



**REGIONAL CONNECTOR TRANSIT
CORRIDOR PROJECT**
Contract No. E0119

Preliminary Fire/Life Safety Assessment

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Prepared for:



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1.0 PURPOSE AND SCOPE

The Regional Connector Transit Corridor Project (the Project) will connect the Metro Gold Line, Blue Line, and Expo Line of the Los Angeles County Metro Rail transit system. The Project includes three new underground transit stations:

- 2nd/ Hope Street Station
- 2nd/ Broadway Station
- 1st/ Central Avenue Station

This purpose of this report is to assess the compliance of the three underground stations of the Project with the fire/life safety provisions of the codes and standards listed in Section 2 of this report.

This report is based on the Preliminary Architectural Drawings for the Project dated December 20, 2011.

Accessible means of egress is addressed in the *Preliminary Accessibility Assessment* for the Project, dated December 20, 2011, and is therefore not addressed in this report. This report also does not address the fire/life safety of the tunnels and trainways of the Project, which will be addressed in a separate report.

2.0 APPLICABLE CODES & STANDARDS

The following are the principal codes and standards governing the fire/life safety requirements of the design of the stations of the Project.

2.1 California Codes

Title 24 of the California Code of Regulations (CCR) governs the design and construction of buildings, and associated facilities and equipment, and constitutes the *California Building Standards Code*, published by the California Building Standards Commission.

The codes of CCR Title 24, the *California Building Standards Code*, 2010 edition, that are relevant to the design of the stations of the Project include:

- Part 1 *California Building Standards Administrative Code*
- Part 2 *California Building Code (CBC)*, based on the 2009 *International Building Code*
- Part 3 *California Electrical Code*, based on the 2008 *National Electrical Code*
- Part 4 *California Mechanical Code*, based on the 2009 *Uniform Mechanical Code*
- Part 5 *California Plumbing Code*, based on the 2009 *Uniform Plumbing Code*
- Part 6 *California Energy Code*
- Part 9 *California Fire Code*, based on the 2009 *International Fire Code*
- Part 11 *California Green Building Standards Code (CALGreen Code)*
- Part 12 *California Reference Standards Code*

City of Los Angeles Building Code, 2011 edition, and related City of Los Angeles codes
County of Los Angeles Building Code, 2011 edition, and related County of Los Angeles codes

For the purposes of this report, the CBC and *not* the City and County codes are cited.

Additional design and construction requirements are provided by the *referenced standards* of the above-listed codes.

2.2 NFPA 130

NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, 2010 edition, is being used in conjunction with the *California Building Code (CBC)* and the other codes of CCR Title 24, the *California Building Standards Code*, for the design of the stations of the Project.

Therefore, the fire/life safety provisions of the *CBC* and the other codes of *CCR Title 24* are superseded in this report by the corresponding applicable provisions of *NFPA 130*. Those relevant fire/life safety provisions of the *CBC* and the other codes of *CCR Title 24*, and their referenced standards, which are not addressed by *NFPA 130*, are considered in this report as remaining in effect.

For the purposes of this report, references in *NFPA 130*, Chapter 5, Stations, to *NFPA 101, Life Safety Code*, are replaced by the corresponding provisions of the *CBC* in accordance with *NFPA 130*, A.5.5.1, which states that “where codes other than *NFPA 101* are in effect, references to *NFPA 101* can be replaced by reference to relevant requirements in the locally applicable building code.”

It should be noted that the fire/life safety elements addressed by *NFPA 101* are also addressed by the *CBC*. However, it should also be noted that unlike the *CBC*, *NFPA 101* is a life safety standard and not a building code, and therefore *NFPA 101* does not address the full scope of code provisions addressed by the *CBC*. The advantages of using the fire/life safety provisions of the *CBC* are: (1) the fire/life safety provisions of the *CBC* are coordinated with the other requirements of the *CBC* (such as structural & seismic design) not addressed by *NFPA 101*; and (2) the fire/life safety provisions of the *CBC* are coordinated with the requirements of the other codes of *CCR Title 24*, the *California Building Standards Code*, listed in 2.1 of this report.

2.3 CBC Section 433, Fixed Guideway Transit Systems

In *CBC*, Chapter 4, Special Detailed Requirements Based on Use and Occupancy, Section 433 incorporates provisions from *NFPA 130* for fixed guideway transit systems, although from earlier editions of *NFPA 130*.

However, for the purposes of this report, the applicable provisions of the 2010 edition of *NFPA 130* are used and referenced, consistent with 2.2 of this report on the use of *NFPA 130* in conjunction with the *CBC* as the underlying building code.

2.4 Metro Rail Design Criteria

Metro Rail Design Criteria, Fire/Life Safety (FLS) Design Criteria, dated October 29, 2010.

The *Metro Rail FLS Design Criteria* pertain to transit stations accommodating passengers and employees of the fixed guideway transit systems and to incidental occupancies in the stations. For the purposes of this report, the provisions of the *Metro Rail FLS Design Criteria* take precedence over the corresponding provisions of *NFPA 130* except when the *Metro Rail FLS Design Criteria* provisions are inconsistent with the performance-based egress and emergency ventilation provisions of *NFPA 130*.

For the purposes of this report, the more stringent of the prescriptive requirements between the *Metro Rail FLS Design Criteria* and the *CBC* are considered to take precedence.

3.0 STATION CONFIGURATIONS

The three underground stations of the Project are enclosed stations as defined in *NFPA 130*, 3.3.44. Described below is the general configuration of each of the three stations.

3.1 2nd/Hope Street Station

The 2nd/Hope Street Station is a five-level underground station consisting of a platform level with a center platform at 269 ft above datum, a concourse level at 285 ft above datum, an ancillary level at 309 ft above datum containing fan rooms and other equipment spaces, an upper ancillary level at 331 ft above datum containing a traction power substation and other equipment spaces, and a street entrance pavilion at 362 ft containing fare control and fare vending equipment.

3.2 2nd/Broadway Station

The 2nd/Broadway Station is a five-level underground station consisting of a platform level with a center platform at 204 ft above datum, a concourse level at 220 ft above datum, an ancillary level at 242 ft above datum containing a traction power substation, auxiliary power rooms, and other equipment spaces, an upper ancillary level at 256 ft above datum containing a mechanical room and ventilation plenums, and a street entrance pavilion at grade containing fare control and fare vending equipment.

3.3 1st/Central Station

The 1st/Central Station is a three-level underground station consisting of a platform/ ancillary level which includes a center platform and ancillary spaces at 225 ft above datum; a concourse/ ancillary level varying from 246 ft to 250 ft above datum; and an on-street entrance and elevators, and an entrance pavilion at 269 ft above datum. A portion of the street pavilion is open to the concourse below.

4.0 USE AND OCCUPANCY CLASSIFICATIONS

The three stations of the Project are classified as mixed-use occupancy buildings in accordance with *CBC* Section 508.1, with the primary use being rail transit stations. The “station” buildings are essentially the platforms, concourses and ancillary levels. Because the stations are more than 30 feet below grade, *CBC* Section 405.1 classifies the stations as underground buildings. *CBC* Section 401.1, Detailed Use and Occupancy Requirements, states that in addition to the occupancy and construction requirements in the other chapters of the *CBC*, the provisions of Chapter 4 apply to the special uses and occupancies described therein. However, *CBC* Section 405.1, Exception 3, exempts fixed guideway transit systems from compliance with the requirements for an underground building. The platform and concourse level of each station will comply with the enclosed station requirements of *NFPA 130*, and with the provisions of *CBC* 433 that are consistent with *NFPA 130*.

The occupancies within the three stations are classified by the *CBC* as follows:

Use Group	Areas/Spaces
A-3 Assembly	Passenger platforms and concourses
B – Business	Employee spaces
F-2 Factory Industrial Group	Electrical rooms/substations; Mechanical rooms & spaces
S-1 Moderate Hazard Storage	Storage Rooms

Fixed-guideway traction power equipment is housed in the traction power substations within the stations. The *CBC* does not specifically classify the occupancy use group for electrical power substations. F-2 factory industrial group classification was selected for the electrical equipment rooms since these spaces resemble the relative fire hazard and occupant loading defined by the *CBC* for this Use Group.

The importance of classifying the occupancy is to establish the number of occupants present, the relative fire hazard, and required fire separation between adjacent occupancies. However, the passenger occupancy loads for egress analyses from the *public areas* of each station will be based on the requirements of *NFPA 130* described in 8.1 of this report and not on the prescriptive requirements of the *CBC*.



5.0 CONSTRUCTION TYPE & FIRE-RESISTANCE RATINGS

Per *CBC* 433.1, the three stations of the Project are underground stations. *CBC* Section 433.2 requires an underground station to be of a minimum Type IB construction. Per *NFPA 130*, Section 5.2.2, building construction type shall be either Type I – or Type II – or combinations thereof as defined by *NFPA 220, Standard on Types of Building Construction*, as determined by an engineering analysis of potential fire exposure hazards to the structure. The fire resistance-rating classification system of *NFPA 220* and the *CBC* are similar. The *Metro Rail Design Criteria, Fire/Life Safety (FLS) Design Criteria* require Type 1 construction as defined in the *CBC* for underground stations. Accordingly, the three stations of the Project will be a minimum of Type IB construction. The fire-resistance ratings of the station building structural elements per *CBC* Table 601, and of the shaft enclosures per *CBC* 708.4, are as follows:

<u>Building Element</u>	<u>Type IB Construction</u>
Structural frame ^a	2 hours
Bearing walls Exterior Interior	2 hours 2 hours
Nonbearing walls and partitions Exterior Interior	See Fire Separations Below
Floor construction	2 hours
Roof Construction (< 20 ft above floor below)	1 hour
Shaft enclosures	2 hours

Notes:

a. The structural frame shall be considered to be the columns and the girders, beams, trusses, and spandrels having direct connections to the columns and bracing members designed to carry gravity loads. The members of floor or roof panels that have no connection to the columns shall be considered secondary members and not part of the structural frame.

6.0 FIRE SEPARATIONS

As noted in Section 4 of this report, per the *CBC* the stations of the Project are mixed-use occupancy buildings consisting of: A-3 Assembly; B – Business; F-2 Factory Industrial, Low Hazard; and S-1 Moderate Hazard Storage.

CBC Table 508.2.5 addresses specific incidental accessory occupancies within a building requiring a fire separation assembly and/or automatic sprinkler protection. *NFPA 130*, *CBC* 433.2.2, and *Metro Rail FLS Design Criteria* 2.2.6 and 2.2.7 require fire separations of traction power substations, electrical control rooms, auxiliary electrical rooms, and associated battery rooms that are unique to transit operations, which are summarized in the following table. The *Metro Rail FLS Design Criteria* fire separations are the most stringent, and will therefore be applied to each station.

***CBC* Table 508.2.5 Incidental Accessory Occupancies & Section 433
NFPA 130 5.2.3.2 ^a Ancillary Spaces
Metro Rail FLS Design Criteria 2.2.6 & 2.2.7**

Room or Area	Separation		
	<i>CBC</i>	<i>NFPA 130</i> ^a	<i>Metro FLS Design Criteria</i>
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons, or a lithium-ion capacity of 1,000 pounds, used for facility standby power, emergency power, or uninterrupted power supplies	2 hours	2 hours	3 hours
Traction power substations	3 hours	3 hours	3 hours
Electrical control rooms, auxiliary electrical rooms, and associated battery rooms	2 hours	2 hours	2 hours
Trash rooms > 100 square feet	1 hour	1 hour	2 hours
Train control rooms and associated battery rooms	2 hours	2 hours	2 hours
Public areas from nonpublic areas	2 hours	2 hours	2 hours



Notes:

a. Based on the 2007 edition of NFPA 130. The 2010 edition does not provide specific fire-resistance ratings for the fire separation of these spaces, but references NFPA 101.

Fire separation assemblies will comply with *CBC* Section 707, fire barriers. Openings in fire barriers will comply with *CBC* Section 715. 1-1/2-hour fire-resistance rated (B-label) door assemblies will be provided in 2-hour rated fire barriers, and 3-hour fire-resistance rated (A-label) door assemblies will be provided in 3-hour rated fire barriers, per *CBC* Table 715.4.



7.0 INTERIOR FINISHES

All surfaces exposed to the interior of the station, including fixed or movable walls and partitions, columns and ceilings will meet *CBC* requirements for interior finish.

Chapter 8 of the *CBC* contains the performance requirements for controlling fire growth within buildings by restricting interior finish materials. The provisions of Chapter 8 require materials used as interior finishes and comply with flame spread index criteria or to be flame resistant, based on the relative fire hazard associated with the occupancy. The tables below prescribe the minimum requirements for interior finishes applied to walls and ceilings that will be applied to the three Project stations.

**Interior Wall and Ceiling Finishes: Minimum Classes by Sprinklered^a Occupancy
(Ref: *CBC* Table 803.9)**

Use Group	Exit Stairways & Exit Passageways	Exit Access Corridors	Rooms and Enclosed Spaces
A-3	B	B	C
B	B	C	C
F	C	C	C
S	C	C	C

Notes:

a. Applies when the vertical exits, exit passageways, exit access corridors or exit ways, or rooms and spaces are protected by a sprinkler system installed in accordance with Section 903.3.1.1.

**Interior Wall and Ceiling Finish Material Classes
(Ref: *CBC* 803.1.1)**

	Flame Spread Index	Smoke Developed Index
Class A	0-25	0-450
Class B	26-75	0-450
Class C	76-200	0-450

The purpose of regulating the flame spread of finish materials is to control potential fire growth and spread, as well as smoke development within the means of egress.

8.0 MEANS OF EGRESS

The concourses, and the enclosed exit stairways and passageways leading up from the ends of the station platforms to the street, are established as points of safety at all three of the Project stations. Emergency egress from each station platform is provided by two open escalator/stair pairs leading to the concourse point of safety, and by the enclosed exit stairways at the ends of the platforms, together providing four egress paths from the platform of each station.

The egress capacity calculations in Appendix A of this report demonstrate that: (1) the egress capacity of the platform at each station is sufficient to evacuate the platform occupant load in 4-minutes or less; and (2) that the number and capacity of the egress elements permit evacuation from the most remote point on each station platform to the points of safety in 6-minutes or less.

8.1 Occupant Loads

Occupant loads required by *NFPA 130* for egress analyses from the *public areas* of the station are based on the peak period passenger load of trains simultaneously entering the station on all tracks in normal traffic directions plus the simultaneous entraining load awaiting trains as determined by patronage demand volumes. The train loads for each track are based on the train load per train headway factored to account for service disruptions and system reaction time. The entraining loads for each track are based on the entraining load per train headway factored to account for service disruptions and system reaction time. (Ref: *NFPA 130*, 5.5.5)

See Appendix A of this report for the calculation of the occupant loads for the public areas of each of the stations of the Project, based on the Travel Demand Model of L.A. Metro.

The occupant loads for means of egress from the *non-public service areas* of the stations are based on the occupant loads prescribed by the *CBC* Table 1004.1.1.

**Maximum Floor Area Allowances per Occupant
For Non-Public Service Areas of the Stations
(Ref: *CBC* Table 1004.1.1)**

Function of Space	Floor Area in Square Feet per Occupant
Accessory storage areas	300 gross
Mechanical equipment rooms	300 gross
Electrical equipment rooms	300 gross
Business (operations) areas	100 gross

8.2 Open Stairs & Escalators as Egress Components

In addition to enclosed exit stairways, open stairs and escalators are permitted by *NFPA 130* as egress components for an emergency evacuation of a station. (Ref: *NFPA 130*, 5.2.3.1.1 & 5.5.1.2). Escalators will be constructed of non-combustible materials; escalators used for emergency egress and running in the direction of egress will remain operating, escalators running reverse to the direction of egress will be capable of being stopped locally and remotely (see Section 9 of this report). (Ref: *NFPA 130*, 5.5.2)

In calculating the egress capacity of escalators, the escalator at each level having the most adverse effect upon egress capacity is considered as being out of service. (Ref: *NFPA 130*, 5.5.6)

8.3 Points of Safety

NFPA 130, 3.3.35, defines a point of safety as: (1) an enclosed fire exit that leads to a public way or safe location outside the station, trainway, or vehicle; (2) an at-grade point beyond the vehicle, enclosing station, or trainway; or (3) any other approved location.

8.3.1 Concourses as Points of Safety

In accordance with *NFPA 130*, 5.5.6.2.2, a concourse of an enclosed station can also be defined as a point of safety if the station is equipped with an emergency ventilation system which provides protection for the concourse from the effects of a train fire at the platform, as confirmed by engineering analysis. An emergency ventilation system will be provided at each of the three stations of the Project to establish the concourse of each station as a point of safety.

The engineering analysis for the evaluation of the ventilation system includes a validated subway analytical simulation program applying validated computational fluid dynamics (CFD) techniques. The engineering analyses for the evaluation of the ventilation systems are described in a separate report.

8.3.2 Enclosed Exit Stairways & Exit Passageways

The enclosed exit stairways at the ends of each station leading up to sidewalk exit hatchways, are also points of safety as defined by *NFPA 130*. The enclosed exit stairways at the ends of the platform at each station offset or shift over at one or two levels of each station as they ascend to street level. At some locations the offset or shift is sufficient to require a passageway to connect the enclosed exit stairway from below to the enclosed exit stairway leading up to the street.

To maintain the level of exit protection per *CBC 1020.1*, the connecting passageways will be constructed as exit passageways per *CBC 1023.1*, and would normally be separated from the exit stairways by rated fire barriers and fire doors in accordance with *CBC 1022.2.1*. However, since any smoke that might enter the exit enclosures would rise in the direction of egress and thereby would be dispersed through the exit hatchways to the atmosphere, it is recommended that there be no fire barriers/doors separating the exit stairways from the connecting exit passageways.

The current practice of L.A. Metro does not require the fire separation of exit stairways from exit passageways in offset enclosed exits. The current practice of L.A. Metro also does not require the pressurization of the offset enclosed exits. The design builder(s) should be required in final design to

evaluate the tenability of the enclosed exits as part of the final design CFD simulations for each station.

This approach to the enclosed exits will require the concurrence of the authority having jurisdiction (AHJ) for code compliance.

As required by *CBC 1023.3*, exit passageways will have the same fire-rated construction as any exit enclosure to which they connect. As required by *CBC 1023.3*, openings in exit passageways other than exterior openings will be limited to those necessary for exit access to the exit passageway from *normally occupied spaces* and for egress from the exit passageway. This usually requires the introduction of an exit access vestibule or corridor between an equipment room and an exit passageway.

8.4 Number & Capacity of Egress Elements: Public Areas of Stations

8.4.1 NFPA 130 Prescriptive Platform Egress Requirements

Although *NFPA 130* requires performance-based egress analyses, it also contains several important prescriptive platform egress requirements that are incorporated into the design of each of the three stations of the Project.

- At least two remote means of egress are provided from each station platform. (Ref: *NFPA 130*, 5.5.1.3)
- The travel distances on the platforms are well within the *NFPA 130* maximum distance of 325-feet to the vertical circulation elements (and the *CBC* maximum distance of 300-feet to a point of safety). (Ref: *NFPA 130*, 5.5.6.1.1 and *CBC*, 433.3.5)
- Since the enclosed exit stairways are at the ends of each platform, there are no common paths of travel at ends of the platforms, and therefore the platforms meet the *NFPA 130* limitation of 82-feet for common paths of travel at ends of platforms. (Ref: *NFPA 130*, 5.5.1.4)

8.4.2 Other Prescriptive Egress Requirements

Other prescriptive egress requirements are incorporated into the design of each of the three stations of the Project.

- At least two means of egress, a minimum of 40-feet apart, are provided at each station concourse. (Ref: *Metro Rail FLS Design Criteria 2.5.3.9*)
- Exits other than fare collection gates provide for at least 50 percent of the exit capacity in any fare barrier. (Ref: *Metro Rail FLS Design Criteria 2.5.3.12*)

8.4.3 Timed-Egress Analyses

NFPA 130 requires timed-egress analyses to demonstrate that the number and capacity of the egress components meet the criteria for platform evacuation and evacuation to a point of safety:

- Dynamic capacities (people per inch per minute) and travel speeds (feet per minute) are given for each component of an egress path. (Ref: *NFPA 130*, 5.5.6.3)

- Platform Evacuation Time: Egress capacity is to be sufficient to evacuate the platform occupant load from a station platform in 4-minutes or less (*the 4-minute test*). (Ref: *NFPA 130*, 5.5.6.1)
- Evacuation Time to a Point of Safety: The station is to be designed to permit evacuation from the most remote point on a platform to a point of safety in 6-minutes or less (*the 6-minute test*). (Ref: *NFPA 130*, 5.5.6.2)

See Appendix A to this report for the egress capacity calculations for the public areas of each of the stations of the Project. For the purpose of the egress capacity calculations, the points of safety within the exit enclosures at the ends of the platform of each station were designated as a location at the concourse level within each exit enclosure. The calculations demonstrate the compliance of each of the stations to the above NFPA-130 timed-egress criteria, as summarized in the following table.

Summary of Timed-Egress Analyses

Station	Platform Evacuation		Longest Time to a Point of Safety		Longest Time To Street
	Time (minutes)	4-Minute Criterion	Time (minutes)	6-Minute Criterion	Time (minutes)
2nd/Hope Street	2.36	Pass	3.37	Pass	8.39
2nd/Broadway	2.37	Pass	3.42	Pass	8.77
1st/Central Avenue	2.44	Pass	3.25	Pass	5.91

In addition to the determining conformance to the timed-egress criteria of Chapter 5 of *NFPA 130*, the calculated egress times are used as a basis for determining the time-of-tenability criteria, and as a factor is evaluating the time that the required airflow rates of the emergency ventilation system are to be maintained, in accordance with Chapter 7 of *NFPA 130* (see 10.1 of this report).

8.5 Means of Egress: Non-Public Service Areas of Stations

Exits from the service areas of each station of the Project are provided by exit stairways and, for those service areas on the concourse levels, by exits to the concourse point of safety.

NFPA 130 states that the means of egress requirements for a station shall comply with *NFPA 101* except where modified by the provisions of *NFPA 130*. (Ref: *NFPA 130*, 5.5.1) Since egress from the non-public service areas are not specifically addressed by *NFPA 130*, the guidance of *NFPA 130* is to use the egress provisions of *NFPA 101*. However, as noted, in Section 2.2 of this report, *NFPA 101, Life Safety Code* does not address the full scope of code provisions addressed by the CBC, therefore references to *NFPA 101* are replaced in this report by the corresponding provisions of the CBC, in accordance with *NFPA 130A.5.5.1*.



8.5.1 Common Paths of Egress Travel

According to the *CBC* 1014.3, the common paths of egress travel shall not exceed 75 feet; however, the common path of egress travel for Group B, F, and S occupancies is allowed to be not more than 100 feet provided that the building is equipped throughout with an automatic sprinkler system installed in accordance with *CBC* Section 903.3.1.1. The common paths of egress travel in the non-public service areas of the stations do not exceed the 100-foot maximum of the *CBC*.

8.5.2 Exit Access Travel Distances

The exit access travel distances for non-public service areas of station are within the maximum exit access travel distances prescribed by *CBC* Table 1016.1.

CBC Table 1016.1
Maximum Exit Access Travel Distances with Sprinkler System

Occupancy	Exit Access Travel Distance (Feet)
A-3	250 ^a
B	300 ^a
F-2	400 ^a
S-1	250 ^a

Note:

a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1

8.5.3 Dead End Corridors

Per *CBC* 1018.4, where more than one exit or exit access doorway is required, the exit access shall be arranged such that dead end corridors shall not exceed 20 feet. However, in occupancy group B, F, and S, where the building is equipped throughout with an automatic sprinkler system, the length of the dead-end corridors can be increased to a maximum of 50 feet. The corridors in the service areas of the stations do not exceed the dead-end requirements.

8.6 Maintenance of the Level of Exit Protection

Per *CBC*, 1020.1, once a given level of exit protection is achieved (such as the level of protection of an exit enclosure), such level of protection shall not be reduced until arrival at the exit discharge. Therefore an egress path cannot lead from an exit stairway or exit passageway to an exit access corridor, which has a lesser level of protection. The level of exit protection of the egress paths through the concourses will be maintained by the station emergency ventilation systems to the exit discharges to the public ways. The level of exit protection of the exit stairway enclosures will be maintained from the platform level to the exit discharge hatches at street level.

