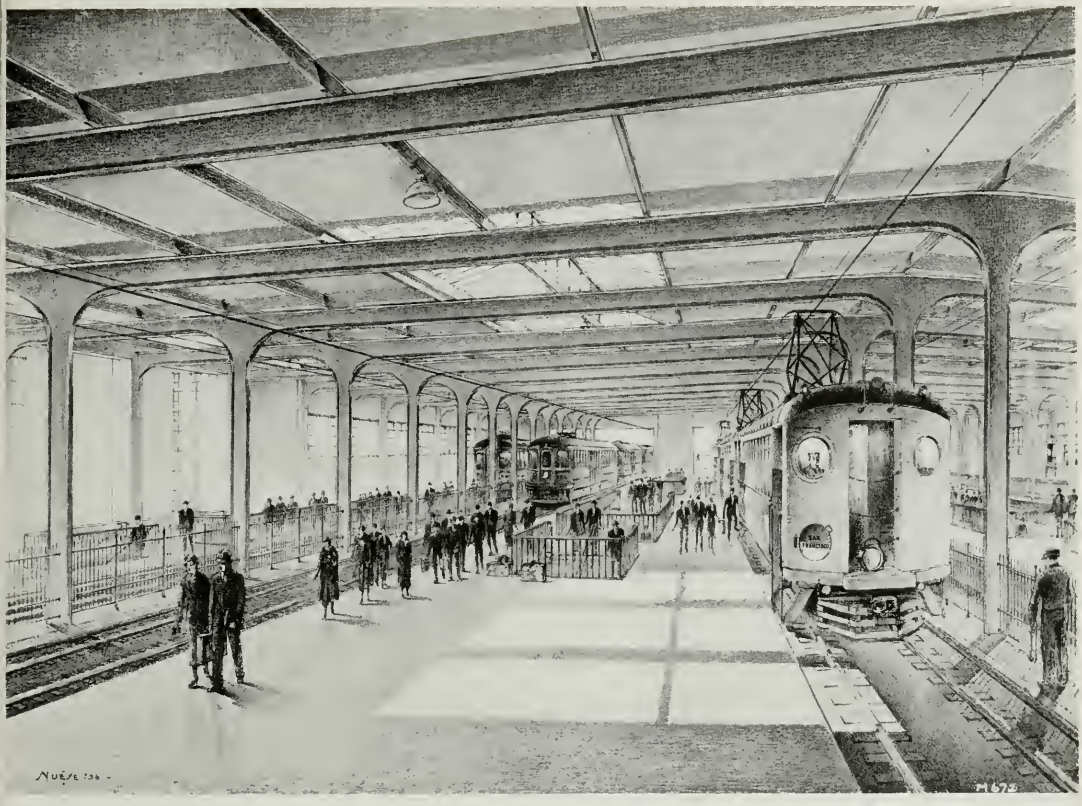


Interurban Train Platforms for San Francisco Terminal of Bay Bridge

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

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

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

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

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

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

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

Safety Enforced by Bridge Squad

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

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

"All over the world."

Pony Express riders during the early California pioneer days.

Since the road was taken over by the State, improvements have been made as needed to keep the road in shape to serve the changing types of traffic. The advent of the automobile required the provision of a hard surface and, as driving speeds increased, it became necessary to improve the alignment and grades in the interest of public safety.

The present road is a part of U. S. Route 50, which is one of the main east-west transcontinental roads. In addition to serving a large number of through tourists each year and caring for considerable volumes of local traffic, this route is serving an increasing number of persons traveling to and from recreational areas located along the American River and the south end of Lake Tahoe.

ELIMINATE CURVES

The Folsom to Placerville section of this road was constructed in 1915, the pavement width being only 12 feet, to which borders were subsequently added. The alignment was satisfactory at that time but the short radius curves used make it practically impossible to maintain what is now considered to be a reasonable speed. Reconstruction of this section will be undertaken as funds become available.

The first unit of this construction, on which work is now under way, is located southwest of Placerville between El Dorado and Clark's Corner. The new construction is principally on new alignment at some distance from the old road and is about 1.9 miles shorter than the old route, the total length of the new project being 4.3 miles.

The minimum radius of curvature on the new alignment is 3000 feet, except for one 1550-foot curve and one 1000-foot curve, which were necessitated by local controls. On the old road there are many more curves, the majority of which have very short radii, many of them 100 feet or less. In order to obtain satisfactory standards of grade and alignment, roadway excavation of some 50,000 cubic yards a mile was required. In addition to the customary drainage structures it was necessary to provide for several crossings of the old Missouri Flat ditch.

The new highway crosses Webber Creek about three-quarters of the way through the project. The adopted grade line at the crossing of this creek, at a considerable height above streambed, required a bridge 322 feet in length. This bridge, which will provide a clear roadway width of 26 feet, will be of the reinforced concrete girder type, having three 71-foot spans and two 54-foot 6-inch spans on concrete bents and abutments. This bridge is being built under a separate contract.

The contractor has already completed most of the grading work on the road contract. Work will be suspended during the winter months and surfacing operations are to be started as soon as weather conditions permit in 1938. The surfacing will consist of plant-mixed bituminous treated crushed rock 22 feet wide by 0.25 of a foot thick on a crusher run base 23 feet wide by 0.4 of a foot thick. It is estimated that the entire project will be completed and public traffic routed over it in July of next year.

The estimated cost of the grading and surfacing is $190,000, with the Webber Creek Bridge estimated to cost an additional $41,000. Hemstreet and Bell are the contractors on the highway project, with Mr. J. D. Greene acting as resident engineer for the State. On the bridge construction the contractor is the Campbell Construction Company and the resident engineer is Mr. J. H. Horn.

U. S. Begins Study of Kings River Project

John R. Iakisch, United States Bureau of Reclamation Engineer, has begun a study of the proposed Kings River Project in Fresno, Kings and Tulare counties, which is listed by the State of California as a unit of the comprehensive state-wide Water Plan, a long-range program for the ultimate development of California's water resources.

The report to be filed by Mr. Iakisch will be of interest to the California Basin Committees, recently appointed by Governor Frank F. Merriam to recommend to President Roosevelt through the National Resources committee various water, irrigation and reclamation projects in this State which urgently require Federal aid.

Before going to Fresno to undertake his survey, Mr. Iakisch together with Walker R. Young, construction engineer of the Central Valley Project, conferred in Sacramento with State Engineer Edward Hyatt.

Port of Oakland Overhead Work Now Under Way

RAPID progress is being made in the construction of the Port of Oakland overhead highway and the electric interurban overheads on the eastern approach to the San Francisco-Oakland Bay Bridge, a $450,000 project being built under authorization of the California Toll Bridge Authority, of which Governor Frank F. Merriam is chairman.

Contracts for the building of the Port of Oakland overhead highway, transbay train overhead, catenary bridges and other work on the storage yards approximate $1,222,000. The job is being done by the Department of Public Works. C. H. Purcell is Chief Engineer.

The highway overhead will cross above the Southern Pacific and Key Route interurban electric trains in the East Bay yards and will connect with the direct four-lane East Bay highway approach to the Bay Bridge.

TWO-LANE RAMPS

Two-lane "On" and "Off" ramps will permit traffic to enter and leave the main bridge approach without intersecting traffic.

The total width of the Port of Oakland approach is 42 feet, with 22-foot "On" and "Off" ramps.

Port of Oakland is constructing the highway connecting with the overhead and the Port. The project will be lighted by sodium vapor luminaires, similar to those used on the Bay Bridge.

FOR AUTOS AND TRUCKS

The highway overhead will carry automobile and truck traffic in four lanes over the bridge railway system, separating in two "On" and "Off" ramps at the main bridge highway approach east of the Bay Bridge toll plaza.

Interurban Southern Pacific electric trains will be routed over an overhead "Y" structure at the end of 26th Street. From this structure Oakland and Alameda trains will proceed south through the 16th Street station. Berkeley trains will be routed north from the "Y."

Trains are scheduled to start operating over the Bay Bridge in November, 1938.

Upper drawing on aerial photo shows East Bay electric railway approaches to Bay Bridge. Key Route trains will proceed through subway. Southern Pacific trains will be routed overhead at end of 26th Street. Lower—Section of Port of Oakland overhead with Bay Bridge and its Toll Plaza in distance. Overhead will connect with bridge highway by ramps as shown in lower picture.

This picture shows the laying of ties for the San Francisco-Oakland Bay Bridge railway system at easterly edge of span.

FIRST RAILWAY TIE IS LAID ON BAY BRIDGE

THE first of 105,000 ties for the $17,000,000 railway system of the San Francisco-Oakland Bay Bridge was laid on the morning of November 29 on the bridge proper.

Operating from a specially designed machine, the tie was neatly slipped into place by Bridge Engineer Charles E. Andrew at a point in Span E-22 on the easterly end of the structure.

The bridge proper will have 50,000 redwood ties, 8 inches by 9 inches thick and varying in length from 9 to 15 feet. Each tie is marked for its own position on the rail deck.

