

BICYCLE SAFETY STUDY FOR THE GOLDEN GATE BRIDGE

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1. Introduction

This report presents a study of bicycle safety issues on the Golden Gate Bridge (Bridge) sidewalks including the rules of operation, bicycle and pedestrian user counts, bicycle collision history, and bicycle speeds. The report provides recommendations to reduce accidents on the Bridge Sidewalks – solo bicycle, bicycle-bicycle, and bicycle-pedestrian. The study area of this report includes both the east and west sidewalks between the north and south entry gates; other sections of pathway or roadway approaching the Bridge (e.g. Conzelman Road) are not included in this study. The Appendix includes a brief review of relevant speed regulations, enforcement strategies, and other speed countermeasures on shared pedestrian and bicycle facilities from other North American locations.

2. Existing Conditions

Bridge Sidewalk Conditions & Regulations

The sidewalks on the Golden Gate Bridge allow for bicycle and pedestrian access across the Bridge, subject to certain regulations on different times and days of the week. The sidewalks are approximately 10 feet wide across most of the span. The 10 foot effective width is reduced at light poles and at other areas where maintenance equipment is stored along the outside railing. At their narrowest point the sidewalks are 5.5 feet wide around the Bridge pylons, shown in Figure 1. At the Bridge towers the sidewalks narrow to approximately 7.5 feet in width. The sidewalks are separated from the adjacent vehicular travel lanes by a curb and a steel safety barrier. The rise in elevation across the Bridge roadway is 84.4 feet.¹

Bridge Access Rules

Signs are posted at each sidewalk entry point that define the schedule for bicycle and pedestrian use on the two sides of the Bridge. Figure 2 and Figure 3 show the existing signs posted on the east and west sides displaying the sidewalk rules. These rules are intended to provide safe travel and separation for non-motorized



Figure 1: A narrow section of the sidewalk adjacent to a pylon on the east side



Figure 2 Golden Gate Bridge Rules and Restrictions Sign –East Side

¹ <http://www.goldengatebridge.org/research/facts.php#rise> . Viewed on 8/23/2010.

users. Bicyclists and pedestrians use different sides of the Bridge during peak periods. Skateboards, skating, and scooters are not permitted on the sidewalks.² More details regarding the access rules are in the following two sections.

Pedestrians

Pedestrians and wheelchairs are allowed only on the east sidewalk (facing San Francisco) which is open daily. Roller blades, skateboards, and roller skates are not permitted. Dogs are not permitted on the sidewalk except for service animals. Pedestrians are allowed on the east sidewalk from 5 AM to 6 PM during Pacific Standard Time, and from 5 AM to 9 PM during Daylight Savings Time. Hours are enforced by automatically-controlled gates that open and close at the appropriate times.

Bicyclists

Bicyclists currently have toll-free access to the Bridge's sidewalks at all times. Bicyclists are instructed to yield to pedestrians and are advised to use caution in the areas of the towers where sight distances are constrained and there is limited space to maneuver. Electric bicycles may be pedaled on the sidewalks but may not be used under power.

Pacific Daylight Time 2010

Weekdays

- Bicyclists use the east sidewalk between 5 AM to 3:30 PM, sharing it with pedestrians and the west sidewalk from 3:30 PM to 9 PM during the peak period.
- Bicyclists use the east sidewalk 9 PM to 5 AM via remotely controlled security gates located at both ends of the sidewalk. Cyclists press the "buzzer" located near the closed security gate. After security staff identifies the cyclist on a security camera, the gate is opened remotely. Cyclists repeat this procedure to exit through the security gate at the other end.
- During the night period all cyclists are logged in and out for security purposes.

Weekends and Holidays

- Bicyclists use the west sidewalk from 5 AM to 9 PM.
- Bicyclists use the east sidewalk from 9 PM to 5 AM, using remotely controlled security gate system described above.

Pacific Standard Time 2010-2011

Weekdays



Figure 3 Golden Gate Bridge Rules and Restrictions Sign – West Side

² Sidewalk Access for Pedestrians and Bicyclists, Golden Gate Bridge, Highway and Transportation District. Viewed on 5/24/2010: <http://goldengatebridge.org/bikesbridge/bikes.php>

- Bicyclists use the east sidewalk between 5 AM to 3:30 pm, sharing it with pedestrians and the west sidewalk from 3:30 PM to 6 PM during the peak period.
- Bicyclists use the east sidewalk 6 PM to 5 AM via remotely controlled security gates located at both ends of the sidewalk. Cyclists press the "buzzer" located near the closed security gate. After security staff identifies the cyclist on a security camera, the gate is opened remotely. Cyclists repeat this procedure to exit through the security gate at the other end.
- During the night period all cyclists are logged in and out for security purposes.

Weekends and Holidays

- Bicyclists use the west sidewalk 5 AM to 6 PM.
- Bicyclists use the east sidewalk from 6 PM to 5 AM, using the remotely controlled security gate system described above.

Existing Bicycle and Pedestrian Count Data

To better understand the safety issues on the Golden Gate Bridge, the project consultant performed a series of bicycle and pedestrian counts on the Bridge.

Methodology

The counts were conducted using a “screenline” methodology where all bicyclists and pedestrians were counted when entering the Bridge as they crossed an imaginary line perpendicular to the sidewalks at each of the four bridge entry points. Only people entering the bridge were counted (i.e. traveling north from the San Francisco side, or traveling south from the Marin side). Counts were conducted on a weekday (Wednesday, August 11th, 2010), a Saturday (August 14th) and a Sunday (August 15th). Counts were collected on all three days on the east side of the Bridge from 5:00 AM to 9:00 PM and on the west side of the Bridge during operating hours, from 3:30 PM to 9:00 PM during the weekday and from 5:00 AM to 9:00 PM during both weekend days. This methodology took account of the fact that not all pedestrians or bicyclists cross the Bridge in its entirety on the sidewalks. While some bicyclists and pedestrians enter at one end and leave from the other, others enter from the south and leave from there too.

Peak Hour

Table 1 presents the peak hour times and counts of bicyclists and pedestrians from the Golden Gate Bridge and the number and percent of bicyclists on the Bridge for the three days surveyed. Findings include:

- The San Francisco side of the Bridge (both east and west sidewalks) has higher overall volumes of people entering the Bridge sidewalks. This is likely due to the higher concentration of tourists accessing the Bridge from San Francisco.
- Peak hours for the east sidewalk are all in the afternoon. On the west sidewalk, peak hours are evening commute hours and midday weekends.
- The most significant peak period is weekdays on the west sidewalk, suggesting that bicyclists are more likely to use the bridge as a commuting route.
- There are nearly twice as many users on the bridge sidewalks on the weekend than during weekdays. This differential is consistent for both pedestrians and bicyclists.

