Aluminum Falsework

Is Used on Richmond-San Rafael Bridge

By FRANCIS J. MURPHY, C.E.*

A CONTRACT in the amount of approximately $25,000,000 for the construction of the superstructure of the Richmond-San Rafael Bridge was recently awarded to Judson Pacific-Murphy-Kiewit, a joint venture consisting of the Judson Pacific-Murphy Corporation of Emeryville, California; Peter Kiewit Sons' Company of Omaha, Nebraska; Stolte, Inc., of Oakland, California, and the Fred J. Early, Jr., Company of San Francisco, California.

The bridge is 4.01 miles long and, when completed, will be the second longest over-water bridge in the world; the longest being the San Francisco-Oakland Bay Bridge, and the third longest being the recently completed Chesapeake Bay Bridge. The new span is being built under the direct supervision of Norman C. Raab, Projects Engineer of the Division of San Francisco Bay Toll Crossings.

New Developments

There are many new developments being used by the contractors in the construction of this job. One of the most noteworthy, and the one we shall dwell upon in this article, is the use of structural aluminum for falsework. It is believed that this is the first such use of aluminum in construction history.

The job is composed of 36 100-foot girder spans, two cantilever spans having identical anchor spans of 537.5 feet with main span clearance of 1,070 feet, and 36 289-foot truss spans. The aluminum falsework is being used for the erection of 27 of the 36 289-foot spans. The remaining nine 289-foot truss spans have been floated into place in one piece because the bottom chord elevation was low enough so that the use of aluminum was not necessary.

Method of Erection

The aluminum span as shown in *Figure 1* was fabricated in Judson Pacific-Murphy Corporation's plant in Emeryville and riveted and assembled

Aluminum falsework truss being towed to bridge

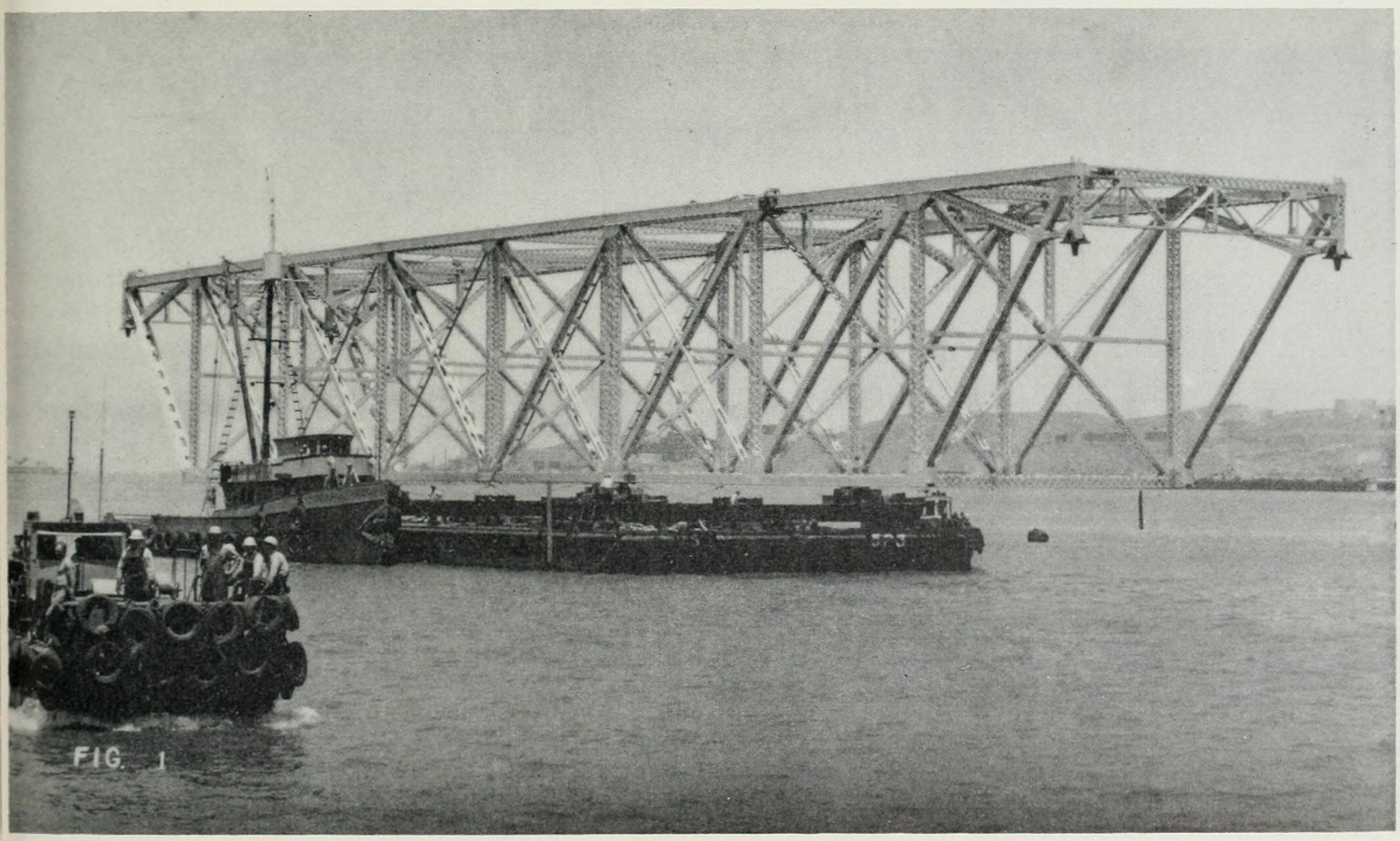


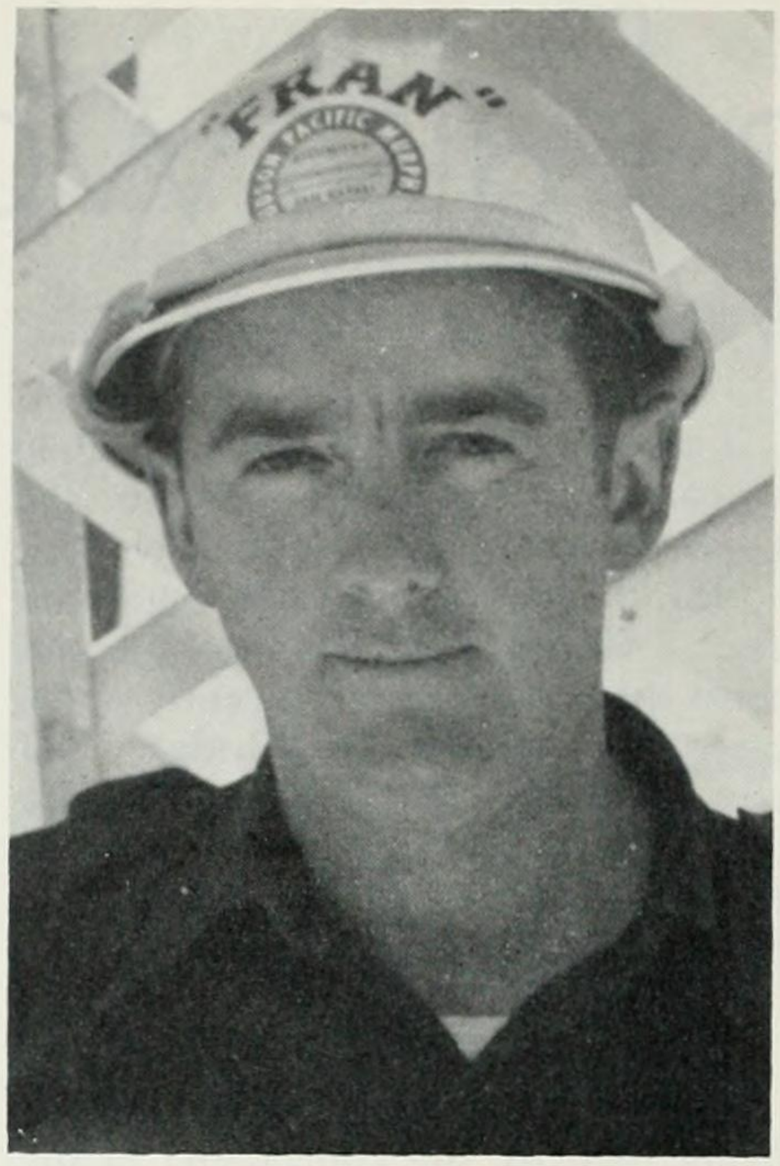
FIG. 1

* NOTE: Francis J. Murphy received his B.S. in Civil Engineering at the University of Santa Clara. He is an associate member of the ASCE and project manager on the superstructure contract of the Richmond-San Rafael Bridge. A registered engineer in the State of California, Mr. Murphy has been employed by the Judson Pacific-Murphy Corporation since its formation in 1945.

by joint venture personnel at its Richmond yard. It was then raised by two conventional derrick barges onto two Army surplus BK barges and floated out to the jobsite. It was then raised into position and supported by vertical wooden timber bents attached to the existing steel towers and, after erection, it forms a falsework platform. The wooden towers can be seen at either end of the aluminum span in *Figure 2*. The span will support the individual members of the truss span until it is finally swung into place and literally becomes a bridge.

Figure 3 shows a view of the aluminum truss before the steel erection is started. This truss is 285 feet long, 42 feet wide and 42 feet deep and weighs 110 tons. A similar truss made of steel would weigh approximately 330 tons and could not be handled by conventional hoisting equipment.

Figure 4 shows steel erection using a double-boomed erection traveler with the aluminum span as falsework. These aluminum spans cost approximately $150,000 each, and are one of the largest applications of structural aluminum in history. The only larger applications, tonnage-wise, are an arch-type bridge in Canada and the Alcoa Building in Pittsburgh.



FRANCIS J. MURPHY

Steel Rivets Used

Channels up to 12 inches, plate up to three-quarters of an inch, and angles to five-eighths of an inch were rolled at Alcoa's Massena, New York, mill and constituted 90 percent of the tonnage. The largest individual sections of the aluminum truss built up on plates and angles have a cross section of 27¾ inches x 19 inches. The heavy sections and long lengths required the limits of the Massena mill, one of the largest aluminum mills in the world.

Steel rivets were used in the aluminum assembly since they were more readily available and easier to heat and drive.