The ties will be placed directly on the steel stringers, which have been prepared with two coats of a coal tar paint. Before placing, the ties will have been "dapped" or notched at each end, with the cuts 6 feet, 6 inches apart, and at depths varying from a quarter-inch to an inch and a quarter and averaging a width of 11 inches. The tie will thus be slipped into its specified place on the stringer. The depth of the dap or notch depends on the location of the ties, which are placed in consecutive order according to number. This schedule assures a smooth running roadbed.

Selection of redwood for ties, Mr. Andrew pointed out, was due to its minimum conductivity of electricity, an essential requisite in the case of the Bay Bridge railway system, which cannot afford waste of current in connection with its elaborate signal system.

Bridge Engineer C. E. Andrew places first railway tie in position on Bay Bridge.

Bay Bridge Is Provided With Air Analyzer

SACRAMENTO laboratories of the Division of Highways have devised an air analyzer for use on the San Francisco-Oakland Bay Bridge, the first ever used on a bridge, it is believed.

The instrument has been placed at the crux of the giant steel cross-beams just below the lower deck at Tower W-2. It works like this: a four-blade scoop-like fan operates a pump which sucks the air into a bottle of distilled water. Thirty revolutions of the fan make one revolution of the pump, scooping up 75 cubic centimeters of air. When the counter on the pump shows up to 99,999 revolutions, the bottle is removed, sealed, and sent to the Division of Highways' laboratories in Sacramento for analysis; 7,500,000 cc. of air can be drawn through the apparatus with accuracy.

First experimental tests, according to Carl Hamilton, Maintenance Engineer of the Bay Bridge, show that the big span breathes an atmosphere consisting, among other things, of sulphates, salt, coffee chaff, and soot.

This instrument is an "air analyzer" used on the San Francisco-Oakland Bay Bridge. Carl Hamilton, Maintenance Engineer of the span, demonstrates its use.

Object of the apparatus is to analyze the air for components destructive to paint.

The air analyzer is being used in conjunction with "washing" tests. So far 120 "spots" on the bridge, of 2½-square feet proportions, have been "washed" by clean cheese cloth dipped in distilled water. The cloth is wrung dry after the process into a bottle and the water sent to Sacramento laboratories for analysis. From 9 ounces of distilled water approximately 8 ounces are recovered after the washing, according to Mr. Hamilton.

Railway Facilities on Bay Span Nearing Completion

With practically all ties laid east of the Center Anchorage and rails placed east of Pier E-6, work on the construction of electric railway facilities for the San Francisco-Oakland Bay Bridge is progressing rapidly, it is announced by Chief Engineer C. H. Purcell.

Approximately 105,000 California Redwood ties, equivalent to 7,000,000 board feet, will be used on the railway facilities and 15,910,000 gross pounds of track rail. On the bridge proper and the viaduct connecting with the Terminal Building 400,000 spikes will be used, approximating a weight of 320,000 pounds.

He: "I'm almost fast asleep."
She: "That's good, because you're plenty slow when awake."

Bay Bridge Traffic Up Slightly

A SLIGHT increase in traffic over February was announced by State Highway Engineer C. H. Purcell in a March report on the San Francisco-Oakland Bay Bridge filed with State Director of Public Works Earl Lee Kelly.

There was a total of 669,431 vehicles crossing the span last month compared to 594,378 in the preceding period. Daily average was 21,595, up 367 vehicles per day over February. Total vehicles using the bridge to date number 12,380,000.

Three additional days in March over February accounted in part for the increase, Mr. Purcell said, with seventeen rainy days recorded last month.

March traffic totals, however, showed a decrease by 96,884 vehicles from the corresponding period last year. An optimistic note was the increase in freight using the span in March. There were 68,607,331 freight pounds recorded, the largest total since the span opened, except for October, when there were 69,243,169 pounds. The March revenues were $348,235.23 as compared with $313,306.17 for February. Comparative totals follow:

	Total March	Total Feb.	Total since Opening
Passenger Autos	617,244	558,239	11,737,625
Auto Trailers	595	513	19,273
Motorcycles	1,895	1,497	41,826
Tricars	1,061	845	11,806
Trucks	35,173	22,983	409,500
Truck Trailers	1,172	878	25,390
Buses	10,586	9,423	133,726
Total Vehicles	669,431	594,378	12,380,851
Extra Passengers	166,045	146,941	2,709,504
Freight Lbs.	68,607,331	54,078,501	926,722,350

Where Bay Bridge trains will enter and leave the easterly end of the span.

BUILDING BAY BRIDGE RAILROAD

BY THE early part of 1939 a three-quarter century old custom around San Francisco Bay will have been altered.

For the picturesque ferry boats which for decades have carried passengers between metropolitan Oakland and San Francisco will be replaced by smooth running electric trains plying across the San Francisco Bay Bridge.

Both Key System and Interurban Electric (Southern Pacific) will operate trains across the span at an average saving to passengers of 15 minutes.

Trains will operate directly from Alameda, Berkeley and Oakland to the terminal in San Francisco.

This structure, facing Mission Street and extending within the vicinity of Beale and Second Streets, will be longer than the Ferry Building, and will bring 50 per cent of the daily commuter traffic to within walking distance of their destination in San Francisco.

REINFORCED CONCRETE TERMINAL

Street cars will loop in front of the terminal over an elevated ramp. The ramp will have three tracks, with a capacity of four cars each.

The terminal is a reinforced concrete structure to be faced with granite. To date, all structural concrete in the building units has been placed up to and including the track floor, the highest floor elevation in the project.

Above the track floor the side walls and roof slab are within 20 per cent of completion. All steel framing over the train shed, with the exception of the east unit, has been erected, and the only steel construction for the viaduct remaining to be placed is that over South First and South Fremont streets.

TRAINS 63 SECONDS APART

Because the Bay Bridge railroad will of necessity handle as many as 17,000 passengers one way at a twenty minute period over one track, close headway schedules will be required. Ten-car trains will run as

close as 63 seconds apart. By way of comparison, New York subway trains have a 90-second headway.

To assure maximum safety and efficiency, the most complete automatic interlocking and signal system has been designed.

Replacing the old system of manually operated levers will be a trim control board, six and a half feet long and four feet and three inches high, designed so that the operator may sit before it as he would at a high-topped desk. Engraved on the face of the board is a track diagram with a signal knob or button placed at the entrance of each "route."

To "set up a route" the operator has only to press the signal knob at the entrance to the route and the completion knob at the exit to the route.

CONTROL BOARDS

Such a control board will be installed in the San Francisco Terminal. The design on this board will show the six tracks over which bridge trains will roll to discharge and pick up passengers. On it will be indicated the 36 track switches and 40 wayside signals which comprise the interlocking plants of the terminal and viaduct.

A similar board will be placed in the high signal tower now completed in the Oakland yards situated just opposite the Toll Plaza. It will differ only in respect to its diagram which will show a design of the yards comprising the storage tracks and the mainline tracks. The Oakland interlocking plant controls 36 track switches and 62 wayside signals.

Each train has its corresponding numeral or letter (numeral for Interurban Electric; letter for Key System) identified on the board. When the train leaves either terminus the operator presses the proper button identifying the train to the operator at the other terminus.

TERMINAL NOISE ELIMINATED

Trains will loop into the San Francisco Terminal from the bridge over a viaduct, so insulated as to eliminate noise to the greatest possible degree.

The trains will leave and enter the lower deck of the bridge at a point west of and paralleling the truck and "off" vehicular ramps.

East and westbound trains will share a common viaduct between the bridge and Clementina street at which point the viaduct separates to form a gigantic loop which will encompass the approximate equivalent of seven city blocks. San Francisco-bound trains from this connection take an easterly to westerly curve into the Terminal.

All foundations for the viaduct are practically completed, as is the neat work on the piers. The concrete crossing over Harrison is finished, and other crossings are rapidly nearing completion.

On the bridge proper, the trains will ply over two tracks on the south side of the lower deck, paralleling the truck lanes.

105,000 RAILROAD TIES

California redwood has been selected for the ties. On the bridge proper the ties are laid directly on the stringers, after the steel had received two coats of inertol.

Trains will leave the westerly end of the bridge over a viaduct paralleling the truck and "off" vehicular ramps.

The San Francisco Terminal, facing Mission Street, showing the center unit well under construction. Street car ramp in the foreground. East and west units not visible.

Each tie is dapped at either end. Ties are marked according to their position on the road-bed and enter the dapping machine in precise relation to the order in which they will be laid on the bridge. The depth of the dap is determined by the stringer, which has been previously surveyed, and upon this depth is also determined the elevation of the track. Depths vary from one-quarter inch to one and one-quarter inch. The dap in most cases is eleven inches wide.

A total of 150,000 ties or approximately 7,000,000 board feet of California redwood comprise the tie order for the Bay Bridge railroad. This is said to be the largest individual order made on the Pacific Coast in a decade.

On the bridge proper all ties have been laid to the center of Span W1-W2, and tracklaying operations on the bridge are in an easterly to westerly direction.

TONS OF RAILS

The running rail is a 90 pound rail, in 39-foot sections. The guard rail is a 90 pound relay. On the main bridge and San Francisco loop the running rails will have a total gross tonnage of 1830; the guard rails, 1315 and the contact rail (to be used by the Key System only) a gross tonnage of 1400 pounds.

The Key System, which now operates on 600 volts, will continue to do so over the bridge. The Interurban Electric will continue to operate on 1200 volts as at present over a catenary system.

