Metro

ISDS PROJECT

INTEGRATED STATION DESIGN SOLUTIONS

Accessibility
White Paper

April 2026

Gensler ARUP STUDIO-MLA Claris Strategy KILOGRAPH

Accessibility
White Paper

1.0 Element Overview and Problem Statement

1.1 Description of Element

Metro strives to ensure that its bus and rail routes, including stations, are fully accessible to all customers. All Metro rail lines are accessible to persons in wheelchairs. Additionally, stations include design features that enhance access for sight-impaired passengers, such as tactile and braille signs that identify the station, platform and direction of travel, as well as tactile platform edge warnings. To further enhance accessibility, Metro has identified the following components that are in need of design solutions:

- Tactile paving, including tactile platform edge warnings, tactile train door locators, and tactile wayfinding.
- Hands-free elevator call buttons.
- Accessible crossing gates.

Figure 1-1 Overuse of tactile tiles creates impediments for other station users, confusion between areas of wayfinding and areas of warning, and an inconsistent tactile format that is challenging to navigate (Willowbrook/Rosa Parks Station).

1.2 Problem Statement

Tactile Wayfinding

Tactile paving is currently used throughout the Metro system to alert passengers to platform edges, which is mandated by federal law. Most Metro stations now also have tactile door locator tiles that help identify the location of train doors. Metro has also begun providing tactile wayfinding pathway systems to guide sight-impaired customers through station public areas. Pathways were piloted at select A and E Line stations, installed with updated layouts in Measure R stations opened in 2022 and 2023, and are included in the design of all Measure R and M alignments. Tactile wayfinding is designed to help blind or partially-sighted white cane users, but also helps orient others with low vision.

Metro's first implementation of tactile wayfinding across a station platform and concourse was the installation of yellow tiles at Willowbrook/Rosa Parks Station (Figure 1-1), preceding the A/E Line pilots. This project drew from ineffective conventions, and user testing found that the tiles did not help with wayfinding. The layout also created an eyesore and impeded wheeled devices.

Metro requires tactile wayfinding design solutions that improve the experience of sight-impaired passengers while considering the needs of other passengers, including those using rolling devices such as wheelchairs, rolling walkers, strollers, carts, and luggage. The pathways should be intuitive and streamlined, enhancing accessibility with minimal materials.

Hands-Free Elevator Access

Metro has received feedback from a community of riders who do not have full use of their arms and legs regarding the difficulties they face operating elevators in the system. In response to this feedback, and continuing Metro's efforts to create a system that is inclusive and accessible to all, Metro would like to begin requiring hands-free elevator access at its station.

No federal or state requirements for hands-free elevator access exist, and there are no such mechanisms currently in place within the Metro system. Riders who do not have full use of their arms and legs must ask for assistance from other passengers, station staff, or station security when operating elevators.

Specific challenges related to hands-free access were raised while investigating various solutions. One key challenge is that the hands-free system should not pose any additional barrier to entry to the system. Therefore, the use of mobile technology solutions or a requirement to preregister for special access keys were not considered viable. Additionally, the hands-free system should not interfere with or replace the existing system of conventional push buttons in current elevators.

Creating a solution that can withstand current unwanted user behavior in elevators is a considerable challenge. Occasionally, some riders may urinate or spill liquids in elevators. As such, any design solution must be able to withstand both corrosive liquids and frequent cleaning.

Metro's priority is to create a more accessible system that serves the needs of all its riders.

Figure 1-2 Metro's station elevators do not feature buttons accessible to those without the use of their hands (Union Station).

Accessible Crossing Gates

Metro is seeking a more streamlined design of grade-crossing warning and barrier systems that is less obtrusive to the surrounding environment and more accessible to all users. Such a system will need to accommodate riders who use assisted mobility devices and do not have full use of their arms and legs.

Currently, Metro employs a mix of grade crossing warning and barrier systems as required and regulated by CPUC, including various combinations of automatic pedestrian gates, manual swing gates (at five pounds maximum), and channelized crossings. The main challenge in creating accessible grade crossings is the user interface of manual swing gates. Grade crossings exclusively relying on swing gates are generally not accessible to riders who don't have full use of their hands and legs, as the design requires the user to pull the swing gate toward themselves to enter the trackway. The direction of swing gate operation cannot be changed due to state and federal requirements. Additionally, automated pedestrian crossing gates cannot be designed into some space-constrained stations.

Metro's first priority for this element is to create a grade crossing system that is accessible to all users. Secondarily, a grade crossing system must be pedestrian-oriented in both scale and function, and visually compatible with the public realm.

Figure 1-3 Manual swing gates for at-grade track crossings create challenges for wheelchair users (Del Mar Station).

2.0 Design Process and Principles

2.1 Design Process

The Project Design Team for this element was led by Gensler, and included Arup and RAW. Cost estimates were provided by Leyland Saylor Associates.

Metro departments across the agency provided input throughout the design process. Beginning in May 2018, Working Group Members accompanied the Project Design Team on site visits of existing Metro stations to observe and document the condition of existing station furnishings. The Project Design Team also conducted a series of interviews with representatives from a wide range of Metro departments, including:

- Arts + Design
- Corporate Safety
- Environmental Compliance and Sustainability
- Facilities Maintenance (including separate interviews with FM field staff and management)
- Fire and Life Safety
- Office of Civil Rights
- Operations Liaison and Planning
- Project Engineering
- System Security & Law Enforcement

Based on the analysis and the information provided during interviews with Metro staff, the Project Design Team developed initial design concepts, which were presented to the Working Group in January 2019.

Using the feedback provided by the Working Group members, the Project Design Team refined the initial design concepts into a Draft Concept Design, which was submitted to the members of the Working Group for review and finalization in May 2019. The Project Design Team then submitted draft, revised and final Design Documentation packages by March 2020.

For additional information, see "Table 2-1 Timeline of Design Process" on page 11.

2.2 Working Group Feedback

Working Group members provided the following feedback on Accessibility:

Tactile Wayfinding

- Less is more: simple, minimalist design is most intuitive to use.
- Narrow platforms create challenges with little open space to add tactile elements.
- Durability and maintainability are top concerns.
- Consider slip-resistant material.
- Color should be integral (not painted).
- Yellow is used for safety throughout Metro system. Customers are trained that yellow represents hazards or areas requiring caution. Yellow should only be used for platform edge warning.
- Gray train door locator tile may be confusing. Consider black edge.
- A large black surface looks like a hole to the visually impaired; this condition should be avoided.
- Visual contrast improves usability.
- Beacon technology being piloted at Metro rail stations may impact the need for tactile wayfinding.

Hands-Free Elevator Access

- Building Code does not allow remote operation of elevators.
- Consider cost (both initial and life-cycle) before identifying a preferred option.
- Consider elevator attendants or station agents as an alternative.
- Consider accessible push plate for elevator control, operable without use of hands.
- Consider how solutions will withstand urine or power washing.
- Metro SEGD to provide final review of all accessibility-related graphic requirements.
- Most elevators in the Metro system only travel between two floors, with no need for up and down options in the controls.
- It is strongly recommended that Metro pilot the hands-free elevator push plates before launching systemwide. These will be expensive to implement and maintain.
- Working Group noted that if the push plate is damaged, elevator will still operate (the existing buttons can be used). If the elevator is still operational, it will still be code-compliant as there are no local, state or federal requirements for hands-free elevator access.

Accessible Crossing Gates

- Existing crossing gates are too bulky.
- This element is inconsistent across the system, and older station designs do not have sufficient space for automated gates.
- Swing gates are difficult to navigate when using a wheelchair. For example, holding a gate open may prevent a user from operating a wheelchair with that hand.
- Solutions should be more pedestrian-friendly, and scaled down from the current pedestrian crossing arms.
- Signage describing accessibility features at crossings is inconsistent.
- Not all at-grade crossings feature automatic gates at crossings.

2.3 Best Practices Research

The Project Design Team also conducted extensive research on best practices in use around the world related to accessibility, and tactile paving in particular. Design principles for this accessibility element (section 2.4) drew from the team's best practices research. Key findings from this research are detailed below.

Tactile Platform Edge Warnings

Tactile platform edge warnings are used extensively around the world. In 2010, the United Nations Development Program (UNDP) published *A Review of International Best Practice in Accessible Public Transportation for Persons with Disabilities*, which concluded that in addition to warning sight-impaired passengers, tactile platform edge warnings can enhance the safety of all passengers. The report notes: “provided the tactile warning strip is uncomfortable to stand on, and there is not space for passengers to stand between it and the platform edge, it will encourage passengers to stand back from the edge” (UNDP, 57).

The design and placement of tactile platform edge warnings varies. European systems including those in London, Copenhagen and Amsterdam, employ a variety of colors, sizes, and designs. In the United States, the size and design of platform edge warnings are more standardized; however, a variety of colors are used. The UNDP report identifies best practices: “install a tactile warning strip at least 800mm (31.5 inches) deep, set back about 500mm (19.7 inches) from the edge, and contrasting with the surrounding floor” (UNDP, 57). This is greater than the current American standard, which requires 24 inch warning tiles; however, the UNDP report also recognizes the importance of using established national standards for consistency within a country.