The firm of Earl and Wright, San Francisco was engaged by the contractors as consultants on this job, and thy have certainly performed remarkably well. In designing the aluminum, they followed closely the "Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy" published as paper No. 2532 in Volume 117 (1952) of the Transac-

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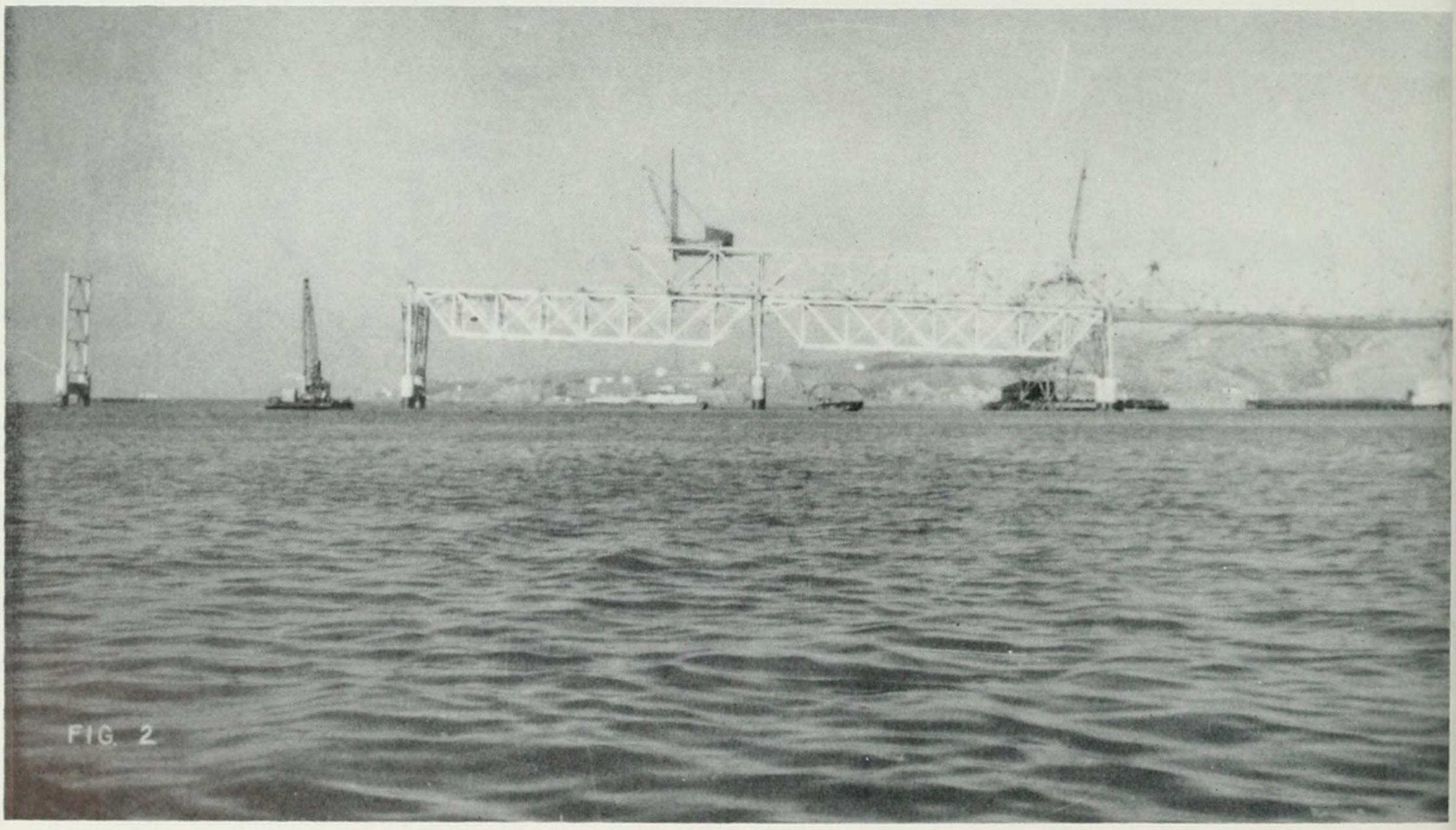
Aluminum falsework truss supporting erection traveler



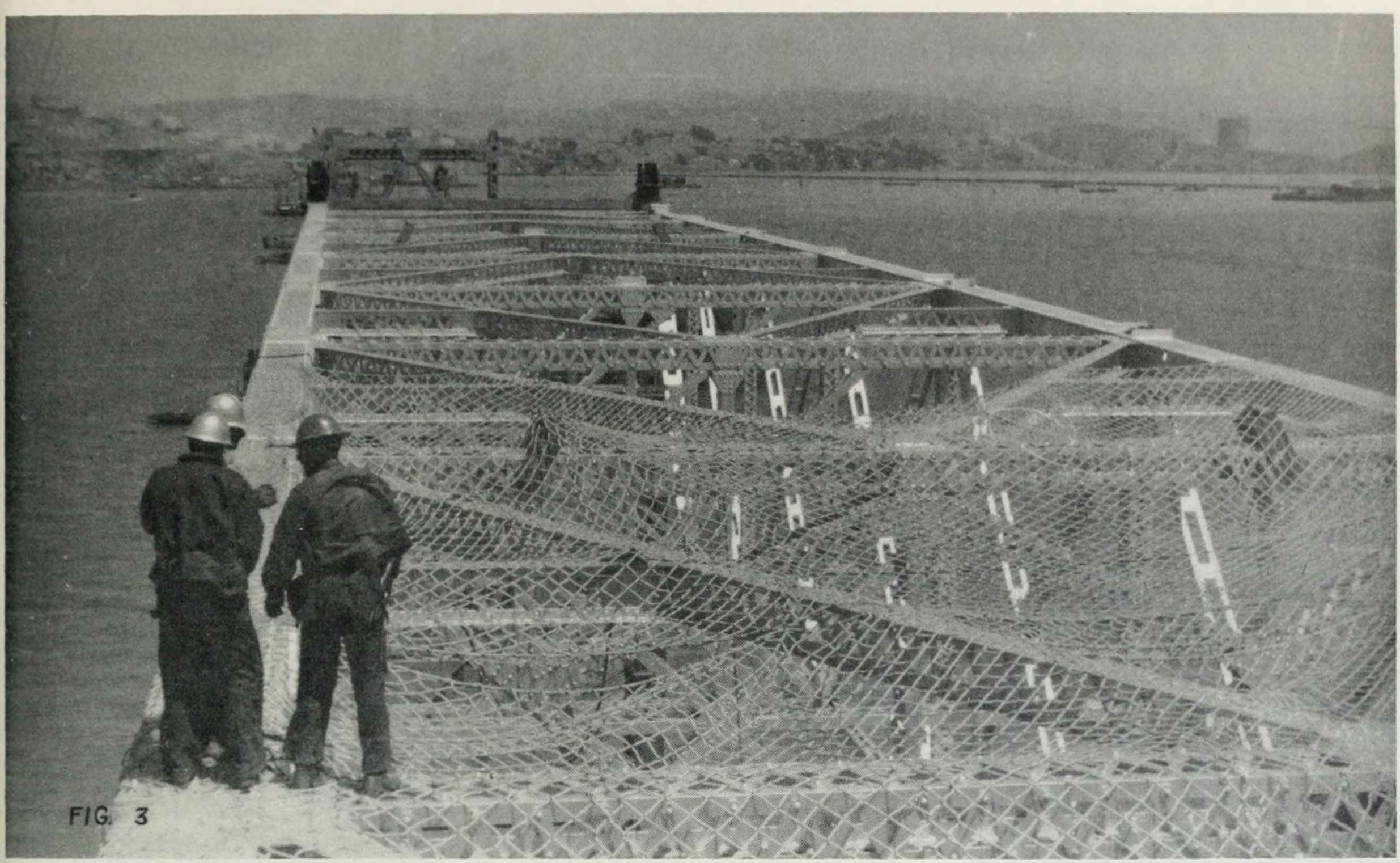


FIG. 3

Spreading safety nets on the aluminum span

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

Status of work under contract for the Richmond-San Rafael Bridge project as of April 30, 1955:

Contract No. 1002A—Borings, $62,000. Awarded February, 1952. Completed July, 1952.

Contract No. 1003—Substructure, $14,500,000. Awarded February, 1953. Completion October, 1955. Status—99 percent complete.

Contract No. 1004D—Superstructure, $21,000,000. Awarded February, 1953. Completion October, 1956. Status—69 percent complete.

Contract No. 1005—Mole Fill, $248,000. Awarded May, 1953. Completed December, 1953.

Contract No. 1007—Trestle Approach, $192,000. Awarded September, 1953. Completed August, 1954.

Contract No. 1008—Richmond Approach, $741,000. Awarded December, 1954. Completion March, 1956. Status—29 percent complete.

Contract No. 1009—San Rafael Approach, $216,000. Awarded March, 1954. Completed November, 1954.

Contract No. 1010—Buildings and Toll Plaza, $290,000. Awarded August, 1954. Completion August, 1955. Status—61 percent complete.

Contract No. 1011—Electrical Work, $1,000,000. Awarded December, 1953. Completion August, 1956. Status—20 percent complete.

Contract No. 1012—Toll Collection Equipment, $280,000. Awarded September, 1954. Completion May, 1956. Status—10 percent complete.

Contract No. 1015—Separation Structures, $610,000. Awarded August, 1954. Completion November, 1955. Status—30 percent complete.

Status of the work on the entire project is 70 percent complete.

Director of Public Works, Frank B. Durkee, on May 12 awarded the last major construction contract on the project as originally planned. Paving of the lower deck of the structure will follow as a separate contract.

The contract awarded went to J. H. Pomeroy & Co., Inc., San Francisco, in the amount of $844,344.40 for the construction of eight reinforced concrete piers on steel piles at pier locations, the erection of 17 structural spans and the erection of 11 structural spans at pier locations in Contra Costa and Marin Counties.

Coincidentally Durkee authorized the Division of San Francisco Bay Toll Crossing to advertise for bids for grading and paving the Richmond toll plaza and approach roads for the bridge and grading and paving the yard area of the San Rafael Maintenance Building and constructing a separation. This work is estimated to cost in excess of $400,000 and with the Pomeroy contract is to be financed from the $50,000,000 construction fund set up under the $62,000,000 issue of Series A bonds, Richmond-San Rafael Bridge Toll Bridge Revenue Bonds.

ALUMINUM FALSEWORK

Continued from page 46 . . .

tions of the American Society of Civil Engineers.

Highest Strength Aluminum Alloy

These specifications were drawn up for the highest strength aluminum alloy (14S-T6), formed by alloying copper and other light metals with aluminum followed by heat-treating. According to these specifications, the following factors in structural aluminum design are important:

Basic allowable tensile working stress is 22,000 psi based on minimum yield strength of 53,000 psi and minimum tensile strength of 60,000 psi.

Modulus of elasticity in tension and compression is 10,600,000 psi (this compares with 30,000,000 psi for steel).

Coefficient of expansion is 0.000012 per degree (double the 0.0000065 per degree F. of steel).

Weight is 0.10 pci (steel is 0.28 pci).

Aluminum structures must be protected by paint, although alloying aluminum reduces resistance to corrosion. The fabricated members are first given a thorough cleaning with a mild phosphoric acid solution. This is followed by a prime coat of zinc chromate. Finish coat for the erected spans is an aluminum pigmented paint.

The major reasons for the contractors using aluminum as falsework are:

1. It eliminated the use of conventional falsework piling for the 27 spans which, due to the location and height of the bridge, and because of the depth of water and mud (down to minus 200 feet in some places) would prove extremely expensive.