Table 1: Golden Gate Bridge Peak Hour Bicycle and Pedestrian Use

East Sidewalk							
Day	Peak Hour				Total		
	Time	Bicycles	Pedestrians	Both	Bicycles	Pedestrians	Both
Weekday	3:00-4:00	249 (20.1%)	989 (79.9%)	1,248	1,910 (26.3%)	5,361 (73.7%)	7,271
Saturday	2:30-3:30	94 (6.3%)	1,406 (93.7%)	1,500	607 (5.7%)	10,090 (94.3%)	10,697
Sunday	2:00-3:00	105 (7.0%)	1,397 (93.0%)	1,502	614 (5.4%)	10,847 (94.6%)	11,461

West Sidewalk							
Day	Peak Hour				Total		
	Time	Bicycles	Pedestrians	Both	Bicycles	Pedestrians	Both
Weekday	5:00-6:00	201	0	201	603	0	603
Saturday	11:30-12:30	1,010	0	1,010	5,502 (99.3%)	40 (0.7%)	5,542
Sunday	12:30-1:30	835	0	835	4,736 (99.9%)	5 (0.1%)	4,741

Daily Volumes

Pedestrian and bicycle volumes vary on the Golden Gate Bridge throughout the day. Figure 4 and Figure 5 present weekday bicycle and pedestrian volumes on the east and west sidewalks in one-hour increments. Bicycles and pedestrians have similar use patterns on weekdays.

Figure 6 and Figure 7 present bicycle and pedestrian volumes on both sides of the Bridge divided into one hour increments on Sunday for the north and south ends. Sunday volumes are presented because its peak hour counts were higher than Saturday's (Table 1). Large volumes of pedestrians enter the bridge around 10:00 AM and volumes remain high until 7:30 PM. Both pedestrian and bicycle volumes are high during the afternoon, and bicyclists have a prominent peak period on the west sidewalk at midday.