9.0 ELEVATOR & ESCALATOR REQUIREMENTS

The elevators and escalators of the three stations of the Project will comply with the requirements of NFPA 130 and Chapter 30 of the *CBC* which references *ASME A.17.1/CSA B44, Safety Code for Elevators and Escalators*. Per *Metro Rail FLS Design Criteria* 2.2.10.3, elevators and escalators will conform to CCR Title 24 and Title 8 Elevator Safety Orders.

As noted in Section 8.2 of this report, escalators will be constructed of non-combustible materials. During an emergency evacuation of a station, escalators used for emergency egress and running in the direction of egress will remain operating; escalators used for emergency egress running reverse to the direction of egress will be capable of being stopped locally and remotely. (Ref: *NFPA 130*, 5.5.2) Escalators will comply with APTA specifications for transportation-grade escalators to the extent consistent with the *Metro Rail Design Criteria*.

NFPA 130, 5.5.6.3.3, permits the use of elevators to account for part of the means of egress capacity in stations; *however* the elevators in the three stations of the Project are not designed as occupant evacuation elevators and are not counted in the timed-egress analyses for the evacuation of the stations.

CBC, 3002.4, requires at least one elevator in buildings four or more stories below grade to provide fire department emergency access to all floors and to be sized to accommodate an ambulance stretcher. This requirement is separate and distinct from the minimum elevator sizes stipulated in *ADAAG* and the *CBC* to provide accessibility for people using wheelchairs. At each station, the elevators connecting the street level to the concourse, and the elevators connecting the concourse to the platforms, will comply with these requirements.

10.0 EMERGENCY VENTILATION/SMOKE CONTROL

10.1 Station Emergency Ventilation System

Emergency ventilation will be provided at each of the three stations of the Project as required for enclosed stations by *NFPA 130*, Section 5.3. The emergency ventilation system will be designed to provide a tenable environment along the paths of egress from a fire incident as required for enclosed stations by *NFPA 130*, 7.2.1. At two of the three stations of the Project the concourse is open to the platform levels below. At each of the three stations the platform and concourse is connected by open stairs and escalators.

NFPA 130, 7.3.2, requires that the emergency ventilation system be capable of operating for a minimum of one hour but not less than the required time of tenability, based on the egress time. The emergency ventilation system serving the platforms and concourse levels, and the VCEs, will be designed to operate for a minimum of one hour based upon the calculated evacuation times (see 8.4.3 of this report) and the performance criteria identified in Chapter 7 of *NFPA 130*.

As required by *NFPA 130*, the ventilation system design methodology will encompass:

- The heat release rate produced by the combustible load of a vehicle and any combustible materials that could contribute to the fire load within the station
- The anticipated fire growth rate and soot release rates
- Non-fire (or cold) air velocities that can be measured during system commissioning to confirm that the smoke control system as built meets the requirements of the quantitative analysis

The smoke control system within the passenger platform and concourse will be activated using heat detectors located throughout the platform area with central supervising and local controls available for monitoring any further actions that may be necessary. The engineering analysis will include realistic delay times in system activation, representative of those anticipated due to the remote manual operation of the system. All emergency ventilation fans will be designed to achieve their full operating speed within 30 seconds from a stopped position when started across the line, as required by *NFPA 130*, 7.3.1.1.

The emergency ventilation/smoke control system equipment will be fire hardened for continued operation in a fire condition. Per *NFPA 130*, Section 7.3.2, emergency ventilation fans, their motors, and all related components exposed to the exhaust airflow will be designed to operate in an atmosphere of 482°F (250°C) for a minimum of 1 hour. A design analysis maybe used to reduce this temperature; however, it will not be reduced to less than 302°F (150°C).

NFPA 130 does not specify the design method required for smoke control system design. A quantitative analysis of airflow dynamics produced in a fire scenario have been undertaken for each station of the Project, using a computational fluid dynamics (CFD) simulation technique, to demonstrate that the ventilation system achieves and maintains tenable conditions in the means of egress. These analyses have confirmed that in each station the concourse qualifies as a point of safety.

10.2 Enclosed Exit Stairways

As noted above in 8.3.2 of this report, the enclosed exit stairways and passageways leading up from the ends of the station platforms to the street are established as points of safety at all three of the Project stations. Also as noted above in 8.3.2, the enclosed exit stairways at the ends of the platform offset or shift over at one or two levels of each station as they ascend to street level. It is assumed that should any smoke enter the exit enclosures, the smoke would rise in the direction of egress and be dispersed to the atmosphere through the exit hatchways, thereby maintaining the tenability of the egress path in the exit enclosures. We therefore recommend that there be no fire barriers/doors separating the vertical and horizontal components of the exit enclosures, which is in accord with the current practice of L.A. Metro, and will require the concurrence of the AHJ for code compliance.

As noted in 8.3.2 of this report, the design builder(s) should be required in final design to evaluate the tenability of the enclosed exits as part of the final design CFD simulations for each station.

11.0 FIRE ALARM & COMMUNICATIONS SYSTEMS

As required by *CBC*, 907.2.26, each station of the Project will be provided with an approved emergency voice/communication system in accordance with *NFPA 72*.

11.1 Fire Detection & Alarm System

As required by *CBC*, 907.2.26.2, each station of the Project will be provided with a fire detection and alarm system consisting of:

- Fire alarm control unit at a location permitted by the enforcing agency.
- Alarm annunciator(s), indicating the type of device and general location of the alarm.
- Emergency telephones (ETELs) throughout passenger areas.
- Automatic smoke detectors in ancillary spaces.

11.2 Emergency Voice/Alarm Communication & Public Address System

As required by *CBC*, 907.2.26.3, each station of the Project will be provided with an emergency voice/alarm communication system capable of transmitting voice and recorded or electronically generated textural messages to all areas of each station. Electronically generated textural messages at each station will be displayed on the variable message signs (VMSs) installed on both sides of the platform, at the fare collection area, and at the station entrance.

It is common practice in passenger stations to utilize the public address system to broadcast emergency instructions to the building occupants in lieu of a dedicated fire alarm voice evacuation and communication system. Public address systems typically afford better audibility characteristics versus conventional fire alarm systems.

In accordance with *Metro FLS Design Criteria*, 2.6.1, the public address system will be utilized for sounding required building-audible fire alarm signals (temporal pattern) from the fire alarm control panel by means of a tone generator preceding verbal announcements to direct patron evacuation. Audibility level shall be a minimum of 10db over any background noise. (Also in accordance with *Metro FLS Design Criteria*, 2.6.1, an alternative option would be to use a horn-strobe or strobe/voice evacuation system in lieu of the public address system to sound the building-audible fire alarm signal, with the approval of the AHJ.)

NOTE: Per the Federal ADA/ABA Accessibility Guidelines, 2004 edition, 702.1, fire alarm systems shall have permanently installed audible and visible alarms complying with *NFPA 72* (1999 or 2002 edition), except that the maximum allowable sound level of audible notification appliances complying with Section 4-3.2.1 of *NFPA 72* (1999 edition) shall have a sound level no more than 110 dB at the minimum hearing distance from the audible appliance. See the separate Project report titled *Preliminary Accessibility Assessment*.



11.3 Blue Light Stations

As defined by *NFPA 130*, 3.3.4, blue light stations are locations where emergency services or authorized personnel can communicate with the operations control center and disconnect traction power. Blue light stations will be provided at the ends of the platform of each station as required by *NFPA 130*, 6.2.71.

12.0 FIRE SUPPRESSION SYSTEMS

12.1 Automatic Sprinkler System

NFPA 130, 5.7.3, requires automatic sprinkler protection be provided in all areas used for concessions, storage, trash rooms; in the steel truss area of all escalators; and other similar areas with combustible loads, except trainways. The installation of the automatic sprinkler system will comply with *NFPA 13*, and will be tested and maintained in accordance with *NFPA 25*.

CBC, 903.2.17, requires the installation of an automatic sprinkler system in all stations of fixed guideway transit systems, except at machinery rooms, electrical rooms and train control rooms protected by an approved automatic fixed fire-extinguishing system; and requires a manually activated station guideway deluge sprinkler system in underground stations with raised platforms.

All areas of each station of the Project will be provided with an automatic sprinkler protection system, including the platform, concourse, and service areas of the station. Those equipment rooms which are not considered appropriate for the use of an automatic sprinkler system will be exempt or provided with an alternative automatic fire suppression system.

Heat detectors mounted as part of the over-platform lighting strip will initiate sprinkler operation within 90-seconds of a train fire breaking through open windows and doors.

12.2 Standpipe System

NFPA 130, 5.7.4, requires the installation of Class I or Class III standpipes in enclosed stations in accordance with *NFPA 14*. The standpipe system is not required to be enclosed in fire-resistance rated construction provided the system is cross-connected or fed from two locations, and provided isolation valves are installed not more than 800-feet apart. In addition to the usual identification required on fire department connections for standpipes, there shall also be wording to identify the fire department connection as part of the station system.

CBC, 905.3.10, requires a Class III standpipe system for underground stations of a fixed guideway transit system.

Therefore, a Class I or Class III standpipe system will be installed in accordance with the requirements of *NFPA 130*, 5.7.4, and *CBC*, 905.3.10.

13.0 EMERGENCY POWER & LIGHTING

Emergency power will be provided at each station of the Project as required by *NFPA 130*, 5.4.11, for:

- Emergency lighting
- Protective signal systems
- Emergency communication systems
- Fire command center

Standby power will be provided for accessible means of egress elevators per *CBC 2702.2.5* and fire service access elevators per *CBC 3007.7*.

The design of the emergency power system will comply with the requirements of Article 700 of *NFPA 70*, Emergency Systems, and Chapter 4 of *NFPA 110*.

The concourse and platform of each station are to be equipped with an emergency lighting system in accordance with the *CBC* and *NFPA 130*. *CBC 1006.2* requires a minimum illumination level of 1-foot candle (11 lux) at the floor level.

Exits will be marked with readily visible illuminated exit signs. Illuminated exit signs will be included in the emergency lighting system and are to be powered by the standby source. Emergency lighting fixtures and exit signs are to be wired on separate circuits from the emergency distribution panels.

Emergency lighting for stairs and escalators will be designed to emphasize illumination on the top and bottom steps and landings. All newel- and comb-lighting on escalator steps will be on emergency power circuits in accordance with *NFPA 130*, 5.6.2.1. Luminous egress path markings will be provided within exit stairways in accordance with *CBC* Section 1024. However, the locations of egress path markings within exit stairways will take into account that the direction of egress from the underground stations of the Project is up (not down) to the street level.



14.0 FIRE COMMAND CENTER / EMERGENCY MANAGEMENT PANEL

NFPA 130 Section 5.7.6 requires a fire command center in underground stations in accordance with *NFPA 72, National Fire Alarm and Signaling Code*, for use by emergency responders for management of fire emergencies. The fire command center at each station will consist of an emergency management panel (EMP). Remote access to the EMP will be provided at each station entrance via a computer connection jack.

The EMP at each station of the Project will provide the following:

- Fire fighter access to visual mapping of the various areas being monitored by the fire alarm and detection system
- Access to the public address system, with the ability to override all other public address system input
- Access to pre-programmed emergency messages for display on the visual display units in the station (in compliance with ADAAG).
- Access to status and controls of emergency ventilation fans, dampers, and other equipment used in the emergency ventilation of the station
- Fire alarm control panel
- Access to the status and controls of escalators and elevators
- Access to the status of emergency exit stair doors
- Access to digitized floor plans of the station showing fire suppression systems, means of egress, and emergency equipment closets

15.0 WIRING REQUIREMENTS

Wiring at each station of the Project will comply with the wiring requirements of *NFPA 70, National Electrical Code*, and to the additional requirements of *NFPA 130, Section 5.4*, including:

- All conduits, raceways, ducts, boxes, cabinets, and equipment enclosures to be constructed of noncombustible materials in accordance with *ASTM E 136*.
- All conductors to be insulated
- All insulations to be moisture- and heat-resistant type
- All wires and cables to be listed as being resistant to the spread of fire and to have reduced smoke emissions
- All conductors, except radio antennas, to be enclosed in their entirety in public areas in armor sheaths, conduits, or enclosed raceways, boxes, and cabinets

16.0 CONCLUSION & RECOMMENDATIONS

It is the conclusion of this Preliminary Fire/Life Safety Assessment that the Preliminary Designs of the three stations of the Regional Connector Transit Corridor Project comply with the applicable requirements of the codes and standards listed in Section 2 of this report. This conclusion is based on the following:

- The Preliminary Architectural Drawings dated December 20, 2011.
- The review of the requirements of the codes and standards described in this assessment by the architectural and engineering design leads for each of the three stations of the Project.
- The Platform Occupant Loads and the Egress Calculations attached as Appendix A to this report.
- The Emergency Ventilation Analyses that have been undertaken for each station of the Project, using a computational fluid dynamics (CFD) simulation technique, to demonstrate that the ventilation system achieves and maintains tenable conditions in the means of egress. These analyses have confirmed that in each station the concourse qualifies as the point of safety.

It is the recommendation of this assessment that separate Final Fire/Life Safety Assessment Reports, based on the Travel Demand Model of L.A. Metro and the Final Design of each of the three stations of the Project, be undertaken by the Design/Builder for each station. The Final Fire/Life Safety Assessment Report for each station of the Project should:

- Address all the fire/life safety requirements for each station addressed by this Preliminary Fire/Life Safety Assessment.
- Include Platform Occupant Loads and the Egress Calculations for each station, based on the Final Design of each station, in accordance with the requirements of *NFPA 130*.
- Include Ventilation Analyses for each station, based on the Final Design of each station, using CFD simulations to demonstrate the tenability of all egress paths from the platforms of each station to the points of safety and from the points of safety to the public ways, and to demonstrate that the concourse of each station will qualify as a point of safety in the emergency evacuation of the station, in accordance with the requirements of *NFPA 130*.

It is also the recommendation of this assessment that the concurrence of the AHJ for code compliance be obtained for:

- The deletion of the fire barriers and fire doors normally required between the stairways and the exit passageways in the offset enclosed exits leading from the platforms up to the exit hatchways at street level, and for not providing pressurization for the enclosed exits, both of which are in accordance with the current practice of L.A. Metro (see 8.3.2 and 10.2 of this report). The design builder(s) should be required in final design to evaluate the tenability of the enclosed exits as part of the final design CFD simulations for each station.
- The replacement of references in *NFPA 130*, Chapter 5, Stations, to *NFPA 101, Life Safety Code*, by the corresponding provisions of the *CBC* in accordance with *NFPA 130*, A.5.5.1 (see 2.2 of this report).



APPENDIX A
Platform Occupant Loads & Egress
Calculations

**2nd and Hope Station:
Egress Capacity Calculations**

Assumptions:

1. Platform occupant load was calculated based on NFPA 130 Standard (2010 edition).
2. One escalator at each level was assumed to be out of service.
3. The Concourse area would be ventilated as per NFPA 130 criteria and is considered as a point of safety.
4. The time to open the Exit Hatch is not included.

Summary

1. The platform clearance time complies with the 4-minute criteria required by NFPA 130.
2. The evacuation time from the platform to the platform emergency stairs complies with the 6-minute NFPA 130 criteria.
3. The longest time for the last occupant to reach a point of safety is 3.37 minutes. The longest time for the last occupant to reach street level is 8.39 minutes.

Route	Egress Paths	Clearing Platform		To a Point of Safety			To Street
		Time (min)	4-minute criteria?	Point of safety at:	Time (min)	6-minute criteria?	Time (min)
1	Platform to Concourse through West Emergency stairway (No. 8), and then to plaza/street level through corresponding Exit Hatch.	2.36	Pass	Concourse	2.88	Pass	4.73
2	Starting 30 ft west on Platform to Concourse through Escalator (No. 4) , Escalator 2a & 1a and then to street level through Hope street Exit.	2.36	Pass	Concourse	3.36	Pass	8.38
3	Starting 90 ft East on Platform to Concourse through Escalator (No. 4), Escalator 2a & 1a and then to street level through Hope street Exit.	2.36	Pass	Concourse	3.36	Pass	8.38
4	Starting 90 ft West on Platform to Concourse through Stair (No. 3), Escalator 2a & 1a and then to street level through Hope street Exit.	2.36	Pass	Concourse	3.20	Pass	8.22
5	Starting 30 ft east on Platform to Concourse through Stair (No. 3), Escalator 2a & 1a and then to street level through Hope street Exit.	2.36	Pass	Concourse	3.20	Pass	8.22
6	Platform to Concourse through East Emergency stairway (No. 5) , and then to plaza/street level through corresponding Exit Hatch.	2.36	Pass	Concourse	3.20	Pass	7.91

Element	Persons per inch per minute	Person per minute per unit	Travel Speed (fpm)	
Platforms, Corridors, and Ramps.	2.08	---	124	
Stairs and Escalators (see note 1):				
(i) Up direction:	1.31	---	40	
(ii) Down direction:	1.41	---	48	
Doors and Gates (single leaf)	---	60	---	Section 5.5.6.3.4.2
Doors and Gates (multi-leaf)	2.08	---	---	Section 5.5.6.3.4.3
Turnstiles	---	25	---	
Exit Hatch	2.08			Assume

Notes:

1. NFPA 130 Standard, Section 5.5.6.3.2.3 specifies the capacity and travel speed for stairs/escalators but does not indicate whether the values are dependent on the travel direction. However, the examples in Annex C indicate that the capacity and travel speed for the up direction are 1.31 pim and 40 fpm, respectively, and the capacity and speed for the down direction are 1.41 pim and 48 fpm, respectively.

2. NFPA 130 Standard, Section 5.5.6.3.5.2 specifies that turnstile-type fare collection gates shall have a capacity of 25 people per minute for egress calculations. Therefore assume a capacity of 25 people per minute for all turnstiles.

Egress Capacity

One escalator at each level is assumed to be out of service (per NFPA 130 2010 edition, Section 5.5.6.3.2.6).

Egress Elements:

Route	Direction	No. of Units	Width (In)	Persons per inch per minute	Person per minute per unit	Total people per minute	
Platform to Lower Concourse:							
Emergency Stair No. 7 Door	Up	1	36		60	60	
Stair No 4	Up	1	72	1.31	94	94	
Stair No.3	Up	1	72	1.31	94	94	
Escalator No. 4	Up	1	48	1.31	63	63	(Standard Escalator Dimension)
Escalator No. 3	Up	0	48	1.31	63	0	Out of Service
-	Up	0	46	1.31	60	0	
-	Up	0	46	1.31	60	0	
Emergency Stair No. 5 Door	Up	1	36		60	60	
Total:						372	
Total stairs:						252	(Excl. Emerg. Stairway Doors at Station Ends)

Platform to Concourse through Emergency Stairway:							
Emergency Stair No. 7	Up	1	54	1.31	71	71	(Stairway Dimension of 4.5 ft)
Emergency Stair No. 5	Up	1	54	1.31	71	71	(Stairway Dimension of 4.5 ft)
Total:						141	
Total stairs:						71	(Excluding East Emergency Stairway)

Concourse Center :							
Councourse Corridor	Up	1	528	2.08	1098	1098	(Subtract 12" for each sidewall, 552-2*12)
Escalator No. 2b	Up	1	40	1.31	52	52	(Standard Escalator Dimension)
Stair No. 2	Up	1	66	1.31	86	86	
Stair No. 2	Up	1	66	1.31	86	86	
Escalator No.2a	Up	0	40	1.31	52	0	(1 Escalator out of service)
Total stairs:						225	(Excluding Corridor)

Concourse: West Emergency Stairway Level							
Corridor		1	30	2.08	62	62	(Subtract 12" for each sidewall,54-2*12)
Emergency Stairway No. 10(West)	Up	1	54	1.31	71	71	

Concourse: East Emergency Stairway Level							
Corridor		1	30	2.08	62	62	(Subtract 12" for each sidewall,54-2*12)
Emergency Stairway No. 9 (East)	Up	1	54	1.31	71	71	

Plenum /Ancillary Level:							
Corridor		1	372	2.08	774	774	(Subtract 12" for each sidewall, 384-1*12)
Escalator No. 1a	Up	1	40	1.31	52	52	(Standard Escalator Dimension)
Stair No. 1	Up	1	66	1.31	86	86	
Stair No. 1	Up	1	66	1.31	86	86	
Escalator No. 1b	Up	0	40	1.31	52	0	(1 Escalator out of service)
Total Stairway & Escalator:						225	

Roof Level (South East):							
East Corridor		1	36	2.08	75	75	(Subtract 12" for each sidewall, 60-2*12)
Sth East side Exit Stairway No. 12	Up	1	54	1.31	71	71	
Sth East satirway No. 12 Exit Hatch		1	48	2.08	100	100	

Plaza Level Plan:							
Entrance Passageway							
Turnstile		5			25	125	
Gate		2			60	120	
Hope St. Exit Door		1	156	2.08	324	324	
Sub Total						245	(Excluding Hope Street Exit)

Passenger Load

Platform

Platform Occupant Load	878	[Based on NFPA 130 Standards (2010 edition).]
Occupant load from ancillary rooms in passenger area	0	
Total Platform Occupant Load	878	

	Egress capacity (ppm)	Percent	Number of passengers
Stairs & Escalators	252	67.7%	594
West Emergency Stairway Door	60	16.1%	142
East Emergency Stairway Door	60	16.1%	142
Total:	100%	878	

Concourse

Concourse West Area Occupant Load- 142 (from platform)

Concourse East Area Occupant Load- 142 (from platform)

Concourse Center Area Occupant Load-	594
Occupant load from ancillary rooms in passenger area	8
Total Concourse Center Area Occupant Load	602
Total Concourse Level Occupant Load	886 (from platform)

	Egress capacity (ppm)	Percent	Number of passengers
Concourse Stairway (No. 2)	173	76.7%	462
Escalator 2b	52	23.3%	140
Total:	100%	602	

Plenum/ Upper Ancillary level

Plenum Area Occupant Load 602 from Concourse center Area

Total Plenum Level Occupant Load 886

Plaza

Plaza Occupant Load 602

Total Plaza Occupant Load 886 (From Plenum Level)

	Egress	Percent	Number
Turnstile (Plaza Level/ Street)	125	51.0%	307
Fair Gates	120	49.0%	295
Total:	100%	602	

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch detail)

Route 1

Egress direction: Passenger starting from 30 ft East of Emergency stairway No. 8, travelling to concourse level and street level using stairway No. 7, 10 and corresponding Emergency Exit Hatch

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	56	124	0.45	R3-A-111
Platform to Concourse, Elevation	T2	16.0	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	15	124	0.12	R3-A-112
Concourse Level-2	T4	8	124	0.06	R3-A-112
Concourse Level To plan Level, Elevation	T5	68	40	1.70	R3-A-202
To safe area	T6	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T6				2.82	

Stairs (from Platform to Concourse)

Platform occupant load =	878	
Exit capacity =	372	
Q1 (platform clearing time) = occupant load / exit capacity	2.36 minutes	
W1 (waiting time) = Q1 - T1	1.91 minutes	2.36 under 4 minutes

Concourse - West Emergency Stairway Corridor (from Concourse to Upper Level)

Platform occupant load =	142
Exit capacity =	62
Q2 (platform clearing time) = occupant load / exit capacity	2.27 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)-West Emergency Stairway to roof Level

Occupant load =	142
Exit capacity =	71
Q3 (clearing time) = occupant load / exit capacity	2.00 minutes
Max. clearing Time	2.36
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

Roof Level -Emerg. Exit Hatch No. 1

Occupant load =	142	
Exit capacity =	100	Assume
Q4 (clearing time) = occupant load / exit capacity	1.42 minutes	
Max. clearing Time	2.36	
W4 (waiting time) = Q4- Max. Time	0.00 minutes	

Total Time to reach Point of Safety **2.88** minutes under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 **4.73** minutes

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch detail)

Route 2

Egress direction: Passenger starting from 30 ft west of Escalator No. 4, travelling to concourse level and street level using Escalator 2a & 1a, Turnstiles and Hope street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	38	124	0.31	R3-A-111
Platform to Concourse, Elevation	T2	16	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	74	124	0.60	R3-A-112
Concourse Level-2	T4	87	124	0.70	R3-A-112
Concourse Level To Upper Ancillary Level, Elevation	T5	46	40	1.15	R3-A-203
Upper Ancillary Level	T6	64	124	0.52	R4-A-114
Upper Ancillary Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	137	124	1.10	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				6.01	

Stairs (from Platform to Concourse)