An approximate total of 400,000 spikes weighing 160 tons will be used for the tracks on the main bridge alone.

Trim steel catenary bridges painted aluminum, are replacing the timber trolley poles used by the trains at present. Erection of the catenary bridges has been completed.

RAPID PROGRESS

In the East Bay yard, a major portion of the trackwork has been placed, and the connection with the easterly end of the bridge has been made.

Opening of the Port of Oakland Highway approach to the bridge is expected early in June. The viaduct of this highway, which passes over the yards and the main highway approach to the Toll Plaza, was constructed in conjunction with the railroad project.

The Bay Bridge railroad system, reputed to be the longest electric overwater railroad in the world, is another project built by the State Department of Public Works under the direction of Earl Lee Kelly. C. H. Purcell is chief engineer, Charles E. Andrew, bridge engineer and Glenn B. Woodruff, engineer of design.

Trains will roll in the San Francisco Terminal over six tracks arranged in pairs. This view of the elevated track level also shows the roof steel just erected.

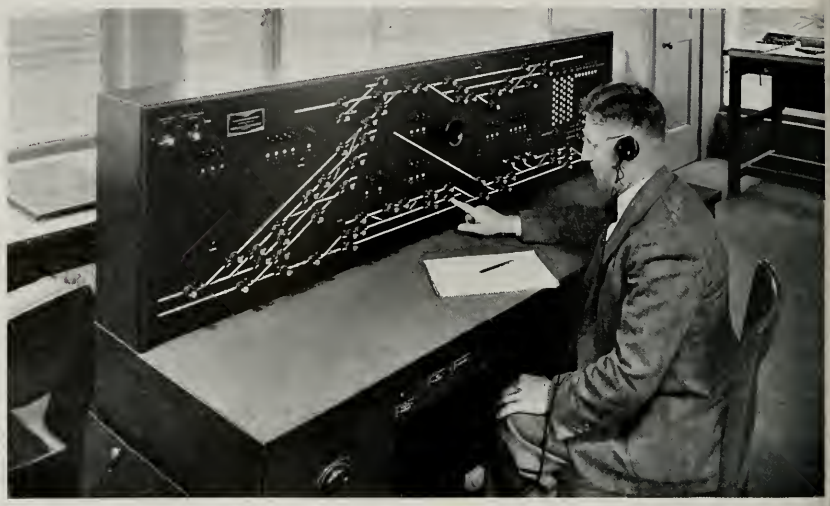
This view looking down the East Bay Crossing shows ties and tracks in place.

Bay Bridge Train Movements Controlled By Push Buttons

THE old switch tower, with its complicated rows of levers, will be replaced in the operation of the San Francisco-Oakland Bay Bridge electric railway system by two specially designed control boards.

One of these boards has been installed in the signal tower of the East Bay Yard opposite the Bay Bridge toll plaza. The other will be placed in the San Francisco terminal building on the track floor.

The long rows of mechanically interlocked individual levers will be succeeded by an all-relay route control system operated by controls arranged directly on a track diagram.



Control board 6½ feet wide operating electric routing and switching of Bay Bridge trains.

To set up a route by the control board, it is necessary only to press in the signal knob at the entrance to the route and the completion button at the exit from that route. The light in the signal knob will flash on instantly and will continue flashing until the switches are properly set and the signals are cleared. It then becomes a steady light.

A mechanical lever system would have required 92 levers and 60-foot switch tower.

AUTOMATIC OPERATIONS

When the train accepts the signal and enters the route, which is made visible on the board by occupancy lights, the signal returns to the stop indication and when the train has passed entirely through the route, the pressed-in knob is released and is ready for another operation.

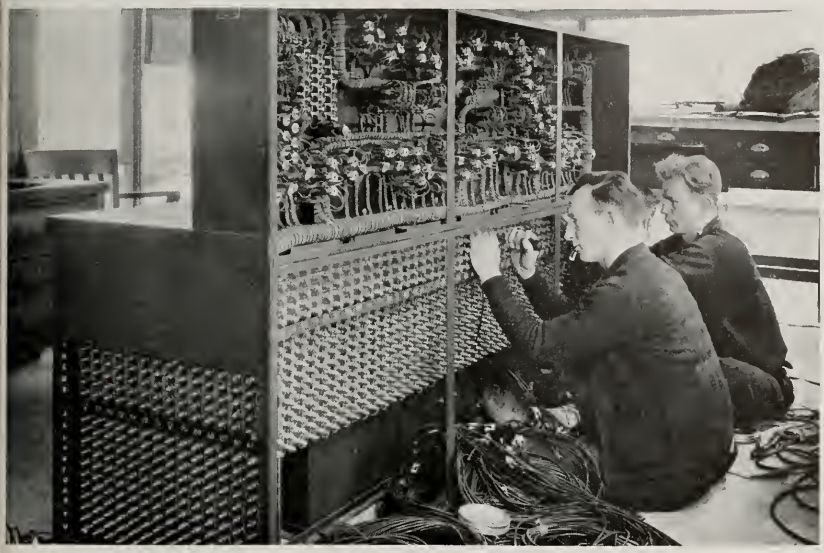
Under the new system it is possible to set up a route for a succession of trains. When this is done, the signal knob is rotated 90 degrees rather than pushed in; but the completion button is operated as for one train.

The wayside signal will automatically clear for the next train while the route remains locked.

An additional feature on each of the control boards is a train identifier system. The tower operator must know the identity of each train as it approaches in order to route it according to the train traffic schedule.

TRAIN CLEARING SYSTEM

In the case of westbound trains, as each train leaves the Oakland yard the Oakland operator, in clearing the train, also identifies it. This identity is transmitted to the San Francisco tower by means of lights appearing on the control board each of which bears the number or letter of the train—the Key System trains operating by letter, Interurban Electric (S. P.) by number. As each train enters the San Francisco interlocking area its identification is canceled.



Rear view showing complicated wiring system of 6½-foot control board.

Had the mechanical lever system been used on the Bay Bridge trains, for the operation of the Oakland interlocking plan alone, it would have been necessary to have utilized 92 levers in a tower 60 feet long. The Oakland control board is 6½ feet in length and the San Francisco board is of similar length.

Each board contains the design of the track system for that particular interlocking area. In the case of the former, it includes all trackage in the East Bay Yard and in the case of the latter, the track system for the San Francisco loop, comprising that area from the bridge proper to the terminal building.

Bay Bridge Traffic Shows Increase Over Previous Month

TRAFFIC and revenues for the San Francisco-Oakland Bay Bridge last month reached a highpoint for the year, it was announced by Earl Lee Kelly, State Director of Public Works. A total of 777,363 vehicles crossed the bridge in August, Mr. Kelly said, producing revenues amounting to $405,065.60. An average of 25,076 vehicles crossed the span every day. Comparative figures and totals are shown below.

	Total August	Total July	Total since Opening
Auto Trailers	1,848	1,829	26,299
Passenger Autos	693,297	667,608	14,913,556
Motorcycles	2,994	3,034	55,590
Tricars	1,167	1,001	17,290
Buses	13,432	13,467	194,032
Trucks	39,863	34,414	563,228
Truck Trailers	1,768	1,538	32,939
Toll Vehicles	754,369	722,891	15,802,934
Auto Passes	21,089	17,552	208,100
Truck Passes	1,905	2,029	20,305
Total Vehicles	777,363	742,472	16,031,339
Extra Passengers	244,728	241,163	3,793,908
Freight Pounds	111,016,500	87,499,250	1,374,747,659

The August report of traffic compiled by State Highway Engineer C. H. Purcell, however, indicated a drop from last year's figures, which showed that 853,579 vehicles crossed the bridge during August, 1937, averaging 27,535 vehicles a day, with revenues totaling $453,213.40.

August traffic figures bring the total number of vehicles to cross the span to date to 16,031,339.

Freight increased to 111,016,500 pounds during last month, with the number of trucks and truck trailers totaling 41,631.

Both truck travel and freight pounds showed an increase over July, 1938, which had a total of 35,952 trucks and trailers and 87,499,250 freight pounds. August figures also represented an increase of more than 42,000,000 freight pounds and approximately 13,000 trucks and trailers over the corresponding period last year.

Governor Merriam Pilots First Train Across Bay Bridge

WEARING a brand-new trainman's cap, Governor Frank F. Merriam, chairman of the California Toll Bridge Authority, piloted the first electric train across the San Francisco-Oakland Bay Bridge Friday morning, September 23.

A Key System two-unit streamliner, the train started at 40th and Hollis Street and proceeded to the easterly foot of the bridge, where Governor Merriam boarded with his party. The Governor was accompanied by Chief Engineer C. H. Purcell, Bridge Engineer Charles E. Andrew, Engineer of Design Glenn B. Woodruff, Florence M. McAuliffe and Lloyd W. Dinkelspiel, counsel for the California Toll Bridge Authority.

Railroad officials, who, with newspapermen, were other occupants of the train, included: W. A. Worthington; C. R. Harding; A. T. Mercier; L. B. McDonald, vice presidents of the Southern Pacific; W. H. Kirkbride, chief Engineer; E. E. Mayo, assistant chief engineer; G. E. Gaylord, superintendent; F. E. Sullivan, train master, and E. J. Foulds, attorney, all of the Southern Pacific.

