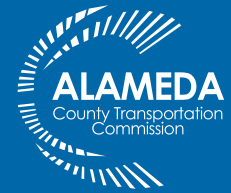


ALAMEDA CTC
COUNTYWIDE
BIKEWAYS NETWORK



Phasing and Implementation Treatments and Materials Toolbox

May 2024



Alameda, CA

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Introduction

Alameda CTC is committed to supporting local agencies in their efforts to advance the implementation of high-quality bikeway networks, including All Ages and Abilities (AAA) bikeways on the Alameda CTC Countywide Bikeways Network (2022). A wealth of bikeway design guidance available from state and national organizations documents bikeway design best practice. To make the guidance more accessible, Alameda CTC maintains an online bikeway design resource that summarizes and references key guidance from the National Association of City Transportation Officials (NACTO), the Federal Highway Administration (FHWA), and other agencies.

This paper supplements national guidance with a detailed toolbox of current construction materials to help agencies evaluate design options for their projects and advance high-quality AAA bikeways in Alameda County. This document is accompanied by the white paper "Phasing and Implementation Strategies and Case Studies," which provides additional discussion of how projects have been implemented in a variety of contexts across Alameda County.

The following toolbox contains a variety of bike lane buffer treatments that have been implemented locally and throughout the US. Specifications are provided for each treatment, including the weight, dimensions, material and reflectivity, in addition to the unit cost and company information, up to date as of January 2024. Each treatment is also evaluated on its aesthetics, comfort for bicyclists, durability and reflectivity. This information was compiled based on information provided from local vendors and implementation learnings from local jurisdictions.



Implementation Considerations

Implementation considerations are based on case study interviews and built examples. These should be reviewed when deciding your preferred buffer treatment.

BUFFER TREATMENT SPACING

- Start with 10'-20' spacing on-center for urban arterials.
- Consider tighter spacing closer to intersections or driveways and in areas with high parking demand, where auto encroachment may be more prevalent.
- Consult with engineering staff on drainage and maintenance considerations for closely spaced buffer treatments.
- Consider the design speed of the corridor when determining treatment spacing. Larger spacing between treatments may be appropriate on higher speed roadways.

COMBINING TREATMENTS

- Consider combining low-profile treatments with taller treatments. Longitudinal, low-profile treatments may be more durable and feel more impactful to vehicles, and taller treatment, such as flex posts, may increase visibility but are easier to knock down.

MAINTENANCE

- Consider more durable or reinforced treatments at locations where high-impact collisions with the buffer treatments are more likely, such as at intersections, to minimize ongoing maintenance costs.
- Pair low treatments like curb stops with object markers or reflective devices for enhanced visibility.
- Consider ordering 20%-50% extra product for ongoing maintenance, depending on the durability of the treatment.
- Work with pavement overlay and resurfacing contractor, city crew, or project manager to develop ways to resurface or overlay roadways while minimizing remove/replacement/reinstallation for the various separation devices. Additional buffer striping/separation devices can result in significant higher percentages of total project construction cost that are not pavement-related.
- Coordinate with maintenance staff to ensure bikeway design and placement of treatments maximize ease of street cleaning and maintenance.

ADA CONSIDERATIONS

- Provide a 5' buffer for parking-protected bike lanes where street width allows so that buffer space can be used as an access aisle from ADA parking spaces.
- Consider the potential tripping hazards for visually impaired pedestrians.
- Do not continue treatments through crosswalks or bus boarding islands to aide in navigability for users who require mobility devices.

Zebra (and Zebra Zero)

Patterned, low-profile, retro-reflective ellipsoid separators.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Fremont, CA

Technical Specifications

MANUFACTURED BY

Zicla

WEIGHT

3-18.75 lbs (varying sizes)

DIMENSIONS

Zebra 5: 32.3" L x 4.7" W x 2" H
 Zebra 9: 30.5" L x 6.5" W x 3.5" H
 Zebra 13: 32.3" L x 8.3" W x 5.1" H

MATERIAL

100% recycled plastic

ANCHORING

3 anchor points

Additional Notes

BIKE COMFORT

Dependent on size of Zebra. Larger Zebras are more of a physical barrier between travel lane and bike lane.

REFLECTIVITY

40% reflective surface

RECOMMENDED APPLICATION

Enhances buffered or separated bikeway at locations without parking or high curb activity.