Platform occupant load =	678	
Exit capacity =	372	
Q1 (platform clearing time) = occupant load / exit capacity	2.36 minutes	
W1 (waiting time) = Q1 - T1	2.06 minutes	2.36
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	602
Exit capacity =	1098
Q2 (clearing time) = occupant load / exit capacity	0.55 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)- To Upper Ancillary level

Occupant load =	602
Exit capacity =	225
Q3 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.36
W3 (waiting time) = Q3 - Max. Time	0.31 minutes

Plenum /Ancillary Level- To Plan level

Occupant load =	602
Exit capacity =	225
Q4 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.67
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

Plaza Level

Occupant load =	602
Exit capacity =	245
Q5 (clearing time) = occupant load / exit capacity	2.46 minutes
Max clearing Time	2.67
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Total Time to reach Point of Safety 3.36 minutes under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 +W5 8.38 minutes

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch detail)

Route 3

Egress direction: Passenger starting from 30 ft East of Escalator No. 4, travelling to concourse level and street level using Escalator 2a & 1a, Turnstiles and Hope street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	98	124	0.79	R3-A-111
Platform to Concourse, Elevation	T2	16	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	74	124	0.60	R3-A-112
Concourse Level-2	T4	87	124	0.70	R3-A-112
Concourse Level To Upper Ancillary Level, Elevation	T5	46	40	1.15	R3-A-203
Upper Ancillary Level	T6	64	124	0.52	R4-A-114
Upper Ancillary Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	137	124	1.10	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				6.50	

Stairs (from Platform to Concourse)

Platform occupant load =	878	
Exit capacity =	372	
Q1 (platform clearing time) = occupant load / exit capacity	2.36 minutes	
W1 (waiting time) = Q1 - T1	1.57 minutes	2.36
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	602
Exit capacity =	1098
Q2 (clearing time) = occupant load / exit capacity	0.55 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)- To Upper Ancillary level

Occupant load =	602
Exit capacity =	225
Q3 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.36
W3 (waiting time) = Q3 - Max. Time	0.31 minutes

Plenum /Ancillary Level- To Plan level

Occupant load =	602
Exit capacity =	225
Q4 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.67
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

Plaza Level

Occupant load =	602
Exit capacity =	245
Q5 (clearing time) = occupant load / exit capacity	2.46 minutes
Max clearing Time	2.67
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Total Time to reach Point of Safety **3.36 minutes** **under 6 minutes**

Total exit time to street = T + W1 + W2 + W3 + W4 +W5 **8.38 minutes**

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch detail)

Route 4

Egress direction: Passenger starting from 90 ft West of Stair No. 3, travelling to concourse level and street level using Escalator 2a & 1a, Turnstiles and Hope street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	106	124	0.85	R3-A-111
Platform to Concourse, Elevation	T2	16	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	54	124	0.44	R3-A-112
Concourse Level-2	T4	87	124	0.70	R3-A-112
Concourse Level To Upper Ancillary Level, Elevation	T5	46	40	1.15	R3-A-203
Upper Ancillary Level	T6	64	124	0.52	R4-A-114
Upper Ancillary Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	137	124	1.10	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				6.40	

Stairs (from Platform to Concourse)

Platform occupant load =

878

Exit capacity =

372

Q1 (platform clearing time) = occupant load / exit capacity

2.36 minutes

W1 (waiting time) = Q1 - T1

1.51 minutes

2.36

under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =

602

Exit capacity =

1098

Q2 (clearing time) = occupant load / exit capacity

0.55 minutes

W2 (waiting time) = Q2 - Q1

0.00 minutes

(Concourse)- To Upper Ancillary level

Occupant load =

602

Exit capacity =

225

Q3 (clearing time) = occupant load / exit capacity

2.67 minutes

Max clearing Time

2.36

W3 (waiting time) = Q3 - Max. Time

0.31 minutes

Plenum /Ancillary Level- To Plan level

Occupant load =

602

Exit capacity =

225

Q4 (clearing time) = occupant load / exit capacity

2.67 minutes

Max clearing Time

2.67

W4 (waiting time) = Q4 - Max. Time

0.00 minutes

Plaza Level

Occupant load =

602

Exit capacity =

245

Q5 (clearing time) = occupant load / exit capacity

2.46 minutes

Max clearing Time

2.67

W5 (waiting time) = Q5 - Max. Time

0.00 minutes

Total Time to reach Point of Safety

3.20 minutes

under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 +W5

8.22 minutes

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch detail)

Route 5

Egress direction: Passenger starting from 30 ft East of Stair No. 3, travelling to concourse level and street level using Escalator 2a & 1a, Turnstiles and Hope street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	39	124	0.31	R3-A-111
Platform to Concourse, Elevation	T2	16	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	54	124	0.44	R3-A-112
Concourse Level-2	T4	87	124	0.70	R3-A-112
Concourse Level To Upper Ancillary Level, Elevation	T5	46	40	1.15	R3-A-203
Upper Ancillary Level	T6	64	124	0.52	R4-A-114
Upper Ancillary Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	137	124	1.10	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				5.66	

Stairs (from Platform to Concourse)

Platform occupant load =	878	
Exit capacity =	372	
Q1 (platform clearing time) = occupant load / exit capacity	2.36 minutes	
W1 (waiting time) = Q1 - T1	2.05 minutes	2.36
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	602
Exit capacity =	1098
Q2 (clearing time) = occupant load / exit capacity	0.55 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)- To Upper Ancillary level

Occupant load =	602
Exit capacity =	225
Q3 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.36
W3 (waiting time) = Q3 - Max. Time	0.31 minutes

Plenum /Ancillary Level- To Plan level

Occupant load =	602
Exit capacity =	225
Q4 (clearing time) = occupant load / exit capacity	2.67 minutes
Max clearing Time	2.67
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

Plaza Level

Occupant load =	602
Exit capacity =	245
Q5 (clearing time) = occupant load / exit capacity	2.46 minutes
Max clearing Time	2.67
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Total Time to reach Point of Safety

3.20 minutes under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 +W5
8.22 minutes

(Refer R3-A-111/112/ 113/115 /102 Mark-up Drawings for Plan Dimension)

(Refer R3-A-202/203/204/201 Mark-up Drawings for Elevation Dimension)

(Refer A3-036 for Exit Hatch detail)

Route 6

Egress direction: Passenger starting from 30 ft West of East Emergency stairway No. 5, travelling to concourse level and street level using stairway No. 9, 12 and corresponding Emergency Exit Hatch

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	53	124	0.43	R3-A-111
Platform to Concourse, Elevation	T2	16	40	0.40	R3-A-202
Concourse Level-Point of Safety	T3	54	124	0.44	R3-A-112
Concourse Level-2	T4	87	124	0.70	R3-A-112
Concourse Level To Upper Ancillary Level, Elevation	T5	46	40	1.15	R3-A-203
Upper Ancillary Level	T6	64	124	0.52	R4-A-114
Upper Ancillary Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	137	124	1.10	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				5.97	

Stairs (from Platform to Concourse)

Platform occupant load =	878	
Exit capacity =	372	
Q1 (platform clearing time) = occupant load / exit capacity	2.36 minutes	
W1 (waiting time) = Q1 - T1	1.94 minutes	2.36
		under 4 minutes

East Emergency Stairway (from Platform to Concourse)

Platform occupant load =	142
Exit capacity =	71
Q2 (platform clearing time) = occupant load / exit capacity	2.00 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)-East Emergency Stairway Corridor

Occupant load =	142
Exit capacity =	62
Q3 (clearing time) = occupant load / exit capacity	2.27 minutes
Max. clearing Time	2.36
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

Roof plan Level -East Emergency Corridor

Occupant load =	142	
Exit capacity =	75	Assume
Q4 (clearing time) = occupant load / exit capacity	1.89 minutes	
Max. clearing Time	2.36	
W11 (waiting time) = Q4- Max. Time	0.00 minutes	

(Roof Level)-East Emergency Stairway to Plaza Level

Occupant load =	142
Exit capacity =	71
Q5 (clearing time) = occupant load / exit capacity	2.00 minutes
Max. clearing Time	2.27
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Roof Level -Emerg. Exit Hatch

Occupant load =	142	
Exit capacity =	100	Assume
Q6 (clearing time) = occupant load / exit capacity	1.42 minutes	
Max. clearing Time	2.36	
W6 (waiting time) = Q6- Max. Time	0.00 minutes	

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4 +...+W6	3.20 minutes	under 6 minutes
------------------------------------------------------------------	---------------------	------------------------

	7.91 minutes	
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**2nd and Hope Station:
Passenger Load**

Background:

Regional connector line 2nd & Hope Station total egress time is to be calculated based on NFPA-130 procedure to determine the required no. of street entrances to station for EIS

Purpose:

To calculate the total platform occupant load for 2nd & Hope Station based on NFPA 130 assumptions and given Link Loads.

References

- 1.) NFPA-30 (2010 Edition)
- 2.) EW Peak Hourly Load Diagram
- 3.) NS Long Peak Hourly Load Diagram
- 4.) NS Short Peak Hourly Load Diagram
- 5) Calc-001
- 6) Email from Gulzar Ahmed dated October 12, 2011

Assumptions

- 1) Only One Train Detraining Passengers in the Peak Direction is considered based on Reference 6
- 2) Entraining load is based on passengers waiting to board trains on three different lines with a service disruption time of 12 minutes or one missed headway, whichever is higher, for the peak direction. A headway of 2.5 minutes is used for the off-peak direction. A missed headway and service disruption time are not assumed for the off-peak direction.
- 3.) NS Long and Short line **southbound** Trains and EW line **westbound** train utilizes Northside platform track (Say No.1)
- 4.) NS Long and Short line **northbound** Trains and EW line **eastbound** train utilizes Southside platform track (Say No.2)
- 5) Surge Factor based on Reference 6.

Surge Factor 1.5

NS Line (Long)				
	Southbound		Northbound	
Link Load	2343	Ppl/Peak hr	1178	Ppl/Peak hr
Detraining Load	142	Ppl/Peak hr	205	Ppl/Peak hr
Entraining Load	53	Ppl/Peak hr	29	Ppl/Peak hr
Peak Headway	10	min		

NS Line (Short)				
	Southbound		Northbound	
Link Load	1588	Ppl/Peak hr	1090	Ppl/Peak hr
Detraining Load	106	Ppl/Peak hr	217	Ppl/Peak hr
Entraining Load	65	Ppl/Peak hr	30	Ppl/Peak hr
Peak Headway	10	min		

EW Line				
	Westbound		Eastbound	
Link Load	1960	Ppl/Peak hr	1323	Ppl/Peak hr
Detraining Load	118	Ppl/Peak hr	342	Ppl/Peak hr
Entraining Load	131	Ppl/Peak hr	55	Ppl/Peak hr
Peak Headway	5	min		

Headway Time for Trains	2.5	min
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Possible Train Schedule

Time (min)	Trains
0	NSL
2.5	EW
5	NSS
7.5	EW
10	NSL
12.5	EW
15	NSS
17.5	EW
20	NSL

NS Line (Long)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	391	Ppl/train headway	196	Ppl/train headway

NS Line (Short)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	265	Ppl/train headway	182	Ppl/train headway

EW Line				
Peak Headway	5			min
	Westbound		Eastbound	
Link Load	163	Ppl/train headway	110	Ppl/train headway

Platform Load

Max. Southbound Entraining Load for Track No. 1	249	Ppl/hr
Average Headway Time	2.5	min.
Total Entraining load for Track No. 1	11	Ppl/Train Headway
Max. Northbound Entraining Load for Track No. 2	114	Ppl/hr
Total Entraining load for Track No. 2	5	Ppl/Train Headway

Maximum Train Load (Crush Load) 795 ppl

Link Load

Max. Southbound Train Load per headway	391	Ppl/Train Headway
Max. Northbound Train peak Headway	196	Ppl/Train Headway

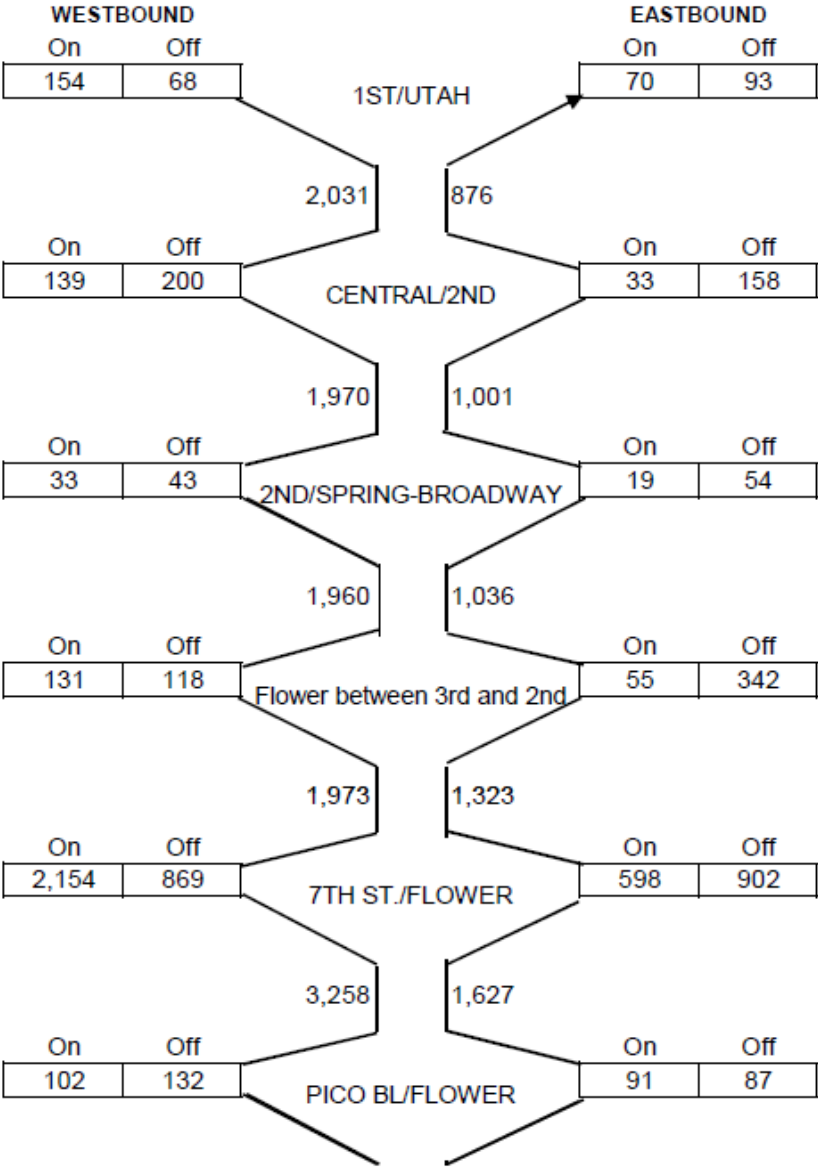
Entraining Load

Peak Direction (South Bound) = [PEAK 15 MIN. LOAD x Surge Factor x MAX (2 x HEADWAY OR 12 MIN.)] / 15
75

Off Peak Direction (North Bound) = [OFF PEAK 15 MIN. LOAD x Surge Factor x (HEADWAY)] / 15
8

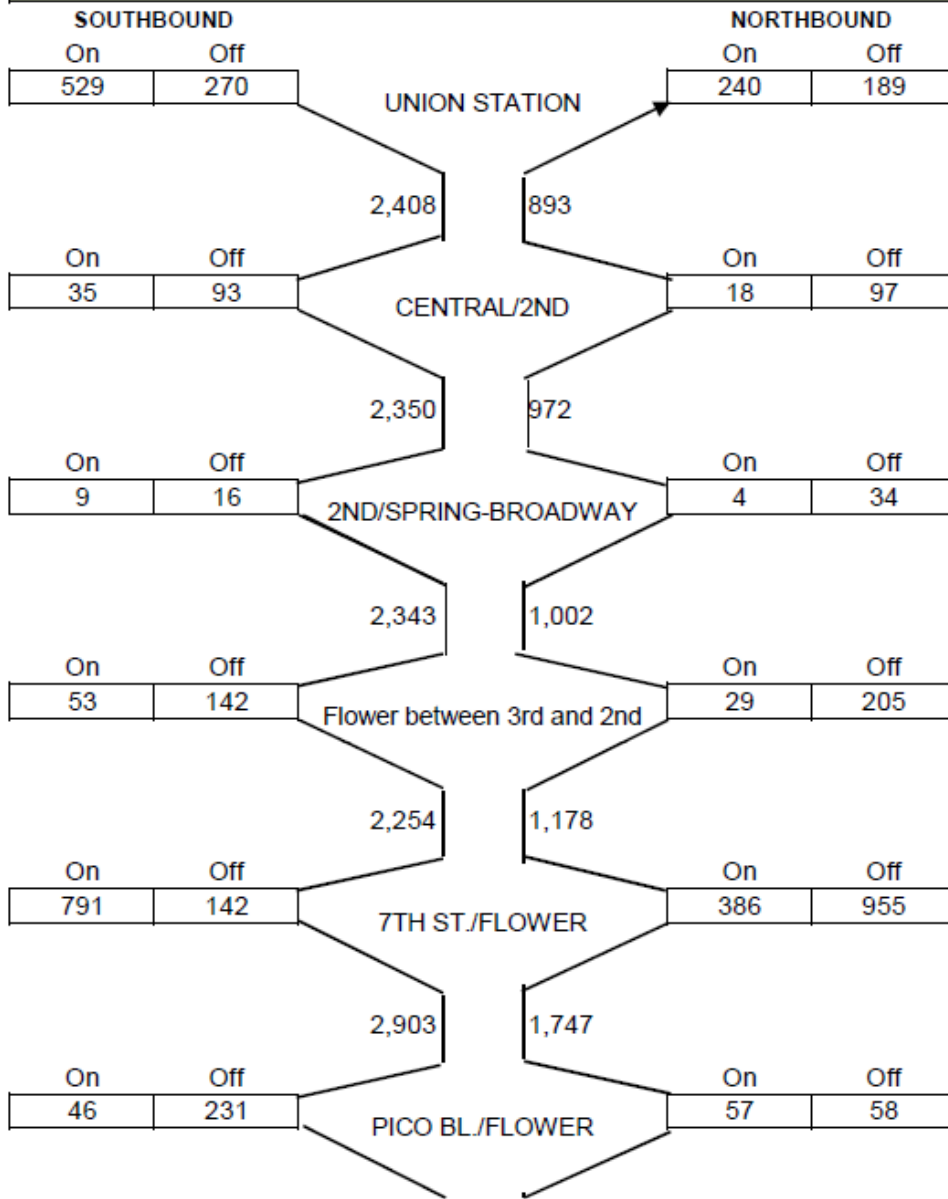
Total Detraining Load 795 ppl
Total Platform Occupant Load 878 ppl

**E-W Line Regional Connector Stations
Peak Hour Boardings and Alightings**



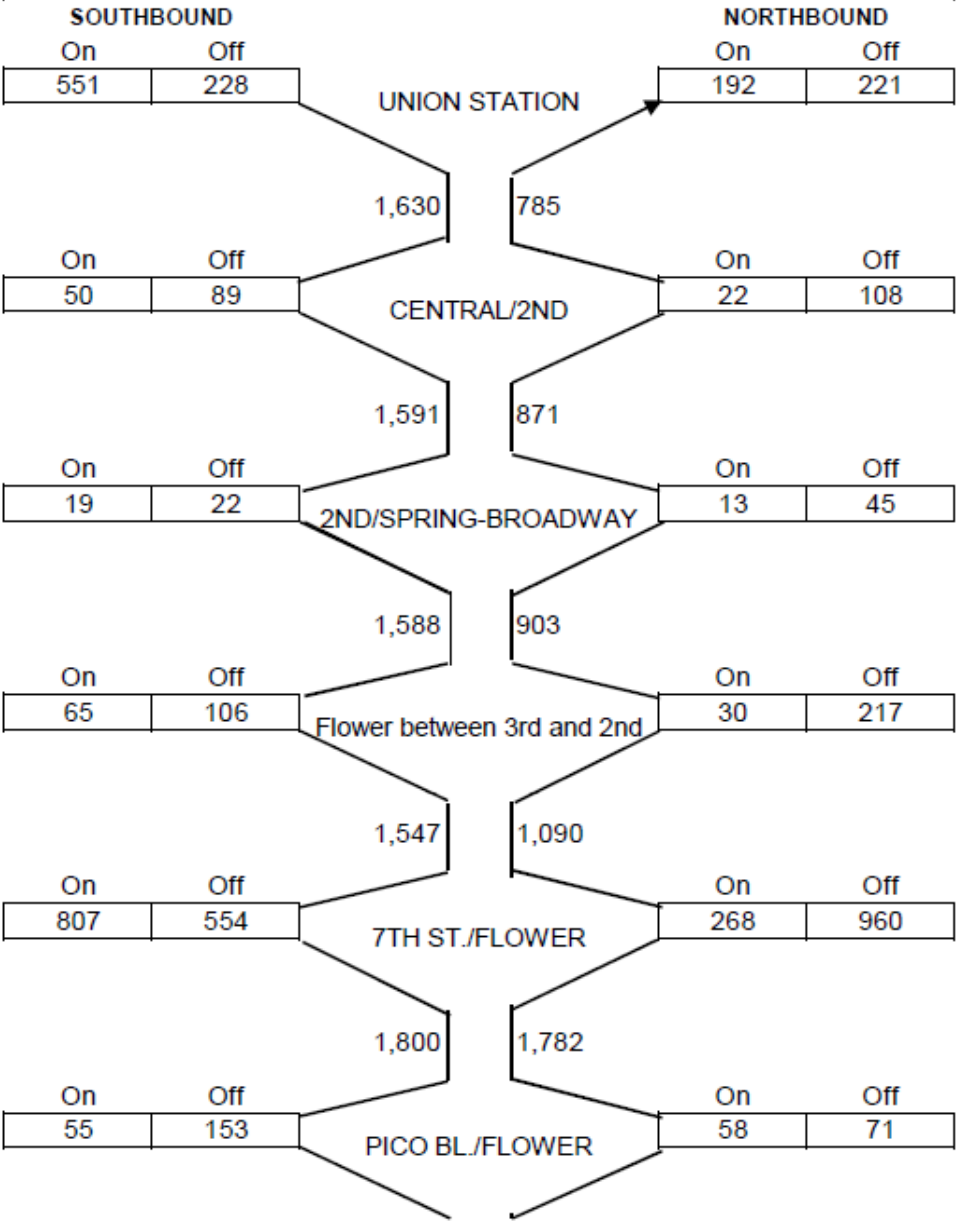
Reference 2

**N-S Line (Long) Azusa/Citrus to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 3

**N-S Line (Short) Siera Madre Villa to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 4

For calculated train load Metro Fire/Life Safety Criteria, Section 2.5.2.1.A has the following requirement.

The following limitations to the calculated train load shall be applied:

- a. No more than one train will unload at any one track to a platform during an emergency.
- b. The load on any single train is limited to the maximum train capacity.
- c. The calculated train load can be no less than the maximum passenger capacity of a single train.

With above limitations the occupant load for emergency exiting calculations for Century City Constellation station will be as follows.

CALCULATED TRAIN LOAD

MAXIMUM CAPACITY OF A SINGLE TRAIN (6 cars per train) = 1446
(61 Seated + 180 Standing = 241 per car x 6 = 1446)

ENTRAINING LOAD

PEAK (Westbound) ENTRAINING LOAD = [PEAK 15 MIN. LOAD x MAX (2 x HEADWAY OR 12 MIN.)] / 15
= $\{(193 \times 1.5)/4\} \times (12/15) = 59$

OFF PEAK (Eastbound) ENTRAINING LOAD = [OFF PEAK 15 MIN. LOAD x (HEADWAY)] / 15
= $\{(328 \times 1.5)/4\} \times (4/15) = 33$

TOTAL ENTRAINING LOAD = 59 + 33 = 92

TOTAL OCCUPANT LOAD FOR CALCULATION = CALCULATED TRAIN LOAD + TOTAL ENTRAINING LOAD
TRUE

2nd and Broadway Station: Egress Capacity Calculations

Assumptions:

1. Platform occupant load was calculated based on NFPA 130 Standard (2010 edition).
2. One escalator at each level was assumed to be out of service.
3. The Concourse area would be ventilated as per NFPA 130 criteria and is considered as a point of safety.
4. The time to open the Exit Hatch is not included.