Key System officials were Alfred J. Lundberg, president; vice presidents William P. St. Sure, C. N. Anderson, Chester C. Vargas, S. G. Culver, Bruce Campbell; Frank Richards, general counsel, Andrew T. Haas, architect. I. S. Shattuck, traffic engineer for the Golden Gate International Exposition was also an observer.

The Governor was originally scheduled only to start the train as a ceremonious gesture. However, after a few brief instructions by Vice President C. N. Anderson in charge of operations for the Key System, the State's chief executive proved himself an able trainman and remained at the controls to guide the train and its 80 some passengers across the bay—the first time in history that a train ever crossed under its own power directly between San Francisco and the East Bay.

The trip proved the success of the bridge railroad constructed by the State Department of Public Works. Unanimous opinion of railroad experts and newspapermen was that the roadbed provided smooth and quiet operation; that the automatic cab control system was highly efficient and that the view from the train windows was unsurpassed.

Chief Engineer C. H. Purcell tersely summed up his inspection following the first test run. He reported: "The cab signal for the run indicated a permissible speed of 35 miles per hour and the train proceeded across the bridge in accordance with this prescribed signal indication. All facilities and equipment operated as intended."

It required approximately an hour to make the round trip over the bridge on the train's first run. This was due to frequent stops for inspection of expansion rails, and to permit newspapermen to photograph the train on the bridge.

It will require approximately 10 minutes after trains are in actual operation, to cross from the center of the San Francisco Bridge Terminal building to the easterly foot of the span.

Bay Bridge Traffic Shows Increase Over September 1937

A FIVE per cent increase in San Francisco-Oakland Bay Bridge traffic over that of a year ago was revealed yesterday by Director of Public Works Earl Lee Kelly from the September traffic report filed by State Highway Engineer C. H. Purcell. A total number of 740,622 vehicles crossed the bridge during last month, as compared to a total of 705,704 for the same period in 1937.

Due to changes in rate parities between the ferries and the bridge since the time of the bridge opening, this is the first time that a parallel comparison could be made between 1937 and 1938 and those for the current year. Other classifications of traffic also showed an increase over last year. Freight pounds were up 67 per cent, with a total of 107,886,750 pounds for September, 1938, as against 64,352,834 for the same month in the previous year. The number of trucks increased approximately 51 per cent with the comparitive figures of 37,684 for September, 1938, and 25,031 for September, 1937. Buses increased 39 per cent with 13,153 buses crossing the span last month and 9462 in September of last year. Traffic for September, 1938, averaged 24,687 vehicles a day—a drop of 389 vehicles from August.

High point of the month was on Saturday, September 24, when 33,762 vehicles crossed the bridge. This increase was due to the St. Mary's football game in Berkeley.

	Total September	*Total August*	*Total since opening*
Auto Trailers	1,473	1,848	27,772
Passenger Autos	657,611	693,297	15,571,167
Motorcycles	2,806	2,994	58,396
Tricars	1,003	1,167	18,293
Buses	13,153	13,432	207,185
Trucks	37,684	39,863	600,912
Truck Trailers	1,637	1,768	34,576
Toll Vehicles	715,367	754,369	16,518,301
Auto Passes	23,245	21,089	231,345
Truck Passes	2,010	1,905	22,315
Total Vehicles	740,622	777,363	16,771,961
Extra Passengers	233,561	244,728	4,027,469
Freight Pounds	107,886,750	111,016,500	1,482,654,409

After a few minutes of instruction, Governor Frank F. Merriam took over the controls, started the motor, and piloted across the San Francisco-Oakland Bay Bridge the first train in history to cross under its own power from Oakland to San Francisco. The Key System two-unit stream line is shown with Governor Merriam at the throttle and below, shaking hands with the Governor are railroad workers: (left to right) Martin Coyne, John Armstead and Fred Welsh.

Combined aerial photo and artist's drawing of Bay Bridge and Terminal. Arrow indicates Terminal Building.

Bay Bridge Terminal Officially Opened

AS THIS ISSUE of the magazine goes to press, Governor Culbert L. Olson is scheduled to officially dedicate the San Francisco-Oakland Bay Bridge terminal, initiating train operations on the monumental structure spanning San Francisco Bay.

One of the most imposing buildings in San Francisco, the Bridge Railway terminal is on Mission street between First and Fremont. Faced with California granite, it is of reinforced concrete construction, modern in line and so designed as to reduce walking to a minimum. The distance from track level to mezzanine (streetcar level) is approximately 10 feet; from mezzanine to ground floor another 10 feet, making a total distance of 20 feet from track to street. Streetcars rise from ground level to mezzanine on a ramp which provides for three tracks.

There is a total of 14 stairs and 11 ramps within the structure, allowing for a wide distribution of passengers, within, while 15 street entrances and exits into and from the terminal tend to eliminate congestion without. These give access to Beale, Fremont, First, Mission, Natoma, and Minna near Second street.

Approximately 60,000 persons, it is conservatively estimated, will pass through the Terminal daily.

Due to the convenience of the Terminal location, 50 per cent of these will be within walking distance of their destinations. This is comparable to 25 per cent now within walking distance from the Ferry Building terminus.

Installation of all signal equipment has been completed. Interurban Electric trains (S. P.) have completed schooling their engineers on nightly runs across the bridge from the easterly end to the Center Anchorage in the West Bay crossing.

Inspection buildings in the East Bay yard are well under way, with major steel work completed, except for the Key System structure.

The Bridge Railway's own telephone system is installed. The system will involve in all 41 telephones, including phones at five crossovers on the bridge proper, the three substations, and four tie stations.

The Bridge Railway was constructed by the State Department of Public Works under the direction of Chief Engineer C. H. Purcell.

An illustrated article showing interior views of the capacious new terminal building will appear in a later issue of this magazine together with details of the dedication ceremonies.

Scene at official opening and dedication of San Francisco-Oakland Bay Bridge Electric Railway Terminal Building in San Francisco.

Bay Bridge Terminal Dedicated

WITH a few formal words uttered at the dedication ceremonies held in San Francisco January 14, Director of Public Works Frank W. Clark turned over to Lieutenant Governor Ellis E. Patterson, representing Governor Culbert L. Olson, the State-owned Bay Bridge and State-built Bay Bridge terminal building and electric railway, the first railway ever to operate directly between Sacramento, Alameda County and San Francisco.

Director Clark said,

"Lieutenant Governor Patterson, I, as State Director of Public Works, declare the San Francisco-Oakland Bay Bridge rail facilities completed for train operation and recommend acceptance by the California Toll Bridge Authority."

Lieutenant Governor Patterson, representing Governor Olson, who is Chairman of the California Toll Bridge Authority, accepted the completed facilities for the Authority and turned the use of them over to the railroads for operation. Mr. Patterson said,

"On behalf of Governor Culbert L. Olson, Chairman of the California Toll Bridge Authority and member of the Authority, your recommendation is accepted and the California Toll Bridge Authority hereby assumes possession."

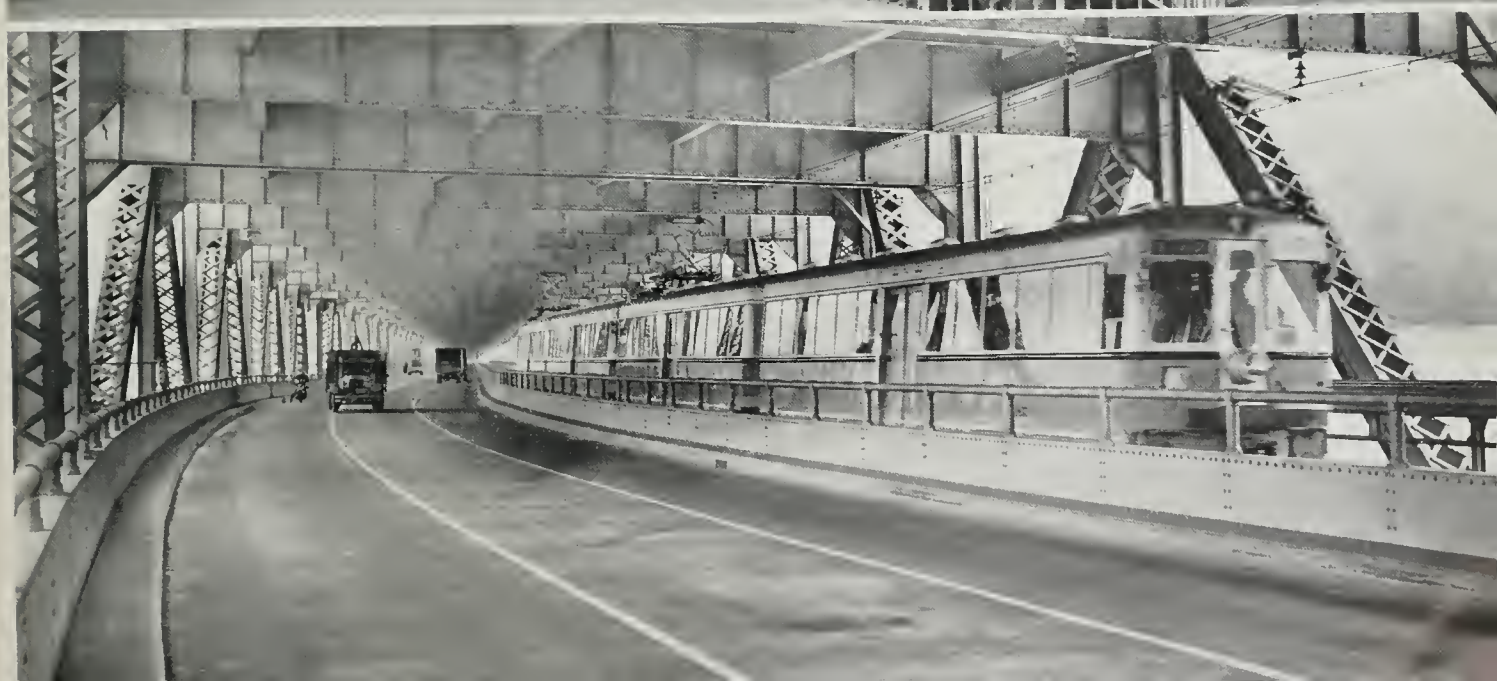
To the strains of "The Star Spangled Banner," and "I Love You, California," the National and Bear flags were then raised by the California Highway Patrol.