CITIES WITH THE PRODUCT INSTALLED

Fremont, CA; San Luis Obispo, CA; Richmond, CA

SPEED AND VOLUME GUIDANCE

N/A

Zipper

Modular, retro-reflective configurable barrier system.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



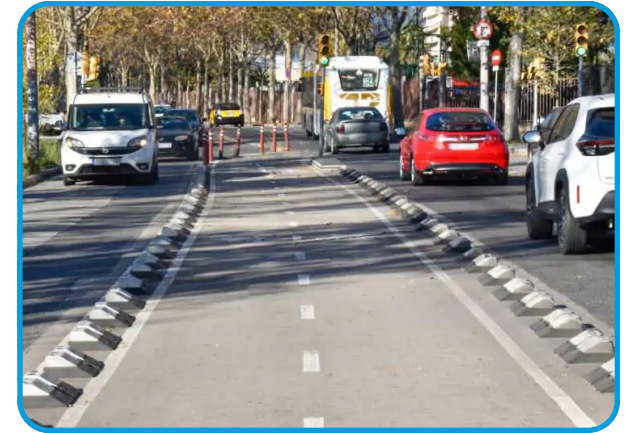
DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Zicla

WEIGHT

Curved piece: 7lb 11oz
Full square: 11lb 7oz

DIMENSIONS

Modular: 11" L x 11" W x 4.9" H (can have curved edge)

MATERIAL

100% recycled plastic

ANCHORING

4 anchor points per middle piece
3 per corner piece

Additional Notes

BIKE COMFORT

Elevated profile on outer side prevents motorists from entering bike lane. Sloped profile on inner side provides gradual redirection warning for cyclists.

REFLECTIVITY

50% reflective surface (top)

RECOMMENDED APPLICATION

Enhances buffered or separated bikeway at intersections and locations without parking or high curb activity.

CITIES WITH THE PRODUCT INSTALLED

Bentonville, AR; New York City, NY

SPEED AND VOLUME GUIDANCE

Medium-high speed and volume

Rubber Curb Stop

Narrow, retro-reflective adjustable bikeway separator.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
6 inches



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

ULINE

WEIGHT

20 lbs

DIMENSIONS

72"L x 6"W x 4"H

MATERIAL

Rubber

ANCHORING

4 anchor points

Additional Notes

BIKE COMFORT

The elevated profile minimizes encroachment. The profile is the same on both sides, lacking the benefits of other products that have a gentler slope on one side for cyclists.

RECOMMENDED APPLICATION

Enhances separated bikeway facility particularly where buffer is too narrow for other separators.

CITIES WITH THE PRODUCT INSTALLED

Santa Monica, CA; Seattle, WA

SPEED AND VOLUME GUIDANCE

N/A

Tuff Curb

Durable, high-visibility curb system with optional integration of vertical plastic posts.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Impact Recovery

WEIGHT

Curb section: 12 lbs
Optional end section: 4 lbs

DIMENSIONS

Curb section: 40" L x 12.5" W x 3.5" H
Optional end cap: 18" L x 3.5" W x 2" H

MATERIAL

Injection molded polyethylene

ANCHORING

3 anchor points

Additional Notes

BIKE COMFORT

The gradual slope of the curb alerts and prevents motorists from veering out of the travel lane. Tuff Curbs are higher profile than Tuff Curb XLPs, and recommended for highest conflict areas.

REFLECTIVITY

2 reflective markers on base

RECOMMENDED APPLICATION

Augments visibility of buffer lane striping and enhances separated bikeway with high-visibility elements.

CITIES WITH THE PRODUCT INSTALLED

Fremont, CA; Oakland, CA

SPEED AND VOLUME GUIDANCE

Epoxy is acceptable for all speed levels given proper substrate.

K-71 Flexible Posts

Multi-color, reflective bollards.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Pleasanton, CA



San Jose, CA

Technical Specifications

MANUFACTURED BY

US Reflector

WEIGHT

5 lbs

DIMENSIONS

4 models: 3-8" W x 15-40" H

MATERIAL

Blend of polyethylene and UV inhibitors

ANCHORING

1 anchor point

Additional Notes

BIKE COMFORT

Serves as a visual cue to drivers, but is designed to allow vehicles to run over the product with no to minimal damage.

RECOMMENDED APPLICATION

Enhances visibility and separation, particularly along (parking) protected bicycle lanes.

CITIES WITH THE PRODUCT INSTALLED

San Jose, CA; Fremont, CA; Los Angeles, CA; Pleasanton, CA

SPEED AND VOLUME GUIDANCE

N/A

K-72 Post

Decorative multi-color, reflective bollards.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

US Reflector

WEIGHT

Information unavailable

DIMENSIONS

30" tall, 10" diameter base

MATERIAL

Blend of polyethylene and UV inhibitors

ANCHORING

1 anchor point

Additional Notes

BIKE COMFORT

Serves as a visual queue to drivers, but is designed to allow vehicles to run over the product with no to minimal damage.

