Metro®

ISDS PROJECT

INTEGRATED STATION DESIGN SOLUTIONS

Lighting
White Paper

November 2021

Gensler ARUP RAW INTERNATIONAL STUDIO-MLA Claris Strategy Kilograph

Lighting
White Paper

1.0 Element Overview and Problem Statement

1.1 Description of Element

Well-designed and maintained station lighting is essential to the safety and comfort of Metro passengers. Enhancements in lighting application and efficacy (a measure of how well a light source produces visible light) contribute positively to the overall passenger experience of both interior and exterior station environments. It is essential that lighting be considered as an integrated element when establishing holistic station design solutions.

The project goal for lighting is to develop recommendations for a consistent lighting design that is effective, aesthetically pleasing and easy to maintain.

1.2 Problem Statement

There is a general lack of consistency in Metro's current approach to lighting design within the interior and exterior of stations. This lack of consistency can lead to potential hazards in regards to decreased safety and accessibility. (Note: Metro currently has standards for lighting levels and design of canopy lighting for at-grade and aerial stations, and for underground station portal canopies, but needs additional standards for other public station areas).

- Lighting levels vary from station to station
- In many areas, lighting levels do not meet Metro requirements outlined in the Metro Rail Design Criteria (MRDC), including platform and stair lighting levels. See Figure 1-1.
- Materials and finishes at many existing Metro stations do not have ideal reflective qualities, therefore creating low levels of perceived brightness in stations.
- Multiple fixture types and lighting strategies employed across stations result in a lack of design continuity and are difficult to maintain over time.
- Many luminaires have exposed sources, creating glare and inhibiting passenger visibility. See Figure 1-2.
- Lack of uniformity and high instances of glare do not meet ADA-recommended light levels.

Metro's priorities for lighting include:

- Consistent lighting standards for typical stations types.
- Ease of installation, cleaning and maintenance. Figure 1-3 shows current luminaires at Metro stations difficult to maintain.
- Support in the transition to LED luminaires.
- Enhanced safety conditions and customer experience.

Figure 1-1 Lighting level do not meet MRDC requirements. E (Expo) Line platform, 7th St/Metro Center station.

Figure 1-2 Uplighting creates a glare and inhibits passenger visibility. Jefferson/USC station, E (Expo) Line.

Figure 1-3 Installation and maintenance of luminaires in difficult to reach areas should be avoided. Universal/ Studio City station, B (Red) Line.

2.0 Design Process and Principles

2.1 Design Process

The Project Design Team for this element was led by Arup, with assistance from Gensler and RAW.

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 lighting conditions.

The Project Design Team also conducted a series of interviews with representatives from a wide range of Metro departments, including:

- Arts + Design
- Environmental Compliance and Sustainability
- Facilities Engineering-Operations
- Facilities/Property Maintenance (including separate interviews with FM field staff and management)
- Fire & 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 March 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 in April 2019. A final Concept Design for lighting was delivered to Metro in June 2019. The draft, revised, and final Design Documentation packages were submitted March 2020. For additional information, see "Table 2-1 Timeline of Design Process" on page 4.

2.2 Working Group Feedback

Working Group members provided the following feedback on Lighting:

- Light pollution complaints from surrounding residents is an ongoing significant issue. (Facilities Maintenance)
- Consider use of natural light in underground stations.
- Lighting should not compromise visibility for train operators. (Rail Transportation)
- Potential to use lighting as a deterrent (for crime and unwanted loitering) in exterior plazas.
- Luminaires providing indirect light for plazas is preferred.
- Flush conditions for ceiling lighting within station interior preferred for ease of maintenance. (Facilities Maintenance)
- Handrail lighting should be flexible to integrate into existing and/or new infrastructure, and be easy to maintain.
- LED pod lighting for handrail to eliminate unwanted glare, offering equal distribution of light. (Office of Civil Rights)

The Metro Project Team provided the following preferred design direction based on feedback from the Working Group, physical samples of fixture types reviewed by Metro departments, and discussions with Gensler and Arup:

- Recessed linear LED lighting for public areas within the underground station, including platform and concourse areas, mid-landings, and stair/escalator wells.
- Linear LED downlight luminaires and edge-lit LED panels for platform edge lighting and signage.
- Luminaires providing indirect lighting for plazas.
- LED handrail pod lights for stairs.
- Luminaires that are easy to maintain and do not require disrupting service or impeding pedestrian circulation.

