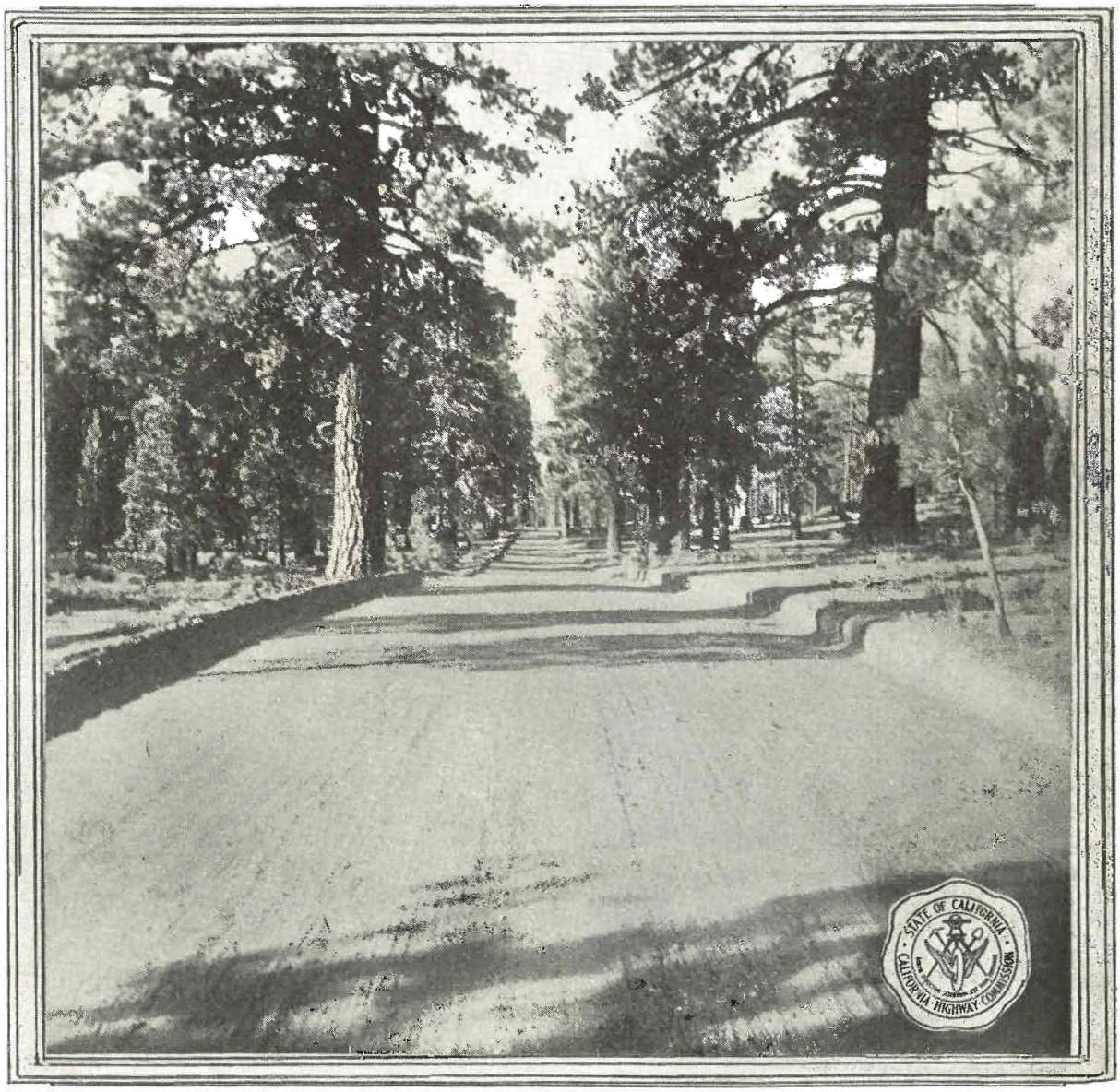
# CALIFORNIA HIGHWAYS

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

Vol. 3 JANUARY, 1926 No. 1




NEW HIGHWAY THROUGH DEADMAN'S HILLS, MONO COUNTY—This section of highway, an accomplishment of Division IX, was graded with General Maintenance Funds, as described in an article in this issue.

*In this issue*: CURING OF CONCRETE—RECENT CALIFORNIA EXPERIMENTS.

# CALIFORNIA HIGHWAYS

HARVEY M. TOY, Chairman;

N. T. EDWARDS and LOUIS EVERDING, Commissioners.

ROBERT M. MORTON, State Highway Engineer.

W. F. MIXON, Secretary.




FRANK B. DURKEE - - - Editor

P. O. Box 1103, Sacramento, California.

Vol. 3 JANUARY, 1926. No. 1

## CALIFORNIA HIGHWAY DEPARTMENT

### CALIFORNIA HIGHWAY COMMISSION

HARVEY M. TOY, Chairman, San Francisco

N. T. EDWARDS, Commissioner, Orange

LOUIS EVERDING, Commissioner, Arcata

R. M. MORTON, State Highway Engineer, Sacramento

PAUL F. FRATESSA, Attorney, San Francisco

W. F. MIXON, Secretary, Woodland

### HEADQUARTERS STAFF, SACRAMENTO

T. E. STANTON, Assistant State Highway Engineer

L. V. CAMPBELL, Office Engineer

FRED J. GRUMM, Engineer of Surveys and Plans

HARLAN D. MILLER, Bridge Engineer

C. S. POPE, Construction Engineer

R. H. STALNAKER, Equipment Engineer

G. R. WINSLOW, Maintenance Engineer

C. L. McKESSON, Materials and Research Engineer

BEN H. MILLIKEN, Superintendent of Prison Road Camps

HERMAN B. WEAVER, Chief Accountant

LOWELL R. SMITH, Purchasing Agent

### DIVISION ENGINEERS

T. A. BEDFORD, Division I, Willits

H. S. COMLY, Division II, Redding

F. W. HASELWOOD (Acting), Division III, Sacramento

J. H. SKEGGS, Division IV, San Francisco

L. H. GIBSON, Division V, San Luis Obispo

J. B. WOODSON, Division VI, Fresno

S. V. CORTELYOU, Division VII, Los Angeles

E. Q. SULLIVAN (Acting), Division VIII, San Bernardino

F. G. SOMNER, Division IX, Bishop

J. C. McLEOD, Division X, Sacramento

General Headquarters, Fifth Floor, Forum Bldg., Sacramento

## TABLE OF CONTENTS.



# SECRETARY JARDINE THANKS CHAIRMAN FOR COOPERATION

## CALIFORNIA'S AID IN ROAD CONSTRUCTION IS APPRECIATED

FEDERAL officials appreciate the cooperation of the State of California in furthering the road work of the United States. This sentiment is expressed by Secretary of Agriculture W. M. Jardine, in a letter of holiday greeting to Chairman Harvey M. Toy, as follows:

DEPARTMENT OF AGRICULTURE
WASHINGTON

December 31, 1925.

Mr. Harvey M. Toy,
Chairman, Highway Commission,
Hotel Manx, 225 Powell St.,
San Francisco, California.
Dear Mr. Toy:

As the year 1925 draws to a close, please accept my appreciation of the cooperation that you have given to the Department of Agriculture in its efforts to be of constructive service in the road work of the United States. It is only through such cooperation that effective progress can be made. In behalf of the department I thank you for your services and ask you to accept for yourself and your department our best wishes for the coming year and our hope that your splendid cooperation may be continued.

Very truly yours,

(Signed) W. M. JARDINE,
Secretary.

Keep the boy on the farm by making your roads so he can get to town in twenty minutes.

The Contractors' Association of Northern California at its recent annual convention in San Francisco adopted resolutions urging congress to continue present federal aid policies.

JANUARY 1926

# California Highways

VOL. 3 No. 1

## Building Highways With General Maintenance Funds

By F. G. SOMNER, Division Engineer, Bishop.

FOLLOWING rigid adherence to specifications, compiled after study of the best efforts of the nation's eminent authorities on concrete, macadam, or other types of pavement, we may with pride point to a completed section of highway, say 16 miles, a paved boulevard, wide and smooth. Such a road, it should be remembered, costs considerable money, but "East of the Sierra" there is a stretch of state road of 16 miles, from 20 to 30 feet in width, paid for from General Maintenance funds. Its cost per mile did not exceed the General Maintenance allotment. There is no choice here between pride and profit, modesty is set aside and the claim is made for both.

"Simple enough," the captious reader may declare, "a grader was dragged over the desert sand and sage brush and its trail called a road."

Doubters should look up the cost record, take a trip over this highway, and then say who wins.

### Route Part of The Original System.

The California Highway Commission, in January, 1925, took over for maintenance an eighteen-mile section of county road in Mono County, extending from Magee Creek to Deadman Creek. The route lies through the "Deadman" country, along the base of the high Sierra, at an elevation of 7100 to 8000 feet. It forms a part of the original state highway system laid out and adopted as a result of the first bond issue of 1909. Its terrors are traditional; only the fittest have survived to find their way out when overtaken by the driving snow storms characteristic of the region.

When taken over, the road long since had been abandoned by the county as far as maintenance was concerned and was annually going from bad to worse. It was demolished finally, during the season of 1924 by a fleet of trucks hauling machinery and supplies for hydro-electric projects then under construction in Mono County. At the close of the hauling season nothing was left but deep ruts and chuck holes, the result of the struggles of truck drivers to find a way through after the county trail was no more. The opening of the road in the spring found it beyond repair. For miles no travelable way was in sight. The ruts had been converted into gulleys by the melting snow.

The county had no funds with which to undertake repairs and, if traffic were to be served, action by the Highway Commission was imperative. The section was taken over and the problem became one for Division IX to solve.

With the season of tourist travel fast approaching, and only "Best Temporary Road" signs to guide the bewildered motorist through the timber, no time was to be lost. Requests for engineering work orders and specific funds were forgotten, when, on May 19th, last, Foreman Paul Peak established his camp. He had a crew of nine men and equipment consisting of two Holt caterpillar tractors, a 5-ton and a 2-ton, a truck, two road graders, a scarifier and a scraper. No teams were employed either for clearing or grading. And on July 20th, the job was completed.

### Short Cuts Bring Results.

Survey parties were not in evidence. With the assistance of the camp foreman, the relocation was flagged out and followed up, as the grading progressed, with such stakes as were necessary. *Short cuts and easy methods produced results commensurate with the purpose involved.*

"Easy enough," explains the skeptic, "a flat country, a 16-mile tangent."

Not so, the route lies through timbered hills, skirting the Mammoth Lakes, in sight of the famous Minarets, and alongside the Casa Diablo, scenic features that hardly signify desert plains.

Lack of funds, therefore, controlled. A line of least resistance had to be developed that, at the same time, maintained proper alignment and grade. Drainage conditions also governed the location to a considerable extent.

The formation of the district is generally of volcanic cinders and sand, which yielded in a satisfactory manner to the grading methods employed and afforded a very good surface. Lava rock was encountered in places.

