

Next stop: digging the future.

TUNNELING Fact Sheet



Shedding Light on Tunnels

New public transportation projects, whether rail or highway, may include construction of tunnels. This fact sheet will provide an overview of some of the factors that help determine when tunnels are appropriate for a project, as well as information on tunnel technology and engineering.

To Build or Not to Build (a Tunnel)

Tunneling is just one option when planning a new transportation project. The costs, benefits and impacts of a tunnel must be evaluated in comparison to alternatives that would build a project at or above ground level. Some factors that are used to determine whether to build tunnels include:

- > **Federal funding criteria/cost-benefit analysis:** Metro often seeks federal matching funds for major projects. We will therefore look to identify a project that ranks well for these highly competitive funds following set federal guidelines for cost-benefit analysis.
- > **Local, state and federal regulations:** Metro follows all applicable regulations, including relevant construction, health and safety regulations. These regulations often have a bearing on project planning, the choice of the type of infrastructure and the construction methodology.
- > **Community input and feedback:** During the project study phases, the community is encouraged to participate in the overall review process. Public input helps inform a project's development.
- > **Demand, ridership and speed:** Travelling below ground can be faster than ground-level alternatives that need to slow down or stop to accommodate traffic. Tunnels may be considered for projects where there is a need to move large numbers of people swiftly to meet forecasted demand.
- > **Dense environment:** The existing setting may not provide enough space above ground to accommodate the new transportation project. This could be due to the width of the right-of-way or street where the project is planned, or existing buildings or other structures in the area. It may also be due to existing traffic levels as ground-level options may reduce automobile travel lanes to accommodate the project. Elevated options may also reduce lanes to accommodate support structures for the project.
- > **Physical environment:** Tunnels may be a better solution when a transportation project needs to cross physical or topographical barriers, such as mountains or waterways.
- > **Real estate acquisition:** All projects typically require Metro to purchase real estate. The need could be temporary for land that is needed only during project construction. Real estate could also be needed permanently for stations, right-of-way, other project features, or underground easements. Projects built at or above ground level will typically need to purchase more ground-level property than below ground projects. *Please see our Property Acquisition fact sheet for more information.*

Various studies, that are part of a project's environmental review process, are completed to determine whether a proposed project warrants construction of a tunnel.

Please see our Environmental Review fact sheet for more information.

Current Tunnel Projects in Los Angeles

As Los Angeles continues to build out a rail transportation network, tunnels have been incorporated for the following projects:

- > **Metro Blue Line:** Includes a short tunnel segment between Metro/7th St and Pico Stations. *Opened 1990.*
- > **Metro Red/Purple Line:** Fully underground from Union Station to North Hollywood and Wilshire/Western Stations. *Opened in phases 1993-2000.*
- > **Metro Gold Line:** Includes trench sections in Highland Park and Pasadena, and a tunnel between Pico/Aliso and Soto Stations. *Opened in phases 2003-2016.*
- > **Metro Expo Line:** Includes a trench section near USC. *Opened in phases 2012-2016.*

In addition, Metro currently has three projects under construction that incorporate tunnels:

- > **Metro Crenshaw/LAX Line:** Includes a tunnel section between Expo/Crenshaw and Leimert Park Stations. *Scheduled to open in 2019.*
- > **Metro Regional Connector:** Fully underground connection between Metro/7th St and Little Tokyo Stations. *Scheduled to open in 2021.*
- > **Metro Purple Line:** Fully underground nine-mile extension between current Wilshire/Western and Westwood/VA Hospital Stations. *Scheduled to open in phases 2023-2026.*

Tunnel Construction Methods

There are two primary methods for building tunnels depending on the conditions where the tunnel is being built.

Tunnel Boring Machine

A Tunnel Boring Machine (TBM) is a giant drill. The TBM slowly drills through the earth, digging tunnels needed for an underground project. Once the TBM is below ground doing its work, it is unlikely that people on the surface will see, hear or feel its operation. Metro continually monitors the progress of the TBM underground to ensure it is operating safely at all times.

The latest technology uses pressurized, closed-face TBMs that maintain pressure in the ground surrounding the tunnel, protect workers inside the TBM, and immediately install concrete tunnel liners that support the tunnel as they proceed in the newly drilled portions of the tunnel. The front section of the TBM is called the shield with a cutter head at the very front. Each cutter head is engineered for the specific ground conditions where the TBM will be operating. A TBM is about the length of a football field at full size and, depending on ground conditions, tunnels at the rate of about 60 feet per day. Several acres of property are needed to launch the TBM to drill the tunnels. That location is often used to remove the dirt from the tunnels. A smaller property is typically needed to remove the TBM at the tunnel's endpoint. Between these starting and ending points, TBMs are generally sufficiently deep to avoid any impact to underground utilities. Exact locations for launching and extracting the TBM, as well as how much space will be needed to do so, is determined as part of the environmental process.

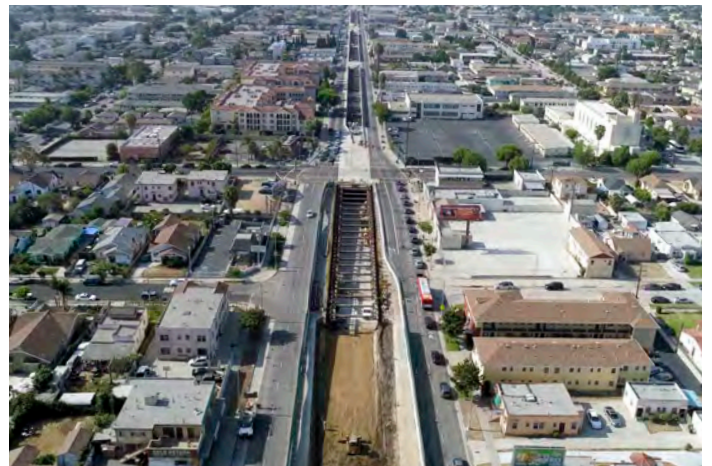


Tunnel Boring Machine at Leimert Park Station

Cut-and-Cover

Cut and cover tunnel construction generally begins by opening the ground surface to an adequate depth to support or relocate existing utility lines, and to install soldier piles or other earth-retaining structures. The surface opening is then covered with a temporary street decking so traffic and pedestrian movement can continue overhead while excavation proceeds beneath the decking. The temporary excavation will be retained by an approved excavation support system, known as a shoring system. Adjacent building foundations will also be supported as necessary. Once the tunnel is built, the remaining excavated space is backfilled and the street is restored.

This methodology is typically employed when tunnels are quite shallow or other conditions preclude the use of TBMs. Underground stations are also typically built using cut-and-cover, even when the tunnels are built using TBMs. Because construction is not fully below ground, it is likely that people at the surface level will see, hear and feel construction activities.



Cut-and-Cover at Hyde Park Station



For more information about Tunneling,
visit metro.net/tunneling

Tunnel Safety

Safety is Metro's top priority. Along with evaluating whether a tunnel is appropriate for a project, numerous factors are considered to ensure that a tunnel will be safe for those building, using and living near the project. Underground construction processes continue to improve, as evidenced by recent transportation tunnel and underground sewers projects, and new construction of buildings with deep basements and underground parking structures here in Southern California and worldwide. Metro continually seeks to take advantage of new developments in tunnel engineering and technology. In some cases, our projects have also set new standards for the industry. All Metro tunnels are evaluated, planned and designed with input from leading experts, including an independent Tunnel Advisory Panel that is comprised of globally recognized geotechnical earthquake engineering and tunnel experts.