In completion of the formal steps necessary to the occasion Lieutenant Governor Patterson then turned to the railroad representatives present and said:

"In accordance with the agreement between the California Toll Bridge Authority and Interurban Electric, Key System, and Sacramento-Northern, I formally place the use of these railway facilities in the hands of representatives of the railroads here today. I am certain, gentlemen, that it will be your policy to operate these facilities to the best interest of the public."

A. T. Mercier, president of Interurban Electric; Alfred J. Lundberg,

At Top—One of four passenger platforms on upper terminal level where trains on six tracks load and unload passengers. Center—Mezzanine concourse entered from street car ramp and ground floor waiting rooms. Bottom—Lower Bridge deck carrying train and truck traffic.



president of Key System, and H. A. Mitchell, president of Sacramento-Northern, then formally accepted the use of the facilities for their companies.

The ceremonies were held in front of the newly completed terminal building facing Mission Street in San Francisco with more than 1500 dignitaries from cities of northern California, Alameda and San Francisco counties participating before a great throng of citizens who came to witness the epochal event.

The legal and essential formalities concluded, the program continued with a number of notable speakers.

"C. H. Purcell, Chief Engineer of the Bay Bridge and its railway facilities, was introduced by Supervisor John Ratto of San Francisco, chairman of the San Francisco citizen committee for the celebration, acting as chairman of the day. Mr. Purcell was described by Mr. Ratto as "a man who has probably accomplished more for the San Francisco Bay Region as a whole in a shorter period of time than any single person" and "a man who has quietly shouldered tremendous responsibilities and who has executed these responsibilities with great skill and amazing success."

Mr. Purcell said, "Into this project have gone the skill and experience of the engineering profession—civil, electrical and mechanical. Great praise is due the staff of engineers employed by the State Department of Public Works on design and in the field. Also to Bridge Engineer Charles E. Andrew and to Engineer of Design Glenn B. Woodruff, who worked faithfully, conscientiously, and ably, special praise is due.

"Appreciation is also due the fine cooperation given by the American workmen employed on the project; by the contractors engaged in the construction of the facilities and by the railroads who will operate the system.

"To the Federal Government, through the Reconstruction Finance Corporation, and to city and county governments thanks are given for the invaluable aid given us."

Mayor Angelo J. Rossi of San Francisco welcomed the visiting Mayors. Among those who spoke briefly were Mayor T. B. Monk of Sacramento; Dr. William McCracken, Mayor of Oakland; Edward N. Ament, Mayor of Berkeley; Henry A. Weichart, Mayor of Alameda; Oliver Ellsworth, Mayor of Piedmont; Earl Derry, Mayor of San Leandro.

Florence M. McAuliffe, special counsel for the California Toll Bridge Authority, read a telegram of regret from Jesse F. Jones, chairman of the Reconstruction Finance Corporation. The telegram, addressed to Charles H. Purcell, said:

FRANK W. CLARK
Director of Public Works

"I very much wish I could be present at the dedicatory ceremonies starting interurban service on the San Francisco-Oakland Bay Bridge. Again I am reminded that the design and construction of this bridge is one of the outstanding engineering feats of our generation. It is beautiful as well as being of great service and will stand a credit to all who had part in the great achievement. I extend hearty congratulations to San Francisco, Oakland and California."

Howard J. Klossner, a director of the Reconstruction Finance Corporation, spoke for the Corporation; and H. R. Judah, chairman of the State Highway Commission and member of the California Toll Bridge Authority, gave a brief but impressive talk.

Frank C. MacDonald, general president of the State Building and Construction Trades Council of California, who was introduced by Director Clark, spoke on behalf of labor.

The 1500 guests had been brought to the ceremonies by Key System and Sacramento-Northern trains. Two six unit Key System trains left 22d and Broadway in Oakland at 10:30 a.m., traveling smoothly over the bridge and arriving at the San Francisco Terminal for the ceremonies at 11:15 o'clock. Labor representatives, contractors' representatives, and civic officials of Alameda and San Francisco counties were present.

A Sacramento-Northern train, originating at Chico, carried mayors and distinguished guests of the Northern California towns along the route. Members of the State Legislature, who had been invited by Governor Olson to attend, were among the guests.

More than 5,000 persons gathered in the plaza before the handsome new Terminal to listen to the ceremonies. After completion of the dedication program the building was opened to the public for inspection. Thousands wandered through the modern structure during the day and evening.

Operation and maintenance of the Bridge Railway is now in the hands of the railways, a board of governors having been named by the railroads for management of the facilities. Named were R. E. Hallawell, General Manager of Interurban Electric; and William P. St. Sure, Vice President of the Key System. F. E. Sullivan was appointed Superintendent of the Bridge Railway and Orman Lutz was named Business Manager by the Board.

The construction chronology of the Bay Bridge Electric Railway facilities is as follows:

(Continued on page 28)

Terminal Plaza showing trolley car loop ramp to mezzanine level and street entrances for pedestrians and automobile passengers.

OFFICIAL GROUP—Left to right—Frank W. Clark, State Director of Public Works; Lieutenant Governor Ellis E. Patterson; Mayor William McCracken of Oakland; Mayor Angelo J. Rossi of San Francisco; John F. Hassler, City Manager of Oakland, and C. H. Purcell, Chief Engineer of Bay Bridge and its railway facilities.

Pinole Grade Crossing Project Presents Many Difficulties

(Continued from page 20)

Santa Fe tracks with a very narrow intersecting road at the westerly end.

This section of highway is in the direct line of heavy auto and freight traffic between the East Bay cities and the Sacramento Valley. Its improvement will correct the substandard condition now existing. An average daily traffic of over 8000 vehicles passes this point. The Sunday traffic amounts to more than 12,000 vehicles.

DETOUR CONSTRUCTED

It has been necessary to maintain close cooperation between the railroad and highway construction operations in order to facilitate an early completion of the project. The maintenance of uninterrupted service on both the railroad and highway demanded close coordination in executing the various phases of the work in the proper sequence. Inasmuch as the railroad cut completely blocked and destroyed the old highway, and since there were no available roads over which highway traffic could by-pass the project, it was necessary to construct a highway detour around the work.

The construction and maintenance of such a detour involved the expenditure of approximately $14,000. This amount was exclusive of the cost of the detour bridge which is to remain in place to serve as a permanent connection to the town of Hercules. Of this amount, approximately $2,000 was required for the installation of warning signs, lights, traffic stripe and guard rail to warn and protect the traveling public.

HIGHWAY BRIDGE BUILT

The realignment of the railroad track, substituting an open cut for the existing railroad tunnel, makes necessary the construction of a highway bridge to span the track. This structure requires new alignment for the highway approaches which are being constructed to a standard divided highway with a 4-foot dividing strip.

The dividing strip separates two 23-foot highway lanes, each of which has a 7-foot shoulder. The 23-foot pavement lanes will be surfaced with six inches of crusher run base topped with three inches of plant mixed surfacing. The shoulders will be given a penetration oil treatment. The dividing strip will be inclosed between concrete curbs. At each end of this section the dividing strip will be carried to the end of the vertical curves, and there will be a 400-foot transition in pavement width, narrowing down to bring the 4-lane pavement to the existing 3-lane pavement width.

At the west end the dividing strip will terminate in the restricted speed zone area within the city limits of Pinole, and the nose of the dividing strip will be provided with 3-inch ruby reflectors. At the east end, due to the faster speed of traffic approaching the divided roadway and the possibility of confusion during night driving and probable fog condition, an automatic amber flasher traffic signal will be installed in the nose of the dividing strip.

GRADE SEPARATION

The grade separation structure spanning the railroad track is of continuous flat slab construction resting on concrete bents with two expansion joints in the deck at the quarter points. The bridge is 425 feet in length, consisting of eleven 34-foot spans and two end spans each 25 feet 6 inches in length. The roadway width between curbs is 54 feet consisting of two 25-foot traffic lanes separated by a 4-foot dividing curb. A 2-foot 6-inch sidewalk is provided on each side of the bridge for pedestrian traffic.