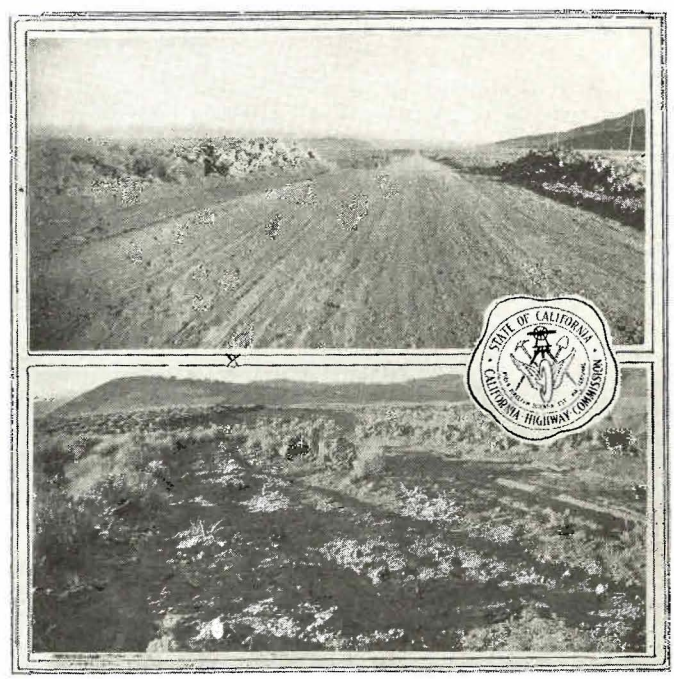
The romantic character of the country and unusual camp environment were in marked contrast to the Mojave desert from which the men were transferred and they entered into the spirit of the project in a creditable manner.

The alignment, surface, and grades, with rather pronounced undulations, are all that may be wished for, and both the road and its surroundings are pleasant to look upon. With minor changes to be made during the season of 1926, a road will be provided, fast enough, and adequate for traffic for a considerable period.

### Local Papers Commend Work.

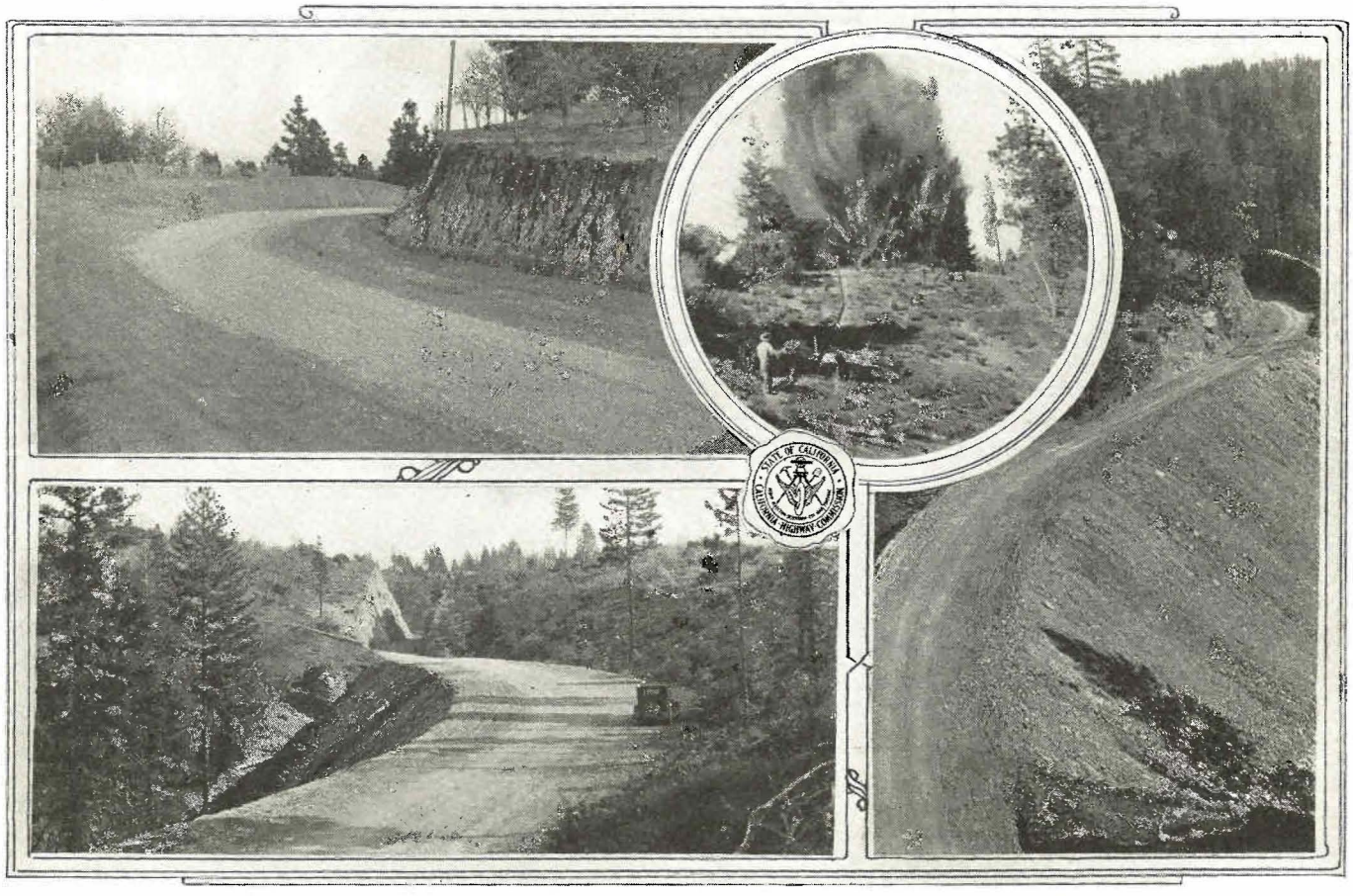
The views reproduced in this issue of the BULLETIN illustrate

(Continued on page 11.)




NEAR THE CASA DIABLO—*Above,* the new state highway between Casa Diablo and Deadman Creek, Mono County. *Below,* the old county road meandering over the plains as it was before the recent work of Division IX.

# COLFAX-GOLD RUN SECTION INVOLVES HEAVY GRADING



IN THE LAND OF THE FORTY-NINERS—Views of recently completed state highway grade near Gold Run, Placer County. *Upper Left,* section of completed roadway with temporary surfacing to handle winter traffic. *Center,* explosives make easier the work of power shovels. *Lower Left and Right,* an eighty-foot cut and a ninety-foot fill, indicative of the heavy work required on this section. (Photos by Div. III.)

By F. W. Haselwood, Acting Division Engineer.

GRADING recently was completed on the Colfax-Gold Run unit of the Victory highway. This interstate highway, now Route 40 of the National highway system, crosses the Sierra Nevada mountains by way of Auburn, Donner Summit, Truckee and the Truckee River Canyon. The new section is eight miles in length and extends from the end of the oil macadam pavement, one mile east of Colfax, to the well-known old mining town of Gold Run, Placer County.

The new grade beyond Colfax follows in general the divide between the American and Bear River drainages. The country traversed is broken and irregular, and numerous deep cuts through sharp ridges and high fills across steep ravines were necessary to secure grades and alignment conforming to the standards now required on California state highways. There are no grades exceeding 6 per cent and no curves the radii of which are less than 300 feet.

### The New And Old Roads Compared.

Interesting comparisons may be made between the new highway and the old state road it replaces. The old road is half a mile longer, has grades as steep as 12.5 per cent, many hairpin turns with radii as sharp as 40 feet, and over three times as many degrees of curvature as the new location. The embankments on the new road are 26 feet wide and the cuts 24 feet, exclusive of two-foot ditches. In comparison, much of the old road is barely wide enough for two machines to pass.

The revised alignment eliminates a grade crossing of the Nevada County Narrow Gauge Railroad by passing under a high steel viaduct. A dangerous subway under the Southern Pacific tracks is abandoned, the highway crossing the railroad at a new location.

Fred Grumm was right when he said, "*You have to move dirt to build a road.*" On this eight-mile unit, 353,000 cubic yards of earth and rock were removed from cuts and placed in embankments, a movement of 44,000 cubic yards of excavation per mile. The cost of the grading and drainage structures was $345,000 or approximately $43,000 per mile.

### Modern Equipment Does Work.

The work was done almost entirely by modern power equipment. The drilling was all done by compressed air and the material from the cuts was loaded by power shovels into trucks for transportation to fills. Two shovels, two fleets of trucks, and two compressors were worked three shifts daily, almost continuously, during the period of construction. Hand labor was used only for clearing and for sloping cuts and finishing the grade.

The contract was awarded on June 11, 1924, to C. R. Adams of Merced. Four hundred and fifty working days were allowed, fixing the date for completion as December 19, 1925. Mr. Adams began operations during the latter part of July, 1924, and continued diligently at a uniform rate of progress. He was always ahead of his schedule and finished on November 10, 1925. J. L. Piper was resident engineer for the California Highway Commission.

# Curing of Concrete—Recent California Experiments

By C. L. McKesson, Materials and Research Engineer.

DURING the summer of 1924 a cooperative series of curing tests were conducted at Sacramento by the California Highway Commission and the Structural Materials Research Laboratory of Chicago. The primary consideration leading up to this experimental work was the possibility of the use of calcium chloride in lieu of ordinary water curing in the arid regions of California. The test series was broadened in scope to include different periods of wet earth curing, curing with asphaltic curing paper, and with sodium silicate.

Bulletin No. 15* recently issued by the Structural Materials Research Laboratory of Chicago, gives a full description of these tests, of the results obtained, and of the conclusions reached. A brief resume of this investigation follows, but it is suggested that those desiring to study the matter in detail secure a copy of the bulletin. The California Highway Commission has a limited number of bulletins for distribution and copies also may be obtained from the Structural Materials Research Laboratory of Chicago or the Portland Cement Association.

Sacramento was chosen as a site for these tests because of the slight probability of rain, the low relative humidity and high mean temperatures during the summer months. The tests were made during July, August, September, and October and climatic conditions during this period were quite unfavorable for the proper curing of unprotected concrete, but are typical of those encountered in semi-arid regions.

## Description of Experiments.

The curing experiments were carried out on plain concrete beams made out-of-doors and cured in the open by the following methods (after removal of forms at 16 to 24 hr.):

(1) Covering with 2 in. earth, wet for 3, 7, 14, 26 and 88 days;
(2) Air curing, no surface treatment;
(3) Covering with asphaltic paper;
(4) Flake calcium chloride, 1½, 2, 2, 2½, 3 and 5 lb. per sq. yd. sprinkled over the surface;
(5) Commercial sodium silicate (41° Baume); applied with a brush, undiluted, 1 to 1½ and 1 to 3 solutions.

The investigation included transverse tests and tests for surface hardness on five hundred and eighteen 7 x 10 x 38 in. beams and compression tests on one hundred and seventy-five 6 by 12 in. cylinders and prisms. The beams were tested at ages of 3 to 90 days with the cured surface in tension. The surface hardness of the concrete was measured by a ball-indentation test. The cylinders were cured in damp sand and tested at ages of 7 to 90 days. The prisms were cured with wet earth and calcium chloride and tested at 28 days.