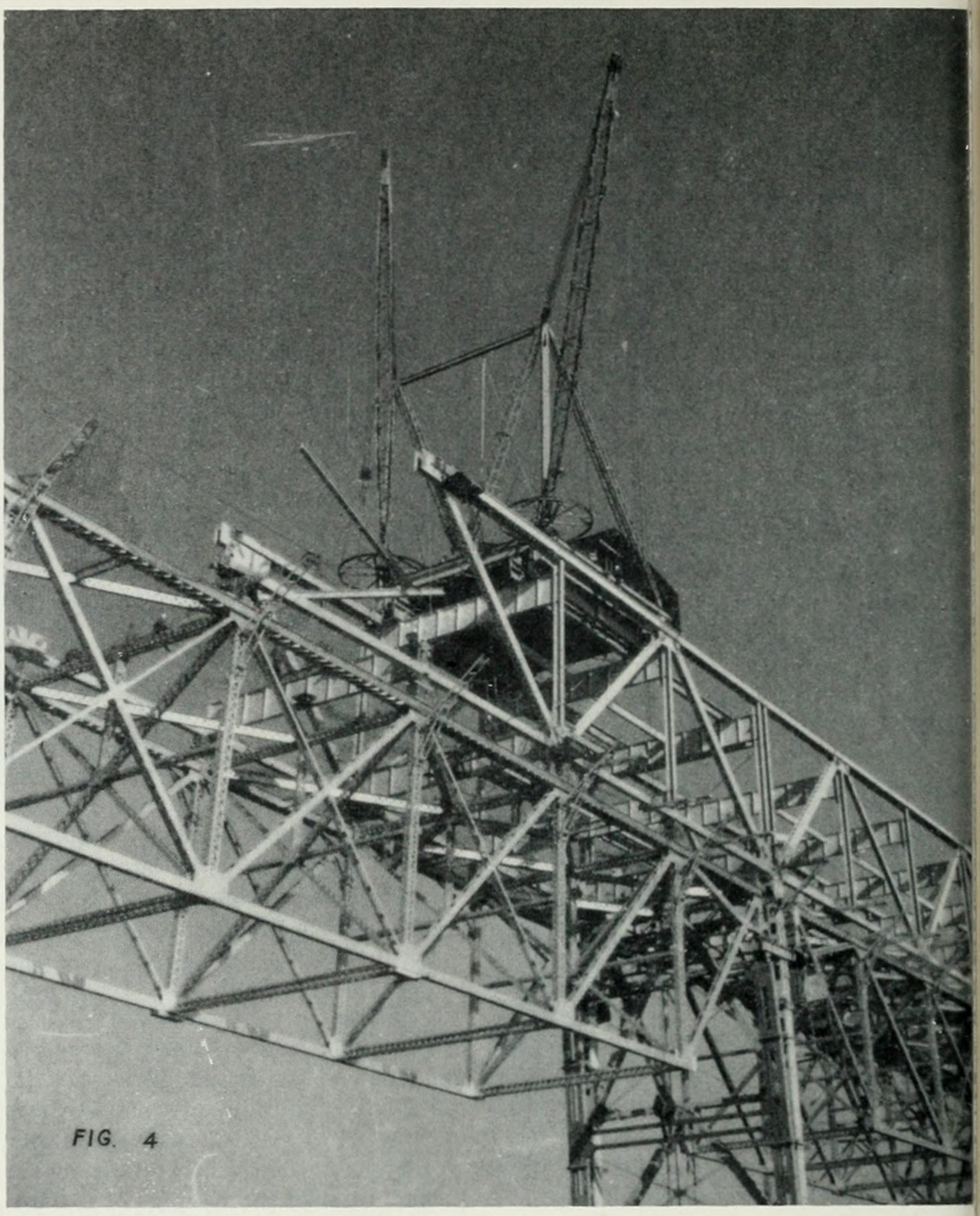
2. The fact that the bridge was designed with 36 typical 289-foot truss spans made it advantageous to use a falsework system that would allow repetition of operation.

3. The aluminum span is covered with a safety net, and the contractors feel that this is one of the safest methods of bridge construction ever devised.

Construction on Schedule

The Richmond-San Rafael Bridge was designed by the Division of San Francisco Bay Toll Crossings under the direction of Norman C. Raab. The engineers for the Judson Pacific-Murphy-Kiewit joint venture who actually designed the aluminum falsework are Earl and Wright of San Francisco.

Construction of this huge project is on schedule, and it is estimated that the bridge will be complete and ready for traffic late in 1956.



Double-boomed traveler setting steel

PLEASED WITH FREEWAYS

SUPPLEE-WILLS-JONES MILK COMPANY
Lincoln-Liberty Bldg.
Philadelphia 7, Pa.

HIGHWAY COMMISSION
Sacramento, California

GENTLEMEN: I had occasion to visit Los Angeles recently and had the pleasure, I might add, extreme pleasure, of riding on your new wonderful freeways in that area. I had been in Los Angeles some four years ago when the freeways were just being started. In the meantime, I had heard here in the east, a lot of newspaper talk about traffic congestion in Los Angeles. I certainly will say that you people have it pretty well licked with your freeways. I want to add my congratulations to the vast number I know you must already have received.

Very truly yours,

SUPPLEE-WILLS-JONES MILK CO.
D. J. CRUMLISH,
Chief Engineer

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

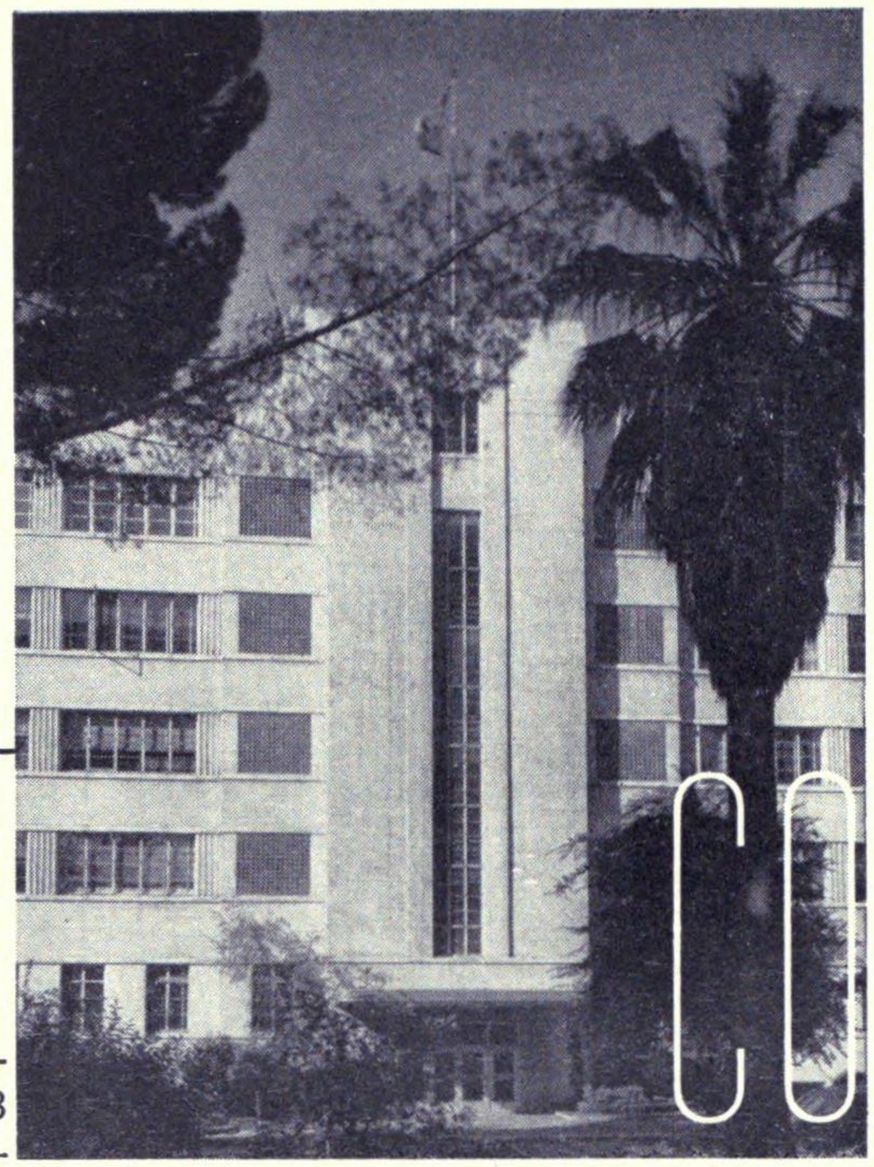
JULY-AUGUST
1956

California Highways and Public Works

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

KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Assistant Editor*
MERRITT R. NICKERSON, *Chief Photographer*

Vol. 35 July-August Nos. 7-8



Public Works Building
Twelfth and N Streets
Sacramento

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Record Span New Crossing

Richmond-San Rafael Bridge About Ready for Traffic

By NORMAN C. RAAB,
Projects Engineer

THE RICHMOND-SAN RAFAEL Bridge, one of the largest construction projects in the San Francisco Bay area, is to be opened to highway traffic on September 1, 1956. This structure, although it does not lay claims for any outstanding features, can, however, be classified as one of the world's largest bridges as shown on the accompanying chart.

Dedication Plans

Elaborate plans for the opening of the Richmond-San Rafael Bridge are being developed by the Department of Public Works and the citizens of Marin and Contra Costa Counties.

On Friday, August 31st, at 11 a.m., official dedication of the bridge will take place at the toll plaza. Governor Knight will deliver the dedicatory address and will unveil a bronze tablet containing an historical record of the project.

Following the dedication ceremony, the structure and buildings will be open for public inspection until 6 p.m. No automobile traffic will be allowed on the bridge during this inspection period.

At 12.01 a.m., Saturday, September 1st, the first vehicle will pass through the toll lanes and the bridge will be opened for business.

Plans are being completed for civic participation and celebration as a part of the opening ceremonies.

On July 10th, the California Toll Bridge Authority adopted the following toll schedule for the bridge:

No.	Classification	Toll
1	Automobile, motorcycle, tricar, light delivery automobile, ambulance, hearse, housecar, noncommercial truck, station wagon, and taxi	$0.75
2	Commutation book (for Class 1 vehicles except light delivery automobile and noncommercial truck) *	18.75
3	Class 1 vehicle drawing a 1-axle trailer	1.25
4	Class 1 vehicle drawing a 2-axle trailer	1.50
5	Truck, 2-axle	1.25
6	Truck,† 3-axle	1.75
7	Truck, 4-axle	2.50
8	Truck, 5-axle	3.00
9	Truck, 6-axle	3.50
10	Truck, 7-axle	4.00
11	Bus, 2-axle	1.50
12	Bus, 3-axle	1.75
13	Vehicles not otherwise specified	5.00

** Book to contain 50 one-way tickets each good for a single passage at any time during the two consecutive calendar months, or fractional part thereof, for which sold.*

† A truck shall include a truck-tractor, or any combination of truck, truck-tractor and trailer or semitrailer.

Preliminary work was started July 1, 1950, under an appropriation by the State Legislature in the amount of $200,000 for an engineering report as to the feasibility to finance and construct a vehicular crossing connecting Contra Costa and Marin Counties. A favorable report on the project prompted the 1951 Session of the Legislature to appropriate an additional $750,000 to be used for further studies and the preparation of plans and specifications for the major contracts. The project, in general, consists of a four-mile overwater crossing with a short piece of highway approach in Marin County and a somewhat longer approach in Contra Costa County.