After relocating the various public utilities which interfered with construction, constructing the detour and routing highway traffic over it, the next step was to start the excavation for the new railroad roadbed. This operation was so planned that work on the grade separation structure could be started immediately. The next order of work was to construct the southerly one-half of the structure, which portion spans the railroad track at its new location. When the southerly one-half was complete, the railroad realigned, and the new track placed in operation, it was then possible to construct the northerly one-half of the structure without interference from train traffic.

The work is being done in cooperation with the A. T. & S. F. Railroad. The railroad company is performing the work of relocating its track and is assuming the cost thereof. The railroad portion amounts to approximately $125,000, and the State's portion, consisting of the construction of the overhead structure together with the cost of highway approaches, will cost approximately $110,000. The State's portion is included in the Federal Aid Grade Separation Program and is being financed from Federal funds.

The excavation for the railroad location is being performed under contract by Sharp and Fellows of Los Angeles, and the construction of the grade separation and highway approaches is being performed under contract by the Union Paving Company of San Francisco. The contract date for completion is June 16, 1939.

Bay Bridge Terminal Dedicated Jan. 14, 1939

(Continued from page 8)

Dec. 21, 1936—First demolition of buildings for terminal site.

July 29, 1937—First shovelful of earth excavated for terminal site, southeast corner of Natoma and Fremont.

Nov. 29, 1937—First tie on bridge proper laid at Span E-22.

Jan. 12, 1938—First structural steel for terminal unit erected at First Street between Natoma and Minna Streets (12-foot steel columns).

Jan. 14, 1938—First major steel erected at Natoma and First Streets (43-foot steel girder).

Feb. 1, 1938—First spike for bridge railway placed at Span E-22.

Mar. 8, 1938—First steel for track level (third story) of Terminal Building erected at Fremont Street.

Sept. 23, 1938—First test train (Key System) ran from East Bridge head to Pier W-1.

Oct. 13, 1938—First test train of Interurban Electric (S. P.) on bridge.

Dec. 14, 1938—First train enters S. F. Terminal (Key System train) for signal tests.

Dec. 17, 1938—First Interurban Electric train enters S. F. Terminal from Oakland.

Dec. 20, 1938—Sacramento-Northern makes first test trip into San Francisco Terminal.

Jan. 5, 1939—Power turned on third rail.

Tests continue nightly until start of operation, January 15.

Bay Bridge

First Phases of Reconstruction For Added Capacity Completed

By N. C. RAAB, Chief Projects Engineer, Division of San Francisco Bay Toll Crossings

The San Francisco-Oakland Bay Bridge was opened to vehicular traffic on November 12, 1936, and from that time to the present there has been an ever increasing volume crossing the structure. The daily average in 1937 was slightly less than 25,000 vehicles; today it is over 100,000.

On May 9, 1937, the first bus lines were started, which were followed by the interurban electric trains on January 15, 1939.

At the time the bridge railway was opened to the public, three lines utilized the rail facilities on the lower deck. They were the Interurban Electric, the Sacramento Northern, and the Key System. Although good, economical transportation was offered the public, the first two companies had to abandon their lines over the bridge within the following two years due to the lack of patronage. The Key System converted a portion of its passenger transportation operation to motor coaches, paralleling in some cases the service provided by the transbay electric trains. The change was primarily brought about to effect operating economies.

Patronage on the trains steadily declined from a maximum of 37,334,000 in 1945 to 6,113,000 in 1957 and as a result the Key System, in 1955, petitioned the Public Utilities Commission for permission to abandon its rail lines and inaugurate motor coach service. A ruling of the commission ordered this change, and on April 20, 1958, mass transit by motor coaches across the Bay Bridge became effective. The rails were no longer in use.

At the time the Key System was seeking relief from its train operation, the California Toll Bridge Authority, in its meeting of December 12, 1956, passed a motion with respect to the financing of any necessary reconstruction of the San Francisco-Oakland

An aerial showing the Transbay Transit Terminal (foreground) in downtown San Francisco with the bus loop connection to the Bay Bridge, and approach ramps from the Embarcadero and Bayshore Freeways.

A ground view of the front of the Transbay Transit Terminal.

Bay Bridge, anticipating the abandonment of rail service.

Legislature Votes Money

In order to provide for this emergency, legislation was enacted and money appropriated by Chapter 27, Statutes of 1957, for studies to be made as to the ways and means of converting the lower deck and the Transbay Transit Terminal, with approaches thereto, for exclusive use of vehicular traffic.

The report of the Division of San Francisco Bay Toll Crossings, dated March 1957, outlined a means of financing the $35,000,000 reconstruction over a four-year period; funds for which were to be obtained from Bay Bridge revenues. Subsequent legislation was enacted, Chapter 2316, Statutes of 1957, approving the plan of construction and method of financing.

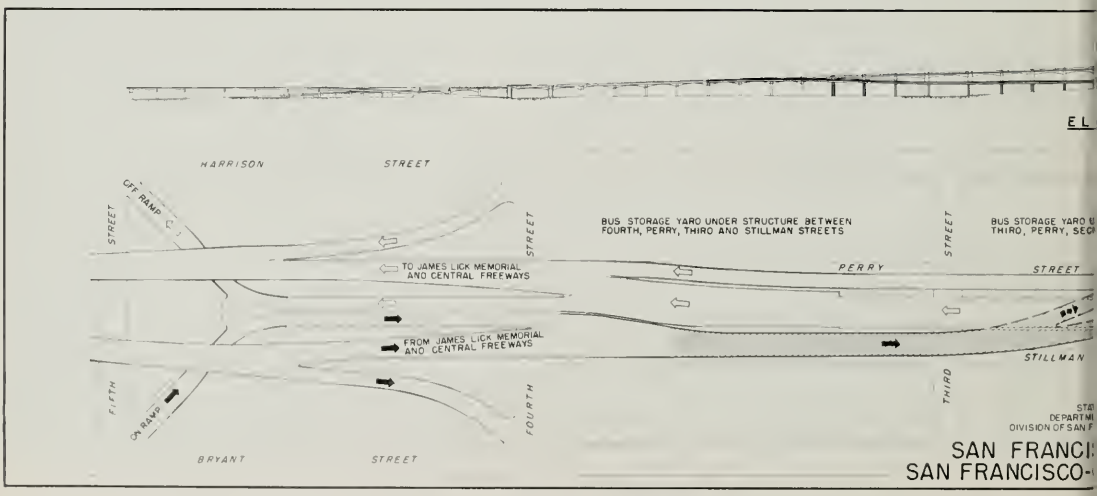
Prior to the start of any construction, it was necessary to evaluate the existing street, highway, and freeway conditions on both sides of the Bay, and proceed with construction in the area where the greatest relief could be obtained in the shortest time.

It was apparent, from existing conditions, that all construction should start on the west end of the crossing and proceed eastward. Contracts were then prepared requiring that all track and rail equipment be moved over the bridge railway and stock-piled in the East Bay Storage Yard, thereby eliminating any additional traffic on the lower deck truck and bus lanes caused by our construction equipment.

Transbay Transit Terminal

The redevelopment of the transportation system for transbay commuter traffic was immediately started by the State of California under its Department of Public Works after the last train crossed the bridge, on April 20, 1958. This, in general, consisted of removing the tracks; paving the vacated areas; and remodeling the Transbay Transit Terminal for the accommodation of bus service.

Besides the immediate emergency construction and changes required in the physical properties in and around the Terminal Building and on the bridge proper for the changeover from trains to busses without interruption of service, there was the long-range planning and construction re-



quired to alleviate the added traffic congestion resulting from the additional busses loading, unloading, and traversing the city streets of San Francisco.

This required the removal of all railway trackage and appurtenances from the bridgehead to the Terminal Building and paving the area. While construction was still in progress, three of the 14 bus lines were routed through the building six months after rail service ceased, or on October 19, 1958. All lines were operating from the terminal by July 12, 1959. On February 1, 1960, Western Greyhound Lines started operating 25 busses in and out of the building each day to the Lafayette, Walnut Creek, and Concord areas.