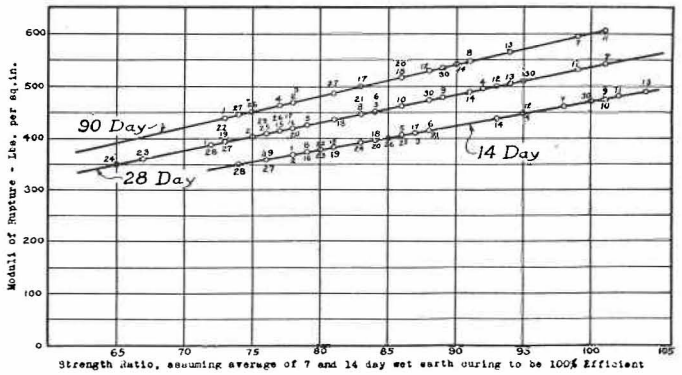
The concrete was machine-mixed in the proportion of 1-2.2-3.0 by loose volume, and contained 6 sacks of cement per cubic yard. The consistency of the concrete was about that used in hand-finished concrete pavements (slump of about 1½ in.). A few tests were made with wetter concrete. In 110 beams and 37 cylinders calcium chloride (2% by weight of cement) was used as an admixture.

In comparing the relative efficiency of the curing methods, the strength of concrete cured with earth wet 7 and 14 days (which showed practically identical results) was taken as the standard; the "strength ratios" for other methods were based on these values.

The moduli of rupture and strength ratios obtained by all of

(Continued on next page.)

CONCRETE CURING TESTS—Made by the California Highway Commission in cooperation with the Structural Materials Research Laboratory of the Lewis Institute at Sacramento, California, July to November, 1924, curve showing relative efficiency of various methods of curing.




METHODS OF TREATMENT AND REFERENCE NUMERALS SHOWN ON ABOVE CURVES.

1. Air only—no curing.
2. Air only—2% Admixture CaC12.
3. Curing paper—top only.
4. Curing paper—top and bottom.
5. Curing paper—top only—1.10 consistency.
6. Curing paper—top and bottom—1.10 consistency.
7. 2" Earth, wet twice daily for 14 days.
8. 2" Earth, wet twice daily for 14 days, 2% admix. CaC12.
9. 2" Earth, wet twice daily for 14 days, 1.10 consistency.
10. 2" Earth, wet twice daily for 14 days, 1.25 consistency.
11. 2" Earth, wet twice daily for 7 days.
12. 2" Earth, wet twice daily for 7 days, 2% admix. CaC12.
13. 2" Earth, wet twice daily for 3 days.
14. 2" Earth, wet twice daily for 3 days, 2% admix. CaC12.
15. 1½ lbs. CaC12 per sq. yd.
16. 2 lbs. CaC12 per sq. yd.
17. 2½ lbs. CaC12 per sq. yd.
18. 2½ lbs. CaC12 per sq. yd., 2% admix. CaC12.
19. 2½ lbs. CaC12 per sq. yd., washed off after 3 hrs.
20. 2½ lbs. CaC12 per sq. yd., washed off after 1 day.
21. 2½ lbs. CaC12 per sq. yd., wet earth subgrade.
22. 2½ lbs. CaC12 per sq. yd., dry earth subgrade.
23. 2½ lbs. CaC12 per sq. yd., 1.10 consistency.
24. 2½ lbs. CaC12 per sq. yd., 1.25 consistency.
25. 3 lbs. CaC12 per sq. yd.
26. 5 lbs. CaC12 per sq. yd.
27. N. Brand Na2Sio3—One application.
28. 1-1½ Na2Sio3—Three applications.
29. 1-3 Na2Sio3—Three applications.
30. 2½ lbs. CaC12 per sq. yd. in concrete forms.
31. 2" Earth, wet twice daily for 28 days.
32. 2" Earth, wet twice daily for 90 days.

**TABLE 1.**

| Method of curing | Modulus of rupture of 7 by 10 inch plain concrete beams, pounds per square inch | | | | | Strength—Ratio per cent | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3d. | 7d. | 14d. | 28d. | 90d. | 3d. | 7d. | 14d. | 28d. | 90d. |
| 2 inch wet-earth covering applied 16 to 24 hours after molding and left in place for 7 or 14 days | ---- | 445 | 470 | 535 | 600 | ---- | 100 | 100 | 100 | 100 |
| 2 inch wet-earth covering applied 16 to 24 hours after molding and left in place for 3 days | 340 | 435 | 490 | 505 | 565 | 100 | 98 | 104 | 94 | 94 |
| Beams molded and cured in concrete forms using surface application of calcium chloride, 2½ pounds per square yard, placed 16 to 24 hours after molding and not removed | ---- | ---- | 470 | 470 | 535 | ---- | ---- | 100 | 88 | 89 |
| Covered with asphaltic paper 16 to 24 hours after molding until 1 day before test (average for paper on top only and top and bottom) | ---- | 410 | 430 | 470 | 465 | ---- | 92 | 91 | 88 | 78 |
| Beams molded in wood forms and cured with surface application of calcium chloride, 2½ pounds per square yard, placed 16 to 24 hours after molding and not removed | 370 | 390 | 410 | 415 | 495 | 109 | 88 | 87 | 78 | 83 |
| Air curing; no surface treatment | 295 | 345 | 365 | 385 | 435 | 87 | 78 | 78 | 72 | 73 |
| Sodium silicate, applied with brush 16 to 24 hours after molding (average for undiluted, 1 to 1½ and 1 to 3 solutions) | ---- | 340 | 355 | 395 | 445 | ---- | 76 | 76 | 74 | 74 |

*Studies of Curing Concrete in a Semi-arid Climate, by H. F. Gonnermann and C. L. McKesson.

the methods of curing are shown graphically in Fig. 1. The strengths for the more important methods of curing are also given in Table 1.

### Field Tests Also Made.

During the season of 1924 a limited number of field tests were also made by the California Highway Commission for the purpose of determining the relative efficiency of curing with the use of flake calcium chloride as compared with usual water curing. The result of these tests shown in Table 2 are in general accord with the test series of 1924 already described.

It will be seen from Table 1 and from Figure 1 that very satisfactory showings were made at all ages with wet earth curing of three to fourteen days. The practice in California heretofore has required fourteen days of watering and it was realized that an appreciable reduction in curing time with a correspondingly earlier opening of pavement to traffic would effect a large saving to the Highway Commission in construction costs and in the reduction of costs of maintaining expensive detours.

The elimination of detours and added comfort and safety to the traveling public also made it exceedingly desirable to reduce the curing period to the minimum consistent with safe construction practice.

Mr. R. M. Morton, State Highway Engineer, therefore, directed that a complete series of field tests, under normal construction conditions, be conducted during the summer of 1925 to fully verify the conclusions arrived at as a result of the previous laboratory study.

### Field Tests Made in 1925.

The 1925 Field Series of Curing Tests by the California Highway Commission were made on a pavement-widening project fourteen miles from Sacramento, California. The strip of pavement was 6′ in width and 7″ in thickness. The concrete was mixed in a central mixing plant and hauled to the work in side dump trucks. The mixing, placing, and finishing were all conducted in the usual way and the pavement is typical of average pavement.

Seven separate sections, each representing a day's run of from 500 to 1500 lineal feet, were designated for the test and each section received different curing treatment. All sections were covered with burlap immediately after laying and with earth on the following morning. Section 1 was watered 14 days; Section 2, 12 days; Section 3, 10 days; Section 4, 8 days; Section 5, 7 days; Section 6, 3 days; and Section 7, 0 days. In all cases, earth covering was removed in 14 days. At the time of the placing of concrete, 6″ x 12″ cylinders, in pairs, were molded from concrete taken at five stations in each section. These 10 specimens from each section were cured in water at the laboratory for 27 days and broken on the 28th day.

Five cores were drilled in each section for 14-, 21- and 28-day tests. Each age and condition was thus represented in the test by five cores. Some honey-combed or otherwise defective cores were obtained, but these were rejected and drilling continued until a full set of apparently perfect cores was secured.

The concrete in the 28-day laboratory-cured specimens having been taken from the identical batches of concrete from which cores were later drilled enabled a comparison to be made of the strength of cores on a basis of the relative strength of concrete used in each. The relative efficiency or strength ratio for each method of curing and at each age of test was obtained by comparing the average strength of the cores with the average strength of 28-day laboratory-cured cylinders from the same section.

Table 3 gives the results of the tests of these cores and the relative efficiency of various periods of watering.

Section 7 with dry earth covering but with NO WATERING, gave high strength ratios in early tests showing that mixing water, conserved to some extent by a covering of dry loose earth, provided nearly enough water to insure proper hydration through the early curing periods. The concrete cured in this way, however, failed to show continued increases in strength between 14- and 90-day tests. In drilling, it was found that the surface of the concrete cured without water was much softer than on the sections which had received water treatment. This verifies the results of the Sacramento Curing Tests in which it was found that concrete which received no water had only about three quarters of the surface hardness of similar concrete cured in water even for 3 days.

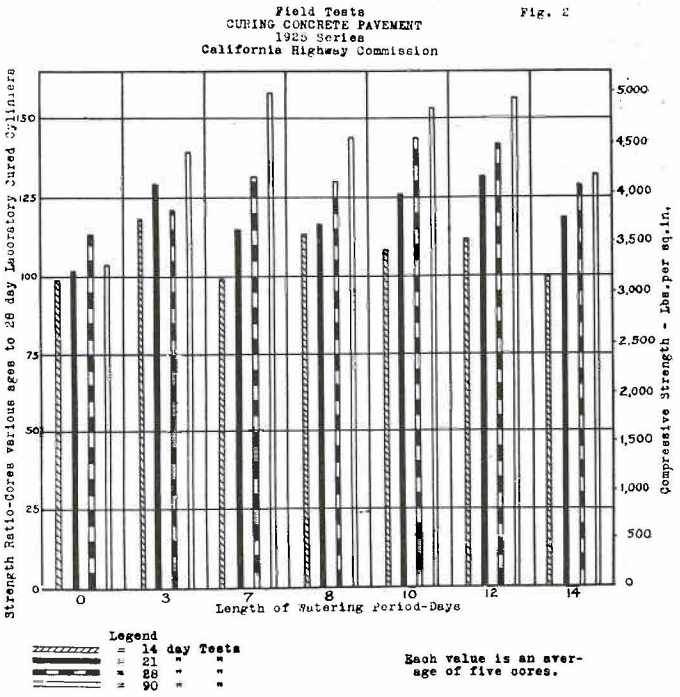
THREE-DAY WATERING on Section 6 gave the highest strength in 14-day tests. This almost exactly checks results in the Sacramento Test of 1924. It is quite apparent that 3-day watering provides all of the water necessary to carry on hydration through a 14-day, or even a 21-day curing period. At the same time, it permits of a higher temperature in the concrete at an early period in the curing and thus accelerates early hardening. It does not provide any free moisture to reduce strength at time of test.

**TABLE 2.**

**Average Compressive Strength.**

| Location of experiment | No. of samples | 6 by 6 by 12 inch molded specimens | | 4½ inch cores from pavement | | Efficiency of calcium chloride,[1] per cent | Remarks |
|---|---|---|---|---|---|---|---|
| | | Cured with water, 28 days | Cured with calcium chloride, 28 days | Cured with water, pounds | Cured with calcium chloride, pounds | | |
| (X–Sac.–4-B) Sacramento-Stockton highway, near Sacramento. | 24 | ---------- | ---------- | [2]4,292 | [2]4,218 | 98 | [1]Hot and dry (water-cured concrete 57 days old. Concrete cured with calcium chloride 70 days old). |
| (VII–L. A.–2–BC) Ventura–Los Angeles highway near Calabasas. | 20 | ---------- | ---------- | [2]5,064 | [2]5,042 | 99 | [2]Cores drilled and at 1 year age. |
| | 32 | 3,064 | 2,763 | ---------- | ---------- | 91 | |
| | 28 | ---------- | ---------- | 4,057 | 3,294 | 81 | Hot and dry. |
| (VII–Ventura–2-A) Los Angeles highway near Newbury Park. | 12 | ---------- | ---------- | 3,491 | 3,093 | 88 | Hot and dry. |
| (I–Hum.–1–GH) Eureka–Arcata highway at Arcata. | 72 | 3,887 | 3,545 | ---------- | ---------- | 92 | Experiment in October. Weather cool, humidity high (70 to 90 per cent). Some rain. |

[1] Efficiency of calcium chloride curing, assuming water curing to be 100 per cent efficient.
[2] Cores drilled with Calyx Shot Drill. Cores tested were free from visible defects. Each strength is an average of 5 cores.



