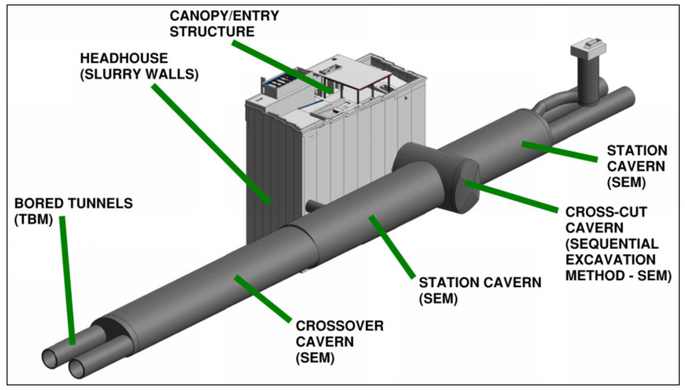
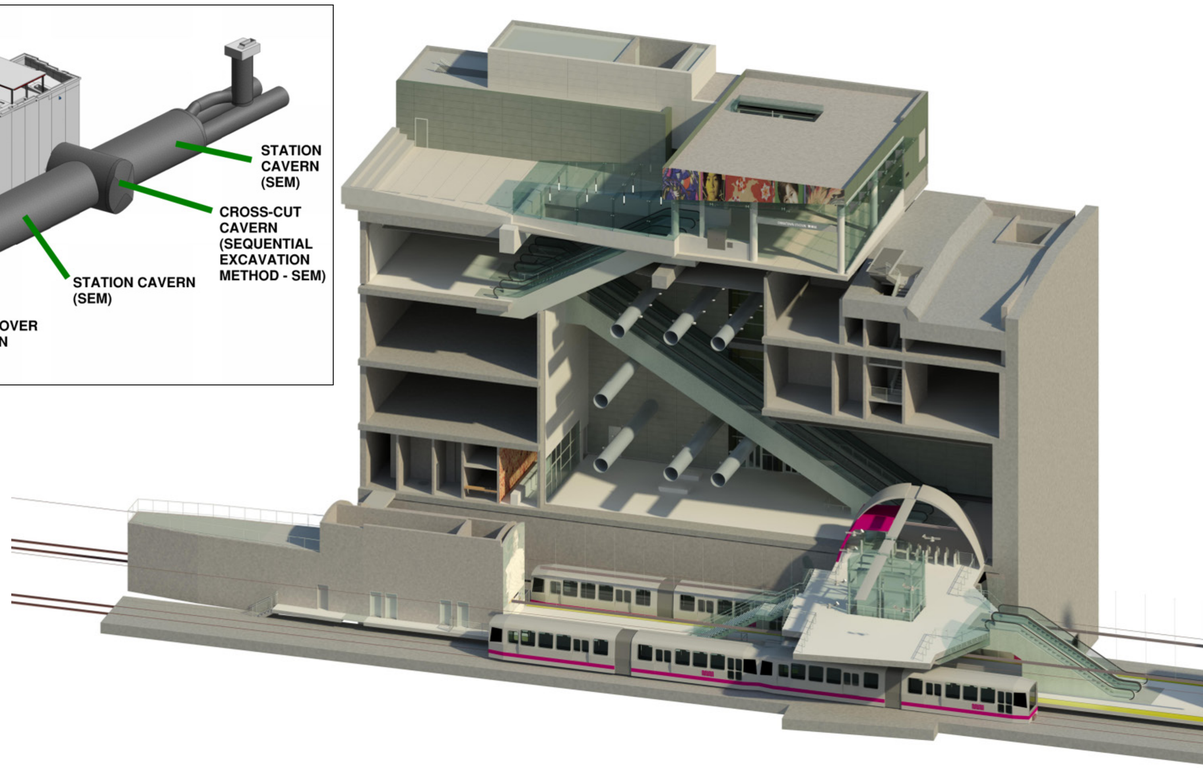
FORELL | ELSESSER
STRUCTURAL ENGINEERS