Two Important Events

In December of 1952, two important events took place to bring the project closer to a reality:

1. The California Toll Bridge Authority authorized the sale of not to exceed $72,000,000 of Richmond-San Rafael Bridge toll bridge revenue bonds; however, it was stipulated that the initial issue of Series A bonds should not exceed $62,000,000.

2. Bids were opened on the two major contracts for the construction of the substructure and the superstructure work; and the low bids were found to be, in each case, below the engineer's estimates. In February of 1953, revenue bonds in the amount of $62,000,000 were sold, and the two major contracts were awarded. The following month work was started on the scheduled 3½-year construction period.

Bond Issue Money

The money obtained from the bond issue for the completion of the upper deck for highway traffic was distributed as follows:

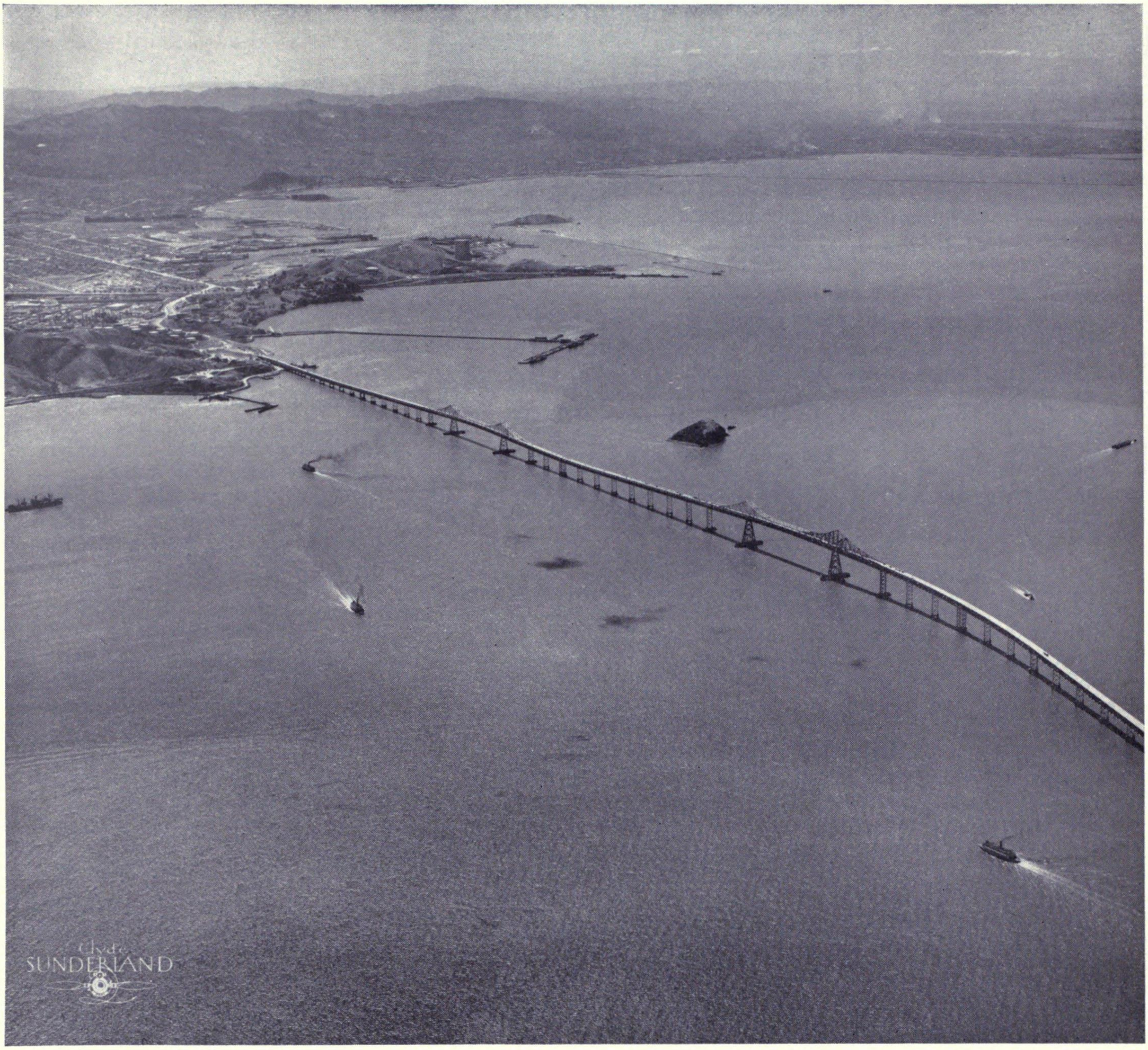
Construction fund	$50,000,000
Current interest fund	10,000,000
Construction reserve fund	2,000,000
Total	$62,000,000

The construction fund of $50,000,000 was further budgeted as follows:

Construction contracts	$45,000,000
Right of way	1,600,000
Salaries and wages	2,000,000
Equipment	100,000
Operating expenses	1,500,000
Insurance	600,000
Appropriation repayments	800,000
Interest on unexpended funds	—1,600,000
Total	$50,000,000

The interest on the $62,000,000 bond issue is payable from the current interest fund of $10,000,000 during the 3½-year construction period and for six months thereafter. Any money remaining is to go into the bridge reserve fund.

The construction reserve fund of $2,000,000 could be used in the event the $50,000,000 was insufficient to complete the construction and open



This aerial view of the Richmond-San Rafael Bridge is looking toward the City of Richmond on the Contra Costa County shore

the bridge to traffic in the allotted time. This $2,000,000, along with any surplus in the construction fund, is to be placed in the reserve fund within six months after the bridge is in operation. There is to be accumulated and remain in the bridge reserve fund the sum of $5,500,000 during the period in which bonds are outstanding.

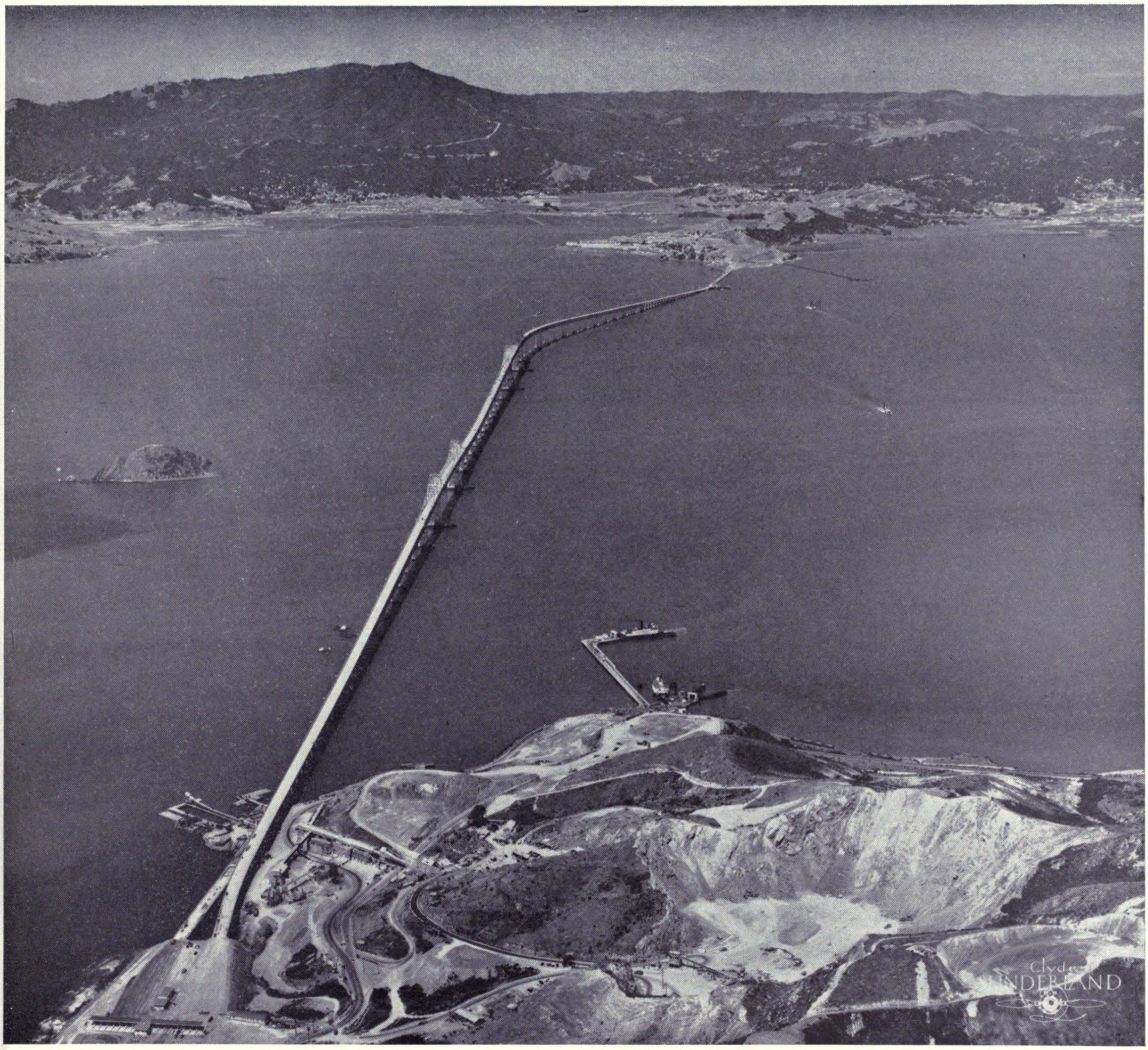
The work performed under the construction fund was divided into 15 different contracts in order to allow similar work to be performed by one contractor and so as to complete certain phases of the project prior to the work of others. Construction could not interfere with Richmond-San Rafael Ferry traffic or the operations of local industries.

The contracts under the construction fund were as follows:

Contract No.	Title	Amount
1003	Substructure	$14,700,000
1004D	Superstructure	24,400,000
1005	Mole fill	250,000
1006	Paving	460,000
1007	Trestle approach	190,000
1008	Richmond approach	870,000
1009	San Rafael approach	210,000
1010	Buildings and toll plaza	360,000
1011	Electrical work	1,100,000
1012	Toll collection equipment	480,000
1015	Separation structures	650,000
1018	Traffic stripes and signs	20,000
1019	Girder spans	830,000
1020	Pier backfill	220,000
1022	Maintenance facilities	260,000
	Total	$45,000,000

Governor Knight Interested

On October 26, 1954, Governor Goodwin J. Knight issued a statement that it would be advantageous to the State and to the motoring public if



This aerial view of the new northbay crossing is looking toward San Rafael on the Marin County shore

the construction of the lower deck of the bridge were not delayed.

It was estimated that additional funds of $6,000,000 would be required to provide for an ultimate six lanes of traffic. The estimated traffic figures were reviewed; and it was the opinion of the department's consultants on traffic, financing, and revenue that this additional liability could be repaid from the bridge revenue.