Best practices for tactile platform edge warnings include:

- Use the established national standard, which in the US is a 24 inch wide strip with truncated domes.
- In the absence of national standards, develop a constant local standard. The US does not have a national standard for the color of tactile platform edge warnings, but the California Building Code has adopted Federal Yellow as the standard color for this station feature.
- Maintain clear passages on platforms. Guidelines in the UK recommend maintaining a minimum clear width of 6.5 ft, but note that this should be increased for busy platforms. (UNDP, 57).

Tactile Train Door Locators

Many systems outside of the United States have platform edge doors eliminating the need for tactile door locators; however, some American transit systems do employ these tactile elements. Tactile train door locator tiles are installed throughout the BART system and their design provides both tactile and visual contrast to the platform edge warning tiles. In contrast to the standard tactile platform edge warning tile (yellow with truncated domes placed in an offset pattern), BART uses a modified tactile platform edge warning tile at train door locations, which is black with directional bars in a parallel pattern. While black is not recommended as it may appear like a hole to partially sighted riders, it effectively provides visual contrast in this application. These modified tactile platform edge warning tiles are used in combination with tactile train door locator tiles that extend beyond the platform edge warning tiles, helping users to identify train door locations (Figure 2-1).

Best practice for tactile train door locator tiles:

- Provide visual and physical contrast. Using parallel bars in a contrasting color to the platform edge warning provides an additional aid to partially sighted passengers.

Tactile Wayfinding Path

According to the United Nations review of best practices, tactile wayfinding is beneficial to some sight-impaired transit users. In its report the UNDP concluded:

> "Sometimes visually impaired people need guidance in using a pedestrian area, especially if the footway crosses larger open spaces where the usual guidance given by the edge of the footway or building base is not available, or when pedestrians need guidance around obstacles. A continuous tactile guideway in the direction of pedestrian travel, which has a different texture to the rest of the footway, can provide this guidance. The different texture can be followed by people using a long or guide cane, and can also be detected underfoot by others with low vision." (UNDP, 8)

Within the sight-impaired community, there is some disagreement about the necessity and efficacy of tactile paving. For example, some advocacy organizations, including the American Council of the Blind, support the installation of detectable warnings at intersections, while others, such as the National Federation of the Blind (NFB), oppose installation of the warning products. Opposition to tactile paving within some organizations is based on the belief that it is unnecessary and potentially discriminatory (Lee, 37).

Figure 2-1 BART indicates train door locations with modified tactile platform edge warning tiles and adjacent parallel directional bars.

Figure 2-2 Subway stations in Stockholm Tunnelbana (left) and Singapore MRT (right) feature low-profile tactile wayfinding bars with consistent layouts.

Best Practices for Tactile Wayfinding Path:

- Use tactile wayfinding sparingly. The United Nations review of best practices recommends that "tactile guideways should be used sparingly, as they can hinder wheelchair users and other pedestrians" (UNDP, 9). Tactile wayfinding could become confusing and ineffective if overused. Tactile wayfinding paths may be useful in large, open areas, but they may be unnecessary on platforms where edge warning tiles provide a contrasting surface that visually impaired riders can follow.
- Provide tactile warning surfaces at top and bottom of stairs. The United Nations recommends that "approaches to steps should have tactile warning surfaces at the foot and head of the stairs to alert blind and partially sighted people." (UNDP, 55) European Union standards require tactile warnings for all stairs and require that they be different from those used for tactile wayfinding paths, where installed (PRM TSI: 4.1.2.15). In the UK, warnings consist of rounded bars that run across the direction of travel, allowing sight-impaired passengers to distinguish between stairs and platform edges (Transport Scotland, 255).
- Maintain clear passages. Tactile wayfinding paths should not be used in narrow areas where it is difficult to maintain a path of travel for passengers with mobility devices. Tactile wayfinding paths may not be needed in areas where walls, railings, or other architectural features provide a surface that sight-impaired users can follow (Figure 2-3 features an example from Copenhagen). This condition is common where vertical circulation enclosures leave narrow walkways on platforms, and Metro has tested discontinuous tactile paths in these settings (Figure 2-4). Architectural features were found to aid navigation by white cane users, however further testing and refinements are needed to standardize pathway layouts in such constrained spaces.

Figure 2-3 Blind or partially sighted Copenhagen Metro users can navigate using tactile pathways as well as walls and architectural features.

Figure 2-4 Metro's tactile wayfinding pilot: the pathway ends where the platform narrows, ensuring an unimpeded space for passengers with wheelchairs and other wheeled devices.

2.4 Design Principles

Based on the comments provided by the Working Group, the project design team identified the following Design Principles for Tactile Warnings and Wayfinding:

Placement / Layout

- Less is more. The best layout creates direct paths with minimal decision points.
- Install tactile wayfinding only where there are no other features that provide a guide.

Material

- Prioritize durability and maintainability.
- Must be slip-resistant.

Color / Design

- Use yellow only for platform edge tactile warnings, not wayfinding.
- Use four parallel stainless steel bars for wayfinding path. This material improves durability and provides distinct contrast with Metro's standard poured-in-place epoxy terrazzo flooring. While there will be tactile wayfinding in various materials across the system, Metro should seek consistency in design and layout, with all installations of this station element compatible with the Systemwide Station Design Standards.
- Use an array of stainless steel truncated domes to indicate features, such as Metro Call Points.
- Include black non-slip inlays for applications on surfaces lighter in color than Metro's standard epoxy terrazzo, including standard three-tone concrete plaza paving.

2.5 Further Studies: Tactile Wayfinding

Following the ISDS Project, Metro tested tactile wayfinding layouts and materials in various iterations. Metro's standards for this element draw from ISDS best practices research and Working Group feedback, as well as the testing outlined in this section.

2021: Surface-Mounted Tactile Testing on A & E Lines

Concurrent to the ISDS Project, Metro's Civil Rights group piloted Metro's first dual-color surface-mounted tactile wayfinding pathways. These were installed at select light rail stations on Metro's A and E Lines, with layouts based on ISDS principles, evolving best practices, and lessons learned from earlier installations on the system. This was the first time Metro utilized black and grey tiles, providing 70% contrast regardless of the surface to which they are applied (see Figure 2-5).

The A & E Line installations underwent user testing in 2021. Feedback from this effort contributed to the refinement of Metro's standards and the design of the tactile wayfinding system for the Regional Connector.

Testing took place at:

- Willowbrook/Rosa Parks Station (installation in Federal Yellow, see Figure 1-1)
- Arcadia Station
- Monrovia Station
- Expo/Sepulveda Station
- 26th St/Bergamot Station

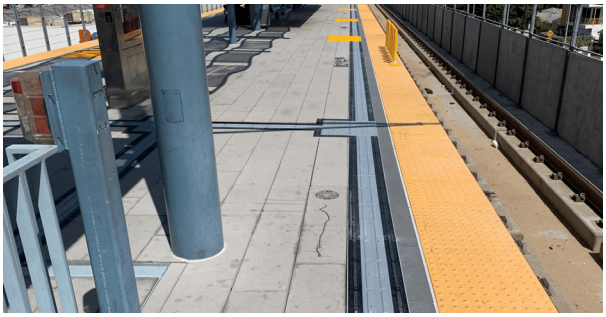


Figure 2-5 Surface-applied tactile wayfinding on Metro E Line, which underwent user testing in 2021.

Key takeaways that were carried forward included:

- Users with low vision confirmed utility of high contrast.
- Rectilinear patterns are easiest to navigate.
- Users prefer pathways adjacent to edge pavers to separated pathways. These should access all train door indicators.

2023: Regional Connector Installations

The Regional Connector's three downtown Los Angeles stations opened in June 2023. In the spring of 2023, Metro's Systemwide Design and Civil Rights groups worked with the design-build contractor to implement tactile wayfinding in these stations that reflected ISDS and lessons from subsequent testing, adjusting the layouts from those in the station plans to accommodate lessons learned discussed earlier in this section.

Figure 2-6 Regional Connector tactile wayfinding (Historic Broadway Station, left; Little Tokyo Station, right).

2024: Testing of Stainless Steel Tactile Wayfinding Elements

In October 2024, with Gensler's support, Metro tested stainless steel directional bars and truncated domes suitable for outdoor applications. These feature black non-slip inlays, contributing to safety in wet weather while consistently achieving the necessary 70% contrast with concrete. Stainless steel alone provides this contrast with Metro's standard terrazzo flooring in station interiors (see section 2-4); when the black component is included the pathways effectively guide users with low vision on concrete and varying plaza finishes across station plazas, at-grade station platforms, and elevated station platforms. The detectability is due to both the contrast with the paving surface and the combination of black and reflective stainless steel.

Figure 2-7 Stainless steel tactile wayfinding elements with black non-slip inlays, in a test installation.

Instructors from the Braille Institute, representing blind customers and those with low vision, participated in testing at Union Station (see Figure 2-7). They broadly supported the use of these materials and shared feedback, including:

- The materials were rated "excellent" or "very good" for detectability and texture clarity.
- The materials were considered an improvement over existing tactile wayfinding in Metro stations (two-toned plastic tiles).
- Stainless steel also provides useful auditory information when using a cane.

