

Van Ness Avenue Bus Rapid Transit

DRAFT
Technical Memorandum
BRT DESIGN CRITERIA

Prepared for:



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TECHNICAL MEMORANDUM

BRT DESIGN CRITERIA

1.0 Introduction

This Technical Memorandum has been prepared to support project development of the Van Ness Avenue Bus Rapid Transit Project, for the San Francisco County Transportation Authority (SFCTA). The document establishes the highway and Bus Rapid Transit (BRT) design criteria to be used on Van Ness Avenue (Hwy 101), in the development of alternatives from preliminary design through final design.

The proposed project consists of implementing BRT within the Van Ness corridor, by reconfiguring the existing roadway cross section to provide for dedicated bus lanes and transit platforms, while upgrading pedestrian safety and urban design features. Left and right turn pocket locations will be adjusted to smooth traffic flow and reduce conflicts with transit.

Several project alternatives are under consideration, representing different cross-sectional and transit operating configurations, such as center-running or side-running. With the exception of localized improvements for turn lanes and intersection corner bulb-outs, and provision of sidewalk streetscape amenities, the majority of the improvements occur within the existing curb-to-curb pavement.

The project limits have been defined as extending along Van Ness Avenue from Mission Street to North Point Street, for a total project length of 2.28 miles. The project is shown in Figure 1.

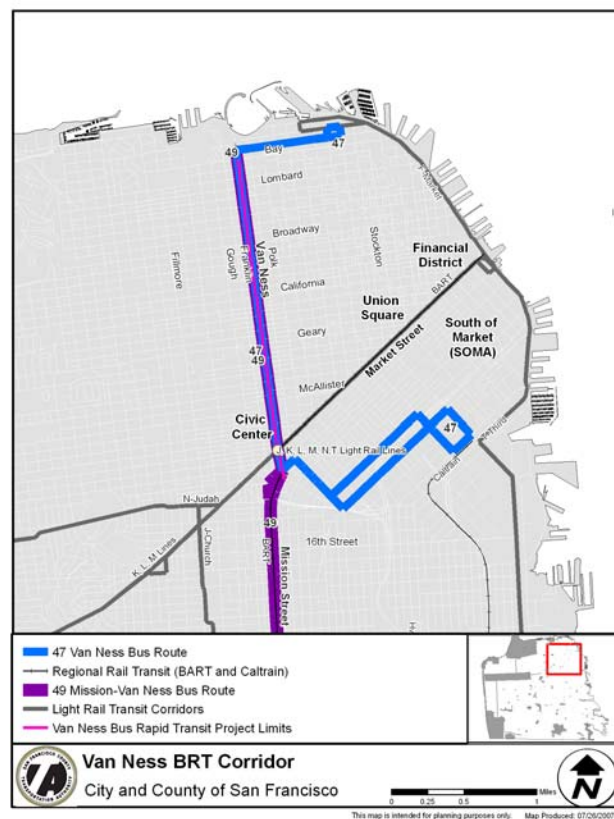


Figure 1: Project Location

2.0 Highway Design Criteria

Between Mission Street and Lombard Street, Van Ness Avenue is designated as US Highway 101 and defined as a Conventional Principal Arterial¹, with no access control. Design Criteria have been established for the mixed traffic lanes and for the designated BRT lanes and facilities, and are common to each alternative.

¹ Designation for a highway primarily for through traffic usually on a continuous route, with no control of access.

All roadway improvements will be designed in accordance with the criteria established in the Caltrans Highway Design Manual, Sixth Edition and updates. Local standards developed by the Department of Public Works (DPW) Bureau of Engineering (BOE) or San Francisco Municipal Transportation Agency (SFMTA) may also be used in lieu of Caltrans standards, subject to approval.

Design criteria specific to the designated BRT lanes and facilities follow the guidelines contained in the Transit Cooperative Research Program (TCRP) guidelines for BRT contained in Report 90 Volume 2: Implementation Guidelines, prepared in 2003 by the Transportation Research Board with sponsorship by the FTA. Design guidelines have also been established to include proposed features that are known to differ from the standards specified in the design criteria. All engineering work will be performed using English units and design criteria. The design criteria and guidelines are shown in Table 1.