Summary

1. The platform clearance time complies with the 4-minute criteria required by NFPA 130.
2. The evacuation time from the platform to the platform emergency stairs complies with the 6-minute NFPA 130 criteria.
3. The longest time for the last occupant to reach a point of safety is 3.42 minutes. The longest time for the last occupant to reach street level is 8.77 minutes.

Route	Egress Paths	Clearing Platform		To a Point of Safety			To Street
		Time (min)	4-minute criteria?	Point of safety at:	Time (min)	6-minute criteria?	Time (min)
1	Platform to Concourse through West Emergency stairway (No. 3), and then to street level through Exit Hatch No. 1	2.37	Pass	Concourse	3.07	Pass	5.63
1a	Platform to Concourse through West Emergency stairway (No. 3), and then to street level through Exit Hatch No. 1 (passengers split)	2.37	Pass	Concourse	3.07	Pass	5.63
2	Platform to Concourse through West Emergency stairway (No. 3), and then to street level through West/ 2nd street Exit.	2.37	Pass	Concourse	3.07	Pass	8.07
3	Platform to Concourse through West Escalator (No. 3) , and then to street Level through West/ 2nd street Exit.	2.37	Pass	Concourse	2.98	Pass	7.38
4	Platform to Concourse through East stairway (No. 5) , and then to street level West/ 2nd street Exit.	2.37	Pass	Concourse	3.42	Pass	7.83
5	Platform to Concourse through East Emergency stairway (No. 6) , and then to street Level through West/ 2nd street Exit.	2.37	Pass	Concourse	2.95	Pass	8.76
6	Platform to Concourse through East Emergency stairway (No. 6), and then to street level through Exit Hatch No. 3.	2.37	Pass	Concourse	2.95	Pass	4.88
6a	Platform to Concourse through East Emergency stairway (No. 6), and then to street level through Exit Hatch No. 3. (passengers split)	2.37	Pass	Concourse	2.95	Pass	4.88

Element	Persons per inch per minute	Person per minute per unit	Travel Speed (fpm)	
Platforms, Corridors, and Ramps.	2.08	---	124	
Stairs and Escalators (see note 1):	1.31	---	40	
(i) Up direction:				
(ii) Down direction:	1.41	---	48	
Doors and Gates (single leaf)	---	60	---	Section 5.5.6.3.4.2
Doors and Gates (multi-leaf)	2.08	---	---	Section 5.5.6.3.4.3
Turnstiles	---	25	---	
Exit Hatch	2.08			Assume

Notes:

1. NFPA 130 Standard, Section 5.5.6.3.2.3 specifies the capacity and travel speed for stairs/escalators but does not indicate whether the values are dependent on the travel direction. However, the examples in Annex C indicate that the capacity and travel speed for the up direction are 1.31 pim and 40 fpm, respectively, and the capacity and speed for the down direction are 1.41 pim and 48 fpm, respectively.

2. NFPA 130 Standard, Section 5.5.6.3.5.2 specifies that turnstile-type fare collection gates shall have a capacity of 25 people per minute for egress calculations. Therefore assume a capacity of 25 people per minute for all turnstiles.

One escalator at each level is assumed to be out of service (per NFPA 130 2010 edition, Section 5.5.6.3.2.6).

Egress Elements:

Route	Direction	No. of Units	Width (in)	Persons per inch per minute	Person per minute per unit	Total people per minute	
Platform to Lower Concourse:							
Emergency Stair No. 3 Door	Up	1	48		60	60	
Stair No 4	Up	1	66	1.31	86	86	
Stair No 5	Up	1	66	1.31	86	86	
Escalator No. 3	Up	1	40	1.31	52	52	(Standard Escalator Dimension)
Escalator No. 4	Up	0	40	1.31	52	0	Out of Service
-	Up	0	46	1.31	60	0	
-	Up	0	46	1.31	60	0	
Emergency Stair No. 6 Door	Up	1	48		60	60	
Total:						345	
Total stairs:						225	(Excl. Emerg. Stairway Doors at Station Ends)

Platform to Concourse through Emergency Stairway:							
Emergency Stair No. 3	Up	1	63	1.31	83	83	(Stairway Dimension of 5.25 ft)
Emergency Stair No. 6	Up	1	63	1.31	83	83	(Stairway Dimension of 5.25 ft)
Total:						165	
Total stairs:						83	(Excluding East Emergency Stairway)

Concourse Center :							
Councourse Corridor	Up	1	432	2.08	899	899	(Subtract 12" for each sidewall, 456-2*12)
Escalator No. 2b	Up	1	40	1.31	52	52	(Standard Escalator Dimension)
Stair No. 2	Up	1	66	1.31	86	86	
Stair No. 2	Up	1	66	1.31	86	86	
Escalator No. 2a	Up	0	40	1.31	52	0	(1 Escalator out of service)
Total stairs:						225	(Excluding Corridor)

Concourse: West Emergency Stairway Level							
Emergency Stairway No. 3 (West)	Up	1	63	1.31	83	83	
Corridor		1	39	2.08	81	81	(Subtract 12" for each sidewall, 63-2*12)
Two Leaf Door ----alt. rou.		1	72	2.08	150	150	
Corridor		1	96	2.08	200	200	(Subtract 12" for each sidewall, 120-2*12)
Single Leaf Door		1	36		60	60	
Corridor		1	54	2.08	112	112	(Subtract 12" for each sidewall, 66-1*12)
Emergency Stairway No. 7(West)	Up	1	63	1.31	83	83	
Towards Concourse Center							
alt. rou.----Corridor		1	96	2.08	200	200	(Subtract 12" for each sidewall, 120-2*12)
Two Leaf Door		1	72	2.08	150	150	

Concourse: East Emergency Stairway Level							
Emergency Stairway No. 6 (East)	Up	1	63	1.31	83	83	Stairway Dimension of 5.25 ft
Corridor		1	72	2.08	150	150	(Subtract 12" for each sidewall, 96-2*12)
Two Leaf Door----alt. rou.		1	72	2.08	150	150	
Corridor		1	72	2.08	150	150	(Subtract 12" for each sidewall, 96-1*12)
Single Leaf Door		1	36		60	60	
Corridor		1	72	2.08	150	150	(Subtract 12" for each sidewall, 96-2*12)
Emergency Stairway No. 8 (East)	Up	1	63	1.31	83	83	Stairway Dimension of 5.25 ft
Towards Concourse Center							
alt. rou.----Corridor		1	96	2.08	200	200	(Subtract 12" for each sidewall, 120-2*12)
Two Leaf Door		1	72	2.08	150	150	

One escalator at each level is assumed to be out of service (per NFPA 130 2010 edition, Section 5.5.6.3.2.6).

Egress Elements:

Route	Direction	No. of Units	Width (in)	Persons per inch per minute	Person per minute per unit	Total people per minute
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Plenum /Ancillary Level:

Corridor		1	258	2.08	537	537	(Subtract 12" for each sidewall, 270-1*12)
Escalator No. 1a	Up	1	40	1.31	52	52	(Standard Escalator Dimension)
Stair No. 1	Up	1	66	1.31	86	86	
Stair No. 1	Up	1	66	1.31	86	86	
Escalator No. 1b	Up	0	40	1.31	52	0	(1 Escalator out of service)
Emergency Stairway No. 8 (East)	Up	1	63	1.31	83	83	
Emergency Stairway No. 7 (West)	Up	1	63	1.31	83	83	
Corridor		1	72	2.08	150	150	(Subtract 12" for each sidewall, 96-2*12)
Single Leaf Door		1	36		60	60	
Corridor		1	120	2.08	250	250	(Subtract 12" for each sidewall, 144-2*12)
Total Stairway & Escalator:						225	

Roof Level:

West Corridor		1	48	2.08	100	100	(Subtract 12" for each sidewall, 72-2*12)
West side Exit Stairway No. 1	Up	1	42	1.31	55	55	
West side Exit Stairway No. 2	Up	1	42	1.31	55	55	
West side Exit Hatch 1		1	48	2.08	100	100	
West side Exit Hatch 2		1	48	2.08	100	100	
East Corridor		1	30	2.08	62	62	(Subtract 12" for each sidewall, 54-2*12)
East side Exit Stairway No 3	Up	1	42	1.31	55	55	
East side Exit Stairway No 4	Up	1	42	1.31	55	55	
East side Exit Hatch 3		1	48	2.08	100	100	Assume
East side Exit Hatch 4		1	48	2.08	100	100	

Plaza Level Plan:

Entrance Passageway							
Turnstile		6			25	150	
Gate		2			60	120	
Broadway Side Exit Door		1	72	2.08	150	150	
W 2nd Street Side IDoor		1	216	2.08	449	449	
Sub Total						270	(Excluding W-2nd Street Side Door)

Platform

Platform Occupant Load	817	[Based on NFPA 130 Standards (2010 edition).]
Occupant load from ancillary rooms in passenger area	0	
Total Platform Occupant Load	817	

	Egress capacity (ppm)	Percent	Number of passengers
Stairs & Escalators	225	65.2%	533
West Emergency Stairway Door	60	17.4%	142
East Emergency Stairway Door	60	17.4%	142
Total:		100%	817

Concourse

Concourse West Area Occupant Load-	142	(from platform)	
West Emergency Stairway (No. 7) Door	60	28.6%	41
Double Door (Twds. Concourse Center)	150	71.4%	101
Total:		100%	142

Concourse East Area Occupant Load-	142	(from platform)	
East Emergency Stairway (No.8) Door	60	28.6%	41
Double Door (Twds. Concourse Center)	150	71.4%	101
Total:		100%	142

Concourse Center Area Occupant Load-	736		
Occupant load from ancillary rooms in passenger area	8		
Total Concourse Center Area Occupant Load	744		
Total Concourse Level Occupant Load	825	(from platform)	
	Egress capacity (ppm)	Percent	Number of passengers
Concourse Stairway (No. 2)	173	76.7%	571
Escalator 2b	52	23.3%	173
Total:		100%	744

Plenum/Ancillary level

Plenum West Area Occupant Load	41	from Concourse West Area	
Emergency Stairway No 7(West)	83	57.9%	24
Emerg. Strway No 7 Door Twds. Plenum Strway(West)	60	42.1%	17
Total:		100%	41

Plenum Center Area Occupant Load-	744	(from Concourse Center Area)	
Total Plenum Center Area Occupant Load-	761		
Total Plenum Level Load	825		
	Egress capacity (ppm)	Percent	Number of passengers
Stairways (Plaza Level/ Street)	173	76.7%	584
Escalator 1a (Plaza Level/Street)	52	23.3%	177
Total:		100%	761

Roof Level

Roof Level West Corridor Occupant Load	24	from Concourse West Area	
West side Exit Stairway No 1	55	50.0%	12
West side Exit Stairway No 2	55	50.0%	12
Total:		100%	24

Roof Level East Corridor Occupant Load	41	from Concourse West Area	
East side Exit Stairway No 3	55	50.0%	20
East side Exit Stairway No 4	55	50.0%	20
Total:		100%	41

Plaza

Plaza Occupant Load 761
Total Plaza Occupant Load 761 (From Plenum Level)
Total Plaza / Street Level Load 825 (from Lower Level)

	Egress	Percent	Number
Turnstile (Plaza Level/ Street)	150	35.7%	272
Fare Gates	120	28.6%	218
S Broadway Side Exit	150	35.7%	271
	Total:	100%	761

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 (Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 1

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and street level using stairway No. 7 and Emergency Exit Hatch No. 1

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	40	124	0.32	R4-A-110
Platform to Concourse, Elevation	T2	16.0	40	0.40	R4-A-202/201
Concourse Level-Point of Safety	T3	38	124	0.31	R4-A-111
Concourse Level-2	T4	68	124	0.55	R4-A-111
Concourse Level To roof Level, Elevation	T5	55	40	1.38	R4-A-202
Roof Level	T6	41	124	0.33	R4-A-114
Street level Stairway from Roof Level, Elevation	T7	8.8	40	0.22	AS-036
To safe area	T8	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T8				3.58	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 2.04 minutes

West Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-West Corridor -1

Occupant load = 142
 Exit capacity = 81
 Q3 (clearing time) = occupant load / exit capacity = 1.75 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-West Double Door -1

Occupant load = 142
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W4 (waiting time) = Q4 - Max. time = 0.00 minutes

(Concourse)-West Corridor -2

Occupant load = 142
 Exit capacity = 200
 Q5 (clearing time) = occupant load / exit capacity = 0.71 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-West Single Door -2

Occupant load = 142
 Exit capacity = 80
 Q6 (clearing time) = occupant load / exit capacity = 2.37 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6 - Max. Time = 0.00 minutes

(Concourse)-West Corridor -3

Occupant load = 142
 Exit capacity = 112
 Q7 (clearing time) = occupant load / exit capacity = 1.28 minutes
 Max. clearing Time = 2.37
 W7 (waiting time) = Q7 - Max. Time = 0.00 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)

(Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

(Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 1

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and steel level using stairway No. 7 and Emergency Exit Hatch No. 1

(To Roof Level)-Stairway

Occupant load =	142	
Exit capacity =	83	
Q8 (clearing time) = occupant load / exit capacity	1.72	minutes
Max Flow Time	2.37	
W8 (waiting time) = Q8 - Max. Time	0.00	minutes

Roof Level -West Corridor

Occupant load =	142	
Exit capacity =	100	
Q9 (clearing time) = occupant load / exit capacity	1.42	minutes
Max Flow Time	2.37	
W9 (waiting time) = Q9 - Max. Time	0.00	minutes

Roof Level -Emerg. Stairway No. 1

Occupant load =	71	
Exit capacity =	55	
Q10 (clearing time) = occupant load / exit capacity	1.29	minutes
Max Flow Time	2.37	
W10 (waiting time) = Q10- Max. Time	0.00	minutes

Roof Level -Emerg. Exit Hatch No. 1

Occupant load =	71	
Exit capacity =	100	Assume
Q11 (clearing time) = occupant load / exit capacity	0.71	minutes
Max Flow Time	2.37	
W11 (waiting time) = Q11- Max. Time	0.00	minutes

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4 +..+W11

3.07	minutes	under 6 minutes
5.63	minutes	

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 (Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 1a

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and street level using stairway No. 7 and Emergency Exit Hatch No. 1
 Assuming passengers split at every level depending upon the egress element capacity

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	40	124	0.32	R4-A-110
Platform to Concourse, Elevation	T2	16.0	40	0.40	R4-A-202/201
Concourse Level-Point of Safety	T3	38	124	0.31	R4-A-111
Concourse Level-2	T4	68	124	0.55	R4-A-111
Concourse Level To roof Level, Elevation	T5	55	40	1.38	R4-A-202
Roof Level	T6	41	124	0.33	R4-A-114
Street level Stairway from Roof Level, Elevation	T7	8.8	40	0.22	AS-036
To safe area	T8	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T8				3.58	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 2.04 minutes

West Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-West Corridor -1

Occupant load = 142
 Exit capacity = 81
 Q3 (clearing time) = occupant load / exit capacity = 1.75 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-West Double Door -1

Occupant load = 142
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W4 (waiting time) = Q4 - Max. Time = 0.00 minutes

(Concourse)-West Corridor -2

Occupant load = 101
 Exit capacity = 200
 Q5 (clearing time) = occupant load / exit capacity = 0.51 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-West Single Door -2

Occupant load = 41
 Exit capacity = 60
 Q6 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6 - Max. Time = 0.00 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 (Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 1a

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and street level using stairway No. 7 and Emergency Exit Hatch No. 1

(Concourse)-West Corridor -3

Occupant load =	41
Exit capacity =	112
Q7 (clearing time) = occupant load / exit capacity	0.36 minutes
Max. clearing Time	2.37
W7 (waiting time) = Q7 - Max. Time	0.00 minutes

(To Roof Level)-Stairway

Occupant load =	41
Exit capacity =	83
Q8 (clearing time) = occupant load / exit capacity	0.49 minutes
Max. clearing Time	2.37
W8 (waiting time) = Q8 - Max. Time	0.00 minutes

Roof Level -West Corridor

Occupant load =	24
Exit capacity =	100
Q9 (clearing time) = occupant load / exit capacity	0.24 minutes
Max Flow Time	2.37
W9 (waiting time) = Q9 - Max. Time	0.00 minutes

Roof Level -Emerg. Stairway No. 1

Occupant load =	12
Exit capacity =	55
Q10 (clearing time) = occupant load / exit capacity	0.21 minutes
Max. clearing Time	2.37
W10 (waiting time) = Q10 - Max. Time	0.00 minutes

Roof Level -Emerg. Exit Hatch No. 1

Occupant load =	12	
Exit capacity =	100	Assume
Q11 (clearing time) = occupant load / exit capacity	0.12 minutes	
Max. clearing Time	2.37	
W11 (waiting time) = Q11- Max. Time	0.00 minutes	

Total Time to reach Point of Safety

3.07 minutes	under 6 minutes
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Total exit time to street = T + W1 + W2 + W3 + W4 +..+W11

5.63 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 (Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 2

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and steel level using Escalator 1a & 2b, turnstiles and West/2nd street exit.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	40	124	0.32	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-203
Concourse Level-Point of Safety	T3	38	124	0.31	R4-A-111
Concourse Level-2	T4	128	124	1.03	R4-A-111
Concourse Level To Plenum Level, Elevation	T5	22	40	0.55	R4-A-203
Plenum Level	T6	64	124	0.52	R4-A-114
Plenum Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	80	124	0.65	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				5.01	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 2.04 minutes

West Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-West Corridor -1

Occupant load = 142
 Exit capacity = 81
 Q3 (clearing time) = occupant load / exit capacity = 1.75 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-West Double Door -1

Occupant load = 142
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W4 (waiting time) = Q4 - Max. Time = 0.00 minutes

(Concourse)-West Corridor -2

Occupant load = 101
 Exit capacity = 200
 Q5 (clearing time) = occupant load / exit capacity = 0.51 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-West Double Door -2 (Towards Concourse Center Area)

Occupant load = 101
 Exit capacity = 150
 Q6 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6 - Max. Time = 0.00 minutes

(Concourse)

Occupant load = 744
 Exit capacity = 225

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 (Refer R4-A-114 & AS-036 for Roof Level & Exit Hatch detail)

Route 2

Egress direction: Passenger starting from 15 ft East of stairway No. 3, travelling to concourse level and stree level using Escalator 1a & 2b, turnstiles and West/2nd street exit.

Q7 (clearing time) = occupant load / exit capacity	3.30 minutes
Max. clearing Time	2.37
W7 (waiting time) = Q7 - Max. Time	0.94 minutes

Plenum/Ancillary Level West Area Door 1

Occupant load =	17
Exit capacity =	60
Q8 (clearing time) = occupant load / exit capacity	0.28 minutes
Max. clearing Time	3.30
W8 (waiting time) = Q8 - Max. Time	0.00 minutes

Plenum /Ancillary Level

Occupant load =	761
Exit capacity =	225
Q9 (clearing time) = occupant load / exit capacity	3.38 minutes
Max. clearing Time	3.30
W9 (waiting time) = Q9 - Max. Time	0.08 minutes

Plaza Level

Occupant load =	761
Exit capacity =	270
Q10 (clearing time) = occupant load / exit capacity	2.82 minutes
Max. clearing Time	3.38
W10 (waiting time) = Q10 - Max. Time	0.00 minutes

Total Time to reach Point of Safety	3.07 minutes	under 6 minutes
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Total exit time to street = T + W1 + W2 + W3 + W4 +..+W10	8.07 minutes
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(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route 3

Egress direction: Passenger starting from 83 ft west of Escalator No. 3, travelling to concourse level and street level using Escalator 1a & 2b, Turnstiles and West/2nd street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	95	124	0.77	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-203
Concourse Level-Point of Safety	T3	26	124	0.21	R4-A-111
Concourse Level-2	T4	55	124	0.44	R4-A-111
Concourse Level To Plenum Level, Elevation	T5	22	40	0.55	R4-A-203
Plenum Level	T6	64	124	0.52	R4-A-114
Plenum Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	80	124	0.65	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				4.77	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 1.60 minutes 2.37
under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load = 744
 Exit capacity = 899
 Q2 (clearing time) = occupant load / exit capacity = 0.83 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes

(Concourse)

Occupant load = 744
 Exit capacity = 225
 Q3 (clearing time) = occupant load / exit capacity = 3.30 minutes
 Max clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.94 minutes

Plenum /Ancillary Level

Occupant load = 761
 Exit capacity = 225
 Q4 (clearing time) = occupant load / exit capacity = 3.38 minutes
 Max clearing Time = 3.30
 W4 (waiting time) = Q4 - Max. Time = 0.08 minutes

Plaza Level

Occupant load = 761
 Exit capacity = 270
 Q5 (clearing time) = occupant load / exit capacity = 2.82 minutes
 Max clearing Time = 3.38
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4 + W5 = 2.98 minutes under 6 minutes
 7.38 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)

(Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route 4

Egress direction: Passenger starting from 83 ft west of Stairway No. 5, travelling to concourse level and stree level using Escalator 1a & 2b, Turnstiles and West/2nd street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	104	124	0.83	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-203
Concourse Level-Point of Safety	T3	81	124	0.65	R4-A-111
Concourse Level-2	T4	55	124	0.44	R4-A-111
Concourse Level To Plenum Level, Elevation	T5	22	40	0.55	R4-A-203
Plenum Level	T6	64	124	0.52	R4-A-114
Plenum Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	80	124	0.65	R4-A-102
To street area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				<u>5.28</u>	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 1.53 minutes
 2.37
 under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load = 744
 Exit capacity = 899
 Q2 (clearing time) = occupant load / exit capacity = 0.83 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes

(Concourse)

Occupant load = 744
 Exit capacity = 225
 Q3 (clearing time) = occupant load / exit capacity = 3.30 minutes
 Max clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.94 minutes

Plenum /Ancillary Level

Occupant load = 761
 Exit capacity = 225
 Q4 (clearing time) = occupant load / exit capacity = 3.38 minutes
 Max clearing Time = 3.30
 W4 (waiting time) = Q4 - Max. Time = 0.08 minutes

Plaza Level

Occupant load = 761
 Exit capacity = 270
 Q5 (clearing time) = occupant load / exit capacity = 2.82 minutes
 Max clearing Time = 3.38
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

Total Time to reach Point of Safety = 3.42 minutes under 6 minutes
 Total exit time to street = T + W1 + W2 + W3 + W4 + W5 = 7.83 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)

(Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route 5

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and stree level using Escalator 1a & 2b, Turnstiles and West/2nd street exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	51	124	0.41	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-203
Concourse Level-Point of Safety	T3	23	124	0.19	R4-A-111
Concourse Level-2	T4	229	124	1.85	R4-A-111
Concourse Level To Plenum Level, Elevation	T5	22	40	0.55	R4-A-203
Plenum Level	T6	64	124	0.52	R4-A-114
Plenum Level to Plaza Level, Elevation	T7	46	40	1.16	R4-A-202
Plaza Level	T8	80	124	0.65	R4-A-102
To safe area	T9	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T9				5.80	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 1.95 minutes

East Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-East Corrdior -1

Occupant load = 142
 Exit capacity = 150
 Q3 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-East Double Door -1

Occupant load = 101
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37
 W4 (waiting time) = Q4 - Max. Time = 0.00 minutes

(Concourse)-East Double Door -2

Occupant load = 101
 Exit capacity = 150
 Q5 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-East Corridor -2

Occupant load = 101
 Exit capacity = 200
 Q6 (clearing time) = occupant load / exit capacity = 0.51 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6- Max. Time = 0.00 minutes

(Concourse)-East Door -3

Occupant load = 101
 Exit capacity = 150
 Q7 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route 5

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and street level using Escalator 1a & 2b, Turnstiles and West/2nd street exit

W7 (waiting time) = Q7 - Max. Time	0.00 minutes	
<u>(Concourse)</u>		
Occupant load =	744	
Exit capacity =	225	
Q8 (clearing time) = occupant load / exit capacity	3.30 minutes	
Max. clearing Time	2.37	
W8 (waiting time) = Q8 - Max. Time	0.94 minutes	
<u>Plenum/Ancillary Level West Area Door 1</u>		
Occupant load =	17	
Exit capacity =	60	
Q9 (clearing time) = occupant load / exit capacity	0.28 minutes	
Max. clearing Time	3.30	
W9 (waiting time) = Q9 - Max. Time	0.00 minutes	
<u>Plenum /Ancillary Level</u>		
Occupant load =	761	
Exit capacity =	225	
Q10 (clearing time) = occupant load / exit capacity	3.38 minutes	
Max. clearing Time	3.30	
W10 (waiting time) = Q10 - Max Time	0.08 minutes	
<u>Plaza Level</u>		
Occupant load =	761	
Exit capacity =	270	
Q11 (clearing time) = occupant load / exit capacity	2.82 minutes	
Max. clearing Time	3.38	
W11 (waiting time) = Q11- Max. Time	0.00 minutes	
Total Time to reach Point of Safety	2.95 minutes	under 6 minutes
Total exit time to street = T + W1 + W2 + W3 + W4 +..+W11	8.76 minutes	

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)
 Route6

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and
 street level using Stairway No. 6, 8, Stairway (No. 3) Exit Hatch No. 3.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	51	124	0.41	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-202/2
Concourse Level-Point of Safety	T3	23	124	0.19	R4-A-111
Concourse Level-2	T4	27	124	0.22	R4-A-111
Concourse Level To Roof Level, Elevation	T5	42	40	1.05	R4-A-204
Roof Level	T6	45	124	0.36	R4-A-114
Street level Stairway from Roof Level, Elevation	T7	9	40	0.22	AS-036
To safe area	T8	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T8				<u>2.93</u>	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 1.95 minutes

East Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-East Corridor -1

Occupant load = 142
 Exit capacity = 150
 Q3 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-East Double Door -1

Occupant load = 142
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W4 (waiting time) = Q4 - Max. time = 0.00 minutes

(Concourse)-East Corridor -2

Occupant load = 142
 Exit capacity = 150
 Q5 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-East Single Door -2

Occupant load = 142
 Exit capacity = 60
 Q6 (clearing time) = occupant load / exit capacity = 2.37 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6- Max. Time = 0.00 minutes

(Concourse)-East Corridor -3

Occupant load = 142
 Exit capacity = 150
 Q7 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W7 (waiting time) = Q7 - Max. Time = 0.00 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route6

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and steel level using Stairway No. 6, 8, Stairway (No. 3) Exit Hatch No. 3.