2024-2025: Tactile Wayfinding Survey

Gensler and Arellano Associates led an extensive survey of Metro's installed tactile wayfinding in late 2024 and early 2025, in support of design updates to 7th Street/Metro Center Station. The survey spanned the Regional Connector stations, A and E Line stations, and Willowbrook/Rosa Parks Station; surface-applied tactile wayfinding is found at these stations, in various layouts as described in the preceding sections. This effort included intercept surveys with all types of riders, to understand how this design element impacts everyone. Gensler and Arellano also organized walkthroughs with representatives from the Braille Institute, Wayfinding Family Services, and the Veterans Administration, fielding detailed feedback. The survey report pointed to rider needs and priorities which serve as a final input for updates to tactile wayfinding standards. Participants mentioned:

- Ramps should be an option for cane users. Stations with ramps use tactile wayfinding to direct users to other vertical circulation.
- Pathways should lead directly to elevator buttons. Some layouts have prioritized simple paths and ended on the opposite side of the elevator door.
- Long gaps in pathways at narrow floor vents are disorienting.
- Where bus stops/bays are adjacent to stations, they should be accessed by tactile pathways.
- Tactile wayfinding is most effective when combined and coordinated with braille, audio cues, other integrated technologies and apps, and user trainings.

Conclusions

Ongoing studies and lessons learned since the ISDS contract have bolstered Metro's ability to provide highly usable state-of-the-art tactile wayfinding in new and refurbished stations. Updates to Metro's standards in progress draw from the input of many stakeholders:

- ISDS Working Group
- Global benchmark agencies
- Tactile wayfinding users in Metro stations
- Other riders impacted

Feedback has consistently steered Metro toward streamlined and intuitive tactile pathways, with a reduction in materials used, more durable and detectable materials, and coordination with other accessibility elements. Metro should implement stainless steel directional bars and truncated domes as a basis of design.

The design solutions and associated drawings for this element reflect research from the ISDS Project and takeaways from the ongoing studies described above. These design solutions are in the process of incorporation into Metro's standards.

Table 2-1 Timeline of Design Process

May to June 2018	Project Design Team and Metro Working Group Members conducted site visits of existing stations.
June to November 2018	Project Design Team conducted interviews with Metro departments.
September to November 2018	Project Design Team developed initial design concepts.
January 2019	Project Design Team presented initial design concepts to the Metro Working Group.
May 2019	Draft Concept Design Package submitted.
May 2019	Revised Concept Design Package submitted.
October 2019	Draft Design Documentation Package and White Paper submitted.
November 2019	Revised Design Documentation Package and White Paper circulated for Working Group Review.
March 2020	Final Design Documentation Package submitted.
2021	User testing of various tactile wayfinding configurations on Metro A and E Lines.
Spring 2023	Tactile wayfinding installed in updated layouts on Regional Connector corridor.
2024	Stainless steel tactile wayfinding elements tested at Union Station.
2024-2025	Gensler and Arellano Associates conducted tactile wayfinding survey, including Measure R stations. Survey Report provided final input for updated tactile wayfinding standards.

3.0 Design Solution

As a basis for standardizing Metro's accessible elements, the project team developed design solutions for tactile wayfinding, hands-free elevator access, and accessible crossing gates, as described below. Tactile wayfinding design solutions also drew from ongoing studies after ISDS (see section 2.5).

3.1 Tactile Wayfinding

Tactile Platform Edge Warnings

The design solution for tactile platform edge warnings is a 24” wide continuous precast concrete tile with integral yellow color and parallel truncated domes, meeting both state and federal requirements. The solution (shown in Figure 3-1) is consistent with existing agency standards.

Tactile Train Door Locators

Tactile train door locators should consist of stainless steel bars with inlays approximating "Federal Yellow" (Federal Standard 595C 33538). The bars should be installed in a 36" x 48" configuration adjacent to the tactile platform edge warnings, as shown in Figure 3-1. This design integrates with the tactile wayfinding path and provides comparable contrast with the terrazzo floor.

The recommended design would require state approval (the layout aligns with CBC, but the code requires product approval). Coordination between Metro and the California Building Standards Commission would be necessary.

Tactile Wayfinding Path

The design solution for tactile wayfinding is a system of stainless steel directional bars and truncated domes, as shown in Figure 3-2. This design is intended to provide 70% visual contrast with the darker epoxy terrazzo floor (Metro's standard flooring). The bars and domes have a non-slip texture, which is integral for indoor installations on the standard terrazzo, and provided by a black non-slip inlay for other installations.

Tactile wayfinding shall be provided along the most direct route feasible based on site layout and constraints. The pathways must guide users from high-traffic locations where Metro property begins (such as street corners and adjacent bus stops) to train cars indicated by tactile door locators on station platforms. Tactile wayfinding should access at least one elevator and one stairway on station levels where these vertical circulation elements exist. In constrained areas where clear floor space must be maintained for mobility devices, and where features such as flush walls and railings are located within 36" of the center of the primary path of travel, a break in the pathway may be considered acceptable. Tactile wayfinding design must respond to site-specific constraints but should make the journey between street and train as efficient and intuitive as possible for blind and sight-impaired customers.

The tactile wayfinding path-of-travel should be indicated by four parallel stainless steel bars 12” long, 1.3” wide, and 0.2” high, 3" on center. Truncated domes, bordered by a frame of directional bars for increased detectability, inform users of turns/decisions and equipment. Turns are indicated by a 24" x 24" area of domes, while the domes are in a 12" x 24" configuration for features such as Metro Call Points, fare gates, and wide floor grates. This design meets both state and federal requirements. Further details are provided in Figures 3-5 and 3-6, as well as Table 3-1 (Key Design Features: Tactile Wayfinding).

Figure 3-1 Tactile platform edge warning tiles and train door locators.

Figure 3-2 Tactile wayfinding concept with four parallel stainless steel bars. Truncated dome array indicates directional pathway change

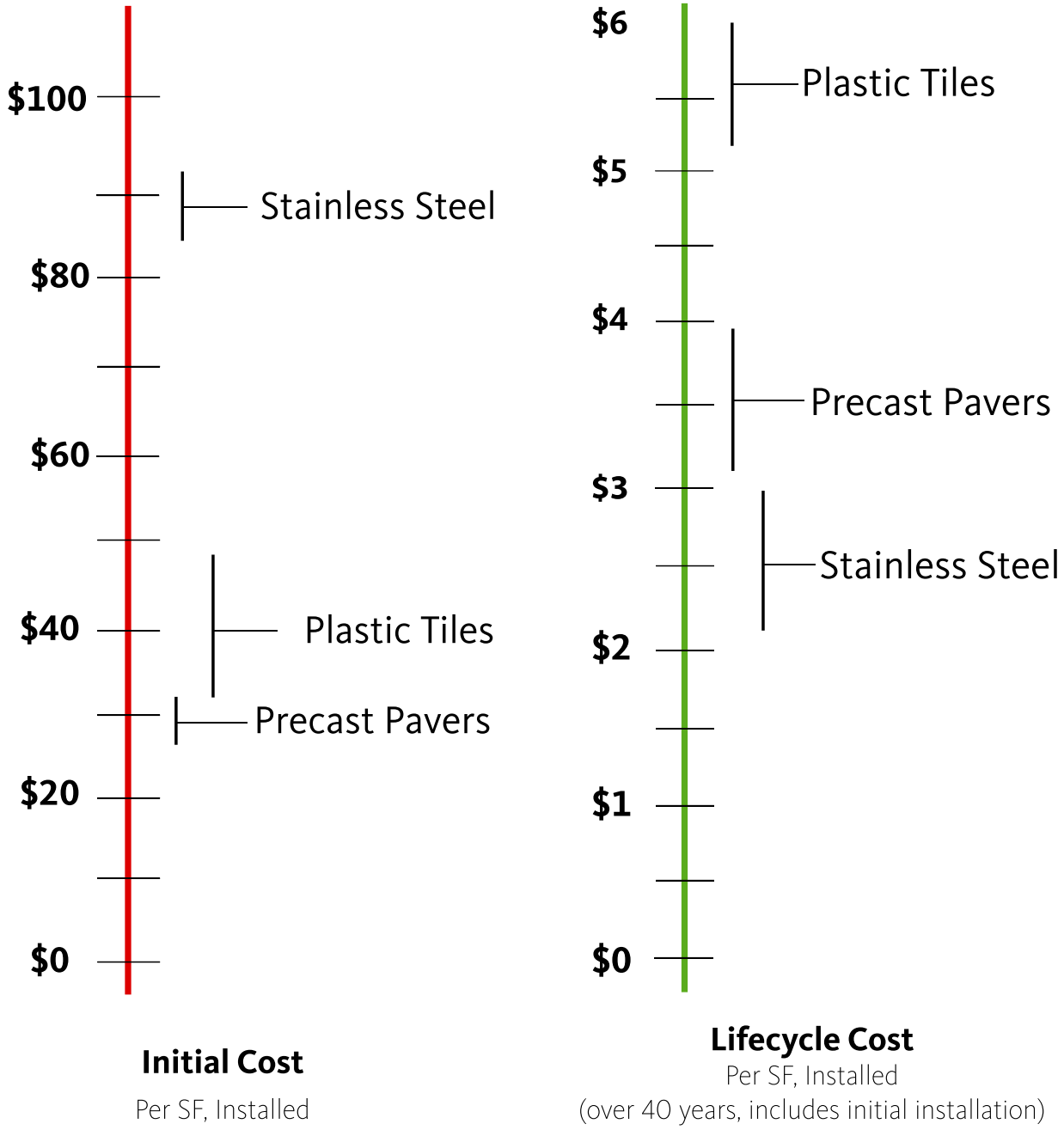
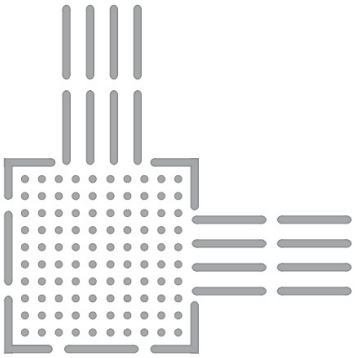


