Bikes & Freeway Interchanges:

Getting Your DOT To Do It Right

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9/606
HDM 1003.3E

Bike Lanes at Basic Interchange Design

- When there are no right turn lanes
- Essentially a low volume ramp situation
- Not common in Santa Clara County or the whole SF Bay Area
Existing HDM and VTA Guidelines do not:

- Address over pass with a right – turn lane
- Address lane width allocation under retrofit situations
- Provide guidance on slowing speeds of the right-turning vehicles
Interchange Design Elements:

- Design speed which determines:
  - Grade
  - Sight distances
    - Stopping sight distance - Horizontal
    - Stopping sight distance - Vertical
    - Decision sight distance
  - Geometrics - Horizontal Curve Radii
  - Lane Widths and Striping
**Design Speed – HDM & AASHTO**

- **Table 101.2 HDM**
- 75 km/h (45mph) is the minimum design standard
- Anything less than 75 km/h (45mph) requires an Advisory Exception. *(signed in District,)*
- Anything less than 55 km/h (35mph) requires a Mandatory Exception (signed in HQ, unlikely on full replacement)
Geometric Issues

- Interchange Configuration (loops and ramps)
- Structure Width****
  - Lane widths
  - sidewalks,
  - bike lanes/shoulders
- Horizontal Curves
- Vertical Curves - grades, sight distances
- Ramp-intersection type******
Ramp Terminal Intersection Type

- Free flowing Ramp-style (BAD)
- 90 degree intersection (GOOD)
Ramp Terminal Intersection Type

Design engineer will probably suggest:
Free Flowing Ramp - Style Intersection

Because:
That’s the way we always do it
Need the capacity
Cars will queue on overpass intolerably
That is what the design guidance says
Ramp Intersection Type

What to aim for: **90 degree Typical Intersection**

Questions to ask to discourage free-flow ramps:

- **Capacity:** only minimal increase in capacity given that right turns are turning onto a one-way ramp and don’t have to wait; ask for the calculations that show the LOS is better with a ramp vs. 90 degree turn

- **Queue:** Ped and bike safety should have priority over queuing cars
90 Degree Typical Intersection:

- Design engineer will probably suggest:
  - Curb Radius of 50+ ft so that tractor-trailers to make the turn; or
  - 45 ft R- Trucks and Articulated buses; or
  - 40 ft R for Single-Unit Trucks / Buses
- What to aim for: 20 or 30 ft Curb Radius
Curb radius and pedestrian distances

A Larger Radius:

- Increases crossing distance for pedestrians
- Also affects speed at which turn is made

<table>
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<tr>
<th>CURB RETURN RADIUS</th>
<th>INCREASE IN CROSSING DISTANCE</th>
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<tr>
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PROBLEMS
1. High speed merge
2. Long pedestrian crossing
3. Increase speed differential between bikes and motor vehicles

60-ft. Radius Off-Ramp (BAD)
If 90 Degree Typical Intersection:

- Questions to ask to discourage large radius:
  - Ask how many tractor trailers are there per signal cycle?
  - How many buses, single unit trucks per cycle?
  - How do they get through other intersections?
  - Ped and bike safety should have priority over the occasional truck or bus making a fast turn
BENEFITS
1. Reduces speed differential
2. Shortens pedestrian crossing
3. Increases safety

20-ft. Radius Off-Ramp (Good)
Free-flow Ramps: Onramp Right-turn Design

- Design engineer will probably suggest:
  - 1-5 degrees - Angle of Departure
  - What to aim for: 0 angle of departure
  - 500 ft Radius for a 45 mph design speed
  - What to aim for: 220 ft Radius maximum for 25 mph maximum design speed
PROBLEMS
1. Starts freeway on local road
2. Sets up acceleration before freeway starts
3. Long & circuitous pedestrian crossing
4. Increases speed differential between bikes and motor vehicles

Freeflow On-Ramp
(BAD)
Free-flow Ramps: Onramp Right-Turn Design

- Points to make to reduce radius of horizontal curve onramp design:
- Does acceleration need to start on arterial or is ramp sufficient length for acceleration?
- Does ped and bike safety have weight in design process over:
  - Facilitating high speed turns
  - Roadway capacity
Bad Offramp Design with Pork Chop
free right-turn

What to aim for: 90 degree intersection

Retrofit Options
1. Bring under Stop sign control
2. Redesign and eliminate them; have Stop or Signal control
3. New construction –DON’T USE THEM
PROBLEMS
1. Takes freeway design standards to local road
2. Sets up high speed merge
3. Long & circuitous pedestrian crossing
4. Increases speed differential between bikes and motor vehicles

“Pork Chop” Off-Ramp (BAD)
BENEFITS
1. Reduces speed differential
2. Maintains traffic flow
3. Shortens pedestrian crossing
4. Increases safety

Retrofit “Pork Chop” & Freeflow Onramp (Good)
Striping/Sidewalks

- Lanes widths-12 ft unless design exception
- Shoulders – unless design exception
  - Right 8’
  - Left 0 – 2 ‘
- Bike Lanes: INSIST between right turn lane and travel lane
- Sidewalks: INSIST both sides
Case Study Evolution of a freeway interchange striping

- First plan: DOT NO Bike Lane VTA insisted on Bike Lanes
- Caltrans insisted on 14 ft inside lane
  - then 12/12/12/5 one sidewalk
- VTA wanted two sidewalks
- Caltrans says no to sidewalk on eastside - the side with most of the ramps, then agreed to ten foot sidewalk on west side
- Project begins construction
Approved Original Striping Plan

- Bike Lane transition wrong: hugs curb till only 100 feet from gore
- 14 ft lanes next to median, not in through lanes next to right turn only lane, or in the right-turn lane where cyclists could use it.
### ORIGINAL PLAN

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### PROPOSED REVISIONS - 3 OPTIONS

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Case Study – Final Striping Plan

Eventually compromised with:
Case Study –
Original and final striping plans
Signage

BEGIN
RIGHT TURN LANE
YIELD TO BIKES

MUTCD R4-4
ADVANCE OF
RIGHT TURN LANES

BIKE LANE
YIELD TO BIKES

BIKE LANE
BIKES MERGING

PROPOSED
Download VTA Bicycle Technical Guidelines in pdf format:
http://www.vta.org/news/vtacmp/Bikes/
More questions?
Email: Michelle.DeRobertis@vta.org
Ken_Eichstaedt@URSCorp.com

VTA is an independent special district responsible for:
Bus and light rail operations; Congestion management; Specific highway improvement projects;
Countywide transportation planning. In short, VTA is both an accessible transit provider;
and a multi-modal transportation planning organization involved with transit, highways and roadways;
bikeways and pedestrian facilities.