Table 2-1 Timeline of Design Process

May to June 2018	Project Design Team and Metro Working Group Members conducted site visits to existing stations, including: 7th St/Metro Center, Arcadia, Aviation/LAX, Bundy, Cal State LA, Harbor Freeway, Hollywood/Highland, North Hollywood, Pacific Coast Highway, and Wilshire/Vermont.
June to November 2018	Project Design Team conducted interviews with Metro departments, including: Arts + Design, Environmental Compliance and Sustainability, Facilities Engineering-Operations, Facilities/Property Maintenance (including separate interviews with FM field staff and management), Fire and Life Safety, Office of Civil Rights, Operations Liaison and Planning, Project Engineering, and System Security & Law Enforcement.
November 2018 to February 2019	Project Design Team developed initial design concepts.
March 2019	Project Design Team initial design concepts presented to the Metro Working Group.
April 2019	Draft Concept Design Package submitted.
June 2019	Revised Concept Design Package submitted.
November 2019	Draft Design Documentation Package and White Paper submitted.
February 2020	Revised Design Documentation Package submitted.
March 2020	Final Design Documentation Package submitted.
March 2020	Draft MRDC and Architectural Standard / Directive Drawings updates submitted.

2.3 Design Principles

Based on the comments provided by the Working Group, the Project Design Team identified the following design principles for lighting:

Safety & Security

- Consistent light levels across space type - through broad washes of lighting onto vertical and horizontal surfaces.

Maintenance & Operations

- Typical fixture types across space types - for ease of maintenance and intelligibility.

Sustainability

- Consistent installation types for all typical luminaires to reduce the need for retrofits and reconstruction, making it more sustainable over time.
- Use of highly-efficient LED luminaires throughout.

Wayfinding and Accessibility

- Consistent placement of light fixture types across space types to establish a visual hierarchy for increased spatial awareness.

Passenger Experience and Placemaking

- Establish a common effect across space types that creates a welcoming, comfortable public realm to attract patronage in transportation environments. Avoid overly dim or harsh lighting.

3.0 Design Solution

Careful consideration was given to integrating the lighting element within the context of the overall station design. The design solution included here establishes an effective, aesthetically pleasing and an easy-to-maintain approach to integrated lighting. Lighting for passenger stations should be bright, consistent, pleasant and calming, similar to what is shown in Figure 3-1. Integrated lighting should not be harsh, stark or dim. To ensure required lighting levels are being met, a proper lighting study is recommended for station-specific lighting plans.

3.1 Public Station Area Ceiling Integration

The lighting design solution for ceilings at typical underground station public areas, including platform, concourse, mid-landing, and stair/escalator wells, includes a recessed LED linear slotlight laid out within a grid ceiling (see Figure 3-2). A staggered layout of recessed LED luminaires allows for even ambient light across station platforms. A minimum reflectance value of 50% at ceilings, 10% at floor and 50% at walls is assumed to maintain optimal light levels per the proposed direct lighting solution (see Figure 3-3). Visible fixture housing shall match surrounding surface materials and be flush with the ceiling. Future underground stations will have high bay ceilings that may require extra coverage of luminaires to meet lighting level needs.

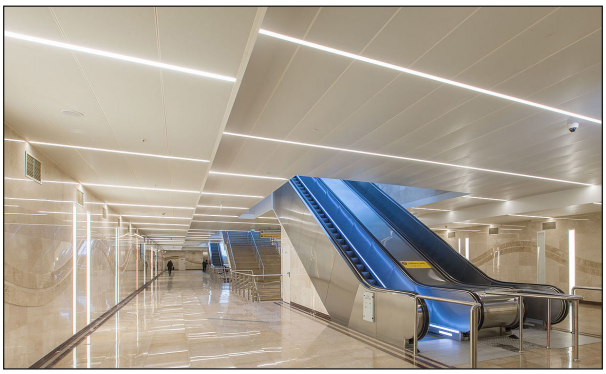


Figure 3-1 Integrated lighting within context of overall station design.