As Route 101, the corridor is under the jurisdiction of Caltrans; however, it is operated and maintained by the City and County of San Francisco (CCSF). If any standard designated as mandatory or advisory in the Highway Design Manual cannot be met, or its use does not appear prudent and feasible, the SFCTA will be notified of the situation, be provided a recommendation, and be requested to provide guidance and direction as to the course of action to be pursued by the Consultant. Those items identified to date are included in Table 1 and summarized in Section 3.0, below.

Table 1: Design Criteria to be used in the development of alternatives for the Van Ness Avenue BRT Project in the City of San Francisco.

Criterion	Design Standard/ Reference¹	Proposed Guideline (If Other than Standard)
FUNCTIONAL CLASSIFICATION		
• Functional Classification:	Principal Arterial (62.3)	
• Setting	Urbanized	
• Terrain	Level	
ACCESS		
• Access Type:	Conventional Highway (No access control) (104.1)	
DESIGN SPEED		
• Design Speed:	30 mph (101.1, 101.2)	

Criterion	Design Standard/ Reference¹	Proposed Guideline (If Other than Standard)
PEDESTRIAN FACILITIES		
• Minimum Sidewalk Width:	5 ft (<u>105.1</u>)	16 ft (Unchanged) (SFMTA)
• Clear Sidewalk Width:	48 in (<u>DIB 82-03</u>)	
• Refuge Width:		9 ft Min. (DIB 82-03)
• Accessibility Requirements (ADA):	Two Ramps/corner (desirable) Ramp openings on curbed channelization/islands Ramp Color Contrast (105.3, <u>105.4(2)</u>) DPW, SFMTA	
• Ramp Slope:	1:12 (DIB 82-03)	
• Ramp Rise:	30 in Max. without landing (DIB 82-03)	
• Crossing Times ² :		2 ½ ft/s (SFMTA)
TRAFFIC OPERATIONS		
• Design Year	2035 (103.2)	
• Level of Service	D (102.1)	E (CMA and City standard)
• Design Vehicle (MF Lanes) Arterial to Arterial Arterial to Local Street	STAA Truck w/ 50 ft turn radius SU w/ 42 ft turn radius (401.3, 404.2, <u>404.3(3)</u>)	
• Design Vehicle (Bus) ³	60 ft A-BUS w/ 45 ft turn radius 40 ft BUS w/42 ft turn radius, 14 ft 3 in max height (Double Deck bus)	
• Number of Lanes:	As required for LOS D	2 MF + 1 BRT Northbound 2 MF + 1 BRT Southbound

² Refer to SFMTA crossing time guidelines for more details

³ See Bus Vehicle, Section 4

Criterion	Design Standard/ Reference ¹	Proposed Guideline (If Other than Standard)
(102.1)		
DESIGN ELEMENTS		
• Sight Distance - <i>Stopping</i> :	200 ft (201.1)	
• Superelevation (max):	4% (202.2)	Normal Crown
• Radius (min):	300 ft (203.2)	
• Grades:	0.3% Min. 6% Max. (204.3)	
• Profile:		Conform to street profile grades. Vertical curve rate of change per SFMTA standards, where feasible.
• Vertical Clearance General Sign Structures Above sidewalk	15 ft 18 ft 8 ft (309.2 (1c), (2))	
CROSS - SECTIONAL ELEMENTS		
• Lane Width (excl. gutter) Through Lane Turn Lane BRT Lane BRT Lane (Fixed Guideway)	12 ft 12 ft 12 ft 12 ft (301.1, 405.2(2), 405.3(2))	10 ft MF 10 ft (left); 9 ft (right) (min.) 12 ft desirable, 10.5 ft min [TBD]
• Shoulder Width: Left Right	0 ft 8 ft (209.3, 302.1)	0 ft
• Median Width:	12 ft (305.1(2))	4 ft
• Parking Lane Width:	8 ft (AASHTO)	8 ft desirable, 7.5 ft min.

Criterion	Design Standard/ Reference¹	Proposed Guideline (If Other than Standard)
• Combined Parking/Thru Lane Width:	20 ft (AASHTO)	18 ft
• Minimum width between curbs:		14 ft (SFMTA)
• Curb Type:	A1-6/8, A2-6/8 (Non-mountable) (303.2)	6 in, 8 in (DPW 87,169-173)
• Corner Bulb Width:		6 ft (SFMTA, TCRP Report 90)
• Roadway Cross-slope	1.5% min 3.0% max (301.2(2))	
• Horizontal Clearance (min):		
Left	1.5 ft	Per existing
Right	1.5 ft (309.1, 309.1(3))	

INTERSECTION ELEMENTS

• Angle of Intersection:	75 ⁰ Min.	Per existing
• Cross Road Setback	13 ft (405.1)	Per existing
• Corner Sight Distance		
Minimum	200 ft	Per existing
Desirable	330 ft (405.1(2))	
• Decision Sight Distance		Per existing
Minimum	200 ft	
Desirable	330 ft (405.1(3))	
• Approach Taper	$WV^2/60$ (405.2)	Per existing
• Bay Taper	60 ft (405.2(2))	Per existing
• Traffic Island Size	50 ft ² Min. 75 ft ² Des.	