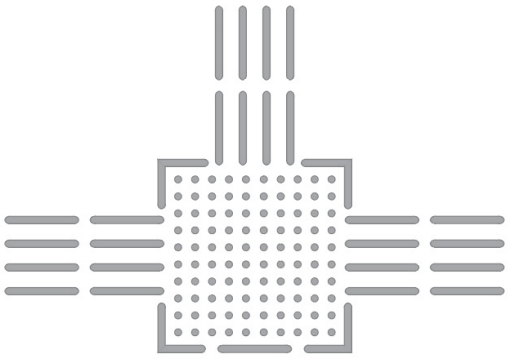
Figure 3-3 Tactile Wayfinding Cost Estimate (based on 2025 data)

Note: Figures provided represent rough cost estimate based on concept design. Actual cost may vary based on exact materials, detailed design, location of installation, number of units ordered, and availability of labor and materials.

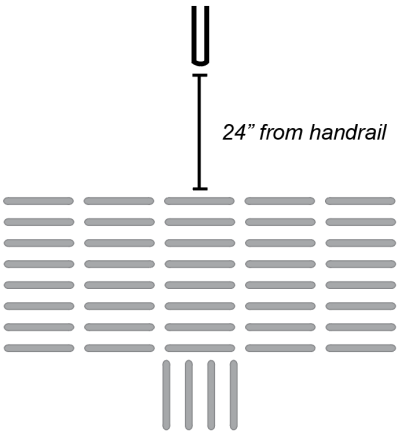
Figure 3-4 Tactile Pathway design solution. Refer to Table 3-1 for details.



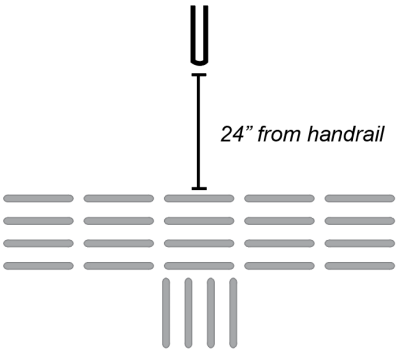
90° turns



Intersecting Pathways

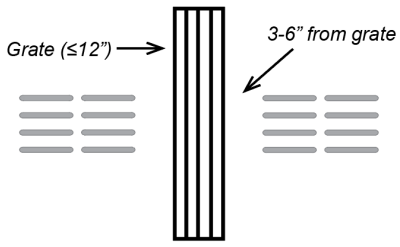


Top of Stairs (spans width of stairs)

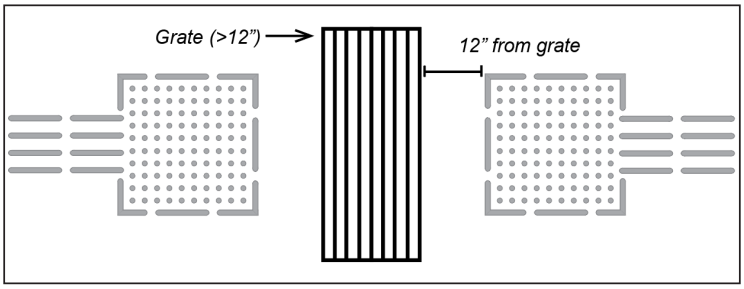


Base of Stairs (spans width of stairs)

Turns (less than 90°)



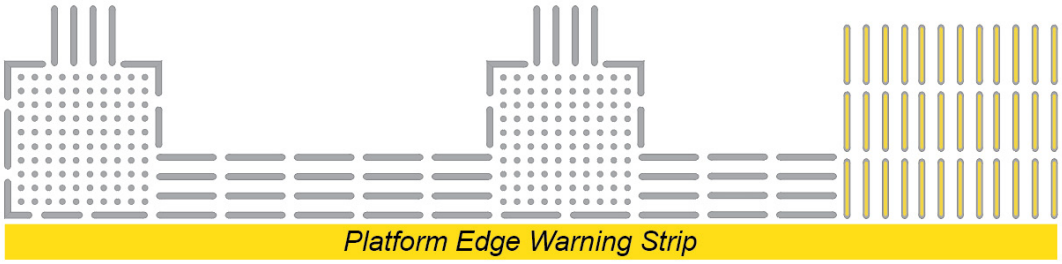
Interface with Narrow Grate



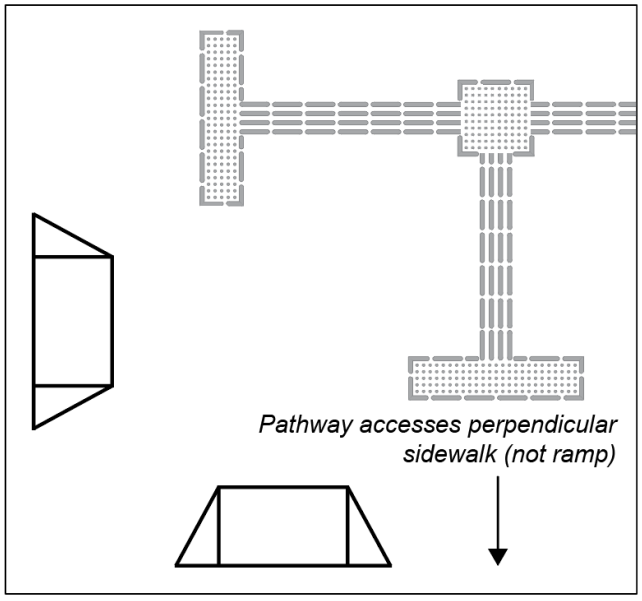
Interface with Wide Grate

Note: Diagrams not to scale.

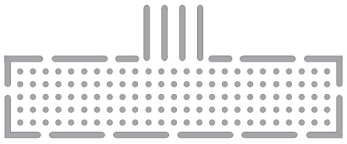
Figure 3-5 Tactile Pathway design solution. Refer to Table 3-1 for details.