SEVEN- AND EIGHT-DAY WATERING (Sections 5 and 4) gave satisfactory strengths at all ages. The strengths and strength ratios for these two treatments were about the same except for 14-day tests. In this average, one of the five cores broke unaccountably low and reduced the average somewhat.

TEN- AND TWELVE-DAY WATERING (Sections 3 and 2) gave about the same strengths as the shorter watering periods in 14-day tests, but showed a large gain in 21-, 28- and 90-day tests.

FOURTEEN-DAY WATERING (Section 1) heretofore accepted as the standard in California, fell behind other periods of watering in most instances. It makes little better showing than no watering in the earlier tests but was decidedly superior to the latter method in 90-day strength tests and in surface hardness tests.

Figure 2 shows the results of these field tests and Figure 3 shows temperature and humidity during the test period. The curing period included some very hot dry weather. There was no rainfall after the expiration of the watering periods and only .05 inches during the entire period of the test.

The field curing tests of 1925 fully corroborate the earlier tests in that they show little practical benefit to be derived from watering pavement longer than seven days after placing.

### Amount of Water For Curing.

In the Sacramento Curing Tests in 1924, concrete of normal consistency contained mixing water amounting to about 8% of the combined weight of the cement, sand and gravel. It was found in this test that the original mixing water, if conserved, was sufficient to carry hydration through a 90-day curing period. The relative strengths obtained by some of the more important methods of curing are shown in Figure 4 which also shows the change in moisture content in the concrete measured in terms of original mixing water. It will be seen that concrete which had no watering, lost about 32% of its moisture content while concrete watered only 3 days, lost only 7.1% of the original mixing water. This indicates that treatment during the first three days after the placing of concrete has much to do with subsequent strengths.

The rate of loss of moisture is dependent upon a number of conditions including size and surface area of the specimen, temperature and humidity of air, and condition of subgrade. In the Sacramento 1924 Series, specimens were cured on waterproof paper to prevent escape of water to subgrade, and a careful record was made of humidity and temperature. The temperature was high and humidity low during these tests and conditions were very favorable for rapid drying of concrete.

The results of the several tests mentioned in this report are applicable to pavement or other concrete resting upon a subgrade and exposed on one surface only. They would also probably apply to concrete in walls or abutments, but concrete in thin structural members has a much larger relative surface area and evaporation of moisture is probably more rapid.

In connection with the curing tests of concrete beams, a study was made of the loss of water in concrete placed in pans and exposed in sunshine.

From these tests it was determined that the loss of moisture was very rapid during the first three days of exposure. After the first three days, the rate of loss was much lower.

In Figure 4 it will be noted that watering up to the time of test at 90 days age resulted in an increase of moisture content over the amount used in mixing. This method of curing provided free moisture not necessary for hydration during this length of curing period, and the strength is appreciably less than for specimens watered shorter periods. These tests indicate that, at 90 days, there is a well defined relation between moisture content in concrete and flexural strength in concrete. A substantial increase or decrease in water content (based on mixing water) is reflected by a decrease in strength.

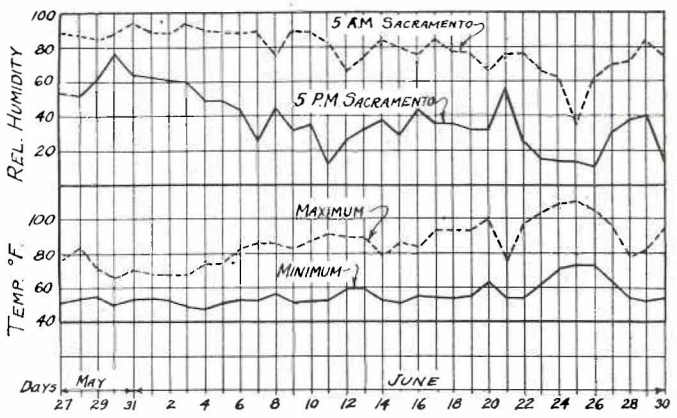



Fig. 3. Temperature and humidity during pavement curing tests in 1925. Sect. 1 laid May 27 and Sect. 7 laid June 3.

### Influence of Temperature on Curing.

It has long been known that the early hardening of cement is retarded by low temperatures and accelerated by high temperatures. Variations in temperature during the curing period similarly affects concrete in roads or structures.

In considering the relative efficiency of various curing methods where early strengths are required, it is reasonable, other conditions being equal, that preference should be given to a method which would give the highest temperature in the concrete during the curing period. Ponding or covering with earth, wet twice daily, results in a considerably lower temperature in concrete than where concrete is similarly exposed under a dry earth covering or without any covering.

A short watering period permits of the earlier drying of the covering and of increased temperature thereafter. It seems reasonable that this had its influence in producing relatively high strengths in concrete cured with short periods of watering.

All of the California curing tests were conducted in the summer weather and should not, without adjustment, be applied to winter conditions. It is quite possible that the time of opening might be based on mean temperature during the curing period.

(Continued on page 9.)

**TABLE 3.**

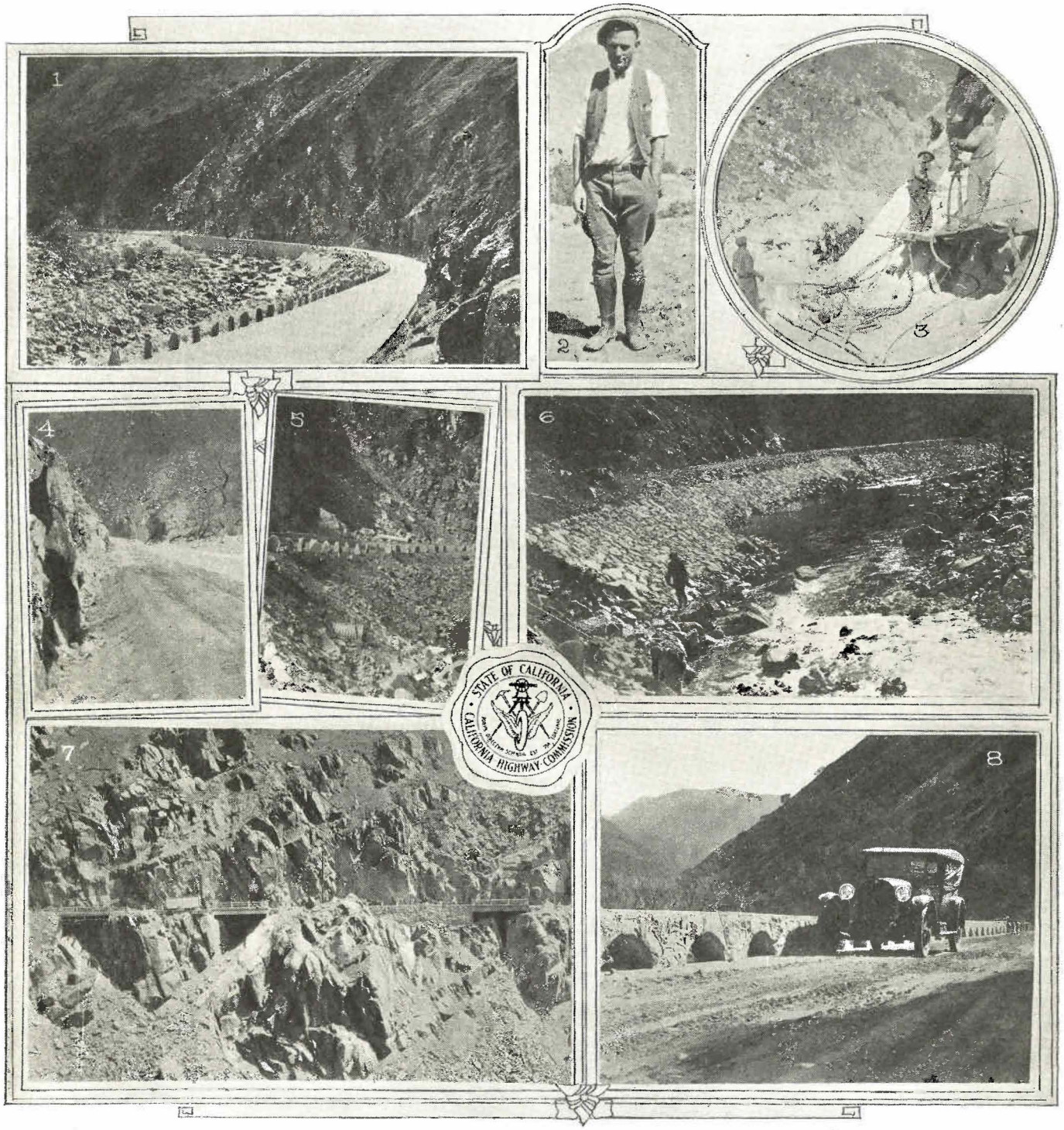
**California Highway Commission Curing Tests—Compressive Strengths.**

6 by 12 inch Moulded Cylinders and 4½ by 7 inch Drilled Cores (1925 Series).

| | Watering period | Age of test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | [1]28 days, 6 by 12 inch cylinders | 14 days | | 21 days | | 28 days | | 90 days | |
| | | | [2]Cores, pounds per square inch | [3]Strength, ratio | [2]Cores, pounds per square inch | [3]Strength, ratio | [2]Cores, pounds per square inch | [3]Strength, ratio | [2]Cores, pounds per square inch | [3]Strength, ratio |
| Section 1 | 14 | 3,296 | 3,285 | 100 | 3,873 | 118 | 4,229 | 128 | 4,301 | 132 |
| Section 2 | 12 | 3,105 | 3,468 | 112 | 4,103 | 132 | 4,414 | 142 | 4,895 | 157 |
| Section 3 | 10 | 2,930 | 3,123 | 107 | 3,694 | 126 | 4,225 | 144 | 4,475 | 153 |
| Section 4 | 8 | 2,968 | 3,366 | 113 | 3,483 | 117 | 3,877 | 130 | 4,264 | 144 |
| Section 5 | 7 | 3,118 | 3,073 | 99 | 3,596 | 115 | 4,101 | 132 | 4,924 | 158 |
| Section 6 | 3 | 3,356 | 3,948 | 118 | 4,323 | 129 | 4,068 | 121 | 4,659 | 139 |
| Section 7 | 0 | 3,378 | 3,329 | 99 | 3,436 | 102 | 3,814 | 113 | 3,465 | 103 |
| Average | | 3,164 | 3,370 | 106 | 3,787 | 119 | 4,104 | 130 | 4,426 | 141 |

[1] 6 by 12 cylinders made in accordance with A.S.T.M. standards, and cured in water for 28 days. Each strength an average of 10 specimens except Section 7, in which only 4 specimens were made.
[2] Cores drilled with Calyx Shot Drill. Cores tested were free from visible defects. Each strength is an average of 5 cores.
[3] Strength ratios are ratios of core strengths to 28 days strengths of cylinders from same section.
Concrete Mix 1–1.9–3.8 using 6 sacks cement per cubic yard.