Criterion	Design Standard/ Reference ¹	Proposed Guideline (If Other than Standard)
	(405.4(1))	

¹ References: Unless otherwise noted, numbers shown in parentheses indicate the Caltrans Highway Design Manual section reference, where applicable, with mandatory standards shown in bold and advisory standards underlined. Other references are as follows:

DIB 82-03: Design Information Bulletin 82-03, Pedestrian Accessibility Guidelines for highway Projects, Caltrans, 2006.

DPW: City and County of San Francisco Bureau of Engineering Standard Plans.

SFMTA: San Francisco Municipal Transportation Agency standards.

TCRP Report 90: Transit Cooperative Research Program Guidelines for BRT contained in Report 90 Volume 2: Implementation Guidelines, Transportation Research Board, 2003.

3.0 Non Standard Features

The following are existing features that have been identified as not meeting Caltrans standards outlined above, and which are likely to remain under all proposed project alternatives. Design Exception Fact Sheets will be prepared for all nonstandard advisory and mandatory features for Caltrans approval.

It should be noted that most non-standard features identified are typical of the city street conditions on the Hwy 101 corridor as a whole, which extends through downtown San Francisco on Van Ness Avenue, Lombard Street and Richardson Avenue.

Mandatory Non-Standard Features

1. Lane Width: Existing through, left and right turn lane widths on Van Ness Avenue are 10 ft, as opposed to standard 12 ft. It is not proposed to increase the lane width under any of the project alternatives.
2. Shoulder Width: No shoulders are currently provided on Van Ness Avenue. For a 4 or 6-lane conventional highway, standard right shoulder width is 8 ft. Shoulders are not proposed under any of the project alternatives.
3. Horizontal clearance: Horizontal clearance to a number of existing features is less than the standard clearance of 1.5 ft for conventional highways with curbs. It is not proposed to remedy existing nonstandard clearance.

Advisory Non-Standard Features

1. Angle of Intersection: The following intersections with Van Ness Avenue are less than the minimum permissible intersection angle of 75 degrees. No changes are proposed to intersection alignment under the project alternatives.

Intersecting Street	Intersection Angle (Degrees)
Mission Street	43
Otis Street	59
Market Street	51

2. **Median Width:** There is currently no median on Van Ness Avenue between Mission Street and Market Street. A median is proposed under all Build Alternatives: however, the median is less than minimum 12 ft under some alternatives.

4.0 Soft BRT Design Features

A number of features specific to the BRT system are proposed, such as transit signal priority, fare pre-payment and all-door boarding, enhanced pedestrian safety, station platform and streetscape facilities, signage and real-time bus arrival information, power delivery and vehicle types. These design features and principles have been developed by the Authority in conjunction with the project partners: San Francisco Municipal Transportation Agency (SFMTA), comprising the Municipal Railway (Muni) and the Department of Parking and Traffic (DPT); the Planning Department; and the Department of Public Works (DPW). These features and amenities are considered “soft” design features that do not require Caltrans or DPW approvals and are therefore not included in the design criteria listed in Table 1, but are summarized below for information. A more complete description of design principles and features can be found in Section 3 and Appendix 7 of the Van Ness Avenue Bus Rapid Transit Feasibility Study. Station design guidelines and governing codes and statutes are detailed in Section 5.

BRT Transitway: The dedicated BRT lanes are distinguished from mixed-traffic lanes by colored pavement⁴ or other special markings. A curb or other means of separation from the mixed-traffic lanes may also be proposed. Bus Lanes will accommodate both Muni and Golden Gate Transit vehicles, and will be available for use by emergency response vehicles.