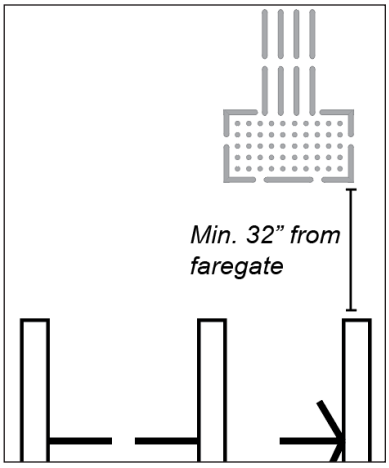
Interface with Platform Edge



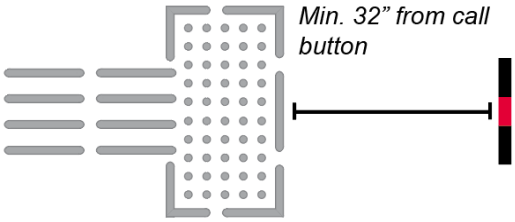
Interface with Street Corner/Curb Ramps



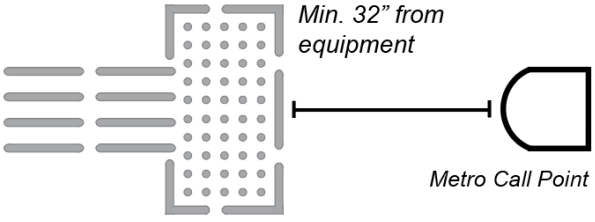
Edge of Metro ROW



Interface with Faregates



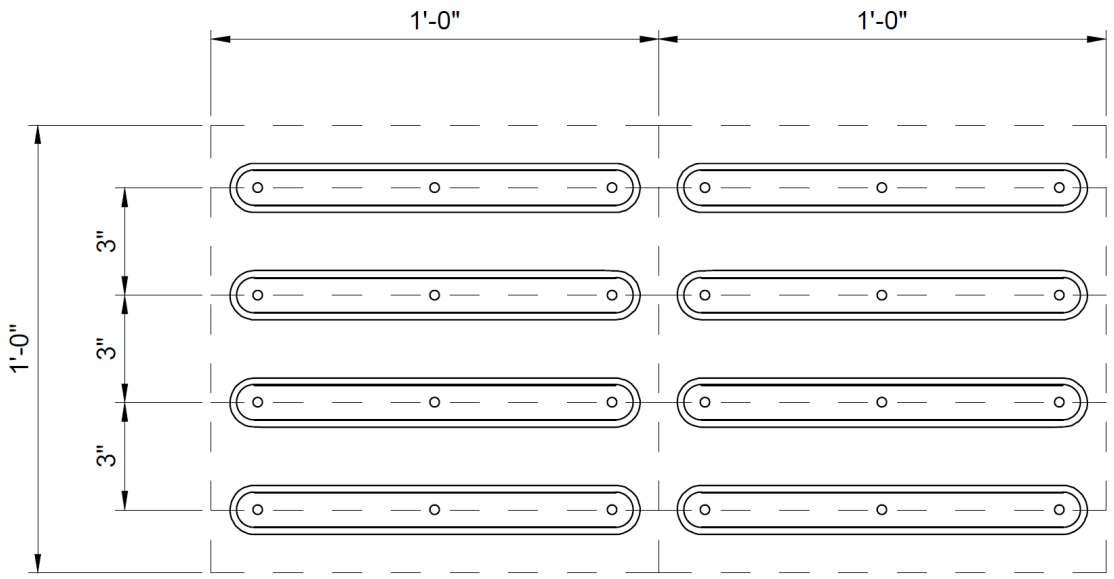
Interface with Elevator



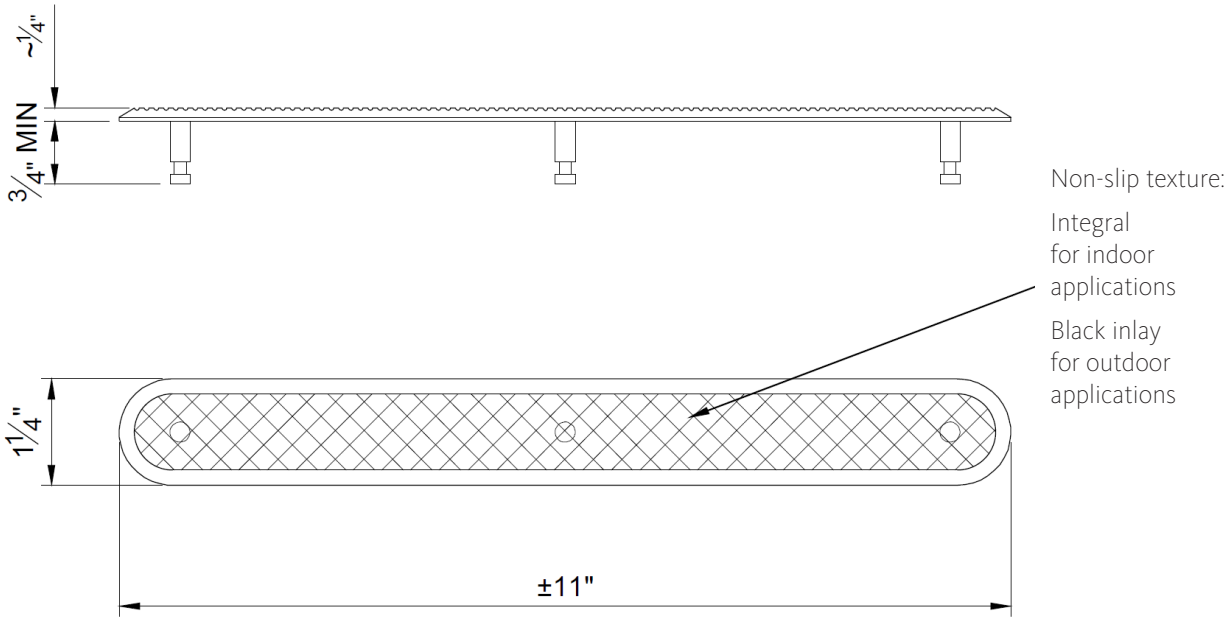
Interface with Operational Equipment

Note: Diagrams not to scale.

Figure 3-6 Tactile Wayfinding details (excerpted from Metro Architectural Standard Drawings)

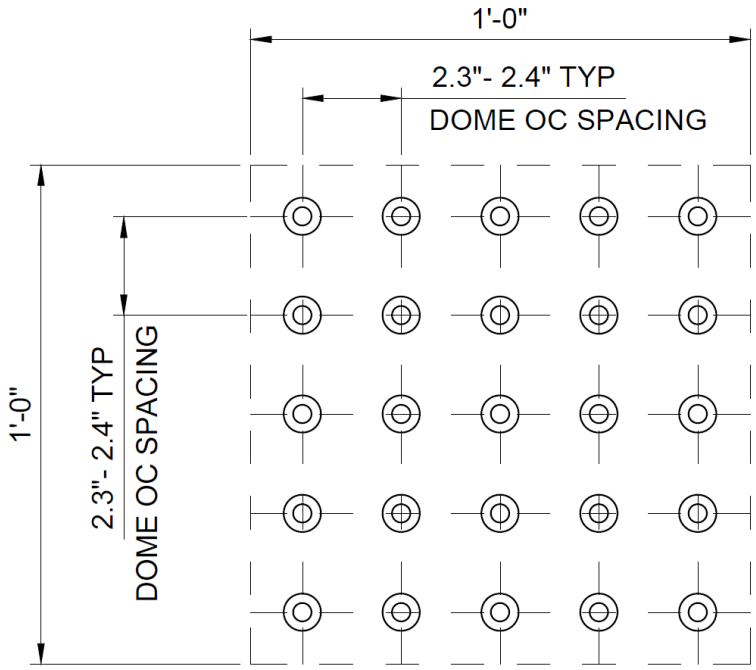


Dimensions: Stainless Steel Directional Bars

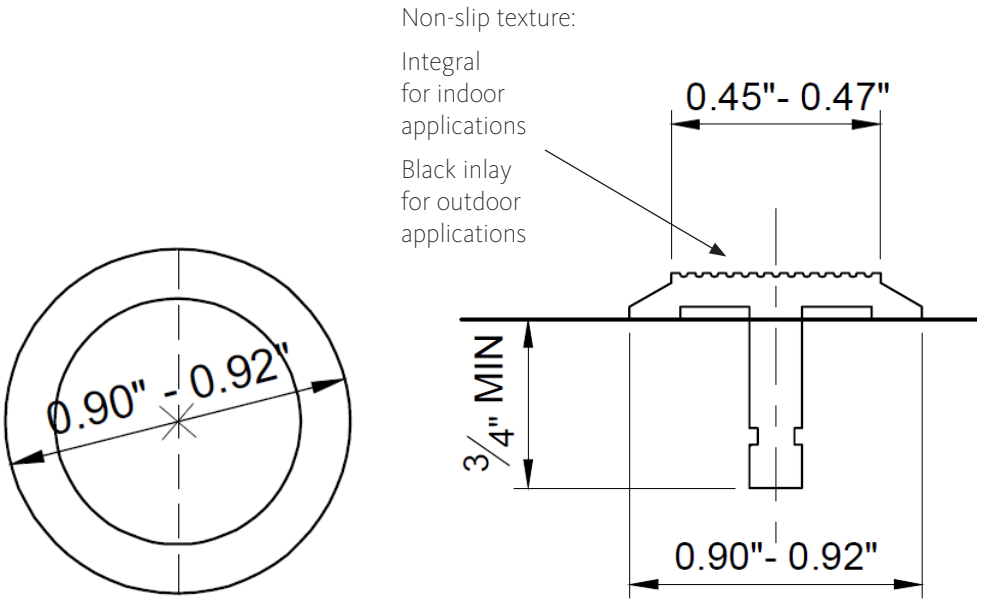


Details: Stainless Steel Directional Bars

Figure 3-7 Tactile Wayfinding details (excerpted from Metro Architectural Standard Drawings)



Dimensions: Stainless Steel Truncated Domes



Details: Stainless Steel Truncated Domes

Table 3-1 Key Design Features: Tactile Wayfinding

Design Feature	Rationale
1. Tactile platform edge warnings shall consist of a continuous edge of 24" wide precast concrete tiles with integral yellow color and parallel truncated domes.	This design meets both state and federal requirements. Precast concrete is more durable and cost-effective than plastic tiles.
2. Tactile train door locators shall consist of stainless steel bars with integral color (Federal Yellow), Bars are installed in a 36" x 48" configuration adjacent to the tactile platform edge warnings, perpendicular to the platform edge, and secured to floor using bolts and epoxy. Door locators shall be placed at the center of the platform. This aligns with center car of three-car LRT trains, second car of two-car LRT trains, or two center cars of six-car HRT trains.	This design meets all federal requirements and California's color requirements but requires state approval of the material. Stainless steel bars are recommended because they are more durable and cost-effective than plastic tiles. All federal requirements are met as is California's requirement to use Federal Yellow, but state approval of the material is needed. The design solution also provides a 70% visual contrast with selected terrazzo flooring (as specified in Station Surfaces and Materials White Paper) and the difference in material provides an audible contrast.
3. Tactile wayfinding shall be provided along the most direct route feasible, from start of Metro ROW to tactile train door locators on station platforms. All elevators and one stairway should be accessed on station levels where these vertical circulation elements exist. Continuity of pathway should be maintained with the exception of instances in which continuous flush walls or railings are located within 36" of the center of the primary path of travel, where a break in the pathway is necessary to provide clearance for mobility devices. Turns in tactile wayfinding should be right angles, unless this would require pathways under four feet between turns due to spatial constraints.	Layouts following these guidelines provide tactile wayfinding users the option of moving from any station entrance to any train via stairs or elevators. It is not necessary to provide redundancy by connecting to more than one stairway because stairways are rarely out of service. Connecting to nearest stairway simplifies pathway and reduces potential confusion for users. Users reported that navigation by right angles is most intuitive.