The State Legislature, by Chapter 159, Statutes of 1955, authorized a loan from the State School Land Fund. These funds became available for expenditure as of September 7, 1955.

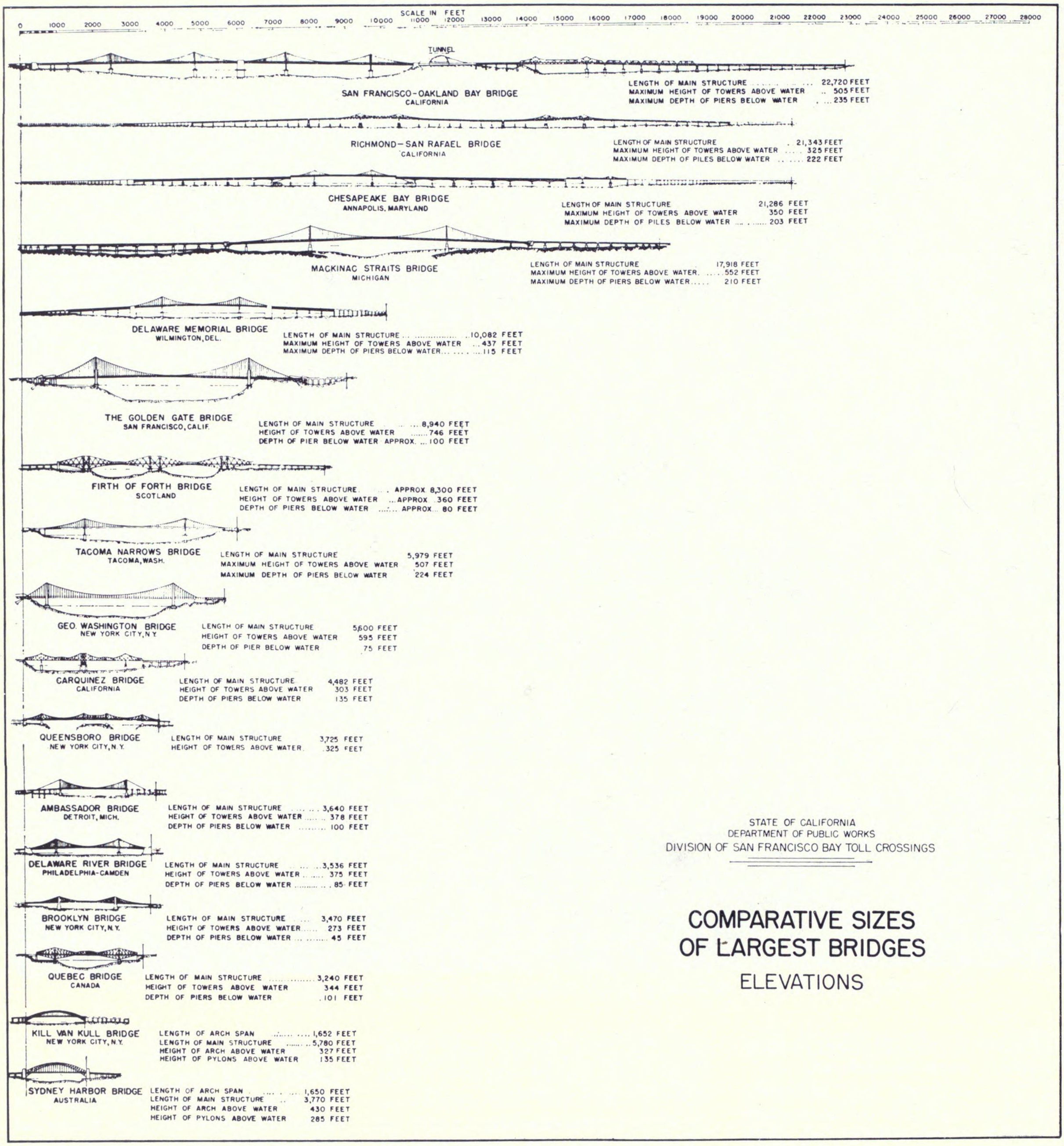
Five Contracts

Five contracts were prepared for the completion of the project, and at present the following contracts have been awarded:

Contract No.	Title	Amount
1014	Highway lighting	$260,000
1017	San Quentin approach	2,920,000
1018A	Traffic stripes and signs	20,000
1021	Lower deck paving	1,140,000

When this work is completed, the structure will then provide two 36-foot roadways; three 12-foot lanes of traffic on the upper deck to San Rafael and the same provision on the lower deck to Richmond.

The quantities of materials used in the construction are here listed for phases I and II. The latter is for the completion of the lower level of the bridge for an ultimate six lanes of traffic.



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

COMPARATIVE SIZES OF LARGEST BRIDGES

ELEVATIONS

STRUCTURAL MATERIAL

	Standard concrete	Light-weight concrete	Rein-forcing steel	Struc-tural steel
	c. y.	c. y.	ton	ton
Phase I	101,270	16,560	6,010	50,000
Phase II	11,110	23,140	2,990	3,000
Totals	112,380	39,700	9,000	53,000

PILING

	Concrete	Timber	Steel
	l. f.	l. f.	l. f.
Phase I	000	201,000	558,170
Phase II	53,000	000	7,930
Totals	53,000	201,000	566,100

MISCELLANEOUS

	2½" Pipe	Cable	Timber	Paint
	l. f.	l. f.	M. B. M.	gallons
Phase I	45,400	251,900	1,100	65,000
Phase II	13,500	64,600	000	000
Totals	58,900	316,500	1,100	65,000

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New Span Open

Richmond-San Rafael Bridge Approaches Being Built

By T. FRED BAGSHAW, Assistant Public Works Director

Governor and Mrs. Knight unveil bronze plaque placed on granite stone at Administration Building, Toll Plaza, of Richmond-San Rafael Bridge

THE RICHMOND-SAN RAFAEL Bridge was formally dedicated on August 31, 1956, and opened to traffic at 12.01 on the morning of September 1, 1956.

Dedication ceremonies, presided over by Frank B. Durkee, Director of Public Works, were high-lighted by the dedicatory address by Governor Goodwin J. Knight, which is reproduced in adjoining columns.

Band music was provided by the 561st Air Force Band of the California National Guard, Don Schary, Chief Warrant Officer, conducting.

An American Flag was presented by William B. Howe, President of the Richmond Allied War Veterans Council. Alfred P. Peracca, Grand President of the Native Sons of the Golden West, on behalf of Richmond Parlor No. 217 and Mt. Tamalpais Parlor No. 64 of San Rafael, made a presentation of the California Bear Flag. Both flags were accepted by Governor Knight on behalf of the State of California and were appropriately raised by a Color Guard from the Mt. Diablo Council, Boy Scouts of America.

Distinguished Guests

Following an invocation by Reverend Kenneth Coates of the Mira Vista Congregational Church and President Richmond Council of Churches, Director Durkee introduced those on the speaker's platform, including Mrs. Knight, United States Senator Thomas H. Kuchel, Congressman John F. Baldwin, George T. McCoy, State Highway Engineer, and Mrs. McCoy; Harry E. Crean, member California Toll Bridge Authority, and Mrs. Crean; Mr. and Mrs. Oliver Olson, representing the Richmond-San Rafael Ferry Company; State Highway Commissioners H. Stephen Chase and Robert L. Bishop, Fred Panhorst and Howard Wood, State Bridge Engineers, B. W. Booker, Assistant State

GOVERNOR TELLS OF DREAM COME TRUE

Dedicating the Richmond-San Rafael Bridge, Governor Goodwin J. Knight said:

The culmination of a dream, which this event represents for the people of Contract Costa and Marin Counties, and for the Bay area, has been realized through the cooperation of a large number of public agencies, working in harmony with the citizens and leaders of many communities.

The need for this magnificent bridge, linking the north coast agricultural, residential and recreational empire with the eastbay industrial centers, has long been recognized by civic leaders. It is interesting to recall that the impetus for this tremendous undertaking was generated by the people of the communities most directly affected, who expressed their needs and

. . . Continued on page 17

Highway Engineer, San Francisco; Mrs. Durkee, T. Fred Bagshaw, Assistant Director of Public Works, and Mrs. Bagshaw; Senator and Mrs. George Miller, Jr., Senator John F. McCarthy, Assemblyman and Mrs. S. C. Masterson, Assemblyman Richard H. McCollister, Contra Costa Supervisor Jack Cummings and Mrs. Cummings, Marin Supervisor Walter Castro, Mayor W. A. Cannon of Richmond and Mrs. Cannon, John McInnis, San Rafael City Councilman; John Inglis of Blyth Co., bond underwriters; Phil Murphy, representing contractors on the project, and Mrs. Murphy; Preston H. Kelsey, representing joint insurance brokers; Highway Patrol Commissioner Bernard R. Caldwell, Assemblyman Donald Doyle, City Manager of Oakland Wayne Thompson, and Robert Walsh.

Nostalgic commuter watches disappearing Richmond-San Rafael Ferry on its last run following midnight opening to traffic of the new bridge

Haggerty Speaks for Labor

George P. Anderson, President Golden Gate Bridge and Highway District, one of the speakers, said: "We bring from the Golden Gate Bridge and Highway District to you, Governor Knight, for your special interest in the project, to Director Durkee, to Engineer Raab, and to the artisans and workmen without whom the structure could not have been built, a word of warm congratulation for an important work well done, and the completion of a vital link in our system of highways which will have a great and beneficial impact on this entire area."

Speaking for organized labor, C. J. Haggerty, Secretary-Treasurer of the California State Federation of Labor, said: "The dedication of this great structure marks another of the many milestones graphically portraying the splendid relationship which exists in this State between management and labor. This great structure has been erected without one moment's loss of time because of disputes between the labor organizations and the contractors involved. Cooperation has been

Dedication scenes. LEFT—Public Works Director Frank B. Durkee, Governor Knight, Mrs. Knight, T. Fred Bagshaw, Assistant Public Works Director. RIGHT—Miss Contra Costa, Barbara Jean Westbrook, Concord; Director Durkee, Governor Knight, Norman C. Raab, Projects Engineer, builder of bridge; Mrs. Knight, Miss Marin, Yvonne Barri, San Rafael.

carried to the highest degree in safety measures observed in the building of this bridge with its splendid results of only one fatality and one serious injury."

Engineer Raab Praises Cooperation

Norman C. Raab, engineer in charge of the project, pointed out that the work had progressed on schedule, saying: "This structure is not the creation of one man, or one group of men; it has resulted from the united efforts of the adjacent communities, the numerous industries, contractors and engineers, and the backing of the State administration. I would like at this time to thank all the personnel of the Division of San Francisco Bay Toll Crossings for their part in this undertaking. Their accomplishment, we believe, will be recognized by the multitudes this bridge will serve in the San Francisco Bay Area for many years to come."

A bronze plaque containing historic information on the project was unveiled by Mrs. Virginia Knight.

Father Daniel McAlister of St. Raphael's Parish, San Rafael, gave the dedication.

Anticipated Traffic

The bridge and its facilities were then thrown open for public inspection and an estimated 10,000 people took advantage of the opportunity to walk out on the bridge.