<u>(To Roof Level)-Stairway</u>		
Occupant load =	142	
Exit capacity =	83	
Q8 (clearing time) = occupant load / exit capacity	1.72 minutes	
Max. clearing Time	2.37	
W8 (waiting time) = Q8 - Max. Time	0.00 minutes	
<u>(At Roof Level)-East Corridor</u>		
Occupant load =	142	
Exit capacity =	62	
Q9 (clearing time) = occupant load / exit capacity	2.27 minutes	
Max. clearing Time	2.37	
W9 (waiting time) = Q9 - Max. Time	0.00 minutes	
<u>Roof Level -Emerg. Stairway no. 3</u>		
Occupant load =	71	
Exit capacity =	55	
Q10 (clearing time) = occupant load / exit capacity	1.29 minutes	
Max. clearing Time	2.37	
W10 (waiting time) = Q10- Max. Time	0.00 minutes	
<u>Roof Level -Emerg. Exit Hatch. 3</u>		
Occupant load =	71	
Exit capacity =	100	Assume
Q11 (clearing time) = occupant load / exit capacity	0.71 minutes	
Max. clearing Time	2.37	
W11 (waiting time) = Q11- Max. Time	0.00 minutes	
Total Time to reach Point of Safety	2.95 minutes	under 6 minutes
Total exit time to street = T + W1 + W2 + W3 + W4 +..+W11	4.88 minutes	

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route6A

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and street level using Stairway No. 6, 8, Stairway (No. 3) Exit Hatch No. 3.

Assuming passengers split at every level depending upon the egress element capacity

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	51	124	0.41	R4-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R4-A-202/2
Concourse Level-Point of Safety	T3	23	124	0.19	R4-A-111
Concourse Level-2	T4	27	124	0.22	R4-A-111
Concourse Level To Roof Level, Elevation	T5	42	40	1.05	R4-A-204
Roof Level	T6	45	124	0.36	R4-A-114
Street level Stairway from Roof Level, Elevation	T7	9	40	0.22	AS-036
To safe area	T8	10	124	0.08	ASSUME
T (total walking time) = summation of T1 through T8				2.93	

Stairs (from Platform to Concourse)

Platform occupant load = 817
 Exit capacity = 345
 Q1 (platform clearing time) = occupant load / exit capacity = 2.37 minutes
 W1 (waiting time) = Q1 - T1 = 1.95 minutes

East Emergency Stairway (from Platform to Concourse)

Platform occupant load = 142
 Exit capacity = 83
 Q2 (platform clearing time) = occupant load / exit capacity = 1.72 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.37
 under 4 minutes

(Concourse)-East Corridor -1

Occupant load = 142
 Exit capacity = 150
 Q3 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-East Double Door -1

Occupant load = 142
 Exit capacity = 150
 Q4 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 1.72
 W4 (waiting time) = Q4 - Max. Time = 0.00 minutes

(Concourse)-East Corridor -2

Occupant load = 142
 Exit capacity = 150
 Q5 (clearing time) = occupant load / exit capacity = 0.95 minutes
 Max. clearing Time = 2.37
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-East Single Door -2

Occupant load = 41
 Exit capacity = 60
 Q6 (clearing time) = occupant load / exit capacity = 0.68 minutes
 Max. clearing Time = 2.37
 W6 (waiting time) = Q6 - Max. Time = 0.00 minutes

(Concourse)-East Corridor -3

Occupant load = 41
 Exit capacity = 150
 Q7 (clearing time) = occupant load / exit capacity = 0.27 minutes
 Max. clearing Time = 2.37
 W7 (waiting time) = Q7 - Max. Time = 0.00 minutes

(Refer R4-A-110/111/112/ 102 Mark-up Drawings for Plan Dimension)
 (Refer R4-A-202/203/204 Mark-up Drawings for Elevation Dimension)

Route6A

Egress direction: Passenger starting from 35 ft East of Stair No 6, Travelling to concourse level and street level using Stairway No. 6, 8, Stairway (No. 3) Exit Hatch No. 3.

<u>(To Roof Level)-Stairway</u>		
Occupant load =	41	
Exit capacity =	83	
Q8 (clearing time) = occupant load / exit capacity	0.49	minutes
Max. clearing Time	2.37	
W8 (waiting time) = Q8 - Max. Time	0.00	minutes
<u>(At Roof Level)-East Corridor</u>		
Occupant load =	41	
Exit capacity =	62	
Q9 (clearing time) = occupant load / exit capacity	0.65	minutes
Max. clearing Time	2.37	
W9 (waiting time) = Q9 - Max. Time	0.00	minutes
<u>Roof Level -Emerg. Stairway no. 3</u>		
Occupant load =	41	
Exit capacity =	55	
Q10 (clearing time) = occupant load / exit capacity	0.74	minutes
Max Flow Time	2.37	
W10 (waiting time) = Q10- Max. Time	0.00	minutes
<u>Roof Level -Emerg. Exit Hatch. 3</u>		
Occupant load =	20	
Exit capacity =	100	Assume
Q11 (clearing time) = occupant load / exit capacity	0.20	minutes
Max. clearing Time	2.37	
W11 (waiting time) = Q11- Max. Time	0.00	minutes
Total Time to reach Point of Safety	2.95	minutes under 6 minutes
Total exit time to street = T + W1 + W2 + W3 + W4 +..+W11	4.88	minutes

**2nd and Broadway Station:
Passenger Load**

Background:

Regional connector line 2nd /Broadway Station total egress time is to be calculated based on NFPA-130 procedure to determine the required no. of street entrances to station for EIS

Purpose:

To calculate the total platform occupant load for 2nd/Broadway Station based on NFPA 130 assumptions and given Link Loads.

References

- 1.) NFPA-30 (2010 Edition)
- 2.) EW Peak Hourly Load Diagram
- 3.) NS Long Peak Hourly Load Diagram
- 4.) NS Short Peak Hourly Load Diagram
- 5) Calc-001
- 6) Email from Gulzar Ahmed dated October 12, 2011

Assumptions

- 1) Ony One Train Detraining Passengers in the Peak Direction is considered based on Reference 6
- 2) Entraining load is based on passengers waiting to board trains on three different lines with a service disruption time of 12 minutes or one missed headway, whichever is higher, for the peak direction. A headway of 2.5 minutes is used for the off-peak direction. A missed headway and service disruption time are not assumed for the off-peak direction.
- 3.) NS Long and Short line **southbound** Trains and EW line **westbound** train utilizes Northside platform track (Say No.1)
- 4.) NS Long and Short line **northbound** Trains and EW line **eastbound** train utilizes Southside platform track (Say No.2)
- 5) Surge Factor based on Reference 6.

Surge Factor 1.5

NS Line (Long)				
	Southbound		Northbound	
Link Load	2350	Ppl/Peak hr	1002	Ppl/Peak hr
Detraining Load	16	Ppl/Peak hr	34	Ppl/Peak hr
Entraining Load	9	Ppl/Peak hr	4	Ppl/Peak hr
Peak Headway	10	min		

NS Line (Short)				
	Southbound		Northbound	
Link Load	1591	Ppl/Peak hr	903	Ppl/Peak hr
Detraining Load	22	Ppl/Peak hr	45	Ppl/Peak hr
Entraining Load	19	Ppl/Peak hr	13	Ppl/Peak hr
Peak Headway	10	min		

EW Line				
	Westbound		Eastbound	
Link Load	1970	Ppl/Peak hr	1036	Ppl/Peak hr
Detraining Load	43	Ppl/Peak hr	54	Ppl/Peak hr
Entraining Load	33	Ppl/Peak hr	19	Ppl/Peak hr
Peak Headway	5	min		

Headway Time for Trains	2.5	min
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Possible Train Schedule

Time (min)	Trains
0	NSL
2.5	EW
5	NSS
7.5	EW
10	NSL
12.5	EW
15	NSS
17.5	EW
20	NSL

NS Line (Long)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	392	Ppl/train headway	167	Ppl/train headway

NS Line (Short)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	265	Ppl/train headway	151	Ppl/train headway

EW Line				
Peak Headway	5			min
	Westbound		Eastbound	
Link Load	164	Ppl/train headway	86	Ppl/train headway

Platform Load

Max. Southbound Entraining Load for Track No. 1	61	Ppl/hr
Average Headway Time	2.5	Min.
Total Entraining load for Track No. 1	3	Ppl/Train Headway
Max. Northbound Entraining Load for Track No. 2	36	Ppl/hr
Total Entraining load for Track No. 2	2	Ppl/Train Headway

Maximum Train Load (Crush Load) 795 ppl

Link Load

Max. Southbound Train Load per headway	392	Ppl/Train Headway
Max. Northbound Train peak Headway	167	Ppl/Train Headway

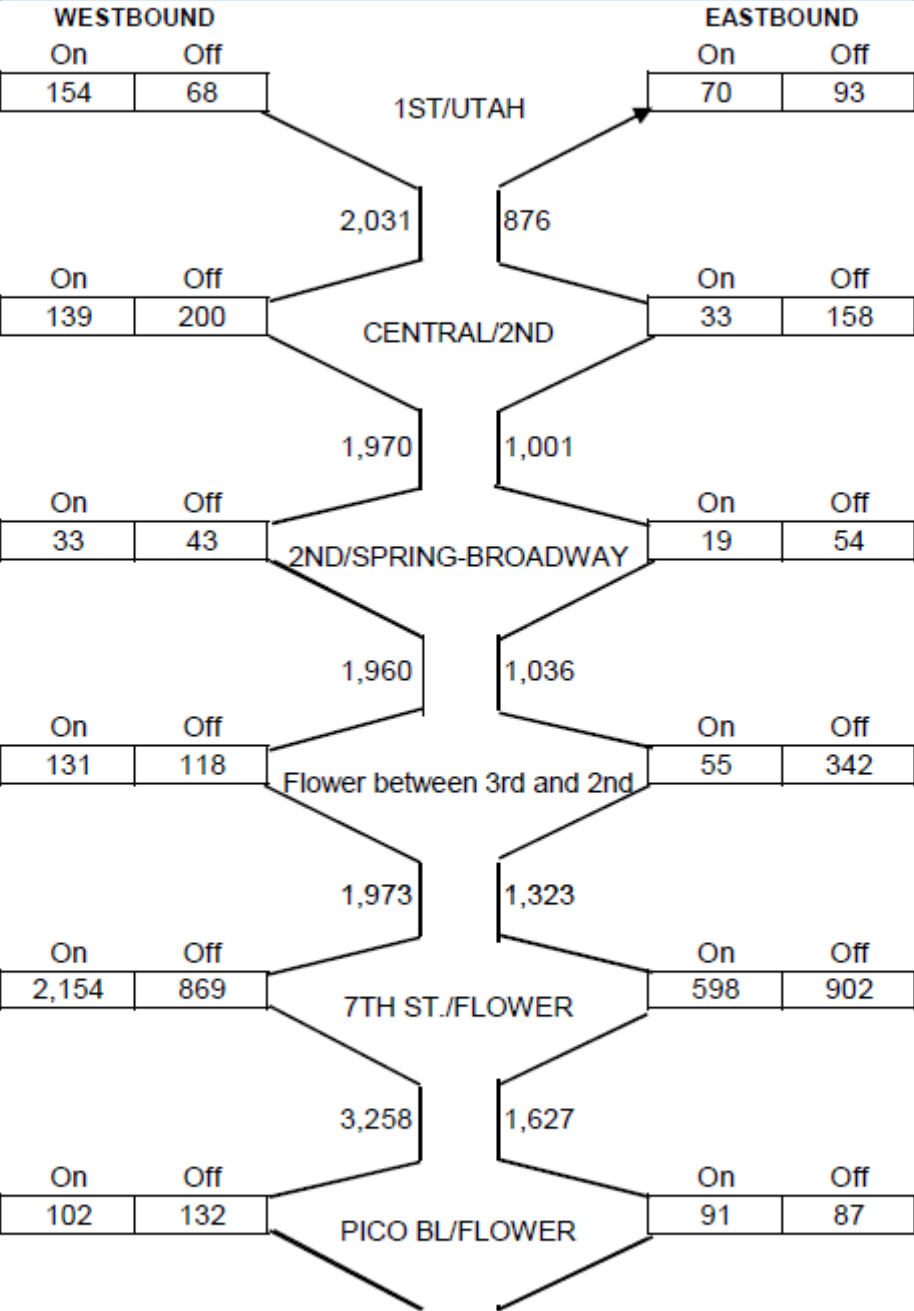
Entraining Load

Peak Direction (South Bound) = [PEAK 15 MIN. LOAD x Surge Factor x MAX (2 x HEADWAY OR 12 MIN.)] / 15
19

Off Peak Direction (North Bound) = [OFF PEAK 15 MIN. LOAD x Surge Factor x (HEADWAY)] / 15
3

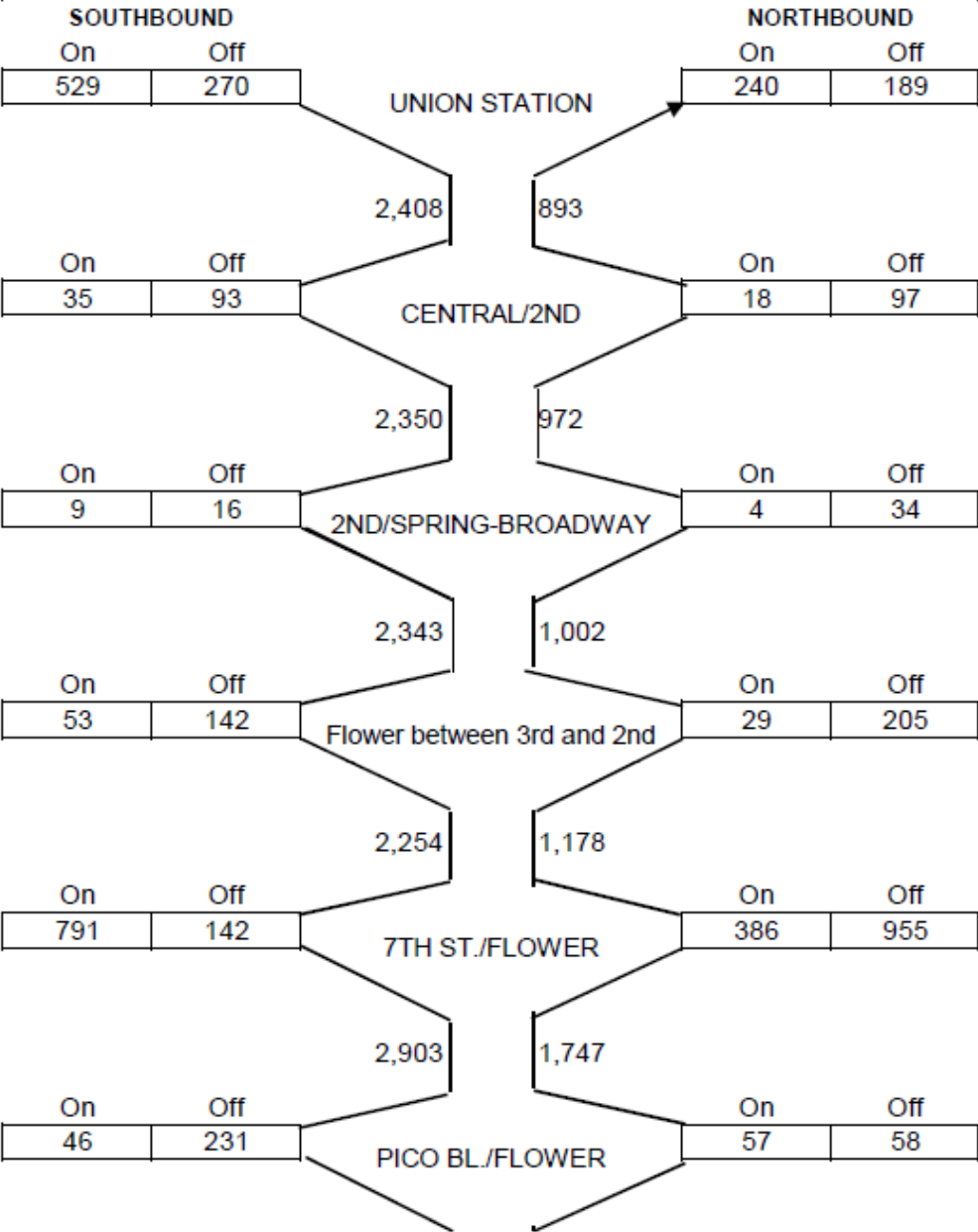
Total Detraining Load 795 ppl
Total Platform Occupant Load 817 ppl

**E-W Line Regional Connector Stations
Peak Hour Boardings and Alightings**



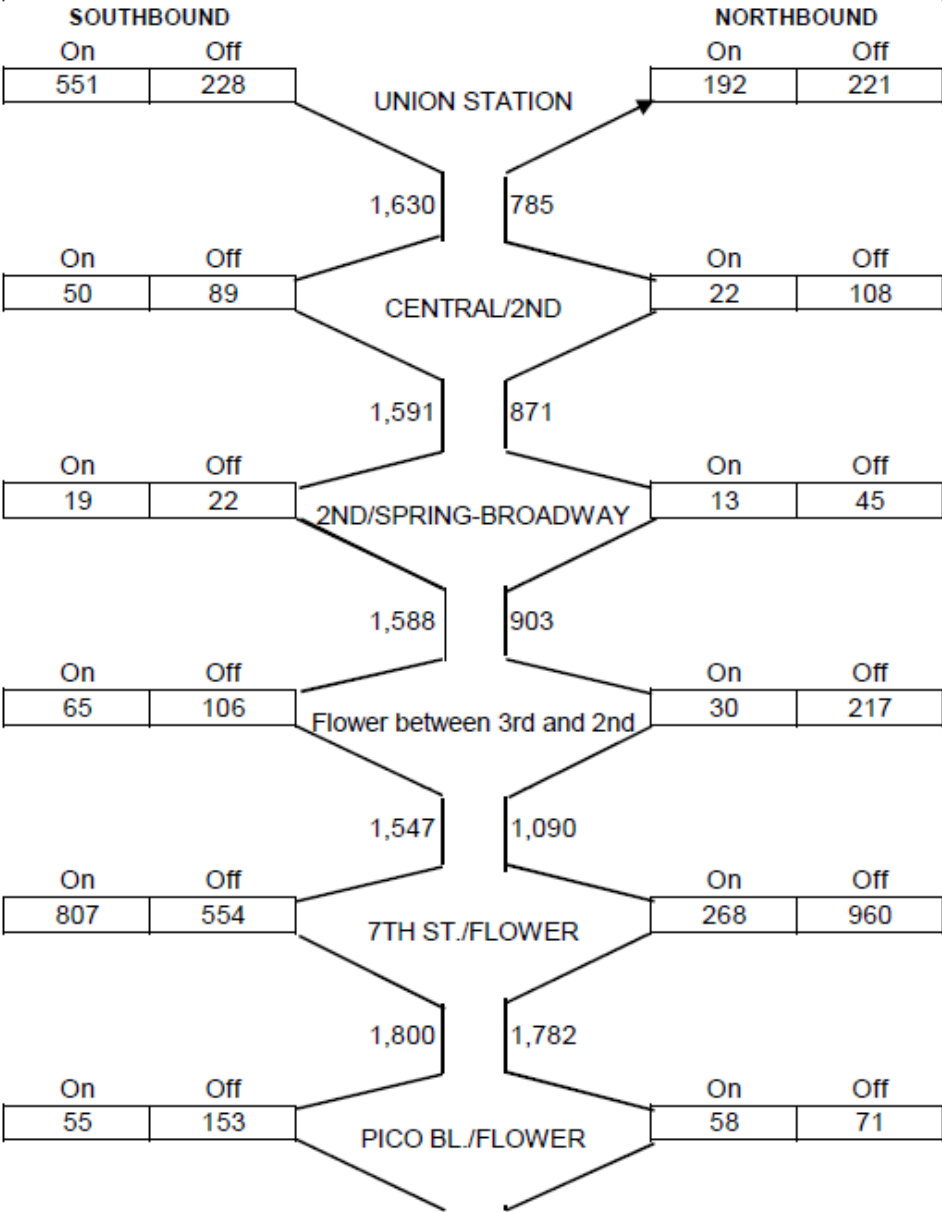
Reference 2

**N-S Line (Long) Azusa/Citrus to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 3

**N-S Line (Short) Sierra Madre Villa to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 4

For calculated train load Metro Fire/Life Safety Criteria, Section 2.5.2.1.A has the following requirement.

The following limitations to the calculated train load shall be applied:

- a. No more than one train will unload at any one track to a platform during an emergency.
- b. The load on any single train is limited to the maximum train capacity.
- c. The calculated train load can be no less than the maximum passenger capacity of a single train.

With above limitations the occupant load for emergency exiting calculations for Century City Constellation station will be as follows.

CALCULATED TRAIN LOAD

MAXIMUM CAPACITY OF A SINGLE TRAIN (6 cars per train) = 1446
(61 Seated + 180 Standing = 241 per car x 6 = 1446)

ENTRAINING LOAD

PEAK (Westbound) ENTRAINING LOAD = [PEAK 15 MIN. LOAD x MAX (2 x HEADWAY OR 12 MIN.)] / 15
= ((193 x 1.5)/4) x (12/15) = 59

OFF PEAK (Eastbound) ENTRAINING LOAD = [OFF PEAK 15 MIN. LOAD x (HEADWAY)] / 15
= ((328 x 1.5)/4) x (4/15) = 33

TOTAL ENTRAINING LOAD = 59 + 33 = 92

TOTAL OCCUPANT LOAD FOR CALCULATION = CALCULATED TRAIN LOAD + TOTAL ENTRAINING LOAD
TRUE

**1st and Central Station:
Egress Capacity Calculations**

Assumptions:

1. Platform occupant load was calculated based on NFPA 130 Standard (2010 edition).
2. One escalator at each level was assumed to be out of service.
3. The Concourse area would be ventilated as per NFPA 130 criteria and is considered as a point of safety.
4. The time to open the Exit Hatch is not included.

Summary

1. The platform clearance time complies with the 4-minute criteria required by NFPA 130.
2. The evacuation time from the platform to the platform emergency stairs complies with the 6-minute NFPA 130 criteria.
3. The longest time for the last occupant to reach a point of safety is 3.37 minutes. The longest time for the last occupant to reach street level is 8.39 minutes.