# MEN FROM FOLSOM PRISON OPEN SOUTHERN SIERRA TO TRAVEL




KERN RIVER CONVICT JOB—Views in the Kern River Canyon, east of Bakersfield, where a section of the state highway built by convicts from Folsom Prison was recently completed and opened to traffic. (1) a section of completed highway, showing parapet wall built by prisoners; (2) Ralph W. Brown, camp superintendent; (3) prisoners operating jack hammers in solid rock; (4) storm water gutter at inside of roadway which carries water to culverts; (5) rock guard rail at outer edge of grade; (6) prisoners building rock rip rap to protect highway grade during high water; (7) view showing rocky formation of the canyon; (8) closeup of the rock parapet shown in number one.

### Safety First.

Tony was having his second son christened and, being very anxious to have his name recorded correctly on the birth certificate, remarked to the clergyman:

"Will ya pleeze nama my babe same as I give ya?"

"Tony, why do you make such a request?" asked the clergyman.

"Well, ya see—it's a lika dis: My firsta boy I tella ya I wanta heem chris'nd 'Tom' and ya putta 'Tomass' on heesa paper. Now, I wanta dis boy nama 'Jack' and no wanta heem name 'Jackass'."

—*San Joaquin Power.*

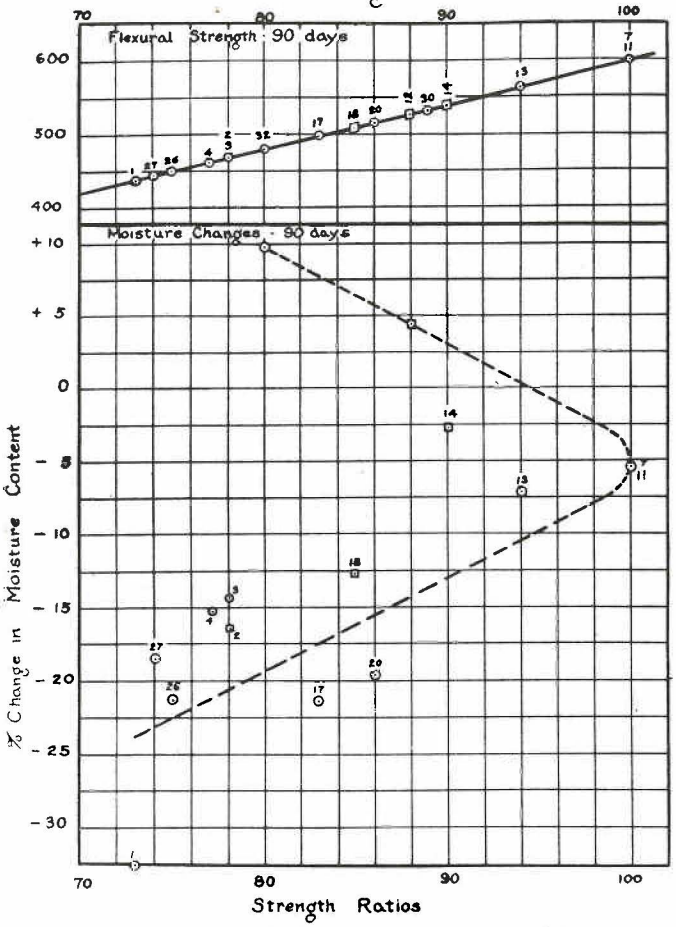
# CURING OF CONCRETE—RECENT CALIFORNIA EXPERIMENTS

(Continued from page 7.)

### Curing Period and Moisture for Continued Hydration.

The proper length of the curing period in this connection, is the time necessary for concrete to develop sufficient strength to safely permit of its use for the purpose for which it was constructed. The length of time will obviously be dependent upon the quality of concrete, temperatupre during curing period, and the efficiency of the curing method. With concrete of the quality used in these tests, with water curing of three or more days duration, and with summer temperatures, compressive strengths above 3000 lbs. and flexural strengths of over 500 lbs. were obtained in 14 days.

Fig. 4.




Reference numerals indicate methods of curing as in Fig. 1

Such concrete would be safe for use in concrete pavement or highway structures.

Concrete made from satisfactory materials continues to develop strength for years after the termination of the curing period. This added strength adds to the factor of safety. It is not necessary and it may not be possible, to supply water during a curing period in sufficient quantity to carry on hydration for a period of years.

It has been shown* that, where hydration in concrete is stopped due to a lack of moisture, it will resume when water is applied even after a long lapse of time, and that thereafter the concrete will increase in strength more or less normally. Concrete in roads will be subjected to occasional rainfall after the curing period ends and moisture for continued hydration will thus become available from time to time. In the curing of concrete, we should, therefore, be most concerned with the water necessary to develop the required strength in the earliest possible time.

### Curing With Flake Calcium Chloride.

Curing with a surface application of flask calcium chloride (2½ lbs. per square yard of surface) was found to be 83% efficient in 90 days in the Sacramento, 1924, curing tests. Field tests in 1924 Table 2 indicated this method to be 81 to 99% efficient. The ball penetration tests in the Sacramento Tests of 1924 showed a somewhat softer and more friable surface on specimens cured with calcium chloride and some scaling has been noted on pavement cured in this manner.

In view of the fact that 3-day water curing is very effective even under most adverse conditions, it does not seem that recourse to calcium chloride would be justified except under very unusual circumstances such as desert construction and under such conditions, the tests do not indicate high efficiency for the calcium chloride.

### Asphaltic Curing Paper.

Retarding the evaporation of mixing water by covering the concrete with asphaltic curing paper immediately after placing the concrete is a method which seems to have possibilities. Curing with asphaltic paper in the tests described gave fair strengths and very good surface hardness. In these tests the curing paper was not placed until the day following the pouring of the concrete. Better results would doubtless be obtained by immediately covering the concrete before any of the mixing water has escaped. In structural work forms might be lined with this material and mixing water conserved for hydration.

### Conclusions.

**The various tests described above seem to justify the following conclusions:**

**1. That seven days of wet earth curing (or watering) is ample to provide moisture for hydration through a curing period of 28 or 90 days.**

**2. That this watering period might be reduced to 3 days where concrete is of high class quality and where a substantial saving can thus be effected.**

**3. That during summer weather concrete pavement may be opened to traffic in 14 days. (During cold weather the hardening of concrete is retarded and the time of opening should depend upon the actual conditions in each case.)**

*Effect of Age and condition of Storage on Compressive Strength of Concrete, by H. F. Gonnermann, Proceedings American Concrete Inst., 1918.

# ADDITIONAL EQUIPMENT PURCHASED FOR MAINTENANCE OF NEW ROADS

THE 1711 miles of county road on state highway routes taken over for maintenance by the Commission on January 1st, in accordance with the provisions of Assembly Bill 589, (Chap. 234, Laws of 1925), has necessitated the purchase of considerable additional equipment.

Recent purchases include the following:

30 8′ rubber-tired leaning-wheel graders.
4 8′ rubber-tired leaning-wheel scarifier graders.
7 7′ rubber-tired leaning-wheel graders.
40 one-man tractor graders.
5 small tractors.
2 30-h.p. tractors.

While a few of the graders are for replacement of others worn out in service, practically all of the new equipment is needed for use on the roads to be maintained. The total expenditure for the above equipment will approximate $130,000.

A considerable reduction in price was again secured by quantity purchase of both graders and tractor graders. It is the intention of the departments concerned to extend this policy as much as possible in making future purchases of equipment.

### Woman's Rights.

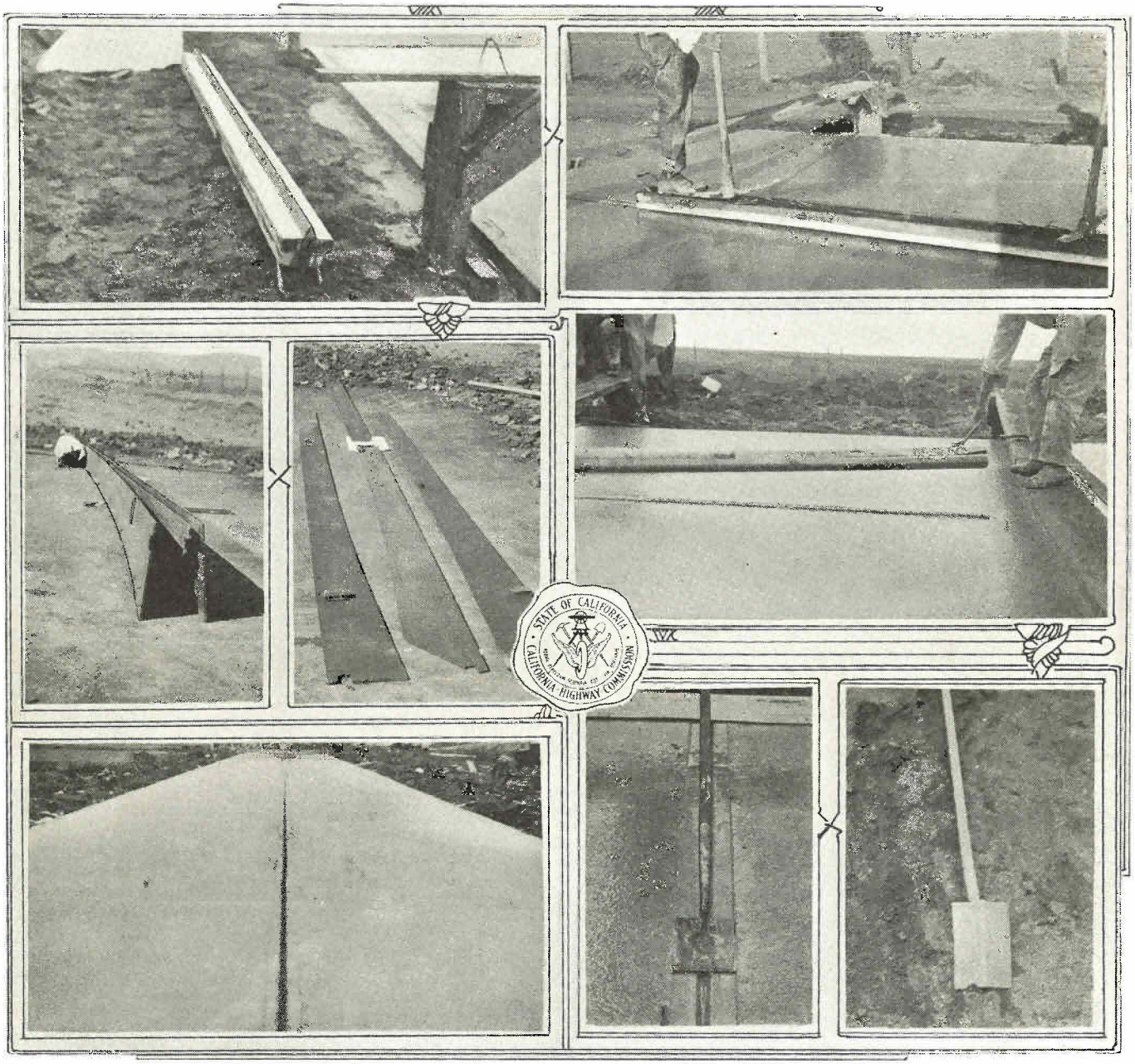
The occupants of the parlor car of the Limited were startled by the abrupt entrance of two masked bandits.