At the present time and for a period of another year, only the upper deck will be in operation. When approach facilities are completed on the Marin side, both decks will be in service, providing three 12-foot lanes on each deck. It is estimated that the first full year of operation will result in 4,000,000 vehicle crossings, compared with 1,000,000 yearly carried by the ferries. The bridge can accommodate 20,000,000 vehicles a year comfortably.

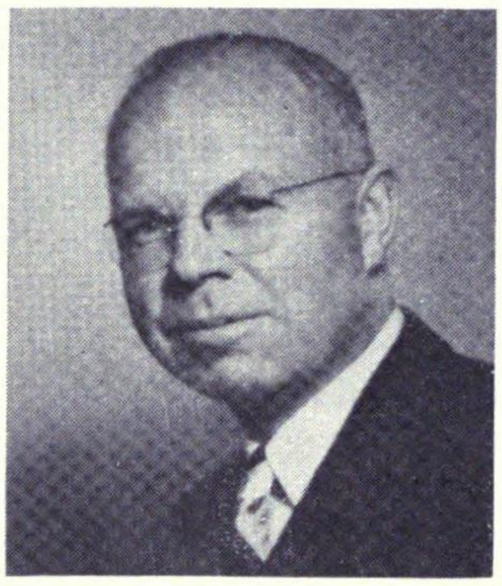
While it is too early to get a reliable indication of traffic volume, the early reports indicate that the basic estimates will prove to be justified.

Ferries Go Out of Service

Opening of the bridge signaled a time for celebration and four days of official ceremonies and fiesta were held. The end of an era of leisurely but time consuming transportation across the bay by picturesque ferry boats was at hand. The ferry boats which had been operating for 41 years were now stilled but not without a note of sadness as many recalled restful trips across the water against the cool bay breezes.

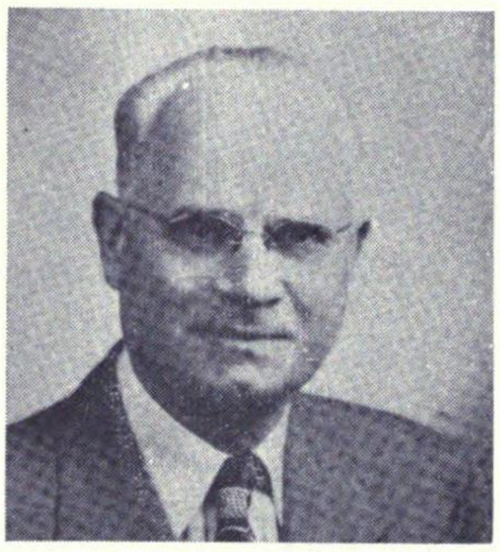
CALIFORNIA TOLL BRIDGE AUTHORITY

GOVERNOR GOODWIN J. KNIGHT
Chairman, California Toll Bridge Authority

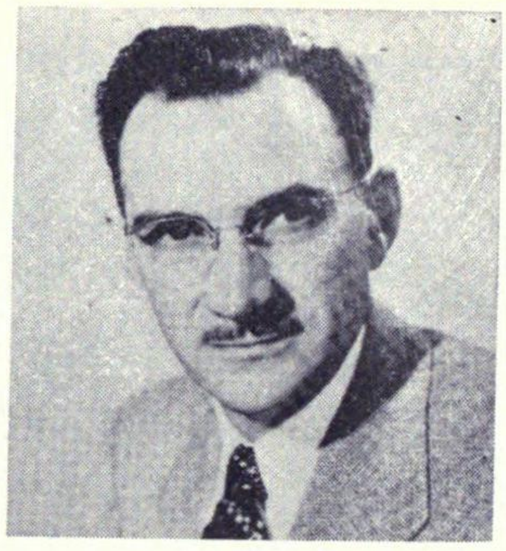


DIRECTOR OF FINANCE JOHN PEIRCE
Member of Authority

LT. GOV. HAROLD J. POWERS
Member of Authority



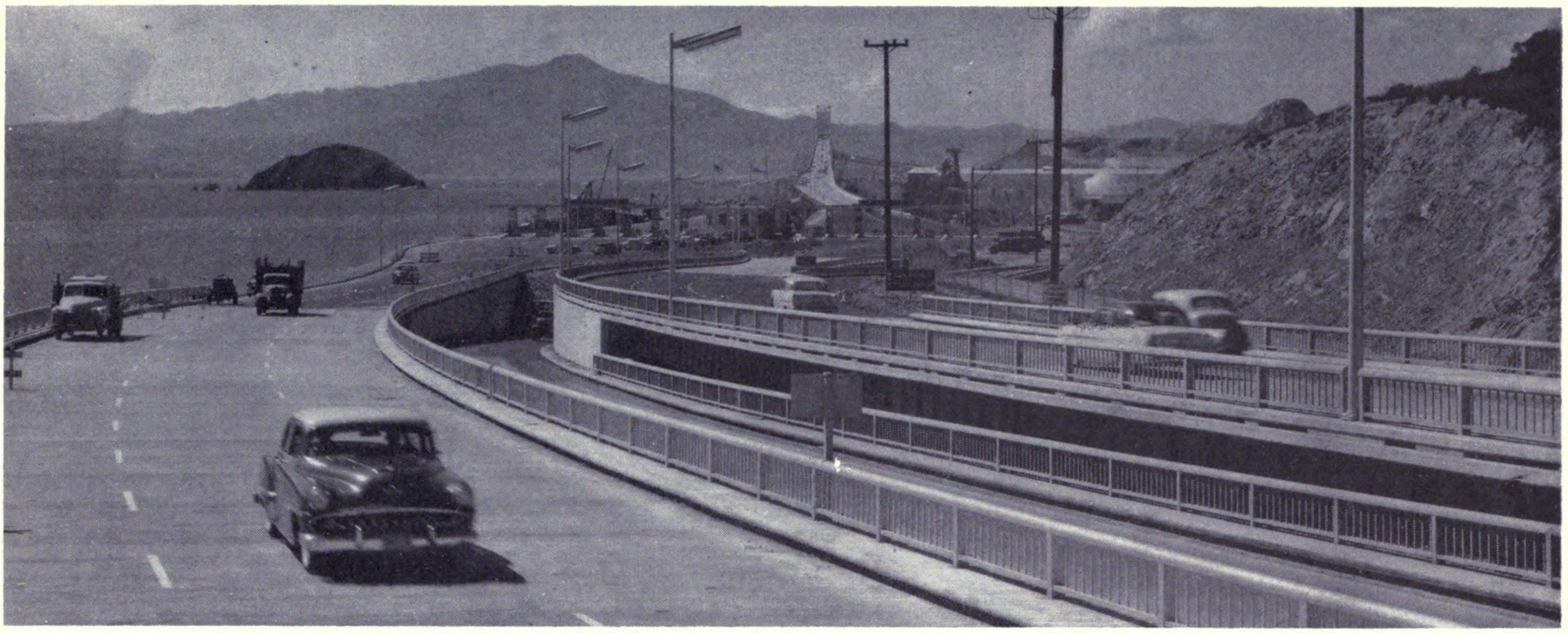
DIRECTOR OF PUBLIC WORKS FRANK B. DURKEE
Member and Secretary of Authority



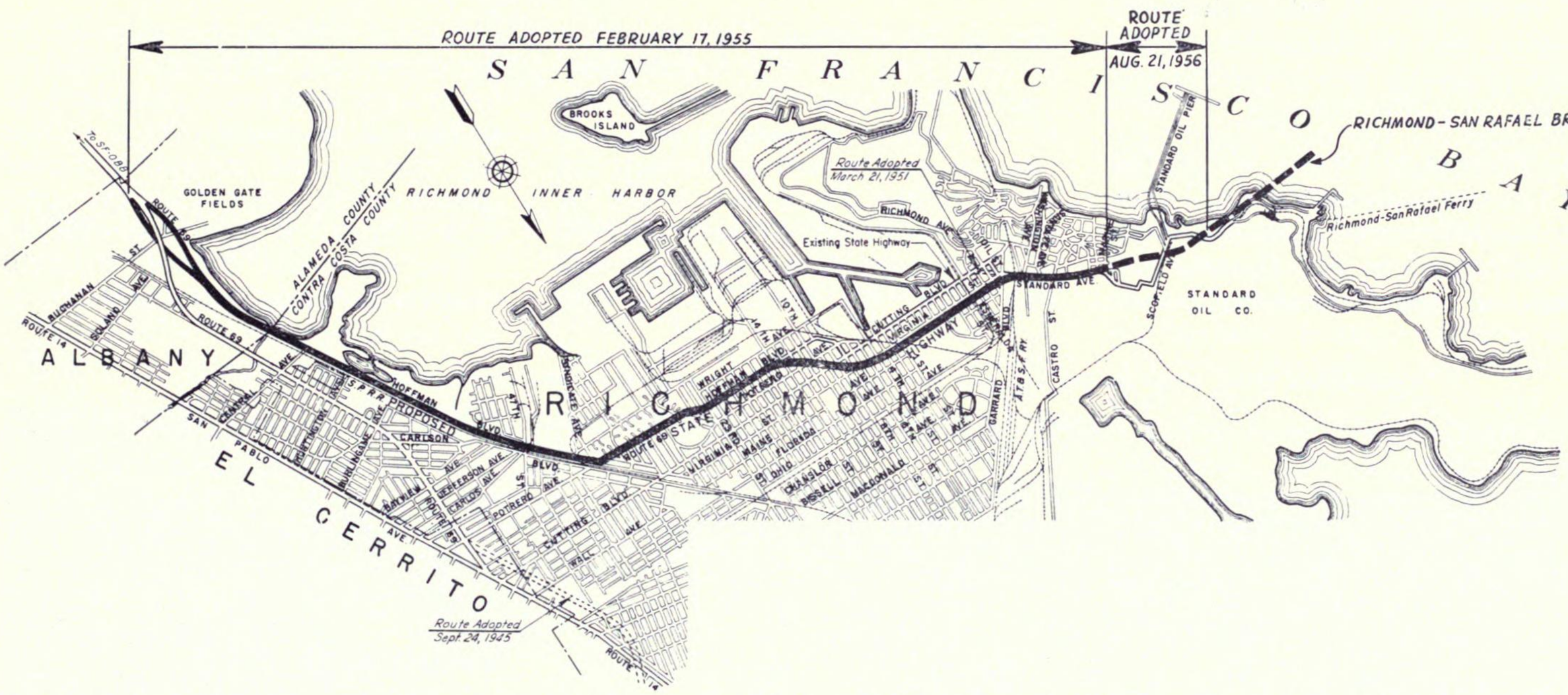
HARRY E. CREAN
Member of Authority

New Era of Development

A new era of development and growth has been with us for some time and the supplanting of the ferries by the bridge and its extensive approaches was dictated by need for a direct and faster link between the



UPPER—Looking west at immediate approaches to Toll Plaza of Richmond-San Rafael Bridge on Contra Costa County side. LOWER—Map shows approach system on east side of span.



commercial, industrial, and residential centers of the East Bay and the North Coast's agricultural, residential, and recreational areas.

