be built on either side. H. Carter is resident engineer.

New men recently added to the Bridge Department staff are: Samuel Potashnick, A. V. Alder, W. B. Anderson, W. J. Christy, J. H. Horn, O. R. Westlund, J. J. White, Wm. T. Haight, T. E. Ferneau, and M. A. Clark, who was transferred from Division VII.

The two subways in North Sacramento have been completed except for minor finishing. The new roadway was opened to traffic December 15th.

Scenic Arch Progressing.

The work on the Charley Creek Bridge, in the Sacramento Canyon, is progressing rapidly. The north approach spans are completed and the arch ring poured. This structure is the highest combination arch and girder bridge ever constructed by the commission. W. H. Johnson is resident engineer.

Work has been completed on the Ventura River bridge extension, on the Coast Route and on the Boulder Creek structures on the California Redwood Park Highway.

SECONDARY ROADS BIBLIOGRAPHY.

The Engineering Societies Library announces the preparation of a bibliography (S. 4085) of books and articles on earth and gravel roads, published between January, 1920, and June, 1925.

The list contains 140 references with brief annotations. Mimeographed copies may be obtained for $1.50 each by writing to the Engineering Societies Library, 29 West 39th street, New York.

Waited Too Long.

"Good heavens! Who gave you the black eye?"
"A bridegroom—for kissing the bride after the ceremony."
"But surely he didn't object to that ancient custom?"
"No—but it was two years after the ceremony."

HIGHWAY NEWS NOTES

W. K. WRIGHT, assistant division engineer in charge of construction, Division X, Sacramento, has been transferred to Division VI at Fresno where he will succeed S. T. Corfield as assistant division engineer. Mr. Corfield is resigning to become construction superintendent for a well known California contractor. He was presented with a handsome gold watch by the employees of the Fresno office.

All headquarters was interested in the announcement of the arrival of Miss Madylon Joyce Barrett, whose mother is Mrs. Fay Barrett, former popular stenographer of the headquarters office.

Division X has received several interesting letters from Miss Ruth Miles, who is accompanying her parents on a tour of the British Isles.

C. E. O'Connell, Chief Clerk at Bishop, formerly of headquarters, modestly announces the arrival of his first son, Comte Edward, Jr., now nearly a month old.

Veteran Engineer Passes.

Division IV announces the passing of L. C. Winkelman, Jr., one of the veteran employees of that division. Mr. Winkelman entered the services of the California Highway Commission as instrument man in 1912. He has held various positions and for four years prior to his death was resident engineer. His last work was in connection with the construction of the Bayshore Highway. The deceased is survived by a widow and four-year-old daughter. A beautiful floral tribute was presented by the employees of the division.

W. H. Irish, assistant resident engineer, has been transferred from Division III to Division V as chief of party.

H. B. LaForge is another Division III man who has been transferred. He is now with Division IV and is located on the Peninsula Highway paving contract.

Long Job Completed.

J. L. Piper, resident engineer who has been located at Colfax for the last two and one-half years has completed his assignment and is temporarily in the Division III office.

R. M. Haverstick, chief of party, Division VII, is the proud father of an eight-pound daughter.

Division VII News.

C. P. McAndrew, assistant resident engineer, has been transferred from the Malibu ranch grading contract to the Foothill Boulevard widening job near San Fernando.

R. D. Kinsey is acting resident engineer on the Middle Causeway contract on the Coast Highway north of Ventura.

Theodore Usher, rodman of Division VI, has resigned to enter the services of the Merced Irrigation District.

H. O. Ragan, resident engineer, Bakersfield, Division VI, has been transferred to Division VIII, San Bernardino.

George L. Lisher, assistant resident engineer, Merced, Division VI, has been transferred to Division V, San Luis Obispo.

C. H. Quinn and J. S. Langenbach have resigned from Division X to do survey work for the Southern Pacific Company.

Division X Foreman Dies.

Richard Bennan, for years in charge of state highway maintenance work at San Andreas, Division X, passed away recently at the El Dorado Hospital, Stockton. The division regrets, exceedingly, the loss of an able and dependable foreman.

The Iron Man.