Route	Egress Paths	Clearing Platform		To a Point of Safety			To Street
		Time (min)	4-minute criteria?	Point of safety at:	Time (min)	6-minute criteria?	Time (min)
1	Platform to Concourse through West Emergency stairway (No. 5), and then to street level through Emergency Stair No. 7 and Exit Hatch No. 1	2.44	Pass	Concourse	3.25	Pass	4.26
1a	Platform to Concourse through West Emergency stairway (No. 5), and then to street level through Emergency Stair No. 7 and Exit Hatch No. 1a (passengers split on concourse)	2.44	Pass	Concourse	3.25	Pass	4.26
2	Platform to Concourse through West Emergency (No. 5) , and then to street Level through South Entrance Exit	2.44	Pass	Concourse	3.25	Pass	5.90
3	Platform to Concourse through West Stairway (No. 3), Turnstiles , and then to street level North Entrance Exit	2.44	Pass	Concourse	3.06	Pass	5.33
4	Platform to Concourse through West Escalator (No. 3), Turnstiles , and then to street level South Entrance Exit	2.44	Pass	Concourse	3.06	Pass	4.91
4a	Platform to Concourse through West Escalator (No. 3), Turnstiles , and then to street level North Entrance Exit	2.44	Pass	Concourse	3.06	Pass	4.99
5	Platform to Concourse through East Emergency stairway (No. 6), and then to street level through Emergency Stair No. 8 and Exit Hatch No. 2	2.44	Pass	Concourse	3.14	Pass	3.80
5a	Platform to Concourse through East Emergency stairway (No. 6), and then to street level through Emergency Stair No. 8 and Exit Hatch No. 2 (passenger split)	2.44	Pass	Concourse	3.14	Pass	3.80
6	Platform to Concourse through East Emergency stairway (No. 6), and then to street level through South Entrance Exit	2.44	Pass	Concourse	3.14	Pass	5.15

Element	Persons per inch per minute	Person per minute per unit	Travel Speed (fpm)	
<i>Reference: NFPA 130 Standard, 2010 Edition</i>				
Platforms, Corridors, and Ramps.	2.08	---	124	
Stairs and Escalators (see note 1):				
(i) Up direction:	1.31	---	40	
(ii) Down direction:	1.41	---	48	
Doors and Gates (single leaf)	---	60	---	Section 5.5.6.3.4.2
Doors and Gates (multi-leaf)	2.08	---	---	Section 5.5.6.3.4.3
Turnstiles	---	25	---	
Exit Hatch	2.08			Assume

Notes:

1. NFPA 130 Standard, Section 5.5.6.3.2.3 specifies the capacity and travel speed for stairs/escalators but does not indicate whether the values are dependent on the travel direction. However, the examples in Annex C indicate that the capacity and travel speed for the up direction are 1.31 pim and 40 fpm, respectively, and the capacity and speed for the down direction are 1.41 pim and 48 fpm, respectively.

2. NFPA 130 Standard, Section 5.5.6.3.5.2 specifies that turnstile-type fare collection gates shall have a capacity of 25 people per minute for egress calculations. Therefore assume a capacity of 25 people per minute for all turnstiles.

Egress Capacity

One escalator at each level is assumed to be out of service (per NFPA 130 2010 edition, Section 5.5.6.3.2.6).

Egress Elements:

Element	Direction	No. of Units	Width (in)	Persons per inch per minute	Person per minute per unit	Total people per minute	
Platform to Concourse:							
Emergency Stair No 5 Door (West End)		1	36		60	60	
Stair No 3	Up	1	66	1.31	86	86	
Stair No 4	Up	1	66	1.31	86	86	
Escalator No. 2	Up	0	48	1.31	63	0	Out of Service (Standard size)
Escalator No. 3	Up	1	48	1.31	63	63	
-	Up	0	46	1.31	60	0	
-	Up	0	46	1.31	60	0	
Emergency Stair No 6 Door (East End)		1	36		60	60	
						Total:	356
						Sub Total stairs:	236 (Excluding emergency stairs at station ends)

Platform to Concourse through Emergency Stairway:							
West Emergency Stairway Corridor		1	38	2.08	79	79	(Subtract 12" for each sidewall, 62-2*12)
Emergency Stair No. 5	Up	1	48	1.31	63	63	
East Emergency Stairway Corridor		1	76	2.08	158	158	(Subtract 12" for each sidewall, 100-2*12)
Emergency Stair No. 6	Up	1	48	1.31	63	63	
						Total:	363
						Sub Total:	142 (Excluding East emergency stairs & corridor)

Concourse Center :							
Councourse Corridor -Point of Safety		1	540	2.08	1123	1123	(Subtract 12" for each sidewall, 564-2*12)
Turnstile		10			25	250	
Gate		2			60	120	
						Total:	370 (Capacity of Turnstile & Gates)

Concourse: West Emergency Stairway Level							
Emergency Stairway No. 5 (West)	Up	1	48	1.31	63	63	
Corridor---alt. rou.		1	36	2.08	75	75	(Subtract 12" for each sidewall, 60-2*12)
Emergency Stairway No. 7 (West)	Up	1	60	1.31	79	79	
Towards Concourse Center							
alt. rou.---Single Leaf Door		1	36		60	60	
Single Leaf Door		1	36		60	60	
Corridor		1	48	2.08	100	100	(Subtract 12" for each sidewall, 72-2*12)
Two Leaf Door		1	72	2.08	150	150	

Concourse: East Emergency Stairway Level							
Emergency Stairway No. 6 (East)	Up	1	48	1.31	63	63	
Corridor---alt. rou.		1	57	2.08	119	119	(Subtract 12" for each sidewall, 81-2*12)
Emergency Stairway No. 8 (East)	Up	1	60	1.31	79	79	
Towards Concourse Center							
alt. rou.---Single Leaf Door		1	36		60	60	
Corridor		1	24	2.08	50	50	(Subtract 12" for each sidewall, 48-2*12)
Single Leaf Door		1	36		60	60	
Corridor		1	48	2.08	100	100	(Subtract 12" for each sidewall, 72-2*12)
Two Leaf Door		1	72	2.08	150	150	

Concourse to North Entrance Plaza Level:							
Escalator No. 1a	Up	1	48	1.31	63	63	
Stair No. 1	Up	1	66	1.31	86	86	
Stair No. 1	Up	1	66	1.31	86	86	
Escalator No. 1b	Up	0	48	1.31	63	0	(1 Escalator out of service)
						Total Stairway & Escalator:	236

Concourse to South Entrance Plaza Level:							
Stair No. 2	Up	1	66	1.31	86	86	
Stair No. 2	Up	1	66	1.31	86	86	
						Total Stairway & Escalator:	173

Egress Capacity

One escalator at each level is assumed to be out of service (per NFPA 130 2010 edition, Section 5.5.6.3.2.6).

Egress Elements:

Element	Direction	No. of Units	Width (In)	Persons per inch per minute	Person per minute per unit	Total people per minute
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Plaza Level Plan:

West side Exit Hatch 1		1	48	2.08	100	100	Assume
North Side Entrance No. 1		1	252	2.08	524	524	(Subtract 12" for each sidewall, 276-2*12)
East Side Exit Hatch 2		1	48	2.08	100	100	Assume
East Side Entrance No. 2		1	312	2.08	649	649	(Subtract 12" for each sidewall, 336-2*12)

Passenger Load

Platform

Platform Occupant Load	868	[Based on NFPA 130 Standard (2010 edition)]
Occupant load from ancillary rooms in passenger area	0	
Total Platform Occupant Load	868	

	Egress capacity (ppm)	Percent	Number of passengers
Stairs & Escalators	236	66.3%	575
West Emergency Stairway (No. 5) Door	60	16.9%	146
East Emergency Stairway (No. 6) Door	60	16.9%	146
Total:		100%	868

Concourse

Concourse West Area Occupant Load-	146	(from platform)	
West Emergency Stairway (No. 7)	79	56.7%	83
Single Door (Twds. Concourse Center)	60	43.3%	63
Total:		100%	146

Concourse East Area Occupant Load-	146	(from platform)	
East Emergency Stairway (No.8)	79	56.7%	83
Single Door (Twds. Concourse Center)	60	43.3%	63
Total:		100%	146

Concourse Center Area Occupant Load-	702		
Occupant load from ancillary rooms on concourse level	8		
Total Concourse Center Area Occupant Load	710		
Total Concourse Level Occupant Load	876	(from platform)	

	Egress capacity (ppm)	Percent	Number of passengers
Concourse Stairway & Escalator (No. 1)	236	57.7%	410
Concourse Stairway & Escalator (No. 2)	173	42.3%	300
Total:		100%	710

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route 1

Egress direction: Passenger starting from 30 ft East of Emergency Stair No. 5, travelling to concourse level and street level using stairway No. 7 and Emergency Exit Hatch No. 1.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	44	124	0.35	R5-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	50	124	0.40	R5-A-111
Concourse Level-2	T4	47	124	0.38	R5-A-111
Concourse To Plaza Level, Elevation	T5	22	40	0.56	R5-A-201
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				2.17	

Stairs (from Platform to Concourse)

Platform occupant load =	868
Exit capacity =	356
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes
W1 (waiting time) = Q1 - T1	2.09 minutes

West Emerg. Stairway Corridor (Beyond West End door into corridor)

Platform occupant load =	146
Exit capacity =	79
Q2 (platform clearing time) = occupant load / exit capacity	1.85 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes
	2.44
	under 4 minutes

West Emergency Stairway (To Concourse Level)

Occupant load =	146
Exit capacity =	63
Q3 (clearing time) = occupant load / exit capacity	2.33 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-West corridor -1

Occupant load =	146
Exit capacity =	75
Q4 (clearing time) = occupant load / exit capacity	1.95 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max time	0.00 minutes

(To Roof Level)-Stairway

Occupant load =	146
Exit capacity =	79
Q5 (clearing time) = occupant load / exit capacity	1.86 minutes
Max. clearing Time	2.44
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Plaza Level -Emerg. Exit Hatch. 1

Occupant load =	146
Exit capacity =	100
Q6 (clearing time) = occupant load / exit capacity	1.47 minutes
Max. clearing Time	2.44
W6 (waiting time) = Q6 - Max. Time	0.00 minutes
	Assume

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4 + W5 + W6	3.25 minutes	under 5 minutes
--------------------------------------------------------------------	---------------------	------------------------

Total exit time to street = T + W1 + W2 + W3 + W4 + W5 + W6	4.26 minutes
--------------------------------------------------------------------	---------------------

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer A5-036 for Exit Hatch Details)

Route 1A

Egress direction: Passenger starting from 30 ft East of Emergency Stair No. 5, travelling to concourse level and street level using stairway No. 7 and Emergency Exit Hatch No. 1.

Assuming passengers split at every level depending upon the egress element capacity

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	43.5	124	0.35	R5-A-110
Platform to Concourse, Elevation	T2	16.1	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	50	124	0.40	R5-A-111
Concourse Level-2	T4	47	124	0.38	R5-A-111
Concourse To Plaza Level, Elevation	T5	22.3	40	0.56	R5-A-201
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				2.17	

Stairs (from Platform to Concourse)

Platform occupant load =	868
Exit capacity =	355
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes
W1 (waiting time) = Q1 - T1	2.09 minutes

West Emerg. Stairway Corridor (Beyond West End door into corridor)

Platform occupant load =	146
Exit capacity =	79
Q2 (platform clearing time) = occupant load / exit capacity	1.85 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes
	2.44
	under 4 minutes

West Emergency Stairway (To Concourse Level)

Occupant load =	146
Exit capacity =	63
Q3 (clearing time) = occupant load / exit capacity	2.33 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-West corridor -1

Occupant load =	146
Exit capacity =	75
Q4 (clearing time) = occupant load / exit capacity	1.95 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max time	0.00 minutes

(To Roof Level)-Stairway

Occupant load =	83
Exit capacity =	79
Q5 (clearing time) = occupant load / exit capacity	1.06 minutes
Max Flow Time	2.44
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Plaza Level -Emerg. Exit Hatch, 1

Occupant load =	83	
Exit capacity =	100	Assume
Q6 (clearing time) = occupant load / exit capacity	0.83 minutes	
Max Flow Time	2.44	
W6 (waiting time) = Q6- Max. Time	0.00 minutes	

Total Time to reach Point of Safety 3.25 minutes under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 +W5+W6 4.26 minutes

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route2

Egress direction: Passenger starting from 30 ft East of Emergency Stair No. 5, travelling to concourse level and street level using stairway No. 2 and South Exit.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	44	124	0.35	R5-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	50	124	0.40	R5-A-111
Concourse Level-2	T4	244	124	1.97	R5-A-111
Concourse To Plaza Level, Elevation	T5	23	40	0.58	R5-A-201
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				3.78	

Stairs (from Platform to Concourse)

Platform occupant load =	868
Exit capacity =	356
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes
W1 (waiting time) = Q1 - T1	2.09 minutes

West Emerg. Stairway Corridor (Beyond West End door into corridor)

Platform occupant load =	146
Exit capacity =	79
Q2 (platform clearing time) = occupant load / exit capacity	1.85 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes
	2.44
	under 4 minutes

West Emergency Stairway (To Concourse Level)

Occupant load =	146
Exit capacity =	63
Q3 (clearing time) = occupant load / exit capacity	2.33 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-West Corridor -1

Occupant load =	146
Exit capacity =	75
Q4 (clearing time) = occupant load / exit capacity	1.95 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

(Concourse)-West Single Door -1

Occupant load =	63
Exit capacity =	60
Q5 (clearing time) = occupant load / exit capacity	1.06 minutes
Max. clearing Time	2.44
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

(Concourse)-West Corridor -2

Occupant load =	63
Exit capacity =	100
Q6 (clearing time) = occupant load / exit capacity	0.63 minutes
Max. clearing Time	2.44
W6 (waiting time) = Q6 - Max. Time	0.00 minutes

(Concourse)-West Double Door -3

Occupant load =	127
Exit capacity =	150
Q7 (clearing time) = occupant load / exit capacity	0.85 minutes
Max. clearing Time	2.44
W7 (waiting time) = Q7 - Max. Time	0.00 minutes

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route2

Egress direction: Passenger starting from 30 ft East of Emergency Stair No. 5, travelling to concourse level and street level using stairway No. 2 and South Exit.

<u>Concourse Level Southern Stairway - (To Plaza Level)</u>		
Occupant load =	427	
Exit capacity =	173	
Q8 (clearing time) = occupant load / exit capacity	2.47 minutes	
Max. clearing Time	2.44	
W8 (waiting time) = Q8 - Max. Time	0.03 minutes	
Total Time to reach Point of Safety	3.25	under 6 minutes
Total exit time to street = T + W1 + W2 + W3 + W4 +...+W8	5.90 minutes	

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)
 (Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)
 (Refer A5-036 for Exit Hatch Details)

Route 3

Egress direction: Passenger starting from 30 ft west of Stair Way No 3, travelling to concourse level and street level using Turnstiles, Stairs & Escalator 1 & 1a, and North exit

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	41	124	0.33	R5-A-110
Platform to Concourse, Elevation	T2	16.0	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	27	124	0.22	R5-A-111
Concourse Level-2	T4	204	124	1.65	R5-A-111
Concourse Level To plaza Level, Elevation	T5	22	40	0.55	R5-A-201
To street area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				3.22	

Stairs (from Platform to Concourse)

Platform occupant load =	868	
Exit capacity =	356	
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes	
W1 (waiting time) = Q1 - T1	2.11 minutes	2.44
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	710
Exit capacity =	1123
Q2 (clearing time) = occupant load / exit capacity	0.63 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)-Turnstile & Gates

Occupant load =	710
Exit capacity =	370
Q3 (clearing time) = occupant load / exit capacity	1.92 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-To Plaza Level

Occupant load =	410
Exit capacity =	236
Q4 (clearing time) = occupant load / exit capacity	1.74 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4	3.06	under 5 minutes
	5.33 minutes	

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route 4

Egress direction: Passenger starting from 85 ft east of Escalator No. 3, travelling to concourse level and street level using Turnstiles, Stair No. 2, and South exit.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	97	124	0.78	R5-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	27	124	0.22	R5-A-111
Concourse Level-2	T4	145	124	1.17	R5-A-111
Concourse Level To plaza Level, Elevation	T5	23	40	0.58	R5-A-201
To street area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				3.23	

Stairs (from Platform to Concourse)

Platform occupant load =	868	
Exit capacity =	356	
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes	
W1 (waiting time) = Q1 - T1	1.66 minutes	2.44
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	710
Exit capacity =	1123
Q2 (clearing time) = occupant load / exit capacity	0.63 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)-Turnstile & Gates

Occupant load =	710
Exit capacity =	370
Q3 (clearing time) = occupant load / exit capacity	1.92 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-To Plaza Level

Occupant load =	427
Exit capacity =	173
Q4 (clearing time) = occupant load / exit capacity	2.47 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max. Time	0.03 minutes

Total Time to reach Point of Safety	3.06	under 6 minutes
Total exit time to street = T + W1 + W2 + W3 + W4	4.91 minutes	

(Refer R5-A-101/110/111/112/1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route 4a

Egress direction: Passenger starting from 85 ft east of Escalator No. 3, travelling to concourse level and street level using Turnstiles, Stair No. 1, and North exit.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	97	124	0.78	R5-A-110
Platform to Concourse, Elevation	T2	16	40	0.40	R5-A-201
Concourse Level-Point of Safety	T3	27	124	0.22	R5-A-111
Concourse Level-2	T4	162	124	1.31	R5-A-111
Concourse Level To plaza Level, Elevation	T5	22	40	0.55	R5-A-206
To street area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				3.34	

Stairs (from Platform to Concourse)

Platform occupant load =	868	
Exit capacity =	356	
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes	
W1 (waiting time) = Q1 - T1	1.66 minutes	2.44
		under 4 minutes

(Concourse) central Corridor -Point of Safety

Occupant load =	710
Exit capacity =	1123
Q2 (clearing time) = occupant load / exit capacity	0.63 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes

(Concourse)-Turnstile & Gates

Occupant load =	710
Exit capacity =	370
Q3 (clearing time) = occupant load / exit capacity	1.92 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-To Plaza Level

Occupant load =	410
Exit capacity =	236
Q4 (clearing time) = occupant load / exit capacity	1.74 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max. Time	0.00 minutes

Total Time to reach Point of Safety

Total exit time to street = T + W1 + W2 + W3 + W4	3.06	under 6 minutes
	4.99 minutes	

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route 5

Egress direction: Passenger starting from 80 ft west of Emergency Stair No. 6, travelling to concourse level and street level using stairway No 8, and Exit hatch No. 2.

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	92	124	0.74	R5-A-110
Platform to Concourse, Elevation	T2	16.5	40	0.41	R5-A-201
Concourse Level-Point of Safety	T3	36	124	0.29	R5-A-111
Concourse Level-2	T4	8	124	0.06	R5-A-111
Concourse Level To Plaza Level, Elevation	T5	20.66	40	0.52	R5-A-202
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				2.11	

Stairs (from Platform to Concourse)

Platform occupant load =	868
Exit capacity =	356
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes
W1 (waiting time) = Q1 - T1	1.70 minutes

East Emerg. Stairway Corridor(Beyond East End door into corridor)

Platform occupant load =	146
Exit capacity =	158
Q2 (platform clearing time) = occupant load / exit capacity	0.93 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes
	2.44
	under 4 minutes

East Emergency Stairway (To Concourse Level)

Occupant load =	146
Exit capacity =	63
Q3 (clearing time) = occupant load / exit capacity	2.33 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-East corridor -1

Occupant load =	146
Exit capacity =	119
Q4 (clearing time) = occupant load / exit capacity	1.23 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max time	0.00 minutes

(To Roof Level)-Stairway

Occupant load =	146
Exit capacity =	79
Q5 (clearing time) = occupant load / exit capacity	1.86 minutes
Max. clearing Time	2.44
W5 (waiting time) = Q4 - Max Time	0.00 minutes

Plaza Level -Emerg. Exit Hatch. 2

Occupant load =	146
Exit capacity =	100
Q6 (clearing time) = occupant load / exit capacity	1.47 minutes
Max. clearing Time	2.44
W6 (waiting time) = Q5- Max Time	0.00 minutes

Total Time to reach Point of Safety

	3.14	under 6 minutes
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Total exit time to street = T + W1 + W2 + W3 + W4 + W5 + W6	3.80 minutes
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(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route 5A

Egress direction: Passenger starting from 80 ft west of Emergency Stair No 6, Travelling to concourse level and street level using stairway No 8, and Exit hatch No. 2.

Assuming passengers split at every level depending upon the egress element capacity

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	92	124	0.74	R5-A-110
Platform to Concourse, Elevation	T2	17	40	0.41	R5-A-201
Concourse Level-Point of Safety	T3	36	124	0.29	R5-A-111
Concourse Level-2	T4	8	124	0.06	R5-A-111
Concourse Level To Plaza Level, Elevation	T5	21	40	0.52	R5-A-202
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				2.11	

Stairs (from Platform to Concourse)

Platform occupant load =	868
Exit capacity =	356
Q1 (platform clearing time) = occupant load / exit capacity	2.44 minutes
W1 (waiting time) = Q1 - T1	1.70 minutes

East Emerg. Stairway Corridor(Beyond East End door into corridor)

Platform occupant load =	146
Exit capacity =	158
Q2 (platform clearing time) = occupant load / exit capacity	0.93 minutes
W2 (waiting time) = Q2 - Q1	0.00 minutes
	2.44
	under 4 minutes

East Emergency Stairway (To Concourse Level)

Occupant load =	146
Exit capacity =	63
Q3 (clearing time) = occupant load / exit capacity	2.33 minutes
Max. clearing Time	2.44
W3 (waiting time) = Q3 - Max. Time	0.00 minutes

(Concourse)-East corridor -1

Occupant load =	146
Exit capacity =	119
Q4 (clearing time) = occupant load / exit capacity	1.23 minutes
Max. clearing Time	2.44
W4 (waiting time) = Q4 - Max. time	0.00 minutes

(To Roof Level)-Stairway

Occupant load =	83
Exit capacity =	79
Q5 (clearing time) = occupant load / exit capacity	1.06 minutes
Max. clearing Time	2.44
W5 (waiting time) = Q5 - Max. Time	0.00 minutes

Plaza Level -Emerg. Exit Hatch. 2

Occupant load =	83
Exit capacity =	100
Q6 (clearing time) = occupant load / exit capacity	0.83 minutes
Max. clearing Time	2.44
W6 (waiting time) = Q6- Max. Time	0.00 minutes

Total Time to reach Point of Safety

3.14	under 6 minutes
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Total exit time to street = T + W1 + W2 + W3 + W4 + W5 + W6

3.80 minutes

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)
 (Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)
 (Refer A5-036 for Exit Hatch Details)

Routes

Egress direction: Passenger starting from 80 ft west of Emergency Stair No. 6, travelling to concourse level and steel level using stairway No. 2 (south exit)

Walking Time For The Longest Exit Route

		ft	fpm	Minutes	
On Platform	T1	92	124	0.74	R5-A-110
Platform to Concourse, Elevation	T2	16.5	40	0.41	R5-A-201
Concourse Level-Point of Safety	T3	36	124	0.29	R5-A-111
Concourse Level-2	T4	164	124	1.32	R5-A-111
Concourse To Plaza Level, Elevation	T5	23.01	40	0.58	R5-A-202
To safe area	T6	10	124	0.08	
T (total walking time) = summation of T1 through T6				3.42	

Stairs (from Platform to Concourse)

Platform occupant load = 868
 Exit capacity = 356
 Q1 (platform clearing time) = occupant load / exit capacity = 2.44 minutes
 W1 (waiting time) = Q1 - T1 = 1.70 minutes

East Emerg. Stairway Corridor(Beyond East End door into corridor)

Platform occupant load = 146
 Exit capacity = 158
 Q2 (platform clearing time) = occupant load / exit capacity = 0.93 minutes
 W2 (waiting time) = Q2 - Q1 = 0.00 minutes
 2.44
 under 4 minutes

East Emergency Stairway (To Concourse Level)

Occupant load = 146
 Exit capacity = 63
 Q3 (clearing time) = occupant load / exit capacity = 2.33 minutes
 Max. clearing Time = 2.44
 W3 (waiting time) = Q3 - Max. Time = 0.00 minutes

(Concourse)-East Corridor -1

Occupant load = 146
 Exit capacity = 119
 Q4 (clearing time) = occupant load / exit capacity = 1.23 minutes
 Max. clearing Time = 2.44
 W4 (waiting time) = Q4 - Max. Time = 0.00 minutes

(Concourse)- East Single Door -1

Occupant load = 63
 Exit capacity = 60
 Q5 (clearing time) = occupant load / exit capacity = 1.06 minutes
 Max. clearing Time = 2.44
 W5 (waiting time) = Q5 - Max. Time = 0.00 minutes

(Concourse)-East Corridor -2

Occupant load = 63
 Exit capacity = 50
 Q6 (clearing time) = occupant load / exit capacity = 1.27 minutes
 Max. clearing Time = 2.44
 W6 (waiting time) = Q6 - Max. Time = 0.00 minutes

(Concourse)- Double Door -3

Occupant load = 127
 Exit capacity = 150
 Q7 (clearing time) = occupant load / exit capacity = 0.85 minutes
 Max. clearing Time = 2.44
 W7 (waiting time) = Q7 - Max. Time = 0.00 minutes

(Refer R5-A-101/110/111/112/ 1113 Mark-up Drawings for Plan Dimension)

(Refer R5-A-201/202/206 Mark-up Drawings for Elevation Dimension)

(Refer AS-036 for Exit Hatch Details)

Route6

Egress direction: Passenger starting from 80 ft west of Emergency Stair No. 6, travelling to concourse level and street level using stairway No. 2 (south exit)

Concourse Level Southern Stairway - (To Plaza Level)

Occupant load =	427
Exit capacity =	173
Q8 (clearing time) = occupant load / exit capacity	2.47 minutes
Max Flow Time	2.44
W8 (waiting time) = Q8 - Max. Time	0.03 minutes

Total Time to reach Point of Safety

3.14 under 6 minutes

Total exit time to street = T + W1 + W2 + W3 + W4 +...+W8

5.15 minutes

**1st and Central Station:
Passenger Load**

Background:

Regional connector line 1st / Central Ave Station total egress time is to be calculated based on NFPA-130 procedure to determine the required no. of street entrances to station for EIS

Purpose:

To calculate the total platform occupant load for 1st / Central Ave Station based on NFPA 130 assumptions and given Link Loads.