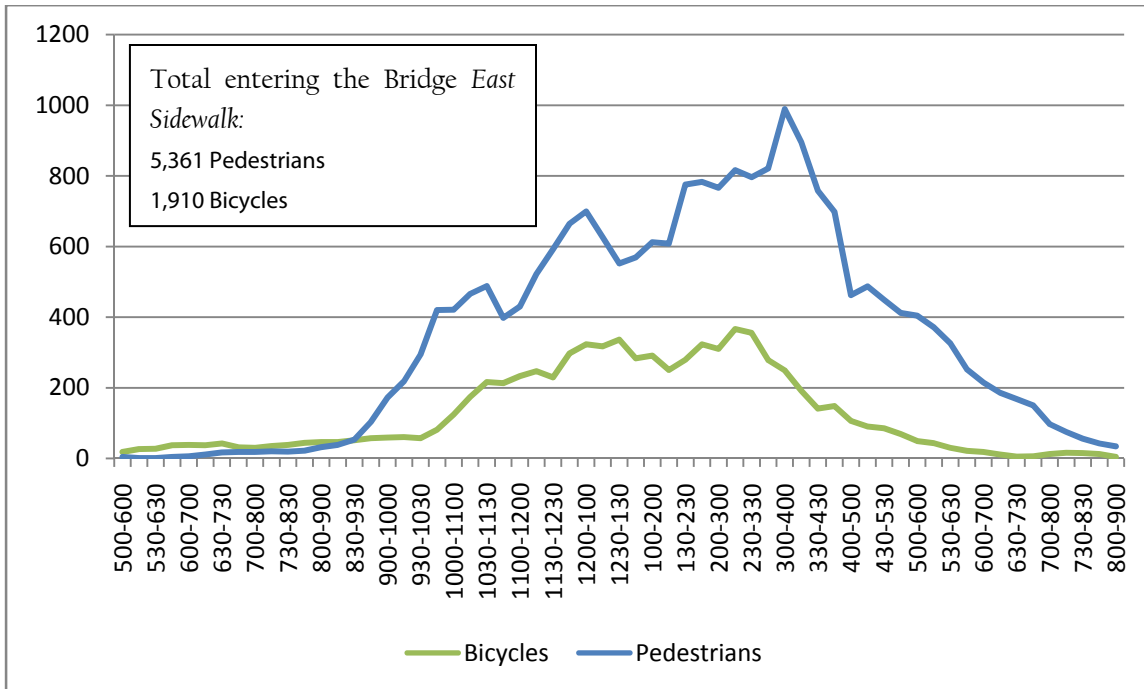


Figure 4: Weekday East Sidewalk Pedestrian and Bicycle Volumes

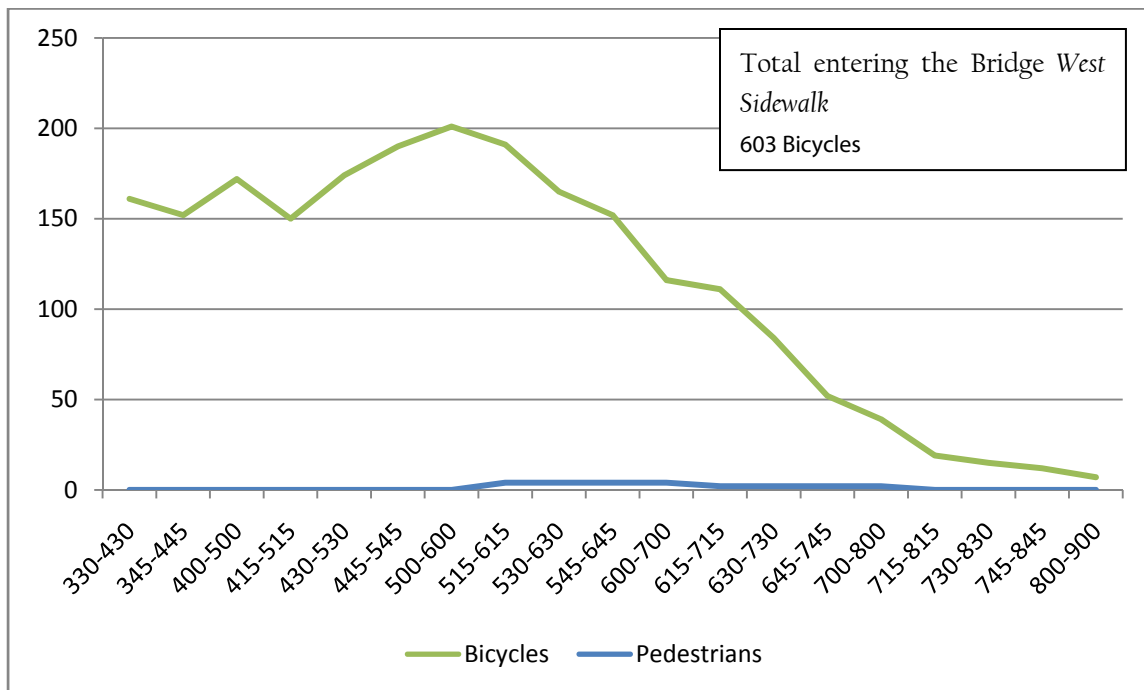


Figure 5: Weekday West Sidewalk Pedestrian and Bicycle Volumes

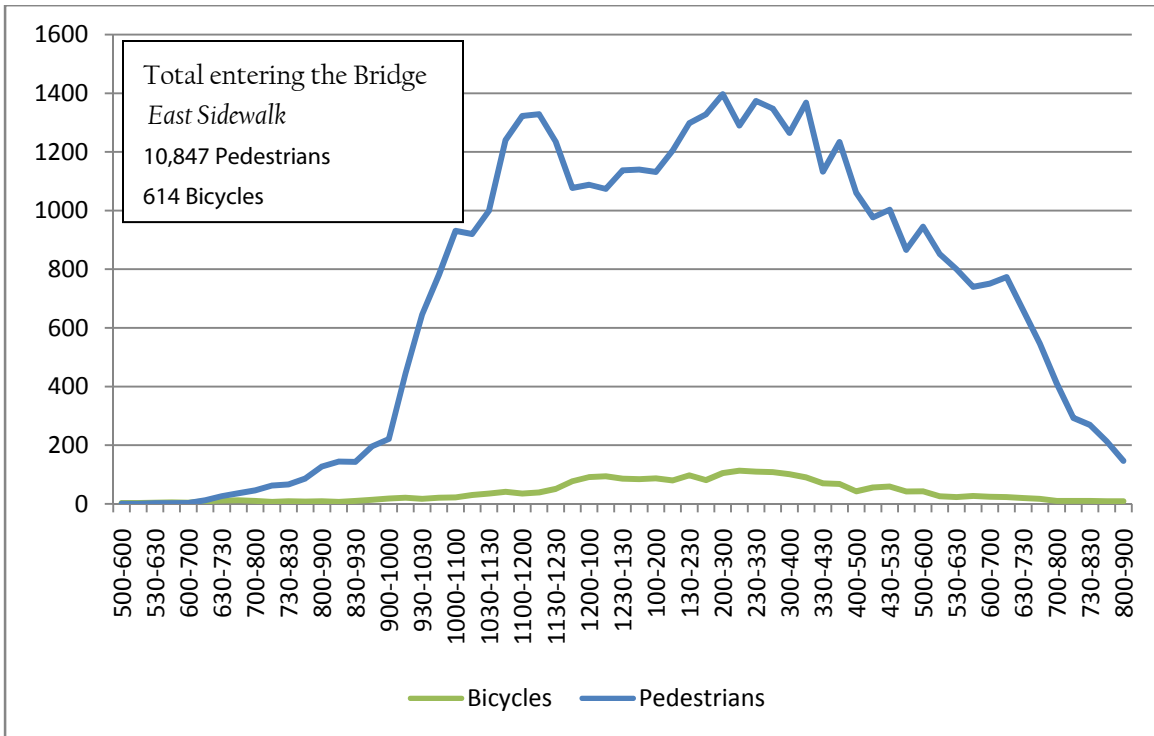


Figure 6: Sunday East Sidewalk Pedestrian and Bicycle Volumes

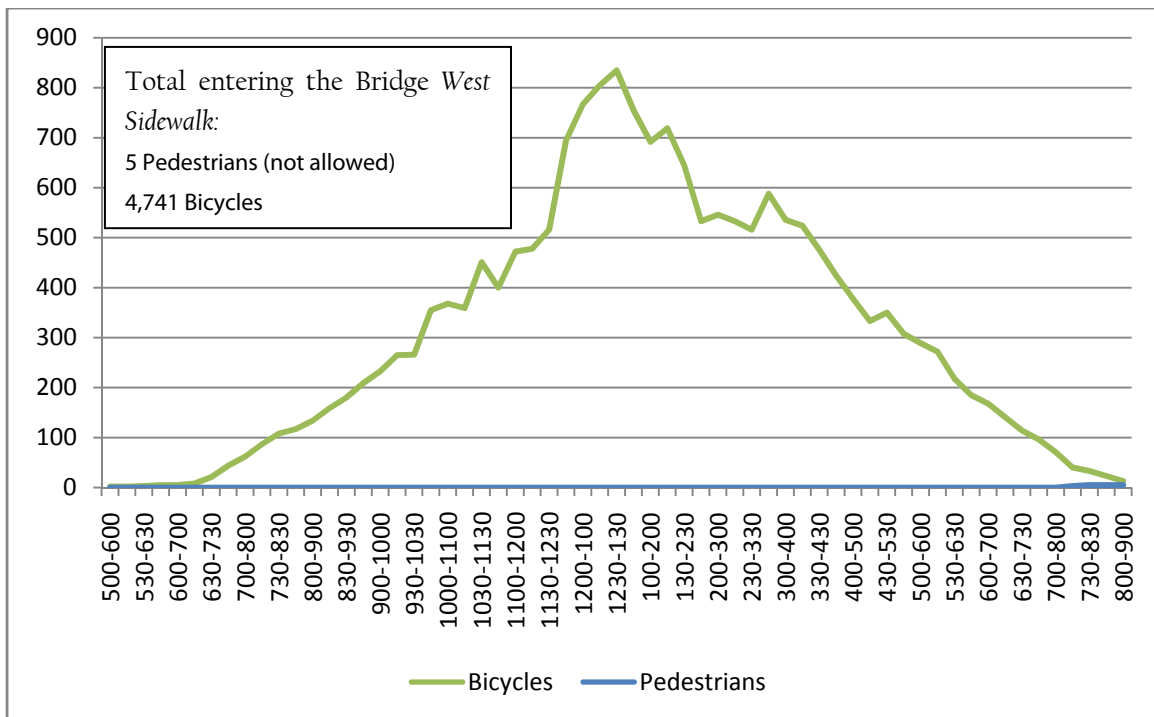


Figure 7: Sunday West Sidewalk Pedestrian and Bicycle Volumes

Bicycle and Pedestrian Collision Analysis

The Golden Gate Bridge District records bicycle collisions that occur on the Bridge. This section reviews the most recent collision data available from Golden Gate Bridge staff. Collisions included in this analysis are only those that occurred on the Bridge sidewalks, and not on connecting paths, roads or parking areas adjacent to the Bridge. Between 2000 and 2009, there were 165 reported collisions involving bicyclists on the Golden Gate Bridge. These collisions resulted in 178 injuries. In 119 of the injury cases (74 percent of incidents) an ambulance responded to the scene.

The most common type of accident on the Bridge sidewalks is the solo bicycle accident. There were approximately five times as many solo bicycle accidents as there were bicycle-pedestrian accidents during the study period. The most common location for an accident is the west sidewalk where pedestrians are prohibited.

Annual Collision Trends

Figure 8 shows the number of bicycle related collisions on the Golden Gate Bridge from 2000-2009. During this period, the number of annual collisions on the Golden Gate Bridge trended upward, with 9 reported bicycle collisions in 2000 increasing to 23 reported collisions in 2009. Volumes of bicyclists have likely increased on the Bridge between 2000 and 2009, which could account for the increase in absolute collisions. The County of Marin and San Francisco Municipal Transportation Agency reported large growth in non-motorized travel during this same time period.^{3 4}

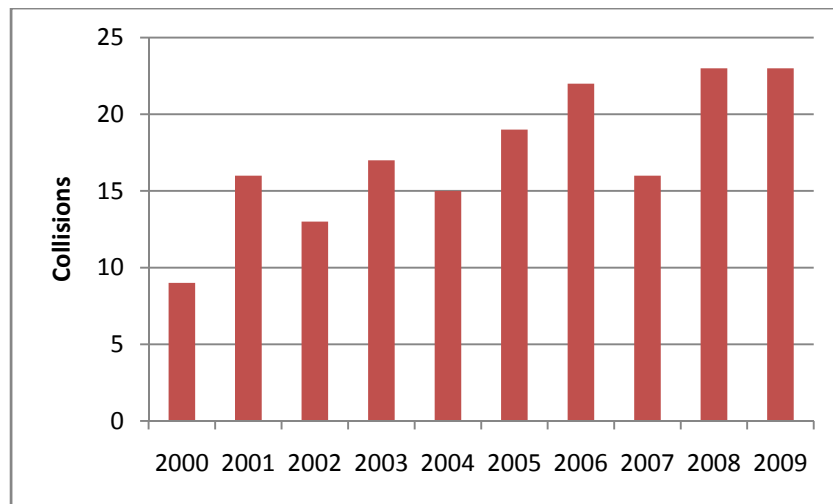


Figure 8 Bicycle Related Collisions on the Golden Gate Bridge

³ Marin County Nonmotorized Transportation Pilot Program, *Summary of 2007, 2008, and 2009 Bicycle and Pedestrian Counts and Surveys*, October 2009. Viewed on 5/27/2010 at:
http://www.walkbikemarin.org/documents/2009%20NTPP_Count_Survey_Report.pdf