Bus Vehicle: The design vehicle for BRT service shall be a low-floor vehicle with the following characteristics:

- Length: 40 - 60 ft
 - Width over body (not including mirrors or other extensions): 102 in
 - Maximum low floor height above pavement: 15 in
 - Kneeler option height above pavement: 11 in
 - Maximum height (Double Deck) 14 ft 3 in
 - Minimum horizontal turn radius (outer body): 42 ft
- Source: SFMTA

Signal Priority: BRT includes technology to ensure that time stopped at traffic signals is minimized. Transit signal priority technology allows buses nearing an intersection to extend a green light long enough for them to pass through (up to 10 seconds). This technology can also provide a “queue jump” signal phase for entering and exiting bus lanes. A queue jump signal gives buses their own signal phase at intersections, allowing the bus to proceed ahead of other traffic. A protected left turn phase will be provided at left turn pockets.

Bus Stop Location: Bus stops will be located on the far side of signalized intersections, as feasible, in order to take advantage of transit signal priority.

⁴ Color to be determined consistent with MUTCD

Station Platforms: Station Platforms will have a minimum length of 120 feet, to accommodate two 60 foot articulated buses. Station platforms will be high-quality with extra amenities for waiting passengers. Station platforms will be low-height, with seating, enhanced bus shelters, lighting and route information. BRT stations also include NextMuni real-time arrival signs, which display actual arrival times of the next bus.

Streetscape Improvements and Amenities: Streetscape improvements and amenities will provide a more comfortable environment for the users of the BRT system and enhance pedestrian safety. Proposed amenities include pedestrian-scale sidewalk lighting, pedestrian countdown and audible signals at all BRT stations, and improved landscaping that also serves to buffer pedestrians and waiting passengers from motor vehicle traffic. Additional pedestrian design guidelines include;

- No restrictions on pedestrian crossings at intersection legs
- Maximum of four lanes between pedestrian refuges
- Minimum 4 ft wide pedestrian refuge, which shall extend through crosswalk

Fare Prepayment and All-Door Boarding: Passengers may pay fares at ticket-vending machines located on the station platforms, and may enter the bus through any door, Fare pre-payment is enforced by a proof-of-payment system and fare inspectors. BRT passengers may also pay cash fares at the front of buses as they do today.

Advanced Traffic and Transit Management Systems: BRT uses a variety of advanced traffic and transit management systems designed to improve service:

- Automatic Vehicle Location (AVL) to manage transit route operations in real-time;
- NextMuni real-time arrival information at station platforms
- CCTV (closed-circuit television) at station platforms helps to ensure passenger security.

5.0 BRT Station Design Features

The design and construction of public transit stations are subject to several state and national codes and statutes. Compliance with these codes and statutes in the development of the station models ensures a high-degree of public safety and affords accessibility for all transit patrons. Of the several codes and statutes applicable to the proposed improvements, the primary ones include:

- California Building Code (2007 California Building Code Title 24 Part 2)
- California Title 24
- Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, July 23, 2004
- U.S. Department of Transportation guidelines for major capital investments
- U.S. Department of Transportation, Transportation for Individuals with Disabilities: 49 CFR Parts 27, 37 and 38
- National Fire Protection Association documents such as NFPA 101 and NFPA 130
- DPW Order 176-707, City excavation codes.

An important element influencing station design is the type of transit vehicle. BRT stations are to be served by manually operated buses running along a transitway. A prototypical BRT vehicle has been assumed that incorporates basic features of the standard articulated bus; however, a variety of bus types may be considered. The design vehicle is described in Section 4.0. As bus characteristics can change over time (the useful life of a bus is 12 years although many are refurbished and retained for longer periods) and several bus types may be operated along the project alignment during the course of its lifetime, stations must be able to accommodate vehicle features that change (e.g., door locations and sizes, ADA lift designs, etc.). Therefore, station architecture shall be kept open and flexible to accommodate desired flexibility in the “design vehicle.”

5.1 BRT Station Guidelines

Basic Features

Criterion	Guideline/ Reference	Proposed Guideline (If Less than Standard)
<ul style="list-style-type: none"> • Platform width: <ul style="list-style-type: none"> ○ Curbside/one-side boarding ○ Center Platform/two-side boarding 	<ul style="list-style-type: none"> • 10-12 ft • 20-25 ft (TCRP Report 90) 	<ul style="list-style-type: none"> • 8 ft Min. • 8 ft Min.
<ul style="list-style-type: none"> • BRT Platform Length: 	<ul style="list-style-type: none"> • 130 ft (TCRP Report 90) 	
<ul style="list-style-type: none"> • BRT Platform Height: 	<ul style="list-style-type: none"> • 12-15 in, or as necessary for level boarding (TCRP Report 90) 	

Station Amenities

The following are common station amenities for waiting passengers. Some items are optional and may not be required at all stations.

