Bicycle Detection at Traffic Actuated Signals

Photo: Bob Sutterfield

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- B.S. Physics, 1970, San Jose State University
- Ph.D. Transportation Engineering, 1980, UC Berkeley
- Chair, ITE Committee 4A-36, *Location of Detector Loops to Reduce Congestion at Intersections*, 1990
- Author, *Using Cumulative Curves to Measure Lost Time and Saturation Flow*, ITE Journal, October 1988
- Instructor, *Traffic Signal Equipment and Operations*, UC Berkeley ITS Extension, 1994
- Instructor, *Traffic Congestion Management*, UC Berkeley ITS Extension, 1990

AB 1581, Fuller

- Addresses problem that has existed since inductive loop detectors were introduced in 1960's
- Signed by Governor Schwarzenegger on October 8, 2007
- Bicyclists and motorcyclists are legitimate users of roadways in California
- Requires all new and replaced traffic signals to detect bicycle or motorcycle traffic
- Will take effect when Caltrans adopts uniform standards, specifications, and guidelines for the detection of bicycle and motorcycle traffic and related signal timing
- Incremental costs of installing sensor wiring subject to State Mandates provisions

Caltrans implementation plan

- Caltrans presents its standards for bicycle detection and its approach for developing standards for bicycle timing to CTCDC (today)
- Caltrans amends scope of PATH project on bicycle detection to add testing of bicycle green interval
- PATH project complete June 2008
- Caltrans adds Action item to Aug 2008 CTCDC agenda
- Caltrans presents final standards on bicycle detection for adoption at April 2009 CTCDC meeting
- Caltrans publishes final bicycle detection and signal timing standards as amendment to next revision of California MUTCD, expected in 2010

But bicyclists have problems being detected NOW

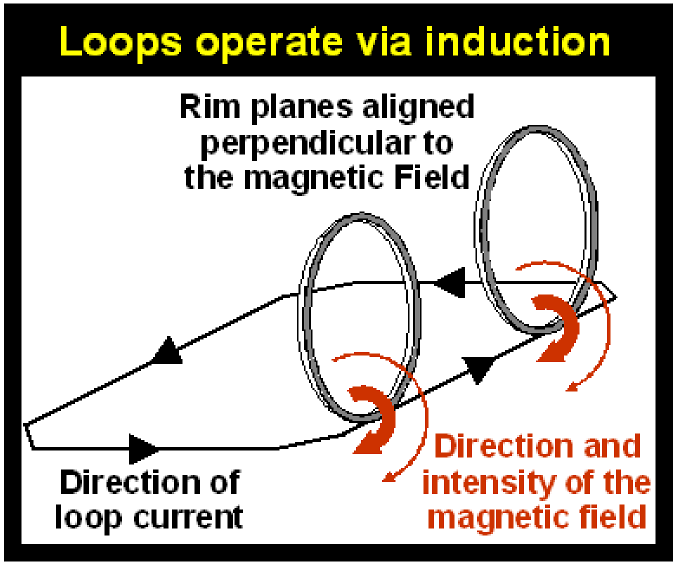
- Caltrans to install Type D loops or video detection for bicycle detection at new & modified actuated signals
- Bicyclists must wait until 2010 for changes to all actuated signals in California, state or local
- Knowledge exists of how to detect bicycles with loops
- Bicyclists need to know where to stop when they cannot see the loop
- To be detected by a loop a bicycle’s rim must be made of metal or have a loop of wire around non-metallic rim
- The problem of bicycles not being detected at actuated signals needs to be addressed immediately and not be postponed for research on extended green intervals