RECOMMENDED APPLICATION

Enhances visibility and separation, particularly along (parking) protected bicycle lanes, with an aesthetic flair.

CITIES WITH THE PRODUCT INSTALLED

Emeryville, CA

SPEED AND VOLUME GUIDANCE

N/A

PEXCO City Post or FG300

Family of flexible plastic posts with varying designs and colors.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Fremont, CA



Oakland, CA

Technical Specifications

MANUFACTURED BY

PEXCO/Davidson

WEIGHT

Varies

DIMENSIONS

Varies in height

MATERIAL

Polyurethane

ANCHORING

Varying anchor points

Additional Notes

BIKE COMFORT

Serves as a visual cue to drivers, but is designed to allow vehicles to run over the product with no to minimal damage.

RECOMMENDED APPLICATION

Enhances visibility and separation, particularly along (parking) protected bicycle lanes. The base is durable and the top piece can be replaced separate from the base.

CITIES WITH THE PRODUCT INSTALLED

Fremont, CA; Oakland, CA; Alameda, CA

SPEED AND VOLUME GUIDANCE

N/A

OmegaPost

Plastic posts with varying designs and colors.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Impact Recovery

WEIGHT

1.5 lbs

DIMENSIONS

28", 36", or 42" tall, 2.375" diameter base

MATERIAL

Proprietary thermoplastic

ANCHORING

Can be attached to a Tuff Curb XLP, which can be installed with 4 screws or epoxy.

Additional Notes

BIKE COMFORT

Alerts and prevents motorists from veering out of the travel lane, especially when combined with Tuff Curb XLP. Effectiveness depends on post spacing.

RECOMMENDED APPLICATION

Enhances visibility and separation, particularly along (parking) protected bicycle lanes.

CITIES WITH THE PRODUCT INSTALLED

San Francisco, CA; Culver City, CA

SPEED AND VOLUME GUIDANCE

N/A

Tuff Curb XLP

Low-profile curb system with optional integration of vertical plastic posts.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Impact Recovery

WEIGHT

6.5 lb (for 40" curb sect.)

DIMENSIONS

40" L x 8" W x 2" H

MATERIAL

Injection-molded polyethylene (single piece)

ANCHORING

2-3 anchor points

Additional Notes

BIKE COMFORT

Alerts and prevents motorists from veering out of the travel lane. The gradual slope of the curb makes the curb less useful for minimizing encroachment, but does increase the durability of the product. XLPs are a lower profile than Tuff Curbs, which reduces impacts if bikes hit them.

RECOMMENDED APPLICATION

Augments visibility of buffer lane striping and enhances separated bikeway with high-visibility elements.

CITIES WITH THE PRODUCT INSTALLED

San Francisco, CA; Portland, OR; Seattle, WA

SPEED AND VOLUME GUIDANCE

N/A

Precast Curb

Modular, adjustable concrete curb system.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Cupertino, CA

Technical Specifications

MANUFACTURED BY

Multiple

WEIGHT

Information unavailable

DIMENSIONS

2' wide minimum
Height and length is per design

MATERIAL

Concrete

ANCHORING

Doweled

Additional Notes

BIKE COMFORT

If spaced closely, the curb acts similar to the sidewalk curb, significantly minimizing the likelihood of encroachment of vehicles.

RECOMMENDED APPLICATION

Robust separation between vehicle and bicycle traffic but allows for future flexibility and drainage requirements.

CITIES WITH THE PRODUCT INSTALLED

Cupertino, CA; Seattle, WA

SPEED AND VOLUME GUIDANCE

N/A

Concrete Curb Stop

Narrow, concrete adjustable bikeway separator.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Bohlmann Quality Products (and others)

WEIGHT

265 lbs

DIMENSIONS

72"L x 9"W x 6.5"H

MATERIAL

Concrete

ANCHORING

2 anchor points

Additional Notes

BIKE COMFORT

The elevated profile minimizes vehicle encroachment. The profile is the same on both sides, lacking the benefits of other products that have a gentler slope on one side for cyclists.

RECOMMENDED APPLICATION

Provides flexible but robust physical separation between vehicles and bicycles.