- Ticket vending machines (TVMs) and validators: minimum of 1 each per platform (2 TVMs desirable at busiest stations)
- Passenger information kiosk/flags with (a) active data display and audio capability as required by ADA indicating bus arrival time (real time) and other limited information, and (b) display space for other passenger static information such as maps, schedules, etc.
- Windscreens, canopy shelters, and benches for limited seating
- ADA access and tactile warning bands
- CCTV
- Phone/intercom as required at major transfer stations/transit centers (an option at less busy stations)
- Lighting, trash receptacles

- Protective railings where required or appropriate for safety
- Space allowance (e.g., cabinets, cases, duct banks, etc.) for electrical and communications systems

All platform amenities and structures shall be located so that there is no interference with the dynamic envelope of BRT vehicles or other buses that may operate along the transitway. The centerline of the BRT lane is assumed to be 5 feet 3 inches from the edge of the platform.

Codes, Station Access, and Fire and Life Safety

Several codes and statutes govern the design of public transit facilities. A number pertain to ADA accessibility requirements. Although a number of the codes and safety guidelines were established for (and pertain specifically to light rail transit stations), BRT stations are assumed to meet the same or similar requirements.

1. General

- Station platforms are “Group A” occupancy.
- Station platforms are “at-grade open stations.”
- All accessible spaces shall be provided with at minimum one accessible means of egress.
- At-grade open stations need not provide emergency lighting or exit signs.
- No automatic sprinklers are required for open stations.
- The top of guardrails shall not be less than 42 inches in height. Open guardrails shall have intermediate rails or ornamental pattern such that a sphere 4 inches in diameter cannot pass through.
- Bridge plates must meet the requirements stated in 36CFR part 1192 or 49CFR part 38. The maximum horizontal gap between vehicle and edge of platform is 3 inches (76 mm).

2. Stairs

- A stairway shall have two or more risers.
- The rise of stairs shall not be less than 4 inches or more than 7 inches. The greatest riser height shall not exceed the smallest by 3/8 inch (10 mm).
- The run of stairs shall not be less than 11 inches. The largest tread shall not exceed the smallest by more than 3/8 inch.
- Stair width shall be a minimum of 48 inches.
- Stair handrails shall be 34 inches to 38 inches above the nosing of the treads. Handrails shall extend a minimum of 12 inches beyond the top nosing, and 12 inches plus one tread width beyond the bottom nosing.
- Stairs shall not be part of an accessible route.

3. Ramps

- Ramps located within an accessible route shall not be steeper than one unit vertical in twelve units horizontal (8.33% slope).
- Level ramp landings shall be provided at the top and bottom of each ramp.
- Top landings shall be not less than 60 inches wide and shall have a length of not less than 60 inches in the direction of ramp run. Bottom landings shall have a dimension in

- the direction of the ramp run not less than 72 inches and shall be at least as wide as the required ramp width.
- Handrails are required on ramps with a rise greater than 6 inches or that provide access if slope exceeds 1 foot rise in 20 feet of horizontal run (5% slope). Handrails shall be placed on each side of each ramp, shall be 34 inches to 38 inches above the ramp surface, and shall extend a minimum of 1 foot beyond the top and bottom of the ramp.
 - Handrails are not required on ramps less than 6 inches rise or 72 inches in length.
 - Ramps open on one or both sides shall have guardrails.
 - Wheel guides are not required on ramps less than 10 feet in length.
 - The cross slope of ramp surfaces shall be no greater than 1 unit vertical in 50 units horizontal (2% slope).
 - Outdoor ramps will not accumulate water on walking surfaces.
4. Detectable Warnings
- Transit platform edges bordering a drop-off and not protected by platform guardrails shall be provided with detectable warnings.
 - Transit boarding platforms shall have a detectable warning texture 24 inches to 36 inches in width extending the full length of the loading area.
5. Sidewalks
- Sidewalks shall be a minimum of 48 inches in clear width.
6. Wheelchairs
- The minimum clear ground space required to accommodate a single, stationary wheelchair and occupant is 30 inches by 48 inches.
 - The minimum clear width for a wheelchair to pass is 32 inches at a point and 36 inches continuously.
 - The space required for a wheelchair to make a 180-degree turn is a clear space of 60 inches.