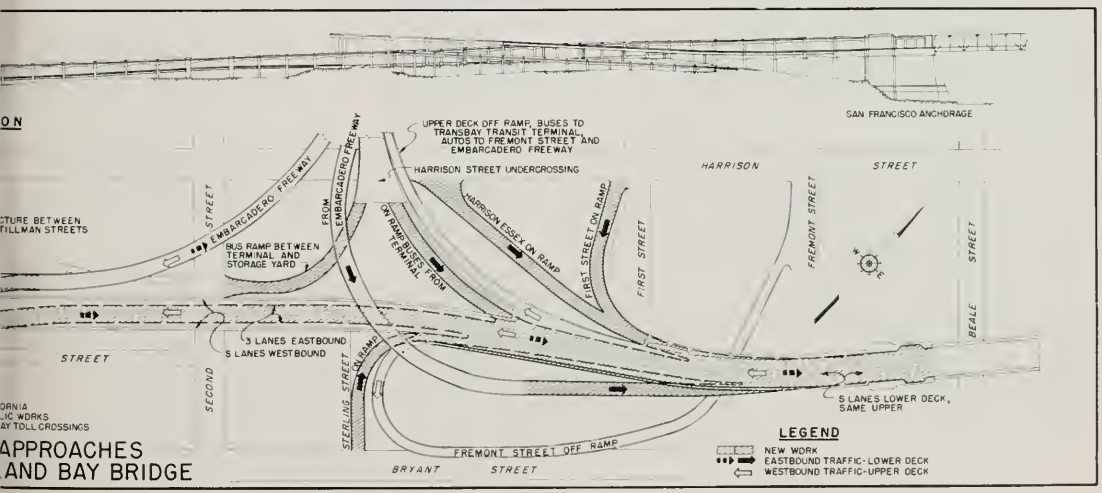
The Transbay Transit Terminal is a four-level structure, having a garage in the basement, waiting and concession areas on the first floor, passenger concourse with ticket offices on the mezzanine, and bus facilities on the upper level. The upper portion of the building is 700 by 164 feet in dimension and is built over both Fremont and First Streets in San Francisco.

Passengers baard ane af the San Francisca-Oakland buses in the remadeled Transit Terminal.

Roadway Is Widened

Formerly, there were six tracks running through the terminal in pairs of two, separated by columns supporting the roof. Tracks were removed, the columns placed on the offside platforms, and the area paved, giving a roadway width of 25 feet which provides sufficient room for a moving bus to pass another at the curb.

There is a longitudinal movement of busses through the building and coach stops are spaced two bus lengths apart, 10 in each roadway, giving a total of 30 for the three roadways. A traffic treadle is located at each stop. The right front wheel of the coach, upon arriving, stops on the treadle, and the driver is notified as to his position by a telltale light on the left curb. At the same time the letter of the busline of the arriving coach is lighted on large indicator boards on the first floor and lobby by the depressed treadle under the coach. Passengers take the escalators or stairways to the mezzanine where smaller indicator signs direct them to the proper ramp or stairways leading to the loading platform. Directly over the bus,



there are lighted indicators giving the letter of the coachline.

In a total blackout, the indicator system is switched to a direct current line which will provide sufficient illumination to guide passengers to the proper busses.

At present, there are two bus companies using the terminal facilities, operating 690 coaches in and out each weekday with about one-half this number on Saturdays, Sundays, and holidays. On workdays, there are approximately 27,000 passengers transported each way.

Since cessation of train operation, there has been a slight increase in bus patronage, somewhat less than one percent over the same months of the previous year. There should be an even greater increase after the Transbay Transit Terminal and grounds are completely rehabilitated and the public becomes better acquainted with the services offered.

San Francisco Approaches

The reconstructed bridge will have five traffic lanes on the upper deck to San Francisco, with the same number running in the opposite direction on the lower deck. The choice of direction was determined by the amount of rearrangement needed to the existing roadway connections to the present structure. It was readily apparent that to effect a westbound movement of traffic on the upper level would require a minimum amount of reconstruction consisting of the partial removal and lowering of only one of the present ramps.

The lower deck of the bridge with its 31-foot, three-lane roadway, had but one connection in the City of San Francisco, located at the intersection of Essex and Harrison Streets. There are now six roadways leading to the lower deck, which include the James Lick Memorial Freeway and the Terminal bus loop. The number of lanes required for each of these ramps was determined from traffic counts. The traffic pattern as described herein will undoubtedly change somewhat after the project has been completed, and travel habits become established.

Generally speaking, about 48 percent of the eastbound traffic to the bridge is generated west of Second Street and uses the freeway as an approach. The new connecting ramp has four lanes between Fourth and Third Streets and three lanes from Third Street to the lower deck.

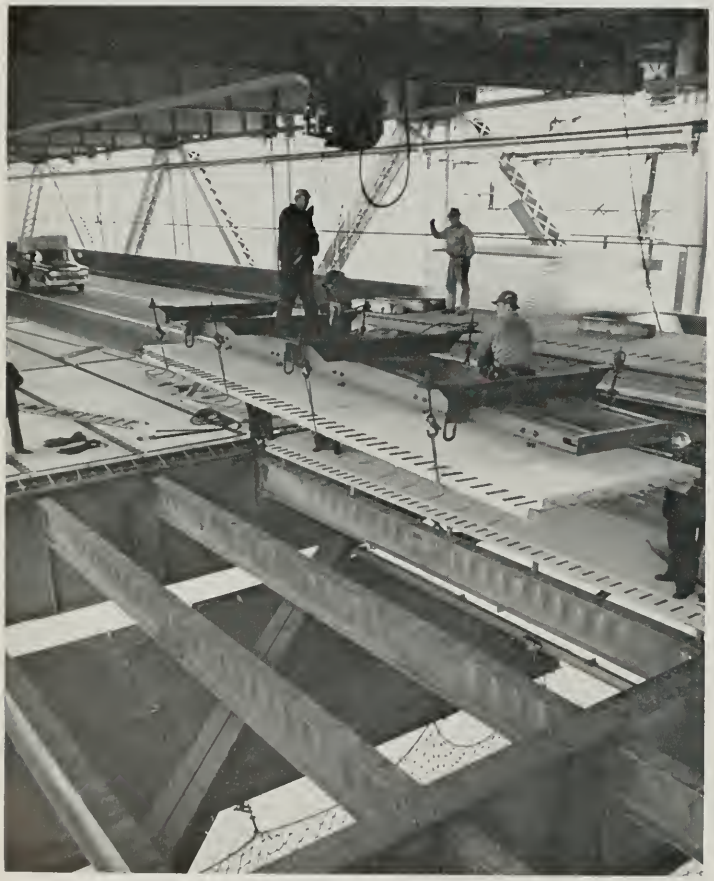
An emergency ramp using Sterling Street with a two-lane roadway under the upper deck was immediately constructed to relieve the Essex-Harrison Street connection during the peak hours between 4.30 and 6.00 p.m. when automobiles are allowed to use the lower level.

A permanent Sterling Street ramp has been completed, which will handle mainly truck traffic originating in the southern part of the city. This traffic has been estimated to be about two percent of the total eastbound peak load. It can serve as an emergency entrance to the bridge in case of tie-ups on the freeway.

The present Essex-Harrison ramp will handle only five percent of the evening peak when one-way operation is put into effect. This traffic will consist mainly of trucks and buses using Folsom and Essex Streets due to the better grades.

Ramp Has Free Lane

The new First Street connection is estimated to handle 20 percent of the afternoon peak hour load. Vehicles



Lower deck reconstruction on the San Francisco-Oakland Bay Bridge. A slab is swung into position across one of the lower deck bays by a special overhead crane. Some 1,400 of these precast concrete slabs, weighing up to nine tons, were used in paving the rail-bed area from San Francisco to Yerba Buena Island. (Photo by "This Earth" magazine.)

using this roadway along with the Essex-Harrison ramp will have a free lane leading onto the north side of the bridge.

The two bus lines using the Terminal Building for their San Francisco station have an evening peak of about two percent of the total eastbound traffic. There would be much less congestion on the lower deck during the afternoon rush hours if more commuters would use the public transportation provided. Buses average 22 persons per trip and closer to 40 during the rush, while the average for the private vehicle is a little less than two persons per trip.

The only ramp that required alteration in San Francisco to provide for the ultimate one-way traffic pattern derives its traffic from the Embarcadero Freeway and handles about 23 percent of the evening load. The major part of this traffic originates in the downtown area and uses the Beale-Mission Street entrance to the bridge. There is a clear lane on the south side of the crossing to accommodate this evening rush.

Another ramp on the San Francisco end of the bridge and not used for vehicular movement across the Bay is the two lane roadway from the Harrison Street undercrossing to Second Street and used by buses going to storage after their morning commuter run. In the latter part of the afternoon the parked buses are moved out of storage to pick up the evening load. The coaches are stored in two lots between Second and Fourth Streets and under the San Francisco approach.

Lower Deck Paving

The work involved in constructing two additional vehicular lanes on the lower deck to provide a 58-foot, five-lane roadway, consisted of removing the two tracks and appurtenant equipment; removing the railway stringer bracing which is no longer needed; removing and relocating the barrier which separated train and highway traffic to the south curb of the structure; and the placing of the precast paving slabs.

All removed material was transported via the bridge railway and into the East Bay Storage Yard where it is periodically sold by contract in lot amounts to the highest bidders.

A view of the completed five-lane lower deck roadway of the San Francisco-Oakland Bay Bridge.

The existing three lanes on the lower deck are required to handle the morning and evening peak hour traffic. The contractor performing the redecking work was not allowed the use of any of the three lanes between the hours of 4.30 p.m. and 8 a.m. This restriction and other details peculiar to the structure dictated the use of precast deck slabs which were transported to a section of the Bridge prepared for placing.

The slabs are a little less than 30 feet long by six feet wide and six inches thick. Four are placed transversely in a 30-foot panel and are supported by the four railway stringers, providing a paved width of 28 feet. Lightweight concrete, averaging 107 pounds per cubic foot, is placed in steel forms along with the steel truss reinforcing bars at the casting yard. After receiving their initial set they are steam cured until a strength of 2,000 pounds per square inch has been reached when they are then removed from the forms. A cycle of 24 hours is required for a set of slabs.