"Throw up yer hands," commanded the bigger of the two. "We're gonna rob all the gents and kiss all the gals."

"No, partner," remonstrated the smaller one gallantly. "We'll rob the gents but we'll leave the ladies alone."

"Mind your own business, young fellow," snapped a female passenger of uncertain age. "The big man is robbing this train."

# DIVISIONS TRY NEW DEVICES FOR MAKING EXPANSION JOINTS




GROOVER AND HEADER PLATES FOR MAKING EXPANSION JOINTS AS DEVELOPED IN DIVISION VII—*Upper left,* groover for forming longitudinal joint. *Upper right,* making the impression in the soft concrete. *Right center,* removing groover after making impression. *Lower right,* finishing the longitudinal joint and tool used for this purpose. *Lower left,* finished longitudinal groove or joint. *Left center,* plates used in making transverse joints. The view at the extreme left shows relative position of plates which are held together by clips forming rigid header three-quarter-inch thick.

AN IMPORTANT problem in connection with the construction of concrete pavements, which has been given much thought by engineers, is the forming of a satisfactory expansion joint. The ideal to be attained is a joint which will properly take care of expansion and contraction, within a width that will not cause severe impact by traffic passing over the pavement surface.

A common practice has been to make the joint 1½ inches wide by the use of header boards. A serious fault of this method has been the obstacle encountered in removing the boards without damage to the ends of the pavement slab, as frequently results when the header is removed shortly after the placing of the concrete. If left for any length of time, it is often difficult to remove at all.

### Metal Plates are Tried.

To overcome these defects, and yet continue the practice of constructing asphalt and sawdust joints, several of the divisions of the California highway organization have been experimenting with *metal* header plates, which make possible a joint with a width of less than one inch.

Headers of this type were used recently in connection with the paving of the San Mateo-San Onofre Creek line change in San

Diego County, Division VII. The work was done under the direction of Resident Engineer W. D. Eaton, who has been studying for some time the development of plates of this type. Similar devices are being tried in Divisions VIII and X, but detail discussion of the results is not yet available.

The wooden headers formerly used were usually 1½ inches wide at the top, tapering to one inch at the bottom, to facilitate removal. The additional width at the top added nothing to the joint in taking up pavement expansion but did increase the probability of impact by traffic.

The new type of header, as developed in Division VII, consists of three ¼-inch *metal plates,* cut to conform with the proposed cross-section of the pavement, and held together by means of six small clips. The outside plates are constructed in halves while the center plate is in three parts, so that, when assembled, the middle section of the center plate laps the joints in the outside plates, making the header rigid.

The assembled header is held in place temporarily with stakes, the concrete being poured, tamped, and finished in the usual manner. The concrete is edged on both sides of the header, and when the pavement has set the plates are removed.

No difficulty in removing the header is reported, nor is the concrete broken, as often occurs with other types. The center section, of three parts, is pulled out first by the use of hooks applied to notches in the plate. This section is oiled before it is placed in position, and when it is removed, the two outer plates fall together and are easily lifted out of the pavement.

Joints constructed with the three-*plate* header have a uniform width extending from the surface of the pavement to the subgrade. The plates are practically indestructible and over any considerable period should prove less costly for construction of joints than the wooden types.

### Groover Also Developed.

Another device used on the San Diego job, and also developed by Mr. Eaton, after a trial of several different devices in Division VII and in other divisions, notably Divisions VIII and X, is a marker or groover used to make a longitudinal groove 1½ inches deep along the center line of concrete pavement.

The groove comes to a sharp angle at the bottom and creates a vertical plane of weakness running longitudinally in the center of the pavement. (Markers similar to this were used in Los Angeles City for a number of years to provide better traction on concrete pavements and also to cause cracks to form in the markings rather than in the pavements.) Stresses which occur in the pavement slab cause the pavement to crack along the plane of weakness which extends from the bottom of the groove vertically to the subgrade.

A longitudinal joint may be formed by this method with less difficulty and at a lower cost than by the use of parting strips of wood or other material. Placing of longitudinal parting strips in concrete pavement, true to line and grade, is quite difficult. If the strips are slightly submerged there is a tendency for the concrete to ravel along the joint, and if they project the finishing of the pavement surface is interfered with. When the kneading type of finish is used, the transverse movement of the machine has a decided tendency to force the center parting strip out of line. This results in a crooked center joint.

The use of the "V" groover does away with the need of parting strips on *second-story* work, while in pavements having a thickness of nine inches at the center, the parking strip may be submerged at least three inches below the surface of the concrete. In Division VII, the practice has been to firmly stake to the subgrade a wooden separator strip ½" thick and 5" in height in position. This leaves but 2½" of concrete to break to form the center joint.

### Apparatus Required.

Apparatus required for forming the longitudinal groove consists of two pieces of 2" x 6" shod with a metal plate which is provided with a "V"-shaped projection 1½ inches deep and running the full length of the board, generally ten feet long.

After the pavement has been finished full width, a chalk line is stretched any desired distance along the center and a straight line "snapped" in the soft concrete. The groover is then centered on the marked line and pressed into the soft concrete under a man's weight, assisted by light tamping with a hammer or pick.

The impression left in the pavement is smoothed and finished with a specially constructed finishing tool, which fits the groove. This tool is provided with a long handle for operating from a bridge.

Results so far in Division VII have been quite satisfactory. In addition to forming a longitudinal joint, the impression made by the groover furnishes a guide for painting the center traffic line on new pavements.

## LOS ANGELES STRIVES TO EQUAL STATE'S RECORD FOR CONCRETE

UNDER the heading "High Strength Concrete on State Highway," the *Municipal Employee,* official publication of the city employees of Los Angeles, has the following to say regarding the very high strength concrete secured on the recent Eureka-Arcata paving project on the Redwood highway, in Humboldt County:

> "The May issue of CALIFORNIA HIGHWAYS gives details concerning a new pavement just completed at Humboldt Bay in which unusually high strengths have been obtained. On 28-day tests the maximum was 6930 pounds, and the minimum 3160 pounds. The average of 64 tests was practically 5000 pounds, or 4980 pounds per square inch. This was obtained through the use of clean aggregate, high quality cement, mechanical tamper, and favorable weather for curing. A great deal of attention was paid to the grading of the sand and the aggregate.
>
> **This sets a very high record for highway work and one which should stimulate all inspectors and engineers to put forth every effort to accomplish results of a similar quality."**

## MAINTENANCE BUILDS MONO ROAD

(Continued from page 3.)

the character of the country traversed and the "before" and "after" conditions. Further convincing testimony that general maintenance funds applied to road construction have produced satisfactory results is provided by the local press, from which the following is quoted:

> **"One of the most appreciated improvements, in grades, alignment and surface made in recent years, is the stretch of sixteen miles recently completed between Convict Creek and Deadman Creek, Mono County. That road, formerly the most trying trip on this slope, is now a wide and fast highway."**

And thus a way was found to circumvent the omnipresent lack of funds. A most formidable barrier to through travel on Route 23 between Mojave and Alpine County has been removed. The terrors of the Deadman hills exist now only as memories and Inyo and Mono approaches to the scenic wonders of the high Sierra country may be reached in comfort and safety. A heretofore little known section of California, destined someday to be the playground of millions, has been made more accessible and has moved a step nearer, the writer believes, to its ultimate destiny.

A rich but very eccentric man died. The clergyman, who was young and new to the parish, thought it a fitting opportunity to call and comfort the widow. "You must not grieve," he told her. "The body that lies here is not your husband. It is merely a husk, an empty shell—the nut has gone to heaven."

# WHAT THE DIVISIONS ARE DOING

## 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.

SEVEN and a half miles of splendid new 20-foot concrete pavement was the Christmas present of the Commission to the people of northern Sonoma County. The new section of "second-story work" on the Redwood Highway, extending from the Russian River to Mark West Creek, was opened to traffic on December 21st. The contractor is now engaged in completing culvert extensions and the placing of quarry waste shoulders.

Grading of two line changes, at Mark West Creek and near the north city boundary of Santa Rosa, is now progressing and the work will be completed for this season by the placing of crushed rock surfacing on these two sections.

### Contra Costa Job Completed.

Widening of the state highway in Contra Costa County, between San Pablo Creek and El Ciervo, has been completed and accepted by the Commission. The improvements in alignment and the widened pavement are being favorably commented upon by motorists. The new width of the surfacing is thirty feet.

S. A. Martindale has completed the placing of approximately two miles of new standard guard rail on the Skyline Boulevard between San Francisco and Kings Mountain, San Mateo County.

## DIVISION VI.

HEADQUARTERS, FRESNO.

J. B. WOODSON, DIVISION ENGINEER.

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

THE Federal Paving Company has completed the placing 8.2 miles of asphalt concrete surfacing on the trunk highway north of Bakersfield. The old concrete pavement has been used as a base for the widened and thickened pavement. Rock borders are now being placed.

Additional land has been purchased to enlarge the maintenance stations at Los Banos, on the Pacheco Pass highway, and at Lemon Cove, on the Sequoia Park lateral.

Fresno County has awarded a contract to the A. J. and J. L. Fairbanks Company for the construction of the Coal Creek cutoff, west of Coalinga, a section of the Sierra to the Sea lateral. When completed, the section will be taken over as a part of the state highway and placed under state maintenance.

## DIVISION VII.

HEADQUARTERS, LOS ANGELES.

S. V. CORTELYOU, DIVISION ENGINEER.

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

ON THE Oceanside-San Onofre reconstruction project, in northern San Diego County, placing of "second-story" pavement has been completed for a distance of four miles. Grade widening has been finished from the San Onofre end of the project to the Las Flores under crossing.

Placing of concrete pavement on the Whittier Boulevard extension will be completed in the immediate future.

### Curves to be Eliminated.

With the exception of an important line change near the Big Tujunga Wash, which will eliminate four dangerous curves, practically all grading has been completed for the widening of the state highway between San Fernando and La Canada on the Foothill Boulevard. Grading of the line changes is now in progress. Placing of flush concrete shoulders to widen the pavement from 15 to 20 feet is in progress.

On the contract for paving from Las Flores Canyon to Latigo Creek, between Santa Monica and Oxnard, fills are being dyked and flooded in connection with the preparation of the subgrade. Rough grading has been completed from Las Flores Canyon to Zuma and is in progress between Zuma Canyon and the easterly end of the Hauser contract.

Placing of sub-base for the asphalt macadam pavement is now in progress on the South Coast Highway from Laguna to Newport, in Orange County. Four miles will be paved with cement concrete and 5.8 miles with asphalt macadam.

