Often called the "San Francisco Earthquake", the October 17, 1989 quake measuring 7.1 on the Richter Scale actually was on the San Andreas Fault, 11.5 miles below the earth's surface and centered in the Loma Prieta area of the Santa Cruz Mountains. These mountains are located fifty miles south of San Francisco and Oakland near the confluence of the land masses which create the San Francisco Bay. When the dust had settled throughout the Bay Area, sixty-eight persons were dead and 3,286 injured[1] in the surrounding ten counties. Forty-two of the deaths occurred in the collapse of the Cypress Viaduct of Highway 880 located in West Oakland.

The Cypress Viaduct was California's first continuous double-deck freeway structure. It was a bi-level structure, constructed so that the southbound roadway

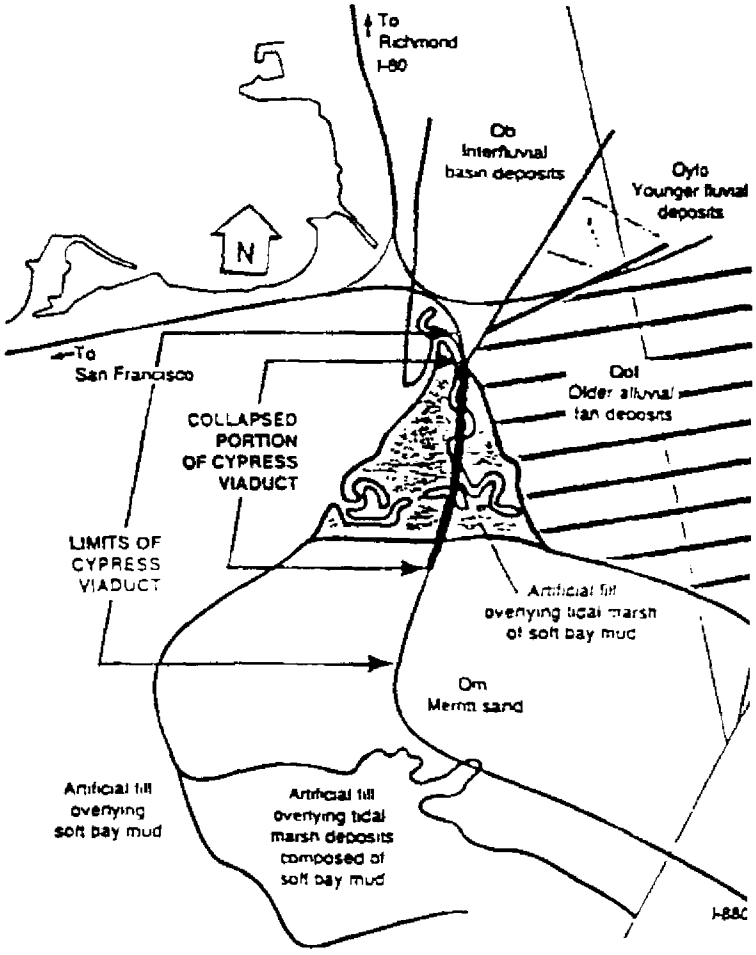
[1]Loma Prieta Earthquake.California, U.S. Geological Survey Publication, 7-90.

was located directly above the northbound roadway. The Viaduct was an eight lane urban expressway with four lanes of travel northbound and four lanes of travel southbound. Construction began in 1954 and was completed in 1957 at a cost of $10,200,000. The viaduct was heralded as a "a solution required to provide for the quick passage of 50,000 vehicles per day through a congested area."(Highway Magazine, 1958). The annual average, daily traffic volume on the Cypress Street Viaduct was 171,000 vehicles per day. In the Caltrans booklet, "1988 Traffic Volumes on California Highways", peak hourly volume of 15,400 vehicles per hour is shown, (total volumes of both directions for 1988).

According to a 1987 Caltrans count, the best estimate of normal traffic volumes for a typical Tuesday in October at 5:00 p.m., near the time of the earthquake, would be 1509 vehicles per hour per southbound lane and 1400 vehicles per hour per northbound lane.

Preliminary design of the structure began in 1949 when the use of prestressed concrete in bridges was new in the United States At that time little was known about seismic design of reinforced concrete structures. The Cypress Viaduct was designed and constructed in compliance with seismic requirements of that era. The viaduct was a brittle structure possessing very little ductility, which was consistent with the practices of the period.

The Cypress Viaduct contained several new and unusual design features, including a large number of different bent types and hinge arrangements. It is believed that the structural system was designed with many hinges and joints to provide for movement and for future construction additions. The many hinges and joints coupled with the inadequate seismic design criteria of the early 1950's, made the structure susceptible to damage or collapse in a strong earthquake. Primary damage from earthquakes is the result of ground shaking. Shaking generally decreases with distance from the fault segment which slips during the quake. However, shaking can be locally amplified, at a great distance, by sedimentary deposits or fill. Geologic maps of the area show that about 6,000 feet of



the Cypress Viaduct was located on the bay plain. The southerly one-third of the viaduct was built on Merritt sand, a loose to relatively dense deposit of beach and wind-blown sands with varying amounts of silt and clay. The Merritt sand is about 60 feet thick but abruptly thins at its northern margin.