In their best year of service the ferries handled approximately 1,000,000 trips per year. In contrast, it is conservatively estimated that the new bridge will handle over 4,000,000 trips in 1956-57. The growth is further emphasized by estimates of 6,000,000 annual trips by the next decade and 8,000,000 by 1976.

Considerable work is being planned for the freeway approaches which are required to handle such volumes of traffic. Approach projects are now under way by both the Division of Bay Toll Crossings and the Division of Highways. The latter organization is designing freeway connections to each end of the bridge work and these extend from the Eastshore Freeway, US 40, at Albany, in Alameda County, to US 101 just south of San Rafael, in Marin County. This represents a total distance of 13.5 miles including the bridge, all of which will be discussed hereinafter.

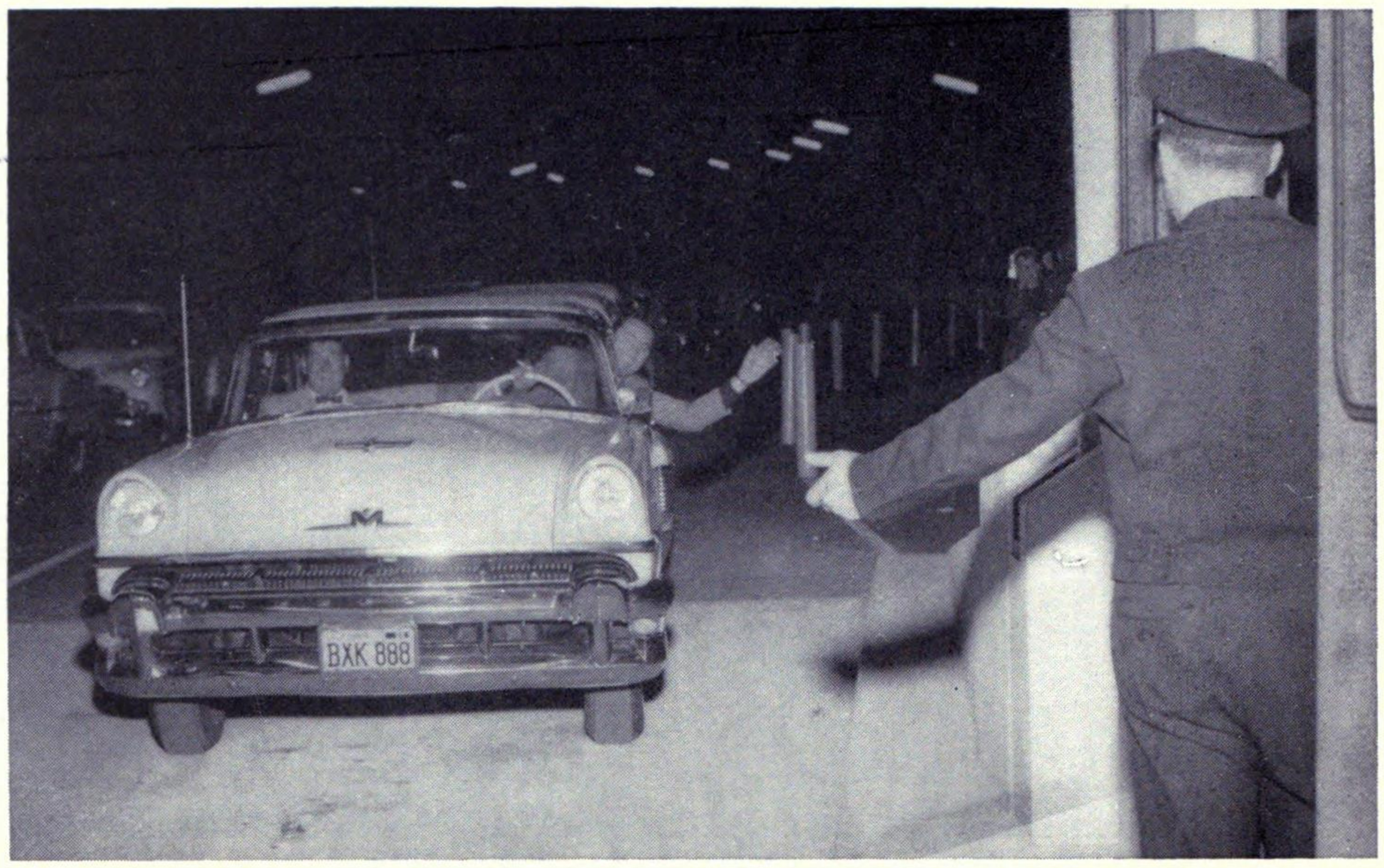
Division of Bay Toll Crossing Projects

Details pertaining to the bridge contracts were presented in the July-August edition of *California Highways and Public Works* in an article by Norman C. Raab, Projects Engineer.

In general, the bridge is 21,343 feet long (4.04 miles) and is second to the Bay Bridge by 1,377 feet as the longest high-level structure in the world.

Presently, only the top deck of the bridge is being used for two lanes of traffic (one lane in each direction). On completion of the lower deck and approaches, which is expected by midsummer of 1957, the top deck will serve the three eastbound lanes and on the lower deck will be the three westbound lanes.

The Division of Bay Toll Crossing projects include the immediate approaches to each end of the bridge. On the east end, the approach extends from Castro Street and includes a traffic interchange at Marine Street. It also includes an extensive grade separation structure at Scofield Avenue and traffic interchange westerly thereof which serves the piers and bay frontage.



Toll collector awaits first automobile to cross Richmond-San Rafael Bridge. Driver is Tony Cortese, Richmond.