CITIES WITH THE PRODUCT INSTALLED

Alameda, CA; Oakland, CA; Santa Monica, CA

SPEED AND VOLUME GUIDANCE

N/A

Narrow Cycle Lane Defenders

Narrow, retro-reflective adjustable bikeway separator with optional posts.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Rosehill Highways

WEIGHT

53-133 lbs (varying sizes)

DIMENSIONS

End section: 78.7" L x 9.3" W x 5" H

Continuation unit: 78.7" L x 9.3" W x 5.1" H

Double end: 78.7" L x 9.3" W x 5.1" H

NCLD lite: 39.4" L x 9.3" W x 5.1" H

MATERIAL

100% recycled plastic

ANCHORING

4 anchor points

Additional Notes

BIKE COMFORT

Minimizes likelihood of encroachment of vehicles and reflective posts provide visual queue to drivers.

RECOMMENDED APPLICATION

Enhances separated bikeway facility particularly where buffer is too narrow for other separators.

CITIES WITH THE PRODUCT INSTALLED

Los Angeles, CA; New York City, NY

SPEED AND VOLUME GUIDANCE

N/A

Bike Rail

Strong, adjustable steel barrier system.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

DezignLine

WEIGHT

Information unavailable

DIMENSIONS

4-8"L x 3" W x 5" H (rail height 7", includes 2" clearance for water below rail)

MATERIAL

Powder coat galvanized steel rail and plastic flex posts

ANCHORING

Anchored at joints, 2 anchors per joint

Additional Notes

BIKE COMFORT

Curb minimizes likelihood of encroachment of vehicles and bollards provide visual queue to drivers.

RECOMMENDED APPLICATION

Enhances bikeway separation with ample opportunity for aesthetic upgrades.

CITIES WITH THE PRODUCT INSTALLED

Minneapolis, MN; Colorado Springs, CO; Reno, NV

SPEED AND VOLUME GUIDANCE

N/A

RailScreen

Artistic vertical steel panels that supplement bikeway separation.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

DezignLine

WEIGHT

Information unavailable

DIMENSIONS

36" tall, mounted on top of BikeRails

MATERIAL

Powder coat galvanized steel rail and panels

ANCHORING

Anchored at joints, 2 anchors per joint

Additional Notes

BIKE COMFORT

Curb minimizes likelihood of encroachment of vehicles and bollards provide visual cue to drivers.

RECOMMENDED APPLICATION

Adds aesthetic flair and visibility to bikeway buffers.

CITIES WITH THE PRODUCT INSTALLED

Charlotte, NC; Fort Collins, CO

SPEED AND VOLUME GUIDANCE

N/A

RailRibbon

Whimsical, artistic vertical bikeway separator.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



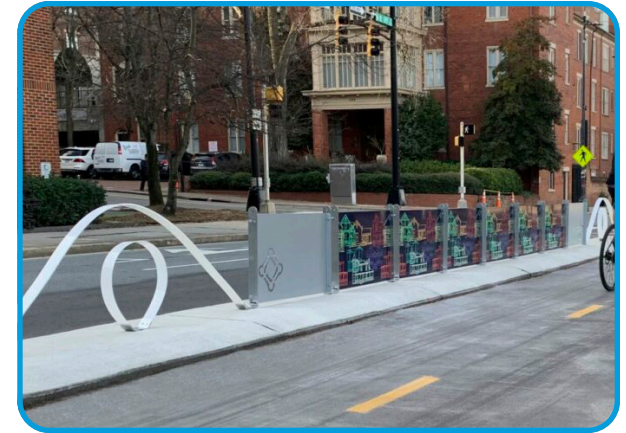
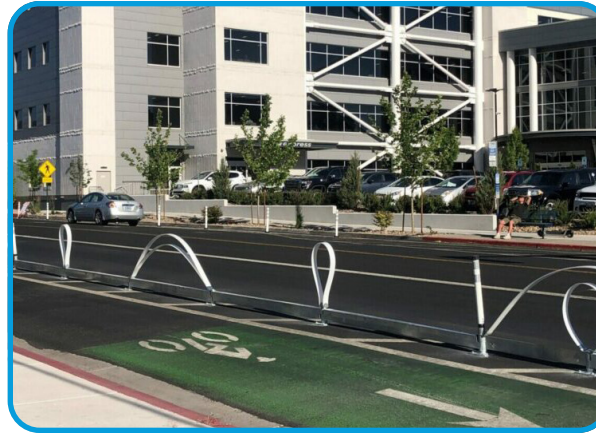
DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

DezignLine

WEIGHT

Information unavailable

DIMENSIONS

Varies

MATERIAL

Powder coat galvanized steel rail and plastic ribbon

ANCHORING

Anchored at joints, 2 anchors per joint

Additional Notes

BIKE COMFORT

Curb minimizes likelihood of encroachment of vehicles and bollards provide visual queue to drivers.

RECOMMENDED APPLICATION

Adds aesthetic flair and visibility to bikeway buffers.