⁴ San Francisco Municipal Transportation Agency, *2008 San Francisco State of Cycling Report*. Viewed on 5/27/2010 at:
<http://www.sfmta.com/cms/bnews/documents/2008SFStateofCyclingReport.pdf>

Collisions by Month

Figure 9 shows bicycle collision data by month, from 2000 to 2009.

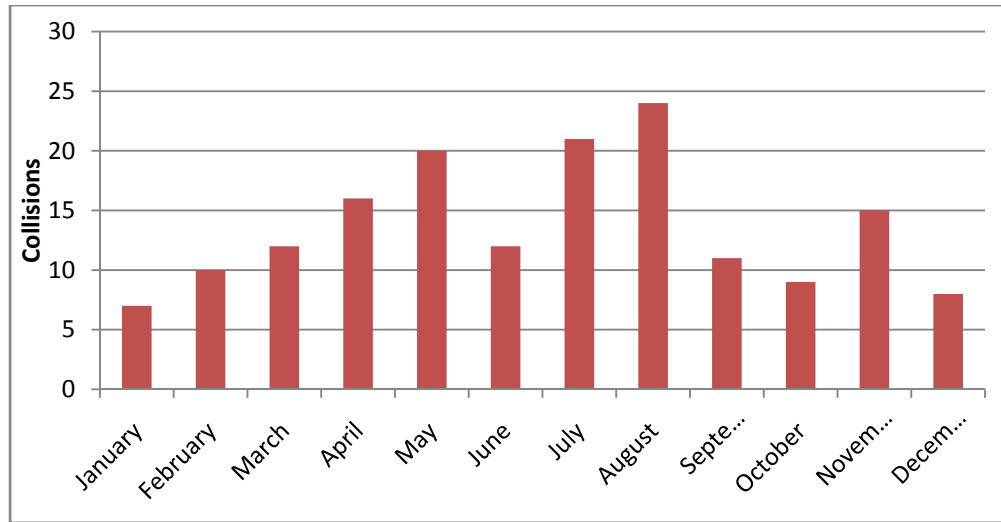


Figure 9 Bicycle Related Collisions on the Golden Gate Bridge by month

Collisions by Hour

Bicycle related collisions on the Golden Gate Bridge occurred between 7 AM and 9 PM. As Figure 10 presents, the highest frequency of these collisions occurred between 11 AM and 5 PM over the ten year span. The peak in midday to late afternoon collision is likely due to the higher volumes of users during these times.

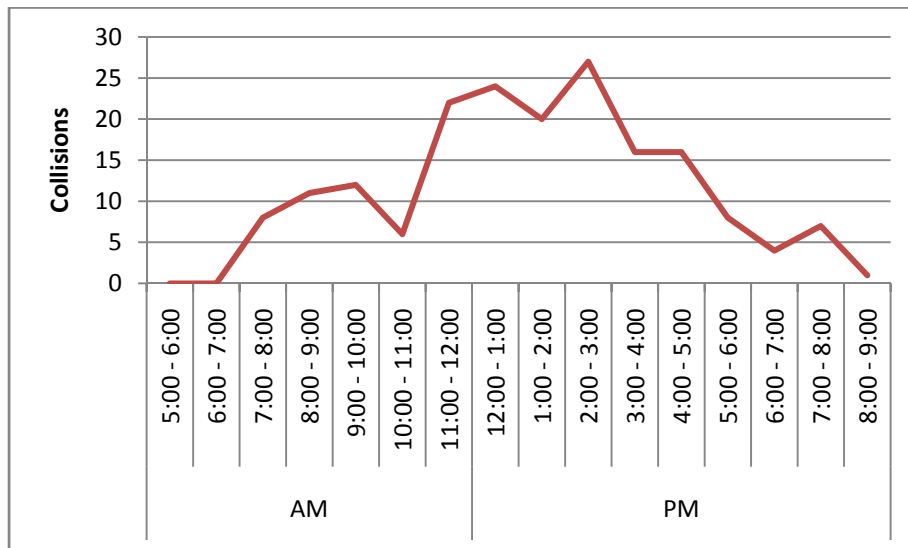


Figure 10 Bicycle Related Collisions on the Golden Gate Bridge Hourly Frequency

Role of Speed in Collisions

Speed was identified as a factor in approximately 39 percent of the 165 total reported collisions between 2000 and 2009 (as reported by the Bridge officer responding to the collision). Approximately 48 percent of such collisions occurred on Saturday and Sunday when the west side was open to bicyclists. Bicyclists may be travelling at higher speeds when using the west sidewalk as there is less “friction” with pedestrian users to slow them down.

While collisions between bicycles and pedestrians represent only 12 percent of bicycle collisions, speed is cited in 63 percent of these incidents, compared to 35 percent for other types of collisions. As Table 2 shows, speed was implicated in 43 percent of bicycle/bicycle collisions and 32 percent of solo bicycle collisions between 2000 and 2009. Addressing excessive bicycle speeds on the Bridge will likely decrease the number and severity of bicycle collisions.

While bicycles generally travel faster on the west sidewalk where pedestrians are not allowed, speed was implicated in a smaller percentage of collisions. This suggests that absolute speeds are not as significant a factor in collisions as speeds relative to other path users.

Table 2: Role of Speed in Bicycle Collisions

Type	Speed a Factor in collision		Speed not a Factor		Total
By Collision Type*					
Solo Bicycle	31	32.0%	66	68.0%	97
Bicycle/Bicycle	20	42.6%	27	57.4%	47
Bicycle/Pedestrian	12	63.2%	7	36.8%	19
By Bridge Side					
East Side	32	40.5%	47	59.5%	79
West Side	32	37.6%	53	62.4%	85
Total	64	39.0%	100	61.0%	165*