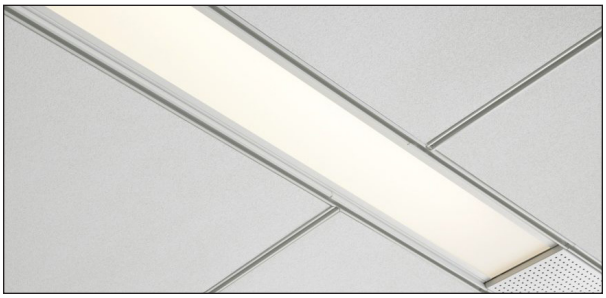
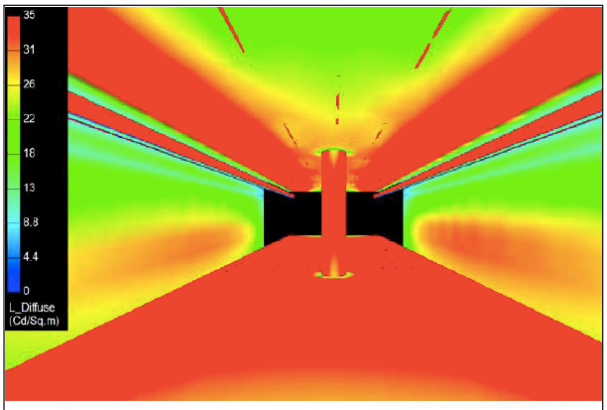


Figure 3-2 Recessed linear slotlight basis of design.



Surface	Reflectance Value
Ceiling	50%
Wall	50%
Floor	10-30%*

*Reflectance value for floor to be refined based on additional analysis of selected material samples.

Figure 3-3 Photometric rendering of typical platform perspective - luminance, light reflected by a surface.

3.2 Platform Signage Integration

The lighting design solution for platform edge signage includes a linear LED downlight. The integrated linear LED installed along the bottom of the signage panel houses a specular louver, which directs and concentrates the light on the platform edge for decreased glare and narrowflood distribution, and for increased concentrated light levels at the platform edge. The optical performance of the louver allows for a concentrated amount of light to meet the required light levels at the platform edge, and therefore is only suitable for this location (see Figures 3-4 and 3-5).

Figure 3-4 Platform edge linear LED downlight example, TfL.

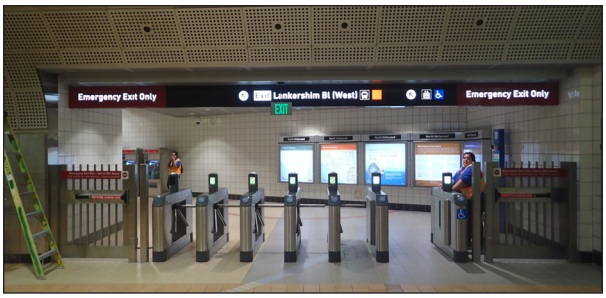


Figure 3-5 Signage panel example, linear LED downlight to be installed along bottom of panel at platform edge locations. North Hollywood station, B (Red) Line.

3.3 Handrail Integration

The lighting design solution for illumination at stairs throughout stations includes an LED pod system integrated at regular intervals into the architectural handrail. LED pods illuminate stairs both asymmetrically and symmetrically, allowing for a low-glare and energy efficient approach to meeting egress and life-safety code required light levels. Handrail LED pods can be installed on both new and existing railings in the system. This solution allows for modularity and ease of maintenance across various applications (see Figures 3-6 and 3-7).

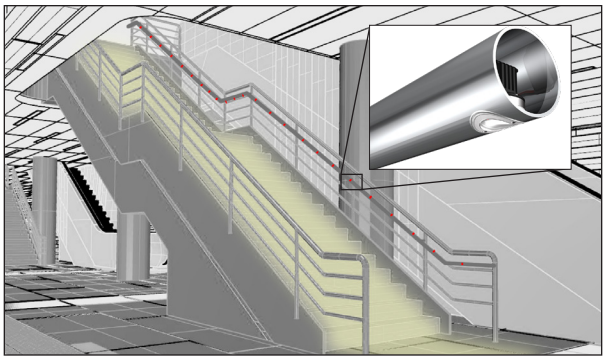


Figure 3-6 Integrated handrail LED pods basis of design with inset detail.

Figure 3-7 Integrated handrail LED pods example.