Design Feature	Rationale
4. Tactile wayfinding shall consist of stainless steel bars and truncated domes secured to floors using epoxy specified for use with stainless steel and the floor finish to which they are applied. Outdoor installations on concrete (including Metro's standard three-tone plaza paving) shall include a black non-slip inlay.	Stainless steel provides a 70% visual contrast with standard terrazzo flooring mix and the difference in material provides both an audible and tactile contrast. Plastic tiles were studied but are not recommended because they are less durable, less cost-effective, and overall substandard material compared to standard kit-of-parts materials such as stainless steel, terrazzo, and architectural grade concrete. Precast concrete pavers installed at the LAX Metro Transit Center were observed to degrade rapidly. Black non-slip inlays applied to the stainless steel elements make tactile wayfinding safe to walk on in wet weather, while providing the required contrast with concrete and other plaza finishes (the combination of steel and inlay distinguishes the pathway from any color or pattern).
5. The path-of-travel shall be indicated by four parallel bars 12" long, 1.3" wide, and 0.2" high, placed 3" on center.	This is based on the ISO standard and is recommended by Metro Civil Rights. A two-bar solution, based on the tactile wayfinding system used successfully in Copenhagen Metro and by Danish National Rail, was originally recommended by the Project Design Team. While this design has been tested and approved by the Danish Association of Blind, the four bar solution was adopted at Metro's direction based on feedback from members of Los Angeles' sight-impaired community.
6. (A) A 90° change in direction or intersection shall be indicated by 24" x 24" of truncated domes, bordered by directional bars. Right angles are to be used unless they require short pathways between turns (under 4 feet). (B) A change in direction less than 90° shall be accommodated by continuous directional bars. (C) An intersection of two or more paths shall be indicated by 24" x 24" of truncated domes, bordered by directional bars.	This is based on the preferred solution recommended by Metro Civil Rights and tested by sight-impaired users.

Design Feature	Rationale
7. On station platforms, tactile wayfinding shall indicate most direct route between door locator tiles and vertical circulation (stairs and elevators) leading to station entrances, as described in design feature #3. Pathway shall be adjacent to platform edge warning strip for lengthwise travel along platform, to extent possible.	This layout provides users the option to access any train directly from any station entrance. Feedback from testing included a preference for pathways adjacent to the platform edge warning strip, as this reduces the number of varying textures in a narrow space. Conversely, directional pathways separated from the warning strip confused sight-impaired passengers and made navigation more difficult for those using wheeled devices, particularly in constrained circulation areas.
8. The base of a stairway shall be indicated by directional bars in the standard 1' wide configuration, parallel to stairs. Directional bars should span the width of the stairway and be 24" from handrail. The top of a stairway shall be indicated by directional bars 2' wide, parallel to stairs. Directional bars should span the width of the stairway and be 24" from handrail.	This is based on the preferred solution recommended by Metro Civil Rights, which prioritizes safety when approaching stairs. The solution also drew from transit facility best practices in the UK.
9. (A) If the pathway crosses a grate or other surface over 12” wide where it cannot be installed, gap shall be indicated by a 12” x 24” area of truncated domes bordered by directional bars, and 12” gap before and after the break. The pathway shall be aligned on both sides of the break. (B) If the pathway must cross a grating or other surface up to 12” in width where it cannot be installed, the pathway shall terminate less than 6" before and after the break and shall be aligned on both sides.	This is based on the preferred solution recommended by Metro’s Civil Rights and the principle of maintaining the continuity of the pathway as much as possible.

Design Feature	Rationale
10. A 12” x 24” area of truncated domes bordered by directional bars, with a clearance of 32" for reach, shall be used to indicate the following features: (A) Elevator call buttons (all). (B) One Metro Call Point (MCP) in each station area (paid and unpaid areas of entrance level; each interior level), or emergency telephone in station retrofits without MCPs. (C) Fare gates. The pathway should follow the most direct route and pass through a standard fare gate rather than the ADA fare gate. If a preferred, more streamlined layout requires using the ADA fare gate, pathway must be centered and continuous.	12” x 12” area of truncated domes originally considered; however, research on best practices from Copenhagen indicates that 24” width is recommended for better detectability. Metro's previous requirements specified that the pathway should connect to the regular fare gate immediately adjacent the ADA fare gate; however the Project Design Team recommends removing this requirement to allow the pathway to connect to the fare gate that provides the most direct path of travel. When the ADA fare gate must be used, it is preferable to maintain a continuous path, as the 12" x 24" area of truncated domes creates a barrier for wheelchair users.
11. The pathway shall begin at edge of Metro ROW, with a 1' x 5' "catchment" area of truncated domes bordered by directional bars. Primary paths of travel to station entrances shall be indicated. At street corners, pathway shall access sidewalk away from curb ramps to provide clearance for wheelchairs.	This is based on the preferred solution recommended by Metro’s Civil Rights and feedback from wheelchair users regarding curb ramps.

Note: This table provides a summary of key features only and is not an exhaustive list of all design features.

3.2 Hands-Free Elevator Access

The recommended design solution for hands-free elevator access features a system of push plates placed near to the ground that can be activated by either a wheelchair footrest or foot, as shown in Figure 3-7. These devices are large enough to not require great precision in their activation. Push plates are to be no more than 6" above the finished floor and at least 12" in height to align properly with most wheelchair footrests. The push plates provide the same functionality as conventional call buttons and can be added to existing elevators or incorporated into new elevators. The push plate finish is stainless steel for durability and easy maintenance. For additional information, see "Table 3-2 Key Design Features: Hands-Free Elevator Access" on page 25.

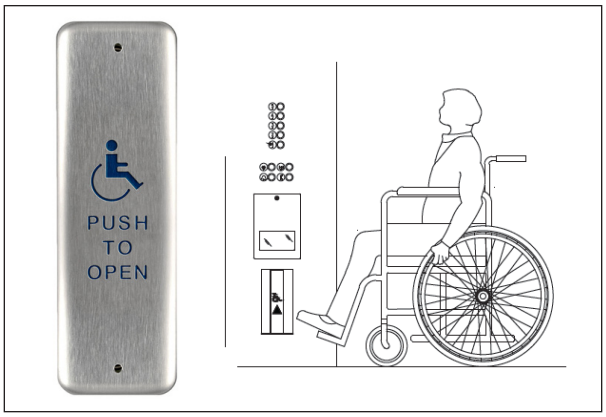


Figure 3-8 Example of hands-free push plate (left) and activation concept (right).

3.3 Accessible Crossing Gates

The design solutions for accessible crossing gates consider three different situations.

The first design solution, for pedestrian-only crossings, features a pedestrian-scale automatic gate and audio/visual active warning assembly (Figure 3-8). In line with current state requirements, a single swing gate for emergency egress is provided, featuring a customized kick plate. When not activated by oncoming train traffic, pedestrian flow is unimpeded at the grade crossing.

The second design solution, for pedestrian crossings that are adjacent to vehicular crossings, features a combined vehicular and pedestrian automatic gate with the required audio/visual active warning assembly. In addition to the automatic gate; a single swing gate that features a kick plate is provided for emergency egress only. When not activated by oncoming train traffic, pedestrian flow is unimpeded at the grade crossing.

The third design solution, for pedestrian-only crossings in constrained spaces, features a channelized chicane-design pedestrian walkway that physically directs the users in the direction of oncoming train traffic, as shown in Figure 3-10. This is coupled with a smaller-scale pedestrian audio/visual active warning assembly. Pedestrian flow is unimpeded at all times, as there are no gates included in this design. For additional information, see "Table 3-3 Key Design Features: Accessible Crossing Gates" on page 26.

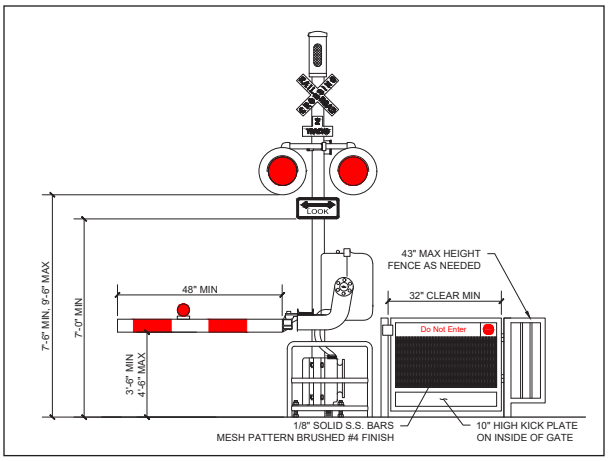


Figure 3-9 Automated pedestrian crossing gate.