**some collisions missing side or type data*

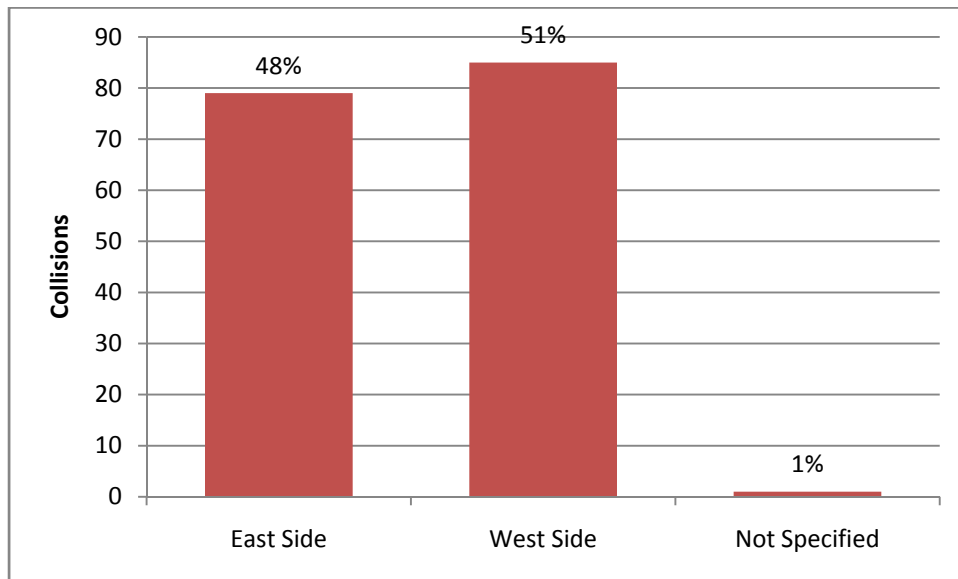


Figure 11 Bicycle Collision Locations

Collision Location

The officer responding to a collision pinpoints the incident to the nearest Golden Gate Bridge light post. Even-numbered light posts are on the west side and odd-numbered light posts are on the east side. Figure 11 shows that approximately 51 percent of bicycle collisions were on the bicycle-only west side of the Bridge and approximately 48 percent of bicycle collisions occurred on the shared-use east side. Collision data for one incident did not indicate which side of the Bridge the collision occurred.

Figure 12 shows collisions according to their corresponding light posts between 2000 and 2009, for both the east and west sides. As the figure shows, 15 collisions occurred at light posts 43 and 44. These posts are adjacent to the Marin Tower. The need for bicyclists to navigate around the tower may result in more collisions. Additionally, there are high numbers of collisions on both sides between light posts numbered 21 to 28, where the sidewalk initially narrows, then widens, and then narrows again around the north end pylons. This constrained sidewalk configuration could result in more user conflicts.

Many incidents also occur at the south end of the Bridge, between light posts 113 and 131. There are obstacles here that may result in increased collisions: The sidewalk narrows around the south end pylons between light posts 113 and 120 and then the sidewalk turns to navigate around the toll booth. Pedestrian activity is also highest on this section of the Bridge, which might explain why the increase is more dramatic on the east sidewalk.

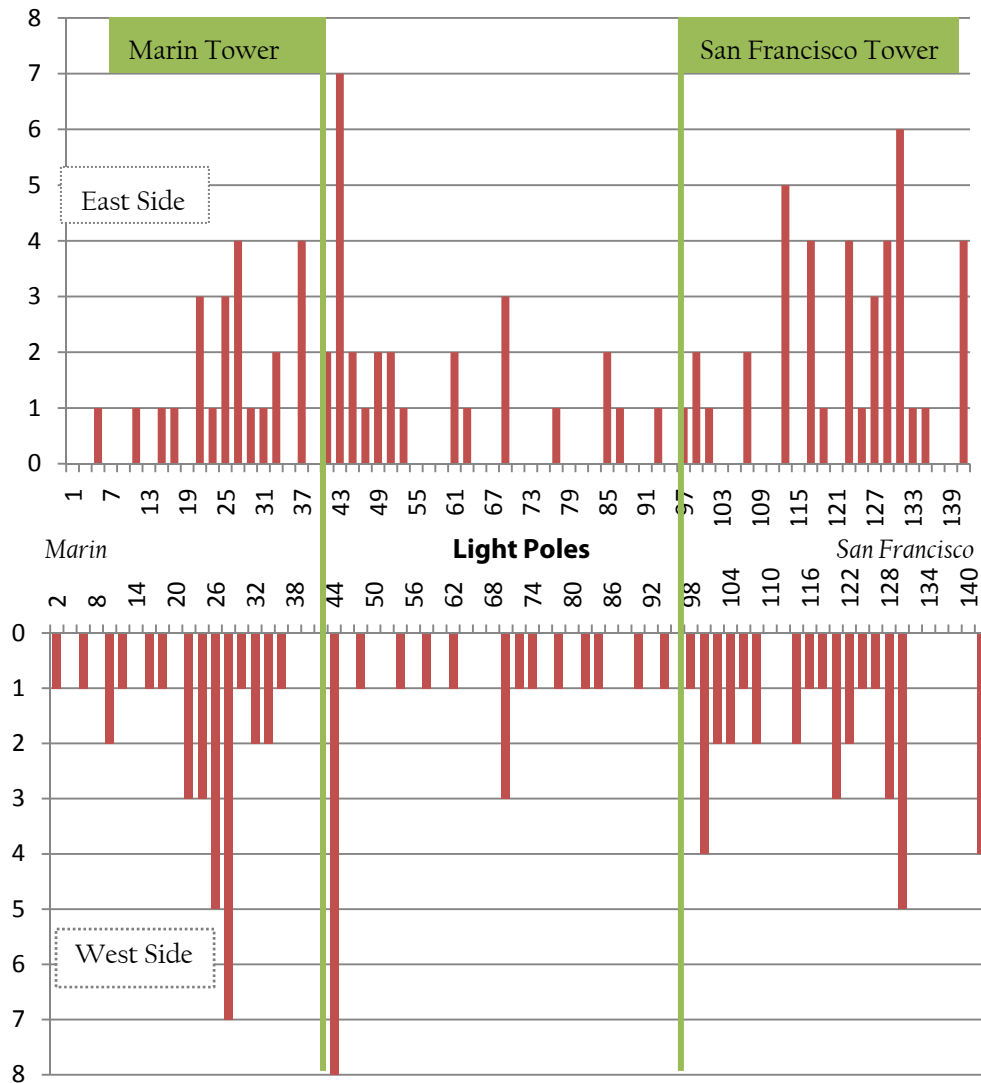


Figure 12: Bicycle Collisions at Light Poles

Collision Type

Of the 165 reported collisions between 2000 and 2009, 163 have data that represent the side of the Bridge where the collision took place: 96 of these were solo bicycle accidents; 47 were bicycle-bicycle accidents; and, 19 were bicycle-pedestrian accidents. Table 3 presents collisions categorized by type on each side of the Bridge. Bicycle-bicycle accidents are twice as common on the west sidewalk as on the east sidewalk.

About 90 percent of bicycle/pedestrian collisions occurred on weekdays, and all but two of these incidents occurred on the east sidewalk. These collisions occurred near the start of the walkways where pedestrians may have mistakenly ventured. Pedestrians are not allowed on the west sidewalk. During the weekends bicycles have full use of the west sidewalk so there are far fewer interactions with pedestrians.

Table 3 Collision Side and Type

Bridge Side	Collision Type	Number	Percent	Bridge Side	Collision Type	Number	Percent
West	Solo Bicycle	50	58.8%	East	Solo Bicycle	46	58.2%
	Bicycle/Bicycle	33	38.8%		Bicycle/Bicycle	14	17.7%
	Bicycle/Pedestrian	2	2.4%		Bicycle/Pedestrian	17	21.5%
	Total	85	100.0%		Total	79	100.0%

Existing Bicycle Speeds

The project consultant team performed a speed survey to calculate the average speeds of bicyclists on the Bridge. Using a bicycle equipped with a speedometer, staff followed behind bicyclists for 20 to 60 seconds to measure their average and maximum speed. This approach was determined to be more accurate and more discrete than using radar to measure speeds (radar measurements were inconsistent due to interference from adjacent vehicles, and users tended to slow down as soon as they saw staff members aiming a radar gun at them). Speeds vary by section of the Bridge, slower on the up slopes and faster on the down slopes.