3.4 Plaza Integration

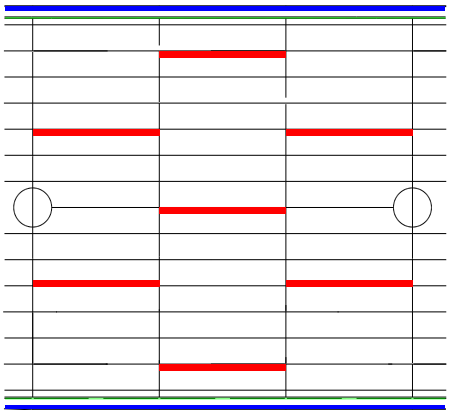
The lighting design solution at station plazas includes a pole-top luminaire that can be employed on a standalone pole at varying heights, or within SMART pole technology (light poles with intelligent LED lighting that can be configured to house other smart technology) to integrate with other station components such as speakers and cameras. An indirect asymmetric reflector with a clear glass lens was chosen for a low-glare approach to illumination at station plazas (see Figure 3-8). Differing pole heights to be employed per plaza functions and adjacencies allows for a streamlined approach to maintenance across stations. Typical pedestrian-scale light poles place the luminaire 12 feet above the finished surface. Light poles in public areas shall be stainless steel with a stainless steel base cover. Light poles within non-public areas can be stainless steel, metallic, or aluminum.

Figure 3-8 Plaza pole light and indirect pole-top luminaire basis of design (inset).

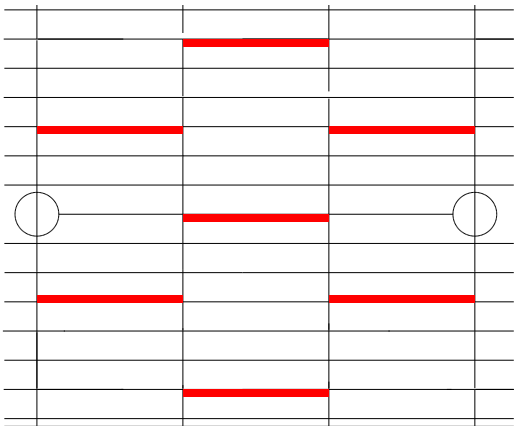
3.5 Underpass Integration

The lighting design solution proposed for pedestrian underpasses beneath aerial stations or bridge/overpass structures is a ceiling mounted linear wallwash luminaire that illuminates vertical surfaces with RGBA color changing illumination. Linear LED lights at the ceiling would provide general uniform illumination for safety and security throughout the space. RGBA color changing illumination offers Metro a streamlined solution that also allows for optional colors, adding dynamic visual interest for both Metro passengers and community members alike. See Figure 3-9 for an example of linear wallwash luminaires.

Figure 3-9 Linear RGBA wallwash basis of design.



Typical reflected ceiling plan for platform lighting.



Typical reflected ceiling plan for concourse lighting.