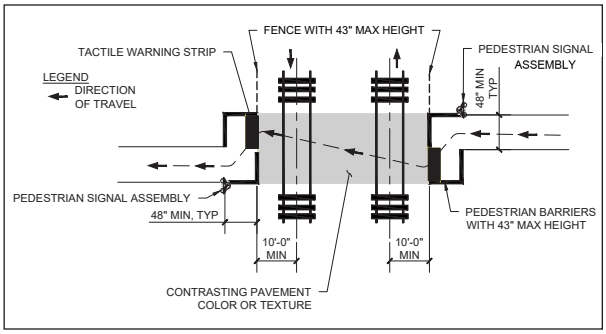


Figure 3-10 Constrained-space accessible crossing.

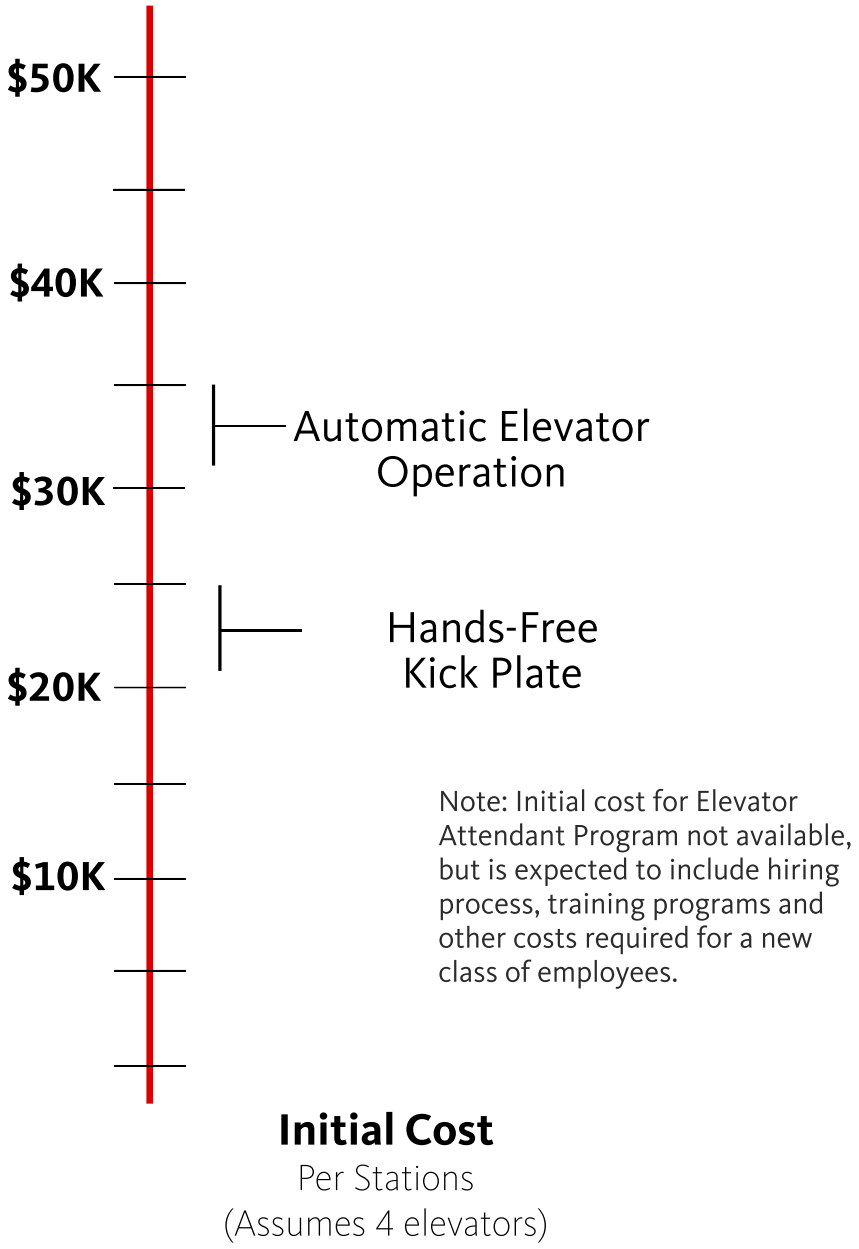
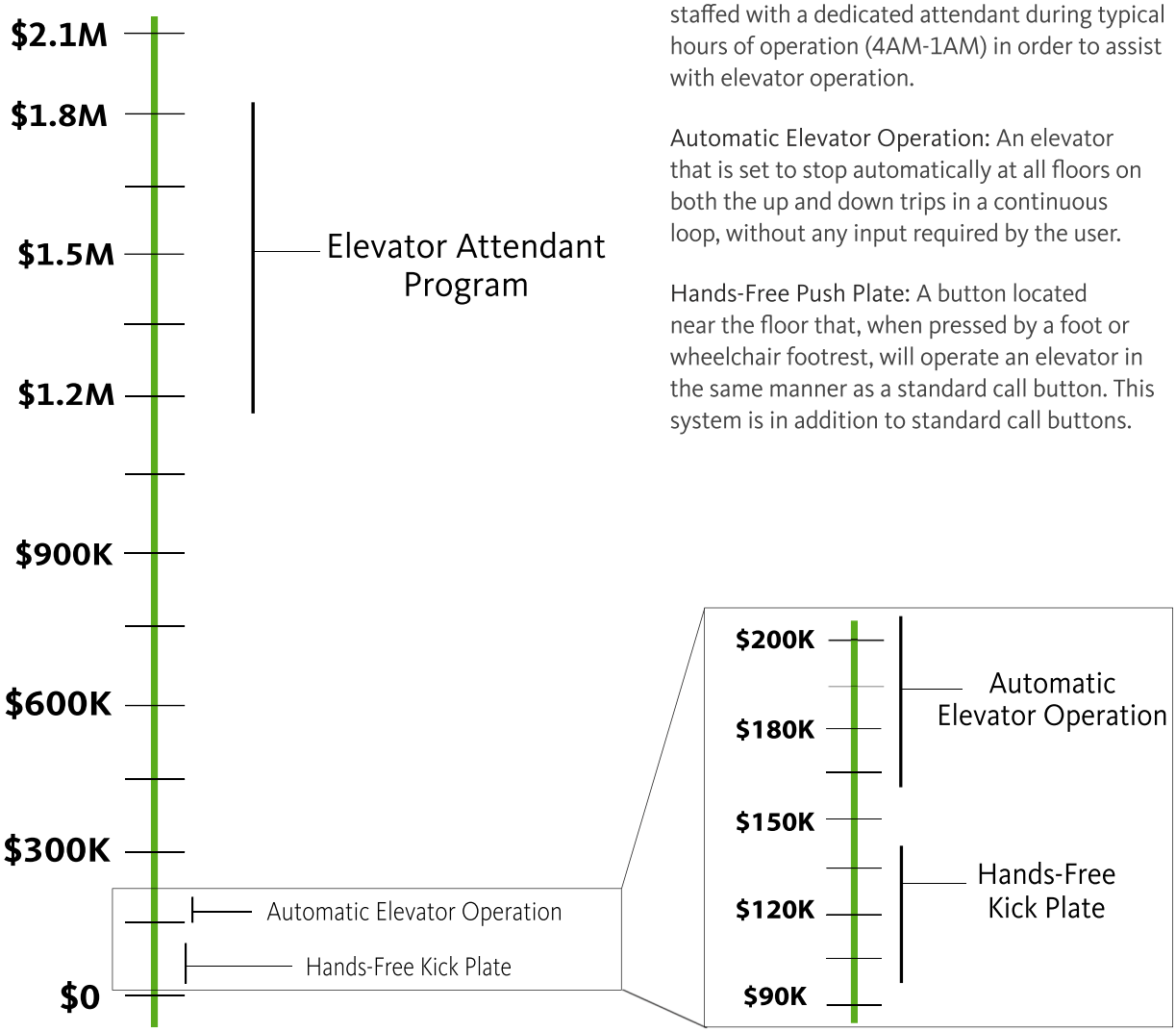


Figure 3-11 Hands-Free Elevator Cost Estimate (Initial Cost).

Note: figures provided represent rough cost estimate based on concept design. Actual cost may vary based on exact material, detailed design, location of installation, number of units ordered, and availability of labor and materials.



Elevator Attendant Program: Each elevator is staffed with a dedicated attendant during typical hours of operation (4AM-1AM) in order to assist with elevator operation.

Automatic Elevator Operation: An elevator that is set to stop automatically at all floors on both the up and down trips in a continuous loop, without any input required by the user.

Hands-Free Push Plate: A button located near the floor that, when pressed by a foot or wheelchair footrest, will operate an elevator in the same manner as a standard call button. This system is in addition to standard call buttons.

Annual Cost
Per Station
(assumes 4 elevators, includes initial installation)

Figure 3-12 Hands-Free Elevator Cost Estimate (Annual Cost).

Note: Assumes typical underground station with four (4) elevators, typical hours of operation: 4AM-1AM, and all four (4) elevators to be equipped for hands-free access. Excludes initial capital cost of the elevator unit.

