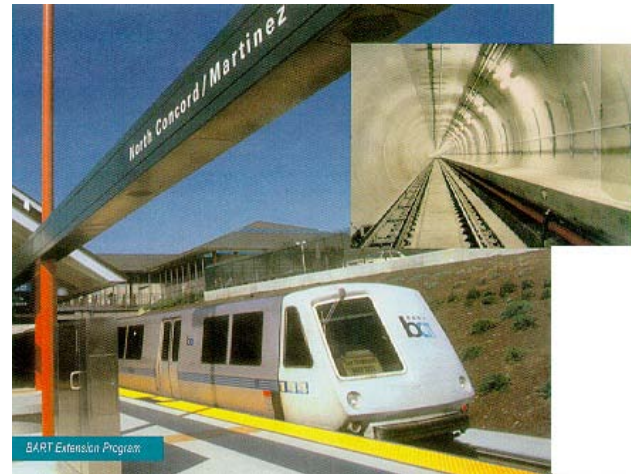


TITLE AND LOCATION (CITY AND STATE) BART Extension and Long-Term Seismic Retrofit Program, Oakland, California		YEAR COMPLETED	
		PROFESSIONAL SERVICES 2005 – 2009	RIZZO CONTRACT \$6.1 Million
PROJECT OWNER'S INFORMATION			
a. PROJECT OWNER BART/Bechtel Infrastructure	b. POINT OF CONTACT NAME Kenneth Mark, Project Manager	c. TELEPHONE NUMBER (415) 768-1234	

RIZZO Associates acquired International Civil Engineering Consultants, Inc. (ICEC) in March 2007, and became part of RIZZO a global engineering and consulting firm headquartered in Pittsburgh, Pennsylvania. This project was completed under ICEC.

RIZZO performed tasks on seismic and dynamic response studies to develop (1) earthquake ground motion time histories which are compatible with the design ground motion response spectra developed for the Extension Program for several site conditions; (2) vibration criteria for girders of elevated structures subjected to moving train loads of various speeds; (3) effective train masses to be included with the structure masses for seismic response analyses of the structures; and (4) seismic design criteria for the standard designs of aerial structures incorporating seismic soil-structure interaction effects. In addition, we were contracted to investigate soil-structure interaction (SSI) effects on the seismic response of the standard BART double-track, single-column aerial structures to be constructed in the Extension Program.



RIZZO worked as a team with Bechtel Infrastructure Corporation to provide engineering services for BART in performing Seismic Vulnerability Evaluation, Seismic Performance Evaluation, and developing Site Response and Seismic Retrofit Criteria for the BART System including Transbay Tube. RIZZO's primary responsibilities were (1) developing the system-wide seismic retrofit criteria, (2) developing seismic vulnerability assessment methodology, (3) performing seismic vulnerability evaluation and developing seismic retrofit conceptual designs of the BART Transbay Tube, the San Francisco and Oakland Ventilation Towers, and the seismic joints of the Transbay Tube, and (4) performing seismic vulnerability assessment and seismic retrofit studies of various underground structures of BART System, and manage bridge engineering strategy. RIZZO is performing detail seismic evaluation and soil-structure interaction on San Francisco and Oakland Ventilation Towers for the Transbay Tube and other critical system-wide structures.



RIZZO was contracted to develop and seismically analyze the global model of the Transbay Tube (TBT) System under the design-basis earthquake (DBE) and lower-level design-basis earthquake (LDBE) conditions. The TBT System is comprised of 3.6-mile long TBT, San Francisco Transition Structure (SFTS) and Oakland Ventilation Structure (OVS) located on the west and east ends of the TBT, respectively, and the seismic joints that link SFTS and OVS to the TBT. The seismic response results obtained from this global model were compared with the corresponding results obtained from the seismic vulnerability study.

RIZZO was contracted to perform seismic analysis and evaluation of the San Francisco Municipal Railway (MUNI) tunnel along outer Market Street. The following types of structures (stations) were seismically analyzed for BART Earthquake Safety Program: (1) Typical cut-and-cover tunnel with two tracks (double-cell box); (2) Bored tunnel consisting of circular tubes; (3) Cut-and-cover tunnel transition section where the Duboce Ave. Line and Market Street Line join together; (4) Cut-and-cover tunnel where the tracks cross each other (crossover section); and (5) Portal where the Duboce Ave. Line exits to the surface (U-Wall).