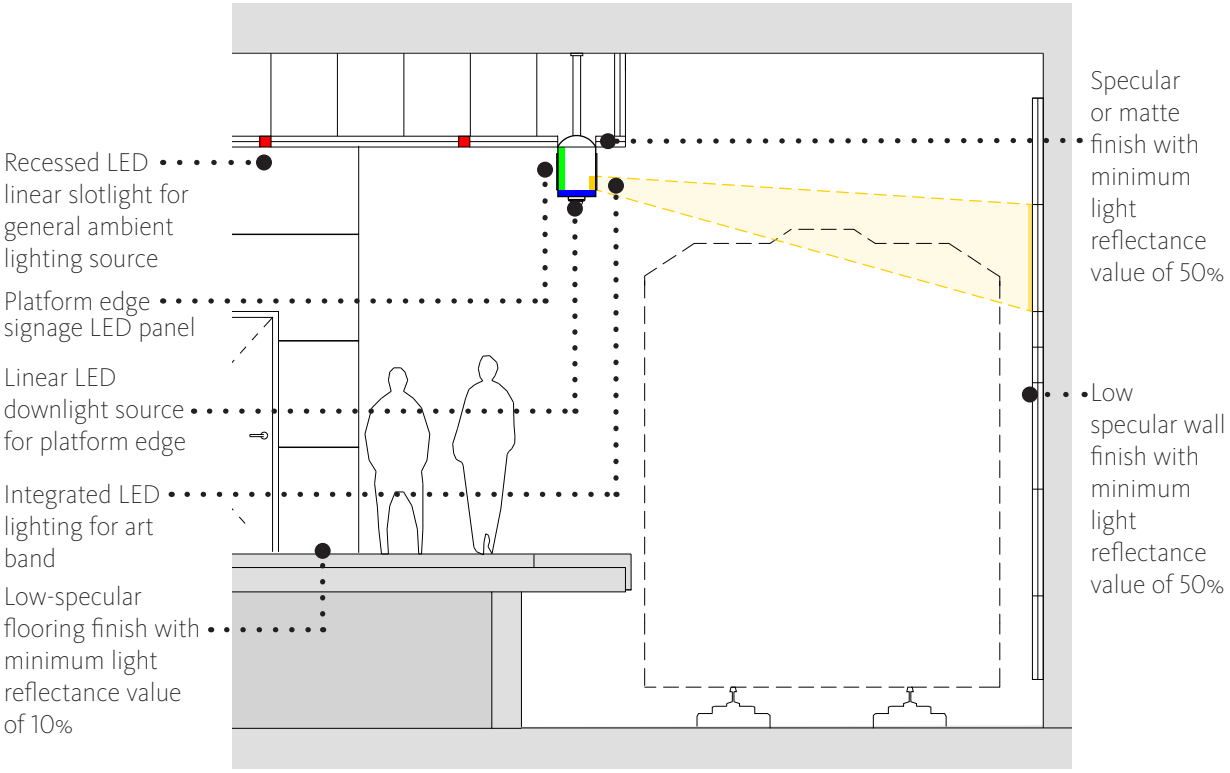


Figure 3-10 Typical Platform and Concourse Lighting diagrams.

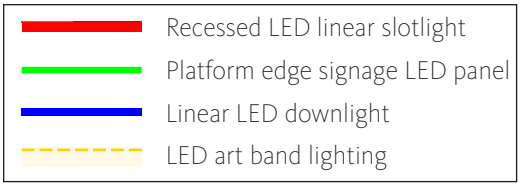


Table 3-1 Key Design Features

Design Feature	Rationale
1. LED drivers shall exhibit a rated lifetime of 50,000 hours or more for their rated application and shall be dimmable to 1% flicker free.	Energy savings and driver longevity lead to reduced operating costs and maintenance issues.
2. All luminaires specified for Metro projects should consider the R9 color performance.	R9 is a specific color metric used to gauge the rendering of the color red for a light source. Good R9 rendering is an indicator of high performance color rendering, and specific R9 criteria shall be established and accepted by the specifier, on behalf of Metro, for key areas requiring greater color consideration.
3. The Standard Deviation Color Matching (SDCM) MacAdam ellipse for all LED sources shall not exceed 2 for interior applications or 3 for exterior applications.	Color consistency across LED sources is vital to maintaining design integrity over time.
4. LED luminaires shall exhibit a minimum efficacy of 60 Lm/W for interior applications and 55 Lm/W for exterior applications.	Ensures luminaires provide the required standard lighting levels while maintaining an efficient output of energy.
5. Metro lighting specifications should include luminaires with integral fuse, drivers and power supplies. Remote drivers and power supplies are acceptable only where accessibility and ease of maintenance is required and where an integrated driver or power supply is not available to achieve the necessary design effect.	Luminaires with integral drivers allow for streamlined installation and ease of maintenance over time.
6. Serviceability for luminaires (LED replacement, as well as driver access) shall be capable from below the ceiling. The lighting design shall avoid the placement of luminaires in difficult-to-access locations (at height), or above equipment and other dangerous or fragile items.	Ease of maintenance is vital to ensuring design integrity over time.

Table 3-2 Key Design Features

Design Feature	Rationale
7. Luminaires shall be clearly labeled when installed.	This helps to facilitate easy identification of the product specs and re-ordering of equipment as needed for replacement, enabling consistency and maintainability of luminaires over time.
8. Site-specific calculations required.	Site specific calculations required during design phase to confirm spacing and placement requirements. A photometric study that includes a lighting summary (including minimum, maximum, and average footcandles, uniformity ratio, etc.) shall be developed for Metro to review during the earliest feasible design phase.

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.

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METRO SYSTEMWIDE DESIGN

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