Caltrans plans no new research into loops

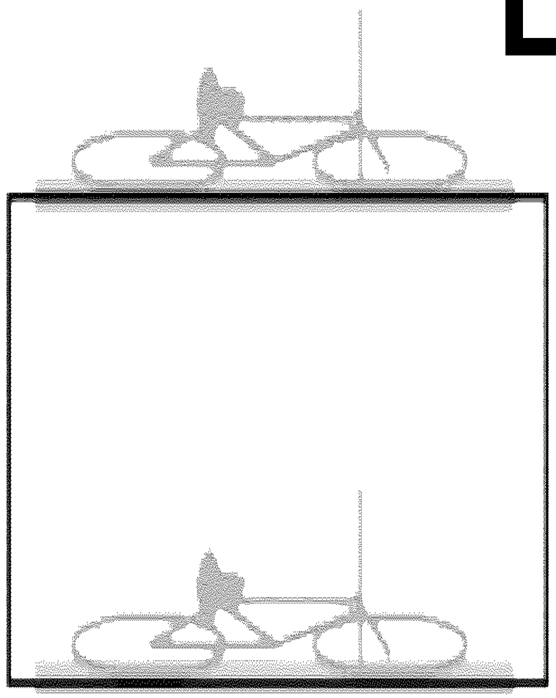
- Strategic direction is to move away from in-pavement detection
- Future research to focus primarily on video systems and other out-of-pavement detection (PATH project)
- Reasons to stop using loops include safety of work crews, congestion, and cost
- Caltrans believes it is difficult to detect narrow objects such as bicycles
- Another reason is that bicycles are increasingly made of non-metallic materials
- Caltrans is seeking solution that is 100% effective when bicyclists are now detected less than 25% of time

Can bicycles be detected with loops?

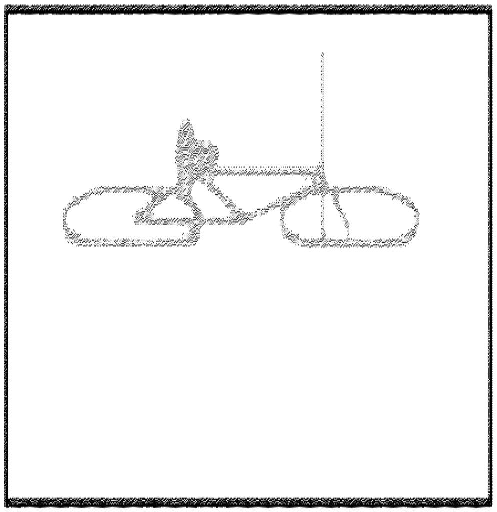
- Magnetic field in a wire is in a circle around the wire
- Left-right horizontal magnetic field intersects the rims at a right angle
- If rim is metal, then bicycle will be detected
- If rim is not metal, then bicyclist needs to wrap several turns of copper wire around rim



Drawing: Dan Gutierrez



Best places for bicycle to be detected



Worst place for bicycle to be detected

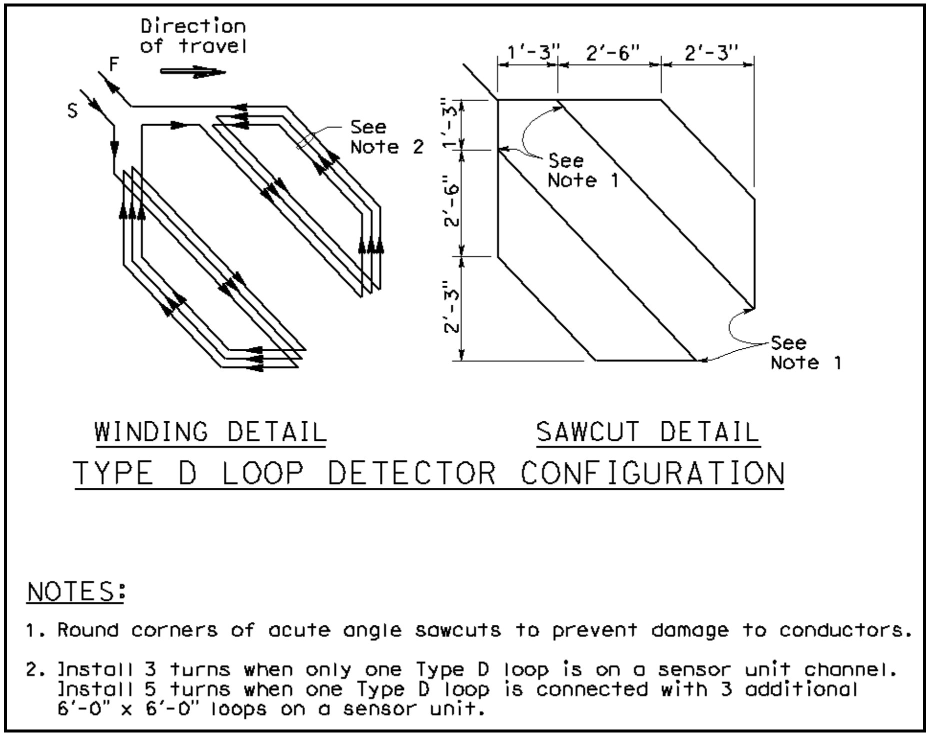
The bicyclist's nightmare: the invisible loop