References

- 1.) NFPA-30 (2010 Edition)
- 2.) EW Peak Hourly Load Diagram
- 3.) NS Long Peak Hourly Load Diagram
- 4.) NS Short Peak Hourly Load Diagram
- 5) Calc-001
- 6) Email from Gulzar Ahmed dated October 12, 2011

Assumptions

- 1) Ony One Train Detraining Passengers in the Peak Direction is considered based on Reference 6
- 2) Entraining load is based on passengers waiting to board trains on three different lines with a service disruption time of 12 minutes or one missed headway, whichever is higher, for the peak direction. A headway of 2.5 minutes is used for the off-peak direction. A missed headway and service disruption time are not assumed for the off-peak direction.
- 3.) NS Long and Short line **southbound** Trains and EW line **westbound** train utilizes Northside platform track (Say No.1)
- 4.) NS Long and Short line **northbound** Trains and EW line **eastbound** train utilizes Southside platform track (Say No.2)
- 5) Surge Factor based on Reference 6.

Surge Factor 1.5

NS Line (Long)				
	Southbound		Northbound	
Link Load	2408	Ppl/Peak hr	972	Ppl/Peak hr
Detraining Load	93	Ppl/Peak hr	97	Ppl/Peak hr
Entraining Load	35	Ppl/Peak hr	18	Ppl/Peak hr
Peak Headway	10	min		

NS Line (Short)				
	Southbound		Northbound	
Link Load	1630	Ppl/Peak hr	871	Ppl/Peak hr
Detraining Load	89	Ppl/Peak hr	108	Ppl/Peak hr
Entraining Load	50	Ppl/Peak hr	22	Ppl/Peak hr
Peak Headway	10	min		

EW Line				
	Westbound		Eastbound	
Link Load	2031	Ppl/Peak hr	1001	Ppl/Peak hr
Detraining Load	200	Ppl/Peak hr	158	Ppl/Peak hr
Entraining Load	139	Ppl/Peak hr	33	Ppl/Peak hr
Peak Headway	5	min		

Headway Time for Trains	2.5	min		
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Possible Train Schedule

Time (min)	Trains
0	NSL
2.5	EW
5	NSS
7.5	EW
10	NSL
12.5	EW
15	NSS
17.5	EW
20	NSL

NS Line (Long)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	401	Ppl/train headway	162	Ppl/train headway

NS Line (Short)				
Peak Headway	10			min
	Southbound		Northbound	
Link Load	272	Ppl/train headway	145	Ppl/train headway

EW Line				
Peak Headway	5			min
	Westbound		Eastbound	
Link Load	169	Ppl/train headway	83	Ppl/train headway

Platform Load

Max. Southbound Entraining Load for Track No. 1	224	Ppl/hr
Average Headway Time	2.5	min.
Total Entraining load for Track No. 1	10	Ppl/Train Headway
Max. Northbound Entraining Load for Track No. 2	73	Ppl/hr
Total Entraining load for Track No. 2	4	Ppl/Train Headway

Maximum Train Load (Crush Load) 795 ppl

Link Load

Max. Southbound Train Load per headway	401	Ppl/Train Headway
Max. Northbound Train peak Headway	162	Ppl/Train Headway

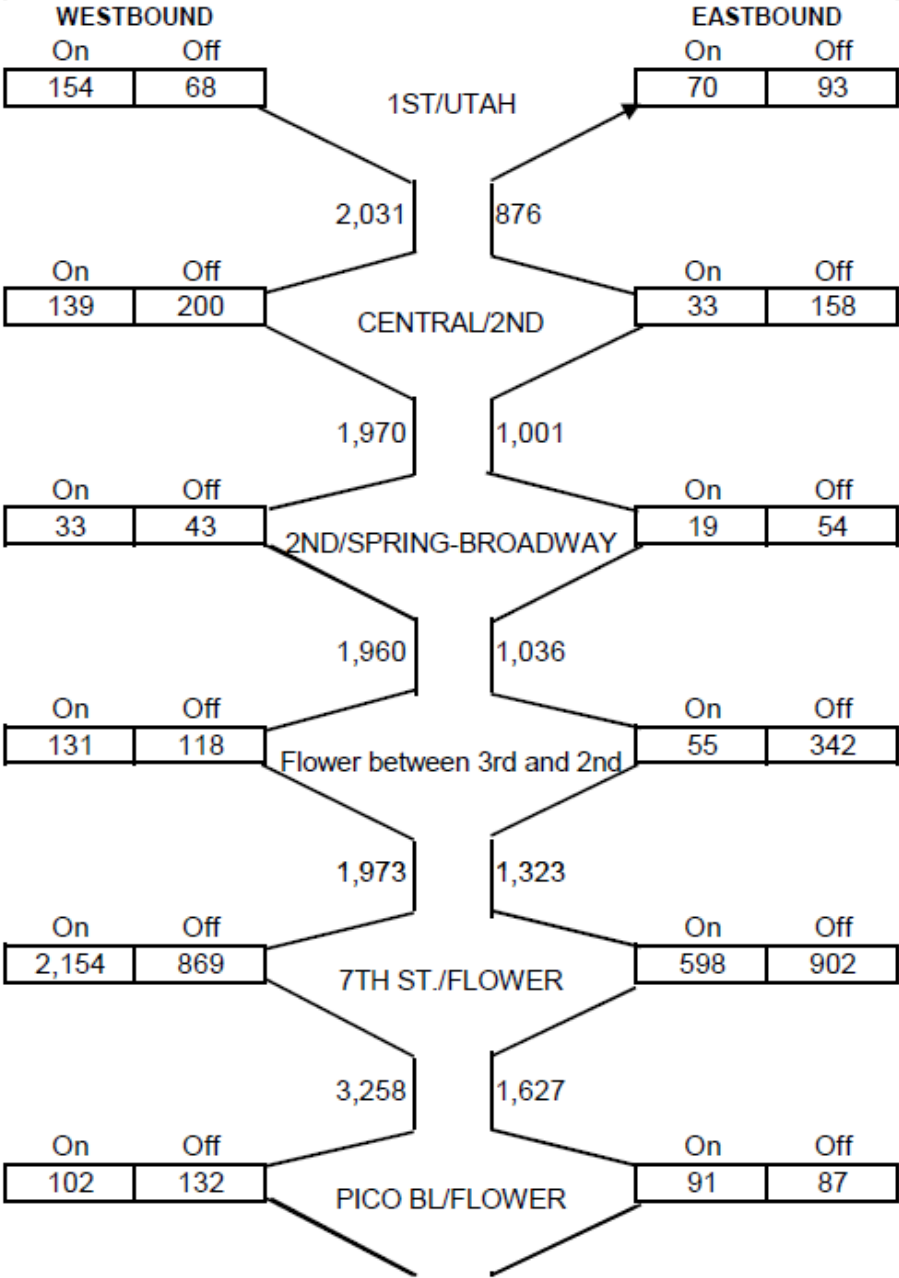
Entraining Load

Peak Direction (South Bound) = [PEAK 15 MIN. LOAD x Surge Factor x MAX (2 x HEADWAY OR 12 MIN.)] / 15
68

Off Peak Direction (North Bound) = [OFF PEAK 15 MIN. LOAD x Surge Factor x (HEADWAY)] / 15
5

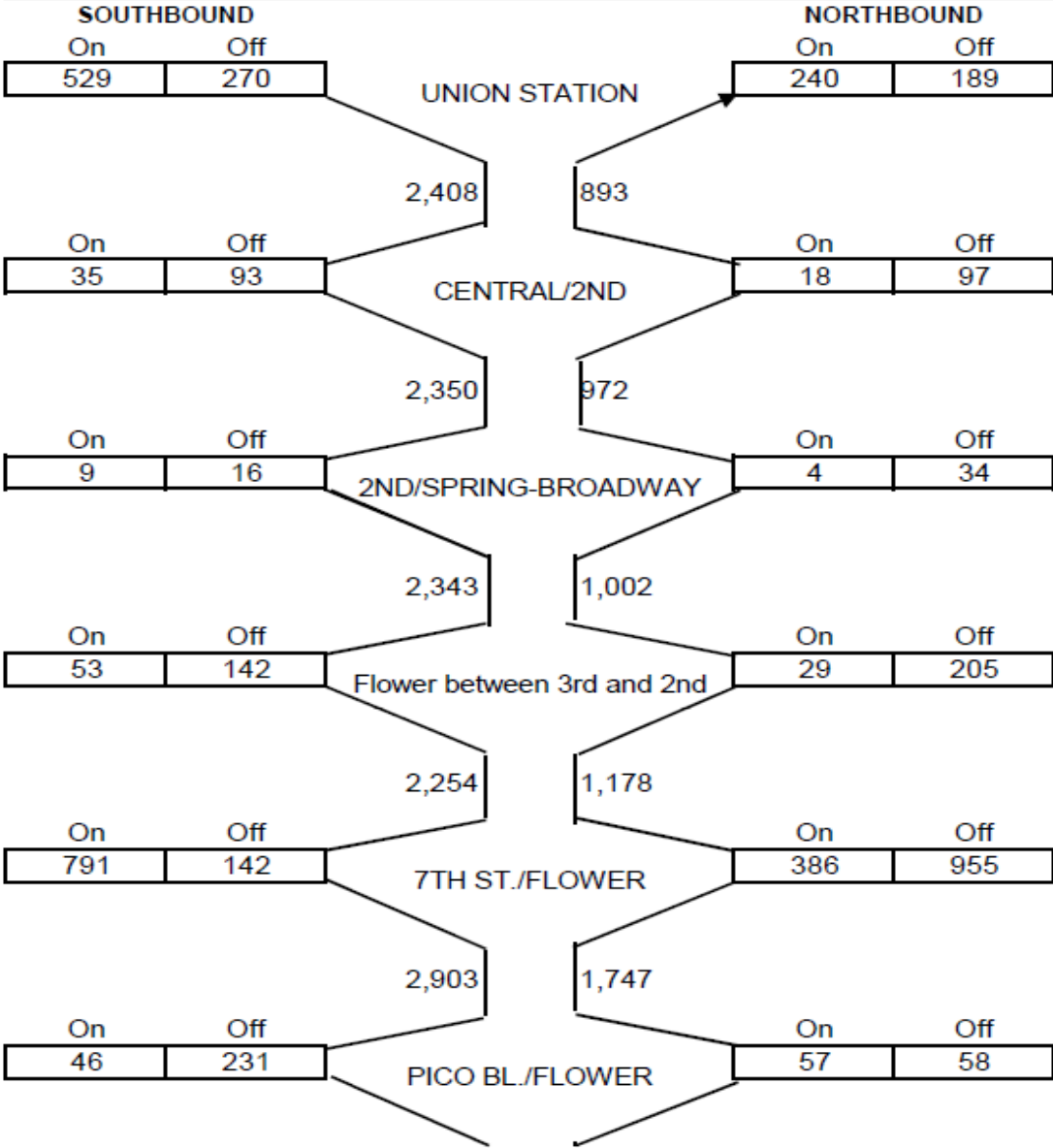
Total Detraining Load	795 ppl
Total Platform Occupant Load	868 ppl

**E-W Line Regional Connector Stations
Peak Hour Boardings and Alightings**



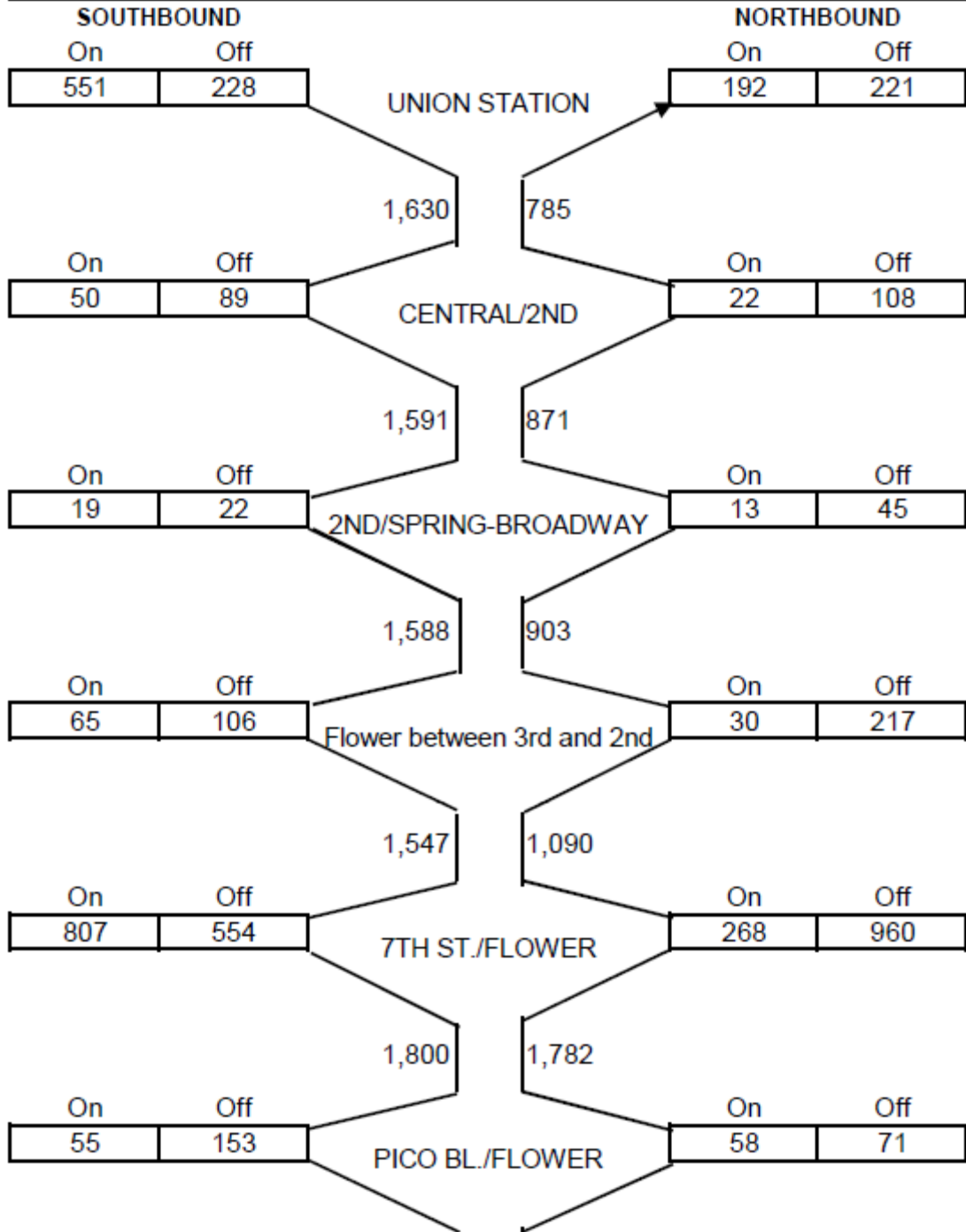
Reference 2

**N-S Line (Long) Azusa/Citrus to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 3

**N-S Line (Short) Sierra Madre Villa to Long Beach (Regional Connector Stations)
Peak Hour Boardings and Alightings**



Reference 4

For calculated train load Metro Fire/Life Safety Criteria, Section 2.5.2.1.A has the following requirement.

The following limitations to the calculated train load shall be applied:

- a. No more than one train will unload at any one track to a platform during an emergency.
- b. The load on any single train is limited to the maximum train capacity.
- c. The calculated train load can be no less than the maximum passenger capacity of a single train.

With above limitations the occupant load for emergency exiting calculations for Century City Constellation station will be as follows.

CALCULATED TRAIN LOAD

MAXIMUM CAPACITY OF A SINGLE TRAIN (6 cars per train) = 1446
(61 Seated + 180 Standing = 241 per car x 6 = 1446)

ENTRAINING LOAD

PEAK (Westbound) ENTRAINING LOAD = [PEAK 15 MIN. LOAD x MAX (2 x HEADWAY OR 12 MIN.)] / 15
= ((193 x 1.5)/4) x (12/15) = 59

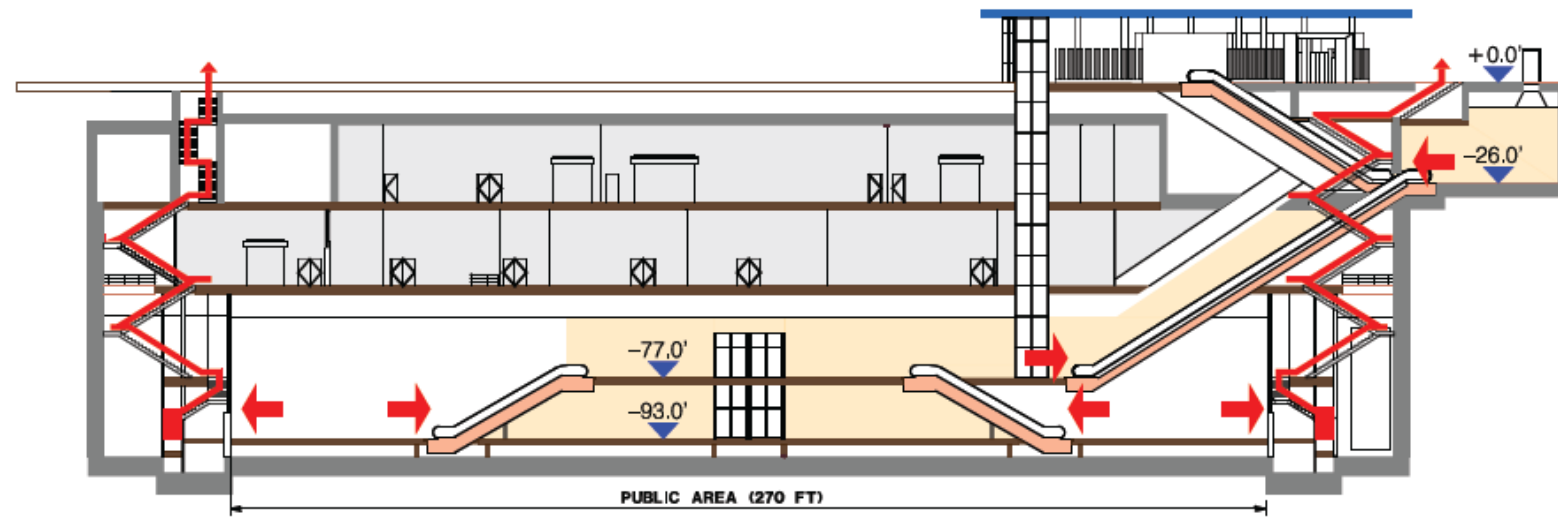
OFF PEAK (Eastbound) ENTRAINING LOAD = [OFF PEAK 15 MIN. LOAD x (HEADWAY)] / 15
= ((328 x 1.5)/4) x (4/15) = 33

TOTAL ENTRAINING LOAD = 59 + 33 = 92

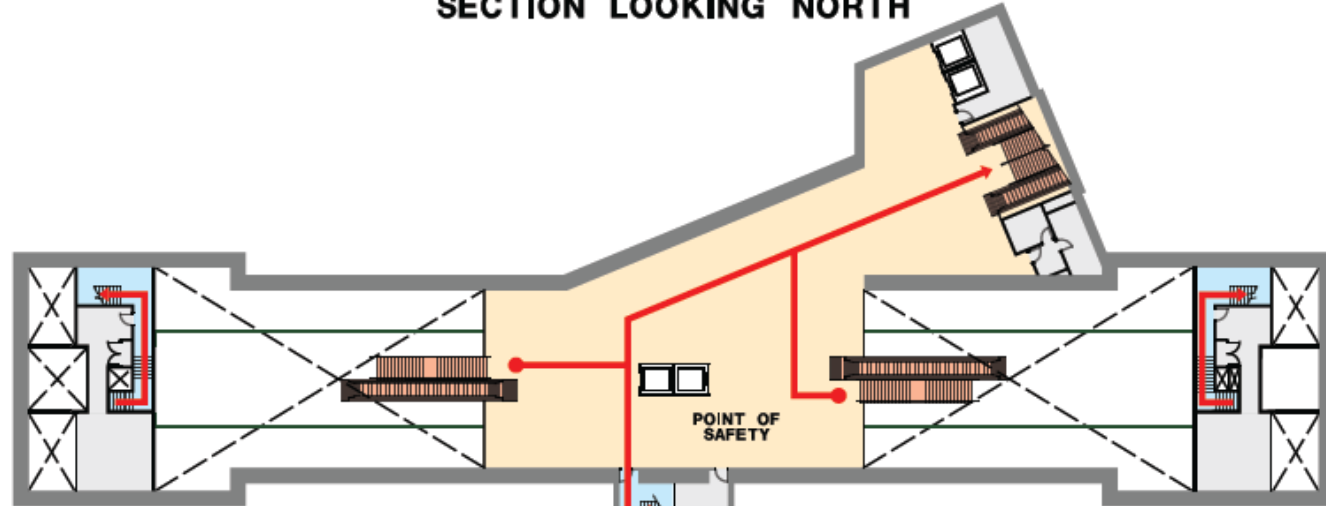
TOTAL OCCUPANT LOAD FOR CALCULATION = CALCULATED TRAIN LOAD + TOTAL ENTRAINING LOAD
TRUE