The northerly two-thirds of the viaduct, the major portion that collapsed, was located on about 7 feet of dense-to-stiff artificial fill over a pre-existing tidal marsh composed of soft bay mud. Depth of the mud ranges from 20 to 25 feet.[2]

A main artery to and from a large number of Bay Area communities, the Cypress Viaduct consisted of two decks. Each of the two decks carried 4 lanes of traffic. On October 17, traffic on this thoroughfare was abnormally light due to the third game of the 1989 World Series which was between the Oakland A's and San Francisco Giants. This game was scheduled for 5:30 p.m and due to the game, a large proportion of residents had either taken the day off work or left their place of employment early and were home preparing to watch this third game of the "Bay Bridge World Series". When the earthquake struck at 5:04 P.M. traffic conditions were unusually light, compared to normal rush hour activity.

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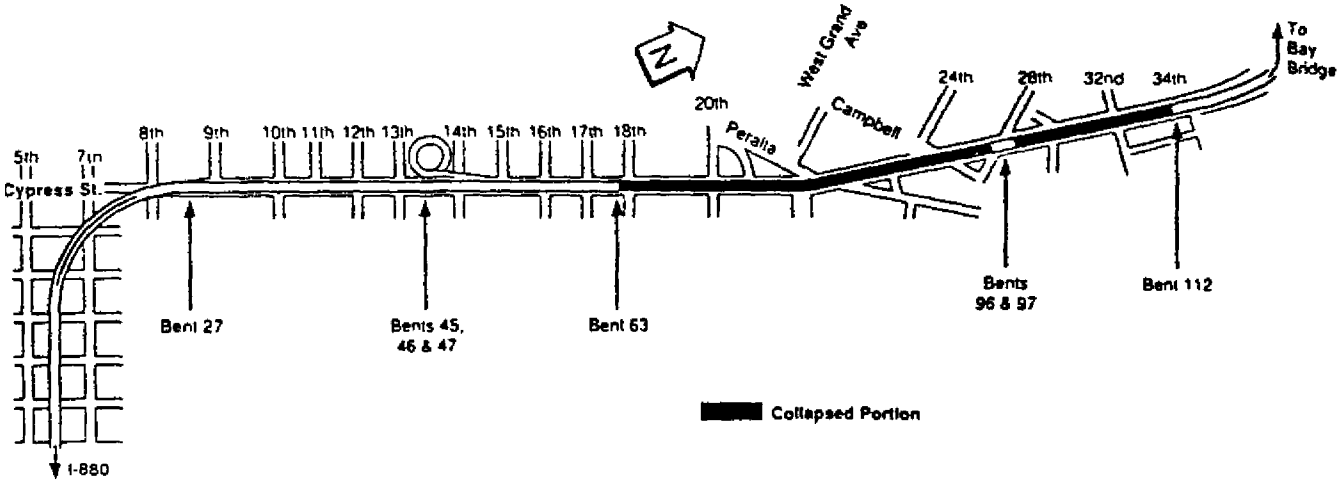
[2]Competing Against Time, Report to Governor George Deukmejian from the Governor's Board of Inquiry on the 1989 Loma Prieta Earthquake. Charles C. Thiel Jr., Editor, Office of Planning and Research, May 1990.

Immediately after the quake, the Fire Department dispatch consoles lit up with incoming calls. Within five minutes of the the earthquake, most of the fire companies in West and North Oakland had been dispatched to reported fires and building collapses.

The first report of the Cypress Viaduct collapse was received at 5:10 P.M., six minutes after the earthquake. Fire Department units sent to investigate the site reported "total collapse as far as the eye can see". Additional units and a chief officer to assume command were requested.



Most reports were coming from fire companies located at the south end of the collapse, near 18th Street. The command post was initially established at the intersection of 18th and Cypress Streets. At the time, it was not clear the collapse extended from 18th Street to 34th Street, an area approximately one and one-half miles long. Cypress Street runs along the side of the elevated decks. The

area directly under the viaduct was used for storage. There was total chaos as large pieces of concrete and other rubble fell from the structure and filled the street. The roadway on the upper level of the structure had fallen at intervals to the lower deck. Some victims were walking around dazed and confused while volunteer rescuers were trying to scramble up onto the structure to assist those trapped.

The success of the initial Cypress rescue operation was due, in large measure, to the efforts of hundreds of citizen volunteers. These volunteers, residents coming from homes and businesses in the neighborhood and some just passing through, performed some of the first rescues of trapped motorists. Using makeshift ladders, ropes and even trees planted beside the freeway, volunteers scrambled up onto the broken structure to render first aid and help the injured and dazed to safety. As fire and paramedic personnel arrived to take over and organize the rescue operation, volunteers continued to augment and assist the professional rescue workers. Initially, it was thought there might be hundreds of people trapped between the fallen freeway decks. The Incident Commander requested additional resources and Command Staff to implement the Incident Command System.