## DIVISION VIII.

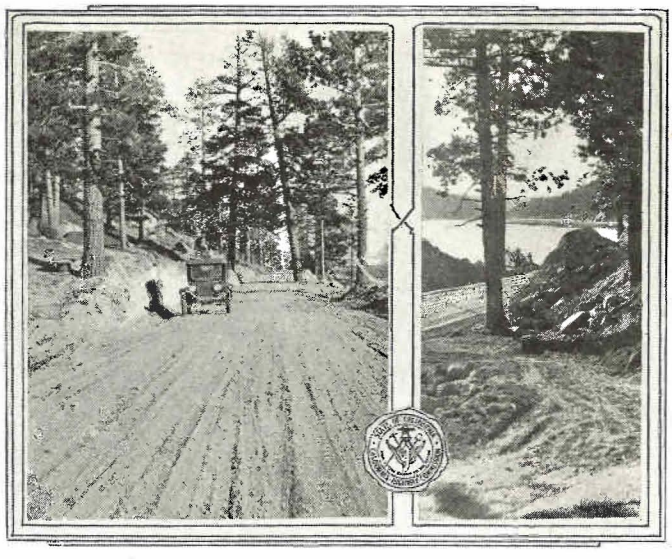
HEADQUARTERS, SAN BERNARDINO.

E. Q. SULLIVAN, ACTING DIVISION ENGINEER.

Counties of San Bernardino, Riverside, and Imperial.

TWO important reconstruction projects have been completed and opened to traffic in Division VIII.

Widening and thickening of the old county pavement from the Santa Ana River bridge to the west city limits of Redlands, an important section of the San Bernardino-Redlands section of the state highway, has been completed. The new pavement has a width of 20 feet with a minimum thickness of five inches. It has two-foot rock borders on either side and the shoulders have been graded evenly to the curb line. Local property owners are considering the installation of curbs and gutters at their own expense. Basich Brothers were the contractors and R. L. Young, resident engineer.



NEW ROAD AT BIG BEAR LAKE—Views of reconstruction recently completed on this popular San Bernardino mountain highway. The new and old roads are shown at the right.

### Fawnskin Grading Completed.

Another reconstruction project in Division VIII was the rebuilding of a section of the scenic Rim of the World highway in the San Bernardino mountains, from the dam at the lower end of Big Bear Lake to Fawnskin. The improvement consists of a relocation of the road along the lake shore and the grading of a roadbed to a width of 20 feet. The stand of pine timber within the right of way has been preserved wherever possible. This route serves a heavy recreational traffic. M. S. Ross was contractor and H. L. Cooper, resident engineer.

(Continued on page 14.)

# COMMISSION APPROVES CALIFORNIA ROUTES IN SYSTEM OF UNITED STATES HIGHWAYS

THE routes within California to be included in the system of United States Highways have been formally approved by the California Highway Commission. No changes were suggested in the system as originally selected by the Joint Board of Interstate Highways, of which R. M. Morton, State Highway Engineer, was a member.

The report of the board which sets up a system of main interstate trunk highways, the more important roads of the federal aid system, recently received the approval of Secretary of Agriculture W. M. Jardine and was by him submitted to the highway departments of the several states.

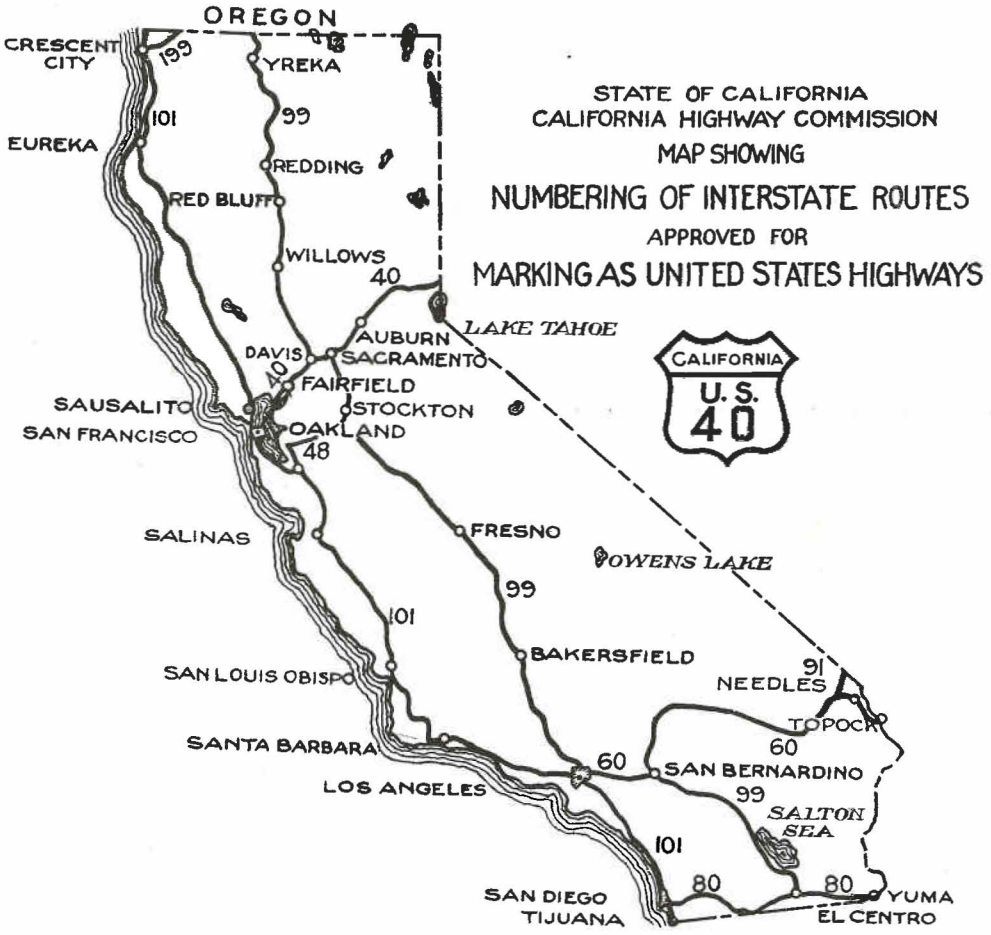
Each route has been given a number, the report also including designs for standard direction and warning signs. The purpose of the movement is to end the present confusion, the result of widely varying systems of highway marking existing in the several states.

### Recommendations of Report.

The 75,884 miles of road selected for marking as United States highways includes 145 routes. Those running east and west are designated by even numbers and those north and south by odd numbers.

All of these routes eventually will be marked with the standard direction and warning signs which are of two general classes. One group, the danger and caution signs, will consist of signs of four different shapes representing as many degrees of danger. These will have a yellow background with black letters and symbols. The other group will include the standard route markers in the form of a United States shield and directional and informational signs. All signs in this group will have a white background with black letters.

The report of the joint board recommends that all of the signs, with the exception of the route marker, be used on all state highways in order to familiarize the public with the signs. The use of the United States shield as a route marker, as shown in connection with the map reproduced on this page, is to be restricted to United States highways.




### Routes in California.

California is crossed by two of the north and south routes and three of those extending east and west.

**Route 99 follows, in part, the route now designated as the Pacific Highway, extending southward through Yreka, Redding, Red Bluff, Willows, Woodland, Davis, Sacramento, Stockton, Fresno, Bakersfield, Los Angeles, San Bernardino to El Centro.**

**Route 101 follows the Redwood and Coast highways through Crescent City, Arcata, Eureka, Willits, Sausalito, San Francisco, San Jose, San Luis Obispo, Santa Barbara, Los Angeles, Whittier, Santa Ana, San Diego to Tijuana.**

**The Crescent City-Grants Pass connection is designated Route 199, and Route 91, which extends north and south through Salt Lake City, enters California near Needles, San Bernardino County.**

**The first east and west route in California is Route 40, the Victory Highway, which passes westward through the center of the nation entering California through the Truckee River canyon, thence through Auburn, Sacramento, Davis, Fairfield, Benicia, Martinez, Richmond to Oakland.**

**The next of the east and west routes is Route 48, which extends from Stockton to Oakland and San Jose.**

**Route 60, the National Old Trails, enters the state at Topock and extends westward through Barstow to San Bernardino and Los Angeles.**

**The most southerly route is Route 80, the Old Spanish Trail, which runs westward through Yuma, Arizona, to El Centro and San Diego.**

### Secretary Stresses Importance of Move.

In his letter of approval Secretary Jardine said, in part:

"This adoption of the proposals of the board will accomplish a marked advance in the highway system and building program of the country as a whole. The clear designation of important routes of travel will be a distinct advantage not only in eliminating confusion, but also in furthering systematic and continuous construction.

"Uniform marking through the system of danger signs provided should promote safety of travel, especially if it can be associated with uniform traffic regulations. The directness of the through routes will doubtless serve a very large number of our population that travel from one general section of our country to another and will facilitate that freedom of communication which more than anything else binds our states and our country in one united nation."

# DIVISION REPORTS

## 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.

IN ADDITION to his regular duties, Maintenance Inspector Clarence Bovey has been acting as inspection for the Divison of Architecture on the grading and graveling of 1.6 miles of roadway in the grounds of the Stoctkon State Hospital. The cooperation was gladly extended at the request of the Division.

Bids have been asked for the dredger fill at the west approach of the M street bridge at West Sacramento, and actual building of an improved approach to Sacramento from the west soon will be under way. This is a part of the general program for the improvement of the Sacramento entrances.

### San Joaquin Project Completed.

The largest of the 1925 projects in Division X, the reconstruction of the state highway between Turner Station and Stanislaus River, San Joaquin County, is now completed and open to traffic, including the sections within the city of Manteca. The highway routes through this municipality were paved full width, the state and local property owners cooperating. J. F. Knapp was the contractor and C. W. Springer, resident engineer.

Some exceptionally low vialog records were made on this project, which is the division's outstanding improvement for the past year.

# EQUIPMENT DEPARTMENT

R. H. STALNAKER, EQUIPMENT ENGINEER.

THE new shop at Fresno has been completed and the Fresno branch of the equipment department soon will be housed in the new building, which provides additional room and better facilities for handling the repair work of the San Joaquin Valley. Major repair work of Division VI will be handled at the new shop.

The Commission has approved an allotment of $4,000 for the installation of additional equipment at the new San Bernardino shops.

A modern paint shop has been installed at the Sacramento headquarters for the handling of paint work on state-owned vehicles operating out of Sacramento.

### Wedding Announced.

The news has reached headquarters of the marriage recently of A. G. Zecher and Miss Madeline Hayes of San Francisco. The groom is foreman in charge of the sub-shop at Bakersfield. Superintendent E. S. Anderson and his assistants of Shop Six extend their congratulations.

# SUPERINTENDENT HONORED

USERS of state highways in the El Dorado section, Division III, at Christmas time presented Maintenance Superintendent Harry L. Montfort with a handsome gold watch and chain, accompanied by a written testimonial of their appreciation of the improvement accomplished during the past year on the route between Placerville and the Nevada line and in the vicinity of Lake Tahoe.

The El Dorado County Chamber of Commerce, the American River Home Owners' Association, stage and resort owners, and individual citizens joined in presenting the gift.

Superintendent Montfort has been in charge of the district for the past two years and has three maintenance foremen working under his direction. The evident approval with which the people view the maintenance of state highways in El Dorado County is gratifying, indeed, to Mr. Montfort's superiors.

# LOS ANGELES ENGINEER SAYS CALIFORNIA STATE HIGHWAY BRIDGES EQUAL NATION'S BEST

BRIDGES now under construction on California state highways are the equal if not superior to similar structures being built in other parts of the country; particularly is this true of the average strength of concrete in California bridges as compared with bridges elsewhere.