Crane is Suspended

The four slabs per panel are positioned by an air-operated traveling crane suspended from the upper deck floor system and are held in place and adjusted to proper elevations above the stringers by surface operated screw jacks. The two ends of the four slabs are brought to the proper elevation by measurements from straight edges. One end of the straight edge rests on the existing roadway slab while the other is placed at the grade elevation marked on the curb. Certain of the slab reinforcing bars are welded to the top flanges of the steel stringer, after which the jacks are removed; the sides are then formed and quick setting concrete is placed in the joint space around the lapped reinforcing steel projections to unite the slabs into a monolithic pavement.

The finished roadway deck is then striped for five lanes; the south lane is barricaded for contractor's operations, leaving four lanes for lower deck traffic, two in each direction, during the construction period.

Upper Deck—Concrete Approach

Probably the most exacting part of the reconstruction so far completed has been the strengthening of the present concrete upper deck approach to the bridge from Fourth to Sterling Streets. Also, the removing of the center columns of the three column bents

Looking east toward the lower deck approach of the Bay Bridge from the Bayshore Freeway.

A section of the lower deck of the Bay Bridge during reconstruction with the railway tracks removed.

Deck slabs in place ready for pouring of concrete into the joints.

supporting the upper deck from Sterling Street to the San Francisco anchorage.

The present upper deck roadway is 58 feet from curb to curb and is striped for six lanes of traffic, three in each direction. The upper deck floor system was not designed for heavy commercial vehicles.

All structural floor system members found deficient were strengthened by prestressing, as were the floor beams which had the center columns removed.

As all state-owned toll bridges carry property damage as well as use and occupancy insurance, and as the reconstruction was a deviation from the ordinary maintenance and repairs to the structure, the insurance brokers for the Toll Bridge Authority require an extra premium on the coverage during the construction period. They also stipulated that the time for the use and occupancy insurance to become effective be increased from 7 to 14 days.

Concrete Is Tested

Two checks were made to observe and verify the results of the stressing of the concrete member, which were by the retensioning of the strands to observe if they still retained their initial stress and the other, the running of precise levels over the upper deck benchmark before and after tensioning. Periodic measurements are to be taken over an extended period of time to observe any movement.

At the present time only a small amount of construction has been accomplished on the upper deck and only in those locations where work on the lower level required an upper deck revision. Several refuge bays were constructed and an acceleration lane for the present Fremont Street onramp to the upper deck was provided. When the project is completed, this structure becomes an offramp and the new widened length performs the function of a deceleration lane. This widening of the upper roadway and spreading of the columns supporting it provided the necessary roadway for the Sterling Street approach.

Bridge Traffic Capacity

Various individuals connected with highway planning and traffic have ex-

A view of the Tronsbay Tronsit Terminal and connecting loop viaduct looking eastward with the Bay Bridge in the background.

pressed some concern as to the estimated increase of from 25 to 35 percent in the traffic-carrying capacity of the bridge when completed for a unidirectional flow on each level. They have based their opinions on data contained in the "Highway Capacity Manual," Bureau of Public Roads, pertaining to streets, highways, freeways, and short structures.

They failed to recognize that this six-mile structure, with six lanes of restricted roadway, three in each direction, having few provisions for vehicular turnouts in case of emergencies, is not a freeway and a stalled vehicle must be immediately handled to maintain the roadway capacity.

Studies for the reconstruction of the Bay Bridge analyzed eight different lane channelization arrangements as to their traffic carrying capacities. The one selected for five unidirectional lanes on each deck was the only arrangement that more nearly satisfied the requirements of providing freeway standards with the maximum of safety and freedom of movement.

From the time the structure was opened to motor vehicles, on November 12, 1936, records indicate that there have been an average of 28 stalled vehicles per day, which has remained somewhat uniform, requiring the services of a tow truck or other maintenance equipment. An average of five stalls occur during the peak hours, one-half of which are in the lanes serving the major direction of traffic.

The Congestion Problem

In 1949 it took an average of 8 minutes (the equivalent of 75,000 vehicles per day) to clear the obstruction; however, in 1957 it took 13 minutes (95,000 vehicles per day). The longer time is presumably due to the greater degree of congestion, making it more difficult for emergency vehicles to reach the scene of the accident. Average recorded counts show that there is an average of 2,850 vehicles per hour passing a stalled vehicle in the two remaining lanes. During the peak hours, two free flowing lanes should have a capacity approaching 4,000 cars. A potential capacity of 2,000 vehicles per lane becomes more realistic with four passing lanes instead of two, resulting from a car stalled in the curb lane.

The bridge reconstruction program includes unidirectional travel on each deck, wider lanes, additional refuge bays, curb lane control signal system, and more frequent intervals between modern call and fire alarm boxes.

About 70 percent of the service calls are for minor causes, such as flat tires and empty fuel tanks. More refuge bays should reduce the number of stalled cars using traffic lanes awaiting emergency vehicles.

The wider lanes and signal control system will provide freer access for vehicles proceeding to the obstruction and more space to perform the necessary operations, thereby reducing the time to clear the lane.

With unidirectional traffic on each deck, the accident record of the bridge, although good, should be greatly improved. Head-on collisions, which result in the most fatalities, should be entirely eliminated.

The theoretical increase in traffic carrying capacity which would be provided by these improvements is 30 percent which could, under favorable conditions and with no breakdowns occurring, reach 35 percent, and could go as low as 25 percent under unfavorable conditions.

Maintenance Facilities

Accompanying the structural work required in the reconstruction are the installation of electrical and mechanical facilities that have been planned to provide a more effective and efficient maintenance and operation procedure.

There is now being installed water, electrical power, compressed air, and communication service across the bridge. It is also planned that the electrical energy, required in the operation of the facility, will be metered on both sides of the Bay with an automatic switch-over if failure occurs on either end.

Spotted at convenient intervals along the south truss of the structure are service platforms, access to which can be had from the lower deck or by ladders from the upper level. From these platforms the various connections can be made to the water, electrical power, compressed air or communication service needed. The latter system will be used by the maintenance crews. The tow car and fire alarm service will be connected to this multiple conductor cable from each level.

The water supply will be metered from Yerba Buena Island and flow by gravity to each end of the bridge. Water is provided for fire protection and for steam cleaning; however, the amount used is small.

The Sterling Street Substation, which was formerly used to transform and supply electrical energy to the trains when crossing the Bay, has been rearranged to receive and meter the energy from the power source, transform it to the proper voltages, and then feed to various outlets. Also located in this building are the electric driven air compressors used for maintenance cleaning, operating air tools, and fog horns. Stations similar to this will be located on Yerba Buena Island and at the east bridgehead.

The installation of these permanent maintenance facilities and the providing of additional movable platforms under the upper and lower decks, together with movable gantries along the outside of the trusses of the bridge, should keep all roadway lanes relatively free of maintenance vehicles.

Roadway Lighting

As the minimum clearance between the lower deck pavement and the floor system of the upper level has been maintained at 16 feet throughout the length of the bridge, it will require a somewhat unusual roadway lighting system to adequately supply a high level of illumination without the usual lamp glare and the alternate bright and dark spots on the roadway.

The lower deck with its 24 hour Yerba Buena Island tunnel lighting will offer another problem; however, if all the roadway lighting for the lower deck is properly located and constructed to give a high level light output, vehicular traffic should be able to negotiate the length at a somewhat higher average rate of speed with added safety.

These facilities, together with the wider, unidirectional roadway lanes, should provide a safer, freer, and possibly faster transit over the structure. The opening of the completed portion of the lower deck to four lanes has already demonstrated the greater comfort in driving on that section of the bridge.

(This article will be followed soon by another on the construction from Yerba Buena Island to the Toll Plaza in Oakland and for the revisions to the upper deck.)

Fair-bound Drivers Will Note Changes

The State Fair in Sacramento is a summer season highlight for thousands of Californians, and recent improvements on highways leading to the state capital will make this year's trip to the fair even more enjoyable than in the past.

The 1960 California State Fair and Exposition will be held August 31 through September 11. Fair officials predict the 1960 event will be the biggest and best ever with new entertainment features added to the usual long list of headliner attractions.

Motorists enroute to the fair will find that every main state highway leading to Sacramento has been improved to some extent in the past year, and new sections of freeway are open in several places.

Between the San Francisco Bay area and Sacramento, US 40 is all freeway and expressway, except two four-lane undivided sections north of Vallejo and on the Yolo Causeway.

New sections of freeway will be evident on this route at Richmond and in the vicinity of Davis. Freeway projects will be under construction near Fairfield.

Motorists who take the US 50-99 route from the Bay area to Sacramento will also encounter long stretches of continuous freeway and expressway. There have also been improvements on US Highways 40 and 50 in the mountains and foothills east of Sacramento.

Nearly 40 miles of new freeway have been opened between Sacramento and Nevada since State Fair time last year.

On US Highway 99E traffic is now using the new Yuba River Bridge at the south city limit of Marysville.

Reconstruction and widening on a section of Sign Route 24 in Sacramento County has been completed in the past year. Motorists will also notice that landscaping and planting work has been carried out on several freeway sections on routes leading to Sacramento.