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Travis Smith and Raymond Forsyth

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16. ABSTRACT

With the completion of construction of a 60-ft highway out and a rock bolted retaining wall in the Potrero Hill area of San Francisco, surface and subsurface movements of sufficient magnitude to cause minor building and foundation damage were observed directly above and adjacent to the wall. Accompanying movements in an unreinforced masonry railroad tunnel 30 feet below the base of the wall indicated the need for immediate correction in order to forestll serious distress to a major passenger and freight facility. The corrective treatment selected was a system of 30 individual reinforced concrete portals or bents around and over the tunnel. Design of this system was based upon a finite element analysis. During construction, six of the portals were instrumented with SR-4 and vibrating wire type strain gages. The stresses and strains indicated by the portal instrumentation revealed reasonably good agreement with those predicted by the finite element analysis.

17. KEYWORDS

Finite element analysis; framing; motion; plain concrete; shales; sliding; soil mechanics; tiltmeters; tunnels; weathering

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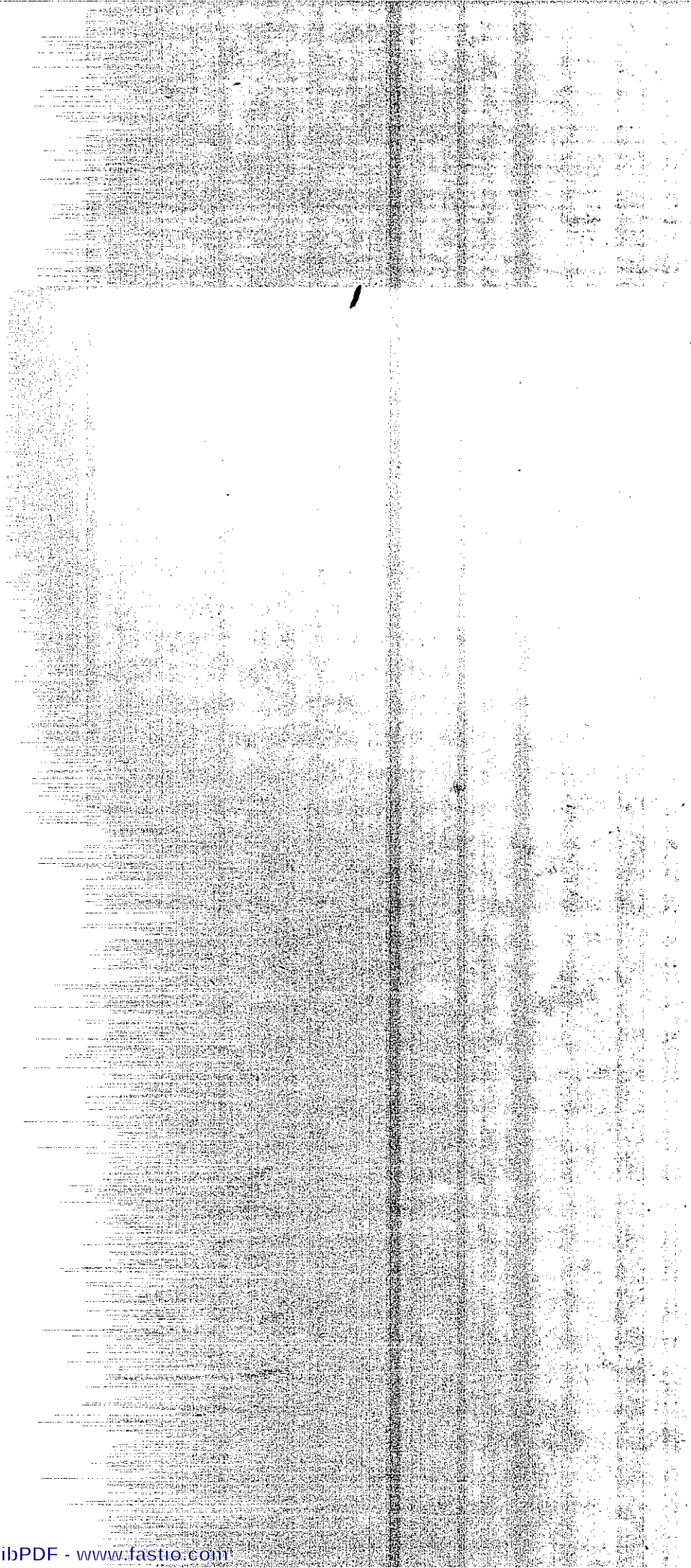

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POTRERO HILL SLIDE AND CORRECTION

By Travis Smith,[1] F. ASCE and Raymond Forsyth,[2] M. ASCE

INTRODUCTION

Southern Pacific Tunnel No. 1.—Southern Pacific Tunnel No. 1 near the San Francisco Bay coastline, San Francisco, was constructed in 1906 or 1907. As shown in Fig. 1, it consists of unreinforced concrete walls 25 in. ± in thickness to a height of 10 ft supporting a 15-ft radius arch consisting of six courses of mortared brick which was later gunited for protection from reactive fumes. The tunnel is a 1,830-ft long 2-track facility 30 ft wide at the base. The floor consists of unreinforced concrete 1 ft to 2 ft in thickness. Because all Southern Pacific Railroad train movements into San Francisco must go through it (140 per day) this facility is a vitally important San Francisco Bay Area Transportation link.

In 1928, as a result of evidence of tunnel movements, copper pins were installed at 50-ft stations to measure changes in distance across the tunnel with time. At that time the minimum width (29.325 ft) was found to be located 580 ft from the northern portal. Measurements continued until 1935 when movement had apparently ceased. During this 7-yr period, a maximum movement of 3/4 in. was reported.

Highway Design Considerations.—In August, 1960, a Project Report proposed a new highway facility to provide immediate relief for the James Lick Freeway (Route 101). In the report, three alternate routes were evaluated. As shown in Fig. 2, the easterly two lines (L and T) were projected through a heavily industrialized area adjacent to San Francisco Bay. The third route (Alternate P) was approximately 1/2 mile westerly lying at the dividing line of the residential and industrial section of this part of San Francisco and traversing

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[1] Asst. Materials and Research Engr., California Div. of Highways, Materials and Research Dept., Sacramento, Cal.

[2] Sen. Materials and Research Engr., California Div. of Highways, Materials and Research Dept., Sacramento, Cal.

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8004 POTRERO HILL SLIDE AND CORRECTION

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ABSTRACT: With the completion of construction of a 60-ft highway cut and a rock bolted retaining wall in the Potrero Hill area of San Franciso, surface and subsurface movements of sufficient magnitude to cause minor building and foundation damage were observed directly above and adjacent to the wall. Accompanying movements in an unreinforced masonry railroad tunnel 30 ft below the base of the wall indicated the need for immediate correction in order to forestall serious distress to a major passenger and freight facility. The corrective treatment selected was a system of 30 individual reinforced concrete portals or bents around and over the tunnel. Design of this system was based upon a finite element analysis. During construction, six of the portals were instrumented with SR-4 and vibrating wire type strain gages. The stresses and strains indicated by the portal instrumentation revealed reasonably good agreement with those predicted by the finite element analysis.

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