- A bicycle that is just a short distance from the sawcut is not detected
- Standard Specification 86-5.01A(5) states, *"If asphalt concrete surfacing is to be placed, the loop conductors shall be installed prior to placing the uppermost layer of asphalt concrete."*
- Bicycle Detector Symbol (2006 California MUTCD Section 9C.05) located over a sawcut shows the bicyclist where to stop
- For practical, financial and institutional reasons, deployment of Bicycle Detector Symbols is relatively rare

Drawing: Caltrans Standard Plan A24C

Type D loops

- Diagonal quadrupole
- Can detect bicycles across its width because it has some horizontal magnetic field everywhere within the loop
- It does an excellent job of rejecting vehicles in adjacent lanes
- If a Type D loop is built larger than 6' and located close to the lane line then bicyclists are more likely to stop over it (but need research to know how large is OK)
- A large Type D loop almost as wide as the lane would not need a Bicycle Detector Symbol



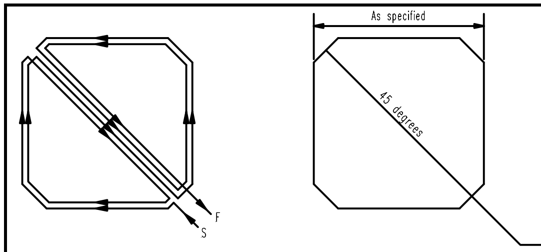
Drawing: Caltrans Standard Plan ES-5B

Caltrans has decided to retrofit with Type D loops

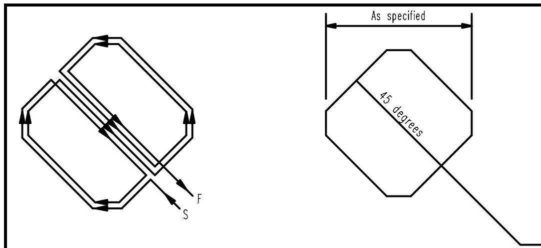
- But the standard Type D loop is only 6 feet wide
- 3 feet between loop and lane stripe remains undetected
- Type D loop has four acute angles, which need to be rounded off to prevent damage to the conductors
- Acute angles cause premature pavement failure and are to be avoided
- The Type D loop is more complex and thus more expensive to install than the Type A, B or E loop
- Division of Research and Innovation (DRI) says, *"Currently, wherever applicable, bicycle detection is installed using the Type D inductive loop. The Type D loop is very expensive to install and hard to maintain"*

Other diagonal quadrupoles

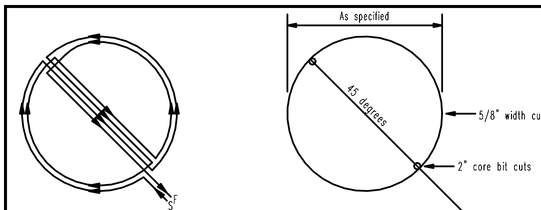
- Add 1 or 2 diagonal sawcuts to Type A, B or E loops
- Type E with diagonal sawcut(s) is called a "quadracircle" (or "quadrocircle")
- Quadracircle being used in Palo Alto, Cupertino and Monterey
- Quadracircle mentioned in *"Implementing Bicycle Improvements at the Local Level,"* FHWA-98-105, 1998
- Quadracircle has similar characteristics to Type D, but is cheaper to install, less complex, and has no sharp acute angles