CENTRAL SUBWAY CHINATOWN ROSE PAK STATION SAN FRANCISCO, CA





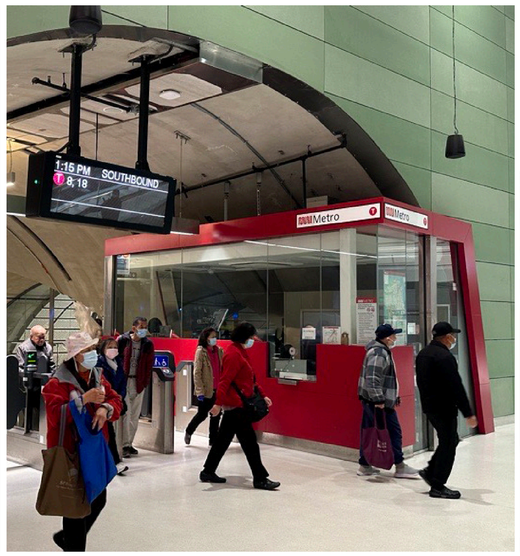
CONNECTING COMMUNITIES

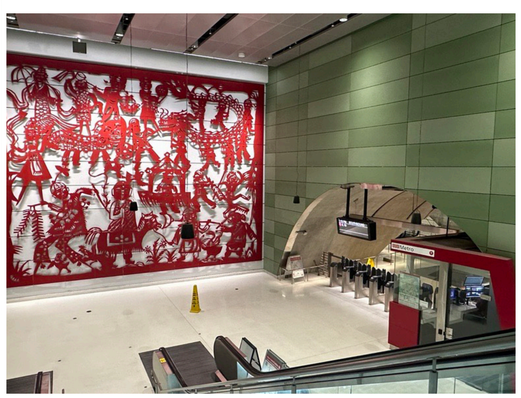
The Central Subway extension serves to improve traffic through this area and provide the residents and visitors to Chinatown with a reliable and convenient public transportation alternative. Due to the existing BART and Muni underground crossings at Market Street and the slope on Stockton Street up towards Washington Street, the tracks at the Chinatown Station are over 100-ft below the sidewalk elevation.

This creates one of the deepest excavations in San Francisco in a tight urban setting and presents challenges in terms of architectural layout and construction sequencing.

PROJECT TEAM

Owner:	San Francisco Municipal Transportation Agency
Architect:	DLR Group
General Contractor:	Tutor Perini
Project Management:	WSP USA
Tunnel Engineering Consultant:	Dr. Sauer Group
Structural Engineering:	**FORELL | ELSESSER**



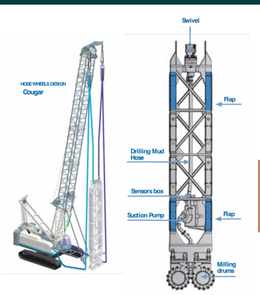


STAGED CONSTRUCTION ANALYSIS

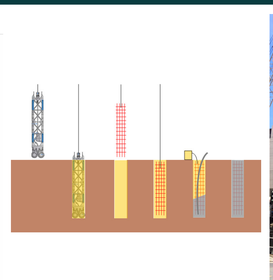
The various steps of construction imposed different structural demands on the permanent structure. We outlined on the structural drawings the assumed construction sequence and analyzed the structure accordingly using Staged Construction Analysis in SAP. We used a simple 1-dimensional model to understand how the headhouse permanent slurry walls were loaded and unloaded throughout construction.

A 2-dimensional model was constructed to better capture the additional construction sequence and the corresponding structural demands related to the Cross Cut Tunnel using the Sequential Excavation Method (SEM).

SLURRY WALL CONSTRUCTION



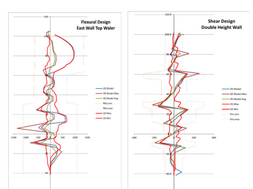
EQUIPMENT
Construction Equipment for Slurry Wall Construction



SEQUENCE
Slurry Wall Construction sequencing

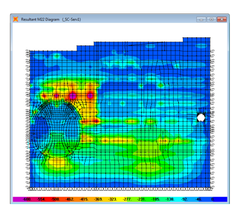
CONSTRUCTION
Slurry Wall Construction at the Station

TYPICAL WALL DEMANDS



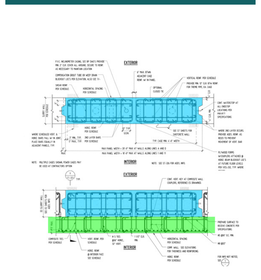
TYPICAL WALL DEMANDS
Envelope of Typical Wall Forces with 1D Staged Construction Analysis using SAP

EAST WALL FORCES



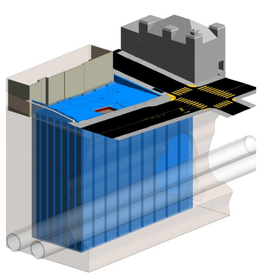
WALL FORCES
Envelope of Bending Moment of East Wall with 2D Staged Construction Analysis using SAP

SLURRY WALL SECTIONS

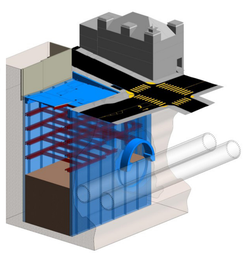


SLURRY WALL
Composite Section Added to Typical Section As Required by Analysis

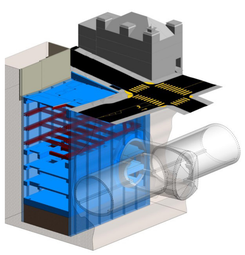
HEADHOUSE SEQUENCE



HEADHOUSE SEQUENCE / 01
Install Slurry Wall Panels and Ground Floor Framing

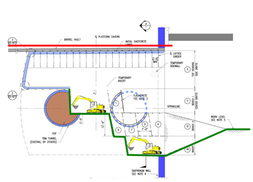


HEADHOUSE SEQUENCE / 02
Excavate to Concourse Level & Start Construction of the Cross-Cut Tunnel



HEADHOUSE SEQUENCE / 03
Install Permanent Floor Framing and Remove Temporary Shoring

SEQUENTIAL EXCAVATION METHOD



SEQUENTIAL EXCAVATION METHOD
Section Showing Sequential Excavation Method