Table 3-2 Key Design Features: Hands-Free Elevator Access

Design Feature	Rationale
1. Hands-free push plates are mounted 6" above the finished floor, and are a minimum 12" high.	The mounting height and button height allow for most wheelchair models' footrests to easily align with and activate the buttons. The buttons are generally located in-line with the standard call buttons, for familiar placement.
2. Hands-free push plates are made of 316 grade stainless steel with #4 brushed finish.	Stainless steel provides a clean and modern aesthetic, consistent with Metro's Systemwide Station Design Standards material palette, and is a high-performance material with reduced maintenance.
3. Graphics for hands-free push plate to be developed/reviewed by Metro SEGD.	This is an existing Metro requirement.

Note: This table provides a summary of key features only and is not an exhaustive list of all design features.

Table 3-3 Key Design Features: Accessible Crossing Gates

Design Feature	Rationale
1. Pedestrian-only and combined pedestrian/vehicle gate assemblies feature gate arms activated by oncoming train traffic.	The active warning system of the gate arm allows for accessible, unimpeded crossing of the trackway when there is no oncoming train traffic. When not activated the assembly provides the following passive warning devices: • Tactile warning strip • Visual warnings (railroad crossing crossbuck, "LOOK" signage) When oncoming train traffic is detected, the active warning devices include: • Automatic pedestrian gate • Alarm bells • Flashing lights
2. The emergency egress swing gate features a 10" high kick plate on the inside (track side) of the gate.	When oncoming train traffic sets off the active warning devices, the swing gate allows for emergency egress from the trackway for anyone who has not cleared the gate in time. The height and flat surface of the kick plate allow for a variety of wheelchair models' footrests to easily align with the kick plate and allow hands-free (push) operation in an emergency egress situation.
3. The constrained space crossing features a chicane-design channelized pedestrian path.	The chicane design orients pedestrians to look in the direction of oncoming train traffic, while allowing for accessible, unimpeded crossing of the trackway. The width of the pedestrian path meets ADA requirements to allow for a wheelchair user to navigate and turn their wheelchair while moving past opposite-direction pedestrian flow.
4. The constrained space crossing features traditional passive and active railroad crossing warnings.	The chicane-design provides the following passive warnings devices: • Tactile warning strip • Visual warnings (railroad crossing crossbuck, "LOOK" signage) The following active warning devices are also provided: • Alarm bells • Flashing lights This is consistent with federal requirements and current Metro practice. An example of a non-gated crossing with these features is the Irwindale station on the Metro A Line, where one side of the crossing does not feature gates.

Note: This table provides a summary of key features only and is not an exhaustive list of all design features. Project design documentation provides complete details and requirements, and is available upon request.

Accessibility
White Paper

Contact Us

METRO SYSTEMWIDE DESIGN

metro.net/projects/station-design-projects/

Adam Light, *Senior Director,* LightA@metro.net

Rachelle Andrews, *Senior Manager, Transportation Planning*, AndrewsRa@metro.net

Kyle Kulmann, *Principal Transportation Planner,* kulmannk@metro.net

4.0 Sources

Almeida, Maria deFatima; Martins, Laura B.; Lima, Francisco J. "Analysis of Wayfinding Strategies of Blind People Using Tactile Maps." 6th International Conference on Applied Human Factors and Ergonomics (AHFE), 2015.

Apelt, Ron; Crawford, John; Hogan, Dennis. " Wayfinding Design Guidelines." CRC Construction Innovation and Queensland Government, 2007.

Bay Area Rapid Transit District (BART). "Elevator Outage Schedule: Progress on effort to improve rider experience in elevators." http://www.bart.gov/news/articles/2016/news20160817. Accessed October 26, 2018.

Bentzen, Billie Louise; Barlow, Janet M.; Tabor, Lee S. "Detectable Warnings: Synthesis of U.S. and International Practice." Accessible Design for the Blind. May 2000.

Crawford, Elise; Wu, Ying. "Wayfinding in the Rail Environment, Technology and Behavior Review." CRC for Rail Innovation, 2011.

Department of the Environment, Transport and the Regions. "Guidance on the Use of Tactile Paving Surfaces." 2007.

De Blasio, Gabriel; Quesada-Arencibia, Alexis; Garcia, Carmelo; Molina-Gil, Jezabel; Caballero-Gil, Candido. "Study on an Indoor Positioning System for Harsh Environments Based on Wi-Fi and Bluetooth Low Energy." National Center for Biotechnology Information. 6 June 2017.

Giudice, Nicholas A.; Legge, Gordon, E.. "Blind Navigation and the Role of Technology." In Engineering Handbook of Smart Technology for Aging, Disability, and Independence, ed. A. Helal, M. Mokhtari, B. Abdulrazak. John Wiley & Sons, January 2008.

Lee, Helen. "Effects of Detectable Warnings on Individuals with Mobility Impairments." PhD diss., Western Michigan University, 2007.

Los Angeles County Metropolitan Transportation Authority (Metro). "Riders with Disabilities." https://www.metro.net/riding/riders-disabilities/. Accessed 22 October, 2018.

Metcalfe, John. "The Bay Area Takes the Fight to Elevator Urinators." CityLab. https://www.citylab.com/equity/2016/08/the-bay-area-pours-thousands-into-fighting-elevator-urinators/496970/. Accessed 22 October, 2018.

Sakpere, Wilson; Adeyeye-Oshin, Michael; Mlitwa, Nhlanhla. "A State-of-the-Art Survey of Indoor Positioning and Navigation Systems and Technologies." South African Computer Journal, Vol. 29, No. 3. December 2017.

United Nations Development Programme (UNDP). "A Review of International Best Practice in Accessible Public Transportation for Persons with Disabilities." 2010.

United States Access Board. "Detectable Warnings Update." < https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/guidance-and-research/detectable-warnings-update>

Zafari, Faheem; Gkelias, Athanasios; Leung, Kin. "A Survey of Indoor Localization Systems and Technologies." Cornell University Library. March 2018.

Acknowledgments

Several internal and external stakeholders shared their feedback and expertise to help develop world-class station design solutions as part of the ISDS project. Thank you for your time and participation.

Priyanka Agarwal, Systemwide Design
Mayen Alcantara, Arts + Design
Benjamin Alcazar, Office of Civil Rights
Rachelle Andrews, Systemwide Design
Mauro Arteaga, TAP
Medford Auguste, Operations Performance Analysis
Shaunt Avanesian, Facilities Maintenance Contracts
Lena Babayan, Facilities Maintenance Contracts
Arkady Bernshteyn, Rail MOW Engineering
Daniel Bigno, Operations & Service Delivery
Nolan Borgman, OEI
Claire Bowin, City of LA Urban Design Studio
Brady Branstetter, Facilities/Property Maintenance
Ebelin Castillo, Marketing
David Chong, Project Engineering
Kristie Crawford, Marketing
Dulce Cristobal, Systems Engineering
Androush Danielians, Engineering Management
Aspet Davidian, Project Engineering
Andres Di Zitti, Rail Transportation
Andrina Dominguez, Environmental Compliance and Sustainability
Bonn Dumaliang, Systems Engineering
Maya Emsden, Arts + Design
Thomas Eng, Safety
Marshall Epler, Rail MOW Engineering
Brandon Farley, Operations Liaison and Planning
Fred Feng, Systems Engineering
Lance Glover, Arts + Design
Angelka Grandov, Project Engineering
Susan Gray, Arts + Design
Holly Harper, City of LA Urban Design Studio
Peter Jung, Project Engineering
Anthony Jusay, Bike Share Planning and Implementation
Andrew Kao, Bike Share Planning and Implementation
Kay Koopman-Glass, Safety
Alvin Kusumoto, Environmental Compliance and Sustainability
Lan-Chi Lam, Marketing
Erica Lee, TAP
Nadine Lee, OEI
Katherine Lemmon, First/Last Mile Planning
Dan Levy, Office of Civil Rights
Emmanuel Liban, Environmental Compliance and Sustainability
Jacob Lieb, First/Last Mile Planning
Adam Light, Systemwide Design
Christopher Limon, Facilities/Property Maintenance
Timothy Lindholm, Facilities Engineering-Operations
Anthony Loui, Operations Liaison and Planning
Israel Marin, Service Planning & Scheduling
Al Martinez, Transit Operations Systems
Carlos Martinez, Facilities Maintenance Contracts
Jila Mendoza, Systemwide Design
Bernadette Mindiola, Marketing
Amador Nafrada, Systems Engineering
Brad Owen, Construction Management
Karen Parks, System Security & Law Enforcement
Austin Phung, Systemwide Design
Craig Reiter, Environmental Compliance and Sustainability
Claire Reyes, Rail Communications
Mario Del Rosario, Systems Engineering
Joseph Russell, Marketing
Eladio Salas, Wayside Systems Facilities Maintenance
Nicholas Saponara, Transit Oriented Communities
Avital Shavit, OEI
Letitia Solis, Light Rail Wayside Systems
Stephen Toms, Asset Management
Susan Walker, System Security & Law Enforcement
Greg Wasz, TAP
Paul Whang, Facilities Engineering-Operations
Jenny Wong, Systemwide Design
Zipporah Yamamoto, Arts + Design
Rami Younan, Rail MOW Engineering
Danai Zaire, City of LA Urban Design Studio
Rafie Zamani, Transit Project Delivery