CITIES WITH THE PRODUCT INSTALLED

Reno, NV; Charlotte, NC

SPEED AND VOLUME GUIDANCE

N/A

K-Rail

Highway-grade concrete median barriers.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
30 inches



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Multiple

WEIGHT

Varies

DIMENSIONS

20'L x 24"W x 32"H

MATERIAL

Concrete

ANCHORING

None

Additional Notes

BIKE COMFORT

If spaced closely, the K-Rail becomes more robust than sidewalk curb, significantly minimizing the likelihood of encroachment.

RECOMMENDED APPLICATION

Offers robust, continuous separation between bicycles and vehicles. Can also be used for robust protection for temporary applications, e.g. construction detours.

CITIES WITH THE PRODUCT INSTALLED

Burbank, CA; New York City, NY; Seattle, WA

SPEED AND VOLUME GUIDANCE

N/A

Self-Watering Planters

Garden planters as bikeway protection.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
3 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Oakland, CA

Technical Specifications

MANUFACTURED BY

EarthPlanter

WEIGHT

Varies

DIMENSIONS

Urban rectangle: 40"L x 22"W x 24"H

Metropolitan square: 32"L x 32"W x

26"H 24"L x 24"W at base

Metropolitan rectangle: 40"L x 22"W x 24"H

MATERIAL

Linear low-density polyethylene

ANCHORING

None

Additional Notes

BIKE COMFORT

Bike comfort varies based on what additional materials the planters are paired with. Planters should not be used alone and should instead be paired with some vertical element and/or curb.

RECOMMENDED APPLICATION

Robust, visible separation between bicycles and vehicles with greenery.

CITIES WITH THE PRODUCT INSTALLED

Oakland, CA; Bethesda, MD

SPEED AND VOLUME GUIDANCE

N/A

Concrete Island

Traditional concrete island installed for bicycle facilities.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
3 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Alameda, CA



Oakland, CA

Technical Specifications

MANUFACTURED BY

Multiple

WEIGHT

Varies based on manufacturer and curb dimensions

DIMENSIONS

3' wide at minimum
Height and length is per design, 6" typical height

MATERIAL

Concrete

ANCHORING

Dependent on design

Additional Notes

BIKE COMFORT

The curb acts similar to the sidewalk curb, significantly minimizing the likelihood of encroachment.

RECOMMENDED APPLICATION

Provides robust physical separation between vehicles and bicycles, particularly along trails and concrete-protected bicycle lanes.

CITIES WITH THE PRODUCT INSTALLED

Alameda, CA; Oakland, CA

SPEED AND VOLUME GUIDANCE

N/A

Extruded Concrete Curb

Concrete curb installed by an extrusion machine on the roadway.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
2 feet



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Local construction contractor
(requires contractor to have specialized equipment)

WEIGHT

Varies based on manufacturer and curb dimensions

DIMENSIONS

2' wide at minimum
Height and length is per design, 6" typical height

MATERIAL

Concrete

Additional Notes

BIKE COMFORT

The curb acts similarly to the sidewalk curb, significantly minimizing the likelihood of vehicle encroachment.

RECOMMENDED APPLICATION

Robust separation typically installed as an upgrade from plastic separation as part of a roadway repaving or restriping project. Not yet in use in Alameda County.

CITIES WITH THE PRODUCT INSTALLED

Santa Monica, CA; Portland, OR

SPEED AND VOLUME GUIDANCE

N/A

Raised Bikeway

Bikeways vertically separated from motor vehicle traffic.

Key Considerations

MINIMUM INSTALLATION WIDTH NEEDED
6" for curb plus gutter pan



ESTIMATED COST



AESTHETICS



BIKE COMFORT



DURABILITY



REFLECTIVITY



MAINTENANCE NEED



Technical Specifications

MANUFACTURED BY

Contractor

DIMENSIONS

Varies, 6" typical curb height

MATERIAL

Concrete and asphalt materials

Additional Notes

BIKE COMFORT

Raised bikeways provide very enhanced comfort by raising bicyclists to sidewalk grade, providing the highest level of separation. Detectable edges and landscaping should be used to separate the bikeway from the pedestrian zone.

RECOMMENDED APPLICATION

Robust, high cost construction method that provides robust physical separation, including where width is constrained. Raised bikeways can have impacts to drainage, adding cost, but can have maintenance benefits with no gutter pan in the bikeway.

CITIES WITH THE PRODUCT INSTALLED

Fremont, CA; Emeryville, CA; Albany, CA; Alameda, CA

SPEED AND VOLUME GUIDANCE

N/A