As off-duty command officers arrived from home the structure was divided into three divisions:

South Division.....18th. St to West Grand.

Central Division.....West Grand to 34th St.

North Division.....34th St. to Bay Bridge

The command post was relocated to West Grand at Cypress Street and a unified command was established with the Oakland Police Department. Under the City of Oakland Disaster Plan, the Police Department has responsibility of scene management and the Fire Department has operational responsibility for emergency mitigation. City of Oakland Public Works employees played a significant role in the early rescue operation, as well as the preparation for the long term operation. In the initial hours the Department of Public Works provided heavy equipment and personnel for clearing Cypress Street. This enabled access for emergency vehicles and equipment. Public Works equipment operators worked feverishly to clear rubble strewn streets to provide access for emergency vehicles. There was a need also to clear years of accumulated storage under the structure to allow shoring and stabilization of the freeway. The Department of Public Works bridged the gap from the initial time of the collapse until the California Department of Transportation was in a position to assume responsibility for their structure.

As the incident began to stabilize, the command staff became increasingly concerned about the literally hundreds of spontaneous volunteers who continued to flood the area. In addition to the volunteer rescuers on the structure, the

command post was inundated by well meaning construction workers, tow truck drivers, and equipment.operators eager to assist in the rescue operation. None of these resources were operating within the established mutual aid and logistical system . They were becoming a distraction to on-site staff who were trying to coordinate staff, machinery, and the volunteers. It became evident this was an added problem which had to be dealt with and managed by on-site staff.[3]

Also of great concern regarding the volunteer rescue workers was the probability of aftershocks and their effect on the already unstable structure. While many volunteers were working under close supervision of fire company officers, as darkness and fatigue set in, the group as a whole lacked adequate supervision, training, and equipment to continue to function safely. A great deal of effort and many resources were required to establish parameters, clear the area, and gain control of the site. While unpopular with many of the potential volunteers, this was critical to establishing an accurate situation and resource status necessary for development of the Incident Action Plan.

As the operation progressed through the rescue, body removal and demolition phases, the unified command structure expanded to include the California

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[3]"Overview of Earthquake Operations, October 17, 1989", Unpublished Paper, Oakland Fire Department. July 1990.

Department of Transportation, California Highway Patrol, and the Alameda County Sheriff's Department.

The Department of Transportation was responsible for technical support, heavy equipment and structural stability. The Highway Patrol initially provided scene security, performed accident investigation/documentation and assumed scene management responsibility later in the operation. The Alameda County Sheriff was responsibile for the Coroner functions, including identification of bodies and their removal to the morgue and notification to the next of kin.

Due to the expanse of the rescue operation, five casualty collection sites were established. In the hours after the quake one hundred sixteen people were triaged, treated and transported to local hospitals in forty ambulances supplied by ten local ambulance companies. The final rescue was completed at 2:00 A.M. As rescue teams continued to search the structure to document vehicle locations, search for signs of life, and evaluate structural conditions, the command staff worked on plans for the next phase in the operation.

The staff identified five areas where possible survivors might be located. These areas would be searched at morning's light, utilizing search dogs and listening devices. Working closely with Department of Transportation Structural Engineers,

the entire structure was surveyed for stability and areas were prioritized based on the engineers' recommendations.

When no signs of life were detected in the five priority areas the operation was consolidated into two branches:

South Branch.....18th Street to West Grand

North Branch.....West Grand to 34th Street

Each branch was assigned (a) task force(s) to carry out continued search and documentation, body removal and personnel safety functions. Each branch was supported by a structural engineer, medical crew, and safety officer.

The Oakland Fire Department Command staff met with OES State Fire Coordinator, Mark Ghilarducci, on the morning of October 19, at the Cypress Command Post. The meeting was to discuss current and future operational needs and methods to obtain additional resources, including three OES Heavy Rescue/Fire aapparatus. One of his suggestions was to obtain a California Department of Forestry overhead (supervisory) team to help OFD personnel with the command, and control functions of such a prolonged disaster.

The point of using this team was to strengthen the existing OFD comman structure and to provide the necessary logistics to conduct a long term operation.

The first members of the overhead team arrived on the evening of October 19. They quickly began to establish the organizational structure following the ICS model used by CDF fire personnel to manage large wildland fires.

The body removal phase was difficult and tedious. Each removal took from three to four hours to complete. A typical removal required cutting through the upper deck of highway, disassembling the crushed vehicle, completing necessary investigation and documentation, and finally removal of the body and identification of the deceased. This continued around the clock for the week that followed until all recoverable remains were removed. Eight bodies could not be recovered until the structure was brought down during demolition.

The demobilization of the Cypress operation began in the evening of Sunday, the 22nd. The first companies to be released were the local agency mutual aid resources, followed by the CDF and USFS support personnel on Wednesday, the 25th. The three OES Heavy Rescue/Fire apparatus were relocated to Oakland fire stations. They remained in Oakland for an additional week until the Cypress operations were concluded.

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