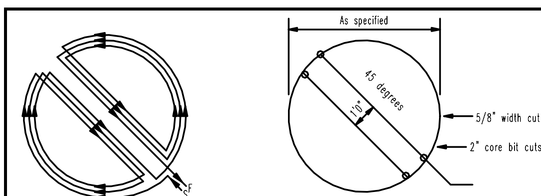
Type A diagonal quadrupole



Type B diagonal quadrupole



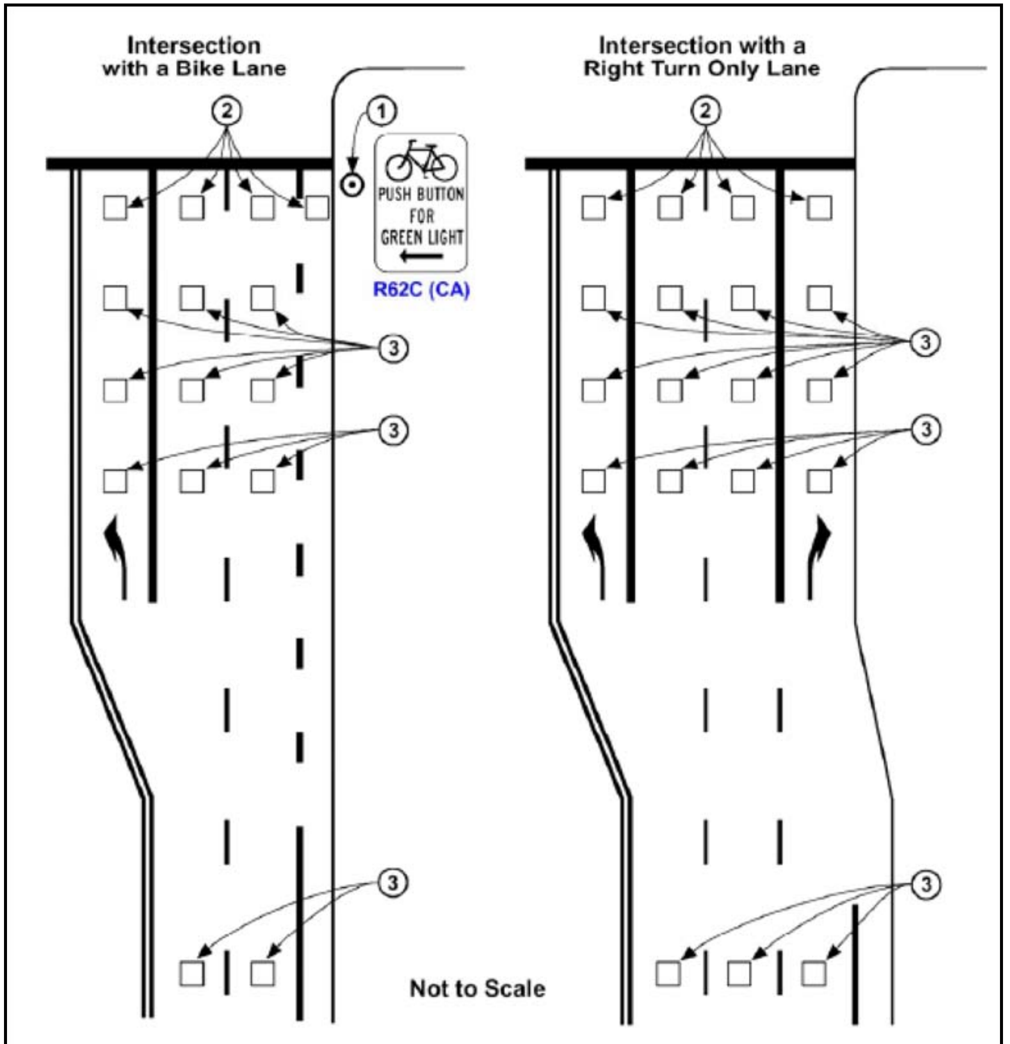
Type E diagonal quadrupole "quadracircle"



Type E diagonal quadrupole with 2 diagonal sawcuts

Locating loops where bicyclists are expected to stop

- At signalized intersections, bicyclists may use left turn lanes to turn left and through lanes to continue straight
- Figure 4D-111(CA) from the 2006 California MUTCD shows bicycle loops centered in each travel lane as well as the bike lane, but bicycle loops in travel lanes are too narrow



NOTES:

1. Bike/Push Button for Green Light (R62C (CA)) Sign or a Type D Loop Detector may be used to activate a traffic signal. A push button should be located so it is convenient to use by bicyclists.
2. Typical Type D Loop Detector locations.
3. Typical Loop Detector locations. See Section 4D.105 (CA).
4. See Standard Plan A24C for Bicycle Loop Detector pavement marking details.

Drawing: Figure 4D-111(CA), California MUTCD

Recommendations

1. Immediately require Bicycle Detector Symbols at all traffic actuated signals
2. Eventually retrofit all traffic actuated signals either with diagonal quadrupole as the head loop, appropriately located and sized, or out-of-pavement bicycle detection
3. Educate bicyclists and bicycle manufacturers of need to use several turns of wire on non-metal bicycle wheels
4. Include diagonal quadrupole loops in future research
5. Include additional diagonal quadrupole loops (e.g., quadracircle) on Caltrans standard plans
6. Continue research into inductive loops, out-of-pavement detection and extended green intervals for bicyclists