Speed of bicyclists on the west and east sides of the Golden Gate Bridge vary. Generally, bicyclists travel faster on the bicycle-only west side than on the east sidewalk shared with pedestrians. Based on observations, the highest speeds and greatest potential for speed-related collisions comes from road cyclists (i.e., non-tourist, experienced recreational cyclist) who may travel up to 10 mph faster on average than other types of bicyclists. For example on the west side, these faster bicyclists are travelling approximately 17 mph on the up slopes, 20 mph on the flats, and 23 mph on the down slopes, compared to 7 mph, 10 mph, and 13 mph for the majority of other riders. These faster riders generally account for about 10 percent of bicyclists on the Bridge, with higher percentages at certain times, such as Saturday mornings when many group rides leave from San Francisco and head into Marin.

West Side Bicycle Speeds

The west side of the Golden Gate Bridge is open to bicyclists during the weekends and on weekdays after 3:30 PM. Generally, bicyclists travel faster on the west side than the east side of the Bridge because there are no pedestrians affecting the flow of bicycle traffic. The greatest potential conflict arises when the bicyclists traveling at higher speeds attempt to pass bicyclists riding at slower speeds. This can include groups of bicyclists passing other groups of bicyclists and can occur in both the northbound and southbound directions. This is especially challenging when the pathway narrows at the pylons and towers. Table 4 presents average speeds for the west side sections of the Bridge with the maximum speeds occurring on the down slope between the two towers.

Table 4 West Side Average Bicyclist Speeds

Bridge Section	Average Speed
Up Slope	7-10 mph
Flat Section	10-13 mph
Down Slope	13-17 mph

East Side Bicycle Speeds

The east side of the Golden Gate Bridge is open to bicyclists during weekdays from 5:00 AM until 3:30 PM. Bicyclists must share the sidewalk space with pedestrians. The greater number of users creates congestion, and this “friction” forces bicyclists to travel at slower speeds for much of the Bridge span. The greatest potential conflicts occur when faster moving bicyclists attempt to pass other cyclists or pedestrians. Pedestrians and bicyclists, including slower moving tourists and faster moving tourists and recreational bicyclists, must occupy the same area on the Bridge. The chance for conflict is greatest at the pylons and towers where the path width is constrained, and when bicyclists are travelling down slope and their speeds are highest.

Like the west side, speeds vary by section of the Bridge, slower on the up slopes and faster on the down slopes. Bicyclists typically ride slower than 10 mph but may travel up to approximately 20 mph on the down slopes.

3. Safety Recommendations

Four recommendations are proposed to enhance safety for bicyclists and pedestrians on the Bridge. These recommendations are: establishing a bicycle speed limit, separating cyclists and pedestrians with the use of signs and pavement markings, developing an outreach campaign and Bridge Ambassador, and continuing the restriction of other user groups. Discussions for each of these recommendations are described in this section.

These recommendations apply to current conditions on the Bridge, but are particularly important due to upcoming construction activity during which bicycle and pedestrian traffic will be required to share one sidewalk during all days and times that the sidewalk is open, increasing the potential for conflicts between users. Based on observations and counts, the following may occur during construction:

- With bicyclists and pedestrians sharing one sidewalk during all days and times when the sidewalk is open, the level of congestion during weekend peak hours will increase greatly. Based on the recent counts, during a peak weekend period there may be nearly 2,000 pedestrians and 800 bicyclists using the same 10 foot wide sidewalk during a one-hour period. Increased congestion will result in more interactions of bicyclists and pedestrians passing one another and may result in more crashes or near misses.
- While more interactions between users could increase the number of incidents, the severity of crashes would likely decrease due to the fact that the increased congestion will lower bicyclist speeds. Speed is the greatest factor in the severity of crashes. During the highest peak periods bicyclists will need to reduce their speeds out of necessity such that in some cases they may not be traveling much faster than the surrounding pedestrians.
- Bicyclists accustomed to riding unimpeded at a relatively quick speed over the Bridge on weekend rides may have difficulty adjusting to sharing the path with slower moving pedestrians. Pedestrians may feel intimidated by large groups of bicyclists passing by.

Recommendation 1: Establish Bicycle Speed Limit

There is no bicycle speed limit posted on the Golden Gate Bridge sidewalks. Based on our observations and measurements of existing bicyclist speeds, this report recommends a speed limit of 10 mph. This is consistent with other speed limits on other shared bicycle / pedestrian bridge sidewalks such as the Burrard Bridge in Vancouver, BC. This 10 mph speed limit should be posted on both existing entrance signs to the sidewalk. Signs should also be posted on Bridge signs not interfering with the existing motorist speed limit signs. Additionally, the speed limit should be stenciled clearly on the sidewalk, as shown in Figure 15. Around the towers the speed limit should be decreased to 5 mph, also clearly signed.

Recommendation 2: Signage and Pavement Markings Delineating Space

Signage and pavement markings will help to delineate specific space on the sidewalk for bicyclists and pedestrians. Currently, during the times of the day when the sidewalk is shared, pedestrians tend to walk on the outside (water side) of the sidewalk and bicyclists tend to ride on the inside (traffic side), no matter what direction they are traveling. The greatest potential for conflict occurs where this “informal” segregation breaks down. Groups of pedestrians may walk across the entire pathway width and blocking bicyclists or bicyclists may weave from right to left through pedestrians

Many multi-use paths address such safety conflicts by segregating users, either providing completely separate pathways for bicyclists and pedestrians, or striping separate space for users on the same path (e.g. bikes stay left, pedestrians stay right). Obviously with the Golden Gate Bridge there is no additional space to add a new path, and the 10-foot sidewalk width is not sufficient to stripe a centerline or other division for its entire length.

We recommend the use of pavement markings placed at intervals that illustrate the general separation of bicycles to the inside and pedestrians to the outside. While this would not create a “defined” space as would an unbroken dividing stripe, it would reinforce the informal bikes inside / pedestrians outside segregation that currently occurs and results in the smoothest observed flows.

This segregation is observed only on the straightaways; there is such heavy congestion around the towers with pedestrians standing on both sides and extremely limited sightlines that the area is seen as a special zone of mixed, extremely slow speed bicyclist travel.

Signage

Signage improvements are recommended on the Golden Gate Bridge to help inform bicyclists and pedestrians where they should be while using the sidewalk. Figure 13 presents the two signs –one for each direction. The signs are a modified version of California Manual on Uniform Traffic Control Devices (MUTCD) sign R9-7.



Figure 13 Recommended Bridge Bicycle/Pedestrian Signage



Figure 14 Existing Bicycle Sign on the Bridge Towers

These are recommended for the light posts, similar to how the existing BICYCLISTS SLOW signs are posted (Figure 14). If needed, the color of the signs can be modified to match the existing yellow bicycle sign placards.