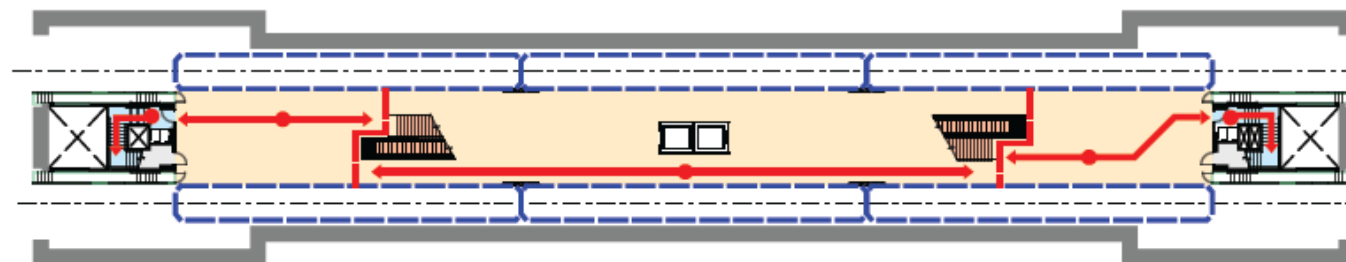
**APPENDIX B
Means of Egress Diagrams**



SECTION LOOKING NORTH



CONCOURSE LEVEL



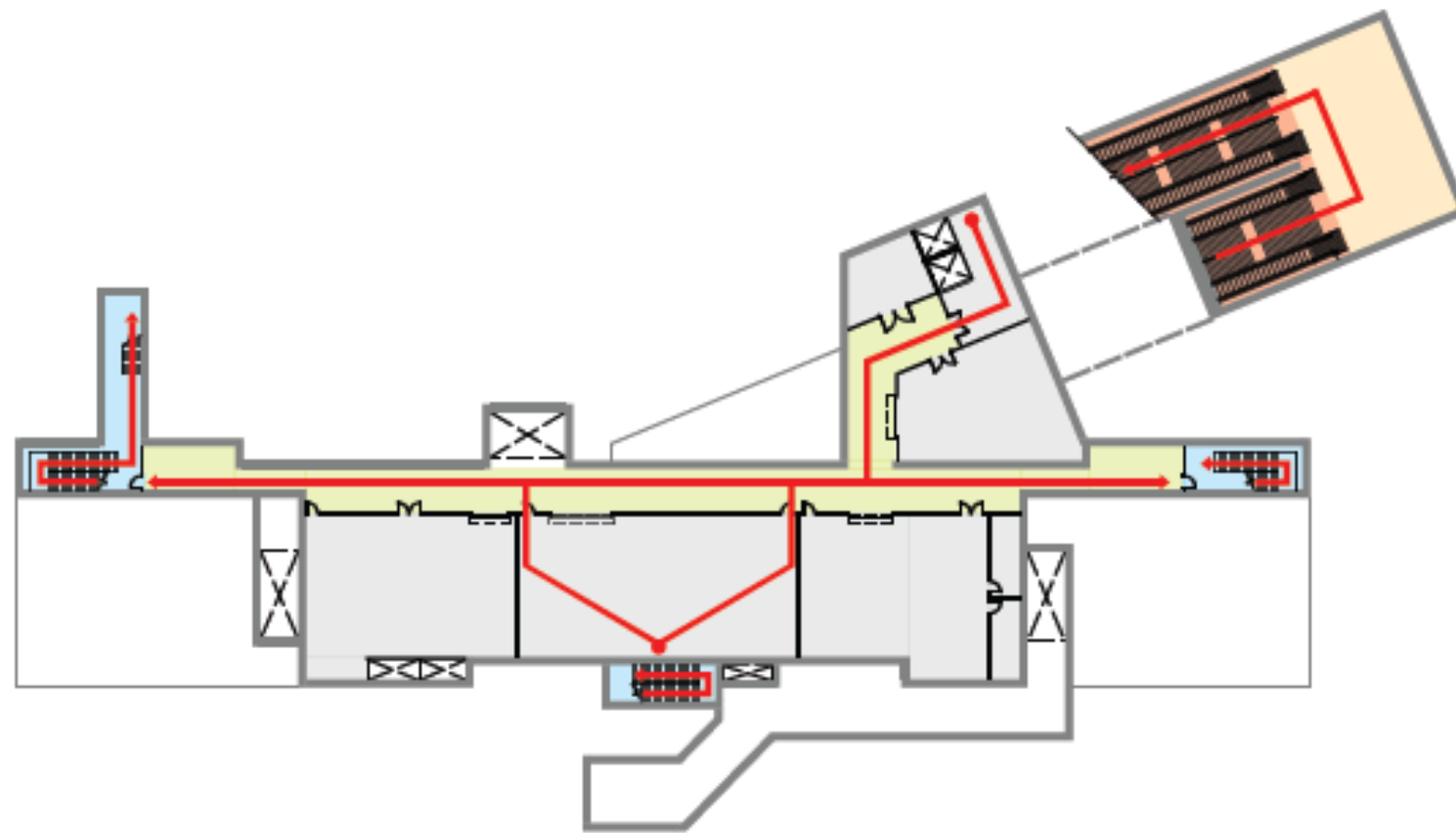
PLATFORM LEVEL

- PUBLIC SPACE
- ANCILLARY ROOMS
- EXIT ACCESS CORRIDOR
- ENCLOSED EXIT
- EGRESS DIRECTION
- EGRESS PATH / STARTING POINT

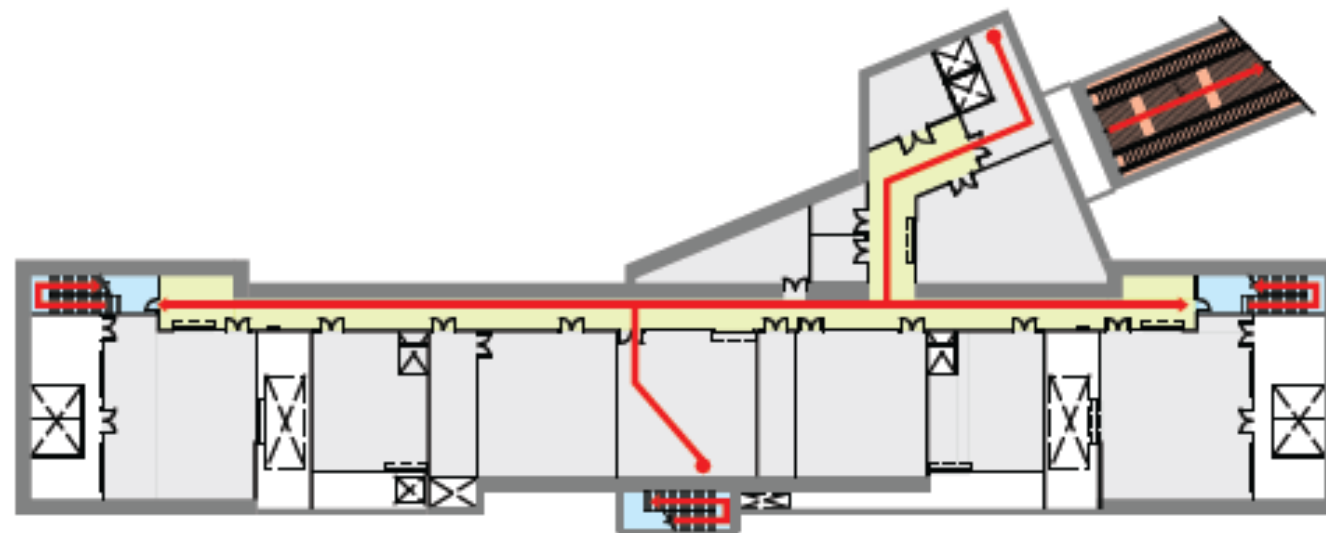
MEANS OF EGRESS

February 17, 2012

2ND/HOPE STREET STATION



UPPER ANCILLARY LEVEL



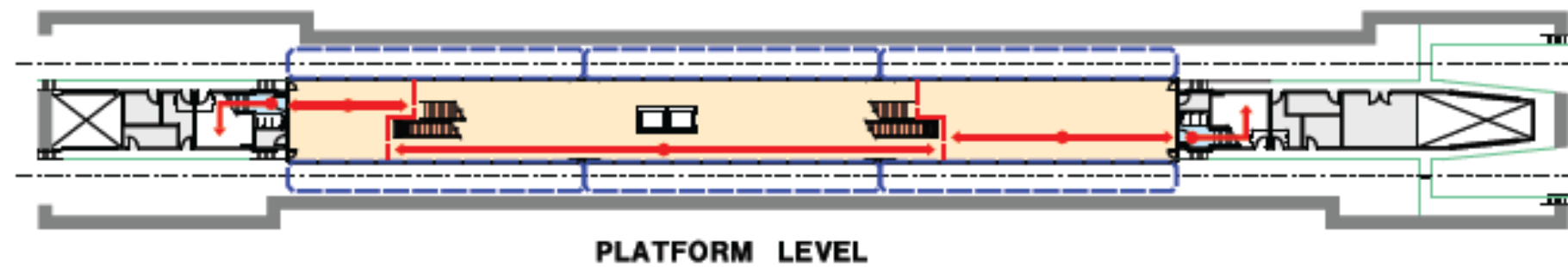
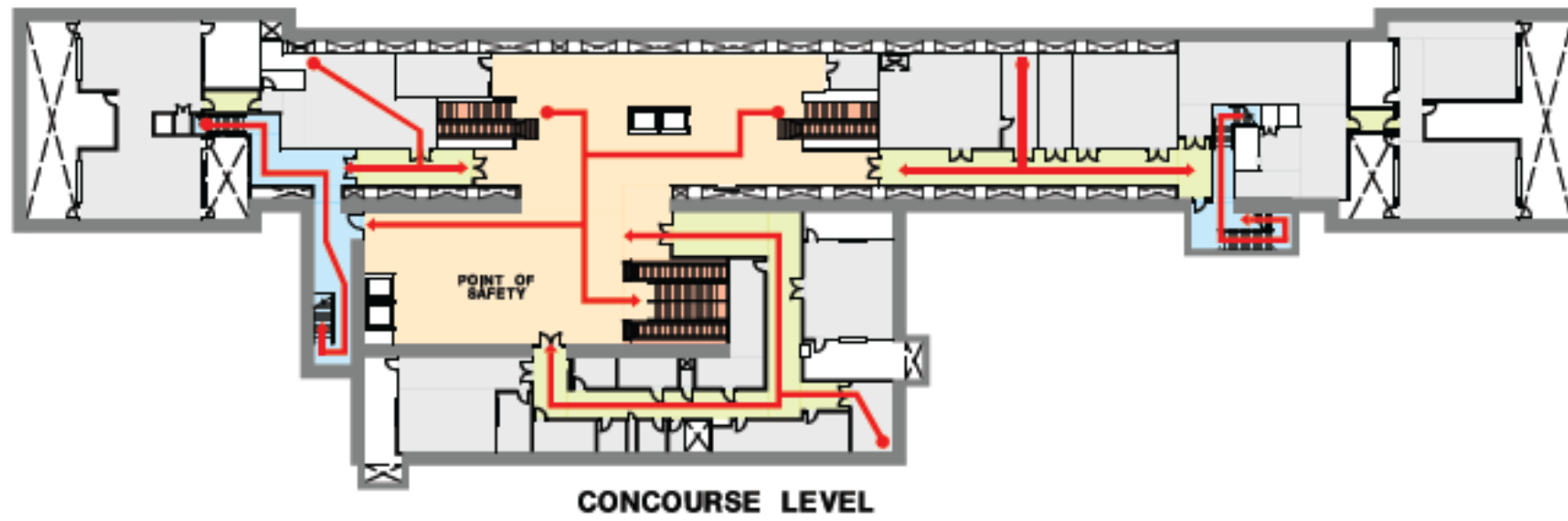
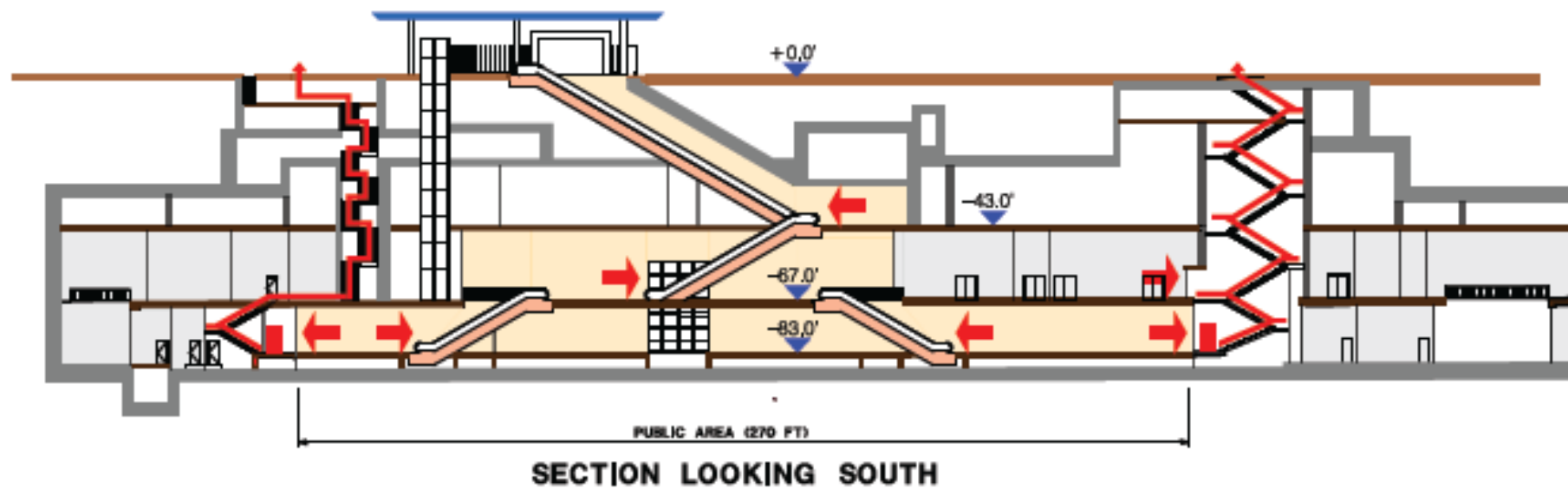
ANCILLARY LEVEL

- PUBLIC SPACE
- ANCILLARY ROOMS
- EXIT ACCESS CORRIDOR
- ENCLOSED EXIT
- EGRESS DIRECTION
- EGRESS PATH / STARTING POINT

MEANS OF EGRESS

February 17, 2012

2ND/HOPE STREET STATION

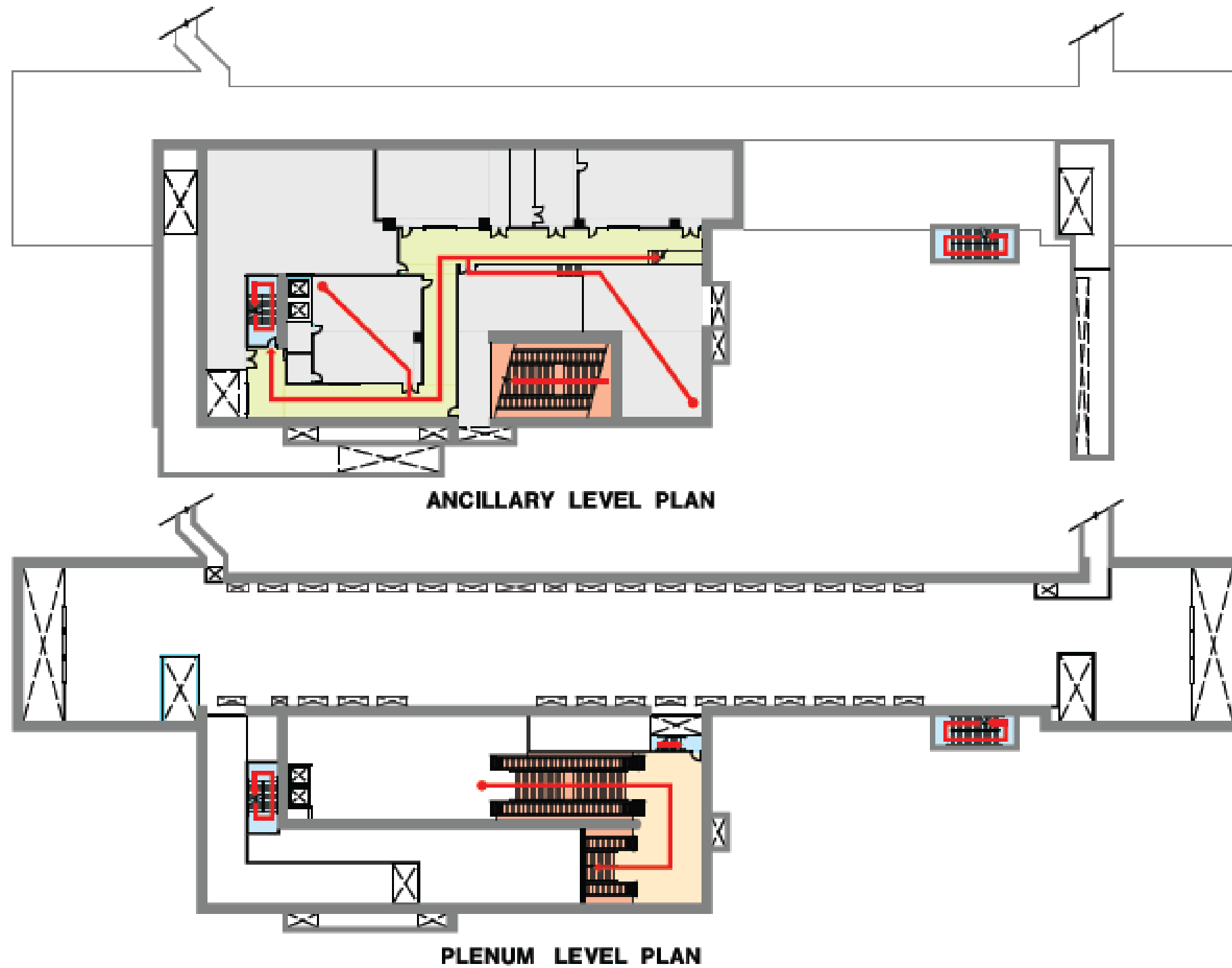


2ND/BROADWAY STATION

- PUBLIC SPACE
- ANCILLARY ROOMS
- EXIT ACCESS CORRIDOR
- ENCLOSED EXIT
- EGRESS DIRECTION
- EGRESS PATH / STARTING POINT

MEANS OF EGRESS

February 17, 2012

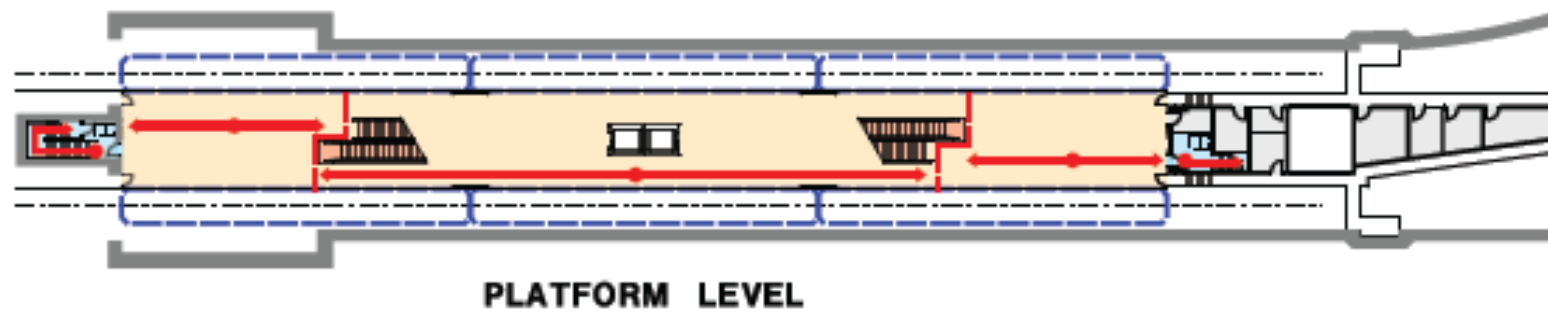
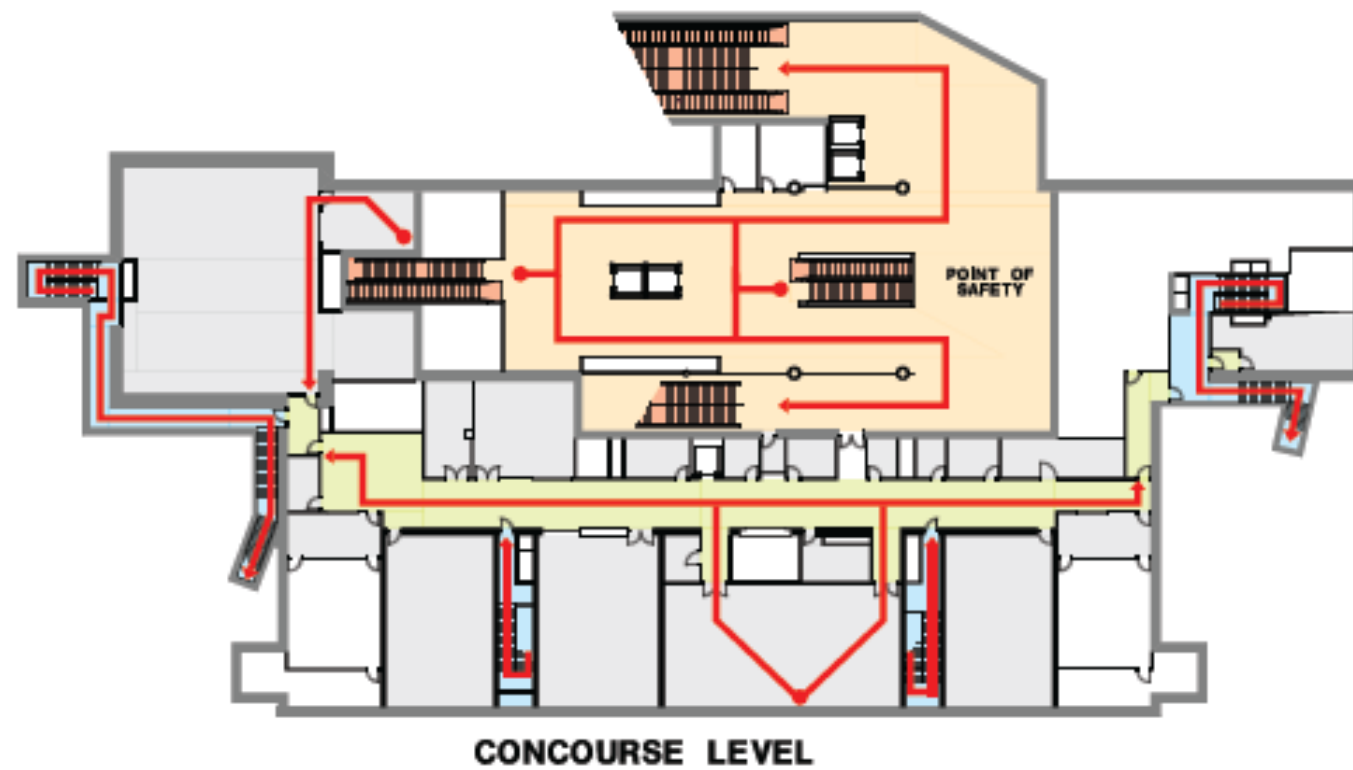
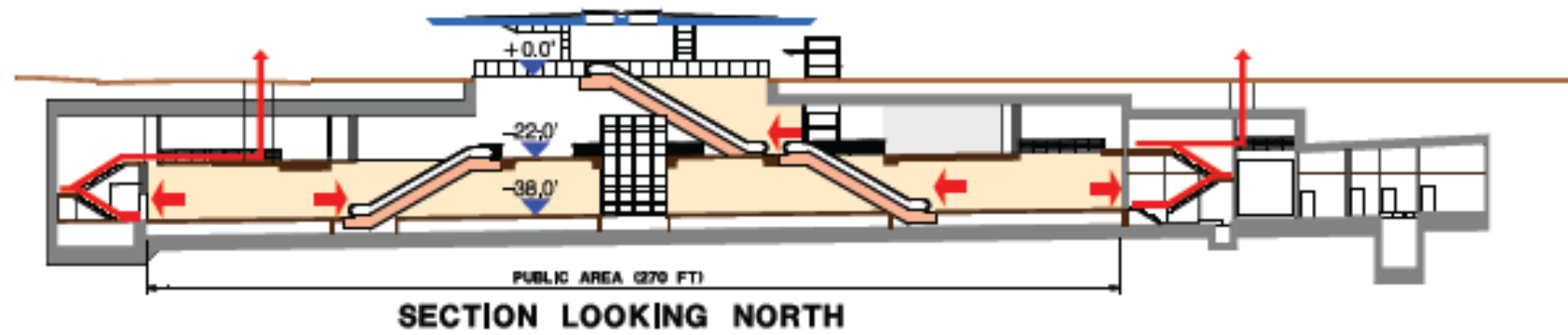


- PUBLIC SPACE
- ANCILLARY ROOMS
- EXIT ACCESS CORRIDOR
- ENCLOSED EXIT
- EGRESS DIRECTION
- EGRESS PATH / STARTING POINT

MEANS OF EGRESS

February 17, 2012

2ND/BROADWAY STATION



1ST/CENTRAL AVENUE STATION

- PUBLIC SPACE
- ANCILLARY ROOMS
- EXIT ACCESS CORRIDOR
- ENCLOSED EXIT
- EGRESS DIRECTION
- EGRESS PATH / STARTING POINT

MEANS OF EGRESS

February 17, 2012