"One man is knocked down by an automobile every twenty minutes in Los Angeles."—News Item.
You would think it would wear him out.—*Motor Chat.*

STATE HIGHWAY FUND CONTRACTS (Bond Funds, Including Federal Aid).

Cont. No.	Division	County	Route	Sec.	Location	Miles	Type	Contractor	Estimated cost	Date contract awarded	Contract time, days
					COMPLETED AND ACCEPTED SINCE NOV. 13, 1925.						
442	III	Placer	37	C	¾ mile north of Colfax to Gold Run	8.03	Grading	C. R. Adams	$356,000 00	June 11, 1924	------
					AWARDED SINCE NOV. 13, 1925.						
488	VIII	Riverside	64	C	Desert Center to 4 miles west Hopkins Well	21.00	Grading	F. C. Payton	31,297 50	Nov. 30, 1925	200
489	VIII	San Bernardino	31, 58	F-E	Hicks to Daggett	18.52	Grading and Rock Surfacing	Ken Hodgman	179,092 12	Nov. 30, 1925	225
490	I	Del Norte	1	A	Head of Richardson Creek to Klamath River	2.00	Grade and Crushed Gravel or Stone Sur.	H. W. Rohl	96,457 50	Dec. 14, 1925	200
					Sub-total	41.52			$306,757 12		
					PENDING AWARD—None.						
					Total State Highway Fund Contracts Awarded and Pending Award	41.52			$306,757 12		

NOTE.—Primary construction covered by the above contracts does not include funds obligated on cooperative forest highway projects, prison camp road activities, or day labor jobs not being done under contract.

STATE HIGHWAY MAINTENANCE FUND CONTRACTS (Including Gasoline Tax Fund).

Cont. No.	Division	County	Route	Sec.	Location	Miles	Type	Contractor	Estimated cost	Date contract awarded	Contract time, days
					COMPLETED AND ACCEPTED SINCE NOV. 13, 1925.						
M-64	VI	Merced	4	C, D	Merced River to Buhach	6.41	P.C.C. Pavement and Shoulders	H. H. Peterson	$166,168 97	Mar. 12, 1925	------
M-86	V	Monterey	2	H, I	One mile north of Bradley to San Ardo	12.10	Rock Borders	Fred Nighbert	30,600 00	June 17, 1925	------
M-91	IV	Santa Cruz	44	A	High Bridge Fall and Cleveland Dam Creek	------	R.C. Bridge and Culverts	A. J. and W. S. Wilson Co	18,004 50	July 18, 1925	------
					AWARDED SINCE NOV. 13, 1925.						
M-107	VIII	San Bernardino, Riverside	19	B, A	Ontario to Riverside	14.62	Asphalt Concrete Pavement	Steele, Finley	238,608 05	Nov. 30, 1925	150
M-108	IX	Kern, Inyo	23	D, E, G	Ricardo to Five Mile Canyon	36.70	Grading	Harry Wilson	21,332 81	Nov. 30, 1925	75
M-109	V	Santa Barbara	2	H	Carpinteria and 2 miles southeast	2.10	A.C. Surface and P.C.C. Widening	Cornwall Construction Co.	58,798 22	Nov. 30, 1925	125
M-110	VII	Los Angeles	4	B, C	Castaic School to 3 miles north of National Forest Inn.	15.00	Macadam Surface	Fred W. Nighbert	62,842 50	Dec. 14, 1925	100
M-111	VII	San Diego	2	B	Carlsbad Crossing	------	Reinforced Concrete Girder Bridge	Coon Brothers	20,666 25	Dec. 14, 1925	125
M-112	VI	Kern	4	F	1 mile south of Delano to 1.8 miles south of Delano	0.75	Asphalt Concrete Pavement	Warren Construction Co.	16,635 38	Dec. 14, 1925	45
					Sub-total	69.17			$418,878 21		
					PENDING AWARD—None.						
					Total State Highway Maintenance Fund Contracts Awarded and Pending Award	69.17			$418,878 21		

NOTE.—The above obligations charged against the State Highway Maintenance Funds do not include funds from these sources obligated for general maintenance and for specific betterments being done under day labor authorization.

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