Pavement Markings

Pavement markings are recommended on the shared bicycle and pedestrian sidewalk. The pavement markings, or stencils, inform bicyclists and pedestrians where they should be while on the sidewalk. The markings, as Figure 15 presents in a photo simulation, reflects the same division as the recommended signs—the inside of the sidewalk for bicyclists and the outside for pedestrians. The bicycle section of the sidewalk is split from the pedestrian section with a white solid line that extends only the length of the markings. The markings should be placed approximately every 500 feet on sections of the sidewalk that are 10 feet wide.



Figure 15 Recommended Pavement Markings

Recommendation 3: Targeted Outreach

Adjusting to sharing one path during afternoon and weekend periods may be difficult for pedestrians and cyclists accustomed to having more segregation of users. It is recommended that the Bridge engage in targeted outreach both before and during the construction period to reach out to bicyclists and pedestrians and alert them of the coming change to shared use, and to encourage safe and respectful behavior, including obeying the 10 mph speed limit. Targeted groups might include the racing cyclists who are most likely to be traveling at higher speeds across the Bridge as part of a training ride, tourists on rental bicycles who may block the sidewalk for photos, and pedestrians. A “Share the Bridge” campaign is recommended – posters and signs

could be printed and posted during construction, encouraging additional caution and courtesy. The Bridge District could work with the San Francisco Bicycle Coalition and Marin County Bicycle Coalition to distribute outreach materials to their members. Materials posted or distributed at the Bridge should be printed in multiple languages and designed to engage users in a non-confrontational way, emphasizing safe behaviors that limit conflicts between bicyclists and pedestrians of all types.

Recommendation 4: Other User Groups

The Bridge currently prohibits roller / inline skaters, skateboards, and dogs (except service animals). These prohibitions should continue as these user groups are not compatible with the high levels of pedestrian and bicycle use experienced on the Bridge sidewalks. Our research into multi-use trail regulations of unicyclists yielded no results; this user group is simply so unique and infrequent that trail and pathway management agencies do not regulate them as a special group. In terms of safety, a “tall bike” (a custom built bike where the seat is situated at a height that may be 5 or more feet off the ground) poses a safety risk to the user from toppling over safety railings. Because the safety rail stands 4’6” tall, prohibition of bicycles or unicycles whose seats are more than 4 feet off the ground might make sense so that no riders topple over the safety railing.

Appendix: Speed Regulation Guidance and Case Studies

To improve safety issues on the Golden Gate Bridge, a review of North American guidance for decreasing bicycle and pedestrian collisions and bicycle speeds on shared-use facilities was reviewed. The speed countermeasure research was conducted online and through queries to email list serves with members in the bicycle, pedestrian, and multi-use path planning, design and management professions. This section highlights the Federal highway Administration's recommendations for improvements that include both programmatic elements such as education and enforcement as well as engineering improvements like signing and striping. Given the inability to widen the Bridge sidewalks, many speed regulations may not apply.

Speed Regulation Guidance

BIKESAFE

The Federal Highway Administration (FHWA) operates the BIKESAFE website, which provides information regarding bicycle safety, including those between users on shared use paths. The BIKESAFE website provides the following alternatives to managing bicyclists' speeds on shared use facilities⁵:

- **Separate bicyclists and pedestrians** by providing physically-separated facilities or through paint or pavement treatments and clearly marked through signage "These include center-line striping to separate directions of travel with broken markings that indicate safe passing zones..."
- Use positive, **educational enforcement** to maximize impacts. Programs can include 'share the path' events, which often include information and giveaways of bells or 'Burma Shave' style signage.
- BIKESAFE does not recommend instating or enforcing a speed limit on shared use paths.

Todd Litman, Director of the Victoria Transport Policy Institute, contributed BIKESAFE Case Study #36 *Share the Trail: Minimizing User Conflicts on Non-Motorized Facilities*. Litman recommends focusing on desired user behavior. On shared facilities, he argues that it is critical to clarify multi-use path rules by setting specific standards for maximum travel speed, and right-of-way and publicizing them in signage, brochures, and through a website.

National Trails Partnership Synthesis

The article, *Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice* by Roger L. Moore (1994), is a synthesis of existing literature created by the National Trails Training Partnership for FHWA. The article provides guidance for implementing conflict mitigation on trails. Conflicts arise and are exacerbated by many factors, including an increase in demand for trail resources, increased use of existing limited trails, lack of user etiquette, and disregard for the varying abilities of trail users.

⁵ Viewed on 5/25/2010: http://www.bicyclinginfo.org/bikesafe/countermeasure.cfm?CM_NUM=34

The report acknowledges that in some situations, speed management and other techniques may be required to reduce user conflicts. The report cites a Rails-To-Trails Conservancy survey of rail-trail managers, which found the following techniques regularly used to overcome conflict-related problems on their trails:

- Signage
- Education
- Police or ranger patrols
- Enforcement of regulations
- Brochures articles in newsletters or local newspapers
- Imposing speed limits

The report cites J. Ryan's study, *Trails for the Twenty-First Century* (1993) with the following guidance on imposing speed limit on multi-use trails where education alone is insufficient: "speed limits should be used only as a last resort since they require consistent, ongoing enforcement, may not improve real or perceived safety on the trail, and may discourage bicyclists from using trails for commuting."

Where speed limits are created, the following strategies are recommended to gain compliance:

- Inform users of the regulations

Post regulations at trailheads and include them in trail brochures and on maps. Communicating why and how the regulations will be enforced and applicable penalties.

Be aware that using wordings such as "Not Recommended" rather than "No" in messages produces a more cooperative atmosphere and better compliance; however, offending users may take advantage of more lenient wordings.

- Communicate the reasons for regulations to the users affected.
- Enforce rules and regulations consistently to assure that there is no perception of discrimination among different user groups.
- Employ a variety of on-site enforcement personnel if possible and appropriate:
- Peer policing programs (e.g., peer pressure).
- Volunteer trail patrols.
- Uniformed enforcement officers.

Conflicts on Multiple-Use Trails recommends promoting guidelines and regulations using signs and brochures and by enlisting the help of public organizations (such as walking and cycling clubs) and schools and by promoting responsible behavior at events such as fairs.

Case Studies

Many jurisdictions throughout the country have implemented various forms of speed reduction techniques on paths. These include speed regulations, enforcement, posted trail etiquette, literature and programmatic events, and specific trail design improvements. This section describes examples of these trail techniques implemented in North American locations. The research provided in this section was gathered from internet



Figure 16 Canada Road, San Mateo County

searches, interviews with local staff, and through professional experience.

Speed Regulations

Most jurisdictions with a formalized speed limit on shared-use paths have implemented the regulation in response to comments and complaints from trail users or residents who do not feel comfortable sharing the path with faster-moving cyclists. Of those interviewed, several regions experienced a bicycle-bicycle or bicycle-pedestrian collision prior to implementing speed limits.

Most speed limits on multi-use paths are 15 mph. Trails with a 15 mph speed limit include:

- Canada Road, San Mateo County, CA (Figure 16)
- Sir Francis Drake/ Cross Marin Trail, CA
- North Augusta Greenway, Augusta Canada
- Centennial Trail, Coeur d'Alene, ID
- Pinellas Trail, FL
- American River Parkway, Sacramento, CA
- Capitol Crescent Trail, Washington DC
- Columbus Recreation and Parks Department Trails, OH

Enforcement of Speed Regulations

Common speed restriction enforcement strategies include posted signage with trail etiquette posted at trailheads. While warning signage and 'Share the Path' style information is used to encourage pedestrians to not make unpredictable movements.