This opinion is expressed by H. P. Cortelyou, Engineer of Construction in the office of the Inspector of Public Works of the city of Los Angeles, which has under way an expenditure of $10,000,000 on heavy bridges and viaducts. That the city might take advantage of latest and best methods of construction, Mr. Cortelyou and Mr. Merrill Butler, Chief of Bridge Design, were sent on a six-weeks trip to study the bridge practice of eastern states. They visited Minneapolis, Chicago, Detroit, Cleveland, Buffalo, Boston, New York, Philadelphia, Washington, D. C., Pittsburgh, St. Louis, and Kansas City, in which cities they were given every opportunity, Mr. Cortelyou reports, to thoroughly inspect bridges, both completed and under construction.

### California Results Not Equaled.

Writing of his trip to Harlan D. Miller, Bridge Engineer for the California Highway Commission, Mr. Cortelyou, says, in part:

> The fineness modulus or other scientific methods of proportioning are being used in only a few rare instances, and in several places its use has been abandoned. Professor Abrams himself says that it is but a means to an end and he now advocates the water cement ratio specification, under which the new Portland Cement Association Building in Chicago is being constructed with excellent results.
>
> I judge that the average strength of 1:2:4 concrete on bridges throughout the country will average about 2000 to 2200 pounds per square inch at 28 days. On the best jobs this average is about 2500 to 3000 pounds per square inch.
>
> **I will say that nowhere in the country have I seen or even heard of the equal of results which you are getting on bridges for the California Highway Commission, for I understand that you are getting an average of about 3700 pounds at 28 days. I consider this a very remarkable achievement and one for which you and your assistants can not be given too much credit.**


ON THE MALIBU JOB—A straightedge with cleats at various angles used for checking slopes on the Malibu Ranch grading contract, Division VII. This device was described in the December issue of the Bulletin.

## BRIDGE DEPARTMENT NEWS

HARLAN D. MILLER, Bridge Engineer.

PLACING of the deck and railings on the great Klamath River bridge on the Redwood Highway has been begun by the contractor and early completion of the bridge may be expected.

Work has been begun on the Merced River bridge at El Portal on the Yosemite National Park highway entrance, and plans have been finished for three additional structures to be built on the Briceburg section of this important highway.

Work has started on the construction of the Carlsbad overhead crossing of the Santa Fe railroad in San Diego County. This structure of five spans of reinforced concrete will eliminate a dangerous grade crossing. W. S. Kingsbury Jr. is resident engineer.

### Villa Creek Bridge Progresses.

Placing of the superstructure of the Villa Creek bridge on the Pismo line change on the Coast Highway has been begun.

In Southern California, work is nearing completion on the large San Gabriel River bridge near Whittier and on the San Juan Creek bridge near San Juan Capistrano. The Montebello subway also is nearing completion.

Three small concrete structures on the state road leading to the California Redwood Park, in Santa Cruz County, have been completed and accepted.

Driving of concrete piles for the foundation of the Willow Brook bridge near Petaluma on the Redwood Highway has been begun by the contractors.

### Draftsmen in Los Angeles.

To facilitate the work of the Bridge Department in the southern part of the state, five or six draftsmen have been transferred to Los Angeles where they have quarters in the offices of Division VII. Chas. W. Jones, formerly of the Sacramento office, is in charge.

Harold J. Peacock, popular member of the headquarters staff of the Bridge Department, has resigned to accept a position with a Sacramento engineering firm.

## MONTECITO RESIDENT COMMENDS DIVISION V HIGHWAY PROJECT

THE STATE highway through Montecito, immediately south of the city of Santa Barbara, recently was reconstructed to a width of thirty feet with heavy cement concrete shoulders and an asphalt concrete surfacing over the old pavement. The work was done under the direction of Division V, and traffic was maintained over the highway right of way during the period of construction.

That local residents believe a good job was done and that they appreciate the manner in which the work was supervised by the division, is evidenced by the following letter received by Division Engineer L. H. Gibson:

> "According to the local papers, you have inspected the stretch of highway recently rebuilt in Montecito, so that it is unnecessary to tell you that it may justly be considered one of the finest pieces of road in the state.
>
> In connection therewith it will, however, not be amiss to say a word of commendation regarding the painstaking manner in which the work, as a whole, was handled by your staff.
>
> The heavy through traffic, in conjunction with the local Montecito traffic, was given the utmost possible consideration, consistent with due regard for the rights of the contractor. There was no interference nor inconvenience caused to auto traffic at any time during the progress of the work.
>
> The writer resides in Montecito, close to the state highway, and daily trips to Santa Barbara warrant an expression of opinion in the matter.
>
> (Signed) A. E. Aeby."

E. B. Brown was resident engineer on this project. The Cornwall Construction Company of Santa Barbara was the contractor.

## FRENCH GRAY NEW COLOR FOR COMMISSION VEHICLES

MOTOR vehicles, including trucks, operated by the Commission hereafter will be finished in a uniform color, a distinctive French gray having been approved for that purpose, it is announced by Equipment Engineer R. H. Stalnaker.

A number of cars already have been turned out by the new headquarters paint shop and within a short while all of the equipment in use in the various divisions will be repainted, and will have impressed upon each vehicle the new seal of the Commission in three colors, red, gold and black.

A transit and a winged wheel are dominant symbols of the seal which bears the latin motto: "Robur directum scientia est via fortunæ." This is translated "Energy directed by science is the highway to prosperity."

Under a ruling of the State Board of Control, other state departments will not be permitted to use the color selected by the Highway Commission.

### New Paint Shop Established.

In pursuance of the new policy, a study of various painting systems was made by the Equipment Department and the use of a nitro-cellulose lacquer for all passenger cars was decided upon. For the present, an oil paint will be used on the trucks and other equipment.

A complete lacquer painting system has been installed at the headquarters shop at Sacramento and two traveling outfits also have been fitted up. These outfits are now making a tour of the several divisions, painting the passenger cars in each division as they pass through. Early in January, this work was more than half completed and in another month or six weeks, Mr. Stalnaker says, all of the passenger cars of the Commission will have been finished in the new standard color and will have the new seal and sign on the doors.

## *HIGHWAY NEWS NOTES*

### Fresno News.

RESIDENT Engineer T. W. Voss has been transferred to El Portal in connection with the work to be done on the Yosemite Highway by the Folsom Prison camp.

Norman Coote, assistant resident engineer at Bakersfield, has resigned to enter the services of a Los Angeles engineering firm.

A. N. Wakefield, chief of party on the Yosemite Highway grading project, was married recently to Miss Hostetter of Mariposa.

### Division X Foreman Transferred.

Division X announces the transfer of J. H. Gates to San Andreas to take over the maintenance district formerly in charge of Foreman R. Brennan, deceased. C. L. Caine, assistant resident engineer, will take the place of Mr. Gates at Fairfield.

T. M. Joyce has been transferred from Briceburg, Division VI, to act as sub-forman under S. E. Harris, at Jamestown.

### Another Packard.

The hopes of L. D. Packard that he might add to the ranks of the Bridge Department were not realized when Miss Betty Jean Packard, the second Packard, arrived recently, without even mentioning the Highway Commission.

Claude Simpson of the filing department won third prize in the Sacramento Christmas tree contest. His entry was a handsome redwood, growing in his front yard, which had been prettily decorated for the holiday season.

Commissioner Louis Everding was a visitor at headquarters recently upon the occasion of the opening of the bids for the Big Lagoon grading and bridge project, in Humboldt County.

### Times and Roads Change.

It's hard for the average local citizen to realize that 40 years ago there was no such thing as a spark plug and every road was a detour.

# 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 DEC. 14, 1925.** | | | | | | |
| 465 | VIII | Imperial | 26 | F, G | Imperial to Brawley | 9.39 | Grade and Gravel Surface | H. G. Fenton | $113,547 83 | April 7, 1925 | ------ |
| 470 | III | Nevada | 38 | A | Across Truckee River at Prosser Creek | ------ | R.C. Girder Bridge | T. H. and M. C. Polk | 25,981 88 | June 17, 1925 | ------ |
| 472 | II | Tehama | 7 | A | Through Corning | 1.00 | P.C. Concrete Pavement | E. A. Burns | 44,268 41 | June 17, 1925 | ------ |
| 481 | IV | San Mateo | 55 | A, B, C | Northerly Boundary to Kings Mountain Road | ------ | Guard Rail | Samuel A. Martindale | 9,112 50 | Sept 3, 1925 | ------ |
| | | | | | **AWARDED SINCE DEC. 14, 1925.** | | | | | | |
| 491 | VIII | Imperial | 27 | B | Across the Sand Hills | 5.96 | Grade and A.C. Pavement | Schmidt and Hitchcock | 319,500 00 | Dec. 30, 1925 | 300 |
| 492 | I | Humboldt | 1 | J | Across Big Lagoon | 1.40 | Grade and Gravel Surf. Timber Trestle | Mercer-Fraser Co. | 140,251 00 | Jan. 18, 1925 | 200 |
| | | | | | Sub-total | 7.36 | | | $459,751 00 | | |
| | | | | | **PENDING AWARD.** | | | | | | |
| ------ | X | Yolo | 6 | C | Fifth Street in Washington to the M Street Bridge | 0.25 | Grading | | 18,000 00 | ------ | 90 |
| | | | | | Total State Highway Fund Contracts Awarded and Pending Award | 7.61 | | | $477,751 00 | | |

NOTE.—Primary construction covered by the above contracts does not include funds obligated on cooperative forest highway projects, prison road camp 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 DEC. 14, 1925.** | | | | | | |
| M-65 | X | San Joaquin | 4-66 | A, B-A | Southerly Boundary to Turner Station | 12.27 | P.C.C. Pavement and Shoulders | J. F. Knapp | $329,436 79 | Mar. 26, 1925 | ------ |
| M-72 | V | Santa Barbara | 2 | J | Ortega Hill to Santa Barbara | 1.87 | P.C.C. Pave. and Shldrs., A.C. Surface | Cornwall Construction Co. | 91,503 84 | May 4, 1925 | ------ |
| M-74 | VII | Orange | 2 | A | San Juan Creek to Galivan | 5.59 | P.C. Concrete Pavement | Jahn and Bressi | 188,662 03 | May 4, 1925 | ------ |
| M-75 | IV | Contra Costa | 14 | A, B | San Pablo Creek to El Ciervo | 6.64 | Asphalt Mac. Surf. and Widening | Kaiser Paving Co. | 165,565 46 | May 4, 1925 | ------ |
| M-81 | III | El Dorado | 11 | E, F | Camino to 2 miles East of Sportsman Hall | 5.77 | Grade and Rock Surface | Irey and Holden | 75,171 58 | May 20, 1925 | ------ |
| M-84 | VIII | San Bernardino | 26 | A | Santa Ana River to Redlands | 5.49 | P.C.C. Pave. and Shldrs., A.C. Surface | Basich Brothers Co. | 157,147 54 | June 3, 1925 | ------ |
| M-99 | VIII | San Bernardino | 43 | D | Big Bear Dam to Fawnskin | 3.27 | Grading | M. S. Ross | 32,609 54 | Sept. 21, 1925 | ------ |
| | | | | | **AWARDED SINCE DEC. 14, 1925**—None. | | | | | | |
| | | | | | **PENDING AWARD**—None. | | | | | | |

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.





CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

42891 1-26 3700