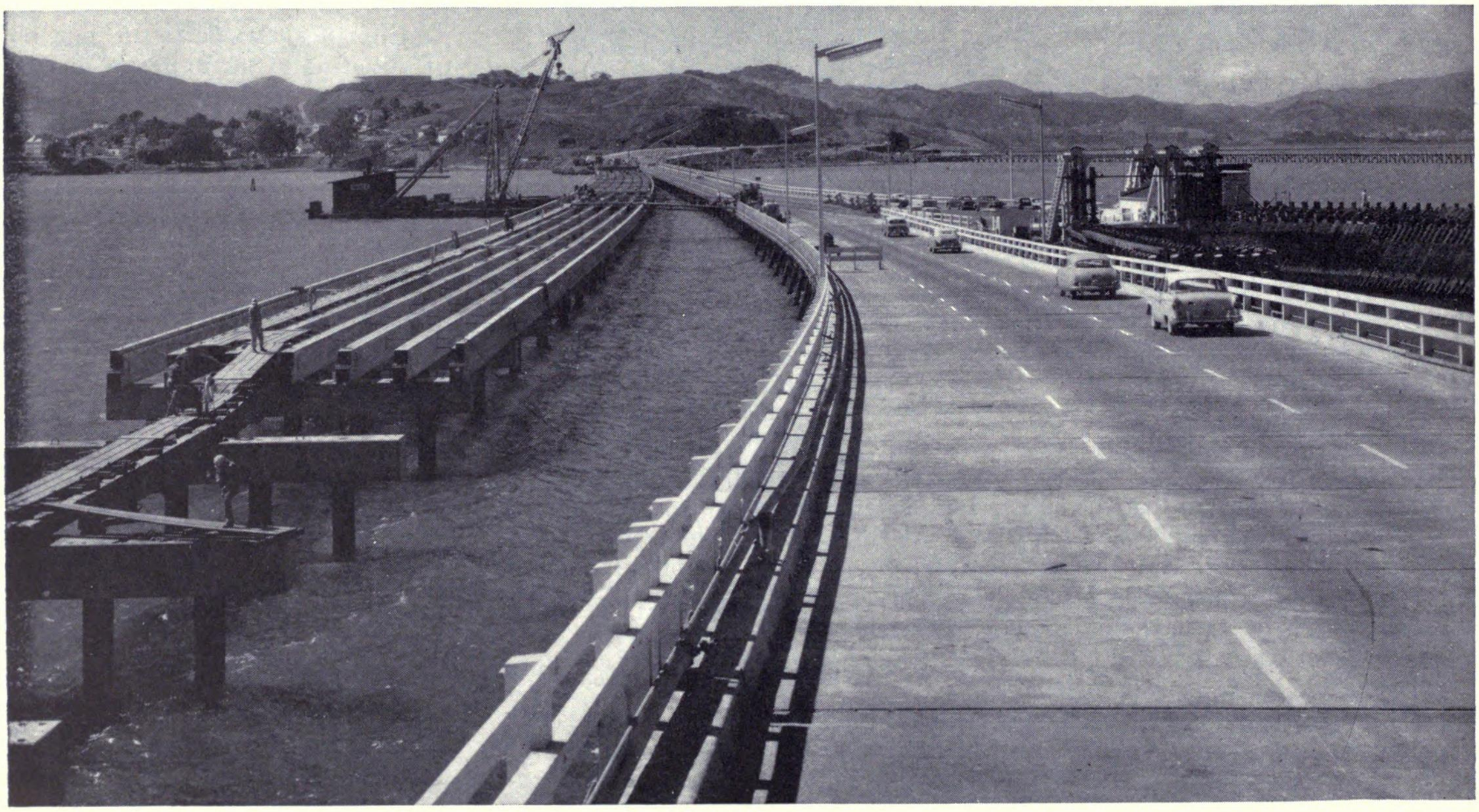
Six-lane Freeway

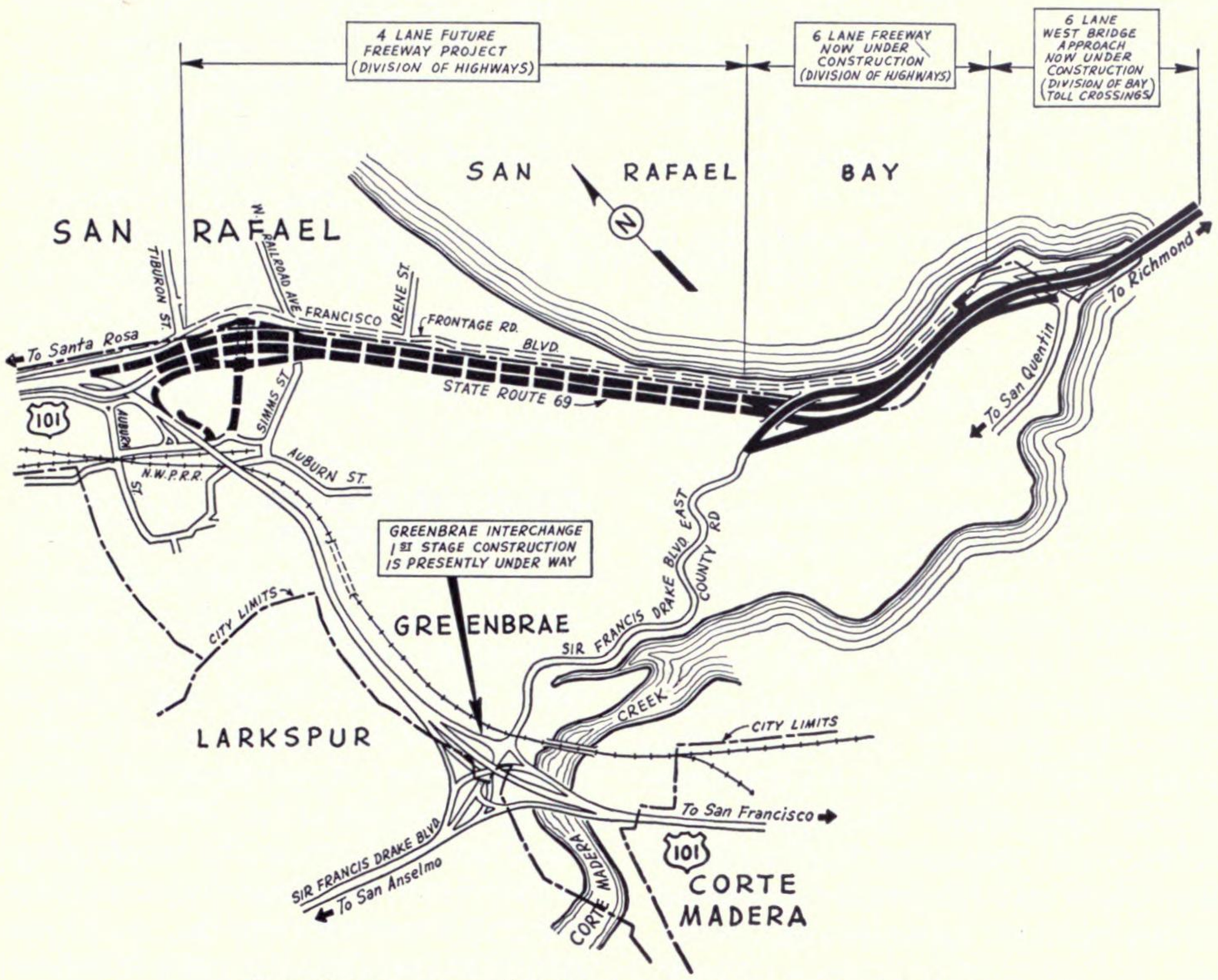
This approach is 1.1 miles long and provides a six-lane freeway at an approximate cost of $3,200,000. Not included in the foregoing costs is the construction of the toll gates and administration buildings. The toll plaza provides eight toll collection gates on each side of two administration buildings. At present only half of the gates are in use and the remainder will be placed in service at the time of the opening of the lower deck.

At the west end of the bridge, the Bay toll crossing approach will provide six traffic lanes and extends to the easterly turnoff to San Quentin and includes a traffic interchange structure at this location. This project is 0.9 mile long and will cost approximately $3,600,000. The major portion of this approach involves two new concrete structures from the west end of the bridge. These will replace the existing timber trestle which has served as an approach to the ferries and will also replace the timber trestle constructed as a temporary connection to the upper deck. When the three-lane lower deck structure is completed, all traffic will be routed over it so that the existing and temporary timber trestles can be removed and the upper deck approach structure constructed.

The entire toll crossing endeavor consists of 20 contracts and the over-

Richmond-San Rafael Bridge looking west. Old ferry wharf right. Upper deck permanent approach under construction left.





Map showing approach system on Marin County side of bridge

all costs, including right of way, will approximate $68,000,000.

Division of Highway Approaches

The Division of Highways has coordinated the improvement of its approaches to provide the proper traffic service during the several stages of bridge development. Under two contracts, in 1952 and 1954, at a cost of $340,000, the street system between Topeka Street and Marine Street was reconstructed to a six-lane divided city street as an interim improvement. These, together with the toll crossing approaches, have replaced winding city streets past the extensive Standard Oil Company refineries and on into Richmond.

An initial six-lane future eight-lane freeway is now under design between the Eastshore Freeway, US 40, in Albany, and the bridge approach at Marine Street. On February 17, 1955, the California Highway Commission adopted the routing for this future freeway connection. The southeasterly terminus is at the El Cerrito Overhead near Golden Gate Fields and the routing follows Hoffman Boulevard in Richmond to approximately 14th Street where it diagonals to approximately Virginia and Fourth Streets and along Virginia to Standard Avenue and Garrard Boulevard, thence along Standard Avenue to the bridge approach at Marine Street. This future freeway is approximately 6.4 miles long and when completed, construction and rights of way will cost about $13,500,000.

Construction on Marin Side

On the Marin side of the bridge the Division of Highways now has under construction a three-fourth-mile six-lane freeway to and including an interchange at Sir Francis Drake Boulevard, East. This project is the first phase in the construction of an eventual two-mile stretch of freeway between the bridge and US 101 near Tiburon Street in San Rafael. Construction cost will approximate $950,000.

This project is scheduled for completion in the late spring of 1957 and in advance of the time that the lower deck of the bridge is opened to traffic. It will adequately care for traffic volumes expected at that time.

The project includes an approximately 700-foot-long overcrossing to carry westbound traffic off the bridge onto Sir Francis Drake Boulevard,

. . . Continued on page 57

GOVERNOR TELLS DREAM

Continued from page 12 . . .

their wishes through their local public officials.

The State of California exhibited sympathy and cooperation when a delegation appeared in Sacramento early in 1950 and presented a preliminary report which had been prepared and financed by the City of Richmond and the County of Marin. Your people had a vision, and after supporting your beliefs with sound engineering and economic arguments, your State Government found it feasible to approve the project and to carry it to a successful conclusion.

Necessary Legislation

An important early step was the passage of necessary legislation. On this phase of the development of this project, full credit must be accorded your Senatorial and Assembly representation in Sacramento, for all required legislation was advanced in an expeditious manner, although not always without difficult opposition. The important point was, however, that you were working together. You had resolved local differences and when the legislative conflict was most difficult, you were united, and most certainly effective. Too much credit cannot be given to Senator George Miller, Senator Jack McCarthy, Assemblyman Dick McCollister, Judge S. C. Masterson and Judge Tom Keating, and I would now like, on behalf of the California Toll Bridge Authority, to thank them for the outstanding legislative work they performed. Their efforts represent an important contribution to the building of this Richmond-San Rafael Bridge.

Raab Makes Record

Once the legislative problems were solved, the next step was the completion of plans, specifications, design and the engineering and administrative work required to get construction under way. The California Toll Bridge Authority assigned this responsibility to the State Department of Public Works and the project has been under the direct control and supervision of the Chief of the Division of San Francisco Bay Tolls Crossings, Mr. Norman C. Raab, whom you have

met here today. I am pleased to report that Mr. Raab, and the technical people and other staff members of his division, have achieved an outstanding record in the task of advancing this project. The project has encountered a minimum of administrative problems. There have been no delays in the execution of the various contracts. All estimates have proven to have been sound, as evidenced by the fact that contractual bids have come well within the limits established.

Financed by Revenue Bonds

As in most matters, money is a very necessary ingredient in the accomplishment of a major undertaking. This one is no exception. This is a toll bridge facility and has been financed entirely by the sale of toll revenue bonds. Taxes are always a problem and a necessary evil, and we constantly try to keep them as low as possible and yet serve the people adequately. This structure, the cost of its building and the cost of operating and maintaining it, will not result in 1 cent of general tax obligation for the people of this area or of the State of California. It has been financed entirely through the sale of revenue bonds. This means that many individuals the world over have advanced the money, through the purchase of these bonds, and they are depending on the return of their money together with a normal rate of interest. The sale of $62,000,000 in revenue bonds was completed through a syndicate headed by Mr. Charles Blyth of San Francisco. Mr. John Inglis is here representing the financial interests. I wish to thank him and his associates for the confidence you have shown in the future of the San Francisco Bay area, and its ultimate growth and destiny, by arranging the necessary financial support so that the bridge could be built.

Fifteen Contractors on Project

All state work is done on an open, competitive bid basis with private business and on this project 15 separate contractors have been involved, with contracts ranging from the smallest for $18,000 to the largest for $25,000,000. The State's relationship with these firms has been most satisfactory. The success of their efforts is attested by the completion of this bridge in record time. Mr. Phil Murphy, of the Judson Pacific Murphy-Kiewit organization is here to represent the contractors on this project. Mr. Murphy's firm had the largest single contract, representing about one-half the cost of the bridge. Through him, I want to congratulate all of the contracting firms for their work on this modern traffic facility.

This is the week end of the Labor Day holiday, and I am especially pleased to pay tribute to the workmen whose skill, courage, sweat and toil resulted in the creation of this masterpiece of construction. It is my understanding that not one day of work has been lost through labor disputes during the 3½-year construction period. The low rate of accidents to workmen is outstanding for a project of this magnitude. This speaks well for the care shown by the workmen themselves and for preventive efforts on the part of management.

Workmen Congratulated

It had been my hope that we could have assembled all of the workmen who had a part in building this bridge, in a seat of honor, so that proper credit and respect could be paid to each and every one of them. However, they number more than 2,000 skilled men, and no practical way could be devised to arrange their participation in that manner. I have, however, personally thanked each workman by card for his contribution to the project. Representing the workingman on the platform today is one of labor's most enlightened and effective leaders, my old friend, C. J. Haggerty, Secretary-Treasurer of the California State Federation of Labor. Neil, speaking for the people of California, I want to extend sincere thanks, congratulations, and best wishes to every man and woman who had a hand in the building of this bridge.

Not much need to be said about the value and the necessity of this over-water traffic link between two of the Bay area's finest and most populous sections.

It is here—a reality at last—for all to view in all of its splendor, and for all citizens to enjoy.

This tremendous structure is ample evidence of the manner in which things are done efficiently, rapidly, and on a grand scale under our traditional American system of free and competitive enterprise.

On behalf of the people of the San Francisco Bay area, and on behalf of all of the people of the State of California, I am proud to dedicate this structure to the men and women whose vision conceived it, and to those whose hearts, hands and minds fashioned it.

VALUE OF LIMITED ACCESS FREEWAYS

Writing in the July issue of *American Highways*, John A. Volpe, Public Works Commissioner of Massachusetts, discusses at length the value of limited access expressways. He says:

"Raytheon Manufacturing Company, with plants in Waltham and Newton, has become the second largest employer in Massachusetts. There are 19,500 workers, and the annual pay roll is $75,000,000. In 1948 Raytheon had 600 workers, and the pay roll was only $250,000.

"Charles Francis Adams, Jr., Raytheon's president, attributes the company's growth in great part to the contribution Route 128 has made to the mobility of workers. 'Good roads and safe roads make that mobility possible,' he says.

" 'Give a man or woman an automobile or membership in a car pool, and good highways to travel on, and distance becomes no barrier to accepting a job or seeking out a better one,' Adams declared. He pointed to an analysis of home communities of employees in Raytheon plants. It showed they came from 239 separate corporate communities in Massachusetts. In addition, 130 people came each day from New Hampshire, 40 from Maine, and 35 from Rhode Island."

FROM LOUISIANA

STATE OF LOUISIANA
DEPARTMENT OF HIGHWAYS

MR. KENNETH C. ADAMS, *Editor*

DEAR MR. ADAMS: I have received your July-August issue of *California Highways and Public Works*. This publication is indeed most interesting and I want to thank you for placing my name on your list to receive same.

Yours very truly,
H. L. LEHMANN