Mary Carter Greenway Trail, CO

The Mary Carter Greenway Trail, located in the Denver Metro area, is a 10-foot wide eight-mile multi-use path. The path experiences significant usage, and a fatal bicycle-bicycle collision occurred on the path in 2003. As a result of the fatality the South Suburban Park and Recreation District implemented a number of user conflict mitigation treatments including:

- Installed 15-mph signs along the trail
- Imposed a court summons for bicyclists "found to be exceeding the speed limit or riding in a dangerous manner"
- Painted a centerline along the trail.

Capitol Crescent Trail, DC

The Capital Crescent Trail is a 10-foot wide trail that connects Georgetown to Silver Spring, MD. The trail has shared use and in 2006 counts revealed that 39 percent of users are bicyclists, 38 percent are walkers and 13 percent are joggers.⁶



Figure 17 Seawall Trail in Vancouver, BC

⁶ Capitol Crescent Trail. (Accessed 8/27/2009). CCT 2006 Use Survey. Available: www.cctrail.org/CCCTsurvey.htm

The Trail in Washington D.C. reduced the bicycle speed limit from 25 mph to 15 mph due to increasing use and user complaints. Violators of the speed limit on the Capitol Crescent Trail in Washington D.C. receive fines of \$50, although the aim is education, and only blatant violators are fined.

Seawall Trail, Vancouver, BC

On the Stanley Park Seawall Trail in the City of Vancouver, B.C., a 15 kph (9 mph) limit was instituted in 1995. Speed checks were taken before and after the installation of the 15 km/h signs. A report by the General Manager of Engineering Services concluded that, “the results ... are inconclusive, showing little change in speeds.” The study found that few cyclists exceed the speed limit by more than six mph, and the average speed of all cyclists was approximately 10 mph. Police give verbal warnings to cyclists who appeared to be exceeding the speed limit, but have not issued any tickets. The report supports using signage to “provide a reminder to cyclists to maintain a moderate speed in keeping with the nature of the facility, even in the absence of enforcement.”⁷

Posted Trail Etiquette

Trail etiquette can include restrictions on cyclists riding abreast, but such regulations are rarely enforced. Etiquette related to reducing speed and user conflicts on narrow facilities are below. These are presented to trail users in maps and associated literature as well as posted on trail signs.

- Fast traffic (e.g., cyclists) always yields to slower traffic (e.g., pedestrians). (Central Park, NY)
- Yield to pedestrians, control speed and warn — call out or use a bell — other trail users before passing. (Gallop-ing Goose Regional Trail, B.C.)
- To avoid conflicts with other trail users, pedestrians should keep to the right. (City of St. George, UT)
- Don't block the trail. When you're in a group or with a pet, use no more than half the trail. Don't block the flow of other users. (Anchorage, AK)

Programs and Events

Marin County, CA

The County of Marin funded a series of “Share the Path” checkpoints on high-volume Marin County multi-use paths as a means of fostering better trail etiquette and respect between users. When possible, checkpoints occur with local law enforcement to educate path users, including bicyclists and pedestrians, about shared rights and responsibilities.

Educational and safety literature is available at the staffed checkpoint. Specifically, this Share the Path program is taking inspiration from the Burma Shave roadside campaigns of the 1940's and 50's. Burma Shave, a popular shaving lotion in that era, would set up small, similar signs, with a rhyme and punch line at intervals along American highways. As speed limits and automobile speeds increased, the small signs had a difficult time being read, and were eventually phased out.

⁷ City of Vancouver, B.C. General Manager of Engineering Services. (1995). *Speed Limits on Recreational Bicycle Paths*. Available: <http://vancouver.ca/ctyclerk/cclerk/951207/vtcl.htm>

Trail Design Improvements

Other strategies for decreasing bicycle speeds on trails and improving space sharing between bicycles and pedestrians are physical design improvements. This section provides detail improvements and others that are not “standard”.

Brooklyn Bridge, NY

The Brooklyn Bridge in New York is a commuting route through the City and is also as a major tourist destination. Currently, nonmotorized traffic is directed such that pedestrians use the south side of the separated path, and bicyclists use the north; however many users, particularly tourists, do not abide by these guidelines. In 2008, a bicyclist seriously injured a tourist on the Brooklyn Bridge, causing the Department of Transportation to seek new solutions.

In winter 2009, the DOT upgraded the signage, including new “Cyclists Yield to Pedestrians” signs, and pavement markings that separate users on the bridge.⁸ Particular consideration was given to ensuring that non-English speakers would understand the channelization. The DOT also installed flexible bollards at the entrances to the bridge, in order to ease the transition and retain the separation. The City also requires all cyclists to have a bell, and the City website encourages the use of the bell when passing on the bridge.



Figure 18: Pavement markings on the Brooklyn Bridge, NY

Burrard Bridge, Vancouver, BC

In May 2009, the City Council of Vancouver, B.C. voted in support of a pilot project to remove one lane of vehicle traffic on Burrard Bridge for bicycle use.⁹ The Bridge has a current hourly traffic count of between 8,000 and 9,000 people. Approximately half are drive-alone trips and 10 percent are walking or cycling trips.

Bicyclists previously shared the bridge sidewalk with pedestrians to downtown. All pedestrians are detoured onto the westernmost sidewalk. Bicyclists ride southbound on the easternmost sidewalk and northbound in the reclaimed travel lane on the west side of the bridge (see Figure 19). The project is being implemented “with the goal of increasing cycling and pedestrian safety while optimizing alternative modes of transportation.”¹⁰



Figure 19 Lane reconfiguration on Burrard Bridge, Vancouver, BC

⁸ NYC DOT. (2009). *NYCycles - The Official Newsletter of NYC DOT's Bike Program*. Available www.nyc.gov/html/dot/html/email/newsletter/bicycles_jan09.html :

⁹ CBC News. (2009). Burrard Bridge bike lanes start summer trial. Available: www.cbc.ca/canada/british-columbia/story/2009/07/13/bc-burrard-bridge-trial.html

¹⁰ City of Vancouver, B.C. (2009). *Administrative Report: Burrard Bridge Lane Re-allocation Trial*. Available: http://vancouver.ca/projects/burrard/pdf/burrard_trial_report.pdf

In addition to creating the physically separated space, the City plan includes:

- a monitoring program to assess the impacts of the trial, and
- a communications program to provide public information on the purpose of the trial and to encourage transportation choices that will minimize the impact.

Hawthorne Bridge, Portland, OR

The Hawthorne Bridge in Portland, OR experiences considerable bicycle and pedestrian traffic from both commuters and tourists. On each side of the Bridge bicyclist traffic is one-way and pedestrian traffic is two ways—with pavement markings indicating expected location for the modes (see Figure 20).

A common criticism of the existing markings is that they require cyclists to ride on the left-hand side of the bridge sidewalk and do not provide space for cyclists to pass each other. The City is prioritizing development of additional bicycle and pedestrian access over the river to alleviate the existing congestion on the Hawthorne Bridge.



Figure 20 One-way markings on the Hawthorne